# TABLE OF CONTENTS

I  Tentative Agenda

II  Tentative Order of Discussion

III  Uniform Mechanical Code Change  
     Public Comments

IV  UMC Condensate Task Group  
     Report

V  UMC Indoor Horticulture Facilities Task Group  
     Report
2022 Uniform Mechanical Code Technical Committee Meetings
Sheraton Park Hotel at the Anaheim Resort, Anaheim, CA
May 4 - 5, 2022
AGENDA

I. Call to Order
II. Chairman Comments
III. Announcements
IV. Self-Introductions
V. Review and Approval of Agenda
VI. Approval of Minutes from Previous Meeting (Virtual Webinar on May 17-21, 2021)
VII. Report of UMC Condensate Task Group Report (Chair)
VIII. Report of UMC Indoor Horticulture Facilities Task Group Report (Chair)
IX. Discussion of Public Comments to the Uniform Mechanical Code
X. Other business
XI. Next scheduled meeting
XII. Adjournment
The following is the tentative order of discussion on which the proposed public comments will be discussed at the Technical Committee Meeting. Proposed code changes that are grouped together are those that are both indented and separated by lines. Indented public comments are those being discussed out of numerical order.

Item # 002
Item # 012
Item # 017
Item # 019
Item # 020
Item # 038
Item # 039
Item # 041
Item # 048
Item # 057
Item # 064
Item # 066
Item # 067
Item # 072
Item # 074
Item # 078
Item # 079
Item # 081
Item # 088
Item # 089
Item # 093
Item # 094
Item # 097
Item # 098
Item # 101
Item # 103
Item # 105
Item # 107
Item # 108
Item # 109
  Item # 110
  Item # 113
Item # 111
Item # 112
  Item # 117
  Item # 121
  Item # 132
    Item # 138
    Item # 139
  Item # 140
    Item # 141
    Item # 143
  Item # 144
  Item # 145
  Item # 147
  Item # 153
  Item # 160
    Item # 161
    Item # 162
  Item # 163
  Item # 164
Item # 171
  Item # 174
  Item # 175
  Item # 180
  Item # 181
  Item # 183
    Item # 199
  Item # 185
  Item # 194
  Item # 196
  Item # 198
  Item # 200
  Item # 202
  Item # 207
  Item # 208
  Item # 212
  Item # 215
  Item # 216
  Item # 217
  Item # 218
    Item # 220
  Item # 224
  Item # 225
  Item # 228
  Item # 229
  Item # 230
  Item # 235
  Item # 237
  Item # 238
  Item # 239
  Item # 239.01
    Item # 239.02
  Item # 241
  Item # 244
  Item # 247
  Item # 249
  Item # 251
  Item # 252
  Item # 253
  Item # 256
  Item # 258
  Item # 261
  Item # 262
  Item # 263
  Item # 264
  Item # 267
  Item # 270
  Item # 273
  Item # 274
  Item # 275
  Item # 279
  Item # 283
  Item # 286
  Item # 287
  Item # 288
  Item # 289
  Item # 290
    Item # 291
    Item # 292
    Item # 293
    Item # 294
    Item # 295
    Item # 296
    Item # 297
    Item # 298
  Item # 299
  Item # 300
  Item # 301
  Item # 306
  Item # 307
  Item # 308
  Item # 309
  Item # 312
  Item # 317
  Item # 319
  Item # 321
  Item # 323
    Item # 324
    Item # 325
    Item # 326
    Item # 327
    Item # 328
    Item # 329
  Item # 330
  Item # 331
  Item # 333
    Item # 334
    Item # 335
    Item # 336
    Item # 337
    Item # 338
    Item # 339
    Item # 340
    Item # 341
    Item # 344
    Item # 345
    Item # 346
  Item # 347
Uniform Mechanical Code Public Comments
Item #: 002
UMC 2024  Section: 104.3.1

SUBMITTER: Adam Segura
Self

RECOMMENDATION:
Revise text

104.0 Permits.

104.3.1 Construction Documents. Construction documents, engineering calculations, diagrams, and other data shall be submitted in two or more sets, or in a digital format where permitted by the Authority Having Jurisdiction, with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the mechanical system designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.

Exception: The Authority Having Jurisdiction shall be permitted to waive the submission of construction documents, calculations, or other data where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with the code.

SUBSTANTIATION:
While paper documentation is still used in the field, digital versions of documentation are also permitted by jurisdictions. The addition of this language will eliminate the paper documents from being printed where not necessary and will allow faster submission of documents where digital format is allowed and accepted.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 309.3  Item #: 002
SUBMITTER: Phillip H Ribbs
PHR Consultants  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

309.0 Workmanship.

309.3 Installation Practices. Mechanical systems shall be installed in a manner that is in accordance with this code, applicable standards, and the manufacturer’s installation instructions. All mechanical systems shall be in accordance with construction documents approved by the Authority Having Jurisdiction.
SUBSTANTIATION:
All mechanical systems shall be in accordance with construction documents approved by the Authority Having Jurisdiction. The proposed change correlates with existing language in the UPC.
Proposals

Item #: 012
UMC 2024  Section: 203.0

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

203.0 – A –
Appliance. A device that utilizes fuel or electricity as an energy source to produce light, heat, power, refrigeration, or air conditioning, or compressed fuel gas. This definition also shall includes vented decorative appliances and electric storage or tankless water heaters.

SUBSTANTIATION:
The change removes enforceable language that is not permitted in a definition per the Manual of Style. The update also removes “compressed fuel gas” as it is used out of context and is now addressed under “fuel.”

Furthermore, the additional language to the “Appliance” definition reintroduces electric water heaters into the mechanical code.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29   NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 203.0  Item #: 012
SUBMITTER: Karan Kapila  Comment #: 1
Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

203.0 – A –
Appliance. A device that utilizes fuel or electricity as an energy source to produce light, heat, power, refrigeration, or air conditioning. This definition also includes vented decorative appliances and electric storage or tankless water heaters.

SUBSTANTIATION:
I agree with the Technical Committee concern that the phrase “fuel or electricity” is limiting. The modification removes such reference and leaves "an energy source" which will encompass all other energy sources such as wind, sun, geothermal, tides, etc.
Proposals

Item #: 017
UMC 2024  Section: 205.0

SUBMITTER: Lance MacNevin, P.Eng.
Chair, UMC Radiant Cooling Working Group

RECOMMENDATION:
Revise text

205.0 – C –
Chilled Water: Water or fluid that is cooled below its ambient temperature via mechanical or other means for the purpose of removing excess heat from conditioned spaces or equipment via hydronic piping distribution.

SUBSTANTIATION:
The UMC Radiant Cooling Working Group was formed in January 2020 by members of ASHRAE TC 6.5, Radiant Heating and Cooling, to address concerns with existing UMC language in Section 1217.3. The working group met through a series of calls throughout 2020 to finalize the language submitted in this proposal.

Proposal 4:
A definition for Chilled Water does not currently exist in the Code. This new definition will assist users who may be unfamiliar with hydronic cooling and especially radiant cooling where there may be multiple temps.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The term “ambient” is ambiguous. The definition is confusing as it contains both “water” and “fluid,” which is not clear. The term “fluid” can be a liquid or gas, which can be misinterpreted. The definition is needed but needs work to clarify the intent. Furthermore, there is insufficient technical justification to warrant the new definition.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 24  NEGATIVE: 5  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
ARYAN: The definition is a bit unclear and needs to be reworded.
KOERBER: I believe a definition is warranted, although wording should be adjusted during the comment phase.
MACNEVIN: A definition for “Chilled Water” is needed for the UMC. An improved proposal will be submitted during public comment, based on feedback from the UMC hearing.
TRAFTON, A: Although the definition is flawed, I believe it is needed in the code as these system are prevalent in HVAC systems.
TRAFTON, P: A definition is needed for “Chilled Water” as it is one of the more widely used systems that the UMC must address. While this one is a little flawed, I would strongly recommend amending it to get it in the Code.

Appended Comments

...
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 205.0  Item #: 0017
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

205.0 – C –
Chilled Water. Water or fluid that is cooled below the surrounding air temperature via mechanical or other means for the purpose of removing excess heat from conditioned spaces or equipment via hydronic piping distribution.

SUBSTANTIATION:
The definition has been reworked to address Committee comments. Chilled water may be water or another fluid, therefore, the term “fluid” should remain. The term “ambient temperature” has been changed to “surrounding air temperature” to avoid ambiguity.
Proposals

Item #: 019

UMC 2024  Section: 206.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

206.0  – D –
Design Pressure. The maximum allowable pressure for which a specific part of a system is designed.

SUBSTANTIATION:
The UMC references the term “Design Pressure” throughout the code, however there is no definition. A definition is needed for clarity. The code change correlates with the USHGC. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The definition is being rejected as there are other purposes of “design pressure,” such as for refrigerant, and the proposed definition may cause confusion. The definition needs work to clarify the intent. Furthermore, this term is already defined in the UMC and will conflict with the existing definition.

Additionally, the Technical Committee disagrees with the the substantiation regarding the necessity for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 28   NEGATIVE: 1   NOT RETURNED: 1   Heine

EXPLANATION OF AFFIRMATIVE:
TRAFTON, P: I agree with Randy Young that this belongs in the Code, but currently, the definition is incomplete and not enforceable.

YOUNG: As a Committee member would I like to see this cleaned up, and possibly brought back either in comment form or next cycle.

EXPLANATION OF NEGATIVE:
TRAFTON, A: Although the definition is incomplete, I believe that this should be workshopped and added as many different systems require different pressure requirements.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 218.0                      Item #: 019
SUBMITTER: Randy Young                                Comment #: 1
Northern California JATC

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

218.0  – P –
Pressure, Design. The maximum allowable pressure for which a specific part of a system is designed.
Pressure, Design (Refrigeration). The maximum working allowable pressure for which a specific part of a refrigeration system is designed.

SUBSTANTIATION:
The new definition and modification are needed for clarity to differentiate between “design pressure” for refrigeration systems for that of all other systems. Furthermore, the term “allowable” is consistent with the intent of the design pressure.
Item #: 020

UMC 2024  Section: 206.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

206.0   – D –
Direct Exchange (DX). A ground-source heat pump that circulates a refrigerant through a closed-loop system. Also known as direct expansion unit or direct expansion system.

SUBSTANTIATION:
The term Direct Exchange (DX) is used in both Appendix E and Appendix F of the UMC. The term is also known as direct expansion unit or direct expansion system. Therefore, a definition is being added to Chapter 2 that also correlates with the USHGC.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The definition is needed, however, should be rewritten to add reference to “direct geothermal exchange” which will better clarify the intent of the definition as used in the appendices. The proposed definition is better suited in Appendix E and Appendix F.

Additionally, the Technical Committee disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

YOUNG: A better, clearly defined definition would be a positive addition to the code if placed in Appendix E and F. I would like to see this brought back in either comment form or next cycle and with no reference to correlation.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 206.0  Item #: 020

SUBMITTER: Randy Young
Northern California JATC

RECOMMENDATION:
Add new text

Request to accept the code change proposal as submitted by this public comment.
SUBSTANTIATION:
Appendix F has been relocated to Chapter 17 of the code. Therefore, the proposed definition of “Direct Exchange (DX)” can appropriately be placed in Chapter 2.
Item #: 038
UMC 2024 Section: 212.0

SUBMITTER: Donald (DJ) Berger
Self

RECOMMENDATION:
Revise text

212.0 – J – Joint, Press-Connect Elastomeric. A permanent mechanical removable or non-removable joint consisting of an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.

SUBSTANTIATION:
The word “Press-Connect” describes one type of technology using elastomeric materials for the joint seal. By revising the definition with the word “Elastomeric” this definition may be expanded to include similar joining technologies employing an elastomeric material for its seal, e.g., push-fit, grooved, bolted, compression repair couplings, etc.

The words “permanent mechanical” are inconsistent with other “permanent” and “mechanical” joint definitions within this section of the 2021 UMC. By revising the definition with the removal of the phrase “The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer,” the definition would be inclusive of similar joining technologies employing elastomeric materials. This revision would provide additional consistency within the code as the 2021 UMC has specific sections that provide information on how joints are to be made.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

212.0 – J – Joint, Elastomeric. A removable or non-removable joint consisting of an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring.

Joint, Press-Connect Elastomeric. A removable or non-removable joint consisting of an elastomeric seal or an elastomeric seal and corrosion resistant grip ring. See Joint, Elastomeric.

COMMITTEE STATEMENT:
The definition to “Joint, Press-Connect” is being modified as the term is still used in the code. A new definition for “Joint, Elastomeric” is being added which addresses the correct definition for these types of joints.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 12 NEGATIVE: 16 ABSTAIN: 1 NOT RETURNED: 1 Heine

Note: Item # 038 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF AFFIRMATIVE:

BERGER: Substantiation was provided for this proposal. The name of the existing definition is press-connect joint when it actually describes a press-connect fitting. There is a difference between a joint and a fitting. The new definition would better describe the sealing component of all fittings employing an elastomeric seal, including press-connect fittings.
Perhaps a letter writing campaign is the way to go when you want to override the decision of the Technical Committee. Download: https://kavi.iapmo.org/apps/org/workgroup/umctc/download.php/414467/RLS042721.pdf

EXPLANATION OF NEGATIVE:

ARYAN: The definition should stay as is.

BALLANCO: The proposed modification is incorrect. To identify all press-connect fittings as elastomeric fittings is not a correct way to define a press-connect fitting.

CUDAHY: This definition should stand as it was. These fittings are described in numerous standards and codes. The proposed revision of the definition of Press-Connect Joint will make the UPC and the UMC the only publications that lump together Press-Connect fittings with other types of mechanical joints. Changing the definition would completely confuse the industry when an established definition is already prevalent and include Press-Connect fittings, which are a permanent joining method, into the same category as Non-Permanent joining methods. Specific standards are written to address Press-Connect fittings (IAPMO PS 117 press-connections, ANSI LC-4/CSA 6.32 Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems, ASME B16.51 Copper and Copper Alloy Pressure-Connect Pressure Fittings, ASTM F3226 Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing System, to name a few. Also, NFPA 31, NFPA 54, NFPA 55, NFPA 58, CGA P-18, Uniform Plumbing Code, Uniform Mechanical Code, National Standard Plumbing Code, CSA B149.1, National Gas and Propane Code for Canada, and many other publications all directly reference Press-Connect fittings.

EGG, K: There is too little justification for the removal of press-connect fittings. These fittings have been a part of both the UL and UMC for more than a decade.

FEEHAN: This definition needs to stay as is. Most elastomeric seals are not removable and the proposal, as written, is incorrect.

GUNZNER: Press-connect fittings are specifically permitted by ASHRAE 15. AMCA supports consistency between related codes and standards, where applicable. These modifications would cause confusion and other disruptions. AMCA supports the work of the UMC A2L Task Group.

HYDE: I believe further research is required as it pertains to press-connect fittings prior to making such code changes.

KOERBER: No technical substantiation was provided for this significant change to the code.

KREITENBERG: No need to modify the definition.

MACNEVIN: The definition should not be changed as it is accurate. Changing the term to "elastomeric" is very open-ended and vague and will add confusion to the code.

TAYLOR: I feel the "press-connect joint" definition needs to stay as its own. I am fine with adding an elastomeric definition if people want. Press-connect joints are non-removable and permanent, so the definition as modified is incorrect and I must vote against this.

TRAFTON, A: Press-connect fittings have been used successfully for years in these systems. If we need to workshop the definition, fine, but I am also fine with it as it is.

TRAFTON, P: Press-connect belongs in the Code for refrigeration, however, the definition as proposed and as modified does not adequately provide for the proper use. I would agree that a little more research is needed for acceptable leak rate and testing.

VAN RITE: I do not agree with the text. This is an attempt to label any component in a refrigeration system that uses "Elastomeric" material as sub-standard, yet Elastomeric describes a wide range of materials that are approved for use in valves and other seals. This language is aimed at blocking the use of crimped connectors which are widely accepted and approved in other codes.

WHITE: No substantiation was provided with the proposal. Press-Connect is a proven method for installations.

WISEMAN: Press-connect fittings have been used successfully in the field for years. There was no evidence given to substantiate the claims that press-connect fittings leak more than an improper weld. The definition should not be changed.

EXPLANATION OF ABSTAIN:

TERZIGNI: Since this has become such a point of contention, I am continuing to research the matter further.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 212.0  Item #: 038

SUBMITTER: Donald (DJ) Berger
National ITC Corporation
Rep. Self

Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

212.0 – J –

Joint, Elastomeric. A removable or non-removable joint consisting of an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring.

Joint, Press-Connect. A permanent mechanical joint consisting of an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer. See Joint, Elastomeric.

SUBSTANTIATION:
The definition to “Joint, Press-Connect” is being modified as the term is still used in the code. A new definition for “Joint, Elastomeric” is being added which addresses the correct definition for these types of joints.

The word “Press-Connect” describes one type of technology using elastomeric materials for the joint seal. By revising the definition with the word “Elastomeric” this definition may be expanded to include similar joining technologies employing an elastomeric material for its seal, e.g., push-fit, grooved, bolted, compression repair couplings, etc.

The words “permanent mechanical” are inconsistent with other “permanent” and “mechanical” joint definitions within this section of the 2021 UMC. By revising the definition with the removal of the phrase “The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer,” the definition would be inclusive of similar joining technologies employing elastomeric materials. This revision would provide additional consistency within the code as the 2021 UMC has specific sections that provide information on how joints are to be made.
Proposals

Item #: 039

UMC 2024  Section: 214.0

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

214.0  – L –
Listed (Third Party Certified). Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection of current production of listed equipment or materials and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner.

Terms used to identify listed equipment, products, or materials include "listed," "certified," or other terms as determined appropriate by the listing agency.

SUBSTANTIATION:
The proposed revision to the definition for "Listed" recognizes that listing organizations may use other terms to identify "listed" equipment, products, or materials. An example of other terms used that meet the definition of "listed" include "certified." The term "certified" is a more globally recognized term used by listing organizations compared to the term "listed."

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Terms are determined by the code and not by the listing agency. The language is already covered within the terminology provided for "Listing Agency."

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:

AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 302.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

302.0 Materials – Standards and Alternates.

302.1 Minimum Standards. Listed piping, pipe fittings, appliances, appurtenances, equipment, materials, and devices used in a mechanical system shall be listed (third-party certified) by a listing agency (accredited conformity assessment body) as complying with the approved applicable recognized standards referenced in this code, and shall be free from defects. Unless otherwise provided for in this code, materials, appurtenances, or devices used or entering into the
construction of mechanical systems, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval prior to being installed.

**SUBSTANTIATION:**
Section 302.1 is being modified to correlate with the UPC. The use of the term “listed” in the beginning of the section suggests that only listed pipe, pipe fittings, appliances, appurtenances, equipment, materials, and devices need to be listed by a listing agency. That is not the intent of this section. As noted by the TC in several other proposals, this is the code section that requires third party certification, which is why it is only necessary to state within the code that a product needs to comply with a referenced standard because it is already understood that products are required to be listed and labeled.

UPC Section 301.2 is shown below for reference only:

301.2 Minimum Standards. Pipe, pipe fittings, traps, fixtures, material, and devices used in a plumbing system shall be listed (third-party certified) by a listing agency (accredited conformity assessment body) as complying with the approved applicable recognized standards referenced in this code, and shall be free from defects. Unless otherwise provided for in this code, materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof shall be submitted to the Authority Having Jurisdiction for approval prior to being installed.
Proposals

Item #: 041

UMC 2024 Section: 214.0, 216.0, 316.12, 316.13

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

214.0 — L —
Limited-Combustible Material. Refers to a building construction material that does not comply with the definition of noncombustible material with limited burning characteristics that, in the form in which it is used, has a potential for combustion and does not comply with the definition of noncombustible material. The heat value not exceeding 3500 British thermal units per pound-force (Btu/lb) (8141 kJ/kg), where tested in accordance with NFPA 259, and includes either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 of an inch (3.2 mm) that has a flame-spread index not greater than 50.

(2) Materials, in the form and thickness used, having neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, where tested in accordance with ASTM E84.

216.0 — N —
Noncombustible Material. As applied to building construction material, means a material that in the form in which it is used is either one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E136 are considered noncombustible material.

(2) Material having a structural base of noncombustible material as defined in item 1 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with item 1 above. No material shall be classed as noncombustible that is subject to increase in combustibility or flame-spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

316.0 Protection of Piping, Tubing, Materials, and Structures.

316.12 Limited-Combustible Material. Limited combustible material shall have a potential heat value not exceeding 3500 British thermal units per pound-force (Btu/lb) (8141 kJ/kg), where tested in accordance with NFPA 259, and shall include either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 of an inch (3.2 mm) that has a flame-spread index not greater than 50.

(2) Materials, in the form and thickness used, having neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, where tested in accordance with ASTM E84.

316.13 Noncombustible Material. Noncombustible material shall meet one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that comply with the requirements of ASTM E136 shall be considered noncombustible material.
(2) Material having a structural base of noncombustible material as defined in item 1 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50. Noncombustible shall not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with item 1 above. No material shall be classed as noncombustible that is subject to increase in combustibility or flame-spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

Note: ASTM E84, ASTM E136, and NFPA 259 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The definitions of Limited-Combustible Material and Noncombustible Material contain mandatory language. Requirements should not be located within definitions as definitions are not enforceable. Therefore, the current definitions should be relocated to the body of the code. Furthermore, the revised definitions are more concise and the appropriate standards for classifying such materials are better suited in Chapter 3.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The current language is needed to describe limited combustible and non-combustible materials. In addition, there are subtle changes which are not supported by technical merit in the substantiation. The proposed modifications of "limited combustible material" and "non-combustible material" are not consistent with the building code as written. It is important to be consistent with the building code to avoid conflicts between codes.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC Section #: 214.0, 216.0, 316.12, 316.13 Item #: 041
SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text
Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The definitions of “Limited-Combustible Material” and “Noncombustible Material” contain mandatory language. Requirements should not be located within definitions as definitions are not enforceable. Therefore, the current definitions should be relocated to the body of the code. Furthermore, the revised definitions are more concise and the appropriate standards for classifying such materials are better suited in Chapter 3.

PUBLIC COMMENT 2
Code Year: 2024 UMC Section #: 216.0 Item #: 041
SUBMITTER: Tim Earl
GBH International

RECOMMENDATION:
Revise text
Request to replace the code change proposal by this public comment.
Noncombustible Material. As applied to building construction material, means a material that in the form in which it is used is either one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Examples of such materials include steel, concrete, masonry, and glass. Materials that are reported as passing ASTM E136 are considered noncombustible material.

(2) A material reported as passing ASTM E136.

(3) Material having a structural base of noncombustible material as defined in item 1 or 2 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with item 1 above.

No material shall be classed as noncombustible that is subject to increase in combustibility or flame spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

Note: ASTM E136 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Rationale: This change will align the UMC definition with the NFPA definition and (to an extent) the ICC codes. The NFPA 5000 definition includes a note, which we have added as a second sentence to (1). Since (1) is vague, the note provides important context.

PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 214.0, 216.0, 316.12, 316.13, Table 1801.1, Table 1801.2  Item #: 041  Comment #: 3

SUBMITTER: Marcelo Hirschler  GBH International

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

Limited-Combustible Material. See Section 316.12. Refers to a building construction material that does not comply with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 British thermal units per pound-force (Btu/lb) (8141 kJ/kg), where tested in accordance with NFPA 259, and includes either of the following:

(1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 of an inch (3.2 mm), that has a flame-spread index not greater than 50.

(2) Materials, in the form and thickness used, having neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame-spread index greater than 25 nor evidence of continued progressive combustion, where tested in accordance with ASTM E84.

Noncombustible Material. See Section 316.13. As applied to building construction material, means a material that in the form in which it is used is either one of the following:

(1) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials that are reported as passing ASTM E136 are considered noncombustible material.

(2) Material having a structural base of noncombustible material as defined in item 1 above, with a surfacing material not over 1/8 of an inch (3.2 mm) thick that has a flame-spread index not higher than 50.

Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with item 1 above. No material shall be classed as noncombustible that is subject to increase in combustibility or flame spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.
**316.12 Limited-Combustible Material.** A material shall be considered a limited-combustible material where all the conditions of Section 316.12.1 and Section 316.12.2, and the conditions of either Section 316.12.3 or Section 316.12.4, are met.

**316.12.1 Compliance.** The material shall not comply with the requirements for noncombustible material in accordance with Section 316.13. [NFPA 5000:7.1.4.2.1]

**316.12.2 Potential Heat Value.** The material, in the form in which it is used, shall exhibit a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) where tested in accordance with NFPA 259. [NFPA 5000:7.1.4.2.2]

**316.12.3 Flame Spread Index.** The material shall have the structural base of a noncombustible material with a surfacing not exceeding a thickness of 1/8 inch (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84 or UL 723. [NFPA 5000:7.1.4.2.3]

**316.12.4 Materials.** The material shall be composed of materials that, in the form and thickness used, neither exhibit a flame spread index greater than 25 nor evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723 and shall be of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [NFPA 5000:7.1.4.2.4]

**316.13 Noncombustible Material.** A material shall be considered noncombustible material where all the conditions of Section 316.13.1 and Section 316.13.2 are met.

**316.13.1 Compliance.** A material that complies with any one of the following shall be considered a noncombustible material:

1. The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
2. The material is reported as passing ASTM E136.
3. The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652. [NFPA 5000:7.1.4.1.1]

**316.13.2 Materials.** Noncombustible does not apply to surface finish materials. Material required to be noncombustible for reduced clearances to flues, heating appliances, or other sources of high temperature shall refer to material in accordance with Section 316.13.1(1). No material shall be classed as noncombustible that is subject to increase in combustibility or flame spread index beyond the limits herein established, through the effects of age, moisture, or other atmospheric condition.

<table>
<thead>
<tr>
<th>TABLE 1801.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>ASTM E136-2019a</td>
<td>Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** ASTM E84, ASTM E136, ASTM E2652, NFPA 259, and UL 723 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>TABLE 1801.2</th>
<th>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
As stated in the proposal, definitions are not supposed to contain requirements because definitions are not enforceable.

The language proposed for the new sections (316.12 and 316.13) is identical to the language in NFPA 101 and
NFPA 5000 (2015 editions; another option, testing using ASTM E2965 for limited combustible material, was added later, and is not being proposed to avoid complicating the issue). The same language is also contained in multiple other NFPA documents, such as NFPA 1 and NFPA 90A. The language proposed for the new Section 316.13.2 is simply relocated from the definition section and mirrors the IBC language in Section 703.3.

The IBC does not recognize the concept of limited combustible material and, therefore, neither the existing language nor the revised language is consistent with the IBC. However, with regard to noncombustible material, the IBC does not have a definition but does have a Section 703.3.1 that reads as shown below and is fully consistent with the proposed language (the exception incorporates partially a concept similar to "limited combustible"). Thus, the proposed revision is more consistent with both the NFPA 5000 and IBC concepts than the existing UMC language.

**IBC:**

**703.3.1 Noncombustible materials.** Materials required to be noncombustible shall be tested in accordance with ASTM E136. Alternately, materials required to be noncombustible shall be tested in accordance with ASTM E2652 using the acceptance criteria prescribed by ASTM E136.

**Exception:** Materials having a structural base of noncombustible material as determined in accordance with ASTM E136, or with ASTM E2652 using the acceptance criteria prescribed by ASTM E136, with a surfacing of not more than 0.125 inch (3.18 mm) in thickness having a flame spread index not greater than 50 when tested in accordance with ASTM E84 or UL 723 shall be acceptable as noncombustible.
Proposals

Item #: 048
UMC 2024  Section: 224.0

SUBMITTER: Adam Segura
Self

RECOMMENDATION: Add new text

224.0  – V –
Vacuum Relief Valve. A device that automatically allows air to enter the piping system to prevent conditions that could siphon water from the system and prevent excessive vacuum in a pressure vessel.

(below shown for reference only)

1005.5 Vacuum Relief Valve. Hot-water heating systems that are subjected to a vacuum while in operation or during shutdown shall be protected with a vacuum relief valve. Where the piping configuration, equipment location, and valve outlets are located below the boiler elevation, the system shall be equipped with a vacuum relief valve at the highest point.

SUBSTANTIATION:
The proposed language adds the definition of a vacuum relief valve as used in a plumbing or mechanical system. The valve is not only protecting the pressure vessel from excessive vacuum, but also preventing conditions that could siphon the water from system and possibly cause damage to water heater and equipment. See Section 1005.5 (Vacuum Relief Valve).

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The language is poorly written and subjective. The term "automatically" may create confusion regarding the term. The phrase "that could" is vague and subject to interpretation.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 224.0
SUBMITTER: Adam Segura
Self

RECOMMENDATION: Add new text

Request to replace the code change proposal by this public comment.
224.0 – V –

**Vacuum Relief Valve.** A device that prevents excessive vacuum in a pressure vessel.

(below shown for reference only)

1005.5 *Vacuum Relief Valve.* Hot-water heating systems that are subjected to a vacuum while in operation or during shutdown shall be protected with a vacuum relief valve that complies with CSA Z21.22. Where the piping configuration, equipment location, and valve outlets are located below the boiler elevation, the system shall be equipped with a vacuum relief valve at the highest point.

**SUBSTANTIATION:**
The UMC Committee stated that the previously submitted proposal was poorly written and subjective. This comment resubmits the proposal using the definition of “Vacuum Relief Valve” taken directly from the 2021 UPC.

The proposed language adds the definition of a vacuum relief valve as used in a plumbing or mechanical system. The valve is not only protecting the pressure vessel from excessive vacuum, but also preventing conditions that could siphon the water from system and possibly cause damage to water heater and equipment. See Section 1005.5 (Vacuum Relief Valve).
Proposals

Item #: 057
UMC 2024  Section: 302.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

302.0 Materials – Standards and Alternates.

302.2 Alternate Materials and Methods of Construction Equivalency. Unless specifically prohibited, nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code. Technical documentation shall be submitted to the Authority Having Jurisdiction to demonstrate equivalency. The Authority Having Jurisdiction shall have the authority to approve or disapprove the system, method, or device for the intended purpose.

However, the exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. An alternate material or method of construction so approved shall not be considered as in accordance with the requirements, intent, or both of this code for a purpose other than that granted by the Authority Having Jurisdiction where the submitted data does not prove equivalency.

SUBSTANTIATION:
Section 302.2 grants authority to AHJ’s to approve materials or products at their discretion. However, Section 302.2 places an obligation on the AHJ to approve only those alternate materials or products which comply “with the intent of this code,” which are “at least the equivalent of that prescribed in this code,” and are not specifically prohibited elsewhere in the code.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 17  NEGATIVE: 11  ABSTAIN: 1  NOT RETURNED: 1  Heine

Note: Item # 057 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF NEGATIVE:

ARYAN: The statement is too broad and may lead to difficulty in the AHJ’s ability to reject certain items/designs.

BALLANCO: This proposal would result in a violation of the Federal Trade Laws of the United States. The FTC website states, "The Sherman Act outlaws "every contract, combination, or conspiracy in restraint of trade," and any "monopolization, attempted monopolization, or conspiracy or combination to monopolize." In accordance with Federal Law, an alternative approval is permitted even when the code specifically prohibits the material or method.

CUDAHY: This seems legally problematic to the code and IAPMO. "Nothing in this code" is deliberate, boilerplate language. Codes are not intended to prevent the use of designs or materials not prescribed.

FEEHAN: "Unless specifically prohibited" means everything which is not forbidden is allowed. It is going to cause confusion and require jurisdictions to list prohibited products, methods, materials, and so on.

GUNZNER: This change would at least cause confusion, if not also what is stated in the other comments.
KOERBER: This change would lead to confusion and potential legal issues.

MACNEVIN: The proposed change adds confusion to the code and is not necessary.

TRAFTON, A: I agree with Michael Cudahy that this may be legally problematic.

TRAFTON, P: I think this statement is overly broad and is not the intent of the Code.

WHITE: The change is not necessary, is confusing, and contrary to the intent of Section 302.2.

WISEMAN: This seems legally problematic.

EXPLANATION OF ABSTAIN:

TERZIGNI: Seems like wordplay to me. While I agree with standards and codes I also believe that the AHJ or even a licensed designer should be able to provide exceptions or exemptions as justified by their knowledge and experience.

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Appended Comments

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PUBLIC COMMENT 1: (Assembly Action)

Code Year: 2024 UMC  Section #: 302.2  Item #: 057

SUBMITTER: Phillip H Ribbs  PHR Consultants  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Section 302.2 grants authority to AHJ's to approve materials or products at their discretion. However, Section 302.2 places an obligation on the AHJ to approve only those alternate materials or products which comply “with the intent of this code,” which are “at least the equivalent of that prescribed in this code,” and are not specifically prohibited elsewhere in the code.

According to the Sherman Act: "What is a Sherman Act violation? Violations of the Sherman Antitrust Act include practices such as fixing prices, rigging contract bids, and allocating consumers between businesses that should be competing for them." (Source: https://www.impactlaw.com/criminal-law/white-collar/antitrust). The proposal in no way violates or conflicts with the Sherman Act. The proposal reinforces the required duties of the AHJ. In no way does the proposal prohibit the use of new technologies or materials that meet the intent of the code.

This code proposal, UMC Item # 057, was reviewed during the Assembly Consideration Meeting by the IAPMO Membership, and it was approved with an overwhelming vote to be approved as submitted.

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PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 302.2  Item #: 057

SUBMITTER: Julius Ballanco, P.E.  JB Engineering and Code Consulting, P.C.  Comment #: 2

RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
The Federal Trade Commission issued a document entitled, “Building Regulatory Practices and the Courts” in September 1980. Under the section regarding alternative approval, the subsection entitled, Codes Cannot be Exclusionary by Specifying Only Code Acceptable Products and Methods, the following was stated:

Courts have held that a building code, which prohibits the use of materials and procedures not specified in the code and does not allow consideration of alternative products and methods, unfairly discriminates against all such products and methods other than those products. In 1936 the court held that the Chicago building code was invalid in that it prohibited the use of plasterboard which was as sanitary and fire-resistant as lath and plaster.

Two years later in Brewer v. Kelly, the court held that the code provision which required that windows be a minimum of seven feet from the floor did not apply to the innovative product called “casement windows.” Instead, the code provision specified the use of traditional sash windows. The court, in reaching its decision, inferred what performance was satisfied when a sash window was used. The court then evaluated casement windows against that performance and found them to meet the standard. On this basis, the court allowed the use of the innovative product.

Here the court sidestepped the constitutional challenge of invalidity and narrowly held that the innovative product was not governed by the allegedly prohibiting code section and, therefore, was eligible for consideration under the code. Of far greater significance was the court’s use of performance measures for determining the adequacy of an innovative product not specified in the code. While this case stands for the principle that codes cannot exclude acceptable products, its reasoning anticipates by several decades the need for an equivalency provision in the codes that is based on performance measures.

While this document dates back more than 40 years, in that period of time, no one with knowledge of code requirements for alternative approval have challenged the legal aspect of this section. This code proposal does just that by ignoring legal precedence regarding unfair discriminatory restrictive practices.

This change needs to be rejected so that the code does not violate U.S. Federal Law.
Proposals

Item #: 064
UMC 2024 Section: 305.5

SUBMITTER: David Mann
CA State Pipe Trades Council

RECOMMENDATION:
Revise text

305.0 Location.

305.5 Drainage Pan. Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, or where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater with not less than 3/4 of an inch (20 mm) diameter drain to an approved location. The terminating end of the drainpipe shall be readily visible. Such pan shall be not less than 1 1/2 inches (38 mm) in depth.

SUBSTANTIATION:
The proposed change will clarify that Section 305.5 is applicable to all water heaters, regardless of the type of water heater. The intent of the section is to prevent damage from occurring in the surrounding vicinity of the water heater should a leak occur.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

WHITE: Language is not consistent with the UPC where they must be readily observable [Section 608.5(8)].

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 064, Section 305.5 (Drainage Pan) and UPC Item # 104, Section 507.5 (Drainage Pan) resulted in conflicting language between the codes. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

305.0 Location.

305.5 Drainage Pan. Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, floor-subfloor assembly or where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater in accordance with the following:
(1) The drainage pan shall be provided with not less than 3/4 of an inch (20 mm) diameter drain to an approved location. The terminating end of the drainpipe shall be readily visible.
(2) The drainage Such pan shall be not less than 1 1/2 inches (38 mm) in depth.
(3) Where a drainage pan pipe is installed, the material of the piping shall be rated for the temperature rating of the
water heater and shall be approved for use with the liquid being discharged. 
(4) Discharge from a relief valve into a drainage pan shall be prohibited.

TCC ACTION:  ACCEPT AS SUBMITTED

TCC STATEMENT:  
The language in UMC Item # 064, Section 305.5 (Drainage Pan) is being revised to correlate with the action taken by the UPC TC for Item # 104, Section 507.5 (Drainage Pan) to separate drainage pan requirements into a numbered list format and add items (3) and (4) for temperature rating and discharge from a relief valve.

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 305.5 regarding separating drainage pan requirements into a numbered list format and adding items (3) and (4) for temperature rating and discharge from a relief valve.

APPENDED COMMENTS

PUBLIC COMMENT 1

Code Year: 2024 UMC   Section #: 305.5   Item #: 064

SUBMITTER: Arnie Rodio   Self   Comment #: 1

RECOMMENDATION:  
Revise text  
Request to accept the code change proposal as modified by this public comment.

305.0 Location.  
305.5 Drainage Pan.  Where a water heater is located in an attic, in or on an attic ceiling assembly, floor-ceiling assembly, floor-subfloor or assembly where damage results from a leaking water heater, a watertight pan of corrosion-resistant materials shall be installed beneath the water heater in accordance with the following:
(1) The drainage pan shall be provided with not less than 3/4 of an inch (20 mm) diameter drain to an approved location. The terminating end of the drainpipe shall be readily visible.  
(2) The drainage pan shall be not less than 1 1/2 inches (38 mm) in depth.  
(3) Plastic drainage pans shall be not less than 0.036 inches (0.9 mm) in thickness. Galvanized steel or aluminum drainage pans shall be not less than 0.0236 inch (0.6010 mm) in thickness.  
(4) Where a drainage pan pipe is installed, the material of the piping shall be rated for the temperature rating of the water heater and shall be approved for use with the liquid being discharged.  
(5) Plastic drainage pans installed beneath gas-fired water heaters shall be constructed of material having a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723.  
(6) Discharge from a relief valve into a drainage pan shall be prohibited.

Note: The ASTM E84 and UL 723 standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Thickness and testing requirements for drainage pans are missing from the code. The proposed change adds thickness requirements for plastic, galvanized steel, and aluminum drainage pans used for water heaters, as well as smoke and flame spread requirements for plastic drain pans used with gas-fired water heaters.
Proposals

Item #: 066
UMC 2024  Section: 305.6

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Add new text

305.0 Location.

305.6 Outdoor Locations. Appliances installed in outdoor locations shall be in accordance with the following:
(1) Listed for outdoor installation.
(2) Provided with approved protection from the outdoor environmental factors that can affect the operation, durability, or safety of such appliances and in accordance with the manufacturer’s installation instructions.
(3) Outdoor cooking appliances shall comply with Section 923.0.

(below shown for reference only)

923.0 Outdoor Cooking Appliances.
923.1 Listed Units. Listed outdoor cooking appliances shall be installed in accordance with their listing and the manufacturer’s installation instructions.
923.2 Unlisted Units. Unlisted outdoor cooking appliances shall be installed outdoors with clearances to combustible material of not less than 36 inches (914 mm) at the sides and back and not less than 48 inches (1219 mm) at the front. In no case shall the appliance be located under overhead combustible construction. [NFPA 54:10.19.2]

SUBSTANTIATION:
Additional provisions for protection of appliances located outdoors are being added for public health and safety. Outdoor appliances are commonly used and additional code language is needed to improve the code.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

305.0 Location.

305.6 Outdoor Locations. Appliances installed in outdoor locations shall be in accordance with the following:
(1) Listed for outdoor installation.
(2) Provided with approved protection from the outdoor elements, environmental factors that can affect the operation, durability, or safety of such appliances and in accordance with the manufacturer’s installation instructions.
(3) Outdoor cooking appliances shall comply with Section 923.0.

COMMITTEE STATEMENT:
The definition is being modified as "elements" is a better understood term than "environmental factors."

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 26  NEGATIVE: 3  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

BALLANCO: While the concept of this change is fine, the wording needs to be corrected by a comment.

KOERBER: In general, the proposal is fine, but the wording should be revised to improve enforceability.
EXPLANATION OF NEGATIVE:

VAN RITE: I agree that the wording is too vague.

WHITE: Item (2) should just require compliance with the manufacturer's instructions, not add an additional requirement to add protection from elements. This is a judgement call as to what additional protection is needed.

WISEMAN: While we support the idea behind this proposal, "approved protection" is vague and unenforceable.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 305.6  Item #: 066
SUBMITTER: David C. Bixby  Comment #: 1
Air Conditioning Contractors of America (ACCA)

RECOMMENDATION:
Delete text without substitution
Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
The phrase “approved protection” is vague and unenforceable. The manufacturer’s instructions will always dictate how the equipment is to be protected from the outdoor environment if it is listed for outdoor installation. The instructions are part of the equipment’s listing to the applicable safety standard.
Proposals

Item #: 067
UMC 2024 Section: 308.0, 308.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

305.0 Location.

308.0 Improper Prohibited Locations.
308.1 General. Piping, appliances, or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

Unless permitted elsewhere in this code, fuel-burning appliances shall not be installed in, or in a space that communicates with, the following:

1. Bedrooms
2. Bathrooms
3. Toilet rooms
4. Storage rooms
5. Surgical rooms

Exception: Central heating boilers and furnaces in accordance with Section 904.0.

(below shown for reference only)

303.2 Closet or Alcove Installations. Central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation. Central heating furnaces not listed for closet or alcove installation shall be installed in a room or space having a volume not less than 12 times the total volume of the furnace. Central heating boilers not listed for closet or alcove installation shall be installed in a room or space having a volume 16 times the volume of the boiler. Where the ceiling height of the room or space exceeds 8 feet (2438 mm), the volume shall be calculated on the basis of an 8 foot (2438 mm) height.

The installation clearances shall be in accordance with the appliance listing, shall not be reduced, and shall be installed in accordance with Section 904.1.

904.0 Central Heating Boilers and Furnaces.
904.1 Location. Central heating furnace and low-pressure boiler installations in bedrooms or bathrooms shall comply with one of the following:

1. Central heating furnaces and low-pressure boilers shall be permitted to be installed in a closet located in the bedroom or bathroom, provided the closet is equipped with a listed, gasketed door assembly, and a listed self-closing device. The self-closing door assembly shall comply with the requirements of Section 904.1.1. The door assembly shall be installed with a threshold and bottom door seal and shall comply with the requirements of Section 904.1.2. Combustion air for such installations shall be obtained from the outdoors. The closet shall be for the exclusive use of the central heating furnace or low-pressure boiler.

2. Central heating furnaces and low-pressure boilers shall be of the direct vent type.

904.1.1 Self-Closing Doors. Self-closing doors shall swing easily and freely, and shall be equipped with a self-closing device to cause the door to close and latch each time it is opened. The closing mechanism shall not have a hold-open feature.

904.1.2 Gasketing. Gasketing on gasketed doors or frames shall be furnished in accordance with the published listings of the door, frame, or gasketing material manufacturer.

Exception: Where acceptable to the Authority Having Jurisdiction, gasketing of noncombustible or limited-combustible material shall be permitted to be applied to the frame, provided closing and latching of the door are not inhibited.
904.2 Clearance. Central heating furnaces and low-pressure boilers shall be provided with clearances in accordance with Section 904.2.1 through Section 904.2.7.

904.2.1 Listed Units. Listed central heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the terms of their listings and the manufacturer’s installation instructions.

904.2.2 Unlisted Units. Unlisted central heating furnaces and low-pressure boilers shall be installed with clearances from combustible material not less than those specified in Table 904.2.2. [NFPA 54:10.3.2.2]

904.2.3 Listed and Unlisted Units. Listed and unlisted central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 303.10.1 and Figure 303.10.1(1) through Figure 303.10.1(3), and such reduction is allowed by the manufacturer’s installation instructions. [NFPA 54:10.3.2.3]

904.2.4 Front Clearance. Front clearance shall be sufficient for servicing the burner and the furnace or boiler. [NFPA 54:10.3.2.4]

904.2.5 Adjacent to Plaster or Noncombustible Materials. Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less. [NFPA 54:10.3.2.5]

904.2.6 Interference. The clearances to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. [NFPA 54:10.3.2.6]

904.2.7 Central Heating Furnaces. Central heating furnaces other than those listed in Section 603.13.2 or Section 603.13.3 shall have clearances from the supply ducts of not less than 18 inches (457 mm) from the furnace plenum for the first 3 feet (914 mm), then 6 inches (152 mm) for the next 3 feet (914 mm) and 1 inch (25.4 mm) beyond 6 feet (1829 mm). [NFPA 54:10.3.2.9]

904.3 Assembly and Installation. A central heating boiler or furnace shall be installed in accordance with the manufacturer’s instructions in one of the following manners:

1. On a floor of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof.

2. On fire-resistant slabs or arches having no combustible material against the underside thereof.

Exceptions:

1. Appliances listed for installation on a combustible floor.

2. Installation on a floor protected in an approved manner. [NFPA 54:10.3.3]

904.3.1 Under-Floor Installation. Furnaces installed in an under-floor area of the building shall be in accordance with the Section 904.3.1.1 through Section 904.3.1.3.

904.3.1.1 Supported by Ground. Where a furnace is supported by the ground, it shall be installed on a concrete slab not less than 3 inches (76 mm) above the adjoining ground level.

904.3.1.2 Supported from Above. Where a furnace is supported from above, a clearance of not less than 6 inches (152 mm) shall be provided from finished grade.

904.3.1.3 Excavation. Where excavation is necessary to install a furnace, it shall be installed in accordance with Section 303.11.

904.4 Temperature or Pressure Limiting Devices. Steam and hot water boilers, respectively, shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature. Safety limit controls shall not be used as operating controls. [NFPA 54:10.3.4]

904.5 Low-Water Cutoff. All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the boiler(s) if the boiler water level drops below the lowest safe water line. In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating. [NFPA 54:10.3.5]

904.6 Steam Safety and Pressure Relief Valves. Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements. A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere. [NFPA 54:10.3.6]

904.6.1 Discharge. Relief valves shall be piped to discharge near the floor. [NFPA 54:10.3.6.1]

904.6.2 Size. The entire discharged piping shall be at least the same size as the relief valve discharge piping. [NFPA 54:10.3.6.2]

904.6.3 End Connections. Discharge piping shall not contain threaded end connection at its termination point. [NFPA 54:10.3.6.3]

904.7 Refrigeration Coils. The installation of refrigeration coils shall comply with the following requirements:

1. A refrigeration coil shall not be installed in conjunction with a forced air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static pressure resistance imposed by the duct system and refrigeration coil at the air flow rate for heating or cooling, whichever is greater.

2. Furnaces shall not be located upstream from refrigeration coils, unless the refrigeration coil is designed or equipped so as not to develop excessive temperature or pressure.

3. Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid...
condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.

(4) Means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element. [NFPA 54:10.3.8]

904.8 Cooling Units Used with Heating Boilers. Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. [NFPA 54:10.3.9.1]

904.8.1 Exposed to Refrigerated Air Circulation. Where hot water heating boilers are connected to heating coils located in air-handling units where they can be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. [NFPA 54:10.3.9.2]

904.9 Furnace (Upright and Horizontal). Upright furnaces shall be permitted to be installed in an attic, furred, or under-floor space exceeding 5 feet (1524 mm) in height, provided the required listings and furnace and duct clearances are observed. Horizontal furnaces shall be permitted to be installed in an attic, furred, or under-floor space, provided the required listings and furnace and duct clearances are observed.

904.10 Solid-Fuel-Fired Furnaces. Factory-built solid fuel-fired furnaces shall comply with UL 391 and shall be installed in accordance with the manufacturer’s installation instructions.

904.11 Oil-Fired Central Furnaces. Oil-fired central furnaces shall comply with UL 727 and shall be installed in accordance with the manufacturer’s installation instructions.

904.12 Commercial or Industrial Gas Heaters. Commercial or industrial gas-fired heaters shall comply with UL 795 and shall be installed in accordance with the manufacturer’s installation instructions.

904.13 Electric Central Furnaces. Electric central heating furnaces shall comply with UL 1995 or UL 60335-2-40 and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The code change provides a list of spaces where fuel burning appliances shall not be installed for public health and safety. For example, Section 303.2 allows central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal needs additional revisions and is currently vague and poorly written.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 308.0, 308.1  Item #: 067

SUBMITTER: Phillip H Ribbs  PHR Consultants  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

308.0 Improper Prohibited Locations.

308.1 General. Piping, appliances, or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

   Fuel-burning appliances shall not be installed in or in a space that freely communicates with the following:

(1) Bedrooms
(2) Bathrooms
(3) Toilet rooms

Exception: Central heating boilers and furnaces in accordance with Section 904.0.
303.2 Closet or Alcove Installations. Central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation. Central heating furnaces not listed for closet or alcove installation shall be installed in a room or space having a volume not less than 12 times the total volume of the furnace. Central heating boilers not listed for closet or alcove installation shall be installed in a room or space having a volume 16 times the volume of the boiler. Where the ceiling height of the room or space exceeds 8 feet (2438 mm), the volume shall be calculated on the basis of an 8 foot (2438 mm) height.

The installation clearances shall be in accordance with the appliance listing, shall not be reduced, and shall be installed in accordance with Section 904.1.

904.0 Central Heating Boilers and Furnaces.

904.1 Application. Central heating furnaces and boilers shall be listed in accordance with the following:

(1) Central heating furnaces and boilers having input ratings up to and including 400 000 Btu/hr (117 kW) shall be listed in accordance with the following as applicable:

(a) Furnaces listed in accordance with ANSI Z21.47/CSA 2.3.

(b) Low-pressure boilers listed in accordance with ANSI Z21.13/CSA 4.9. [NFPA 54:10.3.1.1]

(2) Furnaces and boilers having input ratings greater than 400 000 Btu/hr (117 kW) shall be listed or in accordance with Section 904.1(2)(a) and Section 904.1(2)(b). [NFPA 54:10.3.1.2]

(a) Acceptance of unlisted appliances, equipment, and accessories shall be on the basis of engineering methods. [NFPA54.9.1.1.2]

(b) The unlisted appliance, equipment, or accessory shall be safe and suitable for the proposed service and shall be recommended for the service by the manufacturer. [NFPA 54:9.1.1.3]

904.2 Location. Central heating furnace and low-pressure boiler installations in bedrooms or bathrooms shall comply with one of the following:

(1) Central heating furnaces and low-pressure boilers shall be permitted to be installed in a closet located in the bedroom or bathroom, provided the closet is equipped with a listed, gasketed door assembly, and a listed self-closing device. The self-closing door assembly shall comply with the requirements of Section 904.2.1. The door assembly shall be installed with a threshold and bottom door seal and shall comply with the requirements of Section 904.2.2. Combustion air for such installations shall be obtained from the outdoors. The closet shall be for the exclusive use of the central heating furnace or low-pressure boiler.

(2) Central heating furnaces and low-pressure boilers shall be of the direct vent type.

904.2.1 Self-Closing Doors. Self-closing doors shall swing easily and freely, and shall be equipped with a self-closing device to cause the door to close and latch each time it is opened. The closing mechanism shall not have a hold-open feature.

904.2.2 Gasketing. Gasketing on gasketed doors or frames shall be furnished in accordance with the published listings of the door, frame, or gasketing material manufacturer.

Exception: Where acceptable to the Authority Having Jurisdiction, gasketing of noncombustible or limited-combustible material shall be permitted to be applied to the frame, provided closing and latching of the door are not inhibited.

904.3 Clearance. Central heating furnaces and low-pressure boilers shall be provided with clearances in accordance with Section 904.3.1 through Section 904.2.7.

904.3.1 Listed Units. Listed central heating furnaces and low-pressure boilers shall be installed with clearances in accordance with the terms of their listings and the manufacturer’s installation instructions. (NFPA 54:10.3.3.1) [NFPA54.9.1.1.3]

904.3.2 Unlisted Units. Unlisted central heating furnaces and low-pressure boilers shall be installed with clearances from combustible material not less than those specified in Table 904.3.2. [NFPA 54:10.3.3.2]

904.3.3 Listed and Unlisted Units. Central heating furnaces and low-pressure boilers shall be permitted to be installed with reduced clearances to combustible material, provided that the combustible material or appliance is protected as described in Table 303.10.1 and Figure 303.10.1(1) through Figure 303.10.1(3), and such reduction is allowed by the manufacturer’s installation instructions. (NFPA 54:10.3.3.3)

904.3.4 Front Clearance. Front clearance shall be sufficient for servicing the burner and the furnace or boiler. [NFPA 54:10.3.3.4]

904.3.5 Adjacent to Plaster or Noncombustible Materials. Where the furnace plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish where the clearance specified is 2 inches (51 mm) or less. [NFPA 54:10.3.3.5]

904.3.6 Interference. The clearances to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. [NFPA 54:10.3.3.6]

904.3.7 Central Heating Furnaces. Central heating furnaces other than those listed in Section 603.13.2 or Section 603.13.3 shall have clearances from the supply ducts of not less than 18 inches (457 mm) from the furnace plenum for the first 3 feet (914 mm), then 6 inches (152 mm) for the next 3 feet (914 mm) and 1 inch (25.4 mm) beyond 6 feet (1829 mm). [NFPA 54:10.3.3.9]

904.4 Assembly and Installation. A central heating boiler or furnace shall be installed in accordance with the manufacturer’s instructions in one of the following manners:

(1) On a floor of noncombustible construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof.

(2) On fire-resistive slabs or arches having no combustible material against the underside thereof.

Exceptions:

(1) Appliances listed for installation on a combustible floor.

(2) Installation on a floor protected in an approved manner. [NFPA 54:10.3.4]

904.4.1 Under-Floor Installation. Furnaces installed in an under-floor area of the building shall be in accordance with the Section 904.4.1.1 through Section 904.4.1.3.

904.4.1.1 Supported by Ground. Where a furnace is supported by the ground, it shall be installed on a concrete slab not less than 3
inches (76 mm) above the adjoining ground level.  

904.4.1.2 Supported from Above. Where a furnace is supported from above, a clearance of not less than 6 inches (152 mm) shall be provided from finished grade.

904.5 Temperature or Pressure Limiting Devices. Steam and hot water boilers, respectively, shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature. Safety limit controls shall not be used as operating controls. [NFPA 54:10.3.5]

904.6 Low-Water Cutoff. All water boilers and steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops below the lowest safe water line. In lieu of the low-water cutoff, water tube or coil-type boilers that require forced circulation to prevent overheating and failure shall have an approved flow sensing device arranged to shut down the boiler when the flow rate is inadequate to protect the boiler against overheating. [NFPA 54:10.3.6]

904.7 Steam Safety and Pressure Relief Valves. Steam and hot water boilers shall be equipped, respectively, with listed or approved steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements. A shutoff valve shall not be placed between the relief valve and the boiler or on discharge pipes between such valves and the atmosphere. [NFPA 54:10.3.7]

904.7.1 Discharge. Relief valves shall be piped to discharge near the floor. [NFPA 54:10.3.7.1]

904.7.2 Size. The entire discharged piping shall be at least the same size as the relief valve discharge piping. [NFPA 54:10.3.7.2]

904.7.3 End Connections. Discharge piping shall not contain threaded end connection at its termination point. [NFPA 54:10.3.7.3]

904.8 Refrigeration Coils. The installation of refrigeration coils shall comply with the following requirements:

1) A refrigeration coil shall not be installed in conjunction with a forced air furnace where circulation of cooled air is provided by the furnace blower, unless the blower has sufficient capacity to overcome the external static pressure resistance imposed by the duct system and refrigeration coil at the air flow rate for heating or cooling, whichever is greater.

2) Furnaces shall not be located upstream from refrigeration coils, unless the refrigeration coil is designed or equipped so as not to develop excessive temperature or pressure.

3) Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.

4) Means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element. [NFPA 54:10.3.9]

904.9 Cooling Units Used with Heating Boilers. Boilers, where used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. [NFPA 54:10.3.10.1]

904.9.1 Exposed to Refrigerated Air Circulation. Where hot water heating boilers are connected to heating coils located in air-handling units where they can be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. [NFPA 54:10.3.10.2]

904.10 Furnace (Upright and Horizontal). Upright furnaces shall be permitted to be installed in an attic, furred, or under-floor space exceeding 5 feet (1524 mm) in height, provided the required listings and furnace and duct clearances are observed. Horizontal furnaces shall be permitted to be installed in an attic, furred, or under-floor space, provided the required listings and furnace and duct clearances are observed.

904.11 Solid-Fuel-Fired Furnaces. Factory-built solid-fuel-fired furnaces shall comply with UL 391 and shall be installed in accordance with the manufacturer’s installation instructions.

904.12 Oil-Fired Central Furnaces. Oil-fired central furnaces shall comply with UL 727 and shall be installed in accordance with the manufacturer’s installation instructions.

904.13 Commercial or Industrial Gas Heaters. Commercial or industrial gas-fired heaters shall comply with UL 795 and shall be installed in accordance with the manufacturer’s installation instructions.

904.14 Electric Central Furnaces. Electric central heating furnaces shall comply with UL 1995 or UL 60335-2-40 and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The code change provides a list of spaces where fuel burning appliances shall not be installed for public health and safety. For example, Section 303.2 allows central heating furnaces and boilers installed in closets or alcoves shall be listed for such installation.

The UMC TC stated that “the proposal needs additional revisions and is currently vague and poorly written.” Modifications have been made to clarify the language and intent of the proposal.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 308.0, 308.1  Item #: 067

SUBMITTER: Arnie Rodio  Self

Comment #: 2

RECOMMENDATION: Revise text

Request to replace the code change proposal by this public comment.
308.0 Improper Prohibited Locations.
308.1 General. Piping, appliances, or equipment shall not be so located as to interfere with the normal use thereof or with the normal operation and use of windows, doors, or other required facilities.

SUBSTANTIATION:
The title of Section 308.0 is being updated and the term “appliance” is being added to Section 308.1 to correlate with changes accepted in the UPC.
Proposals

Item #: 072
UMC 2024  Section: 310.3.2

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Add new text

310.0 Condensate Wastes and Control.

310.3 Condensate Waste Pipe Material and Sizing. (remaining text unchanged)

310.3.2 Material. Condensate waste pipes shall be constructed of DWV materials in accordance with the plumbing code.

SUBSTANTIATION:
There is currently no direction for acceptable piping material for condensate waste pipe in the code. This code change adds provisions for condensate waste pipe materials to assist the installer and AHJ with installation of condensate waste pipe. The UPC, Table 701.2, lists the acceptable materials for condensate lines.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed change directs the end user to DWV materials in the plumbing code, which may not contain all applicable materials and sizes for condensate waste pipe. Many condensate drains are smaller than 1¼ inch. The language needs to be rewritten as it is overly restrictive.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 310.3  Item #: 072
SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

310.0 Condensate Wastes and Control.

310.3 Condensate Waste Pipe Material and Sizing. Condensate waste pipes from air-cooling coils shall be sized in accordance with the equipment capacity as specified in Table 310.3. The material of the piping shall comply with the
pressure and temperature rating of the appliance or equipment, and shall be approved for use with the liquid being discharged.

The size of condensate waste pipes is for one unit or a combination of units, or as recommended by the manufacturer. The capacity of waste pipes assumes a 1/8 inch per foot (10.4 mm/m) or 1 percent slope, with the pipe running three-quarters full at the following pipe conditions:

<table>
<thead>
<tr>
<th>Outside Air – 20%</th>
<th>Room Air – 80%</th>
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<tbody>
<tr>
<td>DB</td>
<td>WB</td>
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<tr>
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<td>73°F</td>
</tr>
</tbody>
</table>

For SI units: °C = (°F-32)/1.8

Condensate drain sizing for other slopes or other conditions shall be approved by the Authority Having Jurisdiction.

Air-conditioning waste pipes, 1 ¼ of an inch (32 mm) and larger in size, shall be constructed of materials specified in the plumbing code. Condensate waste piping less than 1 ¼ of an inch (32 mm) in size shall be permitted to be PVC, CPVC, PE, PP, copper, or other rigid materials approved by the Authority Having Jurisdiction.

SUBSTANTIATION:
The modification adds air conditioning waste pipe size requirements and correlates with the actions taken by the UPC TC.

UPC Section 814.3 addresses condensate piping for air-conditioning equipment by stating that the material must meet the requirements found in Chapter 7. If the materials found in UPC Table 701.2 are required to be used, the minimum size of piping, per UPC Table 703.2, would be 1-1/4". Many air-conditioning condensate lines are 3/4" and 1" There is no drainage pipe or fittings available in those sizes. Listing acceptable materials for smaller sizes of condensate waste lines in the Code, will eliminate interpretation issues between installers and the AHJ.
Proposals

Item #: 074

UMC 2024  Section: 310.5

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

310.0 Condensate Wastes and Control.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly, except where permitted in Section 310.6, to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, or leach pits, or the tailpiece of plumbing fixtures. A condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved.

Exception: Direct connections in accordance with Section 310.6.

(below shown for reference only)

310.6 Condensate Waste From Air-Conditioning Coils. Where the condensate waste from air-conditioning coils discharges by direct connection to a lavatory tailpiece or to an approved accessible inlet on a bathtub overflow, the connection shall be located in the area controlled by the same person controlling the air-conditioned space.

SUBSTANTIATION:
The first sentence of Section 310.5 starts with indirect connection and then gives the exception. The change relocates language in Section 310.5 to an exception for clarity and to ensure it is not overlooked. Such “direct” connection to the tailpiece is covered in Section 310.6. Additionally, the term “tailpiece of plumbing fixtures” is grouped with the list of locations allowed for “air gap” or “air breaks.” A connection to a tailpiece of a plumbing fixture is neither through an air break or air gap.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, mop sinks, or leach pits. A condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved.

Exception: Direct connections in accordance with Section 310.6.

COMMITTEE STATEMENT:
The change clarifies that mop sinks are an option for indirect connections for condensate waste discharge. Condensate drainage through mop sinks is common and the modification will assist the end user in installing indirect condensate waste piping.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 27  NEGATIVE: 2  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

WHITE: The removal of connections to tailpieces of plumbing fixtures is wrong. Once that is deleted, Section 310.6 is rendered useless, the tailpiece is no longer an acceptable point of disposal. The proponent states that a tailpiece is not
an air break, but that is not a correct statement. Provided the tailpiece is above the trap weir, it is an air break. This will eliminate a very common method of disposal in multifamily construction.

WISEMAN: It makes no sense to remove lavatory tailpiece from Section 310.5. If you remove it from the current list of specific points-of-discharge, then it becomes an unacceptable discharge point. The industry uses this point-of-discharge all the time without problem.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: 310.4, 310.5, Table 1801.1 Item #: 074
SUBMITTER: Julius Ballanco, P.E.
Chair, UMC Condensate Task Group

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

310.0 Condensate Wastes and Control.

310.4 Appliance Condensate Drains. Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer’s instructions. Condensate drain lines serving more than one appliance shall be approved by the Authority Having Jurisdiction prior to installation connecting to a common indirect waste pipe shall have the connections to the indirect waste pipe protected by a sanitary waste valve complying with ASME A112.18.8, condensate trap complying with IAPMO IGC 196, or trap with a trap primer.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, mop sinks, or leach pits. An individual condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved in accordance with Section 310.4.

Exception: Direct connections in accordance with Section 340.6.

<table>
<thead>
<tr>
<th>TABLE 1801.1</th>
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<td>REFERENCED STANDARDS</td>
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<table>
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<td>Sanitary Waste Valves for Plumbing Drainage Systems</td>
<td>Sanitary Waste Valves</td>
<td>310.4</td>
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<tr>
<td>IAPMO IGC 196-2018</td>
<td>Condensate Traps and Overflow Switches for Air-Conditioning Systems</td>
<td>Condensate Traps</td>
<td>310.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.18.8 and IAPMO IGC 196 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The primary concern with the connection to indirect waste pipe from multiple condensate drains is the free passage of air between spaces. Without a means of preventing the movement of air in the indirect waste pipe, biohazardous airborne materials can easily migrate between building spaces. This can result in a medical emergency from exposure to viruses, germs, or chemicals emanating into a space.

Since the connection of the condensate is indirect, there are no hard piping connections that closes off the piping between different building spaces. There needs to be a means or mechanism that isolates the open piping while still allowing the pipe to serve as an indirect waste pipe. This mechanism would prevent the movement of contaminated air between different spaces in a building. Two currently available devices that would provide the isolation of air movement through an indirect waste pipe are sanitary waste valves and condensate traps. These devices are regulated by ASME A112.18.8 and IAPMO IGC 196 respectively. Both devices will isolate the air movement and are proven by testing and listing to the referenced standards.
To a lesser degree, a water seal trap could provide isolation of air movement. The problem with a trap is that if the trap loses the water seal, the trap provides no protection against air movement. Condensate drains may not operate for months, thus leaving the trap with no source of water for refilling due to evaporation. For that reason, the only possible means of accepting a water seal trap as an alternative to the two devices is to mandate a trap seal primer valve. While the alternative of a trap with trap seal primer is included in the acceptable means of protection from air movement, it is the poorest of the three methods identified.

This public comment is a life safety issue in protecting the public from transmission of airborne contaminants between building spaces. This concern has become more apparent with the current pandemic facing the world. It is imperative that the Plumbing Code and Mechanical Code address the issue with means of preventing a hazardous situation.

The UMC/UPC Condensate Task Group was appointed by the Chairs of the Plumbing Technical Committee and Mechanical Technical Committee. The Task Group met numerous times to develop this public comment.
Proposals

Item #: 078

UMC 2024  Section: 311.2 - 311.4

SUBMITTER: Phil Pettit  
Control Air Conditioning Corporation  
Rep. Self

RECOMMENDATION:  
Revise text

311.0 Heating or Cooling Air System.

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 936.0.

Exceptions:
(1) Air filters used in systems serving single guest rooms or dwelling units shall not be required to be a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

311.3 Prohibited Sources. Outside or return air for a heating or cooling air system shall not be taken from the following locations:
(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside-air inlet.
(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway.
(3) A hazardous or insanitary location, or a refrigeration machinery room as defined in this code.
(4) An area, the volume of which is less than 25 percent of the entire volume served by such system, unless there is a permanent opening to an area the volume of which is equal to 25 percent of the entire volume served.

Exception: Such openings where used for a heating or cooling air system in a dwelling unit shall be permitted to be reduced to not less than 50 percent of the required area, provided the balance of the required return air is taken from a room or hall having not less than three doors leading to other rooms served by the furnace.
(5) A closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room, or unconditioned attic.
(6) Rooms or spaces containing a fuel-burning appliance therein. Where such room or space serves as source of return-air.

Exceptions:
(1) This shall not apply to fireplaces, fireplace appliances, residential cooking appliances, direct vent appliances, enclosed furnaces, and domestic-type clothes dryers installed within the room or space.
(2) This shall not apply to a gravity-type or listed vented wall heating or cooling air system.
(3) This shall not apply to a blower-type heating or cooling air system installed in accordance with the following requirements:
(a) Where the return air is taken from a room or space having a volume exceeding 1 cubic foot (0.03 m³) for each 10 Btu/h (0.003 kW) fuel input rating of fuel-burning appliances therein.
(b) Not less than 75 percent of the supply air is discharged back into the same room or space.
(c) Return-air inlets shall not be located within 10 feet (3048 mm) from an appliance firebox or draft diverter in the same enclosed room or confined space.
(7) Return air shall not be taken from indoor swimming pool enclosures and associated deck areas.

Exceptions:
(a) Where the air from such spaces is dehumidified.
(b) Dedicated HVAC systems serving only such spaces.
(8) Return air from one dwelling unit shall not discharge into another dwelling unit through the heating or cooling air system.

311.4 Return-Air Limitations. Return air from one dwelling unit shall not discharge into another dwelling unit through the heating or cooling air system.
SUBSTANTIATION:
The current wording in Section 311.2 is incorrect and misleading as it can be interpreted that air filters are not required to be installed in dwelling units. The exception is being corrected to clarify that air filters are indeed required in dwelling units, but they do not need to be listed.

Additional return air limitations are also being added to Section 311.3 to address missing return air prohibited sources, such as swimming pool enclosures, garages, boiler rooms, furnace rooms, and unconditioned attics. Section 311.4 is also being combined with Section 311.3 since they cover the same topic.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the language is unenforceable, overly restrictive, and lacks technical justification. The reference to boilers in basements and return air is not an issue. There is no provided reason for prohibiting this. Furthermore, chlorine latent vapors are being let into the building and the humidity can cause structural damage.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: 311.2, 311.3 Item #: 078
SUBMITTER: Randy Young Northern California JATC Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

311.0 Heating or Cooling Air System.

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 935.0.

Exceptions:
(1) Air filters used in systems serving single guest rooms or dwelling units shall not be required to be a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

311.3 Prohibited Sources. Outside or return air for a heating or cooling air system shall not be taken from the following locations:
(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside-air inlet.
(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway.
(3) A hazardous or insanitary location, or a refrigeration machinery room as defined in this code.
(4) An area, the volume of which is less than 25 percent of the entire volume served by such system, unless there is a permanent opening to an area the volume of which is equal to 25 percent of the entire volume served.

Exception: Such openings where used for a heating or cooling air system in a dwelling unit shall be permitted to be reduced to not less than 50 percent of the required area, provided the balance of the required return air is taken from a room or hall having not less than three doors leading to other rooms served by the furnace.
(5) A closet, bathroom, toilet room, kitchen, garage, boiler room, furnace room, or unconditioned attic.
(6) Rooms or spaces containing a fuel-burning appliance therein. Where such room or space serves as source of return-air.

Exceptions:
(1) This shall not apply to fireplaces, fireplace appliances, residential cooking appliances, direct vent appliances, enclosed furnaces, and domestic-type clothes dryers installed within the room or space.
(2) This shall not apply to a gravity-type or listed vented wall heating or cooling air system.
(3) This shall not apply to a blower-type heating or cooling air system installed in accordance with the following requirements:
(a) Where the return air is taken from a room or space having a volume exceeding 1 cubic foot (0.03 m$^3$) for each 10 Btu/h (0.003 kW) fuel input rating of fuel-burning appliances therein.
(b) Not less than 75 percent of the supply air is discharged back into the same room or space.
(c) Return-air inlets shall not be located within 10 feet (3048 mm) from an appliance firebox or draft diverter in the same enclosed room or confined space.

**SUBSTANTIATION:**
The current wording in Section 311.2 is incorrect and misleading as it can be interpreted that air filters are not required to be installed in dwelling units. The exception is being corrected to clarify that air filters are indeed required in dwelling units, but they do not need to be listed.

Furthermore, Section 311.3 is being modified to address additional prohibited sources for return air.
Proposals

Item #: 079
UMC 2024 Section: 311.2.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

311.2 Air Filters. Air filters shall be installed in a heating, cooling, or makeup air system. Media-type air filters shall comply with UL 900. Electrostatic and high efficiency particulate filters shall comply with Section 936.0.

Exceptions:
(1) Systems serving single guest rooms or dwelling units shall not require a listed filter.
(2) Air filters used in listed appliances and in accordance with the manufacturer’s instructions.

311.2.1 Minimum Filtration. In mechanically ventilated buildings, occupied areas of the building shall be provided with air filtration media for outside and return air that provides not less than a Minimum Efficiency Reporting Value (MERV) of 13 or as required by the Authority Having Jurisdiction. Installed filters shall be clearly labeled by the manufacturer indicating the MERV rating.

SUBSTANTIATION:
This code change would make air filters with a MERV of 13 or higher the requirement based on the ASHRAE measurement scale test method. MERV 13 air filters or better are already required by many jurisdictions. Since 2019, California Title 24, Part 6 has had the MERV 13 requirement for air filters. Many jurisdictions require MERV 14 rating in central ventilation systems. MERV 13 filters are beneficial because they are able to remove particles of lower-rated filters, plus smoke, bacteria, droplet nuclei (from a sneeze), smog, and aerosols. Indoor air pollution can cause health problems and one of the best ways to lower the risk of airborne contaminants in occupied spaces is to comply with the MERV 13 requirement. The AHJ can still require other minimum MERV ratings as necessary on a case-by-case basis.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
This item is being rejected as requiring MERV 13 filters is overly stringent and may lower the performance of existing HVAC systems and affect air pressure. MERV 13 filters are already required by energy codes. There may be residential occupancies that will not be able to comply with these requirements. Furthermore, nothing in this code restricts the use of MERV 13 filters.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 12 NEGATIVE: 17 NOT RETURNED: 1 Heine

Note: Item # 079 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF AFFIRMATIVE:

BALLANCO: While I believe MERV 13 filters should be considered for commercial construction, they are not feasible for many residential and light commercial units. This should not be a universal requirement for all systems. Furthermore, it is inappropriate to state, "or as required by the Authority Having Jurisdiction." This statement leaves the requirements wide open without proper guidelines to the AHJ.

KOERBER: I do not believe that MERV 13 requirements for filtration should be mandated by the code. Certainly they may be considered as a beneficial option to occupants, but mandating their use within the code is not a good idea.
MACNEVIN: I agree with the initial Committee Action to Reject this proposal. Mandating a specific filter type in the code is not enforceable because filters are frequently changed.

WHITE: This is a design consideration, not a code decision. Certainly, filters reduce particles in the air and improve IAQ, some better than others. There are design considerations to properly size filters such that the pressure drop is acceptable to the system, those are not free. In residential equipment, simply changing a 1 inch fiberglass filter with a 1 inch MERV 13 will not give the same performance at both the initial clean filter condition, but will degrade performance faster as the MERV 13 loads up with contaminants sooner.

WISEMAN: There are considerable problems implementing residential MERV 13 filters in the field without replacing the duct system. As the static pressure rises with higher efficiency filters, there is often not enough airflow over the coil to allow for proper operation. Thus, many California contractors are either avoiding permits, or returning after the job is completed to remove the MERV 13 filter so the system will operate properly. MERV 13 works wonderfully if the entire system is newly installed and properly designed. It does NOT work if installed on an older restrictive duct system. The decision for what filter is installed should be left to the building/homeowner and the design engineer/contractor.

EXPLANATION OF NEGATIVE:

ADLER: I agree with the statements of Dave Mann and Randy Young.

AGUILAR: Mechanical filters have been shown to reduce significantly indoor concentrations of airborne particles. Modest empirical evidence shows that their use will have positive effects on health. Numerous Committee members indicated this was already happening in their jurisdictions and have no real issues.

ARYAN: MERV 13 filters are already required by the California energy code and the LA City mechanical and green codes. There have not been any issues to enforcing this requirement and it is very feasible to require this as well as beneficial to ensure better air quality.

BENKOWSKI: The filter for a mechanical system should not be selected by the AHJ. The design engineer should select filter to benefit the intended operation of the building.

BERGER; EGG, J: I agree with the comments made by Randy Young and other TC members.

DIAS: One of the concerns was that if MERV 13 filters are required that the air handler would not be able to handle the increased pressure drop. But if it is already a requirement in certain jurisdictions without any issues then I do not think its a legitimate concern.

HAMILTON: MERV 13 can be added to systems with no, as in zero, increase in fan energy or increase in size of the fan.

KREITENBERG: This change is overly restrictive.

MANN: One of the concerns was to residential systems and I believe this is not addressing those systems. I also agree with the comment submitted by Randy Young.

RIBBS: I agree with April Trafton that in new construction, this is important. For remodel of existing systems, this needs to be designed to provide appropriate filtration without damaging existing equipment.

TAYLOR: I feel the minimum filtration rate is important to be in the code.

TERZIGNI: I think this is the right direction and existing buildings can be given an exemption per Section 302.1.3.

TROFTON, A: In new construction, this is important. For remodel of existing systems, this needs to be designed to provide appropriate filtration without damaging existing equipment.

TROFTON, P: As California is already requiring MERV 13 filters in residential applications and in some commercial applications and it has been found that it can be accomplished appropriately, this should be accepted. Though I do agree it should be up to the design professional to properly select and size filters, not the AHJ.

VAN RITE: I do not agree with the MERV 13 requirement.

YOUNG: Mechanical filters have been shown to reduce significantly indoor concentrations of airborne particles. Modest empirical evidence shows that their use will have positive effects on health. Numerous Committee members indicated this was already happening in their jurisdictions and have no real issues.
Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 311.2.1

SUBMITTER: Keith Blazer
Self

RECOMMENDATION:
Add new text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
This code change would make air filters with a MERV of 13 or higher the requirement based on the ASHRAE measurement scale test method. ASHRAE and the CDC recommend MERV 13 filters. Nearly all furnaces and HVAC systems can accommodate a MERV 13 filter without creating any equipment problems. MERV 13 air filters or better are already required by many jurisdictions. Since 2019, California Title 24, Part 6 has had the MERV 13 requirement for air filters. Many jurisdictions require MERV 14 rating in central ventilation systems. MERV 13 filters are beneficial because they are able to remove particles of lower-rated filters, plus smoke, bacteria, droplet nuclei (from a sneeze), smog, and aerosols. Indoor air pollution can cause health problems and one of the best ways to lower the risk of airborne contaminants in occupied spaces is to comply with the MERV 13 requirement. The AHJ can still require other minimum MERV ratings as necessary on a case-by-case basis.
Proposals

Item #: 081

UMC 2024  Section: 313.1, Table 1701.1

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

313.0 Hangers and Supports.
313.1 General. Piping, tubing, appliances, and appurtenances shall be supported in accordance with this code, the manufacturer's installation instructions, and in accordance with the Authority Having Jurisdiction. [Pipe hangers, supports, and anchors used for fuel gas shall be in accordance with Section 1310.3.5. Pipe support hangers and hooks shall comply with IAPMO PS 95.]

(below shown for reference only)

1310.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58. [NFPA 54:7.2.6.1]

Note: IAPMO PS 95 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Pipe hangers and supports must meet the requirements of Section 1310.3.5 for fuel gas piping, which references MSS SP-58, or IAPMO PS 95 for support hangers and hooks. Therefore, a reference to Section 1310.3.5 and the IAPMO PS 95 standard are being added for completeness.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the changes pertaining to hangers and supports in this proposal are already addressed in Section 1310.3.5.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 313.2, 313.7, 1310.3.5  Item #: 081
SUBMITTER: Phillip H Ribbs, PHR Consultants; Randy Young, Northern California JATC  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

313.0 Hangers, Supports, and Anchors.

313.2 Material. Hangers, supports, and anchors shall be of sufficient strength to support the weight of the pipe or tubing and its contents. Piping or tubing shall be isolated from incompatible materials. Pipe support hangers and hooks shall comply with IAPMO PS 95 or shall be of an approved material.

313.7 Gas Piping. Gas piping shall be supported by metal straps or hooks in accordance with Section 1310.3.5 at intervals not to exceed those shown in Table 1310.3.5.1.

1310.0 Gas Piping Installation.

1310.3 Installation of Aboveground Piping. (remaining text unchanged)

1310.3.5 Hangers, Supports, and Anchors. Piping shall be supported with metal pipe hooks, metal pipe straps, metal bands, metal brackets, metal hangers, or building structural components, suitable for the size of piping, of adequate strength and quality, and located at intervals so as to prevent or damp out excessive vibration. Piping shall be anchored to prevent undue strains on connected appliances and equipment and shall not be supported by other piping. Pipe hangers and supports shall conform to the requirements of MSS SP-58 or IAPMO PS 95. ([NFPA 54:7.2.6.1])

Note: IAPMO PS 95 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Pipe hangers and supports for fuel gas piping must meet the requirements of Section 1310.3.5. Therefore, a reference to Section 1310.3.5 is being added for direction. Furthermore, IAPMO PS 95 is being relocated to Chapter 3 to its appropriate location in the code for general installation requirements. This will match with the NFPA 54:7.2.6.1 extract in Section 1310.3.5.
Proposals

Item #: 088
UMC 2024 Section: Chapter 4, Table 1701.1

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 62.1 Extract Update

RECOMMENDATION:
Revise text

402.2 Natural Ventilation Procedure. Natural ventilation systems shall be comply with the requirements of either Section 402.2.1 through Section 402.2.1.6(A) or Section 402.2.2. Designers shall provide interior air barriers, insulation, or other means that separate naturally ventilated spaces from mechanically cooled spaces to prevent high-dew-point outdoor air from coming into contact with mechanically cooled surfaces. [ASHRAE 62.1:6.4]

402.2.1 Prescriptive Compliance Path. Any zone designed in accordance with this section and for natural ventilation shall include a mechanical ventilation system designed in accordance with Section 403.0, Section 404.0, or both.

Exceptions:
(1) An engineered natural ventilation system where approved by the Authority Having Jurisdiction need not comply with Section 402.2.
(2) The mechanical ventilation systems shall not be required where:
(a) Natural ventilation openings that comply with the requirements of Section 402.2.1 and are permanently open or have controls
(b) Controls that prevent the natural ventilation openings from being closed during periods of expected occupancy, or
natural ventilation openings that are permanently open.
(b) the zone is
(2) Zones that are not served by heating or cooling equipment. ([ASHRAE 62.1:6.4 6.4.1])

402.2.1.4 Ceiling Height. The ceiling height, \( H \), to be used in Section 402.2.1.1 through Section 402.2.1.3 shall be the minimum ceiling height in the space.

Exception:
For ceilings that are parallel to the floor, the ceiling height \((H)\) to be used in Section 402.2.3 through Section 402.2.5 shall be the minimum ceiling height in the zone.

For zones where ceilings that are height increases increasing in height as distance from the openings is increased, the ceiling height shall be determined as the average height of the ceiling within 20 feet (6096 mm) from the operable openings. [ASHRAE 62.1:6.4.1.4 6.4.1.1]

402.2.4 Floor Area to be Ventilated. Spaces, or portions of spaces, to be The naturally ventilated area in zones or portions of zones shall be located within extend from the openings to a distance based on the ceiling height, as determined in accordance with Section 402.2.4.1 402.2.3, Section 402.2.4.2 402.2.4, or Section 402.2.4.3 402.2.5. For spaces where ceiling that are not parallel to the floor, the ceiling height shall be determined in accordance with Section 402.2.4.4 402.2.1.1. [ASHRAE 62.1:6.4.4 6.4.1.2]

402.2.1.1 Single Side Opening. For spaces zones with operable openings on only one side of the space zone, the naturally ventilated area shall extend to a distance not greater than 2 times the height of the ceiling from the operable openings shall be not more than \( 2H \), where \( H \) is the ceiling height. [ASHRAE 62.1:6.4.1.4 6.4.1.3]

402.2.4.2 Double Side Opening. For spaces zones with operable openings on two opposite sides of the spaces zone, the naturally ventilated area shall extend between distance from the operable openings shall be not more than \( 5H \), where \( H \) is the ceiling height separated by a distance not greater than 5 times the height of the ceiling. [ASHRAE 62.1:6.4.4.2 6.4.1.4]

402.2.4.3 Corner Openings. For spaces zones with operable openings on two adjacent sides of a spaces zone, the distance from the operable openings shall be not more than \( 5H \) along a line drawn between the two openings that are farthest apart. Floor area outside that line shall comply with Section 402.2.1.1. [ASHRAE 62.1:6.4.4.3 6.4.1.5]
**402.2.2 Location and Size of Openings.** Spaces Zones or portions of spaces zones to be naturally ventilated shall have a permanently open to operable wall airflow path to openings directly connected to the outdoors. The minimum flow rate to the zone shall be determined in accordance with Section 403.2.1. The operable area shall be not less than 4 percent of the net occupiable floor area. Where openings are covered with louveres or otherwise obstructed, operable area shall be based on the net free unobstructed area through the opening. Where interior rooms, or portions of rooms, without direct openings to the outdoors are ventilated through adjoining rooms, the opening between rooms shall be permanently unobstructed and have a free area of not less than 8 percent of the area of the interior room or less than 25 square feet (2.3 m²). This flow rate shall be used to determine the required operable area of openings, accounting only for buoyancy-driven flow. Wind-driven flow shall be used only where it can be demonstrated that the minimum flow rate is provided during all occupied hours. Openings shall be sized in accordance with Section 402.2.1.6. (A). Permanently open airflow path shall include, but not be limited to, pathways that would allow airflow unimpeded by partitions, walls, and furnishings. ([ASHRAE 62.1:6.4.2 6.4.1.6])

**402.2.1.6(A) Sizing Openings.** Where the zone is ventilated using a single opening or multiple single openings located at the same elevation, the operable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.1.6(A)(1). Where the zone is ventilated using two openings located at different elevations or multiple pairs of such openings, the operable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.1.6 (A)(2).

Where openings are obstructed by louveres or screens, the operable area shall be based on the net free area of the opening. Where interior zones, or portions of zones, without direct openings to the outdoors are ventilated through adjoining zones, the opening between zones shall be permanently unobstructed and have a free area of not less than twice the percent of occupiable floor area used to determine the opening size of adjacent exterior zones, or 25 square feet (2.3 m²), whichever is greater. Table 402.2.1.6(A)(1) and Table 402.2.1.6(A)(2) are based on buoyancy-driven flow and shall not address thermal comfort. ([ASHRAE 62.1:6.4.1.6])

**402.2.2 Engineered System Compliance Path.** For an engineered natural ventilation system, the following shall be included:

1. Determine hourly environmental conditions, including outdoor air dry-bulb temperature, dew-point temperature, outdoor concentration of contaminants, including PM2.5, PM10, and ozone where data are available; wind speed and direction; and internal heat gains during expected hours of natural ventilation operation.
2. Determine the effect of pressure losses along natural ventilation airflow paths on the resulting flow rates, including inlet openings, air transfer grills, ventilation stacks, and outlet openings during representative conditions of expected natural ventilation system use.
3. Quantify natural ventilation airflow rates of identified airflow paths accounting for wind induced and thermally induced driving pressures during representative conditions of expected natural ventilation system use.
4. Design to provide outdoor air in quantities sufficient to result in acceptable IAQ as established under Section 403.2.1 or ASHRAE 62.1 during representative conditions of expected natural ventilation system use. ([ASHRAE 62.1:6.4.2])

**402.2.3 Control and Accessibility.** The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied. Controls shall be designed to coordinate operation of the natural and mechanical ventilation systems. ([ASHRAE 62.1:6.4.3])

**403.2 Zone Calculations.** Ventilation zone parameters shall be determined in accordance with Section 403.2.1 through Section 403.2.3 for each ventilation zones served by the ventilation system, except that the ventilation rates from ASHRAE/ASHE 170 shall be used for the occupancy categories, as applicable. ([ASHRAE 62.1:6.2.2 6.2.1])

**403.2.1 Breathing Zone Outdoor Airflow.** The outdoor airflow required in the breathing zone (Vbz) of the occupiable space or spaces in a ventilation zone shall be not less than the value determined in accordance with Equation 403.2.1.

\[ Vbz = Rp\cdot Pz + Ra\cdot Az \] (Equation 403.2.1)

Where:
- \( Az \) = zone floor area, the net occupiable floor area of the ventilation zone, square feet (m²).
- \( Pz \) = zone population, the number of people in the ventilation zone during typical usage.
- \( Rp \) = outdoor airflow rate required per person as determined from Table 402.1.
- \( Ra \) = outdoor airflow rate required per unit area as determined from Table 402.1. ([ASHRAE 62.1:6.2.2 6.2.1])

**403.2.2 Zone Air Distribution Effectiveness.** The zone air distribution effectiveness (Ez) shall be not greater than the default value determined in accordance with Table 403.2.2. ([ASHRAE 62.1:6.2.2 6.2.1])

**403.2.2.2 Stratified Air Distribution Systems.** A stratified air distribution system shall be designed in accordance with Section 403.2.2.1.1 through Section 403.2.2.2.2, or the zone air distribution effectiveness (Ez) shall be determined in accordance with ASHRAE 62.1. ([ASHRAE 62.1:6.2.1.1])

**403.2.2.1 Supply Air.** Cool air shall be at least 4°F (2°C) less than the average room air temperature. ([ASHRAE 62.1:6.2.1.1])

**403.2.2.1.2 Return Air.** The return air openings or pathways shall be located not less than 9 feet (2.8 m) above the floor. ([ASHRAE 62.1:6.2.1.1])

**403.2.2.3 Stratification.** The zone shall not contain any devices that mechanically mix the air, and shall be protected...
from impinging airstreams from adjacent ventilation zones. [ASHRAE 62.1:6.2.1.2.1.3]

### 403.2.2.2 Personalized Ventilation Systems
A personalized ventilation system shall be designed in accordance with the following subsections, or the zone air distribution effectiveness ($E_z$) shall be determined in accordance with ASHRAE 62.1. [ASHRAE 62.1:6.2.1.2.1.2]

#### 403.2.2.2.1 Personalized Air
The personalized air shall be distributed in the breathing zone and designed such that the velocity is equal to or less than 50 feet per minute (0.25 m/s) at the head/facial region of the occupant. [ASHRAE 62.1:6.2.1.2.1.2.1]

#### 403.2.2.2.2 Return Air
The return air openings or pathways shall be located more than 9 feet (2.8 m) above the floor. [ASHRAE 62.1:6.2.1.2.2.2]

### 403.2.3 Zone Outdoor Airflow
The zone outdoor airflow ($V_{oz}$) provided to the ventilation zone by the supply air distribution system shall be determined in accordance with Equation 403.2.3. [ASHRAE 62.1:6.2.2.3]

$$V_{oz} = \frac{V_{bz}}{E_z} \quad \text{(Equation 403.2.3)}$$

### 403.3 Single-Zone Systems
For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to only one ventilation zone, the outdoor air intake flow ($V_{ot}$) shall be determined in accordance with Equation 403.3. [ASHRAE 62.1:6.2.3]

$$V_{ot} = V_{oz} \quad \text{(Equation 403.3)}$$

### 403.4 One Hundred Percent Outdoor Air Systems
For ventilation systems where one or more air handlers supply only outdoor air to one or more ventilation zones, the outdoor air intake flow ($V_{ot}$) shall be determined in accordance with Equation 403.4. [ASHRAE 62.1:6.2.4]

$$V_{ot} = S_{all \; zones} \cdot V_{oz} \quad \text{(Equation 403.4)}$$

### 403.5 Multiple-Zone Recirculating Systems
For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to more than one ventilation zone, the outdoor air intake flow ($V_{ot}$) shall be determined in accordance with Section 403.5.1 through Section 403.5.2. [ASHRAE 62.1:6.2.5]

#### 403.5.1 Uncorrected Outdoor Air Intake
The uncorrected outdoor air intake ($V_{ou}$) flow shall be determined in accordance with Equation 403.5.1. [ASHRAE 62.1:6.2.5.1.1]

$$V_{ou} = D \cdot S_{all \; zones} \cdot (R_{p} \cdot P_{z}) + S_{all \; zones} \cdot (R_{a} \cdot A_{z}) \quad \text{(Equation 403.5.1)}$$

##### 403.5.1.1 Occupant Diversity
The occupant diversity ratio ($D$) shall be determined in accordance with Equation 403.5.1.1 to account for variations in population within the ventilation zones served by the system.

$$D = \frac{P_{s}}{S_{all \; zones} \cdot P_{z}} \quad \text{(Equation 403.5.1.1)}$$

**Exception:** Alternative methods to account for occupant diversity shall be permitted, provided that the resulting ($V_{ou}$) value is not less than that determined in accordance with Equation 403.5.1. [ASHRAE 62.1:6.2.5.1.1.1]

#### 403.5.1.2 System Ventilation Efficiency
The system ventilation efficiency ($E_{v}$) shall be determined in accordance with Section 403.5.1.3 for the simplified procedure or Section 404.0 for the alternate procedure. These procedures also establish zone minimum primary airflow rates for VAV systems. [ASHRAE 62.1:6.2.5.2.2]

##### 403.5.1.3 Simplified Procedure for System Ventilation Efficiency
System ventilation efficiency ($E_{v}$) shall be determined in accordance with Equation 403.5.1.3(1) or Equation 403.5.1.3(2). [ASHRAE 62.1:6.2.5.3.1]

$$E_{v} = 0.88 \cdot D + 0.22 \quad \text{for } D < 0.60 \quad \text{[Equation 403.5.1.3(1)]}$$

$$E_{v} = 0.75 \quad \text{for } D \geq 0.60 \quad \text{[Equation 403.5.1.3(2)]}$$

#### 403.5.1.4 Zone Minimum Primary Airflow
For each zone, the minimum primary airflow ($V_{pz-min}$) shall be determined in accordance with Equation 403.5.1.4. [ASHRAE 62.1:6.2.5.3.2]

$$V_{pz-min} = V_{oz} \cdot 1.5 \quad \text{(Equation 403.5.1.4)}$$

### 403.5.2 Outdoor Air Intake
The design outdoor air intake flow ($V_{ot}$) shall be determined in accordance with Equation...
403.5.2. [ASHRAE 62.1:6.2.5.4 6.2.4.4]

\[ V_{ot} = \frac{V_{ou}}{E_v} \] (Equation 403.5.2)

403.6 Design for Varying Operating Conditions. Ventilation systems shall be designed to be capable of providing not less than the minimum ventilation rates required in the breathing zone where the zone served by the system is occupied, including all full- and part-load conditions. The minimum outdoor air intake flow shall be permitted to be less than the design value at part-load conditions. [ASHRAE 62.1:6.2.6.4 6.2.5 – 6.2.5.1]

403.6.1 Short-Term Conditions. Where it is known that peak occupancy will be of short duration, ventilation will be varied or interrupted for a short period of time, or both, the design shall be permitted to be based on the average conditions over a time period \( T \) determined by Equation 403.6.1.

\[ T = 3v/V_{bz} \] (Equation 403.6.1)

Where:
- \( T \) = averaging time period, minutes.
- \( v \) = the volume of the ventilation zone where averaging is being applied, cubic foot (m\(^3\)).
- \( V_{bz} \) = the breathing zone outdoor airflow calculated in accordance with Equation 403.2.1 and design value of the zone population \((P_z)\), cubic foot per minute (CFM) (m\(^3\)/min).

Acceptable design adjustments based on this optional provision including the following:
1. Zones with fluctuating occupancy: The zone population \((P_z)\) shall be permitted to be averaged over time \((T)\).
2. Zones with intermittent interruption of supply air: The average outdoor airflow supplied to the breathing zone over time \((T)\) shall be not less than the breathing zone outdoor airflow \((V_{bz})\) calculated using Equation 403.2.1.
3. Systems with intermittent closure of the outdoor air intake: The average outdoor air intake over time \((T)\) shall be not less than the minimum outdoor air intake \((V_{ot})\) calculated using Equation 403.3, Equation 403.4, or Equation 403.5 as applicable. [ASHRAE 62.1:6.2.6.2 6.2.5.2]

403.8 Dynamic Reset. The system shall be permitted to be designed to reset the outdoor air intake flow \((V_{ot})\), the space or ventilation zone airflow \((V_{oz})\) as operating conditions change, or both. [ASHRAE 62.1:6.2.7 6.2.6]

403.9 Air Classification and Recirculation. Air shall be classified, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. [ASHRAE 62.1:6.165.18] Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

\[ \text{Air (return, transfer, or exhaust air) leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Table 402.1, Table 403.7, or Table 403.9 or as approved by the Authority Having Jurisdiction. Air leaving spaces or locations that are not listed in Table 402.1, Table 403.7, or Table 403.9 shall be designated with the same classification as air from the most similar space or location listed in terms of occupant activities and building construction.} \]

\[ \text{Exception: Air from spaces where environmental tobacco smoke (ETS) is present (Classification of air from spaces where ETS is present is not addressed. Spaces that are expected to include ETS do not have a classification listed in Table 402.1.) [ASHRAE 62.1:5.18.1]} \]

403.9.1 Class 1 Air. Recirculation or transfer of Class 1 air to other spaces any space shall be permitted. [ASHRAE 62.1:5.16.3.4 5.18.3.1]

403.9.2 Class 2 Air. Recirculation of Class 2 air within the space of origin shall be permitted. Recirculation or transfer of Class 2 air to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space. Transfer of Class 2 air to toilet rooms shall be permitted. Recirculation or transfer of Class 2 air to Class 4 spaces shall be permitted. Class 2 air shall not be recirculated or transferred to Class 1 spaces. Where When using an energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air, and the recirculated Exhaust air transfer ratio of Class 2 air shall not exceed 10 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. [ASHRAE 62.1:5.16.3.2 5.18.3.2 – 5.18.3.2.5]

403.9.3 Class 3 Air. Recirculation of Class 3 air within the space of origin shall be permitted. Class 3 air shall not be recirculated or transferred to any other spaces. Where When using an energy recover device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air, and the recirculated Exhaust air transfer ratio of Class 3 air shall not exceed 5 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. [ASHRAE 62.1:5.16.3.3 5.18.3.3 – 5.18.3.3.2]

403.9.4 Class 4 Air. Class 4 air shall not be recirculated or transferred to any other space or be recirculated within the space of origin. [ASHRAE 62.1:5.16.3.4 5.18.3.4]
404.1 **General System Ventilation Efficiency.** This section presents an alternative procedure for calculating the system ventilation efficiency \((E_v)\) for multiple zone recirculating systems that shall be used when Section 403.5.1.3 is not used. The system ventilation efficiency shall equal the lowest zone ventilation efficiency among the ventilation zones served by the air handler in accordance with Equation 404.1. [ASHRAE 62.1:A1.3] This section presents an alternative procedure for calculating the system ventilation efficiency \((E_v)\) for multiple zone recirculating systems that shall be used when Section 403.5.1.3 is not used.

\[ E_v = \text{minimum} (E_{vz}) \]  
(Equation 404.1)

404.2 **Average Outdoor Air Fraction.** The average outdoor air fraction \((X_s)\) for the ventilation system shall be determined in accordance with Equation 404.2.

\[ X_s = \frac{V_{ou}}{V_{ps}} \]  
(Equation 404.2)

The uncorrected outdoor air intake \((V_{ou})\) shall be determined in accordance with Section 403.5.1, and the system primary airflow \((V_{ps})\) shall be determined at the condition analyzed. [ASHRAE 62.1:A1.1]

404.3 **Zone Ventilation Efficiency.** The zone ventilation efficiency \((E_{vz})\) shall be determined in accordance with Section 404.3.1 or Section 404.3.2. [ASHRAE 62.1:A1.2]

404.3.1 **Single Supply Systems.** For single supply systems, where all of the air supplied to each a ventilation zone is a mixture of outdoor air and system-level recirculated air, zone ventilation efficiency \((E_{vz})\) shall be determined in accordance with Equation 404.3.1. Examples of single supply systems include constant-volume reheat, single-duct VAV, single-fan dual-duct, and multizone systems.

\[ E_{vz} = 1 + X_s - Z_{pz} \]  
(Equation 404.3.1)

The average outdoor air fraction for the system \((X_s)\) shall be determined in accordance with Equation 404.2, and the primary outdoor air fraction for the zone \((Z_{pz})\) shall be determined in accordance with Equation 404.3.1. [ASHRAE 62.1:A1.2.1]

\[ Z_{pz} = \frac{V_{oz}}{V_{pz}} \]  
(Equation 404.3.1)

For VAV systems, \(V_{pz}\) is the lowest zone primary airflow value expected at the design condition analyzed.

404.3.2 **Secondary-Recirculation Systems.** For secondary-recirculation systems where the supply air or a portion thereof to each ventilation zone is recirculated air (air that has not been directly mixed with outdoor air) from other zones, zone ventilation efficiency \((E_{vz})\) shall be determined in accordance with Equation 404.3.2(1). Examples of secondary-recirculation systems include dual-fan dual-duct and fan-powered mixing-box systems, and systems that include transfer fans for conference rooms.

\[ E_{vz} = (F_a + X_s F_b - Z_{pz} E_p F_c) / F_a \]  
(Equation 404.3.2(1))

The system air fractions \(F_a,\) \(F_b,\) and \(F_c\) shall be determined in accordance with Equation 404.3.2(2), Equation 404.3.2(3), and Equation 404.3.2(4), as applicable.

\[ F_a = E_p + (1 - E_p) E_r \]  
(Equation 404.3.2(2))

\[ F_b = E_p \]  
(Equation 404.3.2(3))

\[ F_c = 1 - (1 - E_z)(1 - E_r)(1 - E_p) \]  
(Equation 404.3.2(4))

The zone primary air fraction \((E_p)\) shall be determined in accordance with Equation 404.3.2(5). For single-zone and single-supply systems \(E_p\) shall equal to 1.0. The zone secondary recirculation fraction \((E_r)\) shall be determined by the designer based on system configuration., The zone air distribution effectiveness \((E_z)\) shall be determined in accordance with Section 403.2.2. [ASHRAE 62.1:A1.2.2]

\[ F_a = E_p + (1 - E_p) E_r \]  
(Equation 404.3.2(2))

\[ F_b = E_p \]  
(Equation 404.3.2(3))
\( F_c = 1 - (1 - E_z)(1 - E_r)(1 - E_p) \) [Equation 404.3.2(4)]

\( E_p = \frac{V_{pz}}{V_{dz}} \) [Equation 404.3.2(5)]

Where:

- \( A_z \): Zone floor area: The net occupiable floor area of the ventilation zone, \( \text{ft}^2 \) (m\(^2\)).
- \( D \): Occupant diversity: The ratio of the system population to the sum of the zone populations.
- \( E_p \): Primary air fraction: The fraction of primary air in the discharge air to the ventilation zone.
- \( E_r \): Secondary recirculation fraction: In systems with secondary recirculation of return air, the fraction of secondary recirculated air to the zone that is representative of average system return air rather than air directly recirculated from the zone.
- \( E_v \): System ventilation efficiency: The efficiency with which the system distributes air from the outdoor air intake to the breathing zone in the ventilation-critical zone, which requires the largest fraction of outdoor air in the primary airstream.
- \( E_{vz} \): Zone ventilation efficiency: The efficiency with which the system distributes air from the outdoor air intake to the breathing zone in any particular ventilation zone.
- \( E_z \): Zone air distribution effectiveness: A measure of the effectiveness of supply air distribution to the breathing zone. \( E_z \) is determined in accordance with Section 403.2.2.
- \( F_a \): Supply air fraction: The fraction of supply air to the ventilation zone from sources or air outside the zone.
- \( F_b \): Mixed air fraction: The fraction of supply air to the ventilation zone from fully mixed primary air.
- \( F_c \): Outdoor air fraction: The fraction of outdoor air to the ventilation zone from sources of air outside the zone.
- \( P_s \): System population: the simultaneous number of occupants in the area served by the ventilation system.
- \( P_z \): Zone population: see Section 403.2.1.
- \( R_a \): Area outdoor air rate: see Section 403.2.1.
- \( R_p \): People outdoor air rate: see Section 403.2.1.
- \( V_{bz} \): Breathing zone outdoor airflow: see Section 403.2.1.
- \( V_{dz} \): Zone discharge airflow: The expected discharge (supply) airflow to the zone that includes primary airflow and secondary recirculated airflow, CFM (m\(^3\)/min).
- \( V_{ot} \): Outdoor air intake flow: see Section 403.3, Section 403.4, and Section 403.5.2.
- \( V_{ou} \): Uncorrected outdoor air intake: see Section 403.5.1.
- \( V_{oz} \): Zone outdoor airflow: see Section 403.2.3.
- \( V_{ps} \): System primary airflow: The total primary airflow supplied to all zones served by the system from the air-handling unit at which the outdoor air intake is located.
- \( V_{pz} \): Zone primary airflow: The zone primary airflow to the ventilation zone, including outdoor air and recirculated air.
- \( X_s \): Average outdoor air fraction: At the primary air handler, the fraction of outdoor air intake flow in the system primary airflow.
- \( Z_{pz} \): Primary outdoor air fraction: The outdoor air fraction required in the primary air supplied to the ventilation zone prior to the introduction of any secondary recirculation air. [ASHRAE 62.1:A3]

**TABLE 402.1**

MINIMUM VENTILATION RATES IN BREATHING ZONE \(^{4,2}\)

[ASHRAE 62.1: TABLE 6.2.2.1 6-1]

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY</th>
<th>PEOPLE OUTDOOR Air Rate ( R_p ) (CFM/person)</th>
<th>AREA OUTDOOR Air Rate ( R_a ) (CFM/ft(^2))</th>
<th>DEFAULT OCCUPANT DENSITY (^3) (people/1000 ft(^2))</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANIMAL FACILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal exam room (veterinary office)</td>
<td>10</td>
<td>0.12</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Large-animal holding room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (static cages)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td><strong>CORRECTIONAL FACILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

53
<table>
<thead>
<tr>
<th>Room Type</th>
<th>Area (sq ft)</th>
<th>Height (ft)</th>
<th>Ceiling (ft)</th>
<th>Storeys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booking/waiting</td>
<td>7.5</td>
<td>0.06</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>Cell</td>
<td>5</td>
<td>0.12</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Day-room</td>
<td>5</td>
<td>0.06</td>
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<td>1</td>
</tr>
<tr>
<td>Guard stations</td>
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<td>0.06</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td><strong>EDUCATIONAL FACILITIES</strong></td>
<td></td>
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<td></td>
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<td>Art classroom</td>
<td>10</td>
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<td>20</td>
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</tr>
<tr>
<td>Classrooms (ages 5- to 8)</td>
<td>10</td>
<td>0.12</td>
<td>25</td>
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<tr>
<td>Classrooms (age 9 plus)</td>
<td>10</td>
<td>0.12</td>
<td>35</td>
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<tr>
<td>Computer lab</td>
<td>10</td>
<td>0.12</td>
<td>25</td>
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</tr>
<tr>
<td>Daycare (through age 4)</td>
<td>40</td>
<td>0.18</td>
<td>26</td>
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<td>Daycare sickroom</td>
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<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Daycare (through age 4)</td>
<td>10</td>
<td>0.18</td>
<td>25</td>
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<tr>
<td>Lecture classroom</td>
<td>7.5</td>
<td>0.06</td>
<td>65</td>
<td>1</td>
</tr>
<tr>
<td>Lecture hall (fixed seats)</td>
<td>7.5</td>
<td>0.06</td>
<td>150</td>
<td>1</td>
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<td>Libraries</td>
<td>5</td>
<td>0.12</td>
<td>10</td>
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</tr>
<tr>
<td>Media center</td>
<td>10</td>
<td>0.12</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Multi-use assembly</td>
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<td>0.06</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Music/theater/dance</td>
<td>10</td>
<td>0.06</td>
<td>35</td>
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<tr>
<td>Science laboratories</td>
<td>10</td>
<td>0.18</td>
<td>25</td>
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</tr>
<tr>
<td>University/college laboratories</td>
<td>10</td>
<td>0.18</td>
<td>25</td>
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</tr>
<tr>
<td>Wood/metal shop</td>
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<td>0.18</td>
<td>20</td>
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<tr>
<td><strong>FOOD AND BEVERAGE SERVICE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bars, cocktail lounges</td>
<td>7.5</td>
<td>0.18</td>
<td>100</td>
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</tr>
<tr>
<td>Cafeteria/fast-food dining</td>
<td>7.5</td>
<td>0.18</td>
<td>100</td>
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<td>Kitchen (cooking)</td>
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<tr>
<td>Restaurant dining rooms</td>
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<td>0.18</td>
<td>70</td>
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<td><strong>GENERAL</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Break rooms</td>
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<td>0.06</td>
<td>25</td>
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</tr>
<tr>
<td>Coffee stations</td>
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<td>0.06</td>
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<tr>
<td>Conference/meeting</td>
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<td>0.06</td>
<td>50</td>
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<td>Corridors</td>
<td></td>
<td>0.06</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Occupiable storage rooms for liquids or gels</td>
<td>5</td>
<td>0.12</td>
<td>2</td>
<td>2</td>
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<tr>
<td><strong>HOTELS, MOTELS, RESORTS, DORMITORIES</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Barracks sleeping areas</td>
<td>5</td>
<td>0.06</td>
<td>20</td>
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</tr>
<tr>
<td>Bedroom/living room</td>
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<td>0.06</td>
<td>10</td>
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<td>Laundry rooms, central</td>
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<td>0.12</td>
<td>10</td>
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<td>Laundry rooms within dwelling units</td>
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<tr>
<td>Lobbies/pre-function</td>
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<td>Multipurpose assembly</td>
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<td><strong>OFFICE BUILDINGS</strong></td>
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<td>Break Rooms</td>
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<td>Main-entry-lobbies</td>
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<td>Occupiable storage rooms for dry materials</td>
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<td>Office space</td>
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<td>Reception areas</td>
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<td>Telephone/data entry</td>
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<td><strong>MISCELLANEOUS SPACES</strong></td>
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<td>Facility Type</td>
<td>Floor Area</td>
<td>Freq.</td>
<td>Occupancy</td>
<td>Hazard</td>
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<tr>
<td>---------------</td>
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<td>-------</td>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Banks or bank lobbies</strong>&lt;sup&gt;h&lt;/sup&gt;</td>
<td>7.5</td>
<td>0.06</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Bank vaults/safe deposit&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
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<td>2</td>
</tr>
<tr>
<td>Computer (not printing)&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Freezer and refrigerated spaces (&lt;50°F)&lt;sup&gt;h&lt;/sup&gt;</td>
<td>10</td>
<td>−0</td>
<td>−0</td>
<td>2</td>
</tr>
<tr>
<td>Manufacturing where hazardous materials are not used</td>
<td>10</td>
<td>0.18</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>General manufacturing where hazardous materials are used (excludes heavy industrial and processes-using chemicals processes)</td>
<td>10</td>
<td>0.18</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Pharmacy (prep. area)</td>
<td>5</td>
<td>0.18</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Photo studios</td>
<td>5</td>
<td>0.12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Shipping/receiving&lt;sup&gt;h&lt;/sup&gt;</td>
<td>10</td>
<td>0.12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sorting, packing, light assembly</td>
<td>7.5</td>
<td>0.12</td>
<td>7</td>
<td>2</td>
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<td>Telephone closets</td>
<td>−</td>
<td>−0.00</td>
<td>−</td>
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</tr>
<tr>
<td>Transportation waiting&lt;sup&gt;h&lt;/sup&gt;</td>
<td>7.5</td>
<td>0.06</td>
<td>100</td>
<td>1</td>
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<tr>
<td>Warehouses&lt;sup&gt;h&lt;/sup&gt;</td>
<td>10</td>
<td>0.06</td>
<td>−</td>
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<tr>
<td><strong>OFFICE BUILDINGS</strong></td>
<td></td>
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<td></td>
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<td>Break Rooms</td>
<td>5</td>
<td>0.12</td>
<td>50</td>
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<td>Main entry lobbies</td>
<td>5</td>
<td>0.06</td>
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<tr>
<td>Occupiable storage rooms for dry materials</td>
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<td>0.06</td>
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<tr>
<td>Office space</td>
<td>5</td>
<td>0.06</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Reception areas</td>
<td>5</td>
<td>0.06</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Telephone/data entry</td>
<td>5</td>
<td>0.06</td>
<td>60</td>
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<td><strong>OUTPATIENT HEALTH CARE FACILITIES&lt;sup&gt;1,2,3&lt;/sup&gt;</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Birthing room</td>
<td>10</td>
<td>0.18</td>
<td>15</td>
<td>2</td>
</tr>
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<td>Class 1 imaging rooms</td>
<td>5</td>
<td>0.12</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Dental operatory</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>General examination room</td>
<td>7.5</td>
<td>0.12</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Other dental treatment areas</td>
<td>5</td>
<td>0.06</td>
<td>5</td>
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<td>Physical therapy exercise area</td>
<td>20</td>
<td>0.18</td>
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<tr>
<td>Physical therapy individual room</td>
<td>10</td>
<td>0.06</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Physical therapeutic pool area</td>
<td>−</td>
<td>0.48</td>
<td>−</td>
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<td>Prosthetics and orthotics room</td>
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<tr>
<td>Psychiatric consultation room</td>
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<td>1</td>
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<tr>
<td>Psychiatric examination room</td>
<td>5</td>
<td>0.06</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Psychiatric group room</td>
<td>5</td>
<td>0.06</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>Psychiatric seclusion room</td>
<td>10</td>
<td>0.06</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Speech therapy room</td>
<td>5</td>
<td>0.06</td>
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<tr>
<td>Urgent care examination room</td>
<td>7.5</td>
<td>0.12</td>
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<tr>
<td>Urgent care observation room</td>
<td>5</td>
<td>0.06</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Urgent care treatment room</td>
<td>7.5</td>
<td>0.18</td>
<td>20</td>
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</tr>
<tr>
<td>Urgent care triage room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>1</td>
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<td><strong>PUBLIC ASSEMBLY SPACES</strong></td>
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<td></td>
</tr>
<tr>
<td>Auditorium seating area&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>Courtrooms&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
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</tr>
<tr>
<td>Legislative chambers&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>Libraries</td>
<td>5</td>
<td>0.12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Lobbies&lt;sup&gt;h&lt;/sup&gt;</td>
<td>5</td>
<td>0.06</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td><strong>Museums (children’s)</strong></td>
<td>7.5</td>
<td>0.12</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----</td>
<td>------</td>
<td>----</td>
<td>---</td>
</tr>
<tr>
<td><strong>Museums/galleries</strong>^h</td>
<td>7.5</td>
<td>0.06</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td><strong>Places of religious worship</strong>^h</td>
<td>5</td>
<td>0.06</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td><strong>RESIDENTIAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Common corridors</strong>^h</td>
<td>–</td>
<td>0.06</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td><strong>Dwelling unit</strong>^h^g^h</td>
<td>5</td>
<td>0.06</td>
<td>See foot note^f</td>
<td>4</td>
</tr>
<tr>
<td><strong>RETAIL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sales (except as below)</strong></td>
<td>7.5</td>
<td>0.12</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td><strong>Barber shop</strong>^h</td>
<td>7.5</td>
<td>0.06</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td><strong>Beauty and nail salons</strong></td>
<td>20</td>
<td>0.12</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td><strong>Coin-operated laundries</strong></td>
<td>7.5</td>
<td>0.12</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td><strong>Mall common areas</strong>^h</td>
<td>7.5</td>
<td>0.06</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td><strong>Pet shops (animal areas)</strong></td>
<td>7.5</td>
<td>0.18</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td><strong>Supermarket</strong>^h</td>
<td>7.5</td>
<td>0.06</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td><strong>SPORTS AND ENTERTAINMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bowling alley (seating)</strong></td>
<td>10</td>
<td>0.12</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td><strong>Disco/dance floors</strong>^h</td>
<td>20</td>
<td>0.06</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td><strong>Gambling casinos</strong></td>
<td>7.5</td>
<td>0.18</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td><strong>Game arcades</strong></td>
<td>7.5</td>
<td>0.18</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td><strong>Gym, sports arena (play area)</strong>^a</td>
<td>20</td>
<td>0.18</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Health club/aerobics room</strong></td>
<td>20</td>
<td>0.06</td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td><strong>Health club/weight rooms</strong></td>
<td>20</td>
<td>0.06</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td><strong>Spectator areas</strong>^h</td>
<td>7.5</td>
<td>0.06</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td><strong>Stages, studios</strong>^d^h</td>
<td>10</td>
<td>0.06</td>
<td>70</td>
<td>1</td>
</tr>
<tr>
<td><strong>Swimming (pool &amp; and deck)</strong>^c</td>
<td>–</td>
<td>0.48</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td><strong>TRANSIENT RESIDENTIAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Common corridors</strong></td>
<td>–</td>
<td>0.06</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td><strong>Dwelling unit</strong>^g</td>
<td>5</td>
<td>0.06</td>
<td>–</td>
<td>1</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m\(^3\)/min, 1 square foot = 0.0929 m\(^2\)

**Notes:**
1. This table applies to no-smoking areas. Rates for smoking-permitted spaces shall be determined using other methods.
2. Volumetric airflow rates are based on dry air density of 0.075 pounds of dry air per cubic foot (lbda/ft\(^3\))(1.204 kgda/m\(^3\)) at a barometric pressure of 1 atm (101 kPa) and an air temperature of 70°F (21°C). Rates shall be permitted to be adjusted for actual density.
3. The default occupant density shall be used where actual occupant density is not known.
4. Where the occupancy category for a proposed space or zone is not listed, the requirements for the listed occupancy category that is most similar in terms of occupant density, activities, and building construction shall be used.

**ITEM SPECIFIC NOTES FOR TABLE 402.4**
a. For high school and college libraries, the values shown for “Public Assembly Spaces—Libraries” shall be used.
b. Rate may not be sufficient where stored materials include those having potentially harmful emissions.
c. Rate does not allow for humidity control. “Deck area” refers to the area surrounding the pool that is capable of being wetted during pool use or when the pool is occupied. Deck area that is not expected to be wetted shall be designated as an occupancy category.
d. Rate does not include special exhaust for stage effects such as dry ice vapors and smoke.
e. Where combustion equipment is intended to be used on the playing surface or in the space, additional dilution ventilation, source control, or both shall be provided.
f. Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.
g. Air from one residential dwelling shall not be recirculated or transferred to other spaces outside of that dwelling.
h. Ventilation air for this occupancy category shall be permitted to be reduced to zero where the space is in occupied-stay mode.
1 Outpatient facilities to which the rates apply are freestanding birth centers, urgent care centers, neighborhood clinics and physicians offices, Class 1 imaging facilities, outpatient psychiatric facilities, outpatient rehabilitation facilities, and outpatient dental facilities.

2 The requirements of this table provide for acceptable IAQ. The requirements of this table do not address the airborne transmission of airborne viruses, bacteria, and other infectious contagions.

3 These rates are intended only for outpatient dental clinics where the amount of nitrous oxide is limited. They are not intended for dental operatories in institutional buildings where nitrous oxide is piped.

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY</th>
<th>EXHAUST RATE (CFM/unit)</th>
<th>EXHAUST RATE (CFM/ft²)</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td>–</td>
<td>0.90</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td>–</td>
<td>3.00</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Large-animal holding room</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (static cages)</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Arenas</td>
<td>–</td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>Art classrooms</td>
<td>–</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Auto repair rooms</td>
<td>–</td>
<td>1.50</td>
<td>2</td>
</tr>
<tr>
<td>Barber shops</td>
<td>–</td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>Beauty and nail salons</td>
<td>–</td>
<td>0.60</td>
<td>2</td>
</tr>
<tr>
<td>Cells with toilet</td>
<td>–</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Copy, printing rooms</td>
<td>–</td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>Darkrooms</td>
<td>–</td>
<td>1.00</td>
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</tr>
<tr>
<td>Educational science laboratories</td>
<td>–</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Janitor closets, trash rooms, recycling</td>
<td>–</td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td>Kitchens – commercial</td>
<td>–</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Kitchenettes</td>
<td>–</td>
<td>0.30</td>
<td>2</td>
</tr>
<tr>
<td>Kitchens – commercial</td>
<td>–</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Locker rooms for athletic, industrial, and health care facilities</td>
<td>–</td>
<td>0.50</td>
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</tr>
<tr>
<td>All other Other locker rooms</td>
<td>–</td>
<td>0.25</td>
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<tr>
<td>Shower rooms7, 493</td>
<td>20/50</td>
<td>–</td>
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</tr>
<tr>
<td>Paint spray booths6</td>
<td>–</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Parking garages3</td>
<td>–</td>
<td>0.75</td>
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<tr>
<td>Pet shops (animal areas)</td>
<td>–</td>
<td>0.90</td>
<td>2</td>
</tr>
<tr>
<td>Refrigerating machinery rooms6</td>
<td>–</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Residential – kitchens7</td>
<td>50/100</td>
<td>–</td>
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</tr>
<tr>
<td>Soiled laundry storage rooms5</td>
<td>–</td>
<td>1.00</td>
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</tr>
<tr>
<td>Storage rooms, chemical5</td>
<td>–</td>
<td>1.50</td>
<td>4</td>
</tr>
<tr>
<td>Toilets – private5, 48</td>
<td>25/50</td>
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</table>
Toilets – public
Woodwork shop/classrooms

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
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<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes:

1. Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.
2. Where combustion equipment is intended to be used on the playing surface, additional dilution ventilation, source control, or both shall be provided.
3. Exhaust shall not be required where two or more sides compose walls that are at least 50 percent open to the outside.
4. Rate is per water closet, urinal, or both. Provide the higher rate where periods of heavy use are expected to occur. The lower rate shall be permitted to be used otherwise.
5. Rate is for a toilet room intended to be occupied by one person at a time. For continuous system operation during normal hours of use, the lower rate shall be permitted to be used. Otherwise the higher rate shall be used.
6. See other applicable standards for exhaust rate.
7. For refrigeration machinery rooms, the exhaust rate shall comply with Chapter 11.
8. For unlisted occupancies for a proposed space not listed in the table, the requirements for the listed occupancy that is most similar in terms of occupant density and occupancy type shall be used.
9. Exhaust air that has been cleaned in accordance with the criteria of to meet Class 1 criteria from Section 403.9 shall be permitted to be recirculated.
10. Rate is per shower head showerhead.

**TABLE 403.9**
AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS
[ASHRAE 62.1: TABLE 6-3]

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

**TABLE 403.2.2**
ZONE AIR DISTRIBUTION EFFECTIVENESS1, 2, 3, 4, 5
[ASHRAE 62.1: TABLE 4.2.2.2 6-4]

<table>
<thead>
<tr>
<th>AIR DISTRIBUTION CONFIGURATION</th>
<th>$E_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-Mixed Air Distribution Systems</td>
<td></td>
</tr>
<tr>
<td>Ceiling supply of cool air.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air and floor return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air 15°F or more above space temperature and ceiling return.</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than 15°F above space temperature and ceiling return provided that the supply air-jet velocity is less than 150 feet per minute (fpm) and the supply air-jet reaches to within 4.5 feet of the floor level.</td>
<td>4.06-0.8</td>
</tr>
<tr>
<td>Ceiling supply of cool air and ceiling return provided that the vertical throw is more than 50 fpm at a height of 4.5 feet or more above the floor.</td>
<td>1.0</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²
Ceiling supply of warm air less than 15°F above average space temperature where the supply air-jet velocity is equal to or greater than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.

Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification, or underfloor air distribution systems where the vertical throw is 50 fpm or less at a height of 4.5 feet above the floor.

Floor supply of warm air and floor return.

Floor supply of warm air and ceiling return.

Makeup supply drawn in on the opposite side of the room outlet located more than half the length of the space from the exhaust, return, or both.

Makeup supply drawn in near to the outlet located less than half the length of the space from the exhaust, return, or both locations.

Stratified Air Distribution Systems (Section 403.2.2.1)

Floor supply of cool air where the vertical throw is greater than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.

Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.

Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height greater than 18 feet above the floor.

Personalized Ventilation Systems (Section 403.2.2.2)

Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of cool air and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of warm air and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with nonaspirating floor supply devices and ceiling return.

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with aspirating floor supply devices and ceiling return.

For SI units: °C = (°F-32)/1.8, 1 foot per minute = 0.005 m/s, 1 foot = 304.8 mm

Notes:
1 “Cool air” is air cooler than space temperature.
2 “Warm air” is air warmer than space temperature.
3 “Ceiling supply” includes any point above the breathing zone.
4 “Floor supply” includes any point below the breathing zone.
5 As an alternative to using the above values, $E_z$ shall be permitted to be regarded as equal to air change effectiveness determined in accordance with ASHRAE 129 for air distribution configurations except unidirectional flow.
6 For lower velocity supply air, $E_z = 0.8$

### Table 402.2.1.6(A)(1)

**Minimum Openable Areas: Single Openings**

<table>
<thead>
<tr>
<th>$V_{bz}/A_z \leq$ (L/s)/m²</th>
<th>$V_{bz}/A_z \leq$ (cfm/ft²)</th>
<th>TOTAL OPENABLE AREAS IN ZONE AS A PERCENTAGE OF $A_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$HS/WS \leq 0.1$</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>4.0</td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>6.9</td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>9.5</td>
</tr>
<tr>
<td>4.0</td>
<td>0.8</td>
<td>12.0</td>
</tr>
<tr>
<td>5.5</td>
<td>1.1</td>
<td>15.5</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²
Where:

\( \text{Vbz} \) = breathing zone outdoor airflow, per Table 402.1.

\( \text{Az} \) = zone floor area, the net occupiable floor area of the ventilation zone.

\( \text{WS} \) = aggregated width of all single outdoor openings located at the same elevation.

\( \text{HS} \) = vertical dimension of the single opening or the least vertical dimension of the openings where there are multiple openings.

* Volumetric airflow rates used to estimate required operable area are based on the following:
  • Dry-air density of 0.075 lbda/ft\(^3\) (1.2 kgda/m\(^3\)) at a barometric pressure of 1 atm (101.3 kPa) and an air temperature of 70°F (21°C)
  • Temperature difference between indoors and outdoors of 1.8°F (1°C)
  • Gravity constant of 32.2 ft/s\(^2\) (9.81 m/s\(^2\))
  • Window discharge coefficient of 0.6

### TABLE 402.2.1.6(A)(2)

**MINIMUM OPENABLE AREAS: TWO VERTICALLY SPACED OPENINGS**

[ASHRAE 62.1: TABLE 6-6]

<table>
<thead>
<tr>
<th>( \text{Vbz}/\text{Az} ) ( \leq ) (L/s/m(^2))</th>
<th>( \text{Vbz}/\text{Az} ) ( \leq ) (cfm/ft(^2))</th>
<th>( \text{Hvs} \leq ) 8.2 ft</th>
<th>8.2 ft ( &lt; \text{Hvs} ) ( \leq ) 16.4 ft</th>
<th>16.4 ft ( &lt; \text{Hvs} )</th>
<th>( \text{As}/\text{Al} \leq ) 0.5</th>
<th>( \text{As}/\text{Al} &gt; ) 0.5</th>
<th>( \text{As}/\text{Al} \leq ) 0.5</th>
<th>( \text{As}/\text{Al} &gt; ) 0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>2.0</td>
<td>1.3</td>
<td>1.3</td>
<td>0.8</td>
<td>0.9</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>4.0</td>
<td>2.6</td>
<td>2.5</td>
<td>1.6</td>
<td>1.8</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>6.0</td>
<td>3.9</td>
<td>3.8</td>
<td>2.5</td>
<td>2.7</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>0.8</td>
<td>8.0</td>
<td>5.2</td>
<td>5.0</td>
<td>3.3</td>
<td>3.6</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>1.1</td>
<td>11.0</td>
<td>7.1</td>
<td>6.9</td>
<td>4.5</td>
<td>4.9</td>
<td>3.2</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m\(^3\)/min, 1 square foot = 0.0929 m\(^2\)

Where:

\( \text{Vbz} \) = breathing zone outdoor airflow, per Table 402.1.

\( \text{Az} \) = zone floor area, the net occupiable floor area of the ventilation zone.

\( \text{Hvs} \) = vertical separation between the center of the top and bottom openings’ free operable area; in case of multiple horizontally spaced pairs of openings, use shortest distance encountered.

\( \text{As} \) = openable area of smallest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.

\( \text{Al} \) = openable area of largest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.

* Volumetric airflow rates used to estimate required operable area are based on the following:
  • Dry-air density of 0.075 lbda/ft\(^3\) (1.2 kgda/m\(^3\)) at a barometric pressure of 1 atm (101.3 kPa) and an air temperature of 70°F (21°C)
  • Temperature difference between indoors and outdoors of 1.8°F (1°C)
  • Gravity constant of 32.2 ft/s\(^2\) (9.81 m/s\(^2\))
  • Window discharge coefficient of 0.6

203.0 – A –

**Air, Class 1.** Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1: 5.16.1 5.18.1]

**Air, Class 2.** Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1: 5.16.1 5.18.1]

**Air, Class 3.** Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1: 5.16.1 5.18.1]

**Air, Class 4.** Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered as harmful. [ASHRAE 62.1: 5.16.1 5.18.1]

### TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: The AHRI and ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 4 is being revised to the latest edition of ASHRAE 62.1-2019, addendum p as published on February 11, 2020.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

402.2 Natural Ventilation Procedure. Natural ventilation systems shall comply with the requirements of either Section 402.2.1 through Section 402.2.1.6(A) or Section 402.2.2. Designers shall provide interior air barriers, insulation, or other means that separate naturally ventilated spaces from mechanically cooled spaces to prevent high-dew-point outdoor air from coming into contact with mechanically cooled surfaces. [ASHRAE 62.1:6.4]

402.2.1 Prescriptive Compliance Path. Any zone designed for natural ventilation shall include a mechanical ventilation system designed in accordance with Section 403.0.

Exceptions:
(1) Zones in buildings that have all of the following:
   (a) Natural ventilation openings that comply with the requirements of Section 402.2.1.
   (b) Controls that prevent the natural ventilation openings from being closed during periods of expected occupancy, or natural ventilation openings that are permanently open.
(2) Zones that are not served by heating or cooling equipment. {ASHRAE 62.1:6.4.1}

402.2.1.1 Ceiling Height. For ceilings that are parallel to the floor, the ceiling height \( H \) to be used in Section 402.2.3 through Section 402.2.5 shall be the minimum ceiling height in the zone.

For zones where ceiling height increases as distance from the openings is increased, the ceiling height shall be determined as the average height of the ceiling within 20 feet (6096 mm) from the operable openings. [ASHRAE 62.1:6.4.1.1]

402.2.1.2 Floor Area to be Ventilated. The naturally ventilated area in zones or portions of zones shall extend from the openings to a distance determined in accordance with Section 402.2.3, Section 402.2.4, or Section 402.2.5. Openings shall be in accordance with the requirements of Section 402.2.6. For spaces where ceilings are not parallel to the floor, the ceiling height shall be determined in accordance with Section 402.2.1.1. [ASHRAE 62.1:6.4.1.2]

402.2.1.3 Single Side Opening. For zones with openings on only one side of the zone, the naturally ventilated area shall extend to a distance not greater than 2 times the height of the ceiling from the openings. [ASHRAE 62.1:6.4.1.3]

402.2.1.4 Double Side Opening. For zones with openings on two opposite sides of the zone, the naturally ventilated area shall extend between the openings separated by a distance not greater than 5 times the height of the ceiling. [ASHRAE 62.1:6.4.1.4]

402.2.1.5 Corner Openings. For zones with operable openings on two adjacent sides of a zone, the distance from the operable openings shall be not more than 5\( H \) along a line drawn between the two openings that are farthest apart. Floor area outside that line shall comply with Section 402.2.1.1. [ASHRAE 62.1:6.4.1.5]

402.2.1.6 Location and Size of Openings. Zones or portions of zones to be naturally ventilated shall have a permanently open airflow path to openings directly connected to the outdoors. The minimum flow rate to the zone shall be determined in accordance with Section 403.2.1. This flow rate shall be used to determine the required openable area of openings, accounting only for buoyancy-driven flow. Wind-driven flow shall be used only where it can be demonstrated that the minimum flow rate is provided during all occupied hours. Openings shall be sized in accordance with Section 402.2.1.6(A). Permanently open airflow path shall include, but not be limited to, pathways that would allow airflow unimpeded by partitions, walls, and furnishings. {ASHRAE 62.1:6.4.1.6}

402.2.1.6(A) Sizing Openings. Where the zone is ventilated using a single opening or multiple single openings located at the same elevation, the openable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.1.6(A)(1). Where the zone is ventilated using two openings located at different elevations or multiple pairs of such openings, the openable area as a percent of the net occupiable floor area shall be greater than or equal to the value indicated in Table 402.2.1.6(A)(2).

Where openings are obstructed by louvers or screens, the openable area shall be based on the net free area of
the opening. Where interior zones, or portions of zones, without direct openings to the outdoors are ventilated through adjoining zones, the opening between zones shall be permanently unobstructed and have a free area of not less than twice the percent of occupiable floor area used to determine the opening size of adjacent exterior zones, or 25 square feet (2.3 m²), whichever is greater. Table 402.2.1.6(A)(1) and Table 402.2.1.6(A)(2) are based on buoyancy-driven flow and shall not address thermal comfort. [ASHRAE 62.1:6.4.1.6.1]

402.2.2 Engineered System Compliance Path. For an engineered natural ventilation system, the following shall be included:

1. Determine hourly environmental conditions, including outdoor air dry-bulb temperature; dew-point temperature; outdoor concentration of contaminants, including PM2.5, PM10, and ozone where data are available; wind speed and direction; and internal heat gains during expected hours of natural ventilation operation.
2. Determine the effect of pressure losses along natural ventilation airflow paths on the resulting flow rates, including inlet openings, air transfer grills, ventilation stacks, and outlet openings during representative conditions of expected natural ventilation system use.
3. Quantify natural ventilation airflow rates of identified airflow paths accounting for wind induced and thermally induced driving pressures during representative conditions of expected natural ventilation system use.
4. Design to provide outdoor air in quantities sufficient to result in acceptable IAQ as established under Section 403.2.1 or ASHRAE 62.1 during representative conditions of expected natural ventilation system use. {ASHRAE 62.1:6.4.2}

402.2.7 Control and Accessibility. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied. Controls shall be designed to coordinate operation of the natural and mechanical ventilation systems. [ASHRAE 62.1:6.4.3]

403.2 Zone Calculations. Ventilation zone parameters shall be determined in accordance with Section 403.2.1 through Section 403.2.3 for ventilation zones served by the ventilation system, except that the ventilation rates from ASHRAE/ASHE 170 shall be used for the occupancy categories, as applicable. [ASHRAE 62.1:6.2.1]

403.2.1 Breathing Zone Outdoor Airflow. The outdoor airflow required in the breathing zone (Vbz) of the occupiable space or spaces in a ventilation zone shall be not less than the value determined in accordance with Equation 403.2.1.

\[ Vbz = Rp\cdot Pz + Ra\cdot Az \]  
(Equation 403.2.1)

Where:

- \( Az \) = zone floor area, the net occupiable floor area of the ventilation zone, square feet (m²).
- \( Pz \) = zone population, the number of people in the ventilation zone during usage.
- \( Rp \) = outdoor airflow rate required per person as determined from Table 402.1.
- \( Ra \) = outdoor airflow rate required per unit area as determined from Table 402.1. [ASHRAE 62.1:6.2.1.1]

403.2.2 Zone Air Distribution Effectiveness. The zone air distribution effectiveness (Ez) shall be determined in accordance with Table 403.2.2. [ASHRAE 62.1:6.2.1.2]

403.2.2.1 Stratified Air Distribution Systems. A stratified air distribution system shall be designed in accordance with Section 403.2.2.1.1 through Section 403.2.2.2.2, or the zone air distribution effectiveness (Ez) shall be determined in accordance with ASHRAE 62.1. [ASHRAE 62.1:6.2.1.2.1]

403.2.2.1.1 Supply Air. Cool air shall be at least 4°F (2°C) less than the average room air temperature. [ASHRAE 62.1:6.2.1.2.1.1]

403.2.2.1.2 Return Air. The return air openings or pathways shall be located not less than 9 feet (2.8 m) above the floor. [ASHRAE 62.1:6.2.1.2.1.2]

403.2.2.1.3 Stratification. The zone shall not contain any devices that mechanically mix the air, and shall be protected from impinging airstreams from adjacent ventilation zones. [ASHRAE 62.1:6.2.1.2.1.3]

403.2.2.2 Personalized Ventilation Systems. A personalized ventilation system shall be designed in accordance with the following subsections, or the zone air distribution effectiveness (Ez) shall be determined in accordance with ASHRAE 62.1. [ASHRAE 62.1:6.2.1.2.2]

403.2.2.2.1 Personalized Air. The personalized air shall be distributed in the breathing zone and designed such that the velocity is equal to or less than 50 feet per minute (0.25 m/s) at the head/facial region of the occupant. [ASHRAE 62.1:6.2.1.2.2.1]

403.2.2.2.2 Return Air. The return air openings or pathways shall be located more than 9 feet (2.8 m) above the floor. [ASHRAE 62.1:6.2.1.2.2.2]

403.2.3 Zone Outdoor Airflow. The zone outdoor airflow (Voz) provided to the ventilation zone by the supply air distribution system shall be determined in accordance with Equation 403.2.3.

\[ Voz = \frac{Vbz}{Ez} \]  
(Equation 403.2.3)

403.3 Single-Zone Systems. For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to only one ventilation zone, the outdoor air intake flow (Vot) shall be determined in accordance with Equation 403.3.

\[ Vot = Voz \]  
(Equation 403.3)
403.4 One Hundred Percent Outdoor Air Systems. For ventilation systems where one or more air handlers supply only outdoor air to one or more ventilation zones, the outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Equation 403.4. \[ \text{ASHRAE 62.1:6.2.3} \]

\[
V_{ot} = S\text{ all zones } V_{oz} \quad \text{(Equation 403.4)}
\]

403.5 Multiple-Zone Recirculating Systems. For ventilation systems where one or more air handlers supply a mixture of outdoor air and recirculated air to more than one ventilation zone, the outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Section 403.5.1 through Section 403.5.2. \[ \text{ASHRAE 62.1:6.2.4} \]

403.5.1 Uncorrected Outdoor Air Intake. The uncorrected outdoor air intake \( (V_{ou}) \) flow shall be determined in accordance with Equation 403.5.1. \[ \text{ASHRAE 62.1:6.2.4.1} \]

\[
V_{ou} = D S\text{ all zones } (R_p P_z) + S\text{ all zones } (R_a A_z) \quad \text{(Equation 403.5.1)}
\]

403.5.1.1 Occupant Diversity. The occupant diversity ratio \( (D) \) shall be determined in accordance with Equation 403.5.1.1 to account for variations in population within the ventilation zones served by the system.

\[
D = \frac{P_s}{S\text{ all zones } P_z} \quad \text{(Equation 403.5.1.1)}
\]

Where the system population \( (P_s) \) is the total population in the area served by the system.

Exception: Alternative methods to account for occupant diversity shall be permitted, provided that the resulting \( (V_{ou}) \) value is not less than that determined in accordance with Equation 403.5.1. \[ \text{ASHRAE 62.1:6.2.4.1.1} \]

403.5.1.2 System Ventilation Efficiency. The system ventilation efficiency \( (E_v) \) shall be determined in accordance with Section 403.5.1.3 for the simplified procedure or Section 404.0 for the alternate procedure. These procedures also establish zone minimum primary airflow rates for VAV systems. \[ \text{ASHRAE 62.1:6.2.4.2} \]

403.5.1.3 Simplified Procedure for System Ventilation Efficiency. System ventilation efficiency \( (E_v) \) shall be determined in accordance with Equation 403.5.1.3(1) or Equation 403.5.1.3(2). \[ \text{ASHRAE 62.1:6.2.4.3 – 6.2.4.3.1} \]

\[
E_v = 0.88 \cdot D + 0.22 \quad \text{for } D < 0.60 \quad \text{[Equation 403.5.1.3(1)]}
\]

\[
E_v = 0.75 \quad \text{for } D \geq 0.60 \quad \text{[Equation 403.5.1.3(2)]}
\]

403.5.1.4 Zone Minimum Primary Airflow. For each zone, the minimum primary airflow \( (V_{pz-min}) \) shall be determined in accordance with Equation 403.5.1.4. \[ \text{ASHRAE 62.1:6.2.4.3.2} \]

\[
V_{pz-min} = V_{oz} \cdot 1.5 \quad \text{(Equation 403.5.1.4)}
\]

403.5.2 Outdoor Air Intake. The design outdoor air intake flow \( (V_{ot}) \) shall be determined in accordance with Equation 403.5.2. \[ \text{ASHRAE 62.1:6.2.4.4} \]

\[
V_{ot} = V_{ou}/E_v \quad \text{(Equation 403.5.2)}
\]

403.6 Design for Varying Operating Conditions. Ventilation systems shall be designed to be capable of providing not less than the minimum ventilation rates required in the breathing zone where the zones served by the system are occupied, including all full- and part-load conditions. The minimum outdoor air intake flow shall be permitted to be less than the design value at part-load conditions. \[ \text{ASHRAE 62.1:6.2.5 – 6.2.5.1} \]

403.6.1 Short-Term Conditions. Where it is known that peak occupancy will be of short duration, ventilation will be varied or interrupted for a short period of time, or both, the design shall be permitted to be based on the average conditions over a time period \( (T) \) determined by Equation 403.6.1.

\[
T = 3v/V_{bz} \quad \text{(Equation 403.6.1)}
\]

Where:
\( T \) = averaging time period, minutes.
\( v \) = the volume of the ventilation zone where averaging is being applied, cubic foot \( (m^3) \).
\( V_{bz} \) = the breathing zone outdoor airflow calculated in accordance with Equation 403.2.1 and design value of the zone population \( (P_z) \), cubic foot per minute \( (CFM) \) \( (m^3/min) \).
Acceptable design adjustments based on this optional provision including the following:
(1) Zones with fluctuating occupancy: The zone population (Pz) shall be permitted to be averaged over time (T).
(2) Zones with intermittent interruption of supply air: The average outdoor airflow supplied to the breathing zone over time (T) shall be not less than the breathing zone outdoor airflow (Vbz) calculated using Equation 403.2.1.
(3) Systems with intermittent closure of the outdoor air intake: The average outdoor air intake over time (T) shall be not less than the minimum outdoor air intake (Vot) calculated using Equation 403.3, Equation 403.4, or Equation 403.5.1 as applicable. [ASHRAE 62.1:6.2.5.2]

403.8 Dynamic Reset. The system shall be permitted to be designed to reset the outdoor air intake flow (Vot), the space or ventilation zone airflow (Voz) as operating conditions change, or both. [ASHRAE 62.1:6.2.6]

403.9 Air Classification and Recirculation. Air shall be classified, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. [ASHRAE 62.1:5.18] Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

Air (return, transfer, or exhaust air) leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Table 402.1, Table 403.7, or Table 403.9 or as approved by the Authority Having Jurisdiction. Air leaving spaces or locations that are not listed in Table 402.1, Table 403.7, or Table 403.9 shall be designated with the same classification as air from the most similar space or location listed in terms of occupant activities and building construction.

Exception: Air from spaces where environmental tobacco smoke (ETS) is present. (Classification of air from spaces where ETS is present is not addressed. Spaces that are expected to include ETS do not have a classification listed in Table 402.1.) [ASHRAE 62.1:5.18.1]

403.9.1 Class 1 Air. Recirculation or transfer of Class 1 air to any space shall be permitted. [ASHRAE 62.1:5.18.3.1]

403.9.2 Class 2 Air. Recirculation of Class 2 air within the space of origin shall be permitted. Recirculation or transfer of Class 2 air to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space. Transfer of Class 2 air to toilet rooms shall be permitted. Recirculation or transfer of Class 2 air to Class 4 spaces shall be permitted. Class 2 air shall not be recirculated or transferred to Class 1 spaces. When using any energy recover device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air. Exhaust air transfer ratio of Class 2 air shall not exceed 10 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. ([ASHRAE 62.1:5.18.3.2 = 5.18.3.2.5])

403.9.3 Class 3 Air. Recirculation of Class 3 air within the space of origin shall be permitted. Class 3 air shall not be recirculated or transferred to any other spaces. When using an energy recover device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air. Exhaust air transfer ratio of Class 3 air shall not exceed 5 percent of the outdoor air intake flow at the design static pressure differential as defined in AHRI 1060. ([ASHRAE 62.1:5.18.3.3 = 5.18.3.3.2])

403.9.4 Class 4 Air. Class 4 air shall not be recirculated or transferred to any space or recirculated within the space of origin. [ASHRAE 62.1:5.18.3.4]

404.1 System Ventilation Efficiency. The system ventilation efficiency shall equal the lowest zone ventilation efficiency among the ventilation zones served by the air handler in accordance with Equation 404.1. [ASHRAE 62.1:A1.3] This section presents an alternative procedure for calculating the system ventilation efficiency (Ev) for multiple zone recirculating systems that shall be used when Section 403.5.1.3 is not used.

\[ Ev = \text{minimum (Evz)} \] (Equation 404.1)

404.2 Average Outdoor Air Fraction. The average outdoor air fraction (Xs) for the ventilation system shall be determined in accordance with Equation 404.2.

\[ Xs = \frac{Vou}{Vps} \] (Equation 404.2)

Where the uncorrected outdoor air intake (Vou) is determined in accordance with Section 403.5.1, and the system primary airflow (Vps) shall be determined at the condition analyzed. [ASHRAE 62.1:A1.1]

404.3 Zone Ventilation Efficiency. The zone ventilation efficiency (Evz) shall be determined in accordance with Section 404.3.1 or Section 404.3.2. [ASHRAE 62.1:A1.2]

404.3.1 Single Supply Systems. For single supply systems, where all of the air supplied to each ventilation zone is a mixture of outdoor air and system-level recirculated air, zone ventilation efficiency (Evz) shall be determined in accordance with Equation 404.3.1. Examples of single supply systems include constant-volume reheat, single-duct VAV, single-fan dual-duct, and multizone-systems.

\[ Evz = 1 + Xs - Zpz \] (Equation 404.3.1)
Where the average outdoor air fraction for the system ($X_s$) shall be determined in accordance with Equation 404.2, and the primary outdoor air fraction for the zone ($Z_{pz}$) shall be determined in accordance with Equation 404.3.1. [ASHRAE 62.1:A1.2.1]

$$Z_{pz} = \frac{V_{oz}}{V_{pz}} \text{ (Equation 404.3.1)}$$

For VAV systems, $V_{pz}$ is the lowest zone primary airflow value expected at the design condition analyzed.

### 404.3.2 Secondary-Recirculation Systems

For secondary-recirculation systems where the supply air or a portion thereof to each ventilation zone is recirculated air (air that has not been directly mixed with outdoor air) from other zones, zone ventilation efficiency ($E_{vz}$) shall be determined in accordance with Equation 404.3.2(1). Examples of secondary-recirculation systems include dual-fan dual-duct and fan-powered mixing-box systems, and systems that include transfer fans for conference rooms.

$$E_{vz} = \frac{(F_a + X_s \cdot F_b - Z_{pz} \cdot E_p \cdot F_c)}{F_a} \text{ [Equation 404.3.2(1)]}$$

Where system air fractions $F_a$, $F_b$, and $F_c$ are determined in accordance with Equation 404.3.2(2), Equation 404.3.2(3), and Equation 404.3.2(4), as applicable.

$$F_a = E_p + (1 - E_p) \cdot E_r \text{ [Equation 404.3.2(2)]}$$

$$F_b = E_p \text{ [Equation 404.3.2(3)]}$$

$$F_c = 1 - (1 - E_z) \cdot (1 - E_r) \cdot (1 - E_p) \text{ [Equation 404.3.2(4)]}$$

Where the zone primary air fraction ($E_p$) shall be determined in accordance with Equation 404.3.2(5), zone secondary recirculation fraction ($E_r$) shall be determined by the designer based on system configuration, the zone and zone air distribution effectiveness ($E_z$) shall be determined in accordance with Section 403.2.2. [ASHRAE 62.1:A1.2.2]

$$E_p = \frac{V_{pz}}{V_{dz}} \text{ [Equation 404.3.2(5)]}$$

Where:

- $A_z$ = Zone floor area: The net occupiable floor area of the ventilation zone, ft$^2$ (m$^2$).
- $D$ = Occupant diversity: The ratio of the system population to the sum of the zone populations.
- $E_p$ = Primary air fraction: The fraction of primary air in the discharge air to the ventilation zone.
- $E_r$ = Secondary recirculation fraction: In systems with secondary recirculation of return air, the fraction of secondary recirculated air to the zone that is representative of average system return air rather than that directly recirculated from the zone.
- $E_v$ = System ventilation efficiency: The efficiency with which the system distributes air from the outdoor air intake to the breathing zone in the ventilation-critical zone, which requires the largest fraction of outdoor air in the primary airstream.
- $E_{vz}$ = Zone ventilation efficiency: The efficiency with which the system distributes air from the outdoor air intake to the breathing zone in any particular ventilation zone.
- $E_z$ = Zone air distribution effectiveness: A measure of the effectiveness of supply air distribution to the breathing zone. $E_z$ is determined in accordance with Section 403.2.2.
- $F_a$ = Supply air fraction: The fraction of supply air to the ventilation zone from sources or air outside the zone.
- $F_b$ = Mixed air fraction: The fraction of supply air to the ventilation zone from fully mixed primary air.
- $F_c$ = Outdoor air fraction: The fraction of outdoor air to the ventilation zone from sources of air outside the zone.
- $P_s$ = System population: the simultaneous number of occupants in the area served by the ventilation system.
- $P_z$ = Zone population: see Section 403.2.1.
- $R_a$ = Area outdoor air rate: see Section 403.2.1.
- $R_p$ = People outdoor air rate: see Section 403.2.1.
- $V_{bz}$ = Breathing zone outdoor airflow: see Section 403.2.1.
- $V_{dz}$ = Zone discharge airflow: The expected discharge (supply) airflow to the zone that includes primary airflow and secondary recirculated airflow, CFM (m$^3$/min).
- $V_{ot}$ = Outdoor air intake flow: see Section 403.3, Section 403.4, and Section 403.5.2.
- $V_{ou}$ = Uncorrected outdoor air intake: see Section 403.5.1.
- $V_{oz}$ = Zone outdoor airflow: see Section 403.2.3.
- $V_{ps}$ = System primary airflow: The total primary airflow supplied to all zones served by the system from the air-handling unit at which the outdoor air intake is located.
- $V_{pz}$ = Zone primary airflow: The zone primary airflow to the ventilation zone, including outdoor air and recirculated air.
- $X_s$ = Average outdoor air fraction: At the primary air handler, the fraction of outdoor air intake flow in the system primary
**airflow.**

$\textit{Zpz} = \text{Primary outdoor air fraction}: \text{The outdoor air fraction required in the primary air supplied to the ventilation zone prior to the introduction of any secondary recirculation air.} \ [\text{ASHRAE 62.1:A3}]$

### TABLE 402.1

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY</th>
<th>PEOPLE OUTDOOR (R_p) (CFM/person)</th>
<th>AREA OUTDOOR (R_a) (CFM/ft(^2))</th>
<th>DEFAULT OCCUPANT DENSITY (people/1000 ft(^2))</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANIMAL FACILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal exam room (veterinary office)</td>
<td>10</td>
<td>0.12</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Large-animal holding room</td>
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<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (static cages)</td>
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</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
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<td>3</td>
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<tr>
<td><strong>CORRECTIONAL FACILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Booking/waiting</td>
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<td>0.06</td>
<td>50</td>
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<tr>
<td>Cell</td>
<td>5</td>
<td>0.12</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Day room</td>
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<td>30</td>
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<tr>
<td>Guard stations</td>
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<td>0.06</td>
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<tr>
<td><strong>EDUCATIONAL FACILITIES</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>Art classroom</td>
<td>10</td>
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<td>20</td>
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</tr>
<tr>
<td>Classrooms (ages 5 to 8)</td>
<td>10</td>
<td>0.12</td>
<td>25</td>
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</tr>
<tr>
<td>Classrooms (age 9 plus)</td>
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<tr>
<td>Computer lab</td>
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</tr>
<tr>
<td>Daycare sickroom</td>
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<td>0.18</td>
<td>25</td>
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</tr>
<tr>
<td>Daycare (through age 4)</td>
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<tr>
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<td>65</td>
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<tr>
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<td>150</td>
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<tr>
<td>Libraries</td>
<td>5</td>
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<td>–</td>
</tr>
<tr>
<td>Media center</td>
<td>10</td>
<td>0.12</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Multi-use assembly</td>
<td>7.5</td>
<td>0.06</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>Music/theater/dance</td>
<td>10</td>
<td>0.06</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>Science laboratories</td>
<td>10</td>
<td>0.18</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>University/college laboratories</td>
<td>10</td>
<td>0.18</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Wood/metal shop</td>
<td>10</td>
<td>0.18</td>
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<td>2</td>
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<tr>
<td><strong>FOOD AND BEVERAGE SERVICE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bars, cocktail lounges</td>
<td>7.5</td>
<td>0.18</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Cafeteria/fast-food dining</td>
<td>7.5</td>
<td>0.18</td>
<td>100</td>
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</tr>
<tr>
<td>Kitchen (cooking)</td>
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<td>0.12</td>
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</tr>
<tr>
<td>Restaurant dining rooms</td>
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<td>0.18</td>
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<tr>
<td><strong>GENERAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Break rooms</td>
<td>5</td>
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<td>25</td>
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</tr>
<tr>
<td>Coffee stations</td>
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<td>0.06</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Conference/meeting</td>
<td>5</td>
<td>0.06</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>Corridors</td>
<td>Occupiable storage rooms for liquids or gels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HOTELS, MOTELS, RESORTS, DORMITORIES**

<table>
<thead>
<tr>
<th>Barracks sleeping areas</th>
<th>5</th>
<th>0.06</th>
<th>20</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedroom/living room</td>
<td>5</td>
<td>0.06</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Laundry rooms, central</td>
<td>5</td>
<td>0.12</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Laundry rooms within dwelling units</td>
<td>5</td>
<td>0.12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Lobbies/pre-function</td>
<td>7.5</td>
<td>0.06</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Multipurpose assembly</td>
<td>5</td>
<td>0.06</td>
<td>120</td>
<td>1</td>
</tr>
</tbody>
</table>

**MISCELLANEOUS SPACES**

| Banks or bank lobbies    | 7.5 | 0.06 | 15 | 1 |
| Bank vaults/safe deposit| 5   | 0.06 | 5  | 2 |
| Computer (not printing)  | 5   | 0.06 | 4  | 1 |
| Freezer and refrigerated spaces (<50°F) | 10 | 0 | 0 | 2 |

| Manufacturing where hazardous materials are not used | 10 | 0.18 | 7 | 2 |
| Manufacturing where hazardous materials are used (excludes heavy industrial and chemical processes) | 10 | 0.18 | 7 | 3 |
| Pharmacy (prep. area) | 5 | 0.18 | 10 | 2 |
| Photo studios         | 5 | 0.12 | 10 | 1 |
| Shipping/receiving    | 10 | 0.12 | 2  | 2 |
| Sorting, packing, light assembly | 7.5 | 0.12 | 7 | 2 |
| Telephone closets     | – | 0.00 | – | 1 |
| Transportation waiting| 7.5 | 0.06 | 100| 1 |
| Warehouses            | 10 | 0.06 | – | 2 |

**OFFICE BUILDINGS**

| Break Rooms | 5 | 0.12 | 50 | 1 |
| Main entry lobbies | 5 | 0.06 | 10 | 1 |
| Occupiable storage rooms for dry materials | 5 | 0.06 | 2 | 1 |
| Office space | 5 | 0.06 | 5 | 1 |
| Reception areas | 5 | 0.06 | 30 | 1 |
| Telephone/data entry | 5 | 0.06 | 60 | 1 |

**OUTPATIENT HEALTH CARE FACILITIES**

<p>| Birthing room | 10 | 0.18 | 15 | 2 |
| Class 1 imaging rooms | 5 | 0.12 | 5 | 1 |
| Dental operatory | 10 | 0.18 | 20 | 1 |
| General examination room | 7.5 | 0.12 | 20 | 1 |
| Other dental treatment areas | 5 | 0.06 | 5 | 1 |
| Physical therapy exercise area | 20 | 0.18 | 7 | 2 |
| Physical therapy individual room | 10 | 0.06 | 20 | 1 |
| Physical therapeutic pool area | – | 0.48 | – | 2 |
| Prosthetics and orthotics room | 10 | 0.18 | 20 | 1 |
| Psychiatric consultation room | 5 | 0.06 | 20 | 1 |
| Psychiatric examination room | 5 | 0.06 | 20 | 1 |
| Psychiatric group room | 5 | 0.06 | 50 | 1 |
| Psychiatric seclusion room | 10 | 0.06 | 5 | 1 |
| Speech therapy room | 5 | 0.06 | 20 | 1 |
| Urgent care examination room | 7.5 | 0.12 | 20 | 1 |</p>
<table>
<thead>
<tr>
<th><strong>Urgent care observation room</strong></th>
<th>5</th>
<th>0.06</th>
<th>20</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urgent care treatment room</strong></td>
<td>7.5</td>
<td>0.18</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td><strong>Urgent care triage room</strong></td>
<td>10</td>
<td>0.18</td>
<td>20</td>
<td>1</td>
</tr>
</tbody>
</table>

**PUBLIC ASSEMBLY SPACES**

| **Auditorium seating area**    | 5  | 0.06 | 150| 1 |
| **Courtrooms**                 | 5  | 0.06 | 70 | 1 |
| **Legislative chambers**       | 5  | 0.06 | 50 | 1 |
| **Libraries**                  | 5  | 0.12 | 10 | 1 |
| **Lobbies**                    | 5  | 0.06 | 150| 1 |
| **Museums (children’s)**       | 7.5| 0.12 | 40 | 1 |
| **Museums/galleries**          | 7.5| 0.06 | 40 | 1 |
| **Places of religious worship**| 5  | 0.06 | 120| 1 |

**RETAIL**

| **Sales (except as below)**    | 7.5| 0.12 | 15 | 2 |
| **Barber shop**                | 7.5| 0.06 | 25 | 2 |
| **Beauty and nail salons**     | 20 | 0.12 | 25 | 2 |
| **Coin-operated laundries**    | 7.5| 0.12 | 20 | 2 |
| **Mall common areas**          | 7.5| 0.06 | 40 | 1 |
| **Pet shops (animal areas)**   | 7.5| 0.18 | 10 | 2 |
| **Supermarket**                | 7.5| 0.06 | 8  | 1 |

**SPORTS AND ENTERTAINMENT**

| **Bowling alley (seating)**    | 10 | 0.12 | 40 | 1 |
| **Disco/dance floors**         | 20 | 0.06 | 100| 2 |
| **Gambling casinos**           | 7.5| 0.18 | 120| 1 |
| **Game arcades**               | 7.5| 0.18 | 20 | 1 |
| **Gym, sports arena (play area)** | 20 | 0.18 | 7  | 2 |
| **Health club/aerobics room**  | 20 | 0.18 | 40 | 2 |
| **Health club/weight rooms**   | 20 | 0.06 | 10 | 2 |
| **Spectator areas**            | 7.5| 0.06 | 150| 1 |
| **Stages, studios**            | 10 | 0.06 | 70 | 1 |
| **Swimming (pool and deck)**   | –  | 0.48 | –  | 2 |

**TRANSIENT RESIDENTIAL**

| **Common corridors**           | –  | 0.06 | –  | 1 |
| **Dwelling unit**              | 5  | 0.06 | –  | 1 |

For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²

**Notes:**

1. Outpatient facilities to which the rates apply are freestanding birth centers, urgent care centers, neighborhood clinics and physicians offices, Class 1 imaging facilities, outpatient psychiatric facilities, outpatient rehabilitation facilities, and outpatient dental facilities.
2. The requirements of this table provide for acceptable IAQ. The requirements of this table do not address the airborne transmission of airborne viruses, bacteria, and other infectious contagions.
3. These rates are intended only for outpatient dental clinics where the amount of nitrous oxide is limited. They are not intended for dental operatories in institutional buildings where nitrous oxide is piped.
<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY</th>
<th>EXHAUST RATE (CFM/unit)</th>
<th>EXHAUST RATE (CFM/ft²)</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal imaging (MRI/CT/PET)</td>
<td>–</td>
<td>0.90</td>
<td>3</td>
</tr>
<tr>
<td>Animal operating rooms</td>
<td>–</td>
<td>3.00</td>
<td>3</td>
</tr>
<tr>
<td>Animal postoperative recovery room</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal preparation rooms</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Animal procedure room</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Animal surgery scrub</td>
<td>–</td>
<td>1.50</td>
<td>3</td>
</tr>
<tr>
<td>Large-animal holding room</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Necropsy</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (static cages)</td>
<td>–</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Small-animal-cage room (ventilated cages)</td>
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<td>1.50</td>
<td>3</td>
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<td>Arenas²</td>
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<td>Art classrooms</td>
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<tr>
<td>Auto repair rooms¹</td>
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<tr>
<td>Barber shops</td>
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<td>Beauty and nail salons</td>
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</tr>
<tr>
<td>Cells with toilet</td>
<td>–</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Copy, printing rooms</td>
<td>–</td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>Darkrooms</td>
<td>–</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Educational science laboratories</td>
<td>–</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Janitor closets, trash rooms, recycling</td>
<td>–</td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td>Kitchenettes</td>
<td>–</td>
<td>0.30</td>
<td>2</td>
</tr>
<tr>
<td>Kitchens – commercial</td>
<td>–</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>Locker rooms for athletic, industrial, and health care</td>
<td>–</td>
<td>0.50</td>
<td>2</td>
</tr>
<tr>
<td>All other locker rooms</td>
<td>–</td>
<td>0.25</td>
<td>2</td>
</tr>
<tr>
<td>Shower rooms⁷, ⁹</td>
<td>20/50</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Paint spray booths⁶</td>
<td>–</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Parking garages³</td>
<td>–</td>
<td>0.75</td>
<td>2</td>
</tr>
<tr>
<td>Pet shops (animal areas)</td>
<td>–</td>
<td>0.90</td>
<td>2</td>
</tr>
<tr>
<td>Refrigerating machinery rooms⁶</td>
<td>–</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Residential – kitchens⁷</td>
<td>50/100</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Soiled laundry storage rooms⁶</td>
<td>–</td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td>Storage rooms, chemical⁶</td>
<td>–</td>
<td>1.50</td>
<td>4</td>
</tr>
<tr>
<td>Toilets – private⁵, ⁸</td>
<td>25/50</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Toilets – public⁴, ⁸</td>
<td>50/70</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Woodwork shop/classrooms</td>
<td>–</td>
<td>0.50</td>
<td>2</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.0283 m³/min, 1 square foot = 0.0929 m²

Notes:
1 Stands where engines are run shall have exhaust systems that directly connect to the engine exhaust and prevent escape of fumes.
2 Where combustion equipment is intended to be used on the playing surface, additional dilution ventilation, source control, or both shall be provided.
3 Exhaust shall not be required where two or more sides compose walls that are at least 50 percent open to the outside.
Rate is per water closet, urinal, or both. Provide the higher rate where periods of heavy use are expected to occur. The lower rate shall be permitted to be used otherwise.

Rate is for a toilet room intended to be occupied by one person at a time. For continuous system operation during hours of use, the lower rate shall be permitted to be used. Otherwise the higher rate shall be used.

See other applicable standards for exhaust rate.

For continuous system operation, the lower rates shall be permitted to be used. Otherwise the higher rate shall be used.

Exhaust air that has been cleaned to meet Class 1 criteria from Section 403.9 shall be permitted to be recirculated.

Rate is per showerhead.

### TABLE 403.9

**AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS**

[ASHRAE 62.1: TABLE 6-3]

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

### TABLE 403.2.2

**ZONE AIR DISTRIBUTION EFFECTIVENESS**

[ASHRAE 62.1: TABLE 6-4]

<table>
<thead>
<tr>
<th>AIR DISTRIBUTION CONFIGURATION</th>
<th>Ez</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-Mixed Air Distribution Systems</td>
<td></td>
</tr>
<tr>
<td>Ceiling supply of cool air.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air and floor return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air 15°F or more above space temperature and ceiling return.</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than 15°F above space temperature where the supply air-jet velocity is less than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than 15°F above average space temperature where the supply air-jet velocity is equal to or greater than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Floor supply of warm air and floor return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Floor supply of warm air and ceiling return.</td>
<td>0.7</td>
</tr>
<tr>
<td>Makeup supply outlet located more than half the length of the space from the exhaust, return, or both.</td>
<td>0.8</td>
</tr>
<tr>
<td>Makeup supply outlet located less than half the length of the space from the exhaust, return, or both.</td>
<td>0.5</td>
</tr>
<tr>
<td>Stratified Air Distribution Systems (Section 403.2.2.1)</td>
<td></td>
</tr>
<tr>
<td>Floor supply of cool air where the vertical throw is greater than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.</td>
<td>1.05</td>
</tr>
<tr>
<td>Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.</td>
<td>1.2</td>
</tr>
<tr>
<td>Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling</td>
<td>1.5</td>
</tr>
</tbody>
</table>
return at a height greater than 18 feet above the floor.

**Personalized Ventilation Systems (Section 403.2.2.2)**

- Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of cool air and ceiling return. 1.40
- Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of warm air and ceiling return. 1.40
- Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with nonaspirating floor supply devices and ceiling return. 1.20
- Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with aspirating floor supply devices and ceiling return. 1.50

For SI units: °C = (°F-32)/1.8, 1 foot per minute = 0.005 m/s, 1 foot = 304.8 mm

**Notes:**
1 “Cool air” is air cooler than space temperature.
2 “Warm air” is air warmer than space temperature.
3 “Ceiling supply” includes any point above the breathing zone.
4 “Floor supply” includes any point below the breathing zone.
5 As an alternative to using the above values, Ez shall be permitted to be regarded as equal to air change effectiveness determined in accordance with ASHRAE 129 for air distribution configurations except unidirectional flow.
6 For lower velocity supply air, Ez = 0.8

**TABLE 402.2.1.6(A)(1)**

**MINIMUM OPENABLE AREAS: SINGLE OPENINGS**

[ASHRAE 62.1: TABLE 6-5]

<table>
<thead>
<tr>
<th>Vbz/Az = (L/s)/m²</th>
<th>Vbz/Az = (cfm/ft²)</th>
<th>TOTAL OPENABLE AREAS IN ZONE AS A PERCENTAGE OF Az</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HS/WS = 0.1</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>4.0</td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>6.9</td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>9.5</td>
</tr>
<tr>
<td>4.0</td>
<td>0.8</td>
<td>12.0</td>
</tr>
<tr>
<td>5.5</td>
<td>1.1</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Where:

- Vbz = breathing zone outdoor airflow, per Table 402.1.
- Az = zone floor area, the net occupiable floor area of the ventilation zone.
- WS = aggregated width of all single outdoor openings located at the same elevation.
- HS = vertical dimension of the single opening or the least vertical dimension of the openings where there are multiple openings.

* Volumetric airflow rates used to estimate required openable area are based on the following:
  - Dry-air density of 0.075 lbda/ft³ (1.2 kgda/m³) at a barometric pressure of 1 atm (101.3 kPa) and an air temperature of 70°F (21°C)
  - Temperature difference between indoors and outdoors of 1.8°F (1°C)
  - Gravity constant of 32.2 ft/s² (9.81 m/s²)
  - Window discharge coefficient of 0.6

**TABLE 402.2.1.6(A)(2)**

**MINIMUM OPENABLE AREAS: TWO VERTICALLY SPACED OPENINGS**

[ASHRAE 62.1: TABLE 6-6]

<table>
<thead>
<tr>
<th>Vbz/Az = (L/s)/m²</th>
<th>Vbz/Az = (cfm/ft²)</th>
<th>TOTAL OPENABLE AREAS IN ZONE AS A PERCENTAGE OF Az</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hvs = 8.2 ft (2.5 m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As/Al = 0.5</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td>2.0</td>
<td>0.4</td>
<td>4.0</td>
</tr>
</tbody>
</table>

71
Where:

\( V_{bz} \) = breathing zone outdoor airflow, per Table 402.1.
\( A_z \) = zone floor area, the net occupiable floor area of the ventilation zone.
\( H_{vs} \) = vertical separation between the center of the top and bottom openings’ free operable area; in case of multiple horizontally spaced pairs of openings, use shortest distance encountered.
\( A_s \) = openable area of smallest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.
\( A_l \) = openable area of largest opening (top or bottom); in case of multiple horizontally spaced pairs of top-and-bottom openings, use aggregated areas.

* Volumetric airflow rates used to estimate required operable area are based on the following:
  - Dry-air density of 0.075 lbda/ft\(^3\) (1.2 kgda/m\(^3\)) at a barometric pressure of 1 atm (101.3 kPa) and an air temperature of 70°F (21°C)
  - Temperature difference between indoors and outdoors of 1.8°F (1°C)
  - Gravity constant of 32.2 ft/s\(^2\) (9.81 m/s\(^2\))
  - Window discharge coefficient of 0.6

### 203.0 – A –

**Air, Class 1.** Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1:5.18.1]

**Air, Class 2.** Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1:5.18.1]

**Air, Class 3.** Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1:5.18.1]

**Air, Class 4.** Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered as harmful. [ASHRAE 62.1:5.18.1]

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**COMMITTEE STATEMENT:**
In Section 403.9.2 and Section 403.9.3, the language “at the design static pressure differential as defined in AHRI 1060” should be removed as adding the AHRI standard does not add any requirements or improve the code sections since they refer to definitions. Table 1701.1 is also being modified to remove AHRI 1060.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**  **AFFIRMATIVE:** 28  **NEGATIVE:** 1  **NOT RETURNED:** 1  Heine

**EXPLANATION OF NEGATIVE:**

**WHITE:** I disagree with the amended language and believe the proposal should be accepted as submitted. The reference language will keep people from gaming the system.

---

**Appended Comments**
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Chapter 4  Item #: 088

SUBMITTER: Emily Toto  ASHRAE  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

402.2.1.2 Floor Area to be Ventilated. The naturally ventilated area in zones or portions of zones shall extend from the openings to a distance determined in accordance with Section 402.2.1.3, Section 402.2.1.4, or Section 402.2.1.5. Openings shall be in accordance with the requirements of Section 402.2.1.6. For spaces where ceilings are not parallel to the floor, the ceiling height shall be determined in accordance with Section 402.2.1.1. [ASHRAE 62.1:6.4.1.2]

402.2.1.5 Corner Openings. For zones with operable openings on two adjacent sides of a zone, the distance from the operable openings shall be not more than $5H$ along a line drawn between the two openings that are farthest apart. Floor area outside that line shall comply with Section 402.2.1.1 as a zone having openings on only one side of the zone. [ASHRAE 62.1: 6.4.1.5]

403.9.2 Class 2 Air. Recirculation of Class 2 air within the space of origin shall be permitted. Recirculation or transfer of Class 2 air to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space. Transfer of Class 2 air to toilet rooms shall be permitted. Recirculation or transfer of Class 2 air to Class 4 spaces shall be permitted. Class 2 air shall not be recirculated or transferred to Class 1 spaces.

Exception: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air. Exhaust air transfer ratio of Class 2 air shall not exceed 10 percent of the outdoor air intake flow. (ASHRAE 62.1:5.18.3.2 – 5.18.3.2.5)

403.9.3 Class 3 Air. Recirculation of Class 3 air within the space of origin shall be permitted. Class 3 air shall not be recirculated or transferred to any other spaces.

Exception: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device shall be permitted but shall not be counted as outdoor air. Exhaust air transfer ratio of Class 3 air shall not exceed 5 percent of the outdoor air intake flow. (ASHRAE 62.1:5.18.3.3 – 5.18.3.3.2)

TABLE 403.2.2
ZONE AIR DISTRIBUTION EFFECTIVENESS
[ASHRAE 62.1: TABLE 6-4]

<table>
<thead>
<tr>
<th>AIR DISTRIBUTION CONFIGURATION</th>
<th>$E_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling supply of cool air.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air and floor return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Ceiling supply of warm air $15,^\circ F$ or more above space temperature and ceiling return.</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than $15,^\circ F$ above average space temperature where the supply air-jet velocity is less than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceiling supply of warm air less than $15,^\circ F$ above average space temperature where the supply air-jet velocity is equal to or greater than 150 feet per minute (fpm) within 4.5 feet of the floor and ceiling return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Floor supply of warm air and floor return.</td>
<td>1.0</td>
</tr>
<tr>
<td>Floor supply of warm air and ceiling return.</td>
<td>0.7</td>
</tr>
<tr>
<td>Makeup supply outlet located more than half the length of the space from the exhaust, return, or both.</td>
<td>0.8</td>
</tr>
<tr>
<td>Makeup supply outlet located less than half the length of the space from the exhaust, return, or both.</td>
<td>0.5</td>
</tr>
</tbody>
</table>

STRATIFIED AIR DISTRIBUTION SYSTEMS (SECTION 403.2.2.1)

<table>
<thead>
<tr>
<th>Condition</th>
<th>$E_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor supply of cool air where the vertical throw is greater than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.</td>
<td>1.05</td>
</tr>
<tr>
<td>Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height less than or equal to 18 feet above the floor.</td>
<td>1.2</td>
</tr>
<tr>
<td>Floor supply of cool air where the vertical throw is less than or equal to 60 feet per minute (fpm) at a height of 4.5 feet above the floor and ceiling return at a height greater than 18 feet above the floor.</td>
<td>1.5</td>
</tr>
</tbody>
</table>

PERSONALIZED VENTILATION SYSTEMS (SECTION 403.2.2.2)

<table>
<thead>
<tr>
<th>Condition</th>
<th>$E_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of cool air and ceiling return.</td>
<td>1.40</td>
</tr>
</tbody>
</table>
Personalized air at a height of 4.5 feet above the floor combined with ceiling supply of warm air and ceiling return. 1.40

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with nonaspirating floor supply devices and ceiling return. 1.20

Personalized air at a height of 4.5 feet above the floor combined with a stratified air distribution system with aspirating floor supply devices and ceiling return. 1.50

For SI units: °C = °F(5/9), 1 foot per minute = 0.005 m/s, 1 foot = 304.8 mm

Notes:
1 “Cool air” is air cooler than space temperature.
2 “Warm air” is air warmer than space temperature.
3 “Ceiling supply” includes any point above the breathing zone.
4 “Floor supply” includes any point below the breathing zone.
5 As an alternative to using the above values, Ez shall be permitted to be regarded as equal to air change effectiveness determined in accordance with ASHRAE 129 for air distribution configurations except unidirectional flow.
6 For lower velocity supply air, $E_z = 0.8$

<table>
<thead>
<tr>
<th>OCCUPANCY CATEGORY 4</th>
<th>PEOPLE OUTDOOR Air Rate Rp (CFM/person)</th>
<th>AREA OUTDOOR Air Rate Ra (CFM/ft²)</th>
<th>DEFAULT OCCUPANT DENSITY (people/1000 ft²)</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSIENT RESIDENTIAL</td>
<td>–</td>
<td>0.06</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Dwelling unit</td>
<td>6</td>
<td>0.06</td>
<td>–</td>
<td>4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

SUBSTANTIATION:
The above sections have been revised to correlate with ASHRAE 62.1-2019 and Addendum g to ASHRAE 62.1-2019 in accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines).
Proposals

Item #: 089

UMC 2024 Section: 401.1, Table 1701.1, Table 1701.2

SUBMITTER: David Dias
Sheet Metal Workers Local 104

RECOMMENDATION:
Revise text

401.0 General.
401.1 Applicability. This chapter contains requirements for ventilation air supply, exhaust, and makeup air requirements for occupiable spaces within a building. Spaces within buildings, except those within a dwelling unit in residential occupancies where occupants are nontransient, shall comply with Section 402.0 through Section 404.0. Requirements for ventilation air rate for dwelling units in residential occupancies, where the occupants are nontransient, shall be in accordance with Section 405.0 or ASHRAE 62.2.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 62.2-2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
<td>401.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASHRAE 62.2 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 62.2-2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The requirements for ventilation air rate for dwelling units in residential occupancies can either be in accordance with Section 405.0 of the UMC or ASHRAE 62.2, “Ventilation and Acceptable Indoor Air Quality in Residential Buildings,” as the ASHRAE standard contains provisions for dwelling units in residential occupancies similar to the UMC. This change clarifies the intent of Section 401.1.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The current language in the UMC already contains ventilation requirements for residential occupancies, therefore, reference to ASHRAE 62.2 is not necessary.
TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 28  NEGATIVE: 1  NOT RETURNED: 1  Heine
EXPLANATION OF NEGATIVE:
WHITE: ASHRAE 62.2 is an acceptable standard and should be allowed in the code. It could in fact replace the current related UMC language.

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 401.1, Table 1801.1, Table 1801.2  Item #: 089
SUBMITTER: Randy Young  Comment #: 1
Northern California JATC

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The requirements for ventilation air rate for dwelling units in residential occupancies can either be in accordance with Section 405.0 of the UMC or ASHRAE 62.2, “Ventilation and Acceptable Indoor Air Quality in Residential Buildings,” as the ASHRAE standard contains provisions for dwelling units in residential occupancies similar to the UMC. This change clarifies the intent of Section 401.1.
Proposals

Item #: 093
UMC 2024  Section: 402.1.3 - 402.1.3.3.1

SUBMITTER:  Mark Lessans
Johnson Controls

RECOMMENDATION:
Add new text

402.0 Ventilation Air.
402.1 Occupiable Spaces. (remaining text unchanged)

402.1.3 Demand Control Ventilation (DCV). Each occupiable space shall be equipped with a carbon dioxide sensor in accordance with the requirements in Section 402.1.3.1 and Section 402.1.3.3. Mechanical equipment serving each zone(s) shall be equipped with controls in accordance with the requirements in Section 402.1.3.2.

402.1.3.1 Carbon Dioxide Sensor Performance Specifications. Carbon dioxide sensors installed in accordance with Section 402.1.3 shall comply with the following carbon dioxide measurement specifications as certified by the equipment manufacturer:
(1) Range lower bound less than or equal to 400 parts per million.
(2) Range upper bound greater than or equal to 2000 parts per million.
(3) Accuracy within ±75 parts per million at a reading of 1000 parts per million.
(4) Output resolution of 5 parts per million or less.

402.1.3.2 Mechanical System Controls. Controls installed in accordance with Section 402.1.3 shall comply with the following:
(1) Receive data from the carbon dioxide sensor in the occupiable zone(s) at least once per 5 minutes.
(2) Be calibrated to provide pre-established outdoor airflow rates, or be equipped with the necessary instrumentation to measure outdoor airflow.
(3) Be capable of adjusting the outdoor airflow in response to an adjustable outdoor airflow setpoint.
(4) Increase the amount of outdoor air provided to each occupiable zone until the carbon dioxide level in each occupiable zone falls below a maximum threshold as defined by the user.

402.1.3.3 Ventilation Rate Alarming. When carbon dioxide levels are above a maximum level as defined by the user, sensors installed in accordance with Section 402.1.3 shall alert the occupants with a visual and audible indication in the zone or through a building monitoring system.

402.1.3.3.1 Default Carbon Dioxide Threshold Level. The threshold level for carbon dioxide measurement above which triggers an alert in accordance with Section 402.1.3.3 shall be set to 1100 parts per million by default.

SUBSTANTIATION:
Several recently published studies (see [1] and [2] below) have demonstrated that a large portion of indoor occupied spaces to not meet minimum requirements for ventilation as set in ASHRAE Standard 62.1, and have documented the impacts on occupant health, comfort, and productivity. Additionally, providing adequate ventilation is the most effective first step in mitigating the transmission of viruses carried by airborne particulates, an issue that has been highlighted during the COVID-19 pandemic.

This proposal seeks to ensure building occupants have access to adequate ventilation by bringing Demand Control Ventilation (DCV) to each occupiable zone and managing carbon dioxide levels – the best proxy we have for determining inadequate ventilation and/or above-normal occupancy. The proposal requires that every occupiable zone have a basic CO2 sensor, that the CO2 sensor communicate with the building mechanical system, and that the mechanical system be capable of adjusting airflow rates to keep CO2 levels (and therefore ventilation adequacy) within acceptable levels. It also requires that the CO2 sensor notify either the occupants, or the building manager, when ventilation is inadequate. This can be especially helpful first step in helping building occupants...
understand when indoor may be at unhealthy levels and take mitigating action.

If successfully deployed, this proposal would go a long way toward maintaining adequate ventilation, as well as assist in saving energy by preventing over-ventilation of spaces.


COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language needs additional work. The applicability for residential occupancies is unclear. Additional clarity to specify such distinctions is needed. For this reason, the proposed sections are being rejected. The TC suggests rework by the submitter and reintroducing as a public comment.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

EXPLANATION OF AFFIRMATIVE:

WISEMAN: We support DCV, but this proposal as written should not be a part of the minimum code.

Appended Comments

PUBLICATION 1

Code Year: 2024 UMC Section #: Appendix L Item #: 093

SUBMITTER: Mark Lessans Johnson Controls

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

APPENDIX L
CLEAN AIR DELIVERY

L 101.0 General.
L 101.1 Applicability. This appendix provides criteria for an increased protection level for occupant health by delivering and monitoring clean air in occupied areas of certain buildings. The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

L 201.0 Clean Air Delivery Capability.
L 201.1 General. In groups A, B, E, and I occupancies, each mechanical system shall meet the requirements in Section L 201.1.1.
Exception: Occupiable spaces where 100 percent of the supply air meets High-Efficiency Particulate Air (HEPA) filtration.
L 201.1.1 Airflow for Increased Filtration. Mechanical systems shall be sized to accommodate a design airflow at a total static pressure drop which assumes the utilization of a supply air filter with a Minimum Efficiency Reporting Value (MERV) of no less than 13.

L 301.0 Demand Control Ventilation (DCV).
L 301.1 General. Group A, B, E and I occupancies shall be equipped with a minimum of one carbon dioxide sensor for every 500 square feet of occupiable space. Carbon dioxide sensors installed in accordance with this section shall meet the requirements in Sections L 301.1.1 and L 301.1.3 Mechanical equipment serving each zone(s) shall be equipped with controls which meet the requirements in Section L 301.1.2.
L 301.1.1 Carbon Dioxide Sensor Performance Specifications. Carbon dioxide sensors installed in accordance with
Section L 301.0 shall comply with the following carbon dioxide measurement specifications as certified by the equipment manufacturer:
(1) Range lower bound less than or equal to 400 parts per million.
(2) Range upper bound greater than or equal to 2000 parts per million.
(3) Accuracy within ±75 parts per million at a reading of 1000 parts per million.
(4) Output resolution of 20 parts per million or less.

L 301.1.2 Mechanical System Controls. Controls installed in accordance with Section L 301.0 shall comply with the following:
(1) Receive data from the carbon dioxide sensor in the occupiable zone(s) at least once per 15 minutes.
(2) Be calibrated to provide pre-established outdoor airflow rates, or be equipped with the necessary instrumentation to measure outdoor airflow rate.
(3) Be capable of adjusting the outdoor airflow in response to an adjustable outdoor airflow setpoint.
(4) Increase the amount of outdoor air provided to each occupiable zone until the carbon dioxide level in each occupiable zone falls below a maximum threshold as defined by the user.

L 301.1.3 Carbon Dioxide Detection Threshold Level. The default detection threshold level for carbon dioxide measurement above which triggers an alert in accordance with Section L 301.1.4 shall be set to 1100 parts per million. The end user can modify the detection threshold level based on specific operations and needs.

L 301.1.4 Carbon Dioxide Detection Threshold Level Exceeded. When carbon dioxide levels exceed the detection threshold level established in Section L 301.1.3, the mechanical equipment shall modify the outdoor airflow rate as required in Section L 301.1.2. When the carbon dioxide concentration remains above the detection threshold level for a period of 30 minutes or more, the occupants in the zone shall be alerted by approved audible and visual notification devices or through a building monitoring system.

SUBSTANTIATION:
This proposal seeks to “ready” buildings for retrofits and other changes if indoor clean air delivery needs to be increased – such as in response to mitigating an airborne contaminant – per ASHRAE and CDC guidance on reopening buildings during the COVID-19 pandemic. If the mechanical system is not designed with a MERV 13 filter, it would at least be sized to accommodate the use of one later on without having to redesign or replace the system. This is important, as MERV 13 filters are often at the balance point between filtration effectiveness and energy efficiency. However, these filters are thicker and have a larger airflow resistance when compared to conventional filters, and often existing systems cannot accommodate them. This proposal also requires that occupiable spaces be equipped with the electrical infrastructure needed to increase clean air delivery at the zonal level, such as using a HEPA room air cleaning machine.

Taken together, these requirements will result in a modest increase in construction costs, but this cost pales in comparison to the burden of adding them post-construction.

Several recently published studies (see [1] and [2] below) have demonstrated that a large portion of indoor occupied spaces to not meet minimum requirements for ventilation as set in ASHRAE Standard 62.1, and have documented the impacts on occupant health, comfort, and productivity. Additionally, providing adequate ventilation is the most effective first step in mitigating the transmission of viruses carried by airborne particulates, an issue that has been highlighted during the COVID-19 pandemic.

This proposal seeks to ensure building occupants have access to adequate ventilation by bringing Demand Control Ventilation (DCV) to each occupiable zone and managing carbon dioxide levels – the best proxy we have for determining inadequate ventilation and/or above-normal occupancy. The proposal requires that every occupiable zone have a basic CO2 sensor, that the CO2 sensor communicate with the building mechanical system, and that the mechanical system be capable of adjusting airflow rates to keep CO2 levels (and therefore ventilation adequacy) within acceptable levels. It also requires that the CO2 sensor notify either the occupants, or the building manager, when ventilation is inadequate. This can be especially helpful first step in helping building occupants understand when indoor may be at unhealthy levels and take mitigating action.

If successfully deployed, this proposal would go a long way toward maintaining adequate ventilation, as well as assist in saving energy by preventing over-ventilation of spaces.

Proposals

Item #: 094

UMC 2024 Section: 402.3, 402.3.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

402.0 Ventilation Air.

402.3 Mechanical Ventilation. Where natural ventilation is not permitted by this section or the building code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and either return air or exhaust air, or both, as required. Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate wherever the spaces served are occupied. The system shall be designed to maintain minimum outdoor airflow as required by Section 403.0 under any load conditions.

402.3.1 Air Balancing. Air balancing shall be performed on mechanical ventilation systems in accordance with Section 314.0 to meet the ventilation airflow rates of this chapter.

(below shown for reference only)

314.0 Balancing.
314.1 General. Heating, ventilating, and air-conditioning systems (including hydronic systems) shall be balanced in accordance with one of the following methods:
(1) AABC National Standards for Total System Balance
(2) ACCA Manual B
(3) ASHRAE 111
(4) NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems
(5) SMACNA HVAC Systems Testing, Adjusting, and Balancing

SUBSTANTIATION:
An added reference for air balancing in Chapter 4 (Ventilation Air) is recommended to assist in enforcing the air balancing requirements found in Chapter 3 (General Regulations). The reference is a simple change that improves the code. Additionally, in a mechanical ventilation system, supply air is required, and either return air or exhaust air depending on the requirements for the space.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language requires rework as the structuring is confusing and difficult to interpret. The additional language creates confusion and may be misinterpreted by the end user.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 402.3  Item #: 094
SUBMITTER: Randy Young  Northern California JATC  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

402.0 Ventilation Air.

402.3 Mechanical Ventilation. Where natural ventilation is not permitted by this section or the building code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and either return air or exhaust air, or both, as applicable. Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate wherever the spaces served are occupied. The system shall be designed to maintain minimum outdoor airflow as required by Section 403.0 under any load conditions.

SUBSTANTIATION:
When a mechanical ventilation system is installed, supply air is required, and either return air or exhaust air depending on the requirements for the space.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 215.0  Item #: 094
SUBMITTER: Randy Young  Northern California JATC  Comment #: 2

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

215.0  – M –  Mechanical System. A set of components, devices, appliances, and equipment intended to perform a function(s) for which the system is designed, as regulated by this code. Such systems include, but are not limited to, ventilation, air-conditioning, exhaust, duct, venting, refrigeration, piping, hydronic, solar energy, and geothermal energy systems.

SUBSTANTIATION:
A definition is being added for “Mechanical System” as there is currently no definition found in the code. A simple, yet comprehensive definition is being added that addresses all mechanical systems that are addressed in the UMC. “Mechanical Ventilation” is defined which is part of a mechanical system. Furthermore, a mechanical system includes mechanical ventilation and should therefore also be defined. Lastly, considering that this is a mechanical code, mechanical system should be defined.
403.0 Ventilation Rates.

403.10 Air Balance. All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB). Exception: For single family residential, compliance with Section 403.10 shall not be required.

(below shown for reference only)

E 802.1 Commissioning Requirements. HVAC commissioning shall be included in the design and construction processes of the project to verify that the HVAC systems and components meet the owner’s project requirements and in accordance with this appendix. Commissioning shall be performed in accordance with this appendix by personnel trained and certified in commissioning by a nationally recognized organization. Commissioning requirements shall include the following:

1. Owner’s project requirements
2. Basis of design
3. Commissioning measures shown in the construction documents
4. Commissioning plan
5. Functional performance
6. Testing
7. Post construction documentation and training
8. Commissioning report

HVAC systems and components covered by this appendix as well as process equipment and controls, and renewable energy systems shall be included in the scope of the commissioning requirements.

SUBSTANTIATION:
Concerns over airborne transmission of pathogens and the benefits of proper ventilation have highlighted the need for verified adequate ventilation. Inadequate ventilation is a recognized and documented concern (See Supporting Material: CEC-500-2020-049). If the ventilation system is not tested, adjusted, and balanced by a skilled, trained, and certified technician the public has little assurance that the ventilation system conforms to design intent. The listed organizations have significant certification programs which ensure the certified technician, and associated contractors, have the knowledgebase and skillset to accurately perform the Air Balance. (See Supporting Material: TAB-Technical-Report-051220) Section E 802.1 (Commissioning Requirements) of the Uniform Mechanical Code set a precedent for similar requirements where an accurate verification of design intent is required.

[Supporting documentation provided in KAVI for TC review]

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

403.10 Air Balance. All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be
performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB), or other ANSI-accredited agencies. Exception: For single family residential, compliance with Section 403.10 shall not be required.

COMMITTEE STATEMENT:
Modifications have been made by the Technical Committee to add the language “or other ANSI-accredited agencies” to prevent overly restrictive language.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 26 NEGATIVE: 3 NOT RETURNED: 1 Heine
EXPLANATION OF NEGATIVE:
KOERBER: No data was provided to support this change.
WHITE: The proposal is an onerous requirement that is not necessary on ALL jobs. The proponent does hold out single family residential, but there are many similar forms of construction that do not have complex installations requiring this level of certification.
WISEMAN: This is overly restrictive. No proof was submitted that would justify such an onerous requirement.

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 097, Section 403.10 (Air Balance), UMC Item # 110, Section 504.3 (Domestic Range Hoods), and UMC Item # 161, Section 603.9.2 (Duct Leakage Tests) resulted in conflicting language within the code. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

403.0 Ventilation Rates.

403.10 Air Balance. All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other ANSI-accredited equivalent approved agencies. Exception: For single family residential, compliance with Section 403.10 shall not be required.

TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item # 097, Section 403.10 (Air Balance) modifies the phrase “or other ANSI accredited agencies” to “or other equivalent approved agencies” to comply with the ANSI Essential Requirements for referencing products or services. Additionally, UMC Item # 110, Section 504.3 (Domestic Range Hoods) and UMC Item # 161, Section 603.9.2 (Duct Leakage Tests) were modified to correlate with the updated UMC Item # 097 by adding the phrase “or other equivalent approved agencies.”

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 403.10 by modifying the phrase “or other ANSI accredited agencies” to “or other equivalent approved agencies.”

Appended Comments
PUBLICATION COMMENT 1

Code Year: 2024 UMC  Section #: 403.10  Item #: 097

SUBMITTER: Daniel Buuck  Comment #: 1
NAHB

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

403.10 Air Balance. All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies approved technician.

Exception: For single family residential, compliance with Section 403.10 shall not be required.

SUBSTANTIATION:
The committee correctly recognized that the submitted language was overly restrictive. However, the modification does not go far enough. Certified technicians are not available in many regions of the country which adds unreasonable costs and delays to smaller commercial and multifamily projects, and certification is not necessary to carry out the testing on simple systems.

It is not the job of a building code to regulate the labor force or require contractor licensing. The language of this public comment provides the code official with the assurance that a competent technician has performed the required testing without being overly restrictive.

See also NAHB's comment on Item #161.

PUBLICATION COMMENT 2

Code Year: 2024 UMC  Section #: 224.0, 403.10  Item #: 097

SUBMITTER: Phil Pettit  Comment #: 2
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

403.10 Air-Balance Balanced Ventilation System. All mechanical ventilation systems shall be tested, balanced, and operated to demonstrate that the installation and performance of the systems are in accordance with the design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

Exception: For single family residential, compliance with Section 403.10 shall not be required.

224.0 – V – Ventilation System. All of that equipment intended or installed for the purpose of supplying air to or removing air from, any room or space by mechanical means, other than equipment that is a portion of an environmental heating, cooling, absorption, or evaporative cooling system.

Ventilation System, Balanced. A ventilation system that simultaneously supplies outdoor air to and exhausts air from a space, where the mechanical supply airflow rate and the mechanical exhaust airflow rate are each within 10 percent of the average of the two airflow rates.
The term “Balanced Ventilation System” is being defined to guide users in complying with the air balancing requirements in the mechanical code. A balanced ventilation system introduces fresh outdoor air into a space at the same rate (within 10 percent) that indoor air is exhausted from the space. If a balanced ventilation system is designed and installed properly, it neither pressurizes or depressurizes the space. This allows the mechanical ventilation to control the flow of air within the space, rather than relying on natural ventilation to circulate air and remove pollutants.
Proposals

Item #: 098

UMC 2024  Section: 403.7.2, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

403.0 Ventilation Rates.

403.7 Exhaust Ventilation. Exhaust airflow shall be provided in accordance with the requirements in Table 403.7. Exhaust makeup air shall be permitted to be a combination of outdoor air, recirculated air, and transfer air.

403.7.1 Parking Garages. Exhaust rate for parking garages shall be in accordance with Table 403.7. Exhaust rate shall not be required for enclosed parking garages having a floor area of 1000 square feet (92.9 m$^2$) or less and used for the storage of 5 or less vehicles.

403.7.2 Enclosed Parking Garages. Mechanical ventilation systems for enclosed parking garages shall operate continuously.

Exceptions:
(1) Mechanical ventilation systems shall be permitted to operate intermittently where the system is designed to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.
(2) Approved automatic carbon monoxide sensing devices, and nitrogen dioxide detectors shall be permitted to modulate the ventilation system to not exceed a maximum average of 50 parts per million of carbon monoxide, or 1 part per million nitrogen dioxide during an eight-hour period with a concentration of not more than 200 parts per million for carbon monoxide, or 5 parts per million nitrogen dioxide, for a period not exceeding 15 minutes. Automatic sensing devices installed in modulated parking garage ventilation systems shall be approved in accordance with Section 301.2. Such sensing devices shall be listed and labeled in accordance with UL 2075 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2075-2013</td>
<td>Gas and Vapor Detectors and Sensors (with revisions through December 21, 2017)</td>
<td>Detectors, sensors</td>
<td>403.7.2</td>
</tr>
</tbody>
</table>

Note: UL 2075 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
UL 2075 is being added to this section as the standard provides requirements that apply to gas and vapor detectors and sensors.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There was nothing in the standard that specified nitrogen dioxide. There is also concern with the phrase “listed and labeled” in this section as it is not needed since the code already requires third party certification.
TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 24  NEGATIVE: 5  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

BALLANCO: This change should have been accepted as submitted. The justification provided supports the change.

FEEHAN: The language and standards are necessary for safety.

MACNEVIN: I do not agree with the rationale for rejection of this item. UL 2075 appears to be an appropriate standard for this purpose. This should be accepted during Public Comment with the removal of "listed and labeled."

WHITE: The Committee action is wrong. The standard is acceptable. Disqualifying the proposal based on the "style" use of language is a poor excuse as well. Style can be easily amended or considered editorial to correct.

WISEMAN: UL 2075 is appropriate for this application. It should be accepted as written.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 403.7.2, Table 1801.1  Item #: 098

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

403.0 Ventilation Rates.

403.7 Exhaust Ventilation. (remaining text unchanged)

403.7.2 Enclosed Parking Garages. Mechanical ventilation systems for enclosed parking garages shall operate continuously.
Exceptions:
(1) Mechanical ventilation systems shall be permitted to operate intermittently where the system is designed to operate automatically upon detection of vehicle operation or the presence of occupants by approved automatic detection devices.
(2) Approved automatic carbon monoxide sensing devices, and nitrogen dioxide detectors shall be permitted to modulate the ventilation system to not exceed a maximum average of 50 parts per million of carbon monoxide, or 1 part per million nitrogen dioxide during an eight-hour period with a concentration of not more than 200 parts per million for carbon monoxide, or 5 parts per million nitrogen dioxide, for a period not exceeding 15 minutes. Automatic sensing devices installed in modulated parking garage ventilation systems shall be approved in accordance with Section 301.2. Such sensing devices shall comply with UL 2075 and shall be installed in accordance with the manufacturer's installation instructions.

TABLE 1801.1
REFERENCED STANDARDS

<table>
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<td>Detectors, sensors</td>
<td>403.7.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 2075 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
SUBSTANTIATION:
UL 2075 is being added to this section as the standard provides requirements that apply to gas and vapor detectors and sensors.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

As noted in the scope of the standard, “A gas detector and/or sensor and/or vapor detector, as covered by these requirements, consists of an assembly of electrical components coupled with a sensing means inside a chamber or by separate components to detect toxic and/or combustible gases or vapors and in accordance with National Electrical Code, NFPA 70, the Fire Alarm and Signaling Code, NFPA 72, and Fuel Gases and Warning Equipment, NFPA 715. The detector includes provision for the connection to a source of power and signaling circuits.”

As noted in Section 15 of the standard, the performance of a detector or a sensor shall be verified for each gas that it is intended to detect. The standard does include specific concentration levels for certain gases. Alternatively, as noted in Section 15.8, “for combustible and toxic gas detectors other than CO alarms intended for residential or commercial applications, the cross sensitivity and contamination gases and gas concentrations are to be specified by the manufacturer and outlined in the users manual. The gases and concentrations identified in the users manual shall constitute the list of gases to be used for selectivity testing.”

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO's Manual of Style.
Proposals

Item #: 101

UMC 2024 Section: 406.0, 406.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

406.0 Minimizing Transmission of Diseases and Viruses from Airborne Particles.
406.1 Ultraviolet Light (Lamp) Air Sterilization or Purification Systems. UV-C germicidal lamp systems installed in ductwork shall be listed and labeled in accordance with UL 1995 or UL 60335-2-40, and shall be installed in accordance with the manufacturer’s installation instructions. Germicidal equipment and systems installed in rooms or spaces shall be listed and labeled in accordance with UL 8802 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1 REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 8802-2020</td>
<td>Outline of Investigation for Germicidal Systems</td>
<td>Air purification</td>
<td>406.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1995 and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: UL 8802 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The need for requirements for air sterilization or purification systems to follow before, during, and after a pandemic has become increasingly apparent. The proposed code change provides requirements for UV light air sterilization or purification systems that can be applied to a building’s mechanical system to minimize transmission of diseases and viruses from airborne particles during a pandemic. UL 8802 has been specifically developed to address the associated risks and hazards for installation within rooms or spaces. Following manufacturer’s installation instructions are critical.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as UL 1995 does not mention air cleaning capabilities. There must be additional research conducted to determine which methods and standards are the most effective at promoting health and safety.

Furthermore, the title of both sections should be revised to prevent misuse of the provisional language. It is recommended by the Technical Committee that these provisions be reworked and brought back as public comment.
since the provided standards do aid in preventing the incorrect systems from being installed. There is also concern that these are not the only UV sterilization devices to be used within ducts.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 27  NEGATIVE: 2  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
KOERBER: Proposal should be accepted and the standards added to the code.
WHITE: These standards would be good additions to the code.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 406.0, 406.1, Table 1801.1  Item #: 101

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

406.0 Minimizing Transmission of Diseases and Viruses from Airborne Particles,
406.1 Ultraviolet Light (Lamp) Air Sterilization or Purification Systems. UV-C germicidal lamp systems installed in ductwork shall comply with UL 1995 or UL 60335-2-40, and shall be installed in accordance with the manufacturer’s installation instructions. Germicidal equipment and systems installed in rooms or spaces shall comply with UL 8802 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1801.1
REFERRED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 8802-2020</td>
<td>Outline of Investigation for Germicidal Systems</td>
<td>Air Purification</td>
<td>406.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1995 and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: UL 8802 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The intent of this proposal is not to mandate that these types of systems be installed, but to provide minimum safety requirements if they are installed, in order to mitigate the associated risks and hazards.

The need for requirements for air sterilization or purification systems to follow before, during, and after a pandemic has become increasingly apparent. The proposed code change provides requirements for UV light air sterilization or purification systems that can be applied to a building’s mechanical system to minimize transmission of diseases and viruses from airborne particles during a pandemic. UL 8802 has been specifically developed to address the associated risks and hazards for installation within rooms or spaces. Following manufacturer’s installation instructions are critical.
This proposal addresses UV-C germicidal lamp systems installed within ductwork, as well as systems installed in rooms or spaces. The requirements are different for the two applications because of the difference in risks.

To address the concern raised by the TC regarding the applicability of UL 1995, these products are called “UV lamp systems” within this standard. They are defined in Section 2 as:

“Ultraviolet (UV) Lamp - Equipment that directly generates ultraviolet radiation typically used to supplement the normal unit air filters for enhanced air purification and surface cleaning. For the purpose of the standard, UV lamp systems are divided into 3 categories and are defined below:

a) Factory Installed - A UV lamp system that is located within the unit (integral) and installed at the factory. For the purpose of these requirements the term “within the unit” includes all space within the area between inlet and outlet air side of the heating and cooling unit including the area housing the evaporator coil if mounted directly on the unit.
b) Field Installed - A factory designated UV lamp system that is located within the unit (integral) and field installed per the manufactures procedures. For the purpose of these requirements the term “within the unit” includes all within the area between inlet and outlet side of the heating and cooling unit including the area housing the evaporator coil if mounted directly on the unit.
c) Non Integral Field Installed - A duct mounted UV lamp system that is not integral to the unit. For the purpose of these requirements, the term “non integral” refers to all areas of the ductwork that is outside of the heating and cooling unit inlet and outlet excluding the area housing the evaporator coil if mounted directly on the unit.”

These are the UV sterilization devices used within ducts.

The safety requirements for these systems are throughout UL 1995. Supplement SA17 contains the specific requirements for the Ultraviolet (UV) Irradiance Test, and SA18 contains the specific requirements for the markings, and the installation and use instructions.

As for TC's request for additional research regarding what methods and standards are the most effective, we have known since the late 1800s that ultraviolet (UV) light can provide effective sanitization. There has been substantial research on the subject. These proposed referenced standards address the risk of personal injury due to overexposure to UV emissions.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

In regards to IAPMO staff’s note regarding the development of UL 8802, as stated in the Section 3-3.7.1.3, ‘IAPMO's Regulations Governing Committee Projects,’ the TC is permitted to allow standards that were not developed by an open consensus process. Such referenced standards are still required to be written in mandatory language in order to be enforceable. UL 8782 is written using mandatory language.

Sections below are taken from IAPMO's Regulations Governing Committee Projects for reference:

3-3.7.1.2 Mandatory standards referenced in IAPMO codes and standards shall be developed via an open process having a published development procedure. the development procedure shall include a means for obtaining divergent views, if any, the development procedure shall include a means of achieving consensus for the resolution of divergent views and objections.

3-3.7.1.3 Mandatory standards referenced in IAPMO codes and standards not complying with 3-3.7.1.2 are permitted. However, in such instances the TC shall determine that the mandatory standard is appropriate for reference. the TC shall verify the standard is written in mandatory language, is identifiable by title, date or edition, and developing organization, and that it is readily available. any mandatory standard proposed for reference on the basis of this paragraph shall be specifically identified as not complying with 3 3.7.1.2 in a ROP or ROC.

The proposed new section has been reworded to comply with IAPMO's Manual of Style.
507.2.6 Used in Other Applications. Cooking equipment used in fixed, mobile, or temporary concessions, such as trucks, buses, trailers, pavilions, tents, or any form of roofed enclosure, shall comply with this chapter. ([NFPA 96:4.4.9 1.1.3])

507.4.4 Factory Built. Factory-built grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an “F” and a “T” rating equal to the fire resistance rating of the assembly being penetrated from the point at which the duct penetrates a ceiling, wall, or floor to the outlet terminal. ([NFPA 96:4.3.3-4.3.4])

507.4.4.1 Listing. The factory-built grease duct protection system shall be listed in accordance with UL 2221. ([NFPA 96:4.3.3.1-4.3.4.1])

507.4.4.2 Single Wall. Listed single wall factory-built grease ducts shall be permitted to be enclosed with field-applied grease duct enclosure material where the material and the assembly of duct and material are listed for that application and installed in accordance with the grease duct manufacturer’s listing and their installation instructions. ([NFPA 96:4.3.3.2-4.3.4.2])

507.4.4.3 Installation. The factory-built grease duct protection system shall be installed in accordance with the manufacturer’s instructions and the listing requirements. ([NFPA 96:4.3.4.3])

507.4.5 Field Applied. Field-applied grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an “F” and a “T” rating equal to the fire resistance rating of the assembly being penetrated. The surface of the field fabricated grease duct shall be continuously covered on all sides from the point at which the duct enclosure penetrates a ceiling, wall, or floor to the outlet terminal. The field-applied grease duct shall be listed in accordance with ASTM E2336 and installed in accordance with the manufacturer's instructions and the listing requirements. ([NFPA 96:4.3.1-4.3.2.2])

507.4.6 Both Field-Applied and Factory Built. Field-applied grease duct enclosures and factory-built grease duct enclosures shall demonstrate that they provide mechanical and structural integrity, resiliency, and stability when subjected to expected building environmental conditions, duct movement under general operating conditions, and duct movement due to fire conditions. ([NFPA 96:4.3.4.5])

507.4.6.2 Specification. The specifications of material, gauge, and construction of the duct used in the testing and listing of field-applied grease duct enclosures and factory-built grease duct enclosures shall be included as minimum requirements in their listing and installation documentation. ([NFPA 96:4.3.5 4.3.6])

507.4.6.3 Clearance Options. The following clearance options for which field-applied grease duct enclosures and factory-built grease duct enclosures have been successfully evaluated shall be clearly identified in their listing and installation documentation and on their labels:

1. Open combustible construction clearance at manufacturer’s requested dimensions.
2. Closed combustible construction clearance at manufacturer’s requested dimensions, with or without specified ventilation.
3. Rated shaft clearance at manufacturer’s requested dimensions, with or without specified ventilation. ([NFPA 96:4.3.6 4.3.7])

507.5 Drawings. For cooking operations in buildings, aA drawing(s) of the exhaust system installation along with copies of operating instructions for subassemblies and components used in the exhaust system, including electrical schematics, shall be kept on the premises and made available on request to the Authority Having Jurisdiction and
508.2 Listed Type I Hood Assemblies. Listed hood assemblies shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. Listed hood assemblies shall be tested in accordance with UL 710, CAN/ULC-S646 for Canada, or equivalent. [NFPA 96:5.4.1, 5.4.2]

508.2.1 Listed Ultraviolet Hoods. Listed ultraviolet hoods shall be installed and maintained in accordance with the terms of their listing and the manufacturer’s instructions. Duct systems connected to ultraviolet hoods shall comply with Section 510.0. Ultraviolet hoods shall be tested and listed in accordance with UL 710 and UL 749G CAN/ULC-S646 for Canada. [NFPA 96:5.5 – 5.5.2]

509.1 Grease Removal Devices. Listed grease filters or other listed grease removal devices intended for use with commercial cooking operations shall be provided. Listed grease filters and grease removal devices that are removable but not an integral component of a specific listed exhaust hood shall be listed in accordance with UL 1046 or CAN/ULC-S649 for Canada and shall be designated on the filter. [NFPA 96:6.1.1, 6.1.2]

509.1.1 Grease Filters, Mesh-Type. Mesh filters shall not be used unless evaluated as an integral part of a listed exhaust hood or listed in conjunction with a primary filter in accordance with UL 1046 or CAN/ULC-S649 for Canada. [NFPA 96:6.1.3]

510.1.3 Duct Installation. All ducts shall be installed with a minimum 2 percent slope of ¼ inch per linear foot on horizontal runs greater than 75 feet (22 860 mm). Factory-built grease ducts shall be permitted to be installed at a lesser slope in accordance with the listing and the manufacturer’s instructions. All horizontal ducts shall be provided with access in accordance with Section 510.3.3.

Drains shall be provided at low points in horizontal ducts. Where provided, drains shall be continuously welded to the exhaust duct or in accordance with the terms of the listing and the manufacturer’s installation manual.

All ducts shall be installed without forming dips or traps. In manifold (common duct) systems, the lowest end of the main duct shall be connected flush on the bottom with the branch duct. [NFPA 96:7.1.6 – 7.1.7]

510.1.4 Accessibility. Openings required for accessibility shall comply with Section 510.3 through Section 510.3.2. [NFPA 96:7.1.7]

510.1.5 Sign. A sign stating the following shall be placed on all access panels: ACCESS PANEL – DO NOT OBSTRUCT [NFPA 96:7.4.6-7.1.7]

510.1.7 Type I Exhaust Duct Systems. Listed grease ducts shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. [NFPA 96:7.1.7]

510.3.2 Access for Cleaning and Inspection. Exhaust fans with ductwork connected to both sides shall have access for cleaning and inspection within 3 feet (914 mm) of each side of the fan. Wall-mounted exhaust fans shall have access for cleaning and inspection within 3 feet (914 mm) of the exhaust fan. [NFPA 96:7.3.7, 7.3.8]

510.4 Listed Grease Ducts. Listed grease ducts shall be installed in accordance with the terms of the listing and the manufacturer’s instructions. [NFPA 96:7.4.7.1.8]

510.5.2 Factory-Built Grease Ducts. Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to use materials in accordance with their listing. [NFPA 96:7.5.1.2]

510.5.3 Installation. All seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid-tight continuous external weld. [NFPA 96:7.5.2.1]

Exceptions:
(1) Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to incorporate nonwelded joint construction in accordance with their listings. [NFPA 96:7.5.2.1.1]
(2) Duct-to-hood collar connections as shown in Figure 510.5.3 shall not require a liquid-tight continuous external weld. [NFPA 96:7.5.2.2]

510.5.3.2 Welded Duct Connection. Acceptable duct-to-duct connection shall be as follows:
(1) Telescoping joint, as shown in Figure 510.5.3.2(1).
(2) Bell-type joint, as shown in Figure 510.5.3.2(2).
(3) Flange with edge weld, as shown in Figure 510.5.3.2(3).
(4) Flange with filled lap joint weld, as shown in Figure 510.5.3.2(4). [NFPA 96:7.5.5.1]

510.6 Exterior Installations. For cooking operations in buildings, the exterior portion of the ductwork shall be vertical wherever possible and shall be installed and supported on the exterior of a building. Bolts, screws, rivets, and other mechanical fasteners shall not penetrate duct walls. Clearance of ducts shall comply with Section 507.4 through Section 507.4.3. [NFPA 96:7.6.1 – 7.6.3, 7.6.4]

510.6.1 Weather Protection. All ducts shall be protected on the exterior by paint or other suitable weather-protective
coatings. Ducts constructed of stainless steel shall not be required to have additional paint or weather-protective coatings. Ductwork subject to corrosion shall have minimal contact with the building surface. [NFPA 96: 7.6.4—7.6.6 7.6.5-7.6.7]

**FIGURE 510.5.3.2(4)**

**FLANGE WITH FILLED LAP JOINT WELD DUCT CONNECTION**

[NFPA 96: FIGURE 7.5.5.1(d)]

**510.9.1 Rooftop Terminations.** Rooftop terminations shall be arranged with or provided with the following:

1. A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.
2. A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.
3. A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.
4. The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.
5. A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.
6. Listed Grease collection systems that are listed in accordance with UL 710A and meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).
7. A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.
8. A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
   a. Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
   b. The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
9. Other approved fan, provided it meets all of the following criteria:
   a. The fan meets the requirements of Section 510.9.1(3) and Section 511.1.3.
   b. Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.1.3)
   c. Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96: 7.8.2.1]

**511.1.3.2 Within the Building.** Fans installed within the building shall be in accordance with the following:

1. Located in an accessible area of adequate size to allow for service or removal. [NFPA 96: 8.1.4.2]
2. Flexible connectors shall not be used. [NFPA 96: 8.1.4.6]
3. Exhaust fans shall have a drain directed to a readily accessible and visible grease receptacle not to exceed 1 gallon (4 L). [NFPA 96: 8.1.4.6]

**511.1.3.3 Duct Systems.** Where the duct system connected to the fan is in an enclosure, the space or room in which the exhaust fan is located shall have the same fire resistance rating as the enclosure. The fan shall be connected to the exhaust duct by flanges securely bolted as shown in Figure 511.1.2(1) through Figure 511.1.2(4) or by a system specifically listed for such use. [NFPA 96: 8.1.4.3. 8.1.4.4.8 8.1.4.5]

**511.2.3 Exhaust Fan Operation.** A hood exhaust fan(s) shall continue to operate after the extinguishing system has been activated unless fan shutdown is required by a listed component of the ventilation system or by the design of the extinguishing system. The hood exhaust fan shall start upon activation actuation of the extinguishing system if the exhaust fan and all cooking equipment served by the fan have been shut down, unless fan shutdown is required by a listed component of the ventilation system or by the listing of the extinguishing system. The exhaust fan shall be provided with a means so that the fan is activated when any heat-producing cooking appliance under the hood is turned on. [NFPA 96: 8.2.3.1 – 8.2.3.3]

**513.2.5.4 Activation.** Where a separate fire-extinguishing system is used for protection of cooking equipment only, a water-wash fire-extinguishing system listed for protection of the grease removal device(s), hood exhaust plenum(s), exhaust duct(s), or combination thereof shall be provided with instructions and appropriate means for electrical interface for simultaneous activation actuation. [NFPA 96:10.2.8.5]

**513.2.5.5 Water-Wash System.** A water-wash system approved to be used for protection of the grease removal device(s), hood exhaust plenum(s), exhaust duct(s), or combination thereof shall include instructions and appropriate electrical interface for simultaneous activation actuation of the water-wash system from an automatic fire-extinguishing system, where the automatic fire-extinguishing system is used for cooking equipment protection only. [NFPA 96:10.2.8.6]

**513.2.5.6 Exception.** Where the automatic fire-extinguishing system in accordance with NFPA 17A provides protection for the hood and duct in a fixed baffle hood containing a water-wash system, the water-wash system shall be made inoperable or delayed for a minimum of 60 seconds upon operation of the automatic fire-extinguishing system. [NFPA 96:10.2.8.7]

**513.4 Fuel and Electric Power Shutoff.** Upon activation actuation of any fire-extinguishing system for a cooking operation, all sources of fuel and electrical power that produce heat to all equipment requiring protection protected by that the system shall automatically shut off. [NFPA 96:10.4.1]

**513.4.2 Protection Not Required.** Any gas appliances not requiring protection but located under the same ventilation...
513.4.1.1 Filters. Filter-equipped exhaust systems shall not be operated with filters removed. [NFPA 96:4.4.2 12.1.2]

513.6.1 Signaling. Where a fire alarm signaling system is serving the occupancy where the extinguishing system is located, the activation actuation of the automatic fire-extinguishing system shall activate and be provided with instructions for its use in accordance with the requirements of NFPA 72. [NFPA 96:10.6.2]

514.1 Operating Procedures. Exhaust systems shall be operated whenever cooking equipment is turned on. [NFPA 96:4.4.4 12.1.1]

514.1.1 Filters. Filter-equipped exhaust systems shall not be operated with filters removed. [NFPA 96:4.4.2 12.1.2]

514.1.2 Openings. Openings provided for replacing air exhausted through ventilating equipment shall not be restricted by covers, dampers, or any other means that would reduce the operating efficiency of the exhaust system. [NFPA 96:4.1.3 12.1.3]

514.1.3 Posting of Instructions. Instructions for manually operating the fire-extinguishing system shall be posted conspicuously in the kitchen and shall be reviewed with employees by the management. [NFPA 96:4.4.4.3 12.1.4.3]

514.1.4 Listing and Manufacturer's Instructions. Listed exhaust hoods shall be operated in accordance with the terms of their listings and the manufacturer's instructions. [NFPA 96:4.4.6 12.1.5]

514.1.5 Nonoperational. Cooking equipment shall not be operated while its fire-extinguishing system or exhaust system is nonoperational or impaired. [NFPA 96:4.4.6 12.1.6]

514.1.6 Secondary Control Equipment. Secondary filtration and pollution control equipment shall be operated in accordance with the terms of its listing and the manufacturer's recommendations. [NFPA 96:4.4.7 12.1.7]

514.1.7 Inspection Frequency. Inspection and maintenance of “other equipment” as allowed in Section 512.3 shall be conducted by properly trained and qualified persons at a frequency determined by the manufacturer's instructions or the equipment listing. [NFPA 96:4.4.8 12.1.8]

514.2 Inspection, Testing, and Maintenance. Maintenance of the fire-extinguishing systems and listed exhaust hoods containing a constant or fire-activated water system that is listed to extinguish a fire in the grease removal devices, hood exhaust plenums, and exhaust ducts shall be made by properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction at least every 6 months. [NFPA 96:4.4.2.1 12.2.1]

514.2.1 Requirements. All actuation and control components, including remote manual pull stations, mechanical and electrical devices, detectors, and actuators, shall be tested for proper operation during the inspection in accordance with the manufacturer's procedures. The specific inspection and maintenance requirements of the extinguishing system standards as well as the applicable installation and maintenance manuals for the listed system and service bulletins shall be followed. [NFPA 96:4.4.2.2 12.2.2 12.2.3]

514.2.2 Fusible Links and Sprinklers. Fusible links of the metal alloy type and automatic sprinklers of the metal alloy type shall be replaced at least semiannually. [NFPA 96:4.4.2.4 12.2.4]

514.2.3 Inspection Tag. The year of manufacture and the date of installation of the fusible links shall be marked on the system inspection tag. The tag shall be signed or initialed by the installer. Detection devices that are bulb-type automatic sprinklers and fusible links other than the metal alloy type shall be examined and cleaned or replaced annually. [NFPA 96:4.4.2.5 4.4.2.6 12.2.5 12.2.5.1 12.2.6]

514.2.4 Temperature-Sensing Elements. Fixed temperature-sensing elements other than the fusible metal alloy type shall be permitted to remain continuously in service, provided they are inspected and cleaned, or replaced if necessary in accordance with the manufacturer’s instructions, every 12 months or more frequently to ensure proper operation of the system. [NFPA 96:4.4.2.7 12.2.7]

514.2.5 Certification. Where required, certificates of inspection and maintenance shall be forwarded to the Authority Having Jurisdiction. [NFPA 96:4.4.2.8 12.2.8]

514.3 Inspection for Grease Buildup. The entire exhaust system shall be inspected for grease buildup by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction and in accordance with Table 514.3. [NFPA 96:4.4.4 12.4]

514.4 Cleaning of Exhaust Systems. If, upon inspection, the exhaust system is found to be contaminated with deposits from grease-laden vapors, the contaminated portions of the exhaust system shall be cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:4.6.4 12.6.1]

514.4.1 Measurement System. A measurement system of deposition shall be established to trigger a need to clean when the exhaust system is inspected at the frequencies in Table 514.3. [NFPA 96:4.6.4.4 12.6.1.1]

514.4.1.1 Combustible Contaminants. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be
514.4.2 Cleaning. A grease depth gauge comb as shown in Figure 514.4.1.2 shall be placed upon the surface to measure grease depth. [NFPA 96:4.4.1.4.1.2 12.6.1.1.1]

514.4.3 Cleaning Method. Where a measured depth of 0.078 of an inch (2000 µm) is observed, the surfaces shall be cleaned in accordance with Section 514.4. [NFPA 96:11.6.2 12.6.1.3]

514.4.4 Fire Suppression System. Components of the fire suppression system shall not be rendered inoperable during the cleaning process. [NFPA 96:11.6.4 12.6.4]

514.4.5 Inoperable. Fire-extinguishing systems shall be permitted to be rendered inoperable during the cleaning process where serviced by properly trained and qualified persons. [NFPA 96:4.4.6.6 12.6.5]

514.4.6 Solvents/Cleaning Aids. Flammable solvents or other flammable cleaning aids shall not be used. [NFPA 96:4.4.6.6 12.6.6]

514.4.7 Cleaning Chemicals. Cleaning chemicals shall not be applied on fusible links or other detection devices of the automatic extinguishing system. [NFPA 96:4.4.6.7 12.6.7]

514.4.8 Coating. After the exhaust system is cleaned, it shall not be coated with powder or other substance. [NFPA 96:4.4.6.8 12.6.8]

514.4.9 Access Panels and Cover Plates. When cleaning procedures are completed, all access panels (doors) and cover plates shall be restored to their normal operational condition. [NFPA 96:4.4.6.9 12.6.9]

514.4.10 Date of Inspection. When an access panel is removed, a service company label or tag preprinted with the name of the company and giving the date of inspection or cleaning shall be affixed near the affected access panels. [NFPA 96:4.4.6.10 12.6.10]

514.4.11 Airflow. Dampers and diffusers shall be positioned for proper airflow. [NFPA 96:4.4.6.11 12.6.11]

514.4.12 Operable State. When cleaning procedures are completed, all electrical switches and system components shall be returned to an operable state. [NFPA 96:4.4.6.12 12.6.12]

514.4.13 Certification of Service. When an exhaust system is inspected or cleaned, a certificate showing the name of the servicing company, the name of the person performing the work, and the date of inspection or cleaning shall be maintained on the premises. [NFPA 96:4.4.6.13 12.6.13]

514.4.14 Report Provided. After cleaning or inspection is completed, the exhaust cleaning company and the person performing the work at the location shall provide the owner of the system with a written report that also specifies areas that were inaccessible or not cleaned. [NFPA 96:4.4.6.14 12.6.14]

514.4.15 Unclean Area. Where required, certificates of inspection and cleaning and reports of areas not cleaned shall be submitted to the Authority Having Jurisdiction. [NFPA 96:4.4.6.15 12.6.15]

514.4.16 Metal Containers. Metal containers used to collect grease drippings shall be inspected or emptied at least weekly. [NFPA 96:4.4.6.16 12.6.16]

514.5 Cooking Equipment Maintenance. Inspection and servicing of the cooking equipment shall be made at least annually by properly trained and qualified persons. [NFPA 96:4.7.4 12.7.1]

514.5.1 Cleaning. Cooking equipment that collects grease below the surface, behind the equipment, or in cooking equipment flue gas exhaust, such as griddles, deep-fat fryers, or charbroilers, shall be inspected and, if found with grease accumulation, cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:4.7.2 12.7.2]

515.1 Cooking Equipment. Cooking equipment shall be approved based on one of the following criteria:

(1) Listings by a testing laboratory.
(2) Test data acceptable to the Authority Having Jurisdiction. [NFPA 96:4.13.1.1]

515.1.1 Installation. All listed appliances shall be installed in accordance with the terms of their listings and the manufacturer's instructions. Solid fuel used for flavoring within a gas-operated appliance shall be in a solid fuel holder (smoker box) that is listed with the equipment. [NFPA 96:4.13.1.2, 12.7.1.1]

515.1.1.1 Re-evaluation. Cooking appliances requiring protection shall not be moved, modified, or rearranged without prior re-evaluation of the fire-extinguishing system by the system installer or servicing agent, unless otherwise allowed by the design of the fire-extinguishing system. A solid fuel holder shall not be added to an existing appliance until the fire-extinguishing system has been evaluated by the fire-extinguishing system service provider. [NFPA 96:4.2.1.2, 13.1.2.2.1]

515.1.2 Prior Location. The fire-extinguishing system shall not require re-evaluation where the cooking appliances
are moved for the purposes of maintenance and cleaning, provided the appliances are returned to approved design location prior to cooking operations, and any disconnected fire-extinguishing system nozzles attached to the appliances are reconnected in accordance with the manufacturer’s listed design manual. [NFPA 96:14.2.4.3 13.1.2.3]

515.1.1.3 Minimum Space. All deep-fat fryers shall be installed with at least a 16 inch (406 mm) space between the fryer and surface flames from adjacent cooking equipment. [NFPA 96:14.2.1-14.2.3]

515.1.1.4 Space Not Required. Where a steel or tempered glass baffle plate is installed at a minimum 8 inches (203 mm) in height between the fryer and surface flames of the adjacent appliance, the requirement for a 16 inch (406 mm) space shall not apply. [NFPA 96:14.2.1-14.2.3]

515.1.1.5 Minimum Height. If the fryer and the surface flames are at different horizontal planes, the minimum height of 8 inches (203 mm) shall be measured from the higher of the two. [NFPA 96:14.2.1-14.2.3]

515.2 Operating Controls. Deep-fat fryers shall be equipped with a separate high-limit control in addition to the adjustable operating control (thermostat) to shut off fuel or energy when the fat temperature reaches 475°F (246°C) at 1 inch (25.4 mm) below the surface. [NFPA 96:14.2.1-14.2.3]

516.1 General Requirements. Recirculating systems containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

1. The clearance requirements of Section 507.4 through Section 507.4.3.3.
2. A hood complying with the requirements of Section 508.0.
3. Grease removal devices complying with Section 509.0.
4. The air movement requirements of Section 511.2.1 and Section 511.2.2.
5. Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
6. Fire-extinguishing equipment complying with the requirements of Section 513.0.

Exception: Fire-extinguishing equipment in accordance with Section 513.1 and Section 513.5.

7. The use and maintenance requirements of Section 514.0.
8. The minimum safety requirements of Section 515.0.
9. All the requirements of Section 516.0. [NFPA 96:14.3.1]

516.2 Design Restrictions. All recirculating systems shall comply with the requirements of Section 516.2.1 through Section 516.2.9. [NFPA 96:14.3.2]

516.2.1 Gas/Electrically Fueled Cooking Appliances. Only gas-fueled or electrically fueled cooking appliances shall be used. Listed gas-fueled equipment designed for use with specific recirculating systems shall have the flue outlets connected in the intended manner. Gas-fueled appliances shall have a minimum 18 inches (457 mm) clearance from the flue outlet to the filter inlet in accordance with Section 509.2.2 through Section 509.2.2.3 and shall meet the installation requirements of this code, NFPA 54 or NFPA 58. (NFPA 96:14.3.1-14.3.3)

516.2.2 Recirculation. Recirculating systems shall be listed with a testing laboratory in accordance with UL 710B or equivalent. [NFPA 96:14.3.4]

516.2.3 Protection. Cooking appliances that require protection and that are under a recirculating hood shall be protected by either the integral fire protection system in accordance with UL 710B or a system in accordance with Section 513.0. [NFPA 96:14.3.4]

516.2.4 Maximum Limits. A recirculating system shall not use cooking equipment that exceeds that recirculating system’s labeled maximum limits for that type of equipment, stated in maximum energy input, maximum cooking temperature, and maximum square area of cooking surface or cubic volume of cooking cavity. [NFPA 96:14.3.5]

516.2.5 Label. The listing label shall show the type(s) of cooking equipment tested and the maximum limits specified in Section 516.2.4. [NFPA 96:14.3.6]

516.2.6 Fire Damper. A fire-actuated damper shall be installed at the exhaust outlet of the system. [NFPA 96:14.3.7]

516.2.8 Power Supply. The power supply of any electrostatic precipitator (ESP) shall be of the “cold spark,” ferroresonant type in which the voltage falls off as the current draw of a short increases. [NFPA 96:14.3.8]

516.2.9 Listing Evaluation. Listing evaluation shall include the following:

1. Capture and containment of vapors at published and labeled airflow.
2. Grease discharge at the exhaust outlet of the system not to exceed an average of 2.9 E-09 (oz/in²) (5.0 E-06 kg/m²) of exhausted air sampled from that equipment at maximum amount of product that is capable of being processed over a continuous 8 hour test with the system operating at its minimum listed airflow.
3. Listing and labeling of clearance to combustibles from all sides, top, and bottom.
4. Electrical connection in the field in accordance with NFPA 70.
5. Interlocks on all removable components that lie in the path of airflow within the unit to ensure that they are in place during operation of the cooking appliance. (NFPA 96:14.3.9)

516.3 Interlocks. The recirculating system shall be provided with interlocks of all critical components and operations as indicated in Section 516.3.1 through Section 516.3.3.1 such that, if any of these interlocks are interrupted, the cooking appliance will not be able to operate. [NFPA 96:14.3.10]

516.3.1 Airflow Sections. All closure panels encompassing airflow sections shall have interlocks to ensure that the
panels are in place and fully sealed. [NFPA 96: 14.3.2 14.3.2]

516.3.2 Filter Component. Each filter component (grease and odor) shall have an interlock to prove the component is in place. [NFPA 96: 14.3.3 14.3.3]

516.3.3 ESP Interlocks. Each ESP shall have a sensor to prove its performance is as designed, with no interruption of the power to exceed 2 minutes. [NFPA 96: 14.3.4.1 14.3.4.1]

516.3.3.1 Manual Reset. The sensor shall be a manual reset device or circuit. [NFPA 96: 14.3.4.2 14.3.4.2]

516.3.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system's normal operating flow or 10 percent below its listed minimum rating, whichever is lower. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96: 14.3.5.1-14.3.5.3]

516.4 Location and Application Restrictions. The location of recirculating systems shall be approved by the Authority Having Jurisdiction. Items to be reviewed in the fire risk assessment shall include, but not be limited to, life safety, combustibility of surroundings, proximity to air vents, and total fuel load. [NFPA 96: 14.4.1-14.4.2 14.4.1-14.4.2]

516.5 Additional Fire Safety Requirements. In addition to the appliance nozzle(s), a recirculating system shall be listed with the appropriate fire protection for grease filters, grease filtration, odor filtration units, and ductwork, where applicable. [NFPA 96: 14.5.1]

516.5.1 Installation Downstream. In addition to any other fire-extinguishing system activation device, there shall be a fire-extinguishing system activation device installed downstream of any ESP. [NFPA 96: 14.5.2]

516.5.2 Locations. The requirements of Section 513.2 shall also apply to recirculating system locations. [NFPA 96: 14.5.3 14.5.3]

516.6 Use and Maintenance. Automatic or manual covers on cooking appliances, especially fryers, shall not interfere with the application of the fire suppression system. [NFPA 96: 14.6.1]

516.6.1 Manufacturer's Instructions. All filters shall be cleaned or replaced in accordance with the manufacturer's instructions. [NFPA 96: 14.6.2 14.6.2]

516.6.2 Cleaning Schedule. All ESPs shall be cleaned a minimum of once per week and according to the manufacturer’s cleaning instructions. [NFPA 96: 14.6.3 14.6.3]

516.6.3 Hood Plenum and Blower Section Cleaning Schedule. The entire hood plenum and the blower section shall be cleaned a minimum of once every 3 months. [NFPA 96: 14.6.4 14.6.4]

516.6.4 Inspection of Safety Interlocks. Inspection and testing of the total operation and all safety interlocks in accordance with the manufacturer’s instructions shall be performed by qualified service personnel a minimum of once every 6 months or more frequently if required. [NFPA 96: 14.6.5 14.6.5]

516.6.5 Inspection. Fire-extinguishing equipment shall be inspected in accordance with Section 514.2. [NFPA 96: 14.6.6]

516.6.6 Maintenance Log. A signed and dated log of maintenance as performed in accordance with Section 516.6.3 and Section 516.6.4 shall be available on the premises for use by the Authority Having Jurisdiction. [NFPA 96: 14.6.7]

517.1 Venting Application. Venting requirements of solid-fuel cooking operations shall be determined in accordance with Section 517.1.1 through Section 517.1.6. [NFPA 96: 14.4.15.1]

517.1.2 System Compliance. Where the solid-fuel cooking equipment has a self-contained top, is the appliance to be vented in an isolated space (except for a single water heater with its own separate vent), has a separate makeup air system, and is provided with supply and return air (not supplied or returned from other spaces), the system shall comply with Section 517.4 and Section 517.6. [NFPA 96: 14.4.2 15.1.2]

517.1.3 Makeup Air System. Where the solid-fuel cooking equipment is located in a space with other vented equipment, all vented equipment shall have an exhaust system interlocked with a makeup air system for the space per Section 517.6. [NFPA 96: 14.4.3 15.1.4]

517.1.4 Natural Draft Ventilation Systems. Natural draft ventilation systems and power-exhausted ventilation systems shall comply with Section 517.3, Section 517.4, and Section 517.6. [NFPA 96: 14.4.4 15.1.5]

517.1.5 Opening Requirements. Where a solid-fuel cooking appliance allows effluent to escape from the appliance opening, this opening shall be covered by a hood and an exhaust system that meets the requirements of Section 517.3, Section 517.4, and Section 517.6. [NFPA 96: 14.4.5 15.1.6]

517.1.6 Spark Arresters. Solid-fuel cooking operations shall have spark arresters to minimize the passage of airborne sparks and embers into plenums and ducts. Where the solid-fuel cooking operation is not located under a hood, a spark arrester shall be provided to minimize the passage of sparks and embers into flues and chimneys. [NFPA 96: 14.4.6, 14.4.7 15.1.7, 15.1.8]

517.2 Location of Appliances. Every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. [NFPA 96: 14.4.2 15.2.1]

517.2.1 Prohibited Location. Solid-fuel cooking appliances shall not be installed in confined spaces. [NFPA 96: 14.4.2 15.2.2]

Exception: Solid-fuel cooking appliances listed for installation in confined spaces such as alcoves shall be installed in
accordance with the terms of the listing and the manufacturer’s instructions. [NFPA 96:14.2.3 15.2.3]

517.2.2 Flammable Vapors. Solid-fuel cooking appliances shall not be installed in any location where gasoline or any other flammable vapors or gases are present. [NFPA 96:14.2.4 15.2.4]

517.3 Hoods for Solid-Fuel Cooking. Hoods shall be sized and located in a manner capable of capturing and containing all the effluent discharging from the appliances. The hood and its exhaust system shall comply with the requirements of Section 508.0 through Section 513.0. [NFPA 96:14.3.1-14.3.2-15.3.1-15.3.2]

517.3.1 Separation. Except as permitted in Section 517.3.1.1, exhaust systems serving solid-fuel cooking equipment in buildings, including gas or electrically operated equipment, shall be separate from all other exhaust systems. [NFPA 96:14.3.3-15.3.3]

Exception: Cooking equipment not requiring automatic fire-extinguishing equipment (per Section 513.0) shall be permitted to be installed under a common hood with solid-fuel cooking equipment that is served by a duct system separate from other exhaust systems. [NFPA 96:14.3.6-15.3.5]

517.3.1.1 Equipment with Solid Fuel for Flavoring. Gas-operated equipment utilizing solid fuel for flavoring that meets all the following conditions shall not be required to have a separate exhaust system:

(1) The solid fuel holder (smoker box) shall be listed with the gas-operated equipment.
(2) The solid fuel holder shall be located underneath the gas burners.
(3) Spark arresters conforming with Section 517.1.6 shall be provided.
(4) The maximum quantity of solid fuel consumed shall not exceed 1 pound (0.45 kg) per hour per 100 000 Btu/h (29 kW) of gas burner capacity.
(5) The gas-operated equipment shall be protected by a fire suppression system listed for the equipment, including the solid fuel holder.
(6) Gas-operated equipment with integral solid fuel holder(s) intended for flavoring, such as radiant charbroiler(s), shall comply simultaneously with the requirements of UL 300 that address the gas radiant charbroiler(s) and mesquite wood charbroiler(s).
(7) A fire suppression system nozzle(s) shall be installed to protect the solid fuel holder.
(8) The fire suppression system shall be designed and installed to protect the entire cooking operation.
(9) Each solid fuel holder shall be limited to a size of 150 cubic inches (2.5 L), with no dimension to exceed 20 inches (508 mm).
(10) A maximum of one solid fuel holder for each 100 000 Btu/h (29 kW), or portion thereof, of burner capacity shall be permitted.
(11) Solid fuel shall be immersed in water for a continuous period of at least 24 hours immediately prior to being placed in the cooking equipment.
(12) The inspection frequency shall be the same as for solid fuel cooking operations in Table 514.3. [NFPA 96:14.3.4 15.3.4]

517.4 Exhaust Systems for Solid-Fuel Cooking. Where a hood is not required, in buildings where the duct system is three stories or less in height, a duct complying with Section 510.0 shall be provided. [NFPA 96:14.4.1]

517.4.1 Hood. If a hood is used in buildings where the duct system is three stories or less in height, the duct system shall comply with Section 510.0. [NFPA 96:14.4.1-15.4.1]

517.4.2 Building Exceeding Four Stories. A listed or approved grease duct system that is four stories in height or greater shall be provided for solid-fuel cooking exhaust systems. [NFPA 96:14.4.2 15.4.2]

517.4.3 Prohibited. Wall terminations of solid-fuel exhaust systems shall be prohibited. [NFPA 96:14.4.4 15.4.4]

517.5 Grease Removal Devices for Solid-Fuel Cooking. Grease removal devices shall be constructed of steel or stainless steel or be approved for solid-fuel cooking. [NFPA 96:14.5.1-15.5.1]

517.5.1 Spark Arrester Devices. If airborne sparks and embers can be generated by the solid fuel cooking operation, spark arrester devices shall be used prior to using the grease removal device, to minimize the entrance of these sparks and embers into the grease removal device and into the hood and the duct system. [NFPA 96:14.5.2 15.5.2]

517.5.2 Filters. Filters shall be a minimum of 4 feet (1219 mm) above the appliance cooking surface. [NFPA 96:14.5.3 15.5.3]

517.6 Air Movement for Solid-Fuel Cooking. Exhaust system requirements shall comply with Section 511.0 for hooded operation or shall be installed in accordance with the manufacturer’s recommendations for unhooded applications. [NFPA 96:14.6.1-15.6.1]

517.6.1 Replacement Air. A replacement or makeup air system shall be provided to ensure a positive supply of replacement air at all times during cooking operations. [NFPA 96:14.6.2 15.6.2]

517.6.2 Operation. Makeup air systems serving solid-fuel cooking operations shall be interlocked with the exhaust air system and powered, if necessary, to prevent the space from attaining a negative pressure while the solid-fuel appliance is in operation. [NFPA 96:14.6.3 15.6.3]

517.7 Fire-Extinguishing Equipment for Solid-Fuel Cooking. Solid-fuel cooking appliances that produce grease-laden vapors shall be protected by listed fire-extinguishing equipment.

Exception: Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid
masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require fixed automatic fire-extinguishing equipment. [NFPA 96:14.7.1.4, 14.7.2 15.7.1, 15.7.2]

517.7.1 Grease Removal Devices, Hoods, and Duct Systems. Listed fire-extinguishing equipment shall be provided for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:14.7.3 15.7.3]

Exception: Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require automatic fire-extinguishing equipment for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:14.7.4 15.7.4]

517.7.2 Listed Fire-Extinguishing Equipment. Listed fire-extinguishing equipment for solid-fuel-burning cooking appliances, where required, shall comply with Section 513.0 and shall use water-based agents. [NFPA 96:14.7.5 15.7.5]

517.7.3 Rating and Design. Fire-extinguishing equipment shall be rated and designed to extinguish solid-fuel cooking fires. The fire-extinguishing equipment shall be of sufficient size to totally extinguish fire in the entire hazard area and prevent reignition of the fuel. [NFPA 96:14.7.6, 14.7.7 15.7.6, 15.7.7]

517.7.4 Listing/Class. All solid fuel appliances (whether under a hood or not) with fireboxes of 5 cubic feet (0.14 m$^3$) volume or less shall have at least a listed 2-A rated water-spray fire extinguisher or a 1.6 gallon (6.1 L) wet chemical fire extinguisher listed for Class K fires in accordance with NFPA 10 with a maximum travel distance of 20 feet (6096 mm) to the appliance. [NFPA 96:14.7.8 15.7.8]

517.7.5 Fixed-Water Pipe System. Solid fuel appliances with fireboxes exceeding 5 cubic feet (0.14 m$^3$) shall be provided with a fixed-water pipe system with a hose in the kitchen capable of reaching the firebox. The hose shall be equipped with an adjustable nozzle capable of producing a fine to medium spray or mist. The nozzle shall be of the type that cannot produce a straight stream. The system shall have a minimum operating pressure of 40 psi (276 kPa) and shall provide a minimum of 5 gallons per minute (gpm) (0.3 L/s). [NFPA 96:14.7.9.1 – 14.7.9.2 15.7.9.1 – 15.7.9.2]

517.7.6 Fuel Storage. All fuel storage areas for cooking operations in buildings shall be provided with a sprinkler system meeting the requirements of NFPA 13 except as permitted in accordance with the following:

(1) Where acceptable to the Authority Having Jurisdiction, fuel storage areas shall be permitted to be protected with a fixed water pipe system with a hose capable of reaching all parts of the area.

(2) In lieu of the sprinkler system outlined in Section 517.6, a listed 2-A rated water spray fire extinguisher or a 1.6 gallon (6.1 L) wet chemical fire extinguisher listed for Class K fires in accordance with NFPA 10 with a maximum travel distance of 20 feet (6096 mm) to the solid fuel piles shall be permitted to be used for a solid fuel pile, provided that the fuel pile does not exceed 5 cubic feet (0.14 m$^3$) volume. [NFPA 96:14.9.2.8 – 14.9.2.8.2 15.9.2.8, 15.9.2.8.2, 15.9.2.8.3]

517.7.7 Auxiliary Fuel. In addition to the requirements of Section 517.7.4 through Section 517.8.3, where any solid-fuel cooking appliance is also provided with auxiliary electric, gas, oil, or other fuel for ignition or supplemental heat and the appliance is also served by any portion of a fire-extinguishing system complying with Section 513.0, such auxiliary fuel shall be shut off on actuation of the fire-extinguishing system. [NFPA 96:14.7.11 15.7.11]

517.8 Other Safety Requirements. Metal-fabricated solid-fuel cooking appliances shall be listed for the application where produced in practical quantities or shall be approved by the Authority Having Jurisdiction. Where listed, metal-fabricated solid-fuel cooking appliances shall be installed in accordance with the terms of their listings and with the applicable requirements of this chapter. [NFPA 96:14.9.4.1, 14.9.4.2 15.9.4.1, 15.9.4.2]

517.8.1 Site-Built Solid Fuel Cooling Appliances. Site-built solid-fuel cooking appliances shall be submitted for approval to the Authority Having Jurisdiction before being considered for installation. All units submitted to the Authority Having Jurisdiction shall be installed, operated, and maintained in accordance with the approved terms of the manufacturer’s instructions and any additional requirements set forth by the Authority Having Jurisdiction. [NFPA 96:14.9.4.3.1 – 14.9.4.3.2, 15.9.4.3.1 – 15.9.4.3.2]

517.8.2 Additional Devices. Except for the spark arresters required in Section 517.1.6, there shall be no additional devices of any type in any portion of the appliance, flue pipe, and chimney of a natural draft solid-fuel operation. [NFPA 96:14.9.4.4 15.9.4.4]

517.8.3 Prohibited. No solid fuel cooking device of any type shall be permitted for deep fat frying involving more than 1 quart (qt) (1 L) of liquid shortening, nor shall any solid fuel cooking device be permitted within 3 feet (914 mm) of any deep fat frying unit. [NFPA 96:14.9.4.5 15.9.4.5]

518.1 General. Downdraft appliance ventilation system containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

(1) The clearance requirements of Section 507.4 through Section 507.4.3.3.

(2) The primary collection means designed for collecting cooking vapors and residues complying with the requirements of Section 508.0.

(3) Grease removal devices complying with Section 509.0.

(4) Special-purpose filters as listed in accordance with UL 1046 or CAN/ULC-S649 for Canada.

(5) Exhaust ducts complying with Section 510.0.

(6) The air movement requirements of Section 511.2.1 and Section 511.2.2.

(7) Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.

(8) Fire-extinguishing equipment complying with the requirements of Section 513.0, and as specified in Section 518.3.
The use and maintenance requirements of Section 514.0.  
The minimum safety requirements of Section 515.0. [NFPA 96:16.1.1]

518.2 Ventilation System. The downdraft appliance ventilation system shall be capable of capturing and containing all the effluent discharge from the appliance(s) it is serving. [NFPA 96:16.1.2]

518.3 Fire-Extinguishing Equipment. For fire-extinguishing equipment on downdraft appliance ventilation systems, the following shall apply:

(1) Cooking surface, duct, and plenum protection shall be provided.
(2) At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer’s listing.
(3) A fusible link or heat detector shall be provided for each protected cooking appliance located in the plenum area of that appliance or in accordance with the extinguishing system manufacturer’s listing.
(4) A manual activation device shall be provided as part of each appliance at a height acceptable to the Authority Having Jurisdiction.
(5) Portable fire extinguishers shall be provided in accordance with Section 513.10 through Section 513.11. [NFPA 96:16.2]

518.3.1 Integral Fire-Extinguishing System. A listed downdraft appliance ventilation system employing an integral fire-extinguishing system including detection systems that has been evaluated for grease and smoke capture, fire extinguishing, and detection shall be considered as complying with Section 518.3. [NFPA 96:16.2.1]

518.3.2 Interlocks. The downdraft appliance ventilation system shall be provided with interlocks such that the cooking fuel supply will not be activated unless the exhaust and supply air systems have been activated. [NFPA 96:16.2.2]

518.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. [NFPA 96:16.3.1]

518.4.1 Interlocks. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system’s normal operating flow or less than 10 percent its listed minimum rating, whichever is lower. [NFPA 96:16.3.2]

518.4.2 Manual Reset. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96:16.3.3]

518.5 Surface Materials. Any surface located directly above the cooking appliance shall be of noncombustible or limited-combustible materials. [NFPA 96:16.4]

### TABLE 1701.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN/ULC-S646-2010 (R2016)</td>
<td>Exhaust Hoods and Related Controls for Commercial and Institutional Cooking Equipment</td>
<td>Exhaust Hoods</td>
<td>508.2, 508.2.1</td>
</tr>
<tr>
<td>CAN/ULC-S649-2006</td>
<td>Grease Filters for Commercial and Institutional Kitchen Exhaust Systems</td>
<td>Grease Filters</td>
<td>509.1, 509.1.1, 518.1</td>
</tr>
<tr>
<td>CAN/ULC-S662-2009 (R2016)</td>
<td>Factory-Built Grease Ducts</td>
<td>Grease Ducts</td>
<td>510.5.2, 510.5.3(1)</td>
</tr>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>513.6.1</td>
</tr>
<tr>
<td>UL 710A</td>
<td>Rooftop Grease and Oil Collection and Containment Systems</td>
<td>Commercial Kitchens</td>
<td>510.9.1</td>
</tr>
<tr>
<td>UL 710G-2006</td>
<td>Ultraviolet Radiation Systems For Use In The Ventilation Control of Commercial Cooking Operations</td>
<td>Exhaust Hoods</td>
<td>508.2.1</td>
</tr>
</tbody>
</table>

Note: The NFPA and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Chapter 5 is being revised to the latest edition of NFPA 96-2021.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC
 Amend proposal as follows:

507.2.6 Used in Other Applications. Cooking equipment used in fixed, mobile, or temporary concessions, such as trucks, buses, trailers, pavilions, tents, or any form of roofed enclosure, shall comply with this chapter. {NFPA 96:1.1.3}

507.4.4 Factory Built. Factory-built grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an “F” and a “T” rating equal to the fire resistance rating of the assembly being penetrated from the point at which the duct penetrates a ceiling, wall, or floor to the outlet terminal. [NFPA 96:4.3.4.4]

507.4.4.1 Listing. The factory-built grease duct protection system shall be listed in accordance with UL 2221. [NFPA 96:4.3.4.1]

507.4.4.2 Single Wall. Listed single wall factory-built grease ducts shall be permitted to be enclosed with field-applied grease duct enclosure material where the material and the assembly of duct and material are listed for that application and installed in accordance with the grease duct manufacturer’s listing and their installation instructions. [NFPA 96:4.3.4.2]

507.4.4.3 Installation. The factory-built grease duct protection system shall be installed in accordance with the manufacturer’s instructions and the listing requirements. [NFPA 96:4.3.4.3]

507.4.5 Field Applied. Field-applied grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an “F” and a “T” rating equal to the fire resistance rating of the assembly being penetrated. The surface of the field fabricated grease duct shall be continuously covered on all sides from the point at which the duct enclosure penetrates a ceiling, wall, or floor to the outlet terminal. The field-applied grease duct shall be listed in accordance with ASTM E2336 and installed in accordance with the manufacturer’s instructions and the listing requirements. [NFPA 96:4.3.2-4.3.2.2]

507.4.6 Both Field-Applied and Factory Built. Field-applied grease duct enclosures and factory-built grease duct enclosures shall demonstrate that they provide mechanical and structural integrity, resiliency, and stability when subjected to expected building environmental conditions, duct movement under general operating conditions, and duct movement due to fire conditions. [NFPA 96:4.3.5]

507.4.6.2 Specification. The specifications of material, gauge, and construction of the duct used in the testing and listing of field-applied grease duct enclosures and factory-built grease duct enclosures shall be included as minimum requirements in their listing and installation documentation. [NFPA 96:4.3.6]

507.4.6.3 Clearance Options. The following clearance options for which field-applied grease duct enclosures and factory-built grease duct enclosures have been successfully evaluated shall be clearly identified in their listing and installation documentation and on their labels:

(1) Open combustible construction clearance at manufacturer’s requested dimensions.

(2) Closed combustible construction clearance at manufacturer’s requested dimensions, with or without specified ventilation.

(3) Rated shaft clearance at manufacturer’s requested dimensions, with or without specified ventilation. [NFPA 96:4.3.7]

507.5 Drawings. For cooking operations in buildings, a drawing(s) of the exhaust system installation along with copies of operating instructions for subassemblies and components used in the exhaust system, including electrical schematics, shall be kept on the premises and made available on request to the Authority Having Jurisdiction and maintenance persons. [NFPA 96:4.6.4]

508.2 Listed Type I Hood Assemblies. Listed hood assemblies shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. Listed hood assemblies shall be tested in accordance with UL 710—CAN/ULC-S646 for Canada, or equivalent. {NFPA 96:5.4.1, 5.4.2}

508.2.1 Listed Ultraviolet Hoods. Listed ultraviolet hoods shall be installed and maintained in accordance with the terms of their listing and the manufacturer’s instructions. Duct systems connected to ultraviolet hoods shall comply with Section 510.0. Ultraviolet hoods shall be tested and listed in accordance with UL 710 and CAN/ULC-S646 for Canada. {NFPA 96:5.5 – 5.5.2}

509.1 Grease Removal Devices. Listed grease filters or other listed grease removal devices intended for use with commercial cooking operations shall be provided. Listed grease filters and grease removal devices that are removable but not an integral component of a specific listed exhaust hood shall be listed in accordance with UL 1046 or CAN/ULC-S649 for Canada and shall be designated on the filter. {NFPA 96:6.1.1, 6.1.2}

509.1.1 Grease Filters, Mesh-Type. Mesh filters shall not be used unless evaluated as an integral part of a listed exhaust hood or listed in conjunction with a primary filter in accordance with UL 1046 or CAN/ULC-S649 for Canada. {NFPA 96:6.1.3}

510.1.3 Duct Installation. All ducts shall be installed with a minimum slope of ¼ inch per linear foot on horizontal runs up to 75 feet (22 860 mm) and a minimum slope of 1 inch per linear foot on horizontal runs greater than 75 feet (22 860 mm). Factory-built grease ducts shall be permitted to be installed at a lesser slope in accordance with the listing and the manufacturer’s instructions. All horizontal ducts shall be provided with access in accordance with Section 510.3.3.
Drains shall be provided at low points in horizontal ducts. Where provided, drains shall be continuously welded to the exhaust duct or in accordance with the terms of the listing and the manufacturer’s installation manual.

All ducts shall be installed without forming dips or traps. In manifold (common duct) systems, the lowest end of the main duct shall be connected flush on the bottom with the branch duct. [NFPA 96:7.1.5-7.1.5.5]

510.1.4 Accessibility. Openings required for accessibility shall comply with Section 510.3 through Section 510.3.2. [NFPA 96:7.1.6]

510.1.5 Sign. A sign stating the following shall be placed on all access panels: ACCESS PANEL – DO NOT OBSTRUCT [NFPA 96:7.1.7]

510.1.7 Type I Exhaust Duct Systems. Listed grease ducts shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. [NFPA 96:7.1.8]

510.3.2 Access for Cleaning and Inspection. Exhaust fans with ductwork connected to both sides shall have access for cleaning and inspection within 3 feet (914 mm) of each side of the fan. Wall-mounted exhaust fans shall have access for cleaning and inspection within 3 feet (914 mm) of the exhaust fan. [NFPA 96:7.3.8, 7.3.9]

510.4 Listed Grease Ducts. Listed grease ducts shall be installed in accordance with the terms of their listing and the manufacturer’s instructions. [NFPA 96:7.1.8]

510.5.2 Factory-Built Grease Ducts. Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to incorporate nonwelded joint construction in accordance with their listings. [NFPA 96:7.5.1.2]

510.5.3 Installation. All seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid-tight continuous external weld. [NFPA 96:7.5.2.1]

Exceptions:
(1) Factory-built grease ducts listed in accordance with UL 1978 or CAN/ULC-S662 for Canada shall be permitted to incorporate nonwelded joint construction in accordance with their listings. [NFPA 96:7.5.2.1.1]
(2) Duct-to-hood collar connections as shown in Figure 510.5.3 shall not require a liquidtight continuous external weld. [NFPA 96:7.5.2.2]

510.5.3.2 Welded Duct Connection. Acceptable duct-to-duct connection shall be as follows:
(1) Telescoping joint, as shown in Figure 510.5.3.2(1).
(2) Bell-type joint, as shown in Figure 510.5.3.2(2).
(3) Flange with edge weld, as shown in Figure 510.5.3.2(3).
(4) Flange with lap joint weld, as shown in Figure 510.5.3.2(4). [NFPA 96:7.5.5.1]

510.6 Exterior Installations. For cooking operations in buildings, the exterior portion of the ductwork shall be vertical wherever possible and shall be installed and supported on the exterior of a building. Bolts, screws, rivets, and other mechanical fasteners shall not penetrate duct walls. Clearance of ducts shall comply with Section 507.4 through Section 507.4.3.3. [NFPA 96:7.6.1, 7.6.3, 7.6.4]

510.6.1 Weather Protection. All ducts shall be protected on the exterior by paint or other suitable weather-protective coating. Ducts constructed of stainless steel shall not be required to have additional paint or weather-protective coatings. Ductwork subject to corrosion shall have minimal contact with the building surface. [NFPA 96:7.6.5-7.6.7]

510.9.1 Rooftop Terminations. Rooftop terminations shall be arranged with or provided with the following:
(1) A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.
(2) A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.
(3) A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.
(4) The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.
(5) A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.
(6) Grease collection systems that are listed in accordance with UL 710A and meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).
(7) A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.
(8) A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
(a) Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
(b) The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
Other approved fan, provided it meets all of the following criteria:

(a) The fan meets the requirements of Section 510.9.1(3) and Section 511.3.
(b) Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.3)
(c) Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96:7.8.2.1]

511.1.3.2 Within the Building. Fans installed within the building shall be in accordance with the following:

(1) Located in an accessible area of adequate size to allow for service or removal. [NFPA 96:8.1.4.2]
(2) Flexible connectors shall not be used. [NFPA 96:8.1.4.6]
(3) Exhaust fans shall have a drain directed to a readily accessible and visible grease receptacle not to exceed 1 gallon (4 L). [NFPA 96:8.1.4.7]

511.1.3 Duct Systems. Where the duct system connected to the fan is in an enclosure, the space or room in which the exhaust fan is located shall have the same fire resistance rating as the enclosure. The fan shall be connected to the exhaust duct by flanges securely bolted as shown in Figure 511.1.2(1) through Figure 511.1.2(4) or by a system specifically listed for such use. [NFPA 96:8.1.4.3, 8.1.4.5]

511.2.3 Exhaust Fan Operation. A hood exhaust fan(s) shall continue to operate after the extinguishing system has been activated unless fan shutdown is required by a listed component of the ventilation system or by the design of the extinguishing system. The hood exhaust fan shall start upon actuation of the extinguishing system if the exhaust fan and all cooking equipment served by the fan have been shut down, unless a fan shutdown is required by a listed component of the ventilation system or by the listing of the extinguishing system. The exhaust fan shall be provided with a means so that the fan is activated when any heat-producing cooking appliance under the hood is turned on. [NFPA 96:8.2.3.1 – 8.2.3.3]

513.4 Fuel and Electric Power Shutoff. Upon actuation of any fire-extinguishing system for a cooking operation, all sources of fuel and electric power that produce heat to all equipment protected by the system shall automatically shut off. [NFPA 96:10.4.1]

513.4.2 Protection Not Required. Gas appliances not requiring protection but located under the same ventilation equipment where protected appliances are located, shall also be automatically shut off upon actuation of the extinguishing system. [NFPA 96:10.4.3]

513.4.3 Manual Reset. Shutoff devices shall require manual resetting prior to fuel or power being restored. [NFPA 96:10.4.4]

513.5 Manual Activation. All systems shall have both automatic and manual methods of actuation. At least one manual actuation device shall be located in a means of egress or at a location acceptable to the Authority Having Jurisdiction.

The manual actuation device shall clearly identify the hazard protected and be provided with instructions for its use. An automatic sprinkler system shall not require a method of manual actuation. [NFPA 96:10.5.1, 10.5.1.1, 10.5.1.2, 10.5.2]

513.6 System Annunciation. Upon actuation of an automatic fire-extinguishing system, an audible alarm or visual indicator shall be provided to show that the system has actuated. [NFPA 96:10.6.1]

513.6.1 Signaling. Where a fire alarm signaling system is serving the occupancy where the extinguishing system is located, the actuation of the automatic fire-extinguishing system shall activate the fire alarm signaling system in accordance with the requirements of NFPA 72. [NFPA 96:10.6.2]

514.1 Operating Procedures. Exhaust systems shall be operated whenever cooking equipment is turned on. [NFPA 96:12.1.1]

514.1.1 Filters. Filter-equipped exhaust systems shall not be operated with filters removed. [NFPA 96:12.1.2]

514.1.2 Openings. Openings provided for replacing air exhausted through ventilating equipment shall not be restricted by covers, dampers, or any other means that would reduce the operating efficiency of the exhaust system. [NFPA 96:12.1.3]

514.1.3 Posting of Instructions. Instructions for manually operating the fire-extinguishing system shall be posted conspicuously in the kitchen and shall be reviewed with employees by the management. [NFPA 96:12.1.4.3]

514.1.4 Listing and Manufacturer's Instructions. Listed exhaust hoods shall be operated in accordance with the terms of their listings and the manufacturer's instructions. [NFPA 96:12.1.5]
514.1.5 Nonoperational. Cooking equipment shall not be operated while its fire-extinguishing system or exhaust system is nonoperational or impaired. [NFPA 96:12.1.6]

514.1.6 Secondary Control Equipment. Secondary filtration and pollution control equipment shall be operated in accordance with the terms of its listing and the manufacturer’s recommendations. [NFPA 96:12.1.7]

514.1.7 Inspection Frequency. Inspection and maintenance of “other equipment” as allowed in Section 512.3 shall be conducted by properly trained and qualified persons at a frequency determined by the manufacturer’s instructions or the equipment listing. [NFPA 96:12.1.8]

514.2 Inspection, Testing, and Maintenance. Maintenance of the fire-extinguishing systems and listed exhaust hoods containing a constant or fire-activated water system that is listed to extinguish a fire in the grease removal devices, hood exhaust plenums, and exhaust ducts shall be made by properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction at least every 6 months. [NFPA 96:12.2.1]

514.2.1 Requirements. All actuation and control components, including remote manual pull stations, mechanical and electrical devices, detectors, and actuators, shall be tested for proper operation during the inspection in accordance with the manufacturer’s procedures. The specific inspection and maintenance requirements of the extinguishing system standards as well as the applicable installation and maintenance manuals for the listed system and service bulletins shall be followed. [NFPA 96:12.2.2, 12.2.3]

514.2.2 Fusible Links and Sprinklers. Fusible links of the metal alloy type and automatic sprinklers of the metal alloy type shall be replaced at least semiannually. [NFPA 96:12.2.4]

514.2.3 Inspection Tag. The year of manufacture and the date of installation of the fusible links shall be marked on the system inspection tag. The tag shall be signed or initialed by the installer. Detection devices that are bulb-type automatic sprinklers and fusible links other than the metal alloy type shall be examined and cleaned or replaced annually. [NFPA 96:12.2.5, 12.2.5.1, 12.2.6]

514.2.4 Temperature-Sensing Elements. Fixed temperature-sensing elements other than the fusible metal alloy type shall be permitted to remain continuously in service, provided they are inspected and cleaned, or replaced if necessary in accordance with the manufacturer’s instructions, every 12 months or more frequently to ensure proper operation of the system. [NFPA 96:12.2.7]

514.2.5 Certification. Where required, certificates of inspection and maintenance shall be forwarded to the Authority Having Jurisdiction. [NFPA 96:12.2.8]

514.3 Inspection for Grease Buildup. The entire exhaust system shall be inspected for grease buildup by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction and in accordance with Table 514.3. [NFPA 96:12.4]

514.4 Cleaning of Exhaust Systems. If, upon inspection, the exhaust system is found to be contaminated with deposits from grease-laden vapors, the contaminated portions of the exhaust system shall be cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:12.6.1]

514.4.1 Measurement System. A measurement system of deposition shall be established to trigger a need to clean when the exhaust system is inspected at the frequencies in Table 514.3. [NFPA 96:12.6.1.1]

514.4.1.1 Combustible Contaminants. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to remove combustible contaminants to a minimum of 0.002 of an inch (50 µm). [NFPA 96:12.6.1.1.1]

514.4.1.2 Gauge Comb. A grease depth gauge comb as shown in Figure 514.4.1.2 shall be placed upon the surface to measure grease depth. [NFPA 96:12.6.1.1.2]

**FIGURE 514.4.1.2**

[NFPA 96: FIGURE 12.6.1.1.2]

514.4.1.3 Cleaning Method. Where a measured depth of 0.078 of an inch (2000 µm) is observed, the surfaces shall be cleaned in accordance with Section 514.4. [NFPA 96:12.6.1.1.3]

514.4.1.4 Combustible Contaminants. Where a measured depth of 0.125 of an inch (3175 µm) is observed in a fan housing, the surfaces shall be cleaned in accordance with Section 514.4. [NFPA 96:12.6.1.1.4]

514.4.2 Removal of Contaminants. Hoods, grease removal devices, fans, ducts, and other appurtenances shall be cleaned to remove combustible contaminants prior to surfaces becoming heavily contaminated with grease or oily sludge. [NFPA 96:12.6.2]

514.4.3 Electrical Switches. At the start of the cleaning process, electrical switches that could be activated accidentally shall be locked out. [NFPA 96:12.6.3]

514.4.4 Fire Suppression System. Components of the fire suppression system shall not be rendered inoperable during the cleaning process. [NFPA 96:12.6.4]

514.4.5 Inoperable. Fire-extinguishing systems shall be permitted to be rendered inoperable during the cleaning process where serviced by properly trained and qualified persons. [NFPA 96:12.6.5]

514.4.6 Solvents/Cleaning Aids. Flammable solvents or other flammable cleaning aids shall not be used. [NFPA 96:12.6.6]

514.4.7 Cleaning Chemicals. Cleaning chemicals shall not be applied on fusible links or other detection devices of the automatic extinguishing system. [NFPA 96:12.6.7]
514.4.8 Coating. After the exhaust system is cleaned, it shall not be coated with powder or other substance. [NFPA 96:12.6.8]

514.4.9 Access Panels and Cover Plates. When cleaning procedures are completed, all access panels (doors) and cover plates shall be restored to their normal operational condition. [NFPA 96:12.6.9]

514.4.10 Date of Inspection. When an access panel is removed, a service company label or tag preprinted with the name of the company and giving the date of inspection or cleaning shall be affixed near the affected access panels. [NFPA 96:12.6.10]

514.4.11 Airflow. Dampers and diffusers shall be positioned for proper airflow. [NFPA 96:12.6.11]

514.4.12 Operable State. When cleaning procedures are completed, all electrical switches and system components shall be returned to an operable state. [NFPA 96:12.6.12]

514.4.13 Certification of Service. When an exhaust system is inspected or cleaned, a certificate showing the name of the servicing company, the name of the person performing the work, and the date of inspection or cleaning shall be maintained on the premises. [NFPA 96:12.6.13]

514.4.14 Report Provided. After cleaning or inspection is completed, the exhaust cleaning company and the person performing the work at the location shall provide the owner of the system with a written report that also specifies areas that were inaccessible or not cleaned. [NFPA 96:12.6.14]

514.4.15 Unclean Area. Where required, certificates of inspection and cleaning and reports of areas not cleaned shall be submitted to the Authority Having Jurisdiction. [NFPA 96:12.6.15]

514.4.16 Metal Containers. Metal containers used to collect grease drippings shall be inspected or emptied at least weekly. [NFPA 96:12.6.16]

514.5 Cooking Equipment Maintenance. Inspection and servicing of the cooking equipment shall be made at least annually by properly trained and qualified persons. [NFPA 96:12.7.1]

514.5.1 Cleaning. Cooking equipment that collects grease below the surface, behind the equipment, or in cooking equipment flue gas exhaust, such as griddles, deep-fat fryers, or charbroilers, shall be inspected and, if found with grease accumulation, cleaned by a properly trained, qualified, and certified person(s) acceptable to the Authority Having Jurisdiction. [NFPA 96:12.7.2]

515.1 Cooking Equipment. Cooking equipment shall be approved based on one of the following criteria:

(1) Listings by a testing laboratory.

(2) Test data acceptable to the Authority Having Jurisdiction. [NFPA 96:13.1.1]

515.1.1 Installation. All listed appliances shall be installed in accordance with the terms of their listings and the manufacturer’s instructions. Solid fuel used for flavoring within a gas-operated appliance shall be in a solid fuel holder (smoker box) that is listed with the equipment. [NFPA 96:13.1.2.1, 13.1.2.1.1]

515.1.2 Re-evaluation. Cooking appliances requiring protection shall not be moved, modified, or rearranged without prior re-evaluation of the fire-extinguishing system by the system installer or servicing agent, unless otherwise allowed by the design of the fire-extinguishing system. A solid fuel holder shall not be added to an existing appliance until the fire-extinguishing system has been evaluated by the fire-extinguishing system service provider. [NFPA 96:13.1.2.2, 13.1.2.2.1]

515.1.3 Minimum Space. All deep-fat fryers shall be installed with at least a 16 inch (406 mm) space between the fryer and surface flames from adjacent cooking equipment. [NFPA 96:13.1.2.4]

515.1.4 Space Not Required. Where a steel or tempered glass baffle plate is installed at a minimum 8 inches (203 mm) in height between the fryer and surface flames of the adjacent appliance, the requirement for a 16 inch (406 mm) space shall not apply. [NFPA 96:13.1.2.5]

515.1.5 Minimum Height. If the fryer and the surface flames are at different horizontal planes, the minimum height of 8 inches (203 mm) shall be measured from the higher of the two. [NFPA 96:13.1.2.5.1]

515.2 Operating Controls. Deep-fat fryers shall be equipped with a separate high-limit control in addition to the adjustable operating control (thermostat) to shut off fuel or energy when the fat temperature reaches 475°F (246°C) at 1 inch (25.4 mm) below the surface. [NFPA 96:13.2]

516.1 General Requirements. Recirculating systems containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

(1) The clearance requirements of Section 507.4 through Section 507.4.3.3.

(2) A hood complying with the requirements of Section 508.0.

(3) Grease removal devices complying with Section 509.0.

(4) The air movement requirements of Section 511.2.1 and Section 511.2.2.

(5) Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.

(6) Fire-extinguishing equipment complying with the requirements of Section 513.0.

Exception: Fire-extinguishing equipment in accordance with Section 513.1 and Section 513.5.
(7) The use and maintenance requirements of Section 514.0.
(8) The minimum safety requirements of Section 515.0.
(9) All the requirements of Section 516.0. [NFPA 96:14.1]

516.2 Design Restrictions. All recirculating systems shall comply with the requirements of Section 516.2.1 through Section 516.2.9. [NFPA 96:14.2]

516.2.1 Gas/Electrically Fueled Cooking Appliances. Only gas-fueled or electrically fueled cooking appliances shall be used. Listed gas-fueled equipment designed for use with specific recirculating systems shall have the flue outlets connected in the intended manner. Gas-fueled appliances shall have a minimum 18 inches (457 mm) clearance from the flue outlet to the filter inlet in accordance with Section 509.2.2 through Section 509.2.2.3 and shall meet the installation requirements of this code, NFPA 54 or NFPA 58. [NFPA 96:14.2.1-14.2.3]

516.2.2 Recirculation. Recirculating systems shall be listed with a testing laboratory in accordance with UL 710B or equivalent. [NFPA 96:14.2.4]

516.2.3 Protection. Cooking appliances that require protection and that are under a recirculating hood shall be protected by either the integral fire protection system in accordance with UL 710B or a system in accordance with Section 513.0. [NFPA 96:14.2.4.2]

516.2.4 Maximum Limits. A recirculating system shall not use cooking equipment that exceeds that recirculating system’s labeled maximum limits for that type of equipment, stated in maximum energy input, maximum cooking temperature, and maximum square area of cooking surface or cubic volume of cooking cavity. [NFPA 96:14.2.6]

516.2.5 Label. The listing label shall show the type(s) of cooking equipment tested and the maximum limits specified in Section 516.2.4. [NFPA 96:14.2.7]

516.2.6 Fire Damper. A fire-actuated damper shall be installed at the exhaust outlet of the system. [NFPA 96:14.2.8] The actuation device for the fire damper shall have a maximum temperature rating of 375°F (191°C). [NFPA 96:14.2.10]

516.2.8 Power Supply. The power supply of any electrostatic precipitator (ESP) shall be of the “cold spark,” ferroresonant type in which the voltage falls off as the current draw of a short increases. [NFPA 96:14.2.11]

516.2.9 Listing Evaluation. Listing evaluation shall include the following:
(1) Capture and containment of vapors at published and labeled airflows.
(2) Grease discharge at the exhaust outlet of the system not to exceed an average of 2.9 E-09 (oz/in²) (5.0 E-06 kg/m³) of exhausted air sampled from that equipment at maximum amount of product that is capable of being processed over a continuous 8 hour test with the system operating at its minimum listed airflow.
(3) Listing and labeling of clearance to combustibles from all sides, top, and bottom.
(4) Electrical connection in the field in accordance with NFPA 70.
(5) Interlocks on all removable components that lie in the path of airflow within the unit to ensure that they are in place during operation of the cooking appliance. [NFPA 96:14.2.12]

516.3 Interlocks. The recirculating system shall be provided with interlocks of all critical components and operations as indicated in Section 516.3.1 through Section 516.3.3.1 such that, if any of these interlocks are interrupted, the cooking appliance will not be able to operate. [NFPA 96:14.3.1]

516.3.1 Airflow Sections. All closure panels encompassing airflow sections shall have interlocks to ensure that the panels are in place and fully sealed. [NFPA 96:14.3.2]

516.3.2 Filter Component. Each filter component (grease and odor) shall have an interlock to prove the component is in place. [NFPA 96:14.3.3]

516.3.3 ESP Interlocks. Each ESP shall have a sensor to prove its performance is as designed, with no interruption of the power to exceed 2 minutes. [NFPA 96:14.3.4.1]

516.3.3.1 Manual Reset. The sensor shall be a manual reset device or circuit. [NFPA 96:14.3.4.2]

516.3.4 Airflow Switch or Transducer. An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system’s normal operating flow or 10 percent below its listed minimum rating, whichever is lower. The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96:14.3.5.1-14.3.5.3]

516.4 Location and Application Restrictions. The location of recirculating systems shall be approved by the Authority Having Jurisdiction. Items to be reviewed in the fire risk assessment shall include, but not be limited to, life safety, combustibility of surroundings, proximity to air vents, and total fuel load. [NFPA 96:14.4.1-14.4.2]

516.5 Additional Fire Safety Requirements. In addition to the appliance nozzle(s), a recirculating system shall be listed with the appropriate fire protection for grease filters, grease filtration, odor filtration units, and ductwork, where applicable. [NFPA 96:14.5.1]

516.5.1 Installation Downstream. In addition to any other fire-extinguishing system actuation device, there shall be a fire-extinguishing system actuation device installed downstream of any ESP. [NFPA 96:14.5.2]

516.5.2 Locations. The requirements of Section 513.6 shall also apply to recirculating system locations. [NFPA 96:14.5.3]

516.6 Use and Maintenance. Automatic or manual covers on cooking appliances, especially fryers, shall not interfere with the operation of the fire suppression system. [NFPA 96:14.6.1]

516.6.1 Manufacturer’s Instructions. All filters shall be cleaned or replaced in accordance with the manufacturer’s instructions. [NFPA 96:14.6.2]
516.6.2 Cleaning Schedule. All ESPs shall be cleaned a minimum of once per week and according to the manufacturer’s cleaning instructions. [NFPA 96:14.6.3]

516.6.3 Hood Plenum and Blower Section Cleaning Schedule. The entire hood plenum and the blower section shall be cleaned a minimum of once every 3 months. [NFPA 96:14.6.4]

516.6.4 Inspection of Safety Interlocks. Inspection and testing of the total operation and all safety interlocks in accordance with the manufacturer’s instructions shall be performed by qualified service personnel a minimum of once every 6 months or more frequently if required. [NFPA 96:14.6.5]

516.6.5 Inspection. Fire-extinguishing equipment shall be inspected in accordance with Section 514.2. [NFPA 96:14.6.6]

516.6.6 Maintenance Log. A signed and dated log of maintenance as performed in accordance with Section 516.6.3 and Section 516.6.4 shall be available on the premises for use by the Authority Having Jurisdiction. [NFPA 96:14.6.7]

517.1 Venting Application. Venting requirements of solid-fuel cooking operations shall be determined in accordance with Section 517.1.1 through Section 517.1.6. [NFPA 96:15.1]

517.1.2 System Compliance. Where the solid-fuel cooking equipment has a self-contained top, is the appliance to be vented in an isolated space (except for a single water heater with its own separate vent), has a separate makeup air system, and is provided with supply and return air (not supplied or returned from other spaces), the system shall comply with Section 517.4 and Section 517.6. [NFPA 96:15.1.2]

517.1.3 Makeup Air System. Where the solid-fuel cooking equipment is located in a space with other vented equipment, all vented equipment shall have an exhaust system interlocked with a makeup air system for the space per Section 517.6. [NFPA 96:15.1.4]

517.1.4 Natural Draft Ventilation Systems. Natural draft ventilation systems and power-exhausted ventilation systems shall comply with Section 517.3, Section 517.4, and Section 517.6. [NFPA 96:15.1.5]

517.1.5 Opening Requirements. Where a solid-fuel cooking appliance allows effluent to escape from the appliance opening, this opening shall be covered by a hood and an exhaust system that meets the requirements of Section 517.3, Section 517.4, and Section 517.6. [NFPA 96:15.1.6]

517.1.6 Spark Arresters. Solid-fuel cooking operations shall have spark arresters to minimize the passage of airborne sparks and embers into plenums and ducts. Where the solid-fuel cooking operation is not located under a hood, a spark arrester shall be provided to minimize the passage of sparks and embers into flues and chimneys. [NFPA 96:15.1.7, 15.1.8]

517.2 Location of Appliances. For cooking operations in buildings, every appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. [NFPA 96:15.2.1]

517.2.1 Prohibited Location. Solid-fuel cooking appliances shall not be installed in confined spaces. [NFPA 96:15.2.2] Exception: Solid-fuel cooking appliances listed for installation in confined spaces such as alcoves shall be installed in accordance with the terms of the listing and the manufacturer’s instructions. [NFPA 96:15.2.3]

517.2.2 Flammable Vapors. Solid-fuel cooking appliances shall not be installed in any location where gasoline or any other flammable vapors or gases are present. [NFPA 96:15.2.4]

517.3 Hoods for Solid-Fuel Cooking. Hoods shall be sized and located in a manner capable of capturing and containing all the effluent discharging from the appliances. The hood and its exhaust system shall comply with the requirements of Section 508.0 through Section 513.0. [NFPA 96:15.3.1, 15.3.2]

517.3.1 Separation. Except as permitted in Section 517.3.1.1. exhaust systems serving solid-fuel cooking equipment in buildings, including gas or electrically operated equipment, shall be separate from all other exhaust systems. [NFPA 96:15.3.3] Exception: Cooking equipment not requiring automatic fire-extinguishing equipment (per Section 513.0) shall be permitted to be installed under a common hood with solid-fuel cooking equipment that is served by a duct system separate from all other exhaust systems. [NFPA 96:15.3.5]

517.3.1.1 Equipment with Solid Fuel for Flavoring. Gas-operated equipment utilizing solid fuel for flavoring that meets all the following conditions shall not be required to have a separate exhaust system:

(1) The solid fuel holder (smoker box) shall be listed with the gas-operated equipment.

(2) The solid fuel holder shall be located underneath the gas burners.

(3) Spark arresters conforming with Section 517.1.6 shall be provided.

(4) The maximum quantity of solid fuel consumed shall not exceed 1 pound (0.45 kg) per hour per 100 000 Btu/h (29 kW) of gas burner capacity.

(5) The gas-operated equipment shall be protected by a fire suppression system listed for the equipment, including the solid fuel holder.

(6) Gas-operated equipment with integral solid fuel holder(s) intended for flavoring, such as radiant charbroiler(s), shall comply simultaneously with the requirements of UL 300 that address the gas radiant charbroiler(s) and mesquite wood charbroiler(s).

(7) A fire suppression system nozzle(s) shall be installed to protect the solid fuel holder.

(8) The fire suppression system shall be designed and installed to protect the entire cooking operation.

(9) Each solid fuel holder shall be limited to a size of 150 cubic inches (2.5 L), with no dimension to exceed 20 inches (508 mm).
A maximum of one solid fuel holder for each 100 000 Btu/h (29 kW), or portion thereof, of burner capacity shall be permitted.

Solid fuel shall be immersed in water for a continuous period of at least 24 hours immediately prior to being placed in the cooking equipment.

The inspection frequency shall be the same as for solid fuel cooking operations in Table 514.3. [NFPA 96:15.3.4]

### 517.4 Exhaust Systems for Solid-Fuel Cooking

Where a hood is not required, in buildings where the duct system is three stories or less in height, a duct complying with Section 510.0 shall be provided. [NFPA 96:15.4]

If a hood is used in buildings where the duct system is three stories or less in height, the duct system shall comply with Section 510.0. [NFPA 96:15.4.1]

A listed or approved grease duct system that is four stories in height or greater shall be provided for solid-fuel cooking exhaust systems. [NFPA 96:15.4.2]

Wall terminations of solid-fuel exhaust systems shall be prohibited. [NFPA 96:15.4.4]

### 517.5 Grease Removal Devices for Solid-Fuel Cooking

Grease removal devices shall be constructed of steel or stainless steel or be approved for solid-fuel cooking. [NFPA 96:15.5.1]

If airborne sparks and embers can be generated by the solid fuel cooking operation, spark arrester devices shall be used prior to using the grease removal device, to minimize the entrance of these sparks and embers into the grease removal device and into the hood and the duct system. [NFPA 96:15.5.2]

Filters shall be a minimum of 4 feet (1219 mm) above the appliance cooking surface. [NFPA 96:15.5.3]

### 517.6 Air Movement for Solid-Fuel Cooking

Exhaust system requirements shall comply with Section 511.0 for hooded operation or shall be installed in accordance with the manufacturer’s recommendations for unhooded applications. [NFPA 96:15.6.1]

A replacement or makeup air system shall be provided to ensure a positive supply of replacement air at all times during cooking operations. [NFPA 96:15.6.2]

Makeup air systems serving solid-fuel cooking operations shall be interlocked with the exhaust air system and powered, if necessary, to prevent the space from attaining a negative pressure while the solid-fuel appliance is in operation. [NFPA 96:15.6.3]

### 517.7 Fire-Extinguishing Equipment for Solid-Fuel Cooking

Solid-fuel cooking appliances that produce grease-laden vapors shall be protected by listed fire-extinguishing equipment.

Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require fixed automatic fire-extinguishing equipment. [NFPA 96:15.7.1, 15.7.2]

Listed fire-extinguishing equipment shall be provided for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:15.7.3]

Where acceptable to the Authority Having Jurisdiction, solid-fuel cooking appliances constructed of solid masonry or reinforced Portland or refractory cement concrete and vented in accordance with NFPA 211 shall not require automatic fire-extinguishing equipment for the protection of grease removal devices, hoods, and duct systems. [NFPA 96:15.7.4]

### 517.8 Fixed-Water Pipe System

Solid fuel appliances with fireboxes exceeding 5 cubic feet (0.14 m³) shall be provided with a fixed-water pipe system with a hose in the kitchen capable of reaching the firebox. The hose shall be equipped with an adjustable nozzle capable of producing a fine to medium spray or mist. The nozzle shall be of the type that cannot produce a straight stream. The system shall have a minimum operating pressure of 40 psi (276 kPa) and shall provide a minimum of 5 gallons per minute (gpm) (0.3 L/s). [NFPA 96:15.7.9.1 – 15.7.9.2]

### 517.9 Fuel Storage

All fuel storage areas for cooking operations in buildings shall be provided with a sprinkler system meeting the requirements of NFPA 13 except as permitted in accordance with the following:

1. Where acceptable to the Authority Having Jurisdiction, fuel storage areas shall be permitted to be protected with a fixed water pipe system with a hose capable of reaching all parts of the area.

   In lieu of the sprinkler system outlined in Section 517.7.6, a listed 2-A rated water spray fire extinguisher or a 1.6 gallon (6.1 L) wet chemical fire extinguisher listed for Class K fires with a maximum travel distance of 20 feet (6096 mm) to the solid fuel piles shall be permitted to be used for a solid fuel pile, provided that the fuel pile does not exceed 5 cubic feet (0.14 m³) volume. [NFPA 96:15.9.2.8.2, 15.9.2.8.3]
517.7.7 **Auxiliary Fuel.** In addition to the requirements of Section 517.7.4 through Section 517.8.3, where any solid-fuel cooking appliance is also provided with auxiliary electric, gas, oil, or other fuel for ignition or supplemental heat and the appliance is also served by any portion of a fire-extinguishing system complying with Section 513.0, such auxiliary fuel shall be shut off on actuation of the fire-extinguishing system. [NFPA 96:15.7.11]

517.8 **Other Safety Requirements.** Metal-fabricated solid-fuel cooking appliances shall be listed for the application where produced in practical quantities or shall be approved by the Authority Having Jurisdiction. Where listed, metal-fabricated solid fuel cooking appliances shall be installed in accordance with the terms of their listings and with the applicable requirements of this chapter. [NFPA 96:15.9.4.1, 15.9.4.2]

517.8.1 **Site-Built Solid Fuel Cooling Appliances.** Site-built solid-fuel cooking appliances shall be submitted for approval to the Authority Having Jurisdiction before being considered for installation. All units submitted to the Authority Having Jurisdiction shall be installed, operated, and maintained in accordance with the approved terms of the manufacturer’s instructions and any additional requirements set forth by the Authority Having Jurisdiction. [NFPA 96:15.9.4.3.1 – 15.9.4.3.2]

517.8.2 **Additional Devices.** Except for the spark arresters required in Section 517.1.6, there shall be no additional devices of any type in any portion of the appliance, flue pipe, and chimney of a natural draft solid-fuel operation. [NFPA 96:15.9.4.4]

517.8.3 **Prohibited.** No solid fuel cooking device of any type shall be permitted for deep fat frying involving more than 1 quart (qt) (1 L) of liquid shortening, nor shall any solid fuel cooking device be permitted within 3 feet (914 mm) of any deep fat frying unit. [NFPA 96:15.9.4.5]

518.1 **General.** Downdraft appliance ventilation system containing or for use with appliances used in processes producing smoke or grease-laden vapors shall be equipped with components complying with the following:

1. The clearance requirements of Section 507.4 through Section 507.4.3.3.
2. The primary collection means designed for collecting cooking vapors and residues complying with the requirements of Section 508.0.
3. Grease removal devices complying with Section 509.0.
4. Special-purpose filters as listed in accordance with UL 1046 or CAN/ULC-S649 for Canada.
5. Exhaust ducts complying with Section 510.0.
6. The air movement requirements of Section 511.2.1 and Section 511.2.2.
7. Auxiliary equipment (such as particulate and odor removal devices) complying with Section 512.0.
8. Fire-extinguishing equipment complying with the requirements of Section 513.0, and as specified in Section 518.3.
9. The use and maintenance requirements of Section 514.0.
10. The minimum safety requirements of Section 515.0. {[NFPA 96:16.1.1]}

518.2 **Ventilation System.** The downdraft appliance ventilation system shall be capable of capturing and containing all the effluent discharge from the appliance(s) it is serving. [NFPA 96:16.1.2]

518.3 **Fire-Extinguishing Equipment.** For fire-extinguishing equipment on downdraft appliance ventilation systems, the following shall apply:

1. Cooking surface, duct, and plenum protection shall be provided.
2. At least one fusible link or heat detector shall be installed within each exhaust duct opening in accordance with the manufacturer’s listing.
3. A fusible link or heat detector shall be provided for each protected cooking appliance located in the plenum area of that appliance or in accordance with the extinguishing system manufacturer’s listing.
4. A manual actuation device shall be provided as part of each appliance at a height acceptable to the Authority Having Jurisdiction.
5. Portable fire extinguishers shall be provided in accordance with Section 513.10 through Section 513.11. [NFPA 96:16.2]

518.3.1 **Integral Fire-Extinguishing System.** A listed downdraft appliance ventilation system employing an integral fire-extinguishing system including detection systems that has been evaluated for grease and smoke capture, fire extinguishing, and detection shall be considered as complying with Section 518.3. [NFPA 96:16.2.1]

518.3.2 **Interlocks.** The downdraft appliance ventilation system shall be provided with interlocks such that the cooking fuel supply will not be activated unless the exhaust and supply air systems have been activated. [NFPA 96:16.2.2]

518.4 **Airflow Switch or Transducer.** An airflow switch or transducer shall be provided after the last filter component to ensure that a minimum airflow is maintained. [NFPA 96:16.3.1]

518.4.1 **Interlocks.** The airflow switch or transducer shall open the interlock circuit when the airflow falls 25 percent below the system’s normal operating flow or less than 10 percent its listed minimum rating, whichever is lower. [NFPA 96:16.3.2]

518.4.2 **Manual Reset.** The airflow switch or transducer shall be a manual reset device or circuit. [NFPA 96:16.3.3]

518.5 **Surface Materials.** Any surface located directly above the cooking appliance shall be of noncombustible or limited-combustible materials. [NFPA 96:16.4]
TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN/ULC-S646-2010 (R2016)</td>
<td>Exhaust Hoods and Related Controls for Commercial and Institutional Cooking Equipment</td>
<td>Exhaust Hoods</td>
<td>508.2, 508.2.1</td>
</tr>
<tr>
<td>CAN/ULC-S649-2006</td>
<td>Grease Filters for Commercial and Institutional Kitchen Exhaust Systems</td>
<td>Grease Filters</td>
<td>609.1, 609.1.1, 618.1</td>
</tr>
<tr>
<td>CAN/ULC-S662-2009 (R2016)</td>
<td>Factory-Built Grease Ducts</td>
<td>Grease Ducts</td>
<td>510.5.2, 510.5.3(1)</td>
</tr>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>513.6.1</td>
</tr>
<tr>
<td>UL 710A</td>
<td>Rooftop Grease and Oil Collection and Containment Systems</td>
<td>Commercial Kitchens</td>
<td>510.9.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

COMMITTEE STATEMENT:
The UL version of the Canadian standards are not needed in the code and are therefore being removed. Furthermore, the UL 710A standard was not readily available through the provided link.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: Chapter 5 Item #: 103
SUBMITTER: IAPMO Staff - Update Extracts NFPA 96 Extract Update Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

513.0 Fire-Extinguishing Equipment.

513.2 Types of Equipment. (remaining text unchanged)

513.2.3 Installation. Automatic fire-extinguishing systems shall be installed in accordance with the terms of their listing, the manufacturer’s installation instructions, and the following standards where applicable:
(1) NFPA 12
(2) NFPA 13
(3) NFPA 17
(4) NFPA 17A
(5) NFPA 750 [NFPA 96:10.2.6]

513.4 Fuel and Electric Power Shutoff. (remaining text unchanged)

513.4.3 Manual Reset. (remaining text unchanged)
513.4.3.1 Power Restoration. Where an electrical gas valve is used for shutting off gas to appliances, a manually reset relay shall be used to restore electrical power to the gas valve. [NFPA 96:10.4.4.1]
513.4.4 Shutoff Not Required. Solid fuel cooking operations shall not be required to be shut down. [NFPA 96:10.4.5]
513.5 Manual Activation Activation. All systems shall have both automatic and manual methods of actuation. At least one manual actuation device shall be located in a means of egress or at a location acceptable to the Authority Having Jurisdiction.
The manual actuation device shall clearly identify the hazard protected and be provided with instructions for its use. Manual actuation devices installed in locations where accidental operation could occur shall be provided with a guard where required by the Authority Having Jurisdiction.

An automatic sprinkler system shall not require a method of manual actuation. [NFPA 96:10.5.1 – 10.5.2

<table>
<thead>
<tr>
<th>TABLE 1801.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>NFPA 750-2019</td>
<td>Water Mist Fire Protection Systems</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: NFPA 750 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 5 is being revised to the latest edition of NFPA 96-2021.
Proposals

Item #: 105
UMC 2024  Section: 502.2.1

SUBMITTER: Arnie Rodio
Self

RECOMMENDATION:
Revise text

502.0 Termination.

502.2 Termination of Exhaust Ducts. Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.3.

502.2.1 Environmental Air Ducts. Environmental air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building. The discharge of environmental exhaust ducts shall not be directed onto a public walkway.

**Exception:** Whole house fans shall be permitted to discharge into the attic space of an individual dwelling unit.

SUBSTANTIATION:
An exception is being added to Section 502.2.1 as exhaust ducts typically must terminate to the outdoors, however, systems such as whole house fans are designed to exhaust into the attic space.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
While whole house fans usually exhaust into attics, there is concern that not all attics allow the air to escape, which may cause a pressure increase within the attic space. Some attics are not vented in certain parts of the country. Each jurisdiction is permitted to allow whole house fans to discharge into an attic. Discharging into the attic may not always be recommended as it may pressurize the attic and create an unhealthy situation for the homeowners. Whole house fans may need to discharge directly to the outdoors.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 28  NEGATIVE: 1  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

TRAFTON, A: Although I agree with the Committee in part, it is true that many whole house fans do discharge to the attic. We should relook at this.

EXPLANATION OF NEGATIVE:

WHITE: This is very commonly done, in fact, the U.S. DOE encourages the use of these devices as energy savers.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 502.2.1  Item #: 105

SUBMITTER: Arnie Rodio  
Self  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
An exception is being added to Section 502.2.1 as exhaust ducts typically must terminate to the outdoors, however, systems such as whole house fans are designed to exhaust into the attic space.
Proposals

Item #: 107

UMC 2024  Section: 503.2.1, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

503.0 Motors, Fans, and Filters.

503.2 Fans. Parts of fans in contact with explosive or flammable vapors, fumes, or dusts shall be of nonferrous or nonsparking materials, or their casing shall be lined or constructed of such material. Where the size and hardness of materials passing through a fan are capable of producing a spark, both the fan, and the casing shall be of nonsparking materials. Where fans are required to be spark-resistant, their bearings shall not be within the airstream, and parts of the fan shall be grounded. Fans in systems handling materials that are likely to clog the blades, and fans in buffing or woodworking exhaust systems, shall be of the radial-blade or tube-axial type.

Equipment used to exhaust explosive or flammable vapors, fumes, or dusts shall bear an identification plate stating the ventilation rate for which the system was designed.

Fans located in systems conveying corrosives shall be of materials that are resistant to the corrosive or shall be coated with corrosion-resistant materials.

503.2.1 Testing. Fans providing exhaust or outdoor air shall be tested in accordance with ANSI/AMCA 210/ASHRAE 51. Induced flow fans shall be tested in accordance with AMCA 260.

<table>
<thead>
<tr>
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<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI/AMCA 210-2016/ASHRAE 51-2016</td>
<td>Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating</td>
<td>Fans</td>
<td>503.2.1</td>
</tr>
<tr>
<td>AMCA 260-2020</td>
<td>Laboratory Methods of Testing Induced Flow Fans for Rating</td>
<td>Fans</td>
<td>503.2.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ANSI/AMCA 210/ASHRAE 51 and AMCA 260 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Testing requirements are being added for exhaust fans to clarify that such fans must be tested to AMCA 210/ASHRAE 51. This will assist the code official in approving such systems. To be assured that fan performance is factual for exhaust applications utilizing induced flow fans, be sure to specify fans and fan systems that have certified performance ratings. The ratings are based on testing in accordance with AMCA 210/ASHRAE 51 for standard fans and AMCA 260 for induced flow fans. AMCA certified ratings ensure that the product performs as tested and documented by the manufacturer. Caution must be taken when using performance data that is not verified by an independent third party.

COMMITTEE ACTION: REJECT
COMMITTEE STATEMENT:
The proposed standards are aerodynamic testing standards and are not applicable to this code. The change does not do anything to address health or safety. It only gives a design criteria for an end design.

There may be other performance standards available to test and rate exhaust fans. Furthermore, the standards are not used by the installer, but by the engineer. The proposed language is not necessary and does not improve the code.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 27   NEGATIVE: 1   ABSTAIN: 1   NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

WHITE: These standards provide a factual basis for performance of products. This code is not just for installers, engineers design to the requirements and inspectors rely on the code for enforcement. Most standards referenced in the code are not directly used by installers, but they are there to provide quality installations.

EXPLANATION OF ABSTAIN:

GUNZNER: Though this proposal did not originate with AMCA, I am abstaining since it involves AMCA standards.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 503.2, Table 1801.1  Item #: 107

SUBMITTER: Phil Pettit  
Control Air Conditioning Corporation  
Rep. Self  

RECOMMENDATION: 
Revise text

Request to replace the code change proposal by this public comment.

503.0 Motors, Fans, and Filters.

503.2 Fans. Parts of fans in contact with explosive or flammable vapors, fumes, or dusts shall be of nonferrous or nonsparking materials, or their casing shall be lined or constructed of such material. Where the size and hardness of materials passing through a fan are capable of producing a spark, both the fan, and the casing shall be of nonsparking materials. Where fans are required to be spark-resistant, their bearings shall not be within the airstream, and parts of the fan shall be grounded. Fans in systems handling materials that are likely to clog the blades, and fans in buffing or woodworking exhaust systems, shall be of the radial-blade or tube-axial type. Fans providing exhaust or outdoor air shall comply with ANSI/AMCA 210/ASHRAE 51. Induced flow fans shall comply with AMCA 260.

Equipment used to exhaust explosive or flammable vapors, fumes, or dusts shall bear an identification plate stating the ventilation rate for which the system was designed.

Fans located in systems conveying corrosives shall be of materials that are resistant to the corrosive or shall be coated with corrosion-resistant materials.

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<th>REFERENCED SECTION</th>
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<tbody>
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<td>Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating</td>
<td>Fans</td>
<td>503.2</td>
</tr>
<tr>
<td>AMCA 260-2020</td>
<td>Laboratory Methods of Testing Induced Flow Fans for Rating</td>
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<td>503.2</td>
</tr>
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</table>
Note: ANSI/AMCA 210/ASHRAE 51 and AMCA 260 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Testing requirements are being added for exhaust fans to clarify that such fans must be tested to AMCA 210/ASHRAE 51. This will assist the code official in approving such systems. To be assured that fan performance is factual for exhaust applications utilizing induced flow fans, be sure to specify fans and fan systems that have certified performance ratings. The ratings are based on testing in accordance with AMCA 210/ASHRAE 51 for standard fans and AMCA 260 for induced flow fans. AMCA certified ratings ensure that the product performs as tested and documented by the manufacturer. Caution must be taken when using performance data that is not verified by an independent third party.
504.0 Environmental Air Ducts.  
504.1 General. Where not specified in this chapter, exhaust ducts shall be constructed and installed in accordance with Chapter 6 and shall be airtight as approved by the Authority Having Jurisdiction. Environmental air ducts that have an alternate function as a part of an approved smoke-control system in accordance with Section 504.7 do not require design as Class 1 product-conveying ducts.  

Exceptions:  
(1) Ductless range hoods where installed in accordance with the manufacturer’s installation instructions.  
(2) Condensing clothes dryers where installed in accordance with the manufacturer’s installation instructions.  

504.7 Smoke Control Systems. Smoke control systems shall be designed in accordance with NFPA 92 and installed where required by the building code. Pressurized stairways, elevator shafts, and vestibules shall comply with this section and the building code. All components of the smoke control system shall be clearly identified and marked in field. Components include, but are not limited to, fire alarm initiating devices, junction boxes, panels, modules, relays, dampers, doors sensors and air movement sensors.  

504.7.1 Fire Detection Systems. Fire detection systems providing control input or output signals to smoke control systems shall comply with the building code and shall be equipped with a control unit listed and labeled in accordance with UL 864. Activation of the smoke control system is required immediately upon detection.  

221.0 – S –  
Smoke Control System. A system that includes all methods for controlling smoke movement, intended to provide a means of egress for the evacuation or relocation of occupants.  

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 92-2018</td>
<td>Smoke Control Systems</td>
<td>Smoke Control Systems</td>
<td>504.7</td>
</tr>
<tr>
<td>UL 864-2014</td>
<td>Control Units and Accessories for Fire Alarm Systems (with revisions through May 7, 2020)</td>
<td>Control Units</td>
<td>504.7.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)  

Note: NFPA 92 and UL 864 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.  

SUBSTANTIATION:  
A smoke control system is a combination of fans, dampers, warning devices, and other equipment that work together to perform the containment function for any smoke event at any location in a building. Those who work in the health care industry may be familiar with contamination control; smoke control systems are similar; however,
such systems have additional applications. The term “smoke control” includes both the containment of smoke in a
designated zone as well as the management of smoke within a large-volume space and adjacent connected
spaces. The containment method is a smoke control method that uses mechanical equipment to produce pressure
differences across smoke barriers. The management method is a smoke control method that utilizes natural or
mechanical systems to maintain a tenable environment in the means of egress from a large-volume space or to
control and reduce the migration of smoke between the fire area and communicating spaces.

Once it has been established that a smoke control system is required by the building code, the first step is to consult
NFPA 92 and determine whether the system should be based on the smoke-containment concept or the smoke-
management concept. NFPA 92 is arranged around smoke containment and smoke management, providing
approaches and criteria for the implementation of each.

Smoke management generally is used for large multistory spaces, such as atriums. Smoke containment, achieved
using pressurization, is used for elevators, stairways, and zoned smoke systems. Additionally, a building may
include smoke management as well as a smoke containment; the two methodologies are not mutually exclusive
systems and both are often found in the same building. After the design methodology and smoke control objectives
are identified, the design approach(es) should be selected. For smoke-containment systems, the design approach
includes one or more of the following: stairwell pressurization, zoned smoke control, elevator pressurization,
vestibule pressurization, and smoke refuge area pressurization.

NFPA 92 applies to the design, installation, acceptance testing, operation, and ongoing periodic testing of smoke
control systems, and covers both containment and management systems, including stairwell pressurization systems
and testing requirements. NFPA 92A and NFPA 92B were withdrawn and the requirements were incorporated into
NFPA 92. As the industry standard, it is important for designers, installers, and code officials to be familiar with the
document.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language provides life safety requirements. The language may conflict with the building code.
Furthermore, there is no mention of passive smoke control systems nor fire sprinklers used as smoke control
systems.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 221.0, 504.1, 505.7, 505.7.3, Table 1801.1  Item #: 108
SUBMITTER: Keith Blazer  Self  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

504.0 Environmental Air Ducts.
504.1 General. Where not specified in this chapter, exhaust ducts shall be constructed and installed in accordance with
Chapter 6 and shall be airtight as approved by the Authority Having Jurisdiction. Environmental air ducts that have an
alternate function as a part of an approved smoke control system in accordance with Section 505.7.3 do not require
design as Class 1 product-conveying ducts.

Exceptions:
(1) Ductless range hoods where installed in accordance with the manufacturer’s installation instructions.
(2) Condensing clothes dryers where installed in accordance with the manufacturer’s installation instructions.

505.7 Fire Detection, Smoke Control, and Alarm Systems. (remaining text unchanged)
505.7.3 Smoke Control Systems. Smoke control systems shall be designed in accordance with NFPA 92 and installed where required by the building code. Smoke control systems shall be equipped with a control unit that complies with UL 864.

221.0 – S –
Smoke Control System. A system that includes all methods for controlling smoke movement, intended to provide a means of egress for the evacuation or relocation of occupants.

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<tr>
<td>NFPA 92-2018</td>
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</table>

(portions of table not shown remain unchanged)

Note: NFPA 92 and UL 864 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A smoke control system is a combination of fans, dampers, warning devices, and other equipment that work together to perform the containment function for any smoke event at any location in a building. Those who work in the health care industry may be familiar with contamination control; smoke control systems are similar; however, such systems have additional applications. The term "smoke control" includes both the containment of smoke in a designated zone as well as the management of smoke within a large-volume space and adjacent connected spaces. The containment method is a smoke control method that uses mechanical equipment to produce pressure differences across smoke barriers. The management method is a smoke control method that utilizes natural or mechanical systems to maintain a tenable environment in the means of egress from a large-volume space or to control and reduce the migration of smoke between the fire area and communicating spaces.
Item #: 109

UMC 2024  Section: 504.2

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.2 Independent Exhaust Systems. Single or combined mechanical exhaust systems for environmental air shall be independent of other exhaust systems. Combined exhaust systems shall be designed to operate at negative pressure and terminate in accordance with Section 502.2.1. Clothes dryer exhaust systems shall be independent of all other exhaust systems except where permitted in Section 504.4.4.

(below shown for reference only)

207.0 – E – Environmental Air Duct. Ducting used for conveying air at temperatures not exceeding 250°F (121°C) to or from occupied areas of any occupancy through other than heating or air-conditioning systems, such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, and domestic-type clothes dryer exhaust ducts.

502.2.1 Environmental Air Ducts. Environmental air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building. The discharge of environmental exhaust ducts shall not be directed onto a public walkway.

504.4.4 Common Exhaust. Where permitted by the clothes dryer manufacturer’s installation instructions, multiple clothes dryers shall be permitted to be installed with a common exhaust. The common exhaust duct shall be constructed of rigid metal and shall be installed in a fire-resistant rated enclosure in accordance with the building code. The duct material shall be of rigid metal with a thickness of not less than 0.020 of an inch (0.508 mm) (24 gauge). The duct enclosure shall be provided with a cleanout opening at the base of not less than 12 inches by 12 inches (305 mm by 305 mm). The exhaust fan shall be located downstream of branch connections and operated continuously and shall be monitored by an approved means.

SUBSTANTIATION:
The code change provides clarity to Section 504.2 regarding independent exhaust systems. The intention of the section is to prohibit combining of dissimilar exhaust systems. By mentioning “environmental air” the section is improved and clearly states which systems shall not be combined. Additionally, combined exhaust systems must only operate at negative pressure. Furthermore, clothes dryers shall not be combined with any other exhaust systems.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
While the original section needs clarification, the addition of this language does not add clarity. The change should be reworked to specify the intent.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29   NOT RETURNED: 1   Heine
PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 504.2  Item #: 109
SUBMITTER: Phillip H Ribbs  PHR Consultants  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

504.0 Environmental Air Ducts.

504.2 Independent Exhaust Systems. Single or combined mechanical exhaust systems for environmental air shall be independent of other exhaust systems. Combined exhaust systems shall operate at negative pressure and shall terminate in accordance with Section 502.2.1. Clothes dryer exhaust systems shall be independent of all other exhaust systems except where permitted in Section 504.4.4.

(above shown for reference only)

502.2.1 Environmental Air Ducts. Environmental air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building. The discharge of environmental exhaust ducts shall not be directed onto a public walkway.

504.4.4 Common Exhaust. Where permitted by the clothes dryer manufacturer’s installation instructions, multiple clothes dryers shall be permitted to be installed with a common exhaust. The common exhaust duct shall be constructed of rigid metal and shall be installed in a fire-resistant rated enclosure in accordance with the building code. The duct material shall be of rigid metal with a thickness of not less than 0.020 of an inch (0.508 mm) (24 gauge). The duct enclosure shall be provided with a cleanout opening at the base of not less than 12 inches by 12 inches (305 mm by 305 mm). The exhaust fan shall be located downstream of branch connections and operated continuously and shall be monitored by an approved means.

SUBSTANTIATION:
The code change provides clarity to Section 504.2 regarding independent exhaust systems. The intention of the section is to prohibit combining of dissimilar exhaust systems. By mentioning “environmental air” the section is improved and clearly states which systems shall not be combined. Additionally, combined exhaust systems must only operate at negative pressure. Furthermore, clothes dryers shall not be combined with any other exhaust systems.

The UMC TC stated, “While the original section needs clarification, the addition of this language does not add clarity. The change should be reworked to specify the intent.” The proposed change clarifies the language and specifies the intent.
Proposals

Item #: 110
UMC 2024  Section: 504.3

SUBMITTER: Randy Young
Northern CA Valley Sheet Metal Training JATC

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.3 Domestic Range Hoods. Ducts used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces. All kitchen exhaust ducts used in domestic range hoods shall be constructed of metal and shall have a smooth surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181. Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB).

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

Note: UL 181 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
There are currently no provisions to properly seal and test range hoods and ducts. This also clarifies that ducts shall terminate outside and be tested in accordance with the nationally recognized testing standards.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 20  NEGATIVE: 9  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

BALLANCO: The second paragraph of this proposal adds overly restrictive requirements. The amount of exhaust from some of these residential systems does not justify a test by a TAB professional. If the second paragraph was deleted, this would be an acceptable proposal.

FEEHAN: The second paragraph is overly restrictive.

KOERBER: I agree that small residential exhaust systems do not justify a physical verification of exhaust. This is overly restrictive.

MACNEVIN: The second paragraph of this proposal adds overly restrictive requirements, especially for residential systems.
The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item #097, Section 403.10 (Air Balance), UMC Item #110, Section 504.3 (Domestic Range Hoods), and UMC Item #161, Section 603.9.2 (Duct Leakage Tests) resulted in conflicting language within the code. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

504.0 Environmental Air Ducts.

504.3 Domestic Range Hoods. All kitchen exhaust ducts used in domestic range hoods shall be constructed of metal and shall have a smooth surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181. Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:

1. The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
2. Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
3. PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
4. The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item #097, Section 403.10 (Air Balance) modifies the phrase “or other ANSI accredited agencies” to “or other equivalent approved agencies” to comply with the ANSI Essential Requirements for referencing products or services. Additionally, UMC Item #110, Section 504.3 (Domestic Range Hoods) and UMC Item #161, Section 603.9.2 (Duct Leakage Tests) were modified to correlate with the updated UMC Item #097 by adding the phrase “or other equivalent approved agencies.”

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 504.3 by adding the phrase “or other equivalent approved agencies.”
504.3 Domestic Range Hoods. All kitchen exhaust ducts used in domestic range or cooktop hoods shall be constructed of metal and shall have a smooth interior surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181. Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

SUBSTANTIATION:
A clarification is being made to Section 504.3. The “interior” surface of the duct must be smooth, and cooktops are being added as they also may contain a hood.

PUBLIC COMMENT 2

SUBMITTER: Julius Ballanco, P.E.
JB Engineering and Code Consulting, P.C.
Rep. Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

504.3 Domestic Range Hoods. All kitchen exhaust ducts used in domestic range or cooktop hoods shall be constructed of metal and shall have a smooth interior surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181. Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.

— A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.
SUBSTANTIATION:
There is no justification for requiring a residential domestic range hood to be certified by a TAB technician. The Code only requires an exhaust rate of 50 or 100 cfm for these hoods. There is no adjustment for increasing or decreasing the exhaust rate.

This would add a high cost to residential construction by requiring a separate contractor to test just a domestic range hood.
Proposals

Item #: 111
UMC 2024  Section: 504.4.2.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers. (remaining text unchanged)

504.4.2 Domestic Clothes Dryers. (remaining text unchanged)
504.4.2.1 Length Limitation. Unless otherwise permitted or required by the dryer manufacturer's instructions and approved by the Authority Having Jurisdiction, domestic dryer moisture exhaust ducts shall not exceed a total combined horizontal and vertical length of 44 35 feet (4267 10 668 mm), including two 90 degree (1.57 rad) elbows. A length of 2 feet (610 mm) shall be deducted for each 90 degree (1.57 rad) elbow in excess of two.

Exception: Where an exhaust duct power ventilator, in accordance with Section 504.4.2.3, is used, the maximum length of the dryer exhaust duct shall be permitted to be in accordance with the dryer exhaust duct power ventilator manufacturer’s installation instructions.

SUBSTANTIATION:
The first sentence of Section 504.4.2.1 already requires that the total length of the exhaust duct must first be determined by the clothes dryer manufacturer's instructions. In the absence of manufacturer's instructions, the UMC states that the total combined length limitation shall not exceed 14 feet per Section 504.4.2.1. This requirement is overly stringent. This code change would allow up to 35 feet of total length of clothes dryer exhaust duct in the absence of manufacturer's instructions and when approved by the AHJ.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There was no technical justification provided to warrant the change for the maximum length of clothes dryer exhaust duct from 14 feet to 35 feet.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 27  NEGATIVE: 1  ABSTAIN: 1  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

TERZIGNI: The language in the code allows for longer lengths if the manufacturer's instruction permit it. This just sets a "default" maximum.

WHITE: I must agree that there is no technical substantiation provided with the proposal. It has been noted that the manufacturer's instructions would provide for longer lengths, but that is constrained by the AHJ (the code connects them with "and") so if the AHJ will not approve, it is 14 feet. Perhaps through public comment more substantiation can be provided.
EXPLANATION OF NEGATIVE:

BALLANCO: The 35-foot dimension has been substantiated by manufacturers of dryers. This change should have been accepted as submitted.

EXPLANATION OF ABSTAIN:

KOERBER: Abstaining as I would like to hear more information regarding either of the length limitations (14’ or 35’). Just as it can be said the 14’ length is too restrictive, what's to say the 35 length is not too lenient? Looking for a true justification for either length or any length in between.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 504.4.2.1  Item #: 111

SUBMITTER: Phil Pettit  Comment #: 1
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The 35 foot limit is based on the worst case scenario and the intent is to ensure that all domestic clothes dryers, even the least capable clothes dryer available, would still be compatible with a 35 foot duct system and would work properly in all cases. Modern domestic clothes dryers often permit longer lengths. 35 feet is the industry standard and is consistent with other building codes and manufacturer's installation instructions.
Proposals

Item #: 112
UMC 2024  Section: 504.4.2.2

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.4 Clothes Dryers. (remaining text unchanged)

504.4.2 Domestic Clothes Dryers. (remaining text unchanged)

504.4.2.2 Transition Ducts. Listed clothes dryer transition ducts not more than 6 8 feet (1829 2438 mm) in length shall be permitted to be used to connect the Type 1 dryer to the exhaust ducts. Transition ducts and flexible clothes dryer transition ducts shall not be concealed within construction, and shall be installed in accordance with the manufacturer’s installation instructions.

SUBSTANTIATION:
The UMC currently limits the length of clothes dryer transition ducts to 6 feet per Section 504.4.2.2. This requirement is overly stringent. This change allows up to 8 feet total length in the absence of manufacturer’s instructions and when approved by the AHJ.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There was no technical justification provided to warrant the change for the maximum length of clothes dryer transition duct from 6 feet to 8 feet.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 26  NEGATIVE: 3  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted as submitted. The 8-foot dimension is consistent with the listing of transition ducts.

KOERBER: Listed Clothes Dryer Transition Ducts are approved for use in lengths not to exceed 8 feet. The length should be changed to match the scope of the listing standard.

TRAFTON, A: Julius Ballanco is right, however, we should submit the transition information to the Committee for review.

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 504.4.2.2  Item #: 112
SUBMITTER: Phil Pettit  Comment #: 1
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text
Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
According to UL 2158A, Standard for Safety Clothes Dryer Transition Duct, the sample sizes used for the bending test, impact test, tension test, torsion test are based on 8 foot lengths. Section 18.3 (Installation Instructions) of UL 2158A states “the maximum length of the duct is 8 feet.”
Proposals

Item #: 113
UMC 2024  Section: 504.3, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

504.0 Environmental Air Ducts.

504.3 Domestic Range Cooking Exhaust Equipment. Where installed, domestic cooking exhaust equipment shall comply with the following, as applicable:
(1) The fan for overhead range hoods and downdraft exhaust equipment not integral with the cooking appliance shall be listed and labeled in accordance with UL 507.
(2) Overhead range hoods and downdraft exhaust equipment with integral fans shall be listed and labeled in accordance with UL 507.
(3) Domestic cooking appliances with integral downdraft exhaust equipment shall be listed and labeled in accordance with UL 858 or ANSI Z21.1/CSA 1.1.
(4) Microwave ovens with integral exhaust for installation over the cooking surface shall be listed and labeled in accordance with UL 923.
(5) Ducts used for domestic kitchen range or cooktop ventilation shall be of metal and shall have smooth interior surfaces.

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>UL 507-2017</td>
<td>Electric Fans</td>
<td>Fans</td>
<td>504.3</td>
</tr>
</tbody>
</table>

Note: The UL and CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This change adds requirements for domestic cooking exhaust equipment, including fans, overhead range hoods, integral downdraft equipment, and microwave ovens with integral exhaust.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]

COMMITTEE ACTION: REJECT
COMMITTEE STATEMENT:
The proposed Section 504.3(4) is not needed as the UL 923 standard is already addressed in the code regarding microwave ovens and would, therefore, be redundant language and not needed. The phrase “listed and labeled” should be removed as the code already addresses this in Chapter 3.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:     AFFIRMATIVE: 24   NEGATIVE: 5   NOT RETURNED: 1   Heine

EXPLANATION OF NEGATIVE:

BALLANCO: This change should have been accepted as submitted. The substantiation justifies the change.

FEEHAN: This language and these standards are necessary.

KOERBER: The substantiation justifies the change.

WHITE: The substantiation justifies the proposal and should have been accepted.

WISEMAN: These standards are appropriate and necessary. This should have been accepted.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 504.3, Table 1801.1  Item #: 113

SUBMITTER: John Taecker  UL LLC

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

504.3 Domestic Range Hoods Cooking Exhaust Equipment. Domestic cooking exhaust equipment shall comply with the following requirements, as applicable:
(1) The fan for overhead range hoods and downdraft exhaust equipment not integral with the cooking appliance shall comply with UL 507.
(2) Overhead range hoods and downdraft exhaust equipment with integral fans shall comply with UL 507.
(3) Domestic cooking appliances with integral downdraft exhaust equipment shall comply with UL 858 or ANSI Z21.1/CSA 1.1.
(4) Microwave ovens with integral exhaust for installation over the cooking surface shall comply with UL 923.
(5) All domestic kitchen exhaust ducts used in conjunction with domestic range or cooktop hoods shall be constructed of metal and shall have a smooth interior surface, fastened and sealed with duct mastic or metal tapes that meet the requirements of UL 181.

Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided the following conditions are met:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
(2) Not more than 1 inch (25.4 mm) of 6 inch diameter (152 mm) PVC coupling shall be permitted to protrude above the concrete floor surface.
(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
(4) The duct shall terminate above grade outside the building and shall be equipped with a backdraft damper.
(5) Range hoods shall discharge to the outdoors through a single wall duct and shall not terminate in an attic or crawl space.
(6) A physical verification of air volume, operation, and design intent shall be performed by a certified Testing, Adjusting, and Balancing (TAB) technician. The TAB technician shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.
Exception: Ducts for domestic kitchen downdraft grill-range ventilation installed under a concrete slab floor shall be permitted to be of approved Schedule 40 PVC provided:
(1) The under-floor trench in which the duct is installed shall be completely backfilled with sand or gravel.
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(3) PVC pipe joints shall be solvent cemented to provide an air and greasetight duct.
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TABLE 1801.1
REFERENCED STANDARDS

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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ANSI Z21.1/CSA 1.1, UL 507, UL 858, and UL 923 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This change adds requirements for domestic cooking exhaust equipment, including fans, overhead range hoods, integral downdraft equipment, and microwave ovens with integral exhaust.

The proposed Section 504.3(4) is needed and is not redundant with Section 919.4.2(3). Section 504.3.4 is addressing exhaust equipment, which in this case is integral with the microwave oven. Section 919.4.2 is addressing the clearances between an upper cooking appliance, such as a microwave oven, above another cooking appliance. These are two different issues that are being addressed in their respective locations in the code.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment, and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 117
UMC 2024  Section: 504.6

SUBMITTER: John R Hamilton
            International Certification Board
            Rep. DLS

RECOMMENDATION:
Delete text without substitution

504.6 Gypsum Wallboard Ducts. Bathroom and laundry room exhaust ducts shall be permitted to be of gypsum wallboard subject to the limitations of Section 602.4.2.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum. Gypsum has many specific limitations to exposure to humidity and mold growth. Using gypsum for these high humidity ducts is not recommended by the National Gypsum Association; in fact they say not to use gypsum as an HVAC ducting system.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 27  NEGATIVE: 2  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: Gypsum has been used for many years without incident. If there was a problem with this section, failures should have been identified.
KOERBER: Gypsum should be allowed for use under the limitations already set forth in Chapter 6.

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 504.6  Item #: 117  Comment #: 1

SUBMITTER: Tim Earl
            GBH International
            Rep. The Gypsum Association

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.
SUBSTANTIATION:
The substantiation statement given by the proponent is incorrect and misleading. The Gypsum Association is in favor of the use of gypsum panels as ductwork, so long as the panels are properly installed and the system is used properly. To this point, as pointed out by committee member Koerber, so long as the limitations in Chapter 6 of this code are followed, gypsum ducts provide a fire-resistant and viable means of air movement. The elimination of gypsum as a duct material would essentially eliminate a common practice for the construction of ducts that has existed for many years without incident.
Proposals

Item #: 121
UMC 2024  Section: 505.11.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

505.0 Product-Conveying Systems.

505.11 Hoods and Enclosures. (remaining text unchanged)

505.11.1 Fume Hoods. Where installed, fume hoods used for exhausting flammable vapors shall be listed and labeled in accordance with UL 1805.

<table>
<thead>
<tr>
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<th>REFERENCED SECTIONS</th>
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<tr>
<td>UL 1805-2002</td>
<td>Laboratory Hoods and Cabinets (with revisions through June 2, 2006)</td>
<td>Hoods</td>
<td>505.11.1</td>
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</table>

(portions of table not shown remain unchanged)

Note: UL 1805 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The applicable standard for fume hoods used for exhausting hazardous and flammable vapors is UL 1805, Standard for Laboratory Hoods and Cabinets.

[Digital View for UL Standards: https://www.shopulstandards.com/Catalog.aspx]

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Although fume hoods are part of the ventilation and exhaust system, they are outside of the scope of the UMC, and therefore, should not be included in the code. Fume hoods are very specific to certain applications and use per facility.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 22  NEGATIVE: 7  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
ARYAN: This information would be beneficial to the code because currently there is no standard acceptable for fume hoods listed in the code.

BALLANCO: This change should have been accepted as submitted. The substantiation justifies the proposal.

FEEHAN: This language and information is necessary in the code.
KOERBER: I agree with the proposal as the standard is appropriate. If “listed and labeled” does not match with the style of the UMC then the proposal should be modified to reflect “compliance with.”

MACNEVIN: I disagree with the Committee statement for rejection, as this proposal is based on an appropriate UL standard for this purpose. Remove “listed and labeled” and it should be accepted in public comment.

WHITE: This information is necessary in the code and not beyond the scope of the UMC.

WISEMAN: This language is necessary for the code and should be included.

---

PUBLIC COMMENT 1

<table>
<thead>
<tr>
<th>Code Year: 2024 UMC</th>
<th>Section #: 505.11.1, Table 1801.1</th>
<th>Item #: 121</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBMITTER: John Taecker</td>
<td>UL LLC</td>
<td>Comment #: 1</td>
</tr>
</tbody>
</table>

RECOMMENDATION:
Add new text

Request to **replace** the code change proposal by this public comment.

505.0 Product-Conveying Systems.

505.11 Hoods and Enclosures. (remaining text unchanged)

505.11.1 Fume Hoods. Where installed, fume hoods used for exhausting flammable vapors shall comply with UL 1805.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1805-2002</td>
<td>Laboratory Hoods and Cabinets (with revisions through June 2, 2006)</td>
<td>Hoods</td>
<td>505.11.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1805 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The applicable standard for fume hoods used for exhausting hazardous and flammable vapors is UL 1805, Standard for Laboratory Hoods and Cabinets.

Since fume hoods are part of the ventilation and exhaust system, they are within the scope of the UMC. This is not mandating the use of these hoods, but is providing minimum safety requirements where installed in very specific applications and use within certain facilities.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 132

UMC 2024 Section: 512.3, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

512.0 Auxiliary Equipment.

512.3 Other Equipment. Fume incinerators, thermal recovery units, air pollution control devices, or other devices shall be permitted to be installed in ducts or hoods or to be located in the path of travel of exhaust products where specifically listed for such use. [NFPA 96:9.3.1] Where installed, pollution control units shall be listed and labeled in accordance with UL 8782 and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 8782-2017</td>
<td>Outline of Investigation for Pollution Control Units for Commercial Cooking Operations</td>
<td>Miscellaneous</td>
<td>512.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 8782 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The appropriate standard for pollution control units is UL 8782, Pollution Control Units for Commercial Cooking. Section 512.3 (Other Equipment) is a proper location to include the standard for pollution control units.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as UL 8782 is an outline of investigation and such language is not needed as the extracted NFPA language already allows pollution control units that are listed for their use.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLICATION COMMENT 1

Code Year: 2024 UMC Section #: 512.3.1, Table 1801.1 Item #: 132

SUBMITTER: John Taecker UL LLC

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

512.0 Auxiliary Equipment.

512.3 Other Equipment. Fume incinerators, thermal recovery units, air pollution control devices, or other devices shall be permitted to be installed in ducts or hoods or to be located in the path of travel of exhaust products where specifically listed for such use. [NFPA 96:9.3.1]

512.3.1 Pollution Control Units. Where installed, pollution control units shall be in accordance with the following:
(1) Pollution control units shall comply with UL 8782.
(2) Fans serving pollution control units shall comply with UL 705.
(3) Pollution control units shall be supported by noncombustible material securely attached to the structure and designed to carry gravity and seismic loads in accordance with the building code.
(4) Pollution control units shall be installed in accordance with the following:
(a) Pollution control units shall comply with UL 2221 or ASTM E2336, for location in an enclosure.
(b) Shall be installed in a dedicated room or space enclosure in accordance with Section 507.4.5, having the same fire-resistance rating as the duct enclosure.
(c) Shall be readily accessible for servicing and cleaning of the unit.
(d) The dedicated room or space enclosure shall be ventilated in accordance with the manufacturer’s installation instructions.

507.4.5 Field Applied. Field-applied grease duct enclosures shall be protected with a through penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an “F” and a “T” rating equal to the fire resistance rating of the assembly being penetrated. The surface of the field fabricated grease duct shall be continuously covered on all sides from the point at which the duct enclosure penetrates a ceiling, wall, or floor to the outlet terminal. The field-applied grease duct shall be listed in accordance with ASTM E2336 and installed in accordance with the manufacturer’s instructions and the listing requirements. [NFPA 96:4.3.2-4.3.2.2]

TABLE 1801.1 REFERENCED STANDARDS

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<tr>
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<td>Pollution Control Units for Commercial Cooking Operations</td>
<td>Miscellaneous</td>
<td>512.3.1(1)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM E2336, UL 705, and UL 2221 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: UL 8782 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The appropriate standard for pollution control units is UL 8782, Pollution Control Units for Commercial Cooking. Section 512.3 (Other Equipment) is a proper location to include the standard for pollution control units, because “air pollution control devices” is referenced in this section. This proposal is not mandating the use of these pollution control units, but is providing minimum safety requirements where they are installed.

Referencing the standard used for testing and certifying these types of products makes it easier to determine compliance with the code.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require
materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

In regards to IAPMO staff's note regarding the development of UL 8782, as stated in the Section 3-3.7.1.3, 'IAPMO's Regulations Governing Committee Projects,' the TC is permitted to allow standards that were not developed by an open consensus process. Such referenced standards are still required to be written in mandatory language in order to be enforceable. UL 8782 is written using mandatory language.

Sections below are taken from IAPMO's Regulations Governing Committee Projects for reference:

3-3.7.1.2 Mandatory standards referenced in IAPMO codes and standards shall be developed via an open process having a published development procedure. The development procedure shall include a means for obtaining divergent views, if any. The development procedure shall include a means of achieving consensus for the resolution of divergent views and objections.

3-3.7.1.3 Mandatory standards referenced in IAPMO codes and standards not complying with 3-3.7.1.2 are permitted. However, in such instances the TC shall determine that the mandatory standard is appropriate for reference. The TC shall verify the standard is written in mandatory language, is identifiable by title, date or edition, and developing organization, and that it is readily available. Any mandatory standard proposed for reference on the basis of this paragraph shall be specifically identified as not complying with 3 3.7.1.2 in a ROP or ROC.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 138
UMC 2024  Section: 602.1

SUBMITTER:  John R Hamilton
International Certification Board
Rep. DLS

RECOMMENDATION:
Revise text

602.0 Material.
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums. Gypsum board shall not be used for positive pressure ducts. Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the last sentence and second sentence contradict each other regarding concealed spaces being used as ducts or plenums. In addition, there is confusion regarding the meaning of “concealed spaces.”

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 17  NEUTRAL: 0  NEGATIVE: 12  NOT RETURNED: 1  Heine

Note: Item # 138 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF NEGATIVE:

ADLER, MANN: I am in agreement with the comment made by Dave Dias.

AGUILAR: This item should be reconsidered or brought back during public comment. Life and safety issues for the occupants of the buildings should always come before cost or ease of design.

BENKOWSKI: Qualifications for air movement through chases created by building materials will need to be defined for appropriate enforcement in the field.

BERGER: After reviewing the comments for this proposal, I agree it should be reconsidered for public comment.

DIAS: After further consideration of the health and safety of building occupants and workers, I am voting Negative because I really believe that concealed spaces and building materials should not be used as ducts or plenums. No standards exist for constructing ducts or plenums out of building materials.

FENTY: This item places the costs of building construction above the life and safety of the building occupants.

HAMILTON: Why allow materials for duct systems that are not required to meet adopted duct construction standards?
RIBBS: I am voting Negative because I really believe that concealed spaces and building materials in healthcare facilities should not be used as ducts or plenums. No standards exists for constructing ducts or plenums out of building materials.

SEWELL: This item should be reconsidered or brought back during public comment. Life and safety issues for the occupants of the buildings should always come before cost or ease of design.

VAN RITE: I agree that using building materials for ducts is unregulated and therefore should not be allowed. This proposal should be given another chance in public comments.

YOUNG: This item should be reconsidered or brought back during public comment. Life and safety issues for the occupants of the buildings should always come before cost or ease of design.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.1  Item #: 138

SUBMITTER: John R Hamilton
International Certification Board
Rep. DLS

RECOMMENDATION:

Revise text

Request to replace the code change proposal by this public comment.

602.0 Material.

602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall not be permitted to be used as ducts or plenums. Gypsum board shall not be used for positive pressure ducts.

Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION:

Ducts shall be built to meet a standard as per the ASHRAE Design Handbook.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 602.1  Item #: 138

SUBMITTER: Marcelo M. Hirschler
GBH International

RECOMMENDATION:

Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Do not revise the language as proposed. As the committee statement indicates, the proposed revised language is inconsistent with the sentence stating that concealed spaces are permitted to be used as ducts or plenums. NFPA 90A provides clear instructions as to how to build ducts or plenums out of building materials by requiring appropriate fire performance for the materials to be used in plenum construction. The exception for healthcare facilities is related simply to special considerations associated with the transmission of pathogens in those occupancies, coming from, or leading to, patient rooms and the like. That is not an issue that applies to other occupancies.
Proposals

Item #: 139

UMC 2024  Section: 602.1

SUBMITTER:  John R Hamilton
             International Certification Board
             Rep. DLS

RECOMMENDATION:
Revise text

602.0 Material.
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall be permitted to be used as ducts or plenums. Gypsum board shall not be permitted to be used as ducts or plenums used for positive pressure ducts.
Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as it eliminates a widely used construction method. This would result in a significant change in future installed work. If gypsum board is not permitted for such installation, documentation from gypsum board manufacturers should have been submitted to support the proposed changes.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29    NOT RETURNED: 1    Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.1                                          Item #: 139
SUBMITTER: John R Hamilton
           International Certification Board
           Rep. DLS

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

602.0 Material.
602.1 General. Materials used for duct systems shall comply with Section 602.2 through Section 602.6 as applicable. Concealed building spaces or independent construction within buildings shall not be permitted to be used as ducts or plenums. Gypsum board shall not be used for positive pressure ducts.
Exception: In healthcare facilities, concealed spaces shall not be permitted to be used as ducts or plenums.
SUBSTANTIATION:
Ducts shall be built to meet a standard as per the ASHRAE Design Handbook.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 602.1  Item #: 139


RECOMMENDATION:
Revise text
Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Tim Earl:
The substantiation statement given by the proponent is incorrect and misleading. The Gypsum Association is in favor of the use of gypsum panels as ductwork, and relies upon limitations and criteria set forth in the code, in the case of the UMC criteria set forth in Chapter 6, for the proper application and installation. Gypsum panel ducts provide a fire-resistant and efficient means of moving air and are a common practice in construction and have been for many years without issues.

Marcelo Hirschler:
Continue rejecting this proposal.

The second sentence of the code, proposed to be deleted by the proposal, is consistent with the exception and the code would not work properly if it is deleted. Also, there is no valid justification for banning gypsum board ducts from the code. They have been used successfully for years and are also referenced in the IMC and in NFPA 90A. The statement that no standard exists is not a valid reason.

PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 209.0  Item #: 139

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text
Request to replace the code change proposal by this public comment.

209.0 – G –
Gypsum Board (Wallboard). A type of gypsum panel product consisting of a noncombustible core primarily of gypsum with paper surfacing.

SUBSTANTIATION:
This comment adds a commonly used definition for gypsum board/gypsum wallboard since the term is used in the code. The definition harmonizes with other codes, ASTM and industry standards. Defining the term will assist code users in complying with code requirements, such as the requirement in Section 602.1, which states, “Gypsum board shall not be used for positive pressure ducts.”
Proposals

Item #: 140
UMC 2024  Section: 602.1.1

SUBMITTER: John R Hamilton
    International Certification Board
    Rep. DLS

RECOMMENDATION:
Add new text

602.0 Material.
602.1 General. (remaining text unchanged)
602.1.1 Duct Construction. All HVAC ducts and plenums conveying air shall be built to SMACNA standards recognized in the HVAC industry, ANSI, or organizational standards for construction and installation.

SUBSTANTIATION:
ASHRAE recommends all HVAC ducts are made to a standard. There is no standard for using building materials as ductwork. The Gypsum Association does not recommend or have a standard to make ducts out of gypsum.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 22  NEGATIVE: 6  ABSTAIN: 1  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: As written, this proposal has no specific requirement. Without reference to specific standards, the new text is meaningless.

FEEHAN: This language is not necessary.

KOERBER: Although the intent of the proposal appears to be centered on the use of gypsum material for duct construction, the proposal as written would create confusion and potentially limit other duct materials already accepted by current language within the code.

MACNEVIN: The proposed language is not appropriate code language as it would allow ducts and plenums to be built to any standard by any organization, but with no listed standards nor any requirements for certification. The approved new language will create confusion unless it is fixed in public comment.

WHITE: Poor language. How do we determine which SMACNA standards are recognized by the industry and which are not? Too vague and unenforceable.

WISEMAN: Vague and unenforceable.

EXPLANATION OF ABSTAIN:
TERZIGNI: The change could materially affect SMACNA so I will abstain unless required to break a tie.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.1.1  Item #: 140


Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Tim Earl:
The substantiation statement given by the proponent is incorrect and misleading. The Gypsum Association is in favor of the use of gypsum panels as ductwork, and relies upon limitations and criteria set forth in the code, in the case of the UMC criteria set forth in Chapter 6, for the proper application and installation. Gypsum panel ducts provide a fire-resistant and efficient means of moving air and are a common practice in construction and have been for many years without issues.

Marcelo M. Hirschler:
Reject this proposal. As explained by committee members Julius Ballanco and Ralph Koerber, requiring compliance with unnamed standards is unenforceable. Moreover, a key consideration for duct construction is fire safety and this is covered appropriately in NFPA 90A (Standard for the Installation of Air-Conditioning and Ventilating Systems), issued by the companion organization to IAPMO, and not in the SMACNA standards. NFPA 90A appropriately discusses that the ASHRAE Handbook and the applicable SMACNA or NAIMA standards or manuals are to be used in addition to all other safety considerations. Note that NFPA 90A also includes gypsum board air ducts, when appropriate. It would appear that this proposal could be considered to negate that.

David C. Bixby:
The proposal is vague, unenforceable, and not necessary. In addition, the proposal appears to be prohibiting the long-standing use of building materials like gypsum as a plenum for conveying air by requiring all ducts and plenums to be certified to an industry recognized standard. This is design restrictive and will potentially cause confusion in the field as far as approval of air passageways.

Julius Ballanco:
There is no means to enforce this proposed new section. There are no standards listed. What standard should an engineer use to design the system? What standard does a contractor use to install the system? Finally, what standard does the AHJ follow when inspecting the system.

If there are appropriate standards, then they should be added. But a broad based statement is subjective. The Manual of Style states, "All mandatory language shall be reviewed for usability, adoptability, and enforceability." The proposed text fails all three points.
Proposals

Item #: 141
UMC 2024  Section: 602.2, 602.2.5, Table 1701.1

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) through (4) (remaining text unchanged)
(5) Products listed and labeled for installation within plenums in accordance with Section 602.2.1 through Section 602.2.3 602.2.5.
(6) through (8) (remaining text unchanged)

602.2.5 Water Distribution Piping. Nonmetallic water distribution piping in plenums shall be listed and labeled for use in plenums. Piping shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15 and a peak optical density not exceeding 0.5, where tested in accordance with UL 2846, or shall have a flame spread index not to exceed 25 and a smoke developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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</tr>
</thead>
<tbody>
<tr>
<td>UL 2846-2014</td>
<td>Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics (with revisions through December 20, 2016)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM E84, UL 723, and UL 2846 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Adds new section for inclusion of UL 2846, Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics, as an alternative plenum test standard to ASTM E84 / UL 723. This is similar to other standards in the UMC which are product specific, such as; UL 1887 (602.2.2 Fire Sprinkler Piping) and UL 1820 (602.2.3 Pneumatic Tubing). The UL 2846 standard has been in the IMC since the 2014 version.

COMMITTEE ACTION: REJECT
COMMITTEE STATEMENT:
The proposal is being rejected as there is concern that the language may reduce the safety level of existing plenum requirements. Additionally, there are concerns with the method and size of the test specimen, mounting procedures, and the time of the test used in UL 2846 as compared to ASTM E84.

An explanation of the testing methods in question are necessary for approval. Upon review of the proposed standards, it was determined that ASTM E84 is meant for testing of sheets and not piping.

Additionally, the UL 2846 standard has an entirely different test method/protocol than ASTM E84 and provides differing results. For this reason, the existing language is being kept. Furthermore, the proposed language conflicts with Section 602.2.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:   AFFIRMATIVE: 21   NEGATIVE: 8   NOT RETURNED: 1   Heine

EXPLANATION OF NEGATIVE:

BALLANCO: The substantiation justified this change. This should have been approved as submitted.

CUDAHY: The rejection should be overturned in ballot. UL 2846, Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics, is an alternative plenum test standard to ASTM E84/UL 723 similar to other standards already in the UMC which are product specific to rod and tube like products, such as UL 1887 (Section 602.2.2 Fire Sprinkler Piping) and UL 1820 (Section 602.2.3 Pneumatic Tubing). The UL 2846 standard has been in the IMC since the 2014 version.

KOERBER: Proposal should be accepted. The substantiation is sound.

MACNEVIN: I agree that the committee rejection should be overturned. The committee statement is inaccurate, because UL 2846 is actually a safer and more consistent test method for plastic pipes, as compared with ASTM E84 which was intended for flat sheet products, and is therefore open to potential misuse or misinterpretation. UL 2846 is an ANSI-accredited standard that is no less stringent than ASTM E84 and in fact does a better job at standardizing the testing of plastic pipes without misuse or misinterpretation, allowing for safer construction. As mentioned, UL 2846 was accepted in the IMC several code cycles ago, so unless this vote is reversed, the UMC is out-of-date with regards to plenum safety with plastic pipes.

TRAFTON, A: This section is appropriate and should be in code.

TRAFTON, P: This should have been accepted as it clearly provides proper safety for piping within plenums.

WHITE: This should be approved based on its substantiation.

WISEMAN: The substantiation is adequate for this proposal. This should have been approved.

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Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.2, 602.2.5, Table 1701.1  Item #: 141

SUBMITTER: Michael Cudahy  PPFA  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The UL 2846 standard “Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics” is proposed as an addition to the Uniform Mechanical Code.
It should be noted that UL 2846 does not encompass plastic pipe applications other than those that transport and distribute pressurized fluids as outlined in the scope of UL 2846 up to and including 4” in diameter. UL 2846 does not address drain, waste, & vent (DWV) applications and furthermore strictly prohibits the pipes being tested from being filled with any fluids during testing. (e.g. the pipe is tested empty and dry).

UL 2846 is a product standard equivalent to the following fire test standards currently referenced in UMC Chapter 17 for combustible products used in ducts and plenums with similar cylindrical and wire/cable-like shapes and aspect ratios:

- Wire and cable products (NFPA 262)
- Pneumatic Tubing products (UL 1820)
- Plastic sprinkler pipe products (UL 1887)
- Optical Fiber Raceways (UL 2024)

The standard has been approved in the IMC for many development cycles. UL 2846 is not a better or a poorer test than an ASTM E84 test: It is an alternate test method which uses the same furnace and furnace operating conditions as ASTM E84 but is specific to a product – plastic water distribution piping.

Based on correlations of smoke levels produced under ASTM E84 protocols with levels of optical density of smoke produced during UL 2846 testing, the methods are functionally equivalent. This is also based on acceptance of NFPA 262, UL 1887, UL 2024 and UL 1820 among others. It should also be noted that UL 2846 as well as other UL standards mentioned here are 20-minute tests which provides for twice the exposure time of 10 minutes required by ASTM E84.


UL 2846 should be an approved standard in this code. Thank you.
TABLE 1801.1
REFERENCED STANDARDS

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<thead>
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<tr>
<td>UL 2846-2014</td>
<td>Fire Test of Plastic Water Distribution Plumbing Pipe for Visible Flame and Smoke Characteristics (with revisions through January 14, 2019)</td>
<td>Surface Burning Test, Plastic Pipe</td>
<td>602.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 2846 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Both the IMC and NFPA 90A allow, as an exception, the use of "plastic water distribution piping and tubing" listed in accordance with UL 2846 as an alternative to those tested to ASTM E84. The committee statement is correct in that ASTM E84 is a test for sheet materials and does not have any specific requirements or recommendations for testing pipes. For that reason, and because committee ASTM E5 (which issues ASTM E84) could not reach consensus on a mounting practice for pipes in ASTM E84 (as contrasted with the mounting practice for pipe insulation, ASTM E2231, already referenced in the UMC), UL developed UL 2846 as a fire test method that applies only to a subset of plastic pipes (namely "individual pairs of plastic plumbing pipes for distribution of potable water that can be installed in ducts, plenums, and other spaces used for environmental air"). UL 2846 utilizes a modified version of the ASTM E84 test apparatus and determines different properties (flame spread distance, average optical density and peak optical density, as opposed to flame spread index and smoke developed index). In fact, the equipment used for UL 2846 is the same as that used for NFPA 262 and UL 1887, which are used in the UMC for other products.

The wording in the original proposal is flawed and cannot be accepted because there is no way of testing piping in the ASTM E84 test "as a composite product"; it can only be tested as a sheet material since no method exists for doing otherwise. Also, the original proposal created a conflict between the new exception (where piping is tested with all the requirements of ASTM E84 and the new exception where it is supposed to be tested in some other (unidentified) fashion. The addition of the language referring to testing as a "composite product" is most likely intended as a way of allowing testing of piping full of water, which neither ASTM E84 nor UL 2846 allow.
Proposals

Item #: 143

UMC 2024  Section: 602.2

SUBMITTER: Michael Cudahy
Plastic Pipe & Fittings Association

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping Combustible materials installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) through (8) (remain unchanged)

SUBSTANTIATION:
The language, being specific to only plastic piping suggests other combustible materials may not be required to be tested in accordance with or to all requirements of ASTM E84 or UL 723. The last sentence is redundant to the previous.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Removing the existing language would create conflicts with other sections of the code. If this language is removed, it will no longer align with the other sections of the code and may cause confusion. The language should stay for guidance for all users of the code. Additionally, the change would allow all combustible materials to be installed in plenums rather than only plastic piping. All combustible materials would need to be tested to ASTM E84 or UL 723.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 22  NEGATIVE: 6  ABSTAIN: 1  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:
BALLANCO: This section needs to be modified, however, the change results in the first and second sentences saying the same thing. The second and third sentences should be deleted.

EXPLANATION OF NEGATIVE:
CUDAHY: The Committee statement is really inaccurate and the existing language is broken. There are exceptions for many products to the section. The requirement should not apply to just one class of product.

MACNEVIN: This proposal should be accepted as it adds safety to and reduces confusion from the code. Expanding the requirement to all "combustible materials" improves safety. Removing the last sentence reduces confusion, since the ASTM E84 and UL 723 standards should dictate the specific testing and mounting requirements, not the code.

TRAFTON, A: I agree with Michael Cudahy.
TRAFTON, P: This section needs modification as it does not seem to match its heading, but the suggested change does not improve it. Time should be taken to get it right.

WHITE: The section could stop after the first sentence, the remaining text is redundant. As proposed, it does clean up the section.

WISEMAN: This should have been accepted. Michael Cudahy is correct. The Committee statement is really inaccurate and the existing language is broken. There are exceptions for many products to the section. The requirement should not apply to just one class of product.

EXPLANATION OF ABSTAIN:

KOERBER: It is my belief that the entire last 2 sentences, "Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited" should have been relocated as Section 602.2.5 in the same manner as electrical wiring in plenums, fire sprinkler piping in plenums, pneumatic tubing in plenums, and discrete products in plenums. Placing plastic piping in its present location was not the best choice from the start.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.2  Item #: 143
SUBMITTER: Marcelo M Hirschler
GBH International  Comment #: 1

RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Continue rejecting this proposal.

The last sentence of Section 602.2, proposed to be deleted by the proposal, is very important because it ensures that testing to ASTM E84 is not conducted by means of inappropriate mounting methods that are inconsistent with ASTM E84, such as adding water into plastic piping. For this reason, NFPA 90A added wording that is similar in concept, and the section reads as follows: "Plastic piping and tubing used in plumbing systems shall be permitted to be used within a ceiling cavity plenum if it exhibits a flame spread index of 25 or less and a smoke developed index of 50 or less when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or UL 723, Test for Surface Burning Characteristics of Building Materials, at full width of the tunnel and with no water or any other liquid in the pipe during the test."

The addition of water into pipes is an inappropriate means of testing and is inconsistent with ASTM E84 or NFPA 90A.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 602.2  Item #: 143
SUBMITTER: Michael Cudahy
PPFA  Comment #: 2

RECOMMENDATION:
Revise text
Request to replace the code change proposal by this public comment.

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) through (8) (remaining text unchanged)

SUBSTANTIATION:
The modification is to delete entirely the last two sentences of Section 602.2 as all the needed information is in the initial sentence. Per the committee, "Removing the existing language would create conflicts with other sections of the code. If this language is removed, it will no longer align with the other sections of the code and may cause confusion. The language should stay for guidance for all users of the code. Additionally, the change would allow all combustible materials to be installed in plenums rather than only plastic piping. All combustible materials would need to be tested to ASTM E84 or UL 723." The last two sentences should not be to a specific product or eliminate existing listing tests.
Proposals

Item #: 144

UMC 2024  Section: 602.2.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. (remaining text unchanged)
602.2.1 Electrical. Electrical wiring in plenums shall comply with NFPA 70. Electrical wires and cables and optical fiber cables exposed within the plenum shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with NFPA 262, or shall be installed in metal raceways or metal sheathed cable.

Combustible optical fiber and communication raceways exposed within a plenum shall be listed and labeled for use in plenums and shall have a flame spread distance not greater than 5 feet (1524 mm), an average optical density not greater than 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with UL 2024. Only plenum-rated wires and cables shall be installed in plenum-rated raceways.

TABLE 1701.1
REFERRED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2024-2014</td>
<td>Cable Routing Assemblies and Communications Raceways (with revisions through August 5, 2015)</td>
<td>Miscellaneous</td>
<td>602.2.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 2024 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This code change differentiates the requirements for electrical wiring and optical fiber cables in plenums from the requirements for optical fiber cable and communication raceways in plenums. The appropriate standard for the raceways is UL 2024, “Cable Routing Assemblies and Communications Raceways.”

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language is being rejected as the provisions are already covered in Section 602.2.1 and the NFPA 262 standard. These provisions should be addressed in the electrical code. The language is repetitive and should be rewritten to clarify the intent.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 21  NEGATIVE: 8  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted as submitted. The substantiation justifies the proposed change.

FEEHAN: This language and information is necessary for enforcement.

KOERBER: The substantiation is correct and sound. This proposal should be accepted.

MACNEVIN: This proposal should be accepted as submitted as it adds safety to the code. It is appropriate that requirements for communications wiring within ductwork are listed in the UMC, just as requirements for plumbing pipes and other materials installed within ducts are listed in the UMC. UL 2024 is the correct standard for this application.

TRAFTON, A: The substantiation is appropriate for this code change.

TRAFTON, P: This change is properly written and appropriate for this section of the Code, plus its substantiation justifies the change. This method of installation is correct and necessary. It should not have been rejected.

WHITE: The proposal is appropriate, not redundant, and improves the code.

WISEMAN: This proposal is necessary and well written. It would be helpful addition.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 602.2.1, Table 1801.1  Item #: 144

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:

Revise text

Request to accept the code change proposal **as submitted** by this public comment.

SUBSTANTIATION:

This code change differentiates the requirements for electrical wiring and optical fiber cables in plenums from the requirements for optical fiber cable and communication raceways in plenums. The appropriate standard for the raceways is UL 2024, “Cable Routing Assemblies and Communications Raceways.”

The current code requirement does not include provisions for combustible optical fiber and communication raceways. What is currently covered in the code is only the wires and cables, not the raceways. The testing requirements for these raceways are not within the scope of NFPA 262.

These provisions should be addressed in the mechanical code, because Section 602 is addressing what is permitted to be installed within an air plenum. This is within the scope of the mechanical code.

In addition to differentiating between the wiring, cables, and raceways, this proposal also clarifies that either (1) the electrical wiring and optical fiber cables that are exposed within the plenum need to meet the requirements of NFPA 262, or (2) can be installed within metal raceways or metal sheathed cable. The second installation method (within metal raceways or metal sheathed cable) does not require the testing to NFPA 262, because the combustible material is not exposed within the plenum.

This proposal is written in the same manner as what is written in NFPA 90A on this specific subject. NFPA 90A is an ANSI installation standard.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 602.2.5, Table 1801.1  Item #: 144

SUBMITTER: Marcelo Hirschler  GBH International  Comment #: 2

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

602.0 Material.

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
1) through (8) (remaining text unchanged)

602.2.1 Electrical. Electrical wiring in plenums shall comply with NFPA 70. Electrical wires and cables and optical fiber cables shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with NFPA 262.

602.2.2 Fire Sprinkler Piping. Nonmetallic fire sprinkler piping in plenums shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15 and, a peak optical density not exceeding 0.5, where tested in accordance with UL 1887.

602.2.3 Pneumatic Tubing. Nonmetallic pneumatic tubing in plenums shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with UL 1820.

602.2.4 Discrete Products in Plenums. Discrete plumbing, mechanical, and electrical products that are located in a plenum and have exposed combustible material shall be listed and labeled in accordance with UL 2043.

602.2.5 Combustible Cable Routing Assemblies and Communications Raceways. Combustible cable routing assemblies and communications raceways in plenums shall be listed and labeled for use in plenums and shall have a flame spread distance not exceeding 5 feet (1524 mm), an average optical density not exceeding 0.15, and a peak optical density not exceeding 0.5, where tested in accordance with UL 2024.

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<tbody>
<tr>
<td>UL 2024-2014</td>
<td>Cable Routing Assemblies and Communications Raceways (with revisions through August 5, 2015)</td>
<td>Fire test for surface burning characteristics – cable routing assemblies and communications raceways</td>
<td>602.2.5</td>
</tr>
</tbody>
</table>

(Note: UL 2024 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.)

SUBSTANTIATION:
UL 2024 was developed by UL to deal with cable routing assemblies and communications raceways, which are the products in which electrical cable or optical fiber cables are held in place in plenums. These products are not cable and are not electrical or optical fiber products. They differ from one another in that cable routing assemblies are open and the cables are just laid inside, while raceways contain the cables enclosed in them.

Both NFPA 90A and the IMC accept that cable routing assemblies and communications raceways are permitted in plenums if listed and labeled as complying with the pass fail criteria of UL 2024.)
Both the apparatus and the procedure of UL 2024 are different from those in ASTM E84 or UL 2846. Although the basic equipment is the same (25 ft Steiner tunnel), a tray has been added to UL 2024 (same as to NFPA 262 and UL 1887, already referenced in the UMC) to contain the test specimens. Also, UL 2024 measures flame spread distance, average optical density and peak optical density and not flame spread index of smoke developed index like ASTM E84.

Please accept the proposal as modified and be consistent with other requirements as well as with requirements for other products.
Proposals

Item #: 145
UMC 2024  Section: 602.3

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Add new text

602.0 Material.

602.3 Tall Wood (Mass Timber) Buildings. Duct systems installed in Type IV-A, Type IV-B, or Type IV-C tall wood (mass timber) buildings shall comply with the following:
(1) Be designed by a registered design professional in accordance with this code and the building code.
(2) Duct systems shall have a flame-spread index and a smoke developed index in accordance with Section 602.2.
(3) Smoke dampers, fire dampers, and ceiling dampers shall be in accordance with Section 606.0.
(4) Be designed to accommodate expansion, contraction, and differential movement between parts of a mass timber building.

(renumber remaining sections)

(below shown for reference only)

602.2 Combustibles Within Ducts or Plenums. Materials exposed within ducts or plenums shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested as a composite product in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

Exceptions:
(1) Return-air and outside-air ducts, plenums, or concealed spaces that serve a dwelling unit.
(2) Air filters in accordance with the requirements of Section 311.2.
(3) Water evaporation media in an evaporative cooler.
(4) Charcoal filters where protected with an approved fire suppression system.
(5) Products listed and labeled for installation within plenums in accordance with Section 602.2.1 through Section 602.2.3.
(6) Smoke detectors.
(7) Duct insulation, coverings, and linings and other supplementary materials installed in accordance with Section 605.0.
(8) Materials in a hazardous fabrication area including the areas above and below the fabrication area sharing a common air recirculation path with the fabrication area.

606.0 Smoke Dampers, Fire Dampers, and Ceiling Dampers.

606.1 Smoke Dampers. Smoke dampers shall comply with UL 555S, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code.

606.2 Fire Dampers. Fire dampers shall comply with UL 555, and shall be installed in accordance with the manufacturer’s installation instructions where required by the building code. Fire dampers shall have been tested for closure under airflow conditions and shall be labeled for both maximum airflow permitted and direction of flow. Where more than one damper is installed at a point in a single air path, the entire airflow shall be assumed to be passing through the smallest damper area.

Ductwork shall be connected to damper sleeves or assemblies in accordance with the fire damper manufacturer’s installation instructions.
606.3 Ceiling Radiation Dampers. Ceiling radiation dampers shall comply with UL 555C, and shall be installed in accordance with the manufacturer’s installation instructions in the fire-resistant ceiling membrane of floor-ceiling and roof-ceiling assemblies where required by the building code. Fire dampers not meeting the temperature limitation of ceiling radiation dampers shall not be used as a substitute.

606.4 Multiple Arrangements. Where size requires the use of multiple dampers, each damper shall be listed for use in multiple arrangements and installed in accordance with the manufacturer’s installation instructions.

606.5 Access and Identification. Fire and smoke dampers shall be provided with an approved means of access large enough to allow inspection and maintenance of the damper and its operating parts. The access shall not affect the integrity of the fire-resistance-rated assembly. The access openings shall not reduce the fire-resistance rating of the assembly.

   Access shall not require the use of tools. Access doors in ducts shall be tight fitting and approved for the required duct construction. Access points shall be permanently identified on the exterior by a label with letters not less than 1/2 of an inch (12.7 mm) in height reading as one of the following:

(1) Smoke Damper
(2) Fire Damper
(3) Fire/Smoke Damper

606.6 Freedom from Interference. Dampers shall be installed in a manner to ensure positive closing or opening as required by function. Interior liners or insulation shall be held back from portions of a damper, its sleeve, or adjoining duct that would interfere with the damper’s proper operation. Exterior materials shall be installed so as to not interfere with the operation or maintenance of external operating devices needed for the function of the damper.

606.7 Temperature Classification of Operating Elements. Fusible links, thermal sensors, and pneumatic or electric operators shall have a temperature rating or classification as in accordance with the building code.

SUBSTANTIATION:
The building codes include Type IV tall wood buildings (also known as mass timber construction) which are constructed with fire resistive ratings of either three or two hours. Proposed Section 602.3 provides information and direction for fire resistive ratings associated with mass timber construction.

There are no prescriptive requirements for allowance of expansion and contraction of mass timber buildings either during or after completion of construction. Current studies that are monitoring the moisture performance of mass timber building during construction utilize monitors, and there is indication that the mass timber expands during construction and contracts over time. The proposed Section 602.3 provides guidance for the mechanical system design within wood buildings constructed of Type IV-A, Type IV-B, or Type IV-C.

[Supporting documentation provided in KAVI for TC review]

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

602.0 Material.

602.3 Tall Wood (Mass Timber) Buildings. Duct systems installed in Type IV-A, Type IV-B, or Type IV-C tall wood (mass timber) buildings shall comply with the following:

(1) Be designed by a registered design professional in accordance with this code and the building code.
(2) Duct systems shall have a flame-spread index and a smoke developed index in accordance with Section 602.2.
(3) Smoke dampers, fire dampers, and ceiling dampers shall be in accordance with Section 606.0.
(4) Be designed to accommodate expansion, contraction, and differential movement between parts of a mass timber building.

COMMITTEE STATEMENT:
The proposed modification is to remove the listed Types (4A, 4B or 4C). All such types are already found in the building code and are better suited in that location. Including the various types may cause confusion for users of the code.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 19 NEGATIVE: 10 NOT RETURNED: 1 Heine

Note: Item # 145 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.
EXPLANATION OF NEGATIVE:

BALLANCO: This change is unnecessary. There are no special mechanical requirements for tall wood buildings.

CUDAHY: This is an unnecessary language for a subject that the building code would address, if needed.

FEEHAN: This language is unnecessary. A pointer to the building code would be better.

KOERBER: The language proposed is not needed.

MACNEVIN: This change is not appropriate, as there is no need to add duct requirements for each specific type of building construction, which is what this item begins to do. There are no special mechanical requirements for tall wood buildings, and the language is redundant.

TERZIGNI: The change does not provide any real benefit and it does not prescribe (directly or by reference to a standard) how to address the concerns presented.

TRAFTON, A: This does not belong in UMC but as a building code item.

TRAFTON, P: Tall wood buildings belong in the building code and there are no special mechanical details and requirements needed for this type of building.

WHITE: This not appropriate for the UMC, these requirements exist for many types of structures and need not be singled out for one specific type of construction.

WISEMAN: This is not appropriate for the UMC. A reference to the building code would be sufficient.

Appended Comments

PUBLIC COMMENT 1: (Assembly Action)

Code Year: 2024 UMC  Section #: 602.3  Item #: 145

SUBMITTER: Phillip H Ribbs  PHR Consultants  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

602.0 Material.

602.3 Tall Wood (Mass Timber) Buildings. Duct systems installed in tall wood (mass timber) buildings shall comply with the following:
(1) Be designed by a registered design professional in accordance with this code and the building code.
(2) Duct systems shall have a flame-spread index and a smoke developed index in accordance with Section 602.2.
(3) Smoke dampers, fire dampers, and ceiling dampers shall be in accordance with Section 606.0.
(4) Be designed to accommodate expansion, contraction, and differential movement between parts of a mass timber building.

SUBSTANTIATION:
This code proposal, UMC Item # 145, was reviewed during the Assembly Consideration Meeting by the IAPMO Membership, and it was approved with an overwhelming vote to be approved as modified. Furthermore, the TC written ballot failed to achieve the 2/3 affirmative vote by 1 vote.

The building codes include Type IV tall wood buildings (also known as mass timber construction) which are constructed with fire resistive ratings of either three or two hours. Proposed Section 602.3 provides information and direction for fire resistive ratings associated with mass timber construction.

There are no prescriptive requirements for allowance of expansion and contraction of mass timber buildings either during or after completion of construction. Current studies that are monitoring the moisture performance of mass timber building during construction utilize monitors, and there is indication that the mass timber expands during
construction and contracts over time. The proposed Section 602.3 provides guidance for the mechanical system design within wood buildings constructed of Type IV-A, Type IV-B, or Type IV-C.

I have provided supporting information on tall wood buildings, as follows:
1. Monitoring Moisture Performance of CLT
2. Type of Construction Comparison
3. WCTE 2018 Hygrothermal behavior of Mass Timber

[Supporting documentation provided in KAVI for TC review]

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 602.3  Item #: 145

SUBMITTER: Paul Armstrong, American Wood Council (AWC); Marcelo M. Hirschler, GBH International; Michael Cudahy, PPFA; Julius Ballanco, P.E., JB Engineering and Code Consulting, P.C., Rep. Self; Lance MacNevin, Plastic Pipe Institute

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Paul Armstrong:
The proposed new text is unnecessary and lacks justification. There is no technical justification for the limitations being placed on systems installed in “tall wood (mass timber) buildings.” Specifically, the following are relevant to the committee’s deliberations:
1) The phrase “tall wood (mass timber) buildings” as used in the proposed text is not defined and will lead to inconsistent and misinterpretation of the code.
2) The assertion that mass timber buildings are likely to experience expansion and contraction “over time” is incorrect. In fact, construction tolerance of mass timber building elements is more exact than with other materials. Also, the studies monitoring the moisture performance referenced in the reason statement are unknown to the American Wood Council.
3) The new types of mass timber recognized in the 2021 International Building Code and NFPA 5000 have life safety safeguards for occupants and fire responders the exceed what is required for non-combustible buildings of the same height and of unlimited building area.

Use of the phrase “tall wood (mass timber) buildings”
The phrase “tall wood (mass timber) buildings” is not a defined term in the building code, the term could easily be misinterpreted to include structures outside of the scope of Type IV-A, IV-B, and IV-C buildings. The 2021 IBC introduces new allowable height and area limitations for fire resistance rated mass timber buildings. These types of construction are in addition to what has historically been permitted for heavy timber construction, which remains unchanged in both model codes.

Dimensional Change in Mass Timber Buildings

The provided substantiation relies heavily on the assertion that expansion or contraction of tall mass timber is not properly addressed in the building code and manufacturing process. The very nature of mass timber construction limits expansion and contraction. Tall mass timber is designed so that columns bear directly on end-grain, typically using a steel pedestal so the columns do not bear directly on the floor assembly. This is best illustrated in the following article, which states, “The amount a piece of wood will shrink lengthwise, called longitudinal shrinkage, is so small—typically about 0.1% to 0.2%—that it is usually inconsequential to the volumetric shrinkage.”
https://www.wood-database.com/wood-articles/dimensional-shrinkage/

Lumber used to manufacture Cross Laminated Timber (CLT) and glued laminated timber is dried to a predetermined moisture content of between 10% - 12% prior to fabrication. The exact moisture content of the lumber may be selected based on the geographical location of the building for which it is being fabricated. This is done to closely replicate the final equilibrium moisture content that is expected based on the building location. This ensures
the moisture content at the time of fabrication will closely resemble the final equilibrium moisture, thereby, mitigating dimensional change between the time of fabrication and building use. Mass timber will reach an equilibrium moisture content between 8% - 9% during the building’s useful life. When combined with typical detailing found in mass timber construction, dimensional change is minimal.

In The Brock Commons Project (an 18-story mass timber student housing building on the campus of the University of British Columbia in Vancouver) it is stated that the “tolerances are measured in millimeters.”
https://www.youtube.com/watch?v=FmuJ4XeHsbo

The precision of mass timber fabrication and machining is to the nearest millimeter. Mass timber construction generally results in tighter tolerances than steel or concrete construction. This is beneficial when prefabricating components of plumbing and mechanical systems. The dimensional changes along the length (and, for cross laminated timber (CLT), along the width) are negligible. In tall wood buildings, bearing of wood elements perpendicular to grain are avoided. Compression perpendicular to grain, is avoided by using steel pedestals to maintain column end-grain bearing through floor assemblies. Given the above points, it is not substantially different from other materials.

This proposal is also unnecessary. Chapter 23 of the International Building code already includes a requirement for shrinkage analysis (IBC 2304.3.3). It states:

2304.3.3 Shrinkage. Wood walls and bearing partitions shall not support more than two floors and a roof unless an analysis satisfactory to the building official shows that shrinkage of the wood framing will not have adverse effects on the structure or any plumbing, electrical or mechanical systems or other equipment installed therein due to excessive shrinkage or differential movements caused by shrinkage.

Given the above points, it is not substantially different from other materials.

Lastly, in the mass timber project Limnologen in Växjö, Sweden, it included very detailed expansion and contraction documentation. A scholarly journal concluded that the daily variation and sum annual movement in the wood was less than that of concrete and steel construction. https://www.semanticscholar.org/paper/Vertical-Displacements-in-a-Medium-rise-Timber-%3A-in-Zeng-Ren/c06fd3da2f39a5a226374398f521536e4ea8e0ad

Fire Performance of Mass Timber Buildings

Mass timber construction requires safeguards not required by other construction types, not to mention the inherent fire resistance of the mass timber itself. All mass timber buildings must be sprinklered with a full NFPA 13 system. Shafts (where pipes would usually run) and concealed spaces must be covered with at least 40 minutes of noncombustible protection, usually one layer of 5/8th Type X gypsum fire rated wall board or manufactured from noncombustible materials. If the building is over 120 feet, it must have redundant water supplies, which means two fire pumps, fed by two independent water sources, from two different water mains.

Conclusion

This proposal provides no technical justification for the proposed requirement, and provides no documentation, footnotes, or references to even verify its claims. The proposal is out of sync with the new building code requirements and places a restriction in the mechanical code that is unjustified. We ask that this proposal be disapproved.

Marcelo M. Hirschler:
Delete proposed new text both as recommended by the proposal and as amended by the committee.

As indicated by several committee members, this is not a mechanical code issue, and it is covered by the building code. If any special requirements were needed for mechanical issues in tall wood buildings, they should have been brought forward and they were not. Adding this could create a conflict with the building code.

Michael Cudahy:
Mass timber construction does not require additional limitations on materials or installation in the UPC or UMC. These proposed restrictions are technically unjustified, redundant in places when discussing expansion and contraction, and would create conflicts with the commonly adopted International Building Code and other building codes. If some unique engineering is required, we would expect the wood industry to include it in the building codes.
Julius Ballanco:
This proposal is unnecessary and not consistent with the Building Code. There is no Building Code requirement for duct systems to have a flame spread index of 25 or less, nor is there a requirement for a smoke developed index of 50 or less. The proponent references the section for ducts located within a plenum. A tall wood building is not a plenum. Furthermore, what part of a duct system must meet these requirements?

The other items listed are already addressed in the code. There is nothing special in the requirements. This change must be rejected.

Lance MacNevin:
PPI supports the decision of the UMC TC that rejected this proposed addition in 2021.

This proposed addition was submitted without a technically supported Statement of Problem and Substantiation, and it is unclear what problems this new language is intending to resolve or prevent. Further, there are several technical issues with the proposal which should be the basis for its rejection:

602.3: No definition is provided in this Code for a “Mass Timber Building,” so the application of this entire section is subject to misinterpretation.

602.3 (1): According to Sec. 104.3.1 of this code, it is currently required that “The construction documents, computations, and specifications shall be prepared by, and the mechanical system designed by, a registered design professional." There is no reason to restate this requirement for Mass Timber Buildings. Therefore, the new language is redundant and unnecessary, and will add confusion to the code.

602.3 (2): This proposed language is redundant and unnecessary as this requirement is currently part of this code in 602.2 for all buildings. Therefore, the new language is redundant and unnecessary, and will add confusion to the code.

602.3 (3): This proposed language is redundant and unnecessary as this requirement is currently part of this code in 606.0 for all buildings. Therefore, the new language is redundant and unnecessary, and will add confusion to the code.

In summary, the proposed new requirements for Mass Timber Buildings are not justified, are redundant and unnecessary, and would add confusion to this Code while creating conflicts with building codes.
Proposals

Item #: 147

UMC 2024  Section: 602.4, 602.4.4, Table 1701.1, Table 1701.2

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

602.0 Material.

602.4 Nonmetallic Ducts. Nonmetallic ducts shall comply with Section 602.4.1, Section 602.4.2, Section 602.4.3 or Section 602.4.4 through Section 602.4.5.

602.4.4 Fibrous Glass Duct. Fibrous glass ducts, plenums, or fittings shall be constructed in accordance with SMACNA Fibrous Glass Duct Construction Standards or NAIMA Fibrous Glass Duct Construction Standards.

602.4.4 602.4.5 Other Materials. Flexible and rigid ducts, plenums, or fittings for use in heating, ventilation, and air conditioning systems of other nonmetallic materials listed and labeled to UL 181 shall be permitted.

Exception: Plastic ducts shall comply with Section 603.5.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMACNA-2003</td>
<td>Fibrous Glass Duct Construction Standards, Seventh Edition</td>
<td>Fiberglass Ducts</td>
<td>602.4.4</td>
</tr>
<tr>
<td>NAIMA-2002</td>
<td>Fibrous Glass Duct Construction Standards, Fifth Edition</td>
<td>Fiberglass Ducts</td>
<td>602.4.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: The SMACNA and NAIMA standards were not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
A section for fibrous glass duct is being added to Chapter 6 as the UMC is currently silent on provisions for fibrous glass duct. There are two industry standards used for fibrous glass duct: SMACNA Fibrous Glass Duct Construction...
Standards and NAIMA Fibrous Glass Duct Construction Standards. The standards provide the performance characteristics for fibrous glass board as well as specifications for closures and illustrations of how to construct the full range of fittings. Also covered are details for connections to equipment and air terminals, hanger schedules, reinforcement requirements, fabrication of rectangular duct and fittings, closures of seams and joints, channel and tie rod reinforcements, and hangers and supports.

**COMMITTEE ACTION:** ACCEPT AS SUBMITTED

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 28  ABSTAIN: 1  NOT RETURNED: 1  Heine

**EXPLANATION OF ABSTAIN:**

**TERZIGNI:** I abstain because the proposal could materially affect SMACNA.

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**Appended Comments**

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 602.4  **Item #:** 147

**SUBMITTER:** Randy Young  
Northern California JATC  **Comment #:** 1

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal as modified by this public comment.

**602.0 Material.**

**602.4 Nonmetallic Ducts.** Nonmetallic ducts shall comply with Section 602.4.1, Section 602.4.2, Section 602.4.3, Section 602.4.4, or through Section 602.4.5.

**SUBSTANTIATION:**
This modification corrects the section number references for nonmetallic ducts.
Proposals

Item #: 153
UMC 2024  Section: 203.0, 602.4.3, 603.12

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.12 Fabric Air Dispersion Systems. Where installed, fabric air dispersion systems shall be completely in exposed locations in duct systems under positive pressure, and not pass through or penetrate fire-resistant-rated construction. Fabric air dispersion systems shall be listed and labeled in accordance with UL 2518. Exception: Installation of under-floor air dispersion systems shall be permitted where listed and labeled for such use.

602.4.3 Fabric Air Dispersion Systems. Fabric air dispersion systems shall be listed and labeled in accordance with UL 2518.

203.0 – A – Fabric Air Dispersion Systems. Materials such as fabrics or textiles intended for use in air handling systems in exposed locations operating under positive pressure. Also known as fabric duct, air socks, textile ventilation, or textile air dispersion systems.

SUBSTANTIATION:
Air dispersion systems that are listed and labeled for under-floor installation are used in the industry and allowed by jurisdictions. Under-floor air dispersion systems are designed to distribute and disperse air to perimeter and high-heat load locations in Under Floor Air Distribution (UFAD) Systems. Fabric duct for underfloor air dispersion is an ideal alternative to conventional metal ducting for more efficient cooling. Efficient and effective cooling is necessary to create a comfortable indoor environment. Fabric underfloor air dispersion systems are a unique method for delivering conditioned air in buildings or spaces. Ideal for high rise buildings, offices, hospitals, hotels, schools, airports, and other commercial buildings.

Fabric duct for underfloor cooling are based on displacement ventilation principles, requiring that the air stratifies from the floor to the ceiling, where it is either exhausted or recycled back into the conditioned space. Under-floor air dispersion systems reduce heat loss (temperature gain) or thermal decay over extended distances and to perimeter zones. Additionally, porous fabrics eliminate the risk of condensation to the ductwork.

This change clarifies that air dispersion systems are not always installed in completely exposed locations when they are under-floor systems. UL 2518 uses the term "fabric air dispersion system" throughout the standard. Additionally, the code change removes a requirement from the definition of "Air Dispersion Systems" to be installed "in exposed locations." Section 603.12 already requires air dispersion systems to be installed “in exposed locations.”

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as under-floor air dispersion systems should not be allowed under-floor even if listed and labeled for such use. The exception may lead to poor installations that may create safety concerns. Furthermore, the term "fabric" is being rejected as not all air dispersion systems are made of fabric material and conflicts with the specifications of UL 2518.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 203.0, 603.12
SUBMITTER: Kevin Gebke  
DuctSox Corp

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

603.0 Installation of Ducts.

603.12 Air Dispersion Systems. Where installed, air dispersion systems shall be completely in exposed locations in duct systems under positive pressure, and not pass through or penetrate fire-resistant-rated construction. Air dispersion systems shall be listed and labeled in accordance with UL 2518. Installation of under-floor air dispersion systems shall be permitted where listed and labeled for such use. The air dispersion system shall be exposed to the conditioned space that it is dispersing and delivering air to.

203.0 – A – Air Dispersion Systems. Materials intended for use in air handling systems in exposed locations operating under positive pressure. Any diffuser system designed to, both, convey air within a room, space, or area and diffuse air into that space while operating under positive pressure. Systems are commonly constructed of, but not limited to, fabric or plastic film.

SUBSTANTIATION:
This has caused confusion where I am to blame. Somewhat like the thought of electrical wires in an underfloor plenum, if sections of the wire are bare copper, are they exposed? Very early on in my experience at proposing code changes I used, and was a proponent of using the wording "exposed" to help define HVAC products that were either conveying air (not exposed) or dispersing air (exposed). Air dispersion systems disperse air and ducts convey air. If a product is "exposed," then dispersing air is allowed and if a product that was not "exposed" was dispersing air, then it is not allowed (it would be considered leaking). Exposed is used to define if the HVAC component is exposed to the immediate space that the air is being dispersed to. In the case of underfloor plenums, air dispersion systems are dispersing the air into that plenum space, and are exposed in that space.

In the case of raised floor plenums, distribution and mixing of air was, and still is, a very big concern. Underfloor plenums do not work very well if close consideration is not paid to the thermal effects of air distribution in the plenum. This is described in detail in chapter 3, Underfloor Air Supply Plenum Principles, in the ASHRAE UFAD Guide. Air Dispersion Systems have played a big role in reducing the thermal issues with raised floor plenums. They also offer a relatively easy way to retrofit a raised floor plenum to an improved air distribution and mixing system.

For Section 203.0, I suggest using ASHRAE Terminology's definition of Air Dispersion Systems (https://www.ashrae.org/technical-resources/free-resources/ashrae-terminology). The term Air Dispersion Systems is only used in this regard throughout the UMC.

[Supporting documentation is provided in KAVI for TC review]
Proposals

Item #: 160

UMC 2024 Section: 603.9, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. Joints and seams for duct systems shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other means. Crimp joints for round ducts shall have a contact lap of not less than 11/2 inches (38 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint, or an equivalent fastening method. Joints and seams for duct systems in accordance with SMACNA Round Industrial Duct Construction Standards and SMACNA Rectangular Industrial Duct Construction Standards shall be permitted.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMACNA 002-2004</td>
<td>SMACNA Rectangular Industrial Duct Construction Standards</td>
<td>Ducts</td>
<td>603.9</td>
</tr>
<tr>
<td>SMACNA 005-2013</td>
<td>SMACNA Round Industrial Duct Construction Standards</td>
<td>Ducts</td>
<td>603.9</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The SMACNA standards do not meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The “SMACNA HVAC Duct Construction Standards – Metal and Flexible” standard covers general ducts joints and seams; however industrial rectangular and round ducts can also have joints and seams in accordance with the SMACNA Industrial Standards. The SMACNA Industrial Standards are being added to the end of Section 603.9 (Joints and Seams of Ducts).

The SMACNA Round Industrial Duct Construction standard covers joints and seams for round industrial duct and provides a standardized, engineered basis for design and construction of industrial ducts of Classes 1 to 5 air. The standard includes a spiral duct chapter for Classes 1 and 2 air that covers design pressures ranging from 30 in. wg negative to 50 in. wg positive, plus carbon and galvanized steel tables and tables for stainless steel and aluminum, tables for duct sizes up to 96 in. diameter, and Duct Class 5 for systems handling corrosives and spiral lockseam pipe.

The SMACNA Rectangular Industrial Duct Construction standard covers joints and seams for rectangular industrial duct and provides tables for stainless steels and aluminum, plus materials, welding practices, and a guide specification. It covers the simple, low or moderate temperature and pressure (or vacuum) indoor systems as well
as the more complex outdoor systems that operate at moderate to high temperature and pressure (or vacuum), and are subject to higher and more complex external loading.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The SMACNA standards do not meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 28 ABSTAIN: 1 NOT RETURNED: 1 Heine

EXPLANATION OF ABSTAIN:
TERZIGNI: While I support the committee action, I will abstain as this proposal could materially affect SMACNA.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 603.9, Table 1801.1  Item #: 160

SUBMITTER: Phil Pettit  Control Air Conditioning Corporation  Rep. Self  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. Joints and seams for duct systems shall comply with SMACNA HVAC Duct Construction Standards – Metal and Flexible, SMACNA Round Industrial Duct Construction Standards, or SMACNA Rectangular Industrial Duct Construction Standards, as applicable. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other means. All ducts shall be sealed to Seal Class A. Crimp joints for round ducts shall have a contact lap of not less than 1 1/2 inches (38 mm) and shall be mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint, or an equivalent fastening method.

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<td>SMACNA Rectangular Industrial Duct Construction Standards</td>
<td>Ducts</td>
<td>603.9</td>
</tr>
<tr>
<td>SMACNA 005-2013</td>
<td>SMACNA Round Industrial Duct Construction Standards</td>
<td>Ducts</td>
<td>603.9</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The SMACNA standards do not meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The “SMACNA HVAC Duct Construction Standards – Metal and Flexible” standard covers general ducts joints and seams; however industrial rectangular and round ducts can also have joints and seams in accordance with the SMACNA Industrial Standards. The inclusion of the SMACNA Industrial Standards provides additional standards which are acceptable by the industry.

The SMACNA Round Industrial Duct Construction standard covers joints and seams for round industrial duct and provides a standardized, engineered basis for design and construction of industrial ducts of Classes 1 to 5 air. The
standard includes a spiral duct chapter for Classes 1 and 2 air that covers design pressures ranging from 30 in. wg negative to 50 in. wg positive, plus carbon and galvanized steel tables and tables for stainless steel and aluminum, tables for duct sizes up to 96 in. diameter, and Duct Class 5 for systems handling corrosives and spiral lockseam pipe.

The SMACNA Rectangular Industrial Duct Construction standard covers joints and seams for rectangular industrial duct and provides tables for stainless steels and aluminum, plus materials, welding practices, and a guide specification. It covers the simple, low or moderate temperature and pressure (or vacuum) indoor systems as well as the more complex outdoor systems that operate at moderate to high temperature and pressure (or vacuum), and are subject to higher and more complex external loading.
Item #: 161
UMC 2024  Section: 603.9.2

SUBMITTER: Christopher Ruch
National Energy Management Institute Committee (NEMIC)

RECOMMENDATION:
Revise text

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. (remaining text unchanged)

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual. Duct leakage tests shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB). Representative sections totaling not less than 10 percent of the total installed duct area shall be tested. Where the tested 10 percent fail to comply with the requirements of this section, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

(remaining text unchanged)

SUBSTANTIATION:
Duct Air Leakage Testing should be limited to a certified Testing, Adjusting, and Balancing Technician (AABC, NEBB, or TABB). To provide accurate testing results, certified technicians must complete extensive training in the proper use of the SMACNA test methods, mechanical system understanding and the knowledge of the principles of air flow and pressure measurements. The listed certification organizations have proven methods for quality control. (See Supporting Material:TAB-Technical-Report-051220)

Section E 802.1, Commissioning Requirements, of the Uniform Mechanical Code set a precedent for similar requirements where an accurate verification of design intent is required.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

COMMITTEE STATEMENT:
The Technical Committee recommends adding the language “or other ANSI-accredited agencies” via public comment.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 23  NEGATIVE: 6  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

CUDAHY: Do not forget, the Technical Committee recommended adding the language “or other ANSI-accredited agencies” via public comment.
EXPLANATION OF NEGATIVE:

BALLANCO: Not all groups are listed in this proposal.

FEEHAN: The list is not complete.

KOERBER: Too restrictive by limiting to only three organizations. Should at minimum include "or other ...." option.

TRAFTON, A: All groups should be represented.

WHITE: It is not the business of the UMC to dictate worker certifications no matter how many get included via public comment. This is an AHJ issue. This is not necessary.

WISEMAN: This decision is up to the AHJ. The UMC should not be specifying contractor certification criteria.

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 097, Section 403.10 (Air Balance), UMC Item # 110, Section 504.3 (Domestic Range Hoods), and UMC Item # 161, Section 603.9.2 (Duct Leakage Tests) resulted in conflicting language within the code. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts. (remaining text unchanged)

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual. Duct leakage tests shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies. Representative sections totaling not less than 10 percent of the total installed duct area shall be tested. Where the tested 10 percent fail to comply with the requirements of this section, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

(remaining text unchanged)

TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item # 097, Section 403.10 (Air Balance) modifies the phrase “or other ANSI accredited agencies” to “or other equivalent approved agencies” to comply with the ANSI Essential Requirements for referencing products or services. Additionally, UMC Item # 110, Section 504.3 (Domestic Range Hoods) and UMC Item # 161, Section 603.9.2 (Duct Leakage Tests) were modified to correlate with the updated UMC Item # 097 by adding the phrase “or other equivalent approved agencies.”

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 603.9.2 by adding the phrase “or other equivalent approved agencies.”

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 603.9.2
SUBMITTER: Daniel Buuck
NAHB

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual. Duct leakage tests shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies by another approved technician. Representative sections totaling not less than 10 percent of the total installed duct area shall be tested. Where the tested 10 percent fail to comply with the requirements of this section, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

(remaining text unchanged)

SUBSTANTIATION:
Private industry organizations with certification programs should not use the code to guarantee an income stream for themselves or their members. Approving such a requirement sets a bad precedent that will invite other trade organization with a certification program to try and get theirs recognized by the code.

Additionally, certified technicians are not available in many regions of the country, which adds unreasonable costs and delays to smaller projects. And certification is not necessary to carry out the testing on simple systems.

It is not the job of a building code to regulate the labor force or require contractor licensing. The language of this public comment provides the code official with the assurance that a competent technician has performed the required testing without being overly restrictive.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 603.9.2
SUBMITTER: Marcelo Hirschler
GBH International

RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
There is no need to indicate who is entitled to conduct leakage tests. As indicated by several committee members the proposed list is incomplete and, in fact, any list will always have the potential to have to be revised and is unnecessary and will not add anything useful to the code.
603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts.

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and Table 603.9.2. Duct Locations in Table 603.9.2 shall be as defined in ASHRAE 90.1. Test A shall include testing of representative sections totaling not less than the Test A percentage of the total installed duct area for the designated Duct Application, Duct Location, and Pressure Class in Table 603.9.2 shall be tested. Where the tested 10 percent Test A duct sections fail to comply with the leakage requirements of this section, then the Test B percentage of the total installed duct area in Table 603.9.2 shall be tested. Where the tested 40 percent Test B duct sections fail to comply with the requirements of this section, then the Test C percentage of the total installed duct area in Table 603.9.2 shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

\[ L_{\text{max}} = C_L P \times 0.65 \] (Equation 603.9.2)

Where:
- \( L_{\text{max}} \) = maximum permitted leakage, \((\text{ft}^3/\text{min})/100 \text{ square feet} \ [0.0001 \text{ (m}^3/\text{s})/\text{m}^2]\) duct surface area.
- \( C_L \) = six, duct leakage class, \((\text{ft}^3/\text{min})/100 \text{ square feet} \ [0.0001 \text{ (m}^3/\text{s})/\text{m}^2]\) duct surface area at 1 inch water column (0.2 kPa).
- \( P \) = test pressure, which shall be equal to the design duct pressure class rating, inch water column (kPa).

**Exception:** Transfer air duct operating at less than 1 inch of water column (0.25 kPa). Testing is not required where the total duct surface area for a Duct Application, Duct Location, and Pressure Class row in Table 603.9.2 is less than 500 \( \text{ft}^2 \) (46.45 \( \text{m}^2 \)).

**TABLE 603.9.2**

<table>
<thead>
<tr>
<th>DUCT APPLICATION</th>
<th>DUCT LOCATION</th>
<th>PRESSURE CLASS</th>
<th>TEST A PERCENTAGE</th>
<th>TEST B PERCENTAGE</th>
<th>TEST C PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Outdoors</td>
<td>All</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Supply Return</td>
<td>Unconditioned spaces</td>
<td>=3 inch (0.75 kPa)</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 to 2 inch (0.25 to 0.5 kPa)</td>
<td>10</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;1 inch (0.25 kPa)</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Supply</td>
<td>Indirectly</td>
<td>=3 inch</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

| SUBMITTER: Mitch Pinsker  
Affiliated Engineers Inc  
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee |
| Exhaust conditioned spaces (including return air plenums) | 2 inch (0.5 kPa) | 10 | 40 | 100 |
| Conditioned spaces | <2 inch (0.5 kPa) | 0 | NA | NA |
| All | All | 0 | NA | NA |
| All | Underground | 0 | NA | NA |

| TABLE 1701.1 | REFERENCED STANDARDS |
| STANDARD NUMBER | STANDARD TITLE | APPLICATION | REFERENCED SECTION |

(portions of table not shown remain unchanged)

| TABLE 1701.2 | STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES |
| DOCUMENT NUMBER | DOCUMENT TITLE | APPLICATION |

(portions of table not shown remain unchanged)

Note: ASHRAE/IES 90.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 603.9.2 currently requires leakage testing of all ductwork regardless of location, application (e.g. supply vs. return vs. exhaust), and operating static pressure. This is at times onerous, e.g. simply installing a small tenant improvement with a handful of diffusers and small area of ductwork would require expensive testing. On the other hand, this section requires testing of only a small amount of ductwork outside of the building and high pressure ducts, yet leaks from these ducts have the largest impact on energy use. ASHRAE 90.1 requires testing of all exterior ductwork starting with 25% sampling as proposed here. The other testing requirements proposed in Table 603.9.2 are the same stringency as the current requirement for higher pressure classes. They are less stringent than the current requirement for lower pressure classes but still more stringent ASHRAE 90.1 which only requires testing of ductwork 3 inch pressure class and higher. Testing scope is broader for applications where leakage results in thermal heating and cooling impacts (e.g. supply air and return air ducts) as well as fan energy impacts.

An Exception is added for small projects with less than 500 square feet of duct area. This equates to a negligible 30 CFM of leakage for 1 inch pressure class.

Members of the Golden Gate ASHRAE chapter have submitted this recommendation to the ASHRAE 90.1 committee.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Nothing in the code prohibits the proposed requirements from being done. Additionally, the requirements are overly restrictive regarding duct leakage testing. The Technical Committee requests that the exception in Section 603.9.2 be resubmitted as a public comment.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 603.9.2  Item #: 162

SUBMITTER: Mitch Pinsker
AEI

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
I support Item # 162 as written.

Section 603.9.2 currently requires leakage testing of all ductwork regardless of location, application (e.g. supply vs. return vs. exhaust), and operating static pressure. This is at times onerous, e.g. simply installing a small tenant improvement with a handful of diffusers and small area of ductwork would require expensive testing. On the other hand, this section requires testing of only a small amount of ductwork outside of the building and high pressure ducts, yet leaks from these ducts have the largest impact on energy use. ASHRAE 90.1 requires testing of all exterior ductwork starting with 25% sampling as proposed here. The other testing requirements proposed in Table 603.9.2 are the same stringency as the current requirement for higher pressure classes. They are less stringent than the current requirement for lower pressure classes but still more stringent ASHRAE 90.1 which only requires testing of ductwork 3 inch pressure class and higher. Testing scope is broader for applications where leakage results in thermal heating and cooling impacts (e.g. supply air and return air ducts) as well as fan energy impacts.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 603.9.2, Table 1801.1, Table 1801.2  Item #: 162

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

603.0 Installation of Ducts.

603.9 Joints and Seams of Ducts.(remaining text unchanged)

603.9.2 Duct Leakage Tests. Ductwork shall be leak-tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual or ASHRAE 90.1. Duct leakage tests shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies. Representative sections totaling not less than 10 percent of the total installed duct area shall be tested. Where the tested 10 percent fail to comply with the requirements of this section, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested. Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork. The permitted duct leakage shall be not more than the following:

(remaining text unchanged)
### TABLE 1801.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

### TABLE 1801.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

**Note:** ASHRAE/IES 90.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
ASHRAE Standard 90.1 requires air leakage testing of 100% of all outside ductwork and 25% of representative sections of all other ductwork designed to operate at a static pressure in excess of 3 inch water gauge. My experience on projects is that duct leakage testing and sealing of the sample duct is typically better than the remaining ducts. Thus, I recommend that 100% of the ductwork to be tested. To save energy ductwork above 3" WC should be tested at the duct rated pressure and not exceed 1% leakage. The duct rated pressure should be what the rated fan system shutoff pressure would be if a damper failed. The static pressure setting for the limit switches must be set below the maximum test pressure of the duct.
Proposals

Item #: 163
UMC 2024  Section: 605.1.2

SUBMITTER: Kartik Patel
Armacell, LLC

RECOMMENDATION:
Revise text

605.0 Insulation of Ducts.
605.1 General. (remaining text unchanged)
605.1.2 Duct Coverings and Linings. Insulation applied to the surface of ducts, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250 F (121 C). Coverings shall not penetrate a fire-resistance-rate assembly. The duct coverings and linings shall be listed and labeled.

SUBSTANTIATION:
The proposed change will unify the listed and labeled requirements in the Uniform Mechanical Code and International Mechanical Code, Section 602.2.1.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Duct coverings and linings are not required to be listed and labeled.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 605.1.2  Item #: 163
SUBMITTER: Marcelo M. Hirschler
GBH International  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The UMC is too lenient in terms of the fire safety requirements for duct coverings and linings. The International Mechanical Code requires that duct coverings and linings be listed and labeled. Section 604.3 contains the same requirements for compliance with ASTM E84 and ASTM C411, but it requires, additionally, that they be listed and
labeled. Note that the proposal was made by an affected party, namely a manufacturer of such coverings and linings.
605.0 Insulation of Ducts.
605.1 General. (remaining text unchanged)

605.1.2 Duct Coverings and Linings. Insulation applied to the surface of ducts, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C). Coverings shall not penetrate a fire-resistance-rated assembly.

Exception: Polyurethane foam insulation shall be in accordance with Section 605.1.3.

605.1.3 Polyurethane Foam Insulation. Polyurethane foam insulation that is spray applied to the exterior of metallic ducts in attics and crawl spaces shall be tested in accordance with IAPMO/ANSI ES1000 and shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 450, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. The foam plastic insulation shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C) nor shall such foam insulation be applied to flexible air ducts.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI</td>
<td>Spray Applied Polyurethane Foam</td>
<td>Miscellaneous</td>
<td>605.1.3</td>
</tr>
<tr>
<td>ES1000-2020</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM C411, ASTM E84, ASTM E2231, IAPMO/ANSI ES1000, and UL 723 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
A new section for polyurethane foam insulation is being added to Chapter 6 under Insulation of Ducts as foam insulation requires a smoke-developed index not to exceed 450.

**COMMITTEE ACTION:** REJECT

**COMMITTEE STATEMENT:**
IAPMO/ANSI ES1000 is being used in an inappropriate application of the standard. The standard applies to building materials, not duct materials. Furthermore, the IAPMO standard is outside of the scope of the section, and is therefore being rejected.

**TOTAL ELIGIBLE TO VOTE:** 30
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 605.1.2  Item #: 164
SUBMITTER: Phil Pettit  Comment #: 1
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

605.0 Insulation of Ducts.
605.1 General. (remaining text unchanged)

605.1.2 Duct Coverings and Linings. Insulation applied to the interior or exterior surface of ducts located in buildings, including duct coverings, linings, tapes, and adhesives, located in buildings shall have a flame-spread index not to exceed 25 and a smoke-developed index not to exceed 50, where tested in accordance with ASTM E84 or UL 723. The specimen preparation and mounting procedures of ASTM E2231 shall be used. Air duct coverings and linings shall not flame, glow, smolder, or smoke where tested in accordance with ASTM C411 at the temperature to which they are exposed in service. In no case shall the test temperature be less than 250°F (121°C). Coverings shall not penetrate a fire-resistance-rated assembly.

SUBSTANTIATION:
Section 605.1.2 is being reworked to simplify and clarify a few items. First, the section applies to insulation applied to the "interior or exterior" surface of ducts. Second, the statement "located in buildings" is much clearer if moved up after the word "ducts."

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 605.1.2.1  Item #: 164
SUBMITTER: Phil Pettit  Comment #: 2
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

605.0 Insulation of Ducts.
605.1 General. (remaining text unchanged)

605.1.2 Duct Coverings and Linings. (remaining text unchanged)

605.1.2.1 Polyurethane Foam Insulation. Polyurethane foam insulation that is spray applied to the exterior of metallic ducts in attics and crawl spaces shall be tested in accordance with IAPMO/ANSI ES1000.

TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI ES1000-2020</td>
<td>Spray Applied Polyurethane Foam</td>
<td>Duct Insulation</td>
<td>605.1.2.1</td>
</tr>
</tbody>
</table>
Note: The IAPMO/ANSI ES1000 standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The IAPMO/ANSI ES1000 standard appears to be an appropriate standard to include for polyurethane foam insulation that is spray applied to the exterior of metallic ducts in attics and crawl spaces. I believe this should be revisited.
609.0 Automatic Shutoffs.

609.1 Air-Moving Systems and Smoke Detectors. Air-moving systems supplying air in excess of 2000 cubic feet per minute (ft³/min) (0.9439 m³/s) to enclosed spaces within buildings shall be equipped with an automatic shutoff. Automatic shutoff shall be accomplished by interrupting the power source of the air-moving equipment upon detection of smoke in the main supply-air duct served by such equipment. Duct smoke detectors shall comply with UL 268A and shall be installed in accordance with the manufacturer’s installation instructions. Such devices shall be compatible with the operating velocities, pressures, temperatures, and humidities of the system. Where fire-detection or alarm systems are provided for the building, the smoke detectors shall be supervised by such systems in an approved manner.

Exceptions:
(1) Where the space supplied by the air-moving equipment is served by a total coverage smoke-detection system in accordance with the fire code, interconnection to such system shall be permitted to be used to accomplish the required shutoff.
(2) Automatic shutoff is not required where occupied rooms served by the air-handling equipment have direct exit to the exterior, and the travel distance does not exceed 100 feet (30 480 mm).
(3) Automatic shutoff is not required for Group R, Division 3 and Group U Occupancies.
(4) Automatic shutoff is not required for approved smoke-control systems or where analysis demonstrates shutoff would create a greater hazard, such as shall be permitted to be encountered in air-moving equipment supplying specialized portions of Group H Occupancies. Such equipment shall be required to have smoke detection with remote indication and manual shutoff capability at an approved location.
(5) Smoke detectors that are factory installed in listed air-moving equipment shall be permitted to be used in lieu of smoke detectors installed in the main supply-air duct served by such equipment.

609.1.1 Smoke Detector Installation. Smoke detectors shall be installed in accordance with NFPA 72. Access shall be provided to smoke detectors for inspection and maintenance.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>609.1.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: NFPA 72 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Smoke detectors are addressed in Section 609.0. A new section is being created for the installation of smoke detectors. Early warning plays a key role in a facility’s ability to safely evacuate its residents during a fire emergency. As a result, a lot is riding on the fire alarm system’s ability to operate and function properly. NFPA 72, National Fire Alarm and Signaling Code, applies to both residential and commercial buildings and is the model standard used by electricians, architects, engineers, builders, and inspectors to determine what features and
equipment must be included in a fire alarm system.

The NFPA 72 standard covers the application, installation, location, performance, and inspection, testing, and maintenance of fire alarm and emergency communications systems, including Mass Notification Systems (MNS). The standard also includes testing requirements for Energy Storage Systems (ESS) and requirements for HVLS fans and air-sampling smoke detectors which are important for designers, installers, and AHJs.

NFPA 72 also addresses nuisance alarms in several ways. First, all smoke alarms are required to be “listed” by a nationally recognized testing lab. The applicable standard for testing of smoke alarms is UL 217, which has some limited requirements for resistance to nuisances. Second, NFPA 72 has requirements for technology and spacing aimed to limit nuisance alarms.

Standards are constantly changing to adapt to new building technologies and development patterns. NFPA 72 is adopted and incorporated into local building codes by virtually every community in the U.S. in one form or another through their residential, fire, and building codes.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
All of the requirements for smoke detectors are already found in Section 609.1. The proposed language is repetitive and unnecessary.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC Section #: 609.1, Table 1801.1 Item #: 171
SUBMITTER: Keith Blazer Self

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

609.0 Automatic Shutoffs.
609.1 Air-Moving Systems and Smoke Detectors. Air-moving systems supplying air in excess of 2000 cubic feet per minute (ft³/min) (0.9439 m³/s) to enclosed spaces within buildings shall be equipped with an automatic shutoff. Automatic shutoff shall be accomplished by interrupting the power source of the air-moving equipment upon detection of smoke in the main supply-air duct served by such equipment. Duct smoke detectors shall comply with UL 268A and shall be installed in accordance with NFPA 72 and the manufacturer’s installation instructions. Such devices shall be compatible with the operating velocities, pressures, temperatures, and humidities of the system. Where fire-detection or alarm systems are provided for the building, the smoke detectors shall be supervised by such systems in an approved manner.

Exceptions:
(1) through (5) (remaining text unchanged)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>609.1</td>
</tr>
</tbody>
</table>

Note: NFPA 72 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
Duct smoke detectors are addressed in Section 609.1. Early warning plays a key role in a facility’s ability to safely evacuate its occupants during a fire emergency. As a result, a lot is riding on the duct smoke detector’s ability to operate and function properly. NFPA 72, National Fire Alarm and Signaling Code, applies to both residential and commercial buildings and is the model standard used by electricians, architects, engineers, builders, and inspectors to determine what features and equipment must be included in a fire alarm system.

The NFPA 72 standard covers the application, installation, location, performance, and inspection, testing, and maintenance of fire alarm and emergency communications systems, including Mass Notification Systems (MNS). The standard also includes testing requirements for Energy Storage Systems (ESS) and requirements for HVLS fans and air-sampling smoke detectors (including duct smoke detectors) which are important for designers, installers, and AHJs.

NFPA 72 also addresses nuisance alarms in several ways. First, all smoke alarms are required to be “listed” by a nationally recognized testing lab. The applicable standard for testing of smoke detectors for duct applications is UL 268A. Second, NFPA 72 has requirements for technology and spacing aimed to limit nuisance alarms.

NFPA 72 is adopted and incorporated into local building codes by virtually every community in the U.S. in one form or another through their residential, fire, and building codes.
801.0 General.

802.1.1 Installation. Listed chimneys and vents shall be installed in accordance with this chapter and the manufacturer's installation instructions. [NFPA 54:12.2.1]

802.2.6 Direct Vent Appliances. Listed direct vent appliances shall be installed in accordance with the manufacturer’s installation instructions and Section 802.8.2. [NFPA 54:12.3.5.1]

802.2.6.1 Through-the-Wall Vent Terminations. Through-the-wall vent terminations for listed direct vent appliances shall be in accordance with Section 802.8. [NFPA 54:12.3.5.2]

802.2.7 Appliances with Integral Vents. Appliances incorporating integral venting means shall be installed in accordance with the manufacturer’s installation instructions and Section 802.8. [NFPA 54:12.3.6]

802.2.8 Incinerators, Commercial–Industrial. Commercial industrial-type incinerators Incinerators shall be vented in accordance with NFPA 82. [NFPA 54:12.3.7]

802.3.3.5 Exit Terminals. The exit terminals of mechanical draft systems shall be not less than 7 feet (2134 mm) above finished ground level where located adjacent to public walkways and shall be located as specified in Section 802.8 and Section 802.8.1. [NFPA 54:12.4.3.6]

802.3.4 Ventilating Hoods and Exhaust Systems. Where automatically operated appliances, other than food service commercial cooking appliances, are vented through a ventilating hood or exhaust system equipped with a damper or with a power means of exhaust, provisions shall be made to allow the flow of gas to the main burners only when the damper is open to a position to properly vent the appliance and when the power means of exhaust is in operation. [NFPA 54:12.4.4.1]

802.5.1 Factory-Built Chimneys. Factory-built chimneys shall be listed in accordance with UL 103, UL 959, or UL 2561. Factory-built chimneys shall be installed in accordance with the manufacturer’s installation instructions. Factory-built chimneys used to vent appliances that operate at positive vent pressure shall be listed for such application. [NFPA 54:12.6.1.1]

802.5.4 Termination. A chimney for residential-type or low-heat appliances shall extend at least 3 feet (914 mm) above the highest point where it passes through a roof of a building and at least 2 feet (610 mm) higher than a any portion of any a building within a horizontal distance of 10 feet (3048 mm). [NFPA 54:12.6.2.1] (See Figure 802.5.4)

802.5.5 Size of Chimneys. The effective area of a chimney venting system serving listed appliances with draft hoods, Category I appliances, and other appliances listed for use with Type B vents shall be in accordance with one of the following methods:

1. Those listed in Section 803.0.
2. For sizing an individual chimney venting system for a single appliance with a draft hood, the effective areas of the vent connector and chimney flue of a venting system serving a single appliance with a draft hood shall be not less than the area of the appliance flue collar or draft hood outlet or greater than seven times the draft hood outlet area.
3. For sizing The effective area of the chimney flue of a chimney venting system serving two appliances with draft hoods, the effective area of the chimney flue shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.
Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods. [NFPA 54:12.6.3.1]

802.5.7.1 Standard. Chimneys shall be lined in accordance with NFPA 211. Exception: Existing chimneys shall be permitted to have their use continued when an appliance is replaced by an appliance of similar type, input rating, and efficiency, where the chimney complies with Section 802.5.7.3 and the sizing of the chimney is in accordance with Section 802.5.6. [NFPA 54:12.6.4.2]

802.5.8.1 Gas and Liquid Fuel-Burning Appliances. Where one chimney serves gas appliances and liquid fuel-burning appliances, the appliances shall be connected through separate openings or connected through a single opening where joined by a suitable fitting located as close as practical to the chimney. Where two or more openings are provided into one chimney flue, they shall be at different levels. Where the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device. [NFPA 54:12.6.5.2]

### Table 802.6.1

<table>
<thead>
<tr>
<th>ROOF PITCH SLOPE HEIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>[NFPA 54: TABLE 12.7.3]</td>
</tr>
<tr>
<td>(portion of table not show remains unchanged)</td>
</tr>
</tbody>
</table>

#### 802.6.2.1 Category I Appliances.

The sizing of natural draft venting systems serving one or more listed appliances equipped with a draft hood or appliances listed for use with a Type B gas vent, installed in a single story of a building, shall be in accordance with one of the following:

1. The provisions of Section 803.0.
2. Vents serving fan-assisted combustion system appliances, or combinations of fan-assisted combustion system and draft hood-equipped appliances, shall be sized in accordance with Section 803.0 or other approved engineering methods.
3. For sizing an individual gas vent for a single, draft hood-equipped appliance, the effective area of the vent connector and the gas vent shall be not less than the area of the appliance draft hood outlet or greater than seven times the draft hood outlet area.
4. For sizing a gas vent connected to two appliances with draft hoods, the effective area of the vent shall be not less than the area of the larger draft hood outlet plus 50 percent of the area of the smaller draft hood outlet or greater than seven times the smaller draft hood outlet area.
5. Other approved engineering practices. [NFPA 54:12.7.4.1]

#### 802.6.2.3 Category II, Category III, and Category IV Appliances.

The sizing of gas vents for Category II, Category III, and Category IV appliances shall be in accordance with the appliance manufacturer’s instructions. The sizing of plastic pipe specified by the appliance manufacturer as a venting material for Category II, III, and IV appliances shall be in accordance with the appliance manufacturers’ instructions. [NFPA 54:12.7.4.3]

#### 802.6.2.4 Sizing.

Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods. [NFPA 54:12.7.4.4]

#### 802.6.3 Gas Vents Serving Appliances on More than One Floor.

A Where a common vent shall be permitted is installed in a multistory installations installation to vent Category I appliances located on more than one floor level, provided the venting system is shall be designed and installed in accordance with approved engineering methods. For the purpose of this section, crawl spaces, basements, and attics shall be considered as floor levels. [NFPA 54:12.7.5.1]

#### 802.7.3.5 802.7.3.4 Roof Thimble.

Where a single-wall metal pipe passes through a roof constructed of combustible material, a noncombustible, nonventilating thimble shall be used at the point of passage. The thimble shall extend at least 18 inches (457 mm) above and 6 inches (152 mm) below the roof with the annular space open at the bottom and closed only at the top. The thimble shall be sized in accordance with Section 802.7.3.4 802.7.3.5. [NFPA 54:12.8.4.5]

#### 802.7.3.4 802.7.3.5 Combustible Exterior Wall.

Single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:

1. For listed appliances with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be a minimum of 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 2 inches (51 mm) larger in diameter than the metal pipe.
2. For unlisted appliances having draft hoods, the thimble shall be a minimum of 6 inches (152 mm) larger in diameter than the metal pipe.
3. For residential and low-heat appliances, the thimble shall be a minimum of 12 inches (305 mm) larger in diameter than the metal pipe.

**Exception:** In lieu of thimble protection, all combustible material in the wall shall be removed a sufficient distance from...
the metal pipe to provide the specified clearance from such metal pipe to combustible material. Any material used to close up such opening shall be noncombustible. [NFPA 54:12.8.4.6]

802.7.4 Size of Single-Wall Metal Pipe. Single-wall metal piping shall comply with the following requirements:
(a) For a draft hood-equipped appliance, in accordance with Section 803.0.
(b) For a venting system for a single appliance with a draft hood, the areas of the connector and the pipe each shall not be less than the area of the appliance flue collar or draft hood outlet, whichever is smaller. The vent area shall not be greater than seven times the draft hood outlet area.
(c) Other approved engineering methods.
(2) Where a single-wall metal pipe is used and has a shape other than round, it shall have an equivalent effective area equal to the effective area of the round pipe for which it is substituted and the minimum internal dimension of the pipe shall be 2 inches (51 mm).
(3) The vent cap or a roof assembly shall have a venting capacity not less than that of the pipe to which it is attached. [NFPA 54:12.8.5]

802.8 Through-the-Wall Vent Termination. Through-the-wall vent termination shall be in accordance with Section 802.8.1 through Section 802.8.3.
A mechanical draft venting system shall terminate at least 3 feet (914 mm) above any forced air inlet located within 10 feet (3048 mm). (See Figure 802.8)

Exceptions:
(1) This provision shall not apply to the combustion air intake of a direct vent appliance.
(2) This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances. [NFPA 54:12.9.1]

802.8.1 Mechanical Draft Venting System. A mechanical draft venting system of other than direct vent type shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.2]

802.8.2 802.8.1 Direct Vent Appliance Clearance for Through-the-Wall Vent Termination. The clearances for through-the-wall direct vent and non-direct vent terminals shall be in accordance with Table 802.8.2 and Figure 802.8.1. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level.
Exception: The clearances in Table 802.8.1 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.3 12.9.1]

| TABLE 802.8.2 802.8.1 THROUGH-THE-WALL DIRECT VENT TERMINATION CLEARANCES [NFPA 54: TABLE 12.9.3 12.9.1] |
|---------------------------------|-----------------|-----------------|-----------------|
| DIRECT VENT APPLIANCE INPUT RATING | THROUGH-THE-WALL VENT-TERMINAL CLEARANCE FROM ANY AIR OPENING INTO A BUILDING (inches) | 
| 10 000 Btu/h and less | 6 | 
| Greater than 10 000 Btu/h and not exceeding 50 000 Btu/h | 9 | 
| Greater than 50 000 Btu/h and not exceeding 150 000 Btu/h | 12 | 
| > 150 000 Btu/h | In accordance with the appliance manufacturer’s instructions and in no case less than the clearances specified in Section 802.8.1. | 

<table>
<thead>
<tr>
<th>FIGURE CLEARANCE</th>
<th>CLEARANCE LOCATION</th>
<th>MINIMUM CLEARANCES FOR DIRECT VENT TERMINALS</th>
<th>MINIMUM CLEARANCES FOR NON-DIRECT VENT TERMINALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clearance above finished grade level, veranda, porch, deck, or balcony</td>
<td>12 inches</td>
<td>12 inches</td>
</tr>
</tbody>
</table>
|   | Clearance to window or door that is openable | 6 inches for Appliances $\leq 10000$ Btu/hr  
9 inches for Appliances $> 10000$ Btu/hr  
12 inches for Appliances $> 50000$ Btu/hr  
12 inches for Appliances $> 50000$ Btu/hr, in accordance with the appliance manufacturer’s instructions and not less than the clearances specified for non-direct vent terminals in row B | 4 feet below or to side of opening or 1 foot above opening |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Clearance to non-openable window</td>
<td>None unless otherwise specified by the appliance manufacturer</td>
</tr>
<tr>
<td>D</td>
<td>Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal</td>
<td>None unless otherwise specified by the appliance manufacturer</td>
</tr>
<tr>
<td>E</td>
<td>Clearance to unventilated soffit</td>
<td>None unless otherwise specified by the appliance manufacturer</td>
</tr>
<tr>
<td>F</td>
<td>Clearance to outside corner of building</td>
<td>None unless otherwise specified by the appliance manufacturer</td>
</tr>
<tr>
<td>G</td>
<td>Clearance to inside corner of building</td>
<td>None unless otherwise specified by the appliance manufacturer</td>
</tr>
<tr>
<td>H</td>
<td>Clearance to non-mechanical air supply inlet to building and the combustion air inlet to any other appliance</td>
<td>Same clearance as specified for row B</td>
</tr>
<tr>
<td>I</td>
<td>Clearance to a mechanical air supply inlet</td>
<td>10 feet horizontally from inlet or 3 feet above inlet</td>
</tr>
<tr>
<td>J</td>
<td>Clearance above paved sidewalk or paved driveway located on public property or other areas where condensate or vapor can cause a nuisance or hazard</td>
<td>7 feet and not located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard</td>
</tr>
<tr>
<td>K</td>
<td>Clearance to underside of veranda, porch, deck, or balcony</td>
<td>12 inches where the area beneath the veranda, porch, deck, or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.</td>
</tr>
</tbody>
</table>

For SI Units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1000 British thermal units per hour = 0.293 kW
**FIGURE 802.8.1**
EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT VENT VENTING SYSTEMS
[NFPA 54: FIGURE A.12.9 12.9.1]

802.8.3 Category I through Category IV and Noncategorized Appliances. Through-the-wall vents for Category II and Category IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment. Where local experience indicates that condensate is a problem with Category I and Category III appliances, this provision shall also apply. Drains for condensate shall be installed in accordance with the appliance and the vent manufacturer’s installation instructions. [NFPA 54:12.9.4]

802.8.4 802.8.2 Annular Spaces. Where vents, including those for direct vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54:12.9.6 12.9.2]

802.8.5 802.8.3 Vent Terminals. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 feet (610 mm) or more above or 25 feet (7620 mm) or more
802.9 Condensation Drain. Provision shall be made to collect and dispose of condensate from venting systems serving Category II and Category IV appliances and noncategorized condensing appliances in accordance with Section 802.8.3. [NFPA 54:12.10.1]

802.9.1 Local Experience Installation. Where local experience indicates that condensation is a problem, provision shall be made to drain off and dispose of condensate from venting systems serving Category I and Category III appliances in accordance with Section 802.8.3. Drains for condensate shall be installed in accordance with the appliance and vent manufacturers’ installation instructions. [NFPA 54:12.10.2]

802.10.1.4 Medium-Heat Appliances. Vent connectors for medium-heat appliances shall be constructed of factory-built, medium-heat chimney sections or steel of a thickness not less than that specified in Table 802.10.1.4 and shall comply with the following:
(1) A steel vent connector for an appliance with a vent gas temperature in excess of 1000°F (538°C) measured at the entrance to the connector shall be lined with medium-duty fire brick or the equivalent.
(2) The lining shall be at least 2 1/2 inches (64 mm) thick for a vent connector having a diameter or greatest cross-sectional dimension of 18 inches (457 mm) or less.
(3) The lining shall be at least 4 1/2 inches (114 mm) thick laid on the 4 1/2 inches (114 mm) bed for a vent connector having a diameter or greatest cross-sectional dimension greater than 18 inches (457 mm).
(4) Factory-built Where factory-built chimney sections, if employed, are installed, they shall be joined together in accordance with the chimney manufacturer’s instructions. [NFPA 54:12.11.2.5]

802.10.2 Size of Vent Connector. A vent connector for an appliance with a single draft hood or for a Category I fan-assisted combustion system appliance shall be sized and installed in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.1]

802.10.2.1 Manifold. For Where a single appliance having more than one draft hood outlet or flue collar is installed, the manifold shall be constructed according to the instructions of the appliance manufacturer. Where there are no instructions, the manifold shall be designed and constructed in accordance with approved engineering practices methods. As an alternative method, the effective area of the manifold shall equal the combined area of the flue collars or draft hood outlets, and the vent connectors shall have a minimum 1 foot (305 mm) rise. [NFPA 54:12.11.3.2]

802.10.2.2 Size. Where two or more appliances are connected to a common vent or chimney, each vent connector shall be sized in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.3]

As an alternative method applicable only where all of the appliances are draft hood-equipped, each vent connector shall have an effective area not less than the area of the draft hood outlet of the appliance to which it is connected. [NFPA 54:12.11.3.4]

802.10.2.3 Height. Where two or more appliances are vented through a common vent connector or vent manifold, the common vent connector or vent manifold shall be located at the highest level consistent with available headroom and clearance to combustible material and sized in accordance with Section 803.0 or other approved engineering methods. [NFPA 54:12.11.3.5]

As an alternative method applicable only where there are two draft hood-equipped appliances, the effective area of the common vent connector or vent manifold and all junction fittings shall be not less than the area of the larger vent connector plus 50 percent of the area of the smaller flue collar outlet. [NFPA 54:12.11.3.6]

802.10.6 Connector Juncions. Where vent connectors are joined together, the connection shall be made with a manufactured tee or wye fitting. [NFPA 54:12.11.7]

(renumber remaining sections)

802.10.6 Slope. A vent connector shall be installed without any dips or sags and shall slope upward toward the vent or chimney at least 1/4 inch per foot (20.8 mm/m).

Exception: Vent connectors attached to a mechanical draft system installed in accordance with appliance and the draft system manufacturers’ instructions. [NFPA 54:12.11.7 12.11.8]

802.10.7.1 Single Wall Connector. The maximum horizontal length of a single-wall connector shall be 75 percent of the height of the chimney or vent, except for engineered systems. [NFPA 54:12.11.8.1 12.11.9.1]

802.10.7.2 Type B Double Wall Connector. The maximum horizontal length of a Type B double-wall connector shall be 100 percent of the height of the chimney or vent, except for engineered systems. The maximum length of an individual connector for a chimney or vent system serving multiple appliances, from the appliance outlet to the junction with the common vent or another connector, shall be 100 percent of the height of the chimney or vent. [NFPA 54:12.11.8.2 12.11.9.2]

802.10.8 Support. A vent connector shall be supported for the design and weight of the material employed to maintain clearances and prevent physical damage and separation of joints. [NFPA 54:12.11.9 12.11.10]

802.10.9 Chimney Connection. Where entering a flue in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage. [NFPA 54:12.11.11.1] Where a thimble or slip joint is used to
facilitate removal of the connector, the connector shall be firmly attached to or inserted into the thimble or slip joint to prevent the connector from falling out. [NFPA 54:12.11.11.2] Means shall be employed to prevent the connector from entering so far as to restrict the space between its end and the opposite wall of the chimney flue. [NFPA 54: 12.11.10 12.11.11.3]

802.10.10 Inspection. The entire length of a vent connector shall be readily accessible for inspection, cleaning, and replacement. [NFPA 54:42.14-12 12.11.12]

802.10.11 Fireplaces. A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace flue opening is permanently sealed. [NFPA 54:42.14-12 12.11.13]

802.10.12 Medium-Heat Appliances. Vent connectors for medium-heat appliances shall not pass through walls or partitions constructed of combustible material. [NFPA 54:12.11.13-2 12.11.14.2]

802.12 Appliances Requiring Draft Hoods and Draft Controls. Vented appliances shall be installed with draft hoods. Exception: Dual oven-type combination ranges; incinerators; direct vent appliances; fan-assisted combustion system appliances; appliances requiring chimney draft for operation; single-firebox boilers equipped with conversion burners with inputs greater than 400 000 Btu/h (117 kW); appliances equipped with blast, power, or pressure burners that are not listed for use with draft hoods; and appliances designed for forced venting. [NFPA 54:12.13.1] If a draft hood is not supplied by the appliance manufacturer where one is required, a draft hood shall be installed, be of a listed or approved type, and, in the absence of other instructions, be of the same size as the appliance flue collar. Where a draft hood is required with a conversion burner, it shall be of a listed or approved type. [NFPA 54:12.13.2.1] Where a draft hood of special design is needed or preferable, the installation shall be approved and in accordance with the recommendations of the appliance manufacturer. [NFPA 54:12.13.2.2]


802.14 Automatically Operated Vent Dampers. An automatically operated vent damper shall be of a listed type. [NFPA 54:12.15]

802.15.4 802.14.1 Listing. Automatically operated vent dampers for oil-fired appliances shall comply with UL 17. The automatic damper control shall comply with UL 378.

802.14 802.15 Obstructions. Devices that retard the flow of vent gases shall not be installed in a vent connector, chimney, or vent. The following shall not be considered as obstructions:

1. Draft regulators and safety controls specifically listed for installation in venting systems and installed in accordance with the manufacturer’s installation instructions.

2. Approved draft regulators and safety controls designed and installed in accordance with approved engineering methods.

3. Listed heat reclaimers and automatically operated vent dampers installed in accordance with the manufacturer's installation instructions.

4. Vent dampers serving listed appliances installed in accordance with Section 803.1 or Section 803.2 or other approved engineering methods.

5. Approved economizers, heat reclaimers, and recuperators installed in venting systems of appliances not required to be equipped with draft hoods, provided the appliance manufacturer’s instructions cover the installation of such a device in the venting system and performance in accordance with Section 802.3 and Section 802.3.1 is obtained. [NFPA 54:12.16]

803.1.5 Multiple-Input Ratings Two-Stage/Modulating Appliances. For appliances with more than one input rate, the minimum vent capacity (FAN Min) determined from Table 803.1.2(1) through Table 803.2(9) shall be less than the lowest appliance input rating, and the maximum vent capacity (FAN Max/NAT Max) determined from the tables shall be greater than the highest appliance rating input. [NFPA 54:13.1.6]

803.1.6 Corrugated Chimney Liners Reduction. Listed corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Table 803.1.2(1) or Table 803.1.2(2) for Type B vents, with the maximum capacity reduced by 20 percent (0.80 x maximum capacity) and the minimum capacity as shown in Table 803.1.2(1) or Table 803.1.2(2).

Corrugated metallic liner systems installed with bends or offsets shall have their maximum capacity further reduced in accordance with Section 803.1.2. The 20 percent reduction for corrugated metallic chimney liner systems includes an allowance for one long radius 90 degree (1.57 rad) turn at the bottom of the liner. [NFPA 54:13.1.7]

803.1.8 Vertical Vent Upsizing Using the 7 x Times Rule. Where the vertical vent has a larger diameter than the vent
connector, the vertical vent diameter shall be used to determine the minimum vent capacity, and the connector diameter shall be used to determine the maximum vent capacity. The flow area of the vertical vent shall not exceed seven times the flow area of the listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods. [NFPA 54:13.1.9]

803.1.14 Single Run of Vent Multiple Vertical Vent Sizes. In a single run of vent or vent connector, more than one diameter and type shall be permitted to be used, provided that all the sizes and types are permitted by the tables. [NFPA 54:13.1.14]

803.1.17 Engineering Methods. For Where a vent height is lower than 6 feet (1829 mm) and or higher than shown in Table 803.1.2(1) through Table 803.2(9), an engineering methods shall be used to calculate the vent capacities. [NFPA 54:13.1.17]

803.2 Multiple Appliance Vent Table 803.2(1) through Table 803.2(9) Obstructions and Vent Dampers. (remaining text unchanged) [NFPA 54:13.2.1]

803.2.12 Vent Height. For The available total height (H) for multiple appliances all located on one the same floor, available total height (H) shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent. [NFPA 54:13.2.13]

803.2.13 Multistory Vent Height Installations. For multistory installations, Where appliances are located on more than one floor, the available total height (H) for each segment of the system shall be the vertical distance between the highest draft hood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee. [NFPA 54:13.2.14]

803.2.15 Vent Type Multistory Type B Vents Required Installation. (remaining text unchanged) [NFPA 54:13.2.16]

803.2.16 Offsets in Multistory Vent Offsets and Capacity Installations. (remaining text unchanged) [NFPA 54:13.2.17]

803.2.17 Vertical Vent Size Limitation. Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of vertical vent or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods. [NFPA 54:13.2.18]

803.2.18 Multiple Input Ratings Two-Stage/Modulating Appliances. For appliances with more than one input rate, the minimum vent connector capacity (FAN Min) of appliances with more than one input rate shall be determined from the tables and shall be less than the lowest appliance input rating, and the maximum vent connector capacity (FAN Max or NAT Max) shall be determined from the tables shall be greater than the highest appliance input rating. [NFPA 54:13.2.19]

803.2.22 Combination of Pipe Types and Multiple Vent and Connector Sizes. All combinations of pipe sizes, single-wall metal pipe, and double-wall metal pipe shall be allowed within any connector run(s) or within the common vent, provided ALL of the appropriate tables permit ALL of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. Where single-wall and Type B double-wall metal pipes are used for vent connectors within the same venting system, the common vent shall be sized using Table 803.2(2) or Table 803.2(4) as appropriate. [NFPA 54:13.2.25]

803.2.26 Engineering Methods Sizing Vents Not Covered by Tables. For vent heights lower than 6 feet (1829 mm) and higher than shown in the tables, engineering methods shall be used to calculate vent capacities. [NFPA 54:13.2.29]

Note: UL 378 was not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 8 is being revised to the latest edition of NFPA 54-2021.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine
accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 174, Section 802.10.5(1) (Joints) and UPC Item # 115, Section 509.10.5(1) (Joints) resulted in conflicting language between the codes. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

802.0 Venting of Appliances.

802.10 Vent Connectors for Category I Appliances.

802.10.5 Joints. Joints between sections of connector piping and connections to flue collars or draft hood outlets shall be fastened in accordance with one of the following methods:
(1) Mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint.
(2) Vent connectors of listed vent material assembled and connected to flue collars or draft hood outlets in accordance with the manufacturer’s instructions.
(3) Other approved means. \{NFPA 54:12.11.6\}

TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item # 174, Section 802.10.5(1) (Joints) is being revised to correlate with the action taken by the UPC TC for Item # 115, Section 509.10.5(1) (Joints) by rephrasing the sentence to “Mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint.”

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 802.10.5(1) regarding the rephrasing of the sentence to “Mechanically fastened by means of not less than three sheet-metal screws equally spaced around the joint.”

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Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 802.7.2  Item #: 174  Comment #: 1

SUBMITTER: IAPMO Staff - Update Extracts  NFPA 54 Extract Update

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

802.7.2 Termination. The termination of single-wall metal pipe shall meet the following requirements:
(1) Single-wall metal pipe shall terminate at least 5 feet (1524 mm) in vertical height above the highest connected appliance draft hood outlet or flue collar.
(2) Single-wall metal pipe shall extend at least 2 feet (610 mm) above the highest point where it passes through a roof of a building and at least 2 feet (610 mm) higher than any portion of a building within a horizontal distance of 10 feet (3048 mm). \(\text{See Figure 802.5.4}\)
(3) An approved cap or roof assembly shall be attached to the terminus of a single-wall metal pipe. \{NFPA 54:12.8.3\}

SUBSTANTIATION:
The above sections have been revised to correlate with NFPA 54-2021 (latest version) in accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines).
Proposals

Item #: 175
UMC 2024  Section: 802.10.12

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

802.0 Venting of Appliances.

802.10.2 Size of Vent Connector. (remaining text unchanged)

802.10.12 Passage Through Ceilings, Floors, or Walls. A vent connector shall not pass through a ceiling, floor, or fire-resistance-rated wall. A single-wall metal pipe connector shall not pass through an interior wall.

Exceptions:
(1) Vent connectors made of listed Type B or Type L vent material and serving listed appliances with draft hoods and other appliances listed for use with Type B gas vents that pass through walls or partitions constructed of combustible material shall be installed with not less than the listed clearance to combustible material.
(2) Connectors shall be permitted to pass through ceilings, floors, or walls in accordance with Section 802.7.3.1 and Section 802.7.3.4.

( below shown for reference only)

802.7.3.1 Limitations. Single-wall metal pipe shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. A pipe passing through a roof shall extend without interruption through the roof flashing, roof jacket, or roof thimble. [NFPA 54:12.8.4.2]

802.7.3.4 Combustible Exterior Wall. Single-wall metal pipe shall not pass through a combustible exterior wall unless guarded at the point of passage by a ventilated metal thimble not smaller than the following:
(1) For listed appliances with draft hoods and appliances listed for use with Type B gas vents, the thimble shall be a minimum of 4 inches (102 mm) larger in diameter than the metal pipe. Where there is a run of not less than 6 feet (1829 mm) of metal pipe in the opening between the draft hood outlet and the thimble, the thimble shall be a minimum of 2 inches (51 mm) larger in diameter than the metal pipe.
(2) For unlisted appliances having draft hoods, the thimble shall be a minimum of 6 inches (152 mm) larger in diameter than the metal pipe.
(3) For residential and low-heat appliances, the thimble shall be a minimum of 12 inches (305 mm) larger in diameter than the metal pipe.

Exception: In lieu of thimble protection, all combustible material in the wall shall be removed a sufficient distance from the metal pipe to provide the specified clearance from such metal pipe to combustible material. Any material used to close up such opening shall be noncombustible. [NFPA 54:12.8.4.6]

SUBSTANTIATION:
The intent of the exception to Section 802.10.12 is further clarified by directing the end user to Section 802.7.3.1 and Section 802.7.3.4 which permit connectors to pass through ceilings, floors, or wall and are specified in the indicated sections. This change will clarify the intent of Section 802.10.12 and avoid any confusion between the sections.

COMMITTEE ACTION: ACCEPT AS SUBMITTED
TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 23  NEGATIVE: 6  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

BALLANCO: This proposal associates connectors with single-wall metal pipe vents. These are two separate issues that should not be confused. A connector is not a vent and a single-wall metal pipe vent is not a connector. Connectors are not permitted to pass through ceilings, floors, or walls. There are no exceptions to this requirement. This change should have been rejected.

FEEHAN: This proposal is confusing. The beginning says no and the exception says yes. Vent connectors should NOT pass through anything.

KOERBER: I agree the proposal is confusing and could lead to the wrong intent. Hopefully through comment it can be cleared up.

MACNEVIN: I support the comments of Julius Ballanco and Pennie Feehan.

WHITE: Not all single-wall pipes are vent connectors. Vent connectors do not leave the room that the appliance is located in. This should have been rejected.

WISEMAN: This is confusing.

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UPC Item # 116, Section 509.10.12 (Passage Through Ceilings, Floors, or Walls) and UMC Item # 175, Section 802.10.12 (Passage Through Ceilings, Floors, or Walls) resulted in conflicting language between the codes. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

802.10.12 Passage Through Ceilings, Floors, or Walls. A vent connector shall not pass through a ceiling, floor, or fire-resistance-rated wall. A single-wall metal pipe connector shall not pass through an interior wall.

Exceptions:

(1) Vent connectors made of listed Type B or Type L vent material and serving listed appliances with draft hoods and other appliances listed for use with Type B gas vents that pass through walls or partitions constructed of combustible material shall be installed with not less than the listed clearance to combustible material.

(2) Vent connectors shall be permitted to pass through ceilings, floors, or walls in accordance with Section 802.7.3.1 and Section 802.7.3.4.

TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item # 175, Section 802.10.12 (Passage Through Ceilings, Floors, or Walls) is being revised to correlate with the action taken by the UPC TC for Item # 116, Section 509.10.12 (Passage Through Ceilings, Floors, or Walls) by adding the term “vent” to the beginning of Exception (2).

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 802.10.12 regarding the addition of the term “vent” to the beginning of Exception (2).
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 802.10.12  Item #: 175

SUBMITTER: Julius Ballanco, P.E.  Comment #: 1
JB Engineering and Code Consulting, P.C.
Rep. Self

RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
The proponent is mixing single wall vent connectors with single wall metal vents. Single wall vent connectors are NOT permitted to pass through ceilings, floors, or walls. The vent connector must be completely located in the room in which the appliance is installed. The vent (not vent connector) is the passageway that exits the room passing through ceilings, floors, or walls.
Proposals

Item #: 180
UMC 2024  Section: 902.10.1, Table 1701.1

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Add new text

902.0 General.

902.10 Solid-Fuel Burning Appliances. Unless otherwise specified, solid-fuel burning appliances shall be installed in accordance with NFPA 211 and the manufacturer’s installation instructions.

902.10.1 Pellet Fuel-Burning Appliances. Pellet fuel-burning appliances shall be listed and labeled in accordance with ASTM E1509.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM E1509-2012 (R2017)</td>
<td>Room Heaters, Pellet Fuel-Burning Type</td>
<td>Room Heaters</td>
<td>902.10.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM E1509 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Pellet burning appliances such as fireplaces and stoves have risen in popularity thanks to their green credentials of burning renewable or otherwise waste products instead of nonrenewable sources of energy such as gas. Pellet burning fireplaces or stoves differ to wood burning stoves or wood burning fireplaces because they use compressed pellets as the fuel rather than pieces of wood. The pellets themselves are highly compressed pieces of material that burn with a hot flame thanks to their density. The ASTM E1509 standard covers performance requirements, test methods, and marking requirements for automatic feed, pellet fuel-burning room heaters that are intended to burn pellets.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Pellet fuel-burning appliances are outside of the scope of the UMC. The section would only be relevant in new construction that includes a pellet fuel-burning appliance.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC   Section #: 902.10.1, Table 1801.1       Item #: 180

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

902.0 General.

902.10 Solid-Fuel Burning Appliances. Unless otherwise specified, solid-fuel burning appliances shall be installed in accordance with NFPA 211 and the manufacturer’s installation instructions.

902.10.1 Pellet Fuel-Burning Appliances. Pellet fuel-burning appliances shall comply with ASTM E1509.

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<tr>
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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>ASTM E1509-2012</td>
<td>Room Heaters, Pellet Fuel-Burning Type</td>
<td>Room Heaters</td>
<td>902.10.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM E1509 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Pellet burning appliances such as fireplaces, furnaces, and stoves have risen in popularity thanks to their green credentials of burning renewable or otherwise waste products instead of nonrenewable sources of energy such as gas. Pellet burning fireplaces or stoves differ to wood burning stoves or wood burning fireplaces because they use compressed pellets as the fuel rather than pieces of wood. The pellets themselves are highly compressed pieces of material that burn with a hot flame thanks to their density. The ASTM E1509 standard covers performance requirements, test methods, and marking requirements for automatic feed, pellet fuel-burning room heaters that are intended to burn pellets.
Proposals

Item #: 181
UMC 2024  Section: 903.2.7

SUBMITTER: Brad Ketner
KBE, INC

RECOMMENDATION:
Add new text

903.0 Air-Conditioning Appliances.

903.2 Gas-Fired Air Conditioners and Heat Pumps.

903.2.7 Air-Conditioning Coil Freeze Protection. A sensor shall be attached to the air-conditioning coils that will shut off the equipment if it detects a temperature of 29°F (-2°C) to prevent icing of the coils. A manual reset button that is on the sensor shall be pushed to return the system to normal operation.

SUBSTANTIATION:
When any part of the air conditioning unit fails, i.e., the blower motor, low refrigerant, poor air flow, etc., the coils will begin to freeze. This leads to potential flood damage for the homeowner, mold, mildew, and additional equipment failure due running while frozen (txv fails, compressor slugs...), not to mention it is wasted time for the technicians that are waiting for the system to thaw before they can fix the problem, and the homeowner is financially burdened as well. With this safety sensor in place, hundreds of millions of dollars in property damage and equipment breakage can be alleviated.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The language does not provide direction as to where to find the sensor, and there is no standard for the sensor. The language is vague and ambiguous regarding this sensor. There is concern that not every coil needs freeze protection. As written, this requirement would apply to every single unit even if freeze protection is unnecessary. There is also concern regarding the manual reset button to return the system to normal operation. The section would only apply to gas-fired air conditioners based on the proposed location within the code.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29   NOT RETURNED: 1   Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 903.3, Table 1801.1  Item #: 181

SUBMITTER: Brad Ketner
KBE, Inc  Comment #: 1

RECOMMENDATION:
Add new text
Request to replace the code change proposal by this public comment.

903.0 Air-Conditioning Appliances.

903.3 Air-Conditioning Coil Freeze Protection. Where any equipment or appliance is installed in a space where damage can result from frozen evaporator coils (in cooling mode) that are capable of thawing and causing water overflow, a temperature sensor shall be provided. The temperature sensor shall be attached to the air-conditioning evaporator coils by a clamp on any u-bend and shall shut off the equipment if it detects freezing of the evaporator coils (in cooling mode). A manual reset button shall be required to restore the equipment or appliance to normal operation. This installation shall apply to any situation which requires installation of a pan underneath the unit, with or without a drain line switch, in accordance with Section 310.2. The temperature sensor shall comply with UL 60730-1 and UL 60730-2-9. This requirement shall apply to both gas and electric air conditioning heating units.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 60730-1-2016</td>
<td>Automatic Electrical Controls – Part 1: General Requirements</td>
<td>Miscellaneous</td>
<td>903.3</td>
</tr>
<tr>
<td>UL 60730-2-9-2017</td>
<td>Automatic Electrical Controls – Part 2- 9: Particular Requirements for Temperature Sensing Controls (with revisions through June 18, 2020)</td>
<td>Miscellaneous</td>
<td>903.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 60730-1 and UL 60730-2-9 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
When any part of the air conditioning unit fails, i.e., the blower motor, low refrigerant, poor air flow, etc., the evaporator coils (in cooling mode) will begin to freeze. This leads to potential flood damage for the homeowner, mold, mildew, and additional equipment failure due to running while frozen (txv fails, compressor slugs, etc...). With this safety sensor in place, hundreds of millions of dollars in property damage and equipment breakage can be alleviated.
Proposals

Item #: 183

UMC 2024 Section: 911.0 - 911.2.2, Table 1701.1

SUBMITTER: Maria Yepremian
County of Los Angeles Building and Safety

RECOMMENDATION:
Revise text

911.0 Decorative Appliances for Installation in Vented Fireplaces.

911.1 Prohibited installations in Vented Fireplaces. Decorative appliances for installation in vented fireplaces shall not be installed in bathrooms or bedrooms unless the appliance is listed and the bedroom or bathroom has the required volume in accordance with Section 701.4. [NFPA 54:10.6.1]

944.2 911.1.1 Installation. A decorative appliance for installation in a vented fireplace shall be installed only in a vented fireplace having a working chimney flue and constructed of noncombustible materials. These appliances shall not be thermostatically controlled. [NFPA 54:10.6.2]

944.2.4 911.1.2 Listed Decorative Appliance. A listed decorative appliance for installation in a vented fireplace shall be installed in accordance with its listing and the manufacturer's installation instructions.

944.2.2 911.1.3 In Manufactured Homes. A decorative appliance for installation in a vented fireplace, where installed in a manufactured home, shall be listed for installation in manufactured homes. [NFPA 54:10.6.2.2]

944.2.3 911.1.4 Unlisted Decorative Appliance. An unlisted decorative appliance for installation in a vented fireplace shall be installed in a fireplace having a permanent free opening, based on appliance input rating and chimney height, equal to or greater than that specified in Table 911.2. [NFPA 54:10.6.2.3]

944.3 911.1.5 Fireplace Screens. A fireplace screen shall be installed with a decorative appliance for installation in a vented fireplace. [NFPA 54:10.6.3]

911.2 Unvented Decorative Appliances. Unvented factory-built decorative appliances shall be installed in accordance with the manufacturer's installation instructions and its listing.

911.2.1 Alcohol Fuel Burning. Factory-built unvented liquid or gelled alcohol based intended to be fixed shall comply with UL 1370. No combustible material shall be within 18 inches (457 mm) of the appliance.

911.2.2 Prohibited Use. Factory-built unvented decorative appliances shall be used for decorative purposes and shall not be used as a primary heat source, a cooking appliance, or in conjunction with a blower assembly.

Unvented decorative appliances shall not be installed in spaces in which flammable vapors or gases may be present.

Unvented decorative appliances shall not be installed in bathrooms or bedrooms unless the appliance is listed for such purpose, and the bedroom or bathroom has the required volume of indoor air in accordance with Section 701.4.

(below shown for reference only)

701.4 Indoor Combustion Air. The required volume of indoor air shall be determined in accordance with the method in Section 701.4.1 or Section 701.4.2, except that where the air infiltration rate is known to be less than 0.40 ACH (air change per hour), the method in Section 701.4.2 shall be used. The total required volume shall be the sum of the required volume calculated for appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with Section 701.5, are considered a part of the required volume. [NFPA 54:9.3.2]
TABLE 1701.1
REFERRED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1370-2011</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances (with revisions through March 25, 2016)</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances</td>
<td>911.2.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1370 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The existing code does not provide any information for unvented decorative appliances such as alcohol based space heaters. These systems are being installed more and more every day and the UMC does not provide guidance as to what are the appropriate requirements for the safe installation of such systems. UL 1370 is the appropriate standard for such application. Section 911.2 will clarify that such systems shall be installed in accordance with the manufacturer's installation instructions and its listing. This is necessary because there have been instances where the manufacture's installation instructions conflict with the listing. In such case, where the installation instructions conflict the listing, the more stringent provisions shall prevail in accordance with Section 102.1 of the UMC.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
Section 911.2 raises safety concerns as to public health and safety. The proposal also goes beyond the minimum requirements of the code. Furthermore, such unvented decorative appliances can be installed without being inspected.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 911.0 - 911.2.2, Table 1801.1  Item #: 183
SUBMITTER: Bo Manalo  EcoSmart Inc  Comment #: 1
RECOMMENDATION:
Revise text
Request to accept the code change proposal as submitted by this public comment

SUBSTANTIATION:
The existing code does not provide any information for unvented decorative appliances such as alcohol based space heaters. These systems are being installed more and more every day and the UMC does not provide guidance as to what are the appropriate requirements for the safe installation of such systems. UL 1370 is the appropriate standard for such application. Section 911.2 will clarify that such systems shall be installed in accordance with the manufacturer's installation instructions and its listing. This is necessary because there have been instances where the manufacture's installation instructions conflict with the listing. In such case, where the installation instructions conflict the listing, the more stringent provisions shall prevail in accordance with Section 102.1 of the UMC.
Proposals

Item #: 185

UMC 2024  Section: 913.0 - 913.4, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

**913.0 Factory-Built Fireplaces and Fireplace Stoves.**

913.1 Factory-Built Fireplaces. Factory-built fireplaces shall comply be listed and labeled in accordance with UL 127 and shall be installed in accordance with the manufacturer's installation instructions.

913.2 Factory-Built Fireplace Stoves. Fireplace stoves shall comply be listed and labeled in accordance with UL 737 and shall be installed in accordance with the manufacturer's installation instructions.

913.3 Masonry Fireplace Inserts. Solid-fuel-type fireplace inserts intended for installation in masonry fireplaces shall be listed and labeled in accordance with UL 1482 and shall be installed in accordance with the manufacturer's installation instructions.

913.4 Fireplace Accessories. Fireplace accessories for use with masonry fireplaces, including heat exchangers, glass doors assemblies, combustion air vents, and termination caps, shall comply be listed and labeled in accordance with UL 907 and shall be installed in accordance with the manufacturer's installation instructions.

**TABLE 1701.1**

**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through February 25, 2020)</td>
<td>Room Heaters</td>
<td>913.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1482 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address solid-fuel-fired fireplace inserts. UL 907 applies to fireplace accessories that are intended only for field installation into or attachment to existing masonry fireplaces. Fireplace accessories include items such as heat exchangers, glass door assemblies, and the like. For the purpose of these requirements, fireplace accessories do not include fireplace inserts or devices that incorporate a closed fire chamber. UL 1482 is used to evaluate and certify fireplace inserts in masonry fireplaces. Any accessory or addition to a factory built fireplace needs to be evaluated and certified in accordance with UL 127. Determining compliance with a standard is done as “listed and labeled,” which are code-defined terms.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The current language is concise and clearly states the intent of the section. The proposal is overly restrictive. It adds only one standard for masonry fireplace inserts but there may be other standards that apply. Furthermore, the phrase “listed and labeled” should state “comply” as “comply” already implies that the product must be listed and labeled.
TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 24 NEGATIVE: 5 NOT RETURNED: 1 Heine

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted. The standard is the proper standard to reference.
FEEHAN: This language and standard are necessary in the code.
KOERBER: Standard is correct. This should be accepted.
WHITE: This is a good change, is well substantiated and should have been accepted.
WISMAN: This should have been accepted. It would be a helpful addition to code.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 913.0, 913.1.1, 913.2, 913.3, 913.4, Table 1801.1  Item #: 185
SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

913.0 Factory-Built Fireplaces and Fireplace Stoves.
913.1 Factory-Built Fireplaces. (remaining text unchanged)

913.1.1 Factory-Built Fireplace Accessories and Inserts. Fireplace accessories and fireplace inserts shall not be installed in a factory-built fireplace, except where the factory-built fireplace system has been specifically tested with the accessories or inserts in accordance with UL 127.

943.1.1 913.1.2 Gasketed Fireplace Doors. (remaining text unchanged)

913.2 Factory-Built Fireplace Stoves. (remaining text unchanged)

913.3 Masonry Fireplace Inserts. Solid-fuel-type fireplace inserts intended for installation in masonry fireplaces shall comply with UL 1482 and shall be installed in accordance with the manufacturer's installation instructions.

913.3 913.4 Masonry Fireplace Accessories. Fireplace accessories for use with masonry fireplaces, including heat exchangers, glass door assemblies, combustion air vents, and termination caps, shall comply with UL 907 and installed in accordance with the manufacturer's installation instructions.

TABLE 1801.1
REFERRED STANDARDS

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<td>Room Heaters</td>
<td>913.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 127 and UL 1482 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address solid-fuel-fired fireplace inserts. UL 907 applies to fireplace accessories that are intended only for field installation into or attachment to existing masonry fireplaces. Fireplace accessories include items such as heat exchangers, glass door assemblies, and the like. For the purpose of these requirements, fireplace accessories do not include fireplace inserts or devices that incorporate a closed fire chamber. In the past, UL 1482 has been used to evaluate and certify fireplace inserts in masonry fireplaces.
The new Section 913.1.1 has been added to clarify that any accessory or addition to a factory-built fireplace needs to be evaluated and certified in accordance with UL 127. Factory-built fireplaces are typically constructed with zero-clearance to combustible materials. The additional accessories can impact the performance of the fireplace.

UL's Standard Technical Panel for Solid Fuel Appliances, STP 127, and the S600E Technical Committee recently formed a Task Group to address the issue of solid-fueled heaters that have been tested only in free-standing configurations according to UL 1482, and/or CAN/ULC-S627, being installed in factory-built fireplaces. The Task Group confirmed that this type of installation is outside of the Scopes of those standards, as the requirements make clear, but that there are no requirements for instructions or product markings to state this. Revision proposals to add new requirements for markings and instructions in both standards are currently in-process. Additional performance requirements are needed to evaluate a fireplace insert that is included within a factory-built fireplace. The Task Group is now starting work on means to address this type of installation, for which there is evidently a demand, whether by revisions to existing standards, or new standards.

Until such time as the new standard is completed, clarity is needed in the codes that fireplace inserts are not permitted within factory-built fireplaces unless specifically tested together as an assembly. This addresses the field issues that have been reported for these installations.

For more information on UL's code development process, see www.UL.com/standards.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment, and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 194

UMC 2024  Section: 934.1 - 934.5, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

934.0 Refrigeration Appliances.
934.1 Self-Contained Refrigerators and Freezers. Factory-built commercial refrigerators and freezers shall comply be listed and labeled in accordance with UL 471 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.

934.2 Unit Coolers. Factory-built unit coolers for use in refrigerators, freezers, refrigerated warehouses, and walk-in coolers shall comply be listed and labeled in accordance with UL 412 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.

934.3 Self-Contained Mechanical Refrigeration Systems. Self-contained mechanical refrigeration systems for use in walk-in coolers shall comply be listed and labeled in accordance with UL 427 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.

934.4 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

934.5 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 and UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>934.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 109 and UL 207 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Sections are being added to Chapter 9 (Installation of Specific Appliances) to address the safety standards for refrigerant-containing components, accessories, and fittings to aid the code official in verifying safe installation for such systems.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed change is being rejected as UL 207 has been updated to include provisions from UL 109. There is concern whether UL 207 covers these type of refrigerant fittings.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 21  NEGATIVE: 8  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

MANN: I have the same concern the Committee has as to whether UL 207 covers these fittings. Furthermore, the Committee decided years ago to use "comply with" and not "be listed and labeled in accordance with."

EXPLANATION OF NEGATIVE:

BALLANCO: This change should have been either accepted as submitted or accepted as modified with the removal of UL 109 since this standard is incorporated into UL 207. The substantiation justifies the acceptance of this change.

FEEHAN: This language and standard are necessary in the code.

KOERBER: Should be accepted with modification to reference the appropriate standard.

MACNEVIN: This proposal should be accepted as UL 109 is appropriate for this purpose.

TRAFTON, A: This standard is necessary in the code.

VAN RITE: This proposal should be accepted as modified with removal of the UL 109 reference.

WHITE: Should be accepted based on substantiation.

WISEMAN: This is a necessary standard in the code.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 934.4  Item #: 194

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:

Add new text

Request to replace the code change proposal by this public comment.

934.0 Refrigeration Appliances.

934.4 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall comply with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

Note: UL 207 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:

Sections are being added to Chapter 9 (Installation of Specific Appliances) to address the safety standards for refrigerant-containing components and accessories to aid the code official in verifying safe installation for such systems.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.
Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.

PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: 934.1 - 934.5, Table 1801.1  Item #: 194
SUBMITTER: Emily Toto  ASHRAE  Comment #: 2

RECOMMENDATION:
Revise text

Request to replace accept the code change proposal by this public comment.

934.0 Refrigeration Appliances.
934.1 Self-Contained Refrigerators and Freezers. Factory-built commercial refrigerators and freezers shall comply be listed and labeled in accordance with UL 471 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.2 Unit Coolers. Factory-built unit coolers for use in refrigerators, freezers, refrigerated warehouses, and walk-in coolers shall comply be listed and labeled in accordance with UL 412 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.3 Self-Contained Mechanical Refrigeration Systems. Self-contained mechanical refrigeration systems for use in walk-in coolers shall comply be listed and labeled in accordance with UL 427 or UL 60335-2-89 and shall be installed in accordance with the manufacturer’s installation instructions.
934.4 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.
934.5 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 or UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
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<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
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<tbody>
<tr>
<td>UL_109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>934.5</td>
</tr>
</tbody>
</table>

Note: UL 109 and UL 207 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This public comment is being submitted to reinforce the importance of including the applicable safety standards addressing the proper installation of refrigerant-containing components, accessories, and fittings. UL 109 and UL 207 both cover the requirements of Section 934.5, therefore, a choice could be made to follow either standard.
936.0 Air Filter Appliances.  
936.1 Electrostatic Air Cleaners. Electrostatic air cleaners shall comply be listed and labeled in accordance with UL 867 and shall be installed in accordance with the manufacturer’s installation instructions.  
936.2 High-Efficiency Particulate Air Filter Units. High-efficiency particulate air filter units for use in industrial and laboratory exhaust and ventilation systems shall be listed and labeled in accordance with UL 586 and shall be installed in accordance with the manufacturer’s installation instructions.

**TABLE 1701.1**  
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
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<th>STANDARD TITLE</th>
<th>APPLICATION</th>
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</tr>
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<tbody>
<tr>
<td>UL 586-2009</td>
<td>High-Efficiency, Particulate, Air Filter Units (with revisions through December 19, 2017)</td>
<td>Air Filters</td>
<td>936.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** UL 586 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The appropriate standard for high-efficiency particulate air filter units is UL 586, “High-Efficiency, Particulate, Air Filter Units” and is being added to Section 936.2 “High-Efficiency Particulate Air Filter Units.”

**COMMITTEE ACTION:** REJECT

**COMMITTEE STATEMENT:**
There may exist other applicable standards other than UL 586 for high efficiency particulate air filter units. In addition, the Technical Committee would like the submitter to come back with a public comment to modify the wording from “listed and labeled” to “comply with” for consistency throughout the code and to prevent overly restrictive language.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 22  NEGATIVE: 7  NOT RETURNED: 1  Heine

**EXPLANATION OF NEGATIVE:**
ARYAN: This language would be beneficial to the code and the referenced standard is appropriate.

BALLANCO: This change should have been accepted. The substantiation justifies the proposal.

FEEHAN: This language and standard are necessary in the code.
KOERBER: The substantiation was appropriate and the proposal should be accepted.

MACNEVIN: This should be accepted as the UL 586 standard is appropriate for this application, and the proposal adds safety to the code.

WHITE: The change should have been accepted based on the substantiation.

WISEMAN: The substantiation was adequate to accept this proposal.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 935.2, Table 1801.1  Item #: 196

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

935.0 Air Filter Appliances.
935.1 Electrostatic Air Cleaners. Electrostatic air cleaners shall comply with UL 867 and installed in accordance with the manufacturer’s installation instructions.
935.2 High-Efficiency Particulate Air Filter Units. High-efficiency particulate air filter units for use in industrial and laboratory exhaust and ventilation systems shall be comply with UL 586 and installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 586-2009</td>
<td>High-Efficiency, Particulate, Air Filter Units (with revisions through December 19, 2017)</td>
<td>Air Filters</td>
<td>935.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 586 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The appropriate standard for high-efficiency particulate air filter units is UL 586, “High-Efficiency, Particulate, Air Filter Units” and is being added to Section 935.2 “High-Efficiency Particulate Air Filter Units.”

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 198
UMC 2024 Section: 221.0, 939.0, 939.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

939.0 Steam Bath Equipment.
939.1 General, Steam bath equipment shall be listed and labeled in accordance with UL 499 and shall be installed in accordance with their listing and the manufacturer’s installation instructions.

221.0 – S –
Steam Bath Equipment. Includes steam bath generators, combination room and steam generator systems, and steam bath cabinets intended for personal bathing.

Note: UL 499 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address steam bath equipment.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is insufficient technical justification to warrant such change. There is also concern with requiring "listing and labeling" to the standard. The language should only require compliance. The proposed language may also be outside of the scope of the mechanical code. The language may be better suited in the plumbing code.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 22 NEGATIVE: 7 NOT RETURNED: 1 Heine

EXPLANATION OF NEGATIVE:
ARYAN: This change should be accepted in the code per the substantiation.
BALLANCO: This change should have been accepted. The substantiation justifies the proposal.
FEEHAN: This language and standard are necessary in the code.
KOERBER, WISEMAN: The substantiation was adequate to accept this proposal.
MACNEVIN: This proposal should be accepted as it improves the code with the UL 499 requirement, appropriate for this purpose.
WHITE: This should be accepted based on the substantiation.

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 939.0, 939.1, Table 1801.1        Item #: 198
SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

939.0 Steam Bath Equipment.
939.1 General. Steam bath equipment shall comply with UL 499 and shall be installed in accordance with their listing and the manufacturer's installation instructions.

221.0 – S –
Steam Bath Equipment. Includes steam bath generators, combination room and steam generator systems, and steam bath cabinets intended for personal bathing.

Note: UL 499 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address steam bath equipment. This is providing guidance for minimum safety requirements where steam bath equipment is installed. This proposal does not mandate these installations.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO's Manual of Style.
Proposals

Item #: 199
UMC 2024  Section: 223.0, 939.0 - 939.2, Table 1701.1

SUBMITTER: Bo Manalo
EcoSmart Inc

RECOMMENDATION:
Add new text

939.0 Unvented Alcohol Fuel-Burning Decorative Appliances.
939.1 General. Unvented alcohol fuel-burning decorative appliances shall be listed and labeled in accordance with UL 1370 and shall be installed in accordance with the conditions of the listing and manufacturer's installation instructions. 939.2 Marking. Unvented alcohol fuel-burning decorative appliances shall have a permanent factory-applied marking showing the manufacturer's name, model, thermal output (BTU/hr) (kW), approved fuel type, minimum room volume requirement for installation, and required clearances to combustibles.

223.0 – U –
Unvented Alcohol Fuel Burning Decorative Appliance. An unvented, self-contained fire feature appliance fueled by alcohol whose only function is providing an aesthetic effect of flames; intended to be directly or indirectly secured to the wall or floor and not for duct connection.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1370-2011</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances (with revisions through March 25, 2016)</td>
<td>Unvented Alcohol Fuel Burning Decorative Appliances</td>
<td>939.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: UL 1370 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
This proposal adds a provision for a newer type of decorative appliance. It provides clear and specific requirements for the installation of unvented, self-contained alcohol fuel burning appliances. The requisite ANSI consensus Standard UL 1370 includes performance-based criteria that provide a consistent application of requirements and best practices to ensure safe installation and operation. The Standard includes combustion testing for carbon dioxide and carbon monoxide emission limits, oxygen depletion, materials and construction requirements. The Standard also tests for user abuse, stability, temperature, and wind tests. There is also a requirement for markings and instruction manual content.

These appliances are intended for decorative purposes and not intended to be utilized as a primary heat source. Denatured alcohol is formulated for the application and limited to a maximum input rate of 0.25 gallons of fuel per hour (0.95 liters per hour). They are not provided with means for duct connection nor is there electric/mechanical assist of heated air movement, such as a fan-blower assembly. The appliances are also labeled with minimum room
volume requirements for installation. The proposal improves the Code by providing installers and building officials with a clear path on the specifications that pertain to these products. Installation is intended to be in accordance with local codes, the manufacturer's installation instructions and markings on the appliance.

The same proposal was submitted to ICC and approved and are not part of the 2021 ICC Mechanical Code.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language raises safety concerns as to public health and safety. The proposal also goes beyond the minimum requirements of the code. Furthermore, such unvented decorative appliances can be installed without being inspected. These appliances are meant to be decorative only and not used as a primary heat source.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 223.0, 939.0 - 939.2, Table 1801.1  Item #: 199

SUBMITTER: Bo Manalo
EcoSmart Inc

Comment #: 1

RECOMMENDATION:
Add new text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Request to accept the code change proposal as submitted by this public comment. The same proposal has been accepted and included in Section 929 of the 2021 ICC Mechanical Code.

This proposal adds a provision for a newer type of decorative appliance. It provides clear and specific requirements for the installation of unvented, self-contained alcohol fuel burning appliances. The requisite ANSI consensus Standard UL1370 includes performance-based criteria that provide a consistent application of requirements and best practices to ensure safe installation and operation. The Standard includes combustion testing for carbon dioxide and carbon monoxide emission limits, oxygen depletion, materials and construction requirements. The Standard also tests for user abuse, stability, temperature, and wind tests. There is also a requirement for markings and instruction manual content.

These appliances are intended for decorative purposes and not intended to be utilized as a primary heat source. Denatured alcohol is formulated for the application and limited to a maximum input rate of 0.25 gallons of fuel per hour (0.95 liters per hour). They are not provided with means for duct connection nor is there electric/mechanical assist of heated air movement, such as a fan-blower assembly. The appliances are also labeled with minimum room volume requirements for installation. The proposal improves the Code by providing installers and building officials with a clear path on the specifications that pertain to these products. Installation is intended to be in accordance with local codes, the manufacturer's installation instructions and markings on the appliance.
Proposals

Item #: 200

UMC 2024  Section: 939.0, 939.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

939.0 Sauna Heaters,
939.1 General. Sauna heaters shall be listed and labeled in accordance with UL 875 and shall be installed in
accordance with their listing and the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
</tr>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>UL 875-2009</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 875 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's
Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address sauna heaters.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is insufficient technical justification to warrant such change. There is also concern with requiring "listing and
labeling" to the standard. The language should only require compliance. The proposed language may be outside of
the scope of the mechanical code. The language may be better suited in the plumbing code. The proposal should
also clarify that it applies to "electric" sauna heaters only as there are other energy sources that may be used.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 23  NEGATIVE: 6  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: The standard was submitted for review and is appropriate for the application in the proposed change.
FEEHAN: This language and standard are necessary in the code.
KOERBER: The standard is appropriate. The proposal should be accepted.
MACNEVIN: This proposal should be accepted as the UL 875 standard is appropriate for this application and the
change adds safety to the code.
WHITE: This should be accepted based on the substantiation.
WISEMAN: The substantiation is adequate to accept the proposal.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 939.0, 939.1, Table 1801.1  Item #: 200

SUBMITTER: John Taecker  UL LLC  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

939.0 Sauna Heaters.
939.1 General. Sauna heaters shall comply with UL 875 and shall be installed in accordance with their listing and the manufacturer’s installation instructions.

TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 875-2009</td>
<td>Electric Dry-Bath Heaters (with revisions through January 4, 2021)</td>
<td>Sauna heaters</td>
<td>939.1</td>
</tr>
</tbody>
</table>

Note: UL 875 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
A new section is being added to Chapter 9 (Specific Appliances) to address sauna heaters. This is providing guidance for minimum safety requirements where saunas are installed. This proposal does not mandate these installations.

This is within the scope of the mechanical code, because these heaters are producing a dry-heat environment. The relative humidity in the heated environment is in the region of 10 – 25 percent and the purpose of the heated environment is to promote perspiration for the occupants in a short time by means of a relatively warm and dry atmosphere.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO's Manual of Style.
Proposals

Item #: 202

UMC 2024 Section: 1002.2.3, Table 1701.1, Table 1701.2

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

1002.0 Standards.

1002.2 Oil-Burning Boilers. Oil-burning boilers shall comply with Section 1002.2.1 and Section 1002.2.2.
1002.2.1 Listing & Labeling. Oil-burning boilers shall be listed and labeled in accordance with UL 726.
1002.2.2 Installation. Tanks, piping, and valves for oil-burning boilers shall be installed in accordance with NFPA 31.
1002.2.3 Oil Gauging Devices. Liquid-level indicating gauges shall be listed and labeled in accordance with UL 180 and shall be installed in accordance with the manufacturer’s installation instructions.

TABLE 1701.1
REFERREDENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 180-2019</td>
<td>Combustible Liquid Tank Accessories (with revisions through May 8, 2020)</td>
<td>Gauges, Level Gauges</td>
<td>1002.2.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL-180-2012</td>
<td>Liquid-Level Gauges for Oil Burner Fuels and other combustible liquids (with revisions through May 12, 2017)</td>
<td>Gauges, Level Gauges</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 180 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
UL 180 is being added to this section as the standard provides requirements that apply to liquid level gauges for oil burner fuels. By referencing this standard in the code, the reference to the standard needs to move from Table 1701.2 to Table 1701.1.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is insufficient technical justification to warrant such change. There is also concern with requiring "listing and labeling" to the standard. The language should only require compliance. The language should be corrected to clarify the intent of the section.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 23  NEGATIVE: 6  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:

BALLANCO: The standard was submitted for review. The reference to the standard is applicable for the proposed new text. This change should have been accepted.

FEEHAN: This language and standard are necessary and belong in the code.

KOERBER: Proposal should be accepted as the standard is appropriate.

MACNEVIN: UL 180 is appropriate for this purpose and this item should be accepted. Remove "listed and labeled" in public comment.

WHITE: This should have been accepted based on the substantiation.

WISEMAN: The substantiation is adequate to accept this proposal.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1002.2.3, Table 1801.1, Table 1801.2  Item #: 202

SUBMITTER: John Taecker  UL LLC

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1002.0 Standards.

1002.2 Oil-Burning Boilers. (remaining text unchanged)

1002.2.3 Oil Gauging Devices. Liquid-level indicating gauges shall comply with UL 180 and shall be installed in accordance with the manufacturer's installation instructions.

TABLE 1801.1
REFERENCES STANDARDS

<table>
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<tbody>
<tr>
<td>UL 180-2019</td>
<td>Combustible Liquid Tank Accessories (with revisions through May 8, 2020)</td>
<td>Gauges, Level Gauges</td>
<td>1002.2.3</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
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<th>DOCUMENT NUMBER</th>
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</thead>
<tbody>
<tr>
<td>UL 180-2012</td>
<td>Liquid Level Gauges for Oil Burner Fuels and other combustible liquids (with revisions through May 12, 2017)</td>
<td>Gauges, Level Gauges</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 180 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
SUBSTANTIATION:
UL 180 is being added to this section as the standard provides requirements that apply to liquid level gauges for oil burner fuels. By referencing this standard in the code, the reference to the standard needs to move from Table 1801.2 to Table 1801.1.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.
Proposals

Item #: 207
UMC 2024  Section: 1008.1

SUBMITTER: Phillip H Ribbs  
PHR Consultants

RECOMMENDATION:
Revise text

1008.0 Low-Water Cutoff.
1008.1 General. Hot water boilers and steam boilers shall be installed with a low-water cutoff. A coil-type boiler or a water-tube boiler that requires forced circulation to prevent overheating of the coils or tubes shall be installed with a flow-sensing device in the outlet piping in lieu of the low-water cutoff. The low-water cutoff or the flow sensing device shall be installed so as to prevent damage to the boiler and to permit testing of the fuel-supply cutoff without draining the heating system. The low-water cutoff shall shut off the combustion fuel-supply at a water level setpoint that is in accordance with the boiler manufacturer's instructions.

SUBSTANTIATION:
There has been confusion in the field by the requirement in Section 1008.1 to shut off the “combustion.” The intention of the low-water cutoff is to shut off the fuel-supply. The code change replaces “combustion” with “fuel-supply” for clarity.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The term "combustion" is the correct term to be used in the section. Low-water level does not cutoff the fuel-supply, only combustion. A public comment is recommend to substitute the term "energy source."

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1008.1  
Item #: 207  Comment #: 1

SUBMITTER: Phillip H Ribbs  
PHR Consultants

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1008.0 Low-Water Cutoff.
1008.1 General. Hot water boilers and steam boilers shall be installed with a low-water cutoff. A coil-type boiler or a water-tube boiler that requires forced circulation to prevent overheating of the coils or tubes shall be installed with a flow-sensing device in the outlet piping in lieu of the low-water cutoff. The low-water cutoff or the flow sensing device shall be installed so as to prevent damage to the boiler and to permit testing of the fuel-supply cutoff without draining the
heating system. The low-water cutoff shall shut off the combustion energy source at a water level setpoint that is in accordance with the boiler manufacturer’s instructions.

SUBSTANTIATION:
There has been confusion in the field by the requirement in Section 1008.1 to shut off the “combustion.” The intention of the low-water cutoff is to shut off the energy source. The code change replaces the term “combustion” with “energy source” for clarity. This change was recommended by the UMC Technical Committee.
Proposals

Item #: 208

UMC 2024  Section: 1103.1.1, Table 1103.1.1, 1104.6 - 1104.7

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, A2L Task Group

RECOMMENDATION:
Revise text

1103.0 Classification.
1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.

1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

<table>
<thead>
<tr>
<th>TABLE 1103.1.1 REFRIGERANT SAFETY GROUP CLASSIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Flammability</td>
</tr>
<tr>
<td>Flammable</td>
</tr>
<tr>
<td>Lower Flammability</td>
</tr>
<tr>
<td>No Flame Propagation</td>
</tr>
</tbody>
</table>

1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. [ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. [ASHRAE 15:7.6.1-7.6.1.2]

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

(1) The charge size of any independent circuit exceeds $0.212 \times LFL$ (lb), where $LFL$ is in pounds per 1000 $ft^3$ ($6 \times LFL$ [kg] where $LFL$ is in $kg/m^3$).

(2) When the occupancy classification is institutional.

(3) When using the provisions of Section 1104.6.4.

Exception: For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any...
independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

(1) The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]  

Where:
\[ Q_{\text{min}} = \text{minimum airflow rate, ft}^3/\text{min} \]
\[ M = \text{refrigerant charge of the largest independent refrigerating circuit of the system, lb} \]
\[ LFL = \text{lower flammability limit, lb per 1000 ft}^3 \]

For SI units: \( Q = 60 \,000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (\( m^3/h \)), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m\(^3\)).

(2) Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

(3) Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.

(4) Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). \( \text{[ASHRAE 15:7.6.2.4]} \)

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. \( \text{[ASHRAE 15:7.6.3-7.6.3.3]} \)

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

(1) The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   (a) 6.6 lb (3 kg) for residential and institutional occupancies and
   (b) 22 lb (10 kg) for commercial and public/large mercantile occupancies.

(2) The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

(3) A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]

Where:
\[ Q_{\text{min}} = \text{minimum airflow rate, ft}^3/\text{min} \]
\[ M = \text{refrigerant charge of the largest independent refrigerating circuit of the system, lb} \]
\[ LFL = \text{lower flammability limit in lb per 1000 ft}^3 \]

For SI units: \( Q = 60 \,000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (\( m^3/h \)), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m\(^3\)).

(4) The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (30 cm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

(5) Air that is exhausted from the ventilation system shall be either:
   (a) discharged outside of the building envelope or
   (b) discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 1104.6.1.

(6) In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not
contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

(1) Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.

(2) Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).

(3) Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.

(a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.

(b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (30 cm) above the floor and within a horizontal distance of not more than 3.3 feet (1.0 m) with a direct line of sight of the unit.

(4) Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. (ASHRAE 15:7.6.5)

1104.6 1104.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 1104.6.

(renumber remaining sections)

SUBSTANTIATION:
Task Group Recommendation 1 - Human Comfort: These are the extracted requirements from ASHRAE 15-2019 that regulate low GWP refrigerants used in direct systems that fall into the safety classification of Group A2L. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

1103.0 Classification.

1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.

1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

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<td>B1</td>
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1103.2 Classification.

1103.2.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

1104.0 Requirements for Refrigerant and Refrigeration System Use.


Exception: Male flared joint connections for system servicing.

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. (ASHRAE 15:7.6.1-7.6.1.2)

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in
accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 4 lb (1.8 kg) \(0.212 \times \text{LFL (lb)}\), where LFL is in pounds per 1000 ft\(^3\) (6 \(\times\) LFL [kg]) where LFL is in kg/m\(^3\)).
2. When the occupancy classification is institutional.
3. When using the provisions of Section 1104.6.4.

Exception: For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

\[ Q_{min} = 1000 \times \frac{M}{LFL} \quad \text{[Equation 1104.6.2.4]} \]

Where:
- \( Q_{min} \) = minimum airflow rate, ft\(^3\)/min
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
- \( LFL \) = lower flammability limit, lb per 1000 ft\(^3\)

For SI units: \( Q = 60 \ 000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m\(^3\)/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m\(^3\)).

2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
4. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). [ASHRAE 15:7.6.2.4]

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. [ASHRAE 15:7.6.3-7.6.3.3]

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   - (a) 6.6 lb (3 kg) for residential and institutional occupancies applied products, and
   - (b) 4 lb (1.8 kg) for unitary products.
   - (bc) 22 lb (10 kg) for commercial and public/large mercantile occupancies.
2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4 (3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

\[ Q_{min} = 1000 \times \frac{M}{LFL} \]
Where:

\[Q_{\text{min}} = \text{minimum airflow rate, ft}^3/\text{min}\]

\[M = \text{refrigerant charge of the largest independent refrigerating circuit of the system, lb}\]

\[LFL = \text{lower flammability limit in lb per 1000 ft}^3\]

For SI units: \[Q = 60000 \times \frac{M}{LFL}, \text{where } Q \text{ is the supply air flow rate (m}^3/\text{h}), \text{M is the refrigerant charge (kg)}, \text{LFL is the lower flammability limit (g/m}^3)\].

(4) The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (30 cm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

(5) Air that is exhausted from the ventilation system shall be either:

(a) discharged outside of the building envelope or

(b) discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 1104.6.4.

(6) In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrester, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. {{ASHRAE 15:7.6.4}}

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

(1) Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.

(2) Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).

(3) Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.

(a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.

(b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (30 cm) above the floor and within a horizontal distance of not more 3.3 feet (1.0 m) with a direct line of sight of the unit.

(4) Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. {{ASHRAE 15:7.6.5}}

1104.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 1104.6.

(committee statement:)

For safety, all joints used on A2L refrigerant piping shall be brazed. Brazed joints are required to be made with brazing alloys having a liquidous temperature above 1000°F (538°C). Brazed joints have been proven to provide a zero percent leak free (no annual leak rate) system beyond the normal lifespan of the equipment for which the system serves. In the event of elevated system piping temperature, brazed joints provide the highest degree of safety and protection from catastrophic failures for high-probability installations. Additionally, the ASHRAE Standard 15-2019, Section 9.10.2, and IAPMO UMC 2021, Section 1106.9, requires that all joints, located in air ducts conveying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (371°C) without leaking into the airstream. This ASHRAE 15 requirement is applicable to all refrigerants including Group A1 and A2L refrigerants. As most refrigerant piping installations for equipment would be considered in the airstream (i.e. above ceiling, equipment closets, mechanical rooms, etc.), this requirement would be applicable to the majority of refrigeration piping installations.

As the 2021 UMC, Section 1109.1 requires that all refrigeration piping shall be metallic, and as brazed joints are a proven all metallic joining system, all refrigerant piping, especially A2L refrigerant piping, should be required to be brazed.

An exception should be made to Section 1104.6 for the use of male flare joints of access fittings, as these systems will require an access connection for gauges and service equipment. If not already provided by the manufacturer on
the system equipment, male flare fittings may be required to be installed on the system piping. The male flare fitting will be required to be able to be isolated from the system by means of an inline valve or have a Schrader (core type) valve incorporated into its construction. Flare fittings are usually ¼” or 5/16” SAE flare and are usually equipped with a brass cap to protect the threads of the fitting and prevent debris from entering the port.

The proposed amount in Section 1104.6.2.3(1) of 4 pounds (1800 grams) promotes public safety and consumer confidence. As the UL 60335-2-40 and ASHRAE 15 standards already reference required refrigerant detection sensor levels (about 1.8 kg or 4 lbs), there is no need to add any language.

Section 1104.6.4 (1)(a) is being modified to differentiate between applied products and unitary products. Section 1104.6.4(1)(b) was added to be consistent with the modified language in Section 1104.6.2.3. According to AHRI (AHRI Industry Sectors (ahrinet.org) applied products range from Air-cooled water-chilling chillers to water-cooled water-chilling or heat pump water-heating chillers. Unitary products are self-contained equipment to split systems.

Furthermore, Section 1104.6(5)(b) is being stricken and 1104.6(5)(a) is being modified to remove “or” to support the deletion of 1104.6(5)(b). Air should not be exhausted from the ventilation system into the building.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 18 NEGATIVE: 11 NOT RETURNED: 1 Heine

Note: Item # 208 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF AFFIRMATIVE:

BENKOWSKI: For consumer confidence in low GWP and low ODP, refrigerants joints should be brazed. This is not an issue to allow safety to be subverted by low cost.

BERGER: ASHRAE’s research data (RP-1808) for the use of Press-Connect on refrigeration piping is flawed, as well as skewed in favor of an unproven application. RP-1808 did prove that brazed joints were the only joining method included in the report to have a zero percent annual leak rate. I cannot understand why Industry Professionals would be voting against the allowance of environmentally friendly somewhat flammable A2L into the UMC while supporting the misapplication of a technology with a documented annual leak rate, no matter how small, to remain in the code. Perhaps a letter writing campaign is the way to go when you want to override the decision of the Technical Committee.


DIAS: I agree with the changes to this proposal and I believe that only brazed joints should be allowed for A2L refrigerants.

MANN: We are finally accepting A2L refrigerants in direct systems. To require systems utilizing A2L refrigerants to be brazed is the proper installation requirement. There are letters being circulated that are asking for a negative vote on this item. One of the letters states that the singular aim of this item is to remove the use of copper press-connect fittings for refrigerant-containing systems from the UMC. This item is stating that A2L systems in direct systems shall be brazed; only these systems. This item was approved by the A2L sub-committee and amended by the Technical Committee. The amendments improve this section and the Committee statement sums up perfectly as to why the Committee accepted the item as amended.

TERZIGNI: Thanks to all who provided technical information. I also conducted an informal survey and for refrigerant the majority of contractors use brazed connections because they either do not trust the other types or have had significant failures regarding those types of connections. Some (fewer) contractors did use the press-connect as their primary connection. While no joint is perfect, according to the ASHRAE research sent to me, the press-fit connections all leaked under positive pressure to some degree whereas the brazed fittings did not. Since this change is limited to the flammable refrigerants, and although I am very reluctant to limit a "product," I think it is reasonable to limit the connection for now.

YOUNG: I agree with the other comments submitted in support. I for one am not a huge fan of the letter writing campaign that could be misinterpreted as threatening in nature. We all worked diligently on the A2L task force and did all the research on this topic. The simple fact that properly brazed fitting(s) have a zero percent leakage rate. This is very convincing as we place more volatile compounds in the HVAC systems with very little regard to occupant safety. I stand firmly behind the actions taken on this item. Let's consider there are 1 million of these press-connect fittings being used in refrigeration systems. Let's say the average leakage rate is .75 grams per year per fitting, an average based on ASHRAE 1808. This is 750,000 grams of refrigerant we willingly agree to let slip into the atmosphere. This would be about 1651 pounds of refrigerant annually. Is this really ok?
EXPLANATION OF NEGATIVE:

BALLANCO: This change should have been approved as submitted without the modifications. The modifications are inappropriate regarding the prohibition of press-connect fittings, the mandate of brazing for Group A2L refrigerants, the identification of applied and unitary equipment, and the prohibition of using indoor space for dilution. All of these items are inconsistent with ASHRAE 15 and the work by the A2L Task Group. There is no technical justification for mandating brazed joints for Group A2L refrigerants. It is interesting that brazing was mandated for only one group of refrigerant. Similar requirements do not apply to Group A2, A3, B1, B2L, B2, or B3 refrigerants. Furthermore, this change will make the code inconsistent with the listing requirements, thus violating the listing of the product. The use of applied and unitary to define equipment is inappropriate. What does this mean? The code does not have a definition of applied equipment nor unitary equipment. The ventilation air provisions are not technically justified. When dealing with refrigerant concentration level, the room volume is always measured for determining compliance. The change to ventilating to the outdoors is inconsistent with this long accepted concept. The change was made without technical justification.

CUDAHY: This change should be approved as submitted, without the modifications. The modifications are inappropriate regarding the prohibition of press-connect fittings, which seem to be a useful addition to joining.

FEEHAN: The proposal removes press-connect fittings without any technical justification.

GUNZNER: The changes made to this item do not fully take into account the information developed by ASHRAE 15 and the UMC A2L Task Group. AMCA supports the work of the UMC A2L Task Group. The ASHRAE 15 Committee spent several years updating and including data in the standard to safely install equipment that is listed to the UL standard.

KOERBER: Based on the exhaustive work by the A2L Task Group and ASHRAE, I must agree that the proposal should have been accepted without Committee modification. No technical justification was provided to override the language in the proposal.

MACNEVIN: This proposal by the A2L Task Group should be accepted as submitted, without the Committee amendments. There was no evidence submitted to prohibit press-connect fittings. In fact, a previous report submitted to this TC showed that press-connect fittings are the most reliable joining technology overall.

TRAFTON, A: This material should be allowed in the code. Has been used for years.

TRAFTON, P: While I agree with some of the comments regarding letter writing, which should have been done with the submittal of the Change in question, I also believe there has been sufficient research through ASHRAE to show that the press-fit joining methods are reliable. Further, I agree with Julius Ballanco in his descriptions.

VAN RITE: To require brazed joints when newer, better and faster technology exists is short sided. Crimp connectors are proven to be safe and there is no justification for blocking them in the UMC.

WHITE: The changes to the section lack technical justification. I do not see how a sub-committee's work can be disregarded by those who either did not participate in that work or were unsatisfied with the outcome. This besmirched technology is proven and is here to stay. Submission of additional documentation is appropriate during the public comment period. It seems to have been the practice of the Committee to not allow information to be considered that was not submitted by the cutoff date for proposed changes. It is inappropriate to consider additional information at this time.

WISEMAN: Press-connect fittings have been thoroughly tested and have proven reliable in the field. Nothing other than hearsay was given as proof of a problem. A brazed joint is only as good as the human making the weld. To pretend that a human can always provide a properly brazed joint is misleading. Humans make mistakes. There is not a perfect connection method, but without documentation of a problem, the code should stay as written.

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1103.1.1, Table 1103.1.1, 1104.6 - 1104.7  Item #: 208

SUBMITTER: Mary Koban, AHRI; Dominique Taudin, Carrier Corporation; Stephen V. Spletzer, The Chemours Company; Jeff Whitelaw, Mitsubishi Electric US, Cooling and Heating Division  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Task Group Recommendation 1 - Human Comfort: These are the extracted requirements from ASHRAE 15-2019 that regulate low GWP refrigerants used in direct systems that fall into the safety classification of Group A2L. The A2L Task Group modified various portions of the extracted language as needed to address enforceability and health and safety concerns. The requirements follow the extraction policy of IAPMO. AHRI and many members were part of the A2L Task Group.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1109.4.2  Item #: 208

SUBMITTER: Robert Vilches  United Association  Comment #: 2

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1109.4 Location of Refrigeration Piping. (remaining text unchanged)
1109.4.1 Protection from Mechanical Damage. (remaining text unchanged)
1109.4.2 Joints in Concealed Locations. All joints on refrigeration piping installed in concealed spaces shall be brazed.

SUBSTANTIATION:
Brazed joints have a long verified track record of being leak free up to and beyond the life expectancy of the mechanical refrigeration system. By requiring that all joints in concealed locations be brazed we are limiting any serviceability issues with the piping system that would require a wall or ceiling to be cut open. Additionally, ASHRAE 15 section 8.8 requires that all joints in an airstream that carries conditioned air to and from an occupied space must be able to withstand 700°F without leaking refrigerant into the airstream.

PUBLIC COMMENT 3: (Assembly Action)

Code Year: 2024 UMC  Section #: 1103.1.1, Table 1103.1.1, 1104.6, 1104.6.2.3, 1104.6.4  Item #: 208

SUBMITTER: David Mann  CA State Pipe Trades  Comment #: 3

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1103.0 Classification.
1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.
1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

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1104.0 Requirements for Refrigerant and Refrigeration System Use.


**Exception:** Male flared joint connections for system servicing.

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. (ASHRAE 15:7.6.1-7.6.1.2)

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. (ASHRAE 15:7.6.2)

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. (ASHRAE 15:7.6.2.1)

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. (ASHRAE 15:7.6.2.2)

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 4 lb (1.8 kg).
2. When the occupancy classification is institutional.
3. When using the provisions of Section 1104.6.4.

**Exception:** For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

   \[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]  
   \[ \text{[Equation 1104.6.2.4]} \]

   Where:
   - \( Q_{\text{min}} \) = minimum airflow rate, ft\(^3\)/min
   - \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
   - \( LFL \) = lower flammability limit, lb per 1000 ft\(^3\)

   For SI units: \( Q = 60 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m\(^3\)/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m\(^3\)).

2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.

4. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the
value specified in Section 1104.6.5(2). (ASHRAE 15:7.6.2.4)

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. (ASHRAE 15:7.6.3-7.6.3.3)

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   (a) 6.6 lb (3 kg) for applied products.
   (b) 4 lb (1.8 kg) for unitary products.
   (c) 22 lb (10 kg) for commercial and public/large mercantile occupancies.

2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4 (3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

3. A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

\[ Q_{min} = 1000 \times \frac{M}{LFL} \]

Where:

- \( Q_{min} \) = minimum airflow rate, ft³/min
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
- \( LFL \) = lower flammability limit in lb per 1000 ft³

For SI units: \( Q = 60000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m³/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m³).

4. The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (305 mm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

5. Air that is exhausted from the ventilation system shall be discharged outside of the building envelope.

6. In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. (ASHRAE 15:7.6.4)

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.

2. Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).

3. Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.

   (a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.

   (b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (305 mm) above the floor and within a horizontal distance of not more than 3.3 feet (1006 mm) with a direct line of sight of the unit.

4. Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. (ASHRAE 15:7.6.5)

1104.6 1104.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 1104.6.
SUBSTANTIATION:
For safety, all joints used on A2L refrigerant piping shall be brazed. Brazed joints are required to be made with brazing alloys having a liquidous temperature above 1000°F (538°C). Brazed joints have been proven to provide a zero percent leak free (no annual leak rate) system beyond the normal lifespan of the equipment for which the system serves. In the event of elevated system piping temperature, brazed joints provide the highest degree of safety and protection from catastrophic failures for high-probability installations. Additionally, the ASHRAE Standard 15-2019, Section 9.10.2, and IAPMO UMC 2021, Section 1106.9, requires that all joints, located in air ducts conveying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (371°C) without leaking into the airstream. This ASHRAE 15 requirement is applicable to all refrigerants including Group A1 and A2L refrigerants. As most refrigerant piping installations for equipment would be considered in the airstream (i.e. above ceiling, equipment closets, mechanical rooms, etc.), this requirement would be applicable to the majority of refrigeration piping installations.

As the 2021 UMC, Section 1109.1 requires that all refrigeration piping shall be metallic, and as brazed joints are a proven all metallic joining system, all refrigerant piping, especially A2L refrigerant piping, should be required to be brazed.

An exception should be made to Section 1104.6 for the use of male flare joints of access fittings, as these systems will require an access connection for gauges and service equipment. If not already provided by the manufacturer on the system equipment, male flare fittings may be required to be installed on the system piping. The male flare fitting will be required to be able to be isolated from the system by means of an inline valve or have a Schrader (core type) valve incorporated into its construction. Flare fittings are usually ⅛” or 5/16” SAE flare and are usually equipped with a brass cap to protect the threads of the fitting and prevent debris from entering the port.

The proposed amount in Section 1104.6.2.3(1) of 4 pounds (1800 grams) promotes public safety and consumer confidence. As the UL 60335-2-40 and ASHRAE 15 standards already reference required refrigerant detection sensor levels (about 1.8 kg or 4 lbs), there is no need to add any language.

Section 1104.6.4(1)(a) is being modified to differentiate between applied products and unitary products. Section 1104.6.4(1)(b) was added to be consistent with the modified language in Section 1104.6.2.3. According to AHRI (AHRI Industry Sectors (ahrinet.org) applied products range from Air-cooled water-chilling chillers to water-cooled water-chilling or heat pump water-heating chillers. Unitary products are self-contained equipment to split systems.

Furthermore, Section 1104.6(5)(b) is being stricken and 1104.6(5)(a) is being modified to remove “or” to support the deletion of 1104.6(5)(b). Air should not be exhausted from the ventilation system into the building.
Each refrigerant is assigned into not more than one group.

### TABLE 1103.1.1
**REFRIGERANT SAFETY GROUP CLASSIFICATIONS**

<table>
<thead>
<tr>
<th>Flammability</th>
<th>A3</th>
<th>B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Flammability</td>
<td>A2</td>
<td>B2</td>
</tr>
<tr>
<td>Flammable</td>
<td>A2</td>
<td>B2</td>
</tr>
<tr>
<td>Lower Flammability</td>
<td>A2L</td>
<td>B2L</td>
</tr>
<tr>
<td>No Flame Propagation</td>
<td>A1</td>
<td>B1</td>
</tr>
</tbody>
</table>

### 1104.0 Requirements for Refrigerant and Refrigeration System Use.

#### 1104.2 Refrigerant Concentration Limit (RCL)

The concentration of refrigerant in a complete discharge of an independent circuit of high-probability systems shall not exceed the amounts shown in Table 1102.3, except as provided in Section 1104.3, and Section 1104.4 and Section 1104.6. The volume of occupied space shall be determined in accordance with Section 1104.2.1 through Section 1104.2.3.

**Exceptions:**

1. Listed equipment containing not more than 6.6 pounds (2.99 kg) of refrigerant, regardless of the refrigerant safety classification, provided the equipment is installed in accordance with the listing and with the manufacturer’s installation instructions.
2. Listed equipment for use in laboratories with more than 100 square feet (9.29 m²) of space per person, regardless of the refrigerant safety classification, provided that the equipment is installed in accordance with the listing and the manufacturer’s installation instructions. ([ASHRAE 15:7.2])

#### 1104.6 Group A2L Refrigerants for Human Comfort

High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. ([ASHRAE 15:7.6])

**1104.6.1 Refrigerant Concentration Limits.** Occupied spaces shall comply with the releasable charge limitations of the equipment listing and ASHRAE 15. Unoccupied spaces with refrigerant containing equipment, not including continuous piping or tubing, shall comply with the releasable charge limitations of the equipment listing or Section 1104.6.4. ([ASHRAE 15:7.6.1-7.6.1.2])

**1104.6.2 Listing and Installation Requirements.** Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. ([ASHRAE 15:7.6.2])

**1104.6.2.1 Nameplate.** The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. ([ASHRAE 15:7.6.2.1])

**1104.6.2.2 Labeling.** A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. ([ASHRAE 15:7.6.2.2])

**1104.6.2.3 Refrigerant Detection Systems.** Refrigerant detection systems shall be in accordance with the listing and ASHRAE 15.

**1104.6.2.4 Refrigerant Concentration Above Limit.** When the refrigerant detection system senses a refrigerant exceeding its setpoint, the following actions shall be taken:

1. The supply air fan of the equipment shall activate with a minimum airflow rate specified by the manufacturer.
2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detection system has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

**Exception:** The compressor operation shall not be turned off when the compressor operation reduces the leak rate or the total amount of released refrigerant to the indoor space.

3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
4. Mitigation action required by the equipment listing shall be initiated. ([ASHRAE 15:7.6.2.4])

**1104.6.3 Ignition Sources Located in Ductwork.** Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. ([ASHRAE 15:7.6.3-7.6.3.3])

**1104.6.4 Mechanical Ventilation.** When the releasable charge of the refrigeration system exceeds the refrigerant concentration limit specified in Section 1104.6.1, the refrigerant charge and ventilation air flow shall be in accordance with the equipment listing and ASHRAE 15.
1104.6.5 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, the refrigerant charge shall be in accordance with the equipment listing and ASHRAE 15.

1104.6.6 Refrigerant Sensors. Refrigerant sensors required by Section 1104.6.2 shall meet the following requirements:
(1) Refrigerant sensors shall be evaluated by the testing laboratory as part of the equipment listing.
(2) Refrigerant sensors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating.
   (a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant sensors shall be located within the listed equipment.
   (b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant sensor shall be located in the equipment in accordance with the equipment listing. Additional remote refrigerant sensors shall be permitted within the occupied space when included as part of the equipment mitigation system according to manufacturer’s instructions. (ASHRAE 15:7.6.5)

1104.6.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants used in high-probability systems for human comfort shall be in accordance with Section 1104.6.

(renumber remaining sections)

SUBSTANTIATION:
Since the development of this proposal by the A2L Task Group there have been numerous changes that have been accepted by ASHRAE 15 and UL 60335-2-40. The changes impact the listing of the equipment. These changes are also reflected in the manufacturer’s installation instructions.

One of the first changes necessary is the recognition of the change in determining the refrigerant concentration limits. While the A2L listing requirements utilize the RCLs in ASHRAE 34, there are many modifications based on the level of mitigation provided in the equipment and installation. The new terminology is the releasable charge as opposed to the refrigerant charge. The difference is that systems are designed to reduce the release of refrigerant into the space. This can be accomplished with safety shut off valves and pump down systems. The clarification needs to be in Section 1104.2 such that there is direction to use the new A2L requirements for evaluation releasable charge. The modification to Section 1104.6.1 identifies the listing of the equipment for some of the calculations of releasable charge. UL 60335-2-40, Annex GG added requirements regarding releasable charge, as well as the instructions that the manufacturer must provide regarding determination of the releasable charge. Specifically, Clauses GG.2.1DV, GG.10DV, GG.11DV, and GG.12DV list the extensive requirements that are applicable.

The standard revised the terminology of detection systems. The new terminology for the system is “refrigerant detection system.” Part of the system are the actual sensors of a leak. They are referred to as “refrigerant sensors.” Text has been revised to use these terms.

Annex LL of UL 60335-2-40 has been completely updated with requirements for testing and listing refrigerant sensors and refrigeration detection systems. This includes the time required to send an output signal to initiate mitigation measures. These requirements become a part of the listing of the equipment. Rather than duplicating the number of pages in Annex LL of UL 60335-2-40, text has been modified to direct the requirements to the listing of the equipment.

Section 1104.6.2.4 (2) has an exception added regarding the allowance for the compressor to continue operating. This provision is allowed in UL 60335-2-40 for pump down systems. These types of systems reduce the loss of refrigerant by isolating it during pump down.

Refrigerant detection systems may activate the mitigation for the system. This has been added as bullet item (4) to Section 1104.6.2.4. An example of a mitigation means would be the closing of safety shut off valves.

UL 60335-2-40 removed requirements for shutting down the heating elements in the duct. In the event of a false activation, the heat may be shut off resulting in the potential death of the building occupants by hypothermia and/or the freezing of water pipes in the building. For this reason, the heat is allowed to remain on. There are additional protection measures in that air must be flowing for the heating element to activate.

When refrigerant detection systems are required, the sensors must be located inside the equipment. This is clarified in Section 1104.6.5. Remote sensors are allowed in addition to internal sensors. Remote sensors are normally
found with multi-split systems utilizing an additional mitigation measure when determining releasable charge.

A new Section 1104.6.4 is being inserted in the proposal to address systems that have mechanical ventilation as mitigation measures for addressing any leaking refrigerant. Both UL 60335-2-40 and ASHRAE 15 have very extensive requirements that identify the mitigation measures using mechanical ventilation.

Section 1104.6.4 has been revised to reference the requirements in the equipment listing and ASHRAE 15. The text proposed for deletion was taken from the 2019 edition of ASHRAE 15. The standard has been revised with more extensive text that seems inappropriate to extract into the code. If the new text is extracted, it would read:

a. Mechanical ventilation shall be provided that will remove leaked refrigerant from the space where refrigerant leaking from the equipment is expected to accumulate if the equipment is not labeled as enhanced tightness refrigerating system. The space shall be provided with an exhaust or transfer fan.

Fans used to exhaust air from the space or circulate the air to another indoor space in accordance with the following equation:

\[ Q_{\text{min}} = \frac{Q_{\text{REQ}}}{\text{CLFL}} \]

where

- \( Q_{\text{min}} \) = minimum mechanical ventilation airflow rate, ft³/min (m³/h)
- \( Q_{\text{REQ}} \) = the required ventilation, as determined from Table 1104.6.4-1
- \( \text{CLFL} \) = the lower flammability limit conversion factor, as determined from Table 1104.6.4-2

<p>| Table 1104.6.4-1 Required Ventilation for A2L Systems \textsuperscript{a} |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Excluded Charge ((M - \text{MVOL})) \textsuperscript{b} | Q\text{REQ} | Excluded Charge ((M - \text{MVOL})) \textsuperscript{b} | Q\text{REQ} |</p>
<table>
<thead>
<tr>
<th>lb</th>
<th>ft³/min</th>
<th>m³/hr</th>
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<th>ft³/min</th>
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<td>3.5</td>
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<td>95.6</td>
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<td>680</td>
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<td>8.7</td>
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<td>850</td>
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<tr>
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<td>10.4</td>
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<td>1020</td>
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<td>50.3</td>
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</tr>
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<td>1360</td>
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</tr>
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<td>2210</td>
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<td>2300</td>
<td>3910</td>
<td>175.5</td>
<td>79.6</td>
</tr>
</tbody>
</table>

Notes: a. Charge sizes and ventilation rates shown in this table are based on R-32.
b. \((M - \text{MVOL})\) is the amount of refrigerant charge that is removed by mechanical ventilation and is therefore not included in calculations to determine compliance with Section 1104.2. M and MVOL are as defined below.

<p>| Table 1104.6.4-2 Lower Flammability Limit Conversion Factor |
|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Refrigerant Number</th>
<th>( C_{\text{DL}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-32</td>
<td>1.00</td>
</tr>
<tr>
<td>R-452B</td>
<td>1.02</td>
</tr>
<tr>
<td>R-454A</td>
<td>0.92</td>
</tr>
<tr>
<td>R-454B</td>
<td>0.97</td>
</tr>
<tr>
<td>R-454C</td>
<td>0.95</td>
</tr>
<tr>
<td>R-457A</td>
<td>0.71</td>
</tr>
</tbody>
</table>

When the refrigerant charge necessary to be removed by ventilation is known, in order to be compliant with Section
1104.2, an alternative method to determine QREQ uses the following equations. This alternative method shall be used for all A2L refrigerants not listed in Table 7-2.

\[
\begin{align*}
Q_{REQ} &= \frac{(M - MVOL)}{(4 \times LFL)} \times SFVent \quad (I-P) \\
Q_{REQ} &= \frac{(M - MVOL)}{(4 \times LFL)} \times SFVent \times 60 \quad (SI)
\end{align*}
\]

\[MVOL = RCL \times V \times FOCC\]

where

- \(Q_{REQ}\) = required minimum mechanical ventilation airflow rate, ft³/min (m³/h)
- \(M\) = refrigerant charge of the largest independent circuit of the system, lb (kg)
- \(MVOL\) = refrigerant charge permitted in the space, lb (kg)
- \(RCL\) = refrigerant concentration limit, lb/ft³ (kg/m³)
- \(V\) = volume of space established in accordance with Section 7.3, ft³ (m³)
- \(FOCC\) = occupancy adjustment factor. For all occupancies other than institutional, FOCC has a value of 1. For institutional occupancies, FOCC has a value of 0.5.
- \(LFL\) = lower flammability limit, lb/ft³ (kg/m³)
- 4 = assumed leak time (4 minutes)
- \(SFVent\) = safety factor, value of 2
- 60 = conversion of minutes to hours

If the equipment is listed and labeled enhanced tightness refrigerating system, mechanical ventilation shall be provided according to the following formula unless the releasable charge of the equipment complies with Section 1104.6.1.

\[Q_{REQ} = \frac{\theta}{LFL} \times SFVent\]

where

- \(Q_{REQ}\) = required minimum mechanical ventilation airflow rate, ft³/min (m³/h)
- \(\theta\) = the expected maximum leak rate, value of 0.37 in lb/min (10 in kg/h)
- \(LFL\) = lower flammability limit, lb per 1,000 ft³ (kg/m³)
- \(SFVent\) = safety factor, value of 4

b. *Mechanical ventilation shall be permitted to be continuous or activated by a refrigerant detection system. Building fire and smoke systems may override this function.*

1. Continuous Ventilation. Where continuous ventilation is provided, ventilation function shall be continuously verified per Section 1104.6.4(b)(3).
2. Refrigerant Detection System Activated Ventilation. Upon refrigerant detection system activation, the mechanical ventilation shall be started and shall continue to operate for at least five minutes after the refrigerant sensor has sensed a drop in the refrigerant concentration below the setpoint value. Ventilation function of refrigerant detection system activated ventilation shall be verified in accordance with Section 1104.6.4(b)(3) by a monthly self-test.
3. Verification of Ventilation Function. Ventilation function shall be verified by a method that confirms operation of the required fans. Upon detection of a ventilation system failure, compressor operation shall be stopped, and a notification shall be provided. The notification shall be to an operator workstation through a building automation system or by a local audible alarm.

c. While the ventilation system is operating, makeup air shall be provided, and the volume of makeup air shall not exceed the volume of air being exhausted or transferred out of the space. Openings for makeup air shall be positioned to facilitate mixing of makeup air with leaked refrigerant. Inlets for exhaust air and inlets used to mechanically transfer air to another indoor location shall be located such that the bottom of the inlet is within 12 in. (305 mm) of the lowest elevation in the space where leaked refrigerant would be expected to accumulate.

d. The refrigerant concentration of an indoor effective dispersal volume shall not exceed the limit specified in Section 1104.6.1.

e. In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrester, or hot surfaces exceeding 1290°F (700°C), installed within the space where the equipment is located.

f. Electric motors larger than 1 hp driving fans located in the airstream of the discharge side of the ventilation system shall be of the totally enclosed or hermetically sealed type.

g. Fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.

h. Ventilation fans shall be listed in accordance with UL 507 or UL 705. {ASHRAE 15:7.6.4}

Rather than adding all of this text a reference is made to ASHRAE 15. It should be noted that the manufacturer’s installation instructions also include these requirements in accordance with the listing.

Section 1104.7 has been editorially modified to indicate that the requirements only apply to high probability refrigeration systems used for human comfort. This section does not apply to mechanical refrigeration systems such
as large cooler boxes or freezers.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 5

Code Year: 2024 UMC  Section #: 1104.6 - 1104.7  Item #: 208

SUBMITTER: Mary Koban, AHRI; Dominique Taudin, Carrier Corporation; Stephen V. Spletzer, The Chemours Company; Jeff Whitelaw, Mitsubishi Electric US, Cooling and Heating Division

Comment #: 5

RECOMMENDATION:

Revise text

Request to replace the code change proposal by this public comment.

1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. [ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. [ASHRAE 15:7.6.1-7.6.1.2]

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 0.212 \times LFL (lb), where LFL is in pounds per 1000 ft^3 (6 \times LFL [kg] where LFL is in kg/m^3).
2. When the occupancy classification is institutional.
3. When using the provisions of Section 1104.6.4.

Exception: For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \] [Equation 1104.6.2.4]

Where:

\[ Q_{\text{min}} = \text{minimum airflow rate, ft}^3/\text{min} \]
\[ M = \text{refrigerant charge of the largest independent refrigerating circuit of the system, lb} \]
\[ LFL = \text{lower flammability limit, lb per 1000 ft}^3 \]

For SI units: \[ Q = 60,000 \times \frac{M}{LFL}, \text{ where } Q \text{ is the supply air flow rate (m}^3/\text{h}), M \text{ is the refrigerant charge (kg), LFL is the lower flammability limit (g/m}^3) \]

2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
4. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain...
off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). (ASHRAE 15:7.6.2.4)

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. (ASHRAE 15:7.6.3-7.6.3.3)

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, the refrigerant charge shall be in accordance with the equipment listing and ASHRAE 15.

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:
(1) Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
(2) Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).
(3) Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.
(a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.
(b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (305 mm) above the floor and within a horizontal distance of not more 3.3 feet (1006 m) with a direct line of sight of the unit.
(4) Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. (ASHRAE 15:7.6.5)

1104.6.6 1104.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants used in high-probability systems for human comfort shall be in accordance with Section 1104.6.

(renumber remaining sections)

SUBSTANTIATION:
Since the development of this proposal by the A2L Task Group there have been numerous changes that have been accepted by ASHRAE 15 and UL 60335-2-40. The changes impact the listing of the equipment. These changes are also reflected in the manufacturer’s installation instructions.

Section 1104.6.4 has been revised to reference the requirements in the equipment listing and ASHRAE 15. The remaining text in Section 1104.6.4 has been proposed for deletion as it was taken from the 2019 edition of ASHRAE 15. The standard has been revised with more extensive text that seems inappropriate to extract into the code. If the new text is extracted, it would read:

a. Mechanical ventilation shall be provided that will remove leaked refrigerant from the space where refrigerant leaking from the equipment is expected to accumulate if the equipment is not labeled as enhanced tightness refrigerating system. The space shall be provided with an exhaust or transfer fan.

Fans used to exhaust air from the space or circulate the air to another indoor space in accordance with the following equation:

\[ Q_{\text{min}} = \frac{Q_{\text{REQ}}}{CLFL} \]

where:
- \( Q_{\text{min}} \) = minimum mechanical ventilation airflow rate, ft³/min (m³/h)
- \( Q_{\text{REQ}} \) = the required ventilation, as determined from Table 1104.6.4-1
- \( CLFL \) = the lower flammability limit conversion factor, as determined from Table 1104.6.4-2
Notes: a. Charge sizes and ventilation rates shown in this table are based on R-32.
b. \((M - MVOL)\) is the amount of refrigerant charge that is removed by mechanical ventilation and is therefore not included in calculations to determine compliance with Section 1104.2. \(M\) and \(MVOL\) are as defined below.

When the refrigerant charge necessary to be removed by ventilation is known, in order to be compliant with Section 1104.2, an alternative method to determine \(Q_{REQ}\) uses the following equations. This alternative method shall be used for all A2L refrigerants not listed in Table 7-2.

\[
Q_{REQ} = \frac{(M - MVOL)}{(4 \times LFL)} \times SFVent
\]

\[
Q_{REQ} = \frac{(M - MVOL)}{(4 \times LFL)} \times SFVent \times 60
\]

\(\text{MVOL} = RCL \times V \times FOCC\)

\(\text{where} \ Q_{REQ} = \text{required minimum mechanical ventilation airflow rate, ft}^3/\text{min (m}^3/\text{h)}\)

\(\text{M} = \text{refrigerant charge of the largest independent circuit of the system, lb (kg)}\)

\(\text{MVOL} = \text{refrigerant charge permitted in the space, lb (kg)}\)

\(\text{RCL} = \text{refrigerant concentration limit, lb/ft}^3 \text{ (kg/m}^3\text{)}\)

\(\text{V} = \text{volume of space established in accordance with Section 7.3, ft}^3 \text{ (m}^3\text{)}\)

\(\text{FOCC} = \text{occupancy adjustment factor. For all occupancies other than institutional, FOCC has a value of 1. For institutional occupancies, FOCC has a value of 0.5.}\)

\(\text{LFL} = \text{lower flammability limit, lb/ft}^3 \text{ (kg/m}^3\text{)}\)

\(\text{4} = \text{assumed leak time (4 minutes)}\)

\(\text{SFVent} = \text{ safety factor, value of 2}\)

\(\text{60} = \text{conversion of minutes to hours}\)

If the equipment is listed and labeled enhanced tightness refrigerating system, mechanical ventilation shall be provided according to the following formula unless the releasable charge of the equipment complies with Section 1104.6.1.

\(\text{QREQ} = m ?/LFL \times SFVent\)
where
QREQ = required minimum mechanical ventilation airflow rate, ft³/min (m³/h)
? = the expected maximum leak rate, value of 0.37 in lb/min (10 in kg/h)
LFL = lower flammability limit, lb per 1 000 ft³ (kg/m³)
SFVent = safety factor, value of 4

b. *Mechanical ventilation shall be permitted to be continuous or activated by a refrigerant detection system. Building fire and smoke systems may override this function.
1. Continuous Ventilation. Where continuous ventilation is provided, ventilation function shall be continuously verified per Section 1104.6.4(b)(3).
2. Refrigerant Detection System Activated Ventilation. Upon refrigerant detection system activation, the mechanical ventilation shall be started and shall continue to operate for at least five minutes after the refrigerant sensor has sensed a drop in the refrigerant concentration below the setpoint value. Ventilation function of refrigerant detection system activated ventilation shall be verified in accordance with Section 1104.6.4(b)(3) by a monthly self-test.
3. Verification of Ventilation Function. Ventilation function shall be verified by a method that confirms operation of the required fans. Upon detection of a ventilation system failure, compressor operation shall be stopped, and a notification shall be provided. The notification shall be to an operator workstation through a building automation system or by a local audible alarm.
c. While the ventilation system is operating, makeup air shall be provided, and the volume of makeup air shall not exceed the volume of air being exhausted or transferred out of the space. Openings for makeup air shall be positioned to facilitate mixing of makeup air with leaked refrigerant. Inlets for exhaust air and inlets used to mechanically transfer air to another indoor location shall be located such that the bottom of the inlet is within 12 in. (305 mm) of the lowest elevation in the space where leaked refrigerant would be expected to accumulate.
d. The refrigerant concentration of an indoor effective dispersal volume shall not exceed the limit specified in Section 1104.6.1.
e. In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700°C), installed within the space where the equipment is located.
f. Electric motors larger than 1 hp driving fans located in the airstream of the discharge side of the ventilation system shall be of the totally enclosed or hermetically sealed type.
g. Fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.
h. Ventilation fans shall be listed in accordance with UL 507 or UL 705. {ASHRAE 15:7.6.4}

Rather than adding all of this text a reference is made to ASHRAE 15. It should be noted that the manufacturer’s installation instructions also include these requirements in accordance with the listing.

Section 1104.7 has been editorially modified to indicate that the requirements only apply to high probability refrigeration systems used for human comfort. This section does not apply to mechanical refrigeration systems such as large cooler boxes or freezers.

[Supporting documentation is provided in KAVI for TC review]
1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

<table>
<thead>
<tr>
<th>REFREIGERANT SAFETY GROUP CLASSIFICATIONS</th>
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</tr>
<tr>
<td>Lower Toxicity</td>
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<td>Higher Toxicity</td>
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1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. [ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. [ASHRAE 15:7.6.1-7.6.1.2]

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detection Systems. Refrigerant detection systems shall be in accordance with the listing and ASHRAE 15.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detection system senses a refrigerant exceeding its setpoint, the following actions shall be taken:

(1) The supply air fan of the equipment shall activate with a minimum airflow rate specified by the manufacturer.
(2) Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detection system has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).

**Exception:** The compressor operation shall not be turned off when the compressor operation reduces the leak rate or the total amount of released refrigerant to the indoor space.

(3) Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
(4) Mitigation action required by the equipment listing shall be initiated. [ASHRAE 15:7.6.2.4]

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. [ASHRAE 15:7.6.3-7.6.3.3]

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

(1) The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   (a) 6.6 lb (3 kg) for residential and institutional occupancies and
   (b) 22 lb (10 kg) for commercial and public/large mercantile occupancies.
(2) The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
(3) A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

242
\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]

Where:

- \( Q_{\text{min}} \) = minimum airflow rate, \( \text{ft}^3/\text{min} \)
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, \( \text{lb} \)
- \( LFL \) = lower flammability limit in \( \text{lb per 1000 ft}^3 \)

For SI units: \( Q = 60 000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m³/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m³).

4. The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (305 mm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

5. Air that is exhausted from the ventilation system shall be either:
   - (a) discharged outside of the building envelope or
   - (b) discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 1104.6.1.

6. In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrester, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

1104.6.5 Refrigerant Sensors. Refrigerant sensors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant sensors shall be evaluated by the testing laboratory as part of the equipment listing.

2. Refrigerant sensors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating.
   - (a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant sensors shall be located within the listed equipment.
   - (b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant sensor shall be located in the equipment in accordance with the equipment listing. Additional remote refrigerant sensors shall be permitted within the occupied space when included as part of the equipment mitigation system according to manufacturer’s instructions. (ASHRAE 15:7.6.5)

1104.6.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants used in high-probability systems for human comfort shall be in accordance with Section 1104.6.

(renumber remaining sections)

SUBSTANTIATION:

Since the development of this proposal by the A2L Task Group there have been numerous changes that have been accepted by ASHRAE 15 and UL 60335-2-40. The changes impact the listing of the equipment. These changes are also reflected in the manufacturer’s installation instructions.

The standard revised the terminology of detection systems. The new terminology for the system is “refrigerant detection system.” Part of the system are the actual sensors of a leak. They are referred to as “refrigerant sensors.” Text has been revised to use these terms.

Annex LL of UL 60335-2-40 has been completely updated with requirements for testing and listing refrigerant sensors and refrigeration detection systems. This includes the time required to send an output signal to initiate mitigation measures. These requirements become a part of the listing of the equipment. Rather than duplicating the number of pages in Annex LL of UL 60335-2-40, text has been modified to direct the requirements to the listing of the equipment.

Section 1104.6.2.4 (2) has an exception added regarding the allowance for the compressor to continue operating. This provision is allowed in UL 60335-2-40 for pump down systems. These types of systems reduce the loss of refrigerant by isolating it during pump down.

Refrigerant detection systems may activate the mitigation for the system. This has been added as bullet item (4) to Section 1104.6.2.4. An example of a mitigation means would be the closing of safety shut off valves.
UL 60335-2-40 removed requirements for shutting down the heating elements in the duct. In the event of a false activation, the heat may be shut off resulting in the potential death of the building occupants by hypothermia and/or the freezing of water pipes in the building. For this reason, the heat is allowed to remain on. There are additional protection measures in that air must be flowing for the heating element to activate.

When refrigerant detection systems are required, the sensors must be located inside the equipment. This is clarified in Section 1104.6.5. Remote sensors are allowed in addition to internal sensors. Remote sensors are normally found with multi-split systems utilizing an additional mitigation measure when determining releasable charge.

Section 1104.7 has been editorially modified to indicate that the requirements only apply to high probability refrigeration systems used for human comfort. This section does not apply to mechanical refrigeration systems such as large cooler boxes or freezers.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 7

Code Year: 2024 UMC  Section #: 1103.1.1, Table 1103.1.1, 1104.2, 1104.6 - 1104.7,  Item #: 208

SUBMITTER: Mary Koban, AHRI; Dominique Taudin, Carrier Corporation; Stephen V. Spletzer, The Chemours Company; Jeff Whitelaw, Mitsubishi Electric US, Cooling and Heating Division

Comment #: 7

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1103.0 Classification.
1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.

1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

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</table>

| Lower Toxicity | Higher Toxicity |

1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.2 Refrigerant Concentration Limit (RCL). The concentration of refrigerant in a complete discharge of an independent circuit of high-probability systems shall not exceed the amounts shown in Table 1102.3, except as provided in Section 1104.3, and Section 1104.4 and Section 1104.6. The volume of occupied space shall be determined in accordance with Section 1104.2.1 through Section 1104.2.3.

Exceptions:
(1) Listed equipment containing not more than 6.6 pounds (2.99 kg) of refrigerant, regardless of the refrigerant safety classification, provided the equipment is installed in accordance with the listing and with the manufacturer’s installation instructions.

(2) Listed equipment for use in laboratories with more than 100 square feet (9.29 m²) of space per person, regardless of the refrigerant safety classification, provided that the equipment is installed in accordance with the listing and the manufacturer's installation instructions. ([ASHRAE 15:7.2])
1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. [ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with the releasable charge limitations of the equipment listing and ASHRAE 15. Unoccupied spaces with refrigerant containing equipment, not including continuous piping or tubing, shall comply with the releasable charge limitations of the equipment listing or Section 1104.6.4. [ASHRAE 15:7.6.1-7.6.1.2]

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer's instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 0.212 × LFL (lb), where LFL is in pounds per 1000 ft³ (6 × LFL [kg] where LFL is in kg/m³).
2. When the occupancy classification is institutional.
3. When using the provisions of Section 1104.6.4.

Exception: For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

\[
Q_{min} = 1000 \times \frac{M}{LFL} \tag{Equation 1104.6.2.4}
\]

Where:

\[
\begin{align*}
Q_{min} & = \text{minimum airflow rate, ft}^3/\text{min} \\
M & = \text{refrigerant charge of the largest independent refrigerating circuit of the system, lb} \\
LFL & = \text{lower flammability limit, lb per 1000 ft}^3 
\end{align*}
\]

For SI units: \( Q = 60000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m³/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m³).

2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
4. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). [ASHRAE 15:7.6.2.4]

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. [ASHRAE 15:7.6.3-7.6.3.3]

1104.6.4 Mechanical Ventilation. When the releasable charge of the refrigeration system exceeds the refrigerant concentration limit specified in Section 1104.6.1, the refrigerant charge and ventilation air flow shall be in accordance with the equipment listing and ASHRAE 15.

1104.6.5 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   a. 6.6 lb (3 kg) for residential and institutional occupancies and
   b. 22 lb (10 kg) for commercial and public/large mercantile occupancies.
2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
(3) A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]

Where:
- \( Q_{\text{min}} \) = minimum airflow rate, ft\(^3\)/min
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
- \( LFL \) = lower flammability limit in lb per 1000 ft\(^3\)

For SI units: \( Q = 60,000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m\(^3\)/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m\(^3\)).

(4) The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (305 mm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

(5) Air that is exhausted from the ventilation system shall be either:
- (a) discharged outside of the building envelope or
- (b) discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 1104.6.1.

(6) In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrester, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

**1104.6.6 Refrigerant Detectors.** Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
2. Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).
3. Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.
   - (a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.
   - (b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (305 mm) above the floor and within a horizontal distance of not more 3.3 feet (1006 mm) with a direct line of sight of the unit.
4. Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. [ASHRAE 15:7.6.5]

**1104.6 1104.7 Applications for Human Comfort and for Nonindustrial Occupancies.** In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants used in high-probability systems for human comfort shall be in accordance with Section 1104.6.

(renumber remaining sections)

**SUBSTANTIATION:**
Since the development of this proposal by the A2L Task Group there have been numerous changes that have been accepted by ASHRAE 15 and UL 60335-2-40. The changes impact the listing of the equipment. These changes are also reflected in the manufacturer’s installation instructions.

One of the first changes necessary is the recognition of the change in determining the refrigerant concentration limits. While the A2L listing requirements utilize the RCLs in ASHRAE 34, there are many modifications based on the level of mitigation provided in the equipment and installation. The new terminology is the releasable charge as opposed to the refrigerant charge. The difference is that systems are designed to reduce the release of refrigerant into the space. This can be accomplished with safety shut off valves and pump down systems. The clarification needs to be in Section 1104.2 such that there is direction to use the new A2L requirements for evaluation releasable charge. The modification to Section 1104.6.1 identifies the listing of the equipment for some of the calculations of releasable charge. UL 60335-2-40, Annex GG added requirements regarding releasable charge, as well as the instructions that the manufacturer must provide regarding determination of the releasable charge. Specifically, Clauses GG.2.1DV, GG.10DV, GG.11DV, and GG.12DV list the extensive requirements that are applicable.
A new Section 1104.6.4 is being inserted in the proposal to address systems that have mechanical ventilation as mitigation measures for addressing any leaking refrigerant. Both UL 60335-2-40 and ASHRAE 15 have very extensive requirements that identify the mitigation measures using mechanical ventilation. The subsequent sections have been renumbered.

Section 1104.7 has been editorially modified to indicate that the requirements only apply to high probability refrigeration systems used for human comfort. This section does not apply to mechanical refrigeration systems such as large cooler boxes or freezers.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 8
Code Year: 2024 UMC  Section #: 1103.1.1, 1104.6 - 1104.7  Item #: 208
SUBMITTER: Joseph Freese
Parker Hannifin
Comment #: 8
RECOMMENDATION:
Revise text
Request to reject the code change proposal by this public comment.
SUBSTANTIATION:
There is no substantiation in making the changes as proposed in this item. The changes by the technical committee should not be accepted. ASHRAE RP-1808 demonstrated that press fittings have the quickest assembly time, lowest assembly failure rate, and the highest durability with no observed failures during harshness testing.

PUBLIC COMMENT 9
Code Year: 2024 UMC  Section #: 1103.1.1, Table 1103.1.1, 1104.6 - 1104.7  Item #: 208
SUBMITTER: Jay Peters
Codes and Standards International
Rep. Honeywell
Comment #: 9
RECOMMENDATION:
Revise text
Request to replace the code change proposal by this public comment.

1103.0 Classification.
1103.1 Classification of Refrigerants. Refrigerants shall be classified in accordance with Table 1102.3 or in accordance with ASHRAE 34 where approved by the Authority Having Jurisdiction.
1103.1.1 Safety Group. Table 1102.3 classifies refrigerants by toxicity and flammability, and assigns safety groups using combinations of toxicity class and flammability class. For the purposes of this chapter, the refrigerant Groups A1, A2L, A2, A3, B1, B2L, B2, and B3 shall be considered to be individual and distinct safety groups, as shown in Table 1103.1.1. Each refrigerant is assigned into not more than one group.

<table>
<thead>
<tr>
<th>Table 1103.1.1</th>
<th>REFRIGERANT SAFETY GROUP CLASSIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Flammability</td>
<td>A3</td>
</tr>
<tr>
<td>Flammable</td>
<td>A2</td>
</tr>
<tr>
<td>Lower Flammability</td>
<td>A2L</td>
</tr>
<tr>
<td>No Flame Propagation</td>
<td>A1</td>
</tr>
<tr>
<td>Lower Toxicity</td>
<td>Higher Toxicity</td>
</tr>
</tbody>
</table>
1104.0 Requirements for Refrigerant and Refrigeration System Use.

1104.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section. [ASHRAE 15:7.6]

1104.6.1 Refrigerant Concentration Limits. Occupied spaces shall comply with Section 1104.2. Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 1104.6.4. [ASHRAE 15:7.6.1-7.6.1.2]

1104.6.2 Listing and Installation Requirements. Refrigeration systems shall be listed and shall be installed in accordance with listing, the manufacturer’s instructions, and any markings on the equipment restricting the installation. [ASHRAE 15:7.6.2]

1104.6.2.1 Nameplate. The nameplate required by Section 1115.5 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing. [ASHRAE 15:7.6.2.1]

1104.6.2.2 Labeling. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing. [ASHRAE 15:7.6.2.2]

1104.6.2.3 Refrigerant Detectors. A refrigerant detector shall be provided in accordance with Section 1104.6.5 as a part of the listed equipment where any of the following apply:

1. The charge size of any independent circuit exceeds 0.212 × LFL (lb), where LFL is in pounds per 1000 ft³ (6 × LFL [kg] where LFL is in kg/m³).
2. When the occupancy classification is institutional.
3. When using the provisions of Section 1104.6.4.

**Exception:** For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit does not exceed 50 percent of the RCL, a detector shall not be required.

1104.6.2.4 Refrigerant Concentration Above Limit. When the refrigerant detector senses a refrigerant concentration at the maximum value specified in Section 1104.6.5(2), the following actions shall be taken:

1. The minimum airflow rate of the supply air fan shall be in accordance with the following equation:

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]  

Where:

- \( Q_{\text{min}} \) = minimum airflow rate, ft³/min
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, lb
- \( LFL \) = lower flammability limit, lb per 1000 ft³

For SI units: \( Q = 60 \times 0.001 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m³/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m³).

2. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
3. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be listed.
4. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2). [ASHRAE 15:7.6.2.4]

1104.6.3 Ignition Sources Located in Ductwork. Open-flame-producing devices shall not be permanently installed in the ductwork that serves the space. Unclassified electrical devices shall not be located within the ductwork that serves the space. Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized. [ASHRAE 15:7.6.3-7.6.3.3]

1104.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

1. The refrigerant charge of largest independent refrigerating circuit shall not exceed:
   a. 6.6 lb (3 kg) for residential and institutional occupancies and
   b. 22 lb (10 kg) for commercial and public/large mercantile occupancies.
2. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 1104.6.4(3) and a refrigerant detector in accordance with Section 1104.6.5. The mechanical ventilation system shall be started when the refrigerant detector senses refrigerant in accordance with Section 1104.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 1104.6.5(2).
(3) A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

\[ Q_{\text{min}} = 1000 \times \frac{M}{LFL} \]

Where:

- \( Q_{\text{min}} \) = minimum airflow rate, \( \text{ft}^3/\text{min} \)
- \( M \) = refrigerant charge of the largest independent refrigerating circuit of the system, \( \text{lb} \)
- \( LFL \) = lower flammability limit in \( \text{lb} \) per 1000 \( \text{ft}^3 \)

For SI units: \( Q = 60000 \times \frac{M}{LFL} \), where \( Q \) is the supply air flow rate (m³/h), \( M \) is the refrigerant charge (kg), \( LFL \) is the lower flammability limit (g/m³).

(4) The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 inches (305 mm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.

(5) Air that is exhausted from the ventilation system shall be discharged outside of the building envelope.

(6) In addition to the requirements of Section 1104.6.3, there shall be no open-flame-producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located. [ASHRAE 15:7.6.4]

1104.6.5 Refrigerant Detectors. Refrigerant detectors required by Section 1104.6.2 shall meet the following requirements:

1. Refrigerant detectors that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
2. Refrigerant detectors, as installed, shall activate the functions required by Section 1104.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25 percent of the lower flammability limit (LFL).
3. Refrigerant detectors shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one refrigerant detector shall be permitted.
   (a) For refrigerating systems that are connected to the occupied space through ductwork, refrigerant detectors shall be located within the listed equipment.
   (b) For refrigerating systems that are directly connected to the occupied space without ductwork, the refrigerant detector shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 inches (305 mm) above the floor and within a horizontal distance of not more than 3.3 feet (1006 mm) with a direct line of sight of the unit.
4. Refrigerant detectors shall provide a means for an automatic operational self-test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 1104.6.2.4 shall be initiated. [ASHRAE 15:7.6.5]

1104.6 1104.7 Applications for Human Comfort and for Nonindustrial Occupancies. In nonindustrial occupancies, Group A2, A2L, A3, B1, B2L, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 1104.6.

(renumber remaining sections)

SUBSTANTIATION:
Honeywell supports Item #208 as originally proposed by Mr. Jay Egg, chair of the A2L Task Group with one variation.

The task group was directed by the UMC TC to study only ASHRAE 15-2019 and to develop proposals based on the finished standard. As the chair of the UMC A2L task Group subcommittee for machinery rooms and a voting member of both, the A2L direct systems for human comfort subcommittee, and the A2L Task Group, I can verify that the task group and subcommittees adhered to the guidance as directed by the TC.

The original proposal from Mr. Egg was well thought out, followed the TC and task group recommendations and was a direct extract from ASHRAE 15-2019 - the most current published provisions, peer reviewed and finalized. The information chosen for item 208 by the task group was oftentimes unanimous or had broad consensus. During the UMC hearings, the majority of members of the task group, including AHRI, ASHRAE and most manufacturers supported the work of the task group and requested the committee accept the proposal as originally presented.

Since the ASHRAE 15-2019 edition was completed, there has still not been an adoption of the standard to allow for verifiable installations based on the requirements of the ASHRAE 15-2019 standard. This means that there has
been no data, track record or body of knowledge to verify that these provisions are safe - most importantly, there is no reason to reduce the safety requirements in the 2019 edition without such history.

This proposal has one small variation from the original task group report in that the option to dump leaked flammable refrigerant inside the building is eliminated and only allows for the leaked refrigerant to be discharged outside. This amendment to the task group proposal was approved by the UMC Technical Committee at the TC meetings. This issue has also been a big concern in discussions with the fire service and has proven to be an issue based upon NEW A2L Fire testing performed at UL.
Proposals

Item #: 212

UMC 2024  Section: Chapter 11

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 15 Extract Update

RECOMMENDATION:
Revise text

1103.2.1 High-Probability System. Systems in which the basic design, or the location of components, is such that a leakage of refrigerant from a failed connection, seal, or component will enter the occupied space shall be classified as high-probability systems. A typical high-probability system shall be one of the following:
(1) a direct system or
(2) an indirect open spray system in which the refrigerant is capable of producing pressure that is more than the secondary coolant. [ASHRAE 15:5.2.1]

1103.2.2 Low-Probability System. Systems in which the basic design, or the location of the components, is such that a leakage of refrigerant from a failed connection, seal, or component is not capable of entering the occupied space shall be classified as low-probability systems. A typical low-probability system shall be one of the following:
(1) an indirect closed system,
(2) double indirect system, or
(3) an indirect open spray system. In a low-probability indirect open spray system, the secondary coolant pressure remains more than the refrigerant pressure in operating and standby conditions. [ASHRAE 15:5.2.2]

1104.2.2 Nonconnecting Spaces. Where a refrigerating system, or a part thereof, is located in one or more enclosed occupied spaces that do not connect through permanent openings or HVAC ducts, the volume of the smallest occupied space shall be used to determine the refrigerant quantity limit in the system. Where different stories and floor levels connect through an open atrium or mezzanine arrangement, the volume to be used in calculating the refrigerant quantity limit shall be determined by multiplying the floor area of the lowest space by 8.2 feet (2499 mm). [ASHRAE 15:7.3.1]

1104.7.4 Mixing. Refrigerants, including refrigerant blends, with different refrigerant designations as in accordance with Table 1102.3 shall not only be mixed in a system in accordance with the following: Exception:
(1) The addition of a second refrigerant shall be permitted where specified is allowed by the equipment manufacturer to improve oil return at low temperatures. The refrigerant and amount added shall be in accordance with the manufacturer's instructions.
(2) The resulting mixture does not change the refrigerant safety group. [ASHRAE 15:7.5.1.7]

1104.8 Changing Refrigerants. A change in the type of refrigerant in a system shall not be made without notifying the Authority Having Jurisdiction, the user, and due observance of safety requirements. The refrigerant being considered shall be evaluated for suitability. Changes of refrigerant in an existing system to a refrigerant with a different refrigerant designation shall only be allowed where in accordance with Sections 1104.8.1 through Section 1104.8.4. [ASHRAE 15:5.3]

1104.8.1 Approval. The change of refrigerant shall be approved by the owner. [ASHRAE 15:5.3.1]

1104.8.2 Procedures. The change of refrigerant shall be in accordance with one of the following:
(1) Written instructions of the original equipment manufacturer.
(2) An evaluation of the system by a registered design professional or by an approved nationally recognized testing laboratory that validates safety and suitability of the replacement refrigerant.
(3) Approval of the Authority Having Jurisdiction. [ASHRAE 15:5.3.2]

1104.8.3 Replacement Refrigerant of Same Classification. Where the replacement refrigerant is classified into the same safety group, requirements that were applicable to the existing system shall continue to apply. [ASHRAE 15:5.3.3]

1104.8.4 Replacement Refrigerant of Different Classification. Where the replacement refrigerant is classified into a
1106.6 Airflow. There shall be no airflow to or from an occupied space through a machinery room unless the air is ducted and sealed in such a manner as to prevent a refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting. [ASHRAE 15:8.11.7 8.11.3]

1106.11 Restricted Access. Access to the refrigeration machinery room shall be restricted to authorized personnel. Doors shall be clearly marked, or permanent signs shall be posted at each entrance to indicate this restriction. [ASHRAE 15:8.11.8 8.11.4]

1109.1 Materials. Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, the lubricant, or their combination in the presence of air or moisture to a degree that poses a safety hazard. [ASHRAE 15:9.1.1] Refrigerant piping shall be metallic.

1109.1.4 Prohibited Contact. Aluminum, zinc, magnesium, or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used where in contact with any halogenated refrigerants. [ASHRAE 15:9.1.2]

1109.4 Location of Refrigeration Piping. Refrigerant piping crossing an open space that affords passageway in a building shall be not less than 7.25 feet (2210 mm) above the floor unless the piping is located against the ceiling of such space and is permitted by the Authority Having Jurisdiction. [ASHRAE 15:8.10.1]

1109.4.1 Protection from Mechanical Damage. Passages shall not be obstructed by refrigerant piping. Refrigerant piping shall not be located placed in an any elevator, dumbwaiter, or other shaft containing a moving object, or in a any shaft that has openings to living quarters, or to means of egress. Refrigerant piping shall not be installed in an enclosed public stairway, stair landing, or means of egress. [ASHRAE 15:8.10.2]

1109.5.1 Piping in Concrete Floors. Refrigerant piping installed in concrete floors shall be encased in a pipe duct. Refrigerant piping shall be isolated and supported to prevent damaging vibration, stress, or corrosion. [ASHRAE 15:8.10.4]

1110.1 More than 6.6 Pounds of Refrigerant. Systems containing more than 6.6 pounds (2.99 kg) of refrigerant shall have stop valves installed at the following locations:
(1) The suction inlet of a each compressor, compressor unit, or condensing unit.
(2) The discharge of a each compressor, compressor unit, or condensing unit.
(3) The outlet of a each liquid receiver.

Exceptions:
(1) Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge.
(2) Systems that are equipped with the provisions for pumpout of the refrigerant.

1110.2 More than 110 Pounds of Refrigerant. Systems containing more than 110 pounds (49.9 kg) of refrigerant shall have stop valves installed at the following locations:
(1) The suction inlet of a each compressor, compressor unit, or condensing unit.
(2) The discharge outlet of a each compressor, compressor unit, or condensing unit.
(3) The inlet of a each liquid receiver, except for self-contained systems or where the receiver is an integral part of the condenser or condensing unit.
(4) The outlet of a each liquid receiver.
(5) The inlets and outlets of condensers where when more than one condenser is used in parallel in the systems system.

Exceptions:
(1) Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge.
(2) Systems that are equipped with the provisions for pumpout of the refrigerant.

1112.2 Positive Displacement Compressor. A positive displacement compressor with a stop valve in the discharge connection shall be equipped with a pressure-relief device that is sized, and with a pressure setting, in accordance with the compressor manufacturer to prevent rupture of the compressor or to prevent the pressure from increasing to more than 10 percent above the maximum allowable working pressure of any other component located in the discharge line between the compressor and the stop valve or in accordance with Section 1113.5, whichever is larger. The pressure-relief device shall discharge into the low-pressure side of the system or in accordance with Section 1112.11.

Exception: Hermetic refrigerant motor-compressors that are listed and have a displacement not more than 50 cubic feet per minute (1.42 m3/min).

The relief device(s) shall be sized based on compressor flow at the following conditions:
(1) For compressors in single-stage systems and high-stage compressors of other systems, the flow shall be calculated based on 50°F (10°C) saturated suction temperature at the compressor suction.
(2) For low-stage or booster compressors in compound refrigerating systems, the compressors that are capable of running only where
discharging to the suction of a high-stage compressor, the flow shall be calculated based on the saturated suction temperature equal to the design operating intermediate temperature.

(3) For low-stage compressors in cascade systems, the compressors that are located in the lower-temperature stage(s) of cascade systems, the flow shall be calculated based on the suction pressure being equal to the pressure setpoint of the pressure-relieving devices that protect the lowside of the stage against overpressure.

Exceptions: For Section 1112.2(1), Section 1112.2(2), and Section 1112.2(3), the discharge capacity of the relief device shall be permitted to be the minimum regulated flow rate of the compressor where the following conditions are met:
(1) The compressor is equipped with capacity regulation.
(2) Capacity regulation actuates to a flow at not less than 90 percent of the pressure-relief device setting.
(3) A pressure-limiting device is installed and set in accordance with the requirements of Section 1111.0. [ASHRAE 15:9.8]

1112.11.1 Discharging Location Interior to Building. Pressure-relief devices, including fusible plugs, serving refrigeration systems shall be permitted to discharge to the interior of a building where in accordance with all of the following:
(1) The system contains less than 110 pounds (49.9 kg) of a Group A1 or A2L refrigerant.
(2) The system contains less than 6.6 pounds (2.99 kg) of a Group A2, B1, B2L, or B2 refrigerant.
(3) The system does not contain any quantity of a Group A3 or B3 refrigerant.
(4) The system is not required to be installed in a machinery room in accordance with Section 1106.0.
(5) The refrigerant concentration limits in Section 1104.2 are not exceeded. Refrigeration systems that do not comply with the above requirements shall comply with the requirements of Section 1112.11.2 through Section 1112.11.4. [ASHRAE 15:9.7.8.1]

1112.11.4 Discharge Location, Special Requirements. Additional requirements for pressure relief device discharge location and allowances shall apply for specific refrigerants in accordance with Section 1112.11.4.1. [ASHRAE 15:9.7.8.4]

1112.11.4.1 Water (R-718). Where water is the only refrigerant, discharge to a floor drain shall be permitted where all of the following conditions are met:
(1) The pressure-relief device set pressure shall not exceed 15 psig (103 kPa).
(2) The floor drain shall be sized to handle the flow rate from a single broken tube in any refrigerant containing heat exchanger.
(3) Either of the following:
   (a) The Authority Having Jurisdiction finds it acceptable that the working fluid, corrosion inhibitor, and other additives used in this type of refrigeration system are permitted to infrequently be discharged to the sewer system, or
   (b) A catch tank that is sized to handle the expected discharge shall be installed and equipped with a normally closed drain valve and an overflow line to drain. [ASHRAE 15:9.7.8.4.1]

1112.12.3 Maximum Length. The maximum length of the discharge piping installed on the outlet of pressure-relief devices and fusible plugs discharging to the atmosphere shall be determined in accordance with Section 1112.12.4 and Section 1112.12.5. See Table 1112.12.3 for the allowable flow capacity of various equivalent lengths of single discharge piping vents for conventional pressure-relief valves. [ASHRAE 15:9.7.9.3]

<table>
<thead>
<tr>
<th>ATMOSPHERIC PRESSURE AT NOMINAL INSTALLATION ELEVATION (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ASHRAE 15: TABLE 9.7.9.3.2 9-2]</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

1112.12.4 Design Back Pressure. The design back pressure due to flow in the discharge piping at the outlet of pressure-relief devices and fusible plugs, discharging to atmosphere, shall be limited by the allowable equivalent length of piping determined in accordance with Equation 1112.12.4(1).

\[ L = \frac{0.21466d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d\ln\left(P_0 \right)}{6f} \]

Where:
L = Equivalent length of discharge piping, feet.
Cr = Rated capacity as stamped on the pressure relief device in pounds per minute (lb/min), or in standard cubic feet per minute (SCFM) multiplied by 0.0764, or as calculated in Section 1112.14 for a rupture member or fusible plug, or as adjusted for reduced capacity due to piping in accordance with the manufacturer of the device, or as adjusted for reduced capacity due to piping as estimated by an approved method.
f = Moody friction factor in fully turbulent flow.
\[ d = \text{Outside diameter of pipe or tube, inches.} \]
\[ \ln = \text{Natural logarithm.} \]
\[ P_2 = \text{Absolute pressure at outlet of discharge piping, psia.} \]
\[ P_0 = \text{Allowed back pressure (absolute) at the outlet of pressure relief device, (psia).} \]

For SI units: 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa, 1 pound per minute = 0.00756 kg/s

Unless the maximum allowable back pressure \((P_0)\) is specified by the relief valve manufacturer, the following maximum allowable back pressure values shall be used for \(P_0\), where \(P\) is the set pressure and \(P_a\) is atmospheric pressure at the nominal elevation of the installation (see Table 1112.12.3):

1. For conventional relief valves: 15 percent of set pressure:
\[ P_0 = (0.15 \cdot P) + P_a \] [Equation 1112.12.4(2)]

2. For balanced relief valves: 25 percent of set pressure:
\[ P_0 = (0.25 \cdot P) + P_a \] [Equation 1112.12.4(3)]

3. For rupture disks alone, fusible plugs, and pilot-operated relief devices: 50 percent of set pressure:
\[ P_0 = (0.50 \cdot P) + P_a \] [Equation 1112.12.4(4)]

For fusible plugs, \(P\) shall be the saturated absolute pressure for the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller. [ASHRAE 15:9.7.9.3.1, 9.7.9.3.2]

1112.12.5 Simultaneous Operation. When outlets of two or more relief devices or fusible plugs, which are expected to operate simultaneously, connect to a common discharge pipe, the common pipe shall be sized large enough to prevent the back pressure at each pressure-relief device from exceeding the maximum allowable back pressure in accordance with Section 1112.12.4. [ASHRAE 15:9.7.9.3.3]

1112.14 Rating of Rupture Members and Fusible Plugs. The rated discharge capacity of a rupture member or fusible plug discharging to the atmosphere under critical flow conditions, in pounds of air per minute (kg/s), shall be determined in accordance with the following formulas:

\[ C = 0.64P_1d^2 \] [Equation 1112.14(1)]

\[ d = \frac{1.25 \sqrt{C/P_1}}{1.25} \] [Equation 1112.14(2)]

Where:
\[ C = \text{Rated discharge capacity expressed as mass flow of air, pounds per minute.} \]
\[ d = \text{Smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug, or rupture member, inches.} \]

For rupture members:
\[ P_1 = (\text{rated pressure in psig } \times 1.1) + 14.7 \]

For fusible plugs:
\[ P_1 = \text{Absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, pound-force per square inch atmosphere, psia.} \] [ASHRAE 15:9.7.7]

For SI units: 1 inch = 25.4 mm, 1 pound-force per square inch = 6.8947 kPa, 1 pound per minute = 0.00756 kg/s

1113.5 Discharge Capacity. The minimum required discharge capacity of the pressure relief device or fusible plug for each pressure vessel shall be determined in accordance with Equation 1113.5: ASHRAE 15.

\[ C = fDL \] (Equation 1113.5)

Where:
\[ C = \text{Minimum required discharge capacity of the relief device expressed as mass flow of air, pounds per minute (kg/s).} \]
\[ D = \text{Outside diameter of vessel, feet (m).} \]
\[ L = \text{Length of vessel, feet (m).} \]
\[ f = \text{Factor dependent upon type of refrigerant from Table 1113.5.} \]
Where combustible materials are used within 20 ft (6096 mm) of a pressure vessel, the value of \( f \) shall be multiplied by 2.5. Equation 1113.5 is based on fire conditions, other heat sources shall be calculated separately. Where one pressure-relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacity required for every pressure vessel. [ASHRAE 15:9.7.5]

### TABLE 1113.5

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>VALUE OF ( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where used on the lowside of a limited-charge cascade system:</td>
<td>-</td>
</tr>
<tr>
<td>R-23, R-170, R-744, R-1150, R-508A, R-508B</td>
<td>4</td>
</tr>
<tr>
<td>R-13, R-13B1, R-603</td>
<td>2</td>
</tr>
<tr>
<td>R-14</td>
<td>2.5</td>
</tr>
<tr>
<td>Other applications:</td>
<td>-</td>
</tr>
<tr>
<td>R-718</td>
<td>0.2</td>
</tr>
<tr>
<td>R-717</td>
<td>0.5</td>
</tr>
<tr>
<td>R-11, R-32, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-764</td>
<td>4</td>
</tr>
<tr>
<td>R-143a, R-402B, R-403A, R-407A, R-408A, R-413A</td>
<td>2</td>
</tr>
</tbody>
</table>

*In accordance with Section 1102.2, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 15 and is not capable of being modified.*

1115.4 Marking of Pressure-Relief Devices. Pressure-relief valves for refrigerant containing components shall be set and sealed by the manufacturer or an assembler as defined in ASME BPVC Section VIII. Each pressure relief valve shall be marked by the manufacturer or assembler with the data required in ASME BPVC Section VIII. 

**Exception:** Relief valves for systems with design pressures of 15 pounds-force per square inch gauge (psig) (103 kPa gauge) or less shall be marked by the manufacturer with the pressure setting capacity. [ASHRAE 15:9.6.1]

1116.1.1 Testing Procedure. Tests shall be performed with dry nitrogen or another nonflammable, nonreactive, dried gas. Oxygen, air, or mixtures containing them shall not be used. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gage gauge on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system's components.

**Exceptions:**

1. Mixtures of dry nitrogen, inert gases, and Class 1 nonflammable refrigerants shall be permitted for factory tests.
2. Mixtures of dry nitrogen, inert gases, or a combination thereof with flammable Class 2L, Class 2, or Class 3 refrigerants in concentrations not exceeding the lesser of a refrigerant weight fraction (mass fraction) of 5 percent or 25 percent of the LFL shall be permitted for factory tests.
3. Compressed air without added refrigerant shall be permitted for factory tests, provided the system is subsequently evacuated to less than 0.039 inch of mercury (0.132 kPa) before charging with refrigerant. The required evacuation level is atmospheric pressure for systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant. [ASHRAE 15:9.14.1.1]

1116.3 Test Gases. Tests shall be performed with dry nitrogen or other another nonflammable, nonreactive, dried gas. Oxygen, air, or mixtures containing them shall not be used. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gauge on the outlet side. The pressure-relief device shall be set above the test pressure but low...
enough to prevent permanent deformation of the system’s components.

Exceptions:
(1) Mixtures of dry nitrogen, inert gases, or a combination thereof such as Class 1 nonflammable refrigerant refrigerants in concentrations of a refrigerant weight fraction (mass fraction) not exceeding 5 percent shall be permitted for tests.
(2) Mixtures of dry nitrogen, inert gases, or a combination thereof such as flammable Class 2L, Class 2, and Class 3 refrigerants in concentrations not exceeding the lower lesser of a refrigerant weight fraction (mass fraction) of 5 percent or 25 percent of the LFL shall be permitted for tests.
(3) Compressed air without added refrigerants shall be permitted for tests, provided the system is subsequently evacuated to less than 1000 microns (0.1333 kPa) before charging with refrigerant. The required evacuation level is atmospheric pressure for systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant.
(4) Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 of an inch (15.7 mm) outside diameter shall be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at not less than 68°F (20°C). [ASHRAE 15:10.1.2]

220.0 – R –

Recycled Refrigerants. Refrigerants for which contaminants have been reduced by oil separation, removal of noncondensable noncondensible gases, and single or multiple passes through filter driers or other devices that reduce moisture, acidity, and particulate matter. [ASHRAE 15:3]

SUBSTANTIATION:
The above sections have been revised to correlate with ASHRAE 15-2019 (Addendum c) in accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines).
# TABLE 1102.3
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>CHEMICAL FORMULA</th>
<th>CHEMICAL NAME1 (COMPOSITION FOR BLENDS)</th>
<th>SAFETY GROUP7</th>
<th>OEL2 (ppm)</th>
<th>RCL (POUNDS PER 1000 CUBIC FEET OF SPACE lb/Mcf)</th>
<th>LFL (lb/Mcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-11</td>
<td>CCl3F</td>
<td>Trichlorofluoromethane (carbon tetrachloride)</td>
<td>A1</td>
<td>1000</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>R-12</td>
<td>CCl2F2</td>
<td>Dichlorodifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>R-12B1</td>
<td>CBrClF2</td>
<td>Bromochlorodifluoromethane</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>CClF3</td>
<td>Chlorotrifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-13B1</td>
<td>CBrF3</td>
<td>Bromotrifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-13I1</td>
<td>CF3I</td>
<td>Trifluoriodomethane</td>
<td>A1</td>
<td>500</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>R-14</td>
<td>CF4</td>
<td>Tetrafluoromethane (carbon tetrafluoride)</td>
<td>A1</td>
<td>1000</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>R-21</td>
<td>CHCl2F</td>
<td>Dichlorodifluoromethane</td>
<td>B1</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-22</td>
<td>CHClF2</td>
<td>Chlorodifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>R-23</td>
<td>CHF3</td>
<td>Trifluoromethane</td>
<td>A1</td>
<td>1000</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>CH2Cl2</td>
<td>Dichloromethane (methylene chloride)</td>
<td>B1</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-31</td>
<td>CH2ClF</td>
<td>Chlorofluoromethane</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-32</td>
<td>CH2F2</td>
<td>Difluoromethane (methylene fluoride)</td>
<td>A2L</td>
<td>1000</td>
<td>4.8</td>
<td>19.1</td>
</tr>
<tr>
<td>R-40</td>
<td>CH3Cl</td>
<td>Chloromethane (methyl chloride)</td>
<td>B2</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-41</td>
<td>CH3F</td>
<td>Fluoromethane (methyl fluoride)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-50</td>
<td>CH4</td>
<td>Methane</td>
<td>A3</td>
<td>1000</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>R-113</td>
<td>CCl2FCCIF2</td>
<td>1, 1, 2-trichloro-1, 2, 2- trifluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>R-114</td>
<td>CClF2CCIF2</td>
<td>1, 2-dichloro-1, 1, 2, 2- tetrafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>R-115</td>
<td>CClF2CF3</td>
<td>Chloropentfluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>R-116</td>
<td>CF3CF3</td>
<td>Hexafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>R-123</td>
<td>CHCl2CF3</td>
<td>2, 2-dichloro-1, 1, 1- trifluoroethane</td>
<td>B1</td>
<td>50</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>R-124</td>
<td>CHClF2CF3</td>
<td>2-chloro-1, 1, 1, 2- tetrafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>R-125</td>
<td>CHF₂CF₃</td>
<td>Pentfluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>R-134a</td>
<td>CH₂FCF₃</td>
<td>1, 1, 1, 2-tetrafluoroethane</td>
<td>A1</td>
<td>1000</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>R-141b</td>
<td>CH₃CCl₂F</td>
<td>1, 1-dichloro-1-fluoroethane</td>
<td>—</td>
<td>500</td>
<td>0.78</td>
<td>17.8</td>
</tr>
<tr>
<td>R-142b</td>
<td>CH₃CCIF₂</td>
<td>1-chloro-1, 1-difluoroethane</td>
<td>A2</td>
<td>1000</td>
<td>5.1</td>
<td>20.4</td>
</tr>
<tr>
<td>R-143a</td>
<td>CH₃CF₃</td>
<td>1, 1-difluoroethane</td>
<td>A2L</td>
<td>1000</td>
<td>4.4</td>
<td>17.5</td>
</tr>
<tr>
<td>R-152a</td>
<td>CH₃CHF₂</td>
<td>1, 1-difluoroethane</td>
<td>A2</td>
<td>1000</td>
<td>2.0</td>
<td>8.1</td>
</tr>
<tr>
<td>R-170</td>
<td>CH₃CH₃</td>
<td>Ethane</td>
<td>A3</td>
<td>1000</td>
<td>0.54</td>
<td>2.4</td>
</tr>
<tr>
<td>R-E170</td>
<td>CH₃OCH₃</td>
<td>Methoxymethane (Dimethyl ether)</td>
<td>A3</td>
<td>1000</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td>R-218</td>
<td>CF₃CF₂CF₃</td>
<td>Octafluoropropane</td>
<td>A1</td>
<td>1000</td>
<td>43</td>
<td>-</td>
</tr>
<tr>
<td>R-227ea</td>
<td>CF₃CHFCHF₂</td>
<td>1, 1, 1, 2, 3, 3, 3-heptafluoropropane</td>
<td>A1</td>
<td>1000</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td>R-236fa</td>
<td>CF₃CH₂CF₃</td>
<td>1, 1, 1, 3, 3, 3-hexafluoropropane</td>
<td>A1</td>
<td>1000</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>R-245fa</td>
<td>CHF₂CH₂CF₃</td>
<td>1, 1, 1, 3-pentafluoropropane</td>
<td>B1</td>
<td>300</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>R-290</td>
<td>CH₃CH₂CH₃</td>
<td>Propane</td>
<td>A3</td>
<td>1000</td>
<td>0.56</td>
<td>2.4</td>
</tr>
<tr>
<td>R-C318</td>
<td>-(CF₂)₄</td>
<td>Octafluorocyclobutane</td>
<td>A1</td>
<td>1000</td>
<td>41</td>
<td>-</td>
</tr>
<tr>
<td>R-400</td>
<td>zeotrope R-12/114 (50.0/50.0)</td>
<td>A1</td>
<td>1000</td>
<td>10</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-401A</td>
<td>zeotrope R-12/114 (60.0/40.0)</td>
<td>A1</td>
<td>1000</td>
<td>11</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-401B</td>
<td>zeotrope R-22/152a/124 (53.0/13.0/34.0)</td>
<td>A1</td>
<td>1000</td>
<td>6.6</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-402A</td>
<td>zeotrope R-22/290/22 (60.0/2.0/38.0)</td>
<td>A1</td>
<td>1000</td>
<td>17</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-402B</td>
<td>zeotrope R-22/290/22 (38.0/2.0/60.0)</td>
<td>A1</td>
<td>1000</td>
<td>15</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-403A</td>
<td>zeotrope R-290/22/218 (5.0/75.0/20.0)</td>
<td>A2</td>
<td>1000</td>
<td>7.6</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-403B</td>
<td>zeotrope R-290/22/218 (5.0/56.0/39.0)</td>
<td>A1</td>
<td>1000</td>
<td>18</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-404A</td>
<td>zeotrope R-125/143a/134a (44.0/52.0/4.0)</td>
<td>A1</td>
<td>1000</td>
<td>31</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-405A</td>
<td>zeotrope R-125/143a/124b (45.0/7.0/5.5/42.5)</td>
<td>A1</td>
<td>1000</td>
<td>16</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-406A</td>
<td>zeotrope R-125/143a/134a (50.0/40.0/1.0)</td>
<td>A1</td>
<td>1000</td>
<td>19</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>R-407A</td>
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<td>(60.0/10.0/30.0)</td>
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<td>R-32/125/1234ze(E)</td>
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<td>zeotrope</td>
<td>R-32/1234yf/1234ze(E) (68.0/26.0/6.0)</td>
<td>A2L</td>
<td>870</td>
<td>234.3</td>
<td>17.4</td>
</tr>
<tr>
<td>R-459A</td>
<td>zeotrope</td>
<td>R-32/1234yf/1234ze(E) (21.0/69.0/10.0)</td>
<td>A2L</td>
<td>640</td>
<td>345.8</td>
<td>23.3</td>
</tr>
<tr>
<td>R-460A</td>
<td>zeotrope</td>
<td>R-32/125/134a/1234ze(E) (12.0/52.0/14.0/22.0)</td>
<td>A1</td>
<td>669</td>
<td>950</td>
<td>24</td>
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<tr>
<td>R-460B</td>
<td>zeotrope</td>
<td>R-32/125/134a/1234ze(E) (28.0/25.0/20.0/27.0)</td>
<td>A1</td>
<td>950</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>R-461A</td>
<td>zeotrope</td>
<td>R-32/1234yf/1234ze(E) (2.5/2.5/46.0/49.0)</td>
<td>A1</td>
<td>900</td>
<td>20.4</td>
<td>-</td>
</tr>
<tr>
<td>R-462A</td>
<td>zeotrope</td>
<td>R-32/125/134a/1234ze(E) (55.0/5.0/32.0/5.0/3.0)</td>
<td>A1</td>
<td>1000</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>R-463A</td>
<td>zeotrope</td>
<td>R-32/125/134a/1234ze(E) (9.0/42.0/2.0/44.0/3.0)</td>
<td>A2</td>
<td>1000</td>
<td>3.9</td>
<td>16.6</td>
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<tr>
<td>R-463B</td>
<td>zeotrope</td>
<td>R-32/125/134a/1234ze(E) (6.0/36.0/30.0/14.0/14.0)</td>
<td>A1</td>
<td>990</td>
<td>19</td>
<td>-</td>
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<tr>
<td>R-464A</td>
<td>zeotrope</td>
<td>R-32/125/1234ze(E)/227ea (27.0/27.0/40.0/6.0)</td>
<td>A1</td>
<td>930</td>
<td>27.0</td>
<td>-</td>
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<tr>
<td>R-465A</td>
<td>zeotrope</td>
<td>R-32/125/1234yf (21.0/7.9/71.1)</td>
<td>A2</td>
<td>660</td>
<td>2.5</td>
<td>10.0</td>
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<td>R-466A</td>
<td>zeotrope</td>
<td>R-32/125/131l (49.0/11.5/39.5)</td>
<td>A1</td>
<td>860</td>
<td>6.2</td>
<td>-</td>
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<tr>
<td>R-467A</td>
<td>zeotrope</td>
<td>R-32/125/134a/600a (22.0/5.0/72.4/0.6)</td>
<td>A2L</td>
<td>1000</td>
<td>6.7</td>
<td>-</td>
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<tr>
<td>R-468A</td>
<td>zeotrope</td>
<td>R-1132a/32/1234yf (3.5/21.5/75.0)</td>
<td>A2L</td>
<td>610</td>
<td>4.1</td>
<td>-</td>
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<td>R-469A</td>
<td>zeotrope</td>
<td>R-744/R-32/R-125 (35.0/32.5/32.5)</td>
<td>A1</td>
<td>1600</td>
<td>8</td>
<td>-</td>
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<tr>
<td>R-470A</td>
<td>zeotrope</td>
<td>R-744/32/125/134a/1234ze(E)/227ea (10.0/17.0/19.0/7.0/44.0/3.0)</td>
<td>A1</td>
<td>1100</td>
<td>17</td>
<td>-</td>
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<tr>
<td>R-471A</td>
<td>zeotrope</td>
<td>R-1234ze(E)/227ea/1336mzz(E) (78.7/4.3/17.0)</td>
<td>A1</td>
<td>710</td>
<td>9.7</td>
<td>-</td>
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<tr>
<td>R-472A</td>
<td>zeotrope</td>
<td>R-744/32/134a (69.0/12.0/19.0)</td>
<td>A1</td>
<td>2700</td>
<td>4.5</td>
<td>-</td>
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<td>R-500</td>
<td>azeotrope</td>
<td>R-12/152a (73.8/26.2)</td>
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<td>1000</td>
<td>7.87</td>
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<td>azeotrope</td>
<td>R-22/12 (75.0/25.0)</td>
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<td>1000</td>
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<td>-</td>
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<td>R-502</td>
<td>azeotrope</td>
<td>R-22/115 (48.8/51.2)</td>
<td>A1</td>
<td>1000</td>
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<td>R-503</td>
<td>azeotrope</td>
<td>R-23/13 (40.1/59.9)</td>
<td>—</td>
<td>1000</td>
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<td>-</td>
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<td><strong>R-504</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-32/115 (48.2/51.8)</td>
<td>—</td>
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<td>R-31/114 (55.1/44.9)</td>
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<td>R-31/114 (55.1/44.9)</td>
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<td><strong>R-508A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-125/143a (50.0/50.0)</td>
<td>A1</td>
<td>1000</td>
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<tr>
<td><strong>R-508B</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-23/116 (39.0/61.0)</td>
<td>A1</td>
<td>1000</td>
<td>14</td>
<td>—</td>
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<tr>
<td><strong>R-509A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-23/116 (46.0/54.0)</td>
<td>A1</td>
<td>1000</td>
<td>13</td>
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<td><strong>R-510A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1234yf/134a (5.0/95.0)</td>
<td>A2</td>
<td>1000</td>
<td>1.9</td>
<td>7.7</td>
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<td><strong>R-511A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1234yf/134a (58.5/41.5)</td>
<td>A1</td>
<td>640</td>
<td>21</td>
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<tr>
<td><strong>R-512A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1336mzz(Z)/1130 (E)</td>
<td>B1</td>
<td>700</td>
<td>0.53</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>R-513A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1336mzz(Z)/1130 (E)</td>
<td>B1</td>
<td>320</td>
<td>0.53</td>
<td>2.4</td>
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<tr>
<td><strong>R-514A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1234yf/134a/152a (77.5/8.5/14.0)</td>
<td>A2L</td>
<td>590</td>
<td>7.0</td>
<td>13.1</td>
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<tr>
<td><strong>R-515A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-600 CH&amp;subscript;3 CH&amp;subscript;2 CH&amp;subscript;2 CH&amp;subscript;3 Butane</td>
<td>—</td>
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<tr>
<td><strong>R-516A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-600a CH(CH&amp;subscript;3)2 CH&amp;subscript;2 CH&amp;subscript;3 2-methylbutane (isobutene)</td>
<td>—</td>
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<tr>
<td><strong>R-517A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-610 CH&amp;subscript;3 CH&amp;subscript;2 OCH&amp;subscript;2 CH&amp;subscript;3 Ethoxyethane (ethyl ether)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>R-518A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-611 HCOOCH&amp;subscript;3 Methylene formate</td>
<td>—</td>
<td>—</td>
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<tr>
<td><strong>R-519A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-702 H&amp;subscript;2 Hydron</td>
<td>—</td>
<td>—</td>
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<td><strong>R-520A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-704 He Helium</td>
<td>—</td>
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</tr>
<tr>
<td><strong>R-521A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-717 NH&amp;subscript;3 Ammonia</td>
<td>—</td>
<td>—</td>
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<td>—</td>
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<tr>
<td><strong>R-522A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-720 Ne Neon</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td><strong>R-523A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-728 N&amp;subscript;2 Nitrogen</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td><strong>R-524A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-732 O&amp;subscript;2 Oxygen</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td><strong>R-525A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-740 Ar Argon</td>
<td>—</td>
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<tr>
<td><strong>R-526A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-744 CO&amp;subscript;2 Carbon dioxide</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td><strong>R-527A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-764 SO&amp;subscript;2 Sulfur dioxide</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td><strong>R-528A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1130(E) CHCl=CHCl Trans-1,2-dichloroethene</td>
<td>B1</td>
<td>400</td>
<td>3.0</td>
<td>16</td>
</tr>
<tr>
<td><strong>R-529A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1132a CF=CH=CH=CH2 1, 1-difluoroethylene</td>
<td>A2</td>
<td>500</td>
<td>2.0</td>
<td>8.1</td>
</tr>
<tr>
<td><strong>R-530A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1150 CH=CH=CH2 Ethene (ethylene)</td>
<td>A3</td>
<td>200</td>
<td>—</td>
<td>2.2</td>
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<tr>
<td><strong>R-531A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1224yd(Z) CF=CHOCF=CF=CH2 (Z)-1-chloro-2,3,3,3-tetrafluoropropene</td>
<td>A1</td>
<td>1000</td>
<td>23</td>
<td>—</td>
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<tr>
<td><strong>R-532A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1233zd(E) CF=CHOCH=CF=CF=CH2 Trans-1-chloro-3,3,3-trifluoro-1-propene</td>
<td>A1</td>
<td>800</td>
<td>5.3</td>
<td>—</td>
</tr>
<tr>
<td><strong>R-533A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1234if CF=CHOCH=CH2 2, 3, 3, 3-tetrafluoro-1-propene</td>
<td>A2L</td>
<td>500</td>
<td>4.7</td>
<td>18.0</td>
</tr>
<tr>
<td><strong>R-534A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1234ze(E) CF=CHOCH=CF2 Trans-1,3,3,3-tetrafluoro-1-propene</td>
<td>A2L</td>
<td>800</td>
<td>4.7</td>
<td>18.8</td>
</tr>
<tr>
<td><strong>R-535A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1270 CH=CH=CH2 Propene (propylene)</td>
<td>A3</td>
<td>500</td>
<td>0.11</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>R-536A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1336mzz(E) CF=CHOCH=CH2 Trans-1,1,1,4,4,4-hexafluoro-2-butene</td>
<td>A1</td>
<td>400</td>
<td>3.0</td>
<td>—</td>
</tr>
<tr>
<td><strong>R-537A</strong></td>
<td>azeotrope &amp;superscript;3</td>
<td>R-1336mzz(Z) CF=CH=CH=CH=CF3 Cis-1,1,1,4,4,4-hexafluoro-2-butene</td>
<td>A1</td>
<td>500</td>
<td>5.4</td>
<td>5.2</td>
</tr>
</tbody>
</table>

For SI units: 1 pound = 0.453 kg, 1 cubic foot = 0.0283 m$^3$
Notes:
1. The preferred chemical name is followed by the popular name in parenthesis.
2. The OELs are 8-hour TWAs; a “C” designation denotes a ceiling limit.
3. Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.
4. The exact composition of this azeotrope is in question and additional experimental studies are needed.
5. R-507, R-508, and R-509 are allowed alternative designations for R-507A, R-508A, and R-509A due to a change in designations after assignment of R-500 through R-509. Corresponding changes were not made for R-500 through R-506.
6. The RCL values for these refrigerant blends are approximated in the absence of adequate data for a component comprising less than 4 percent m/m of the blend and expected to have a small influence in an acute, accidental release.
7. Refrigerant flammability classification of Class 2L shall comply with the requirements for flammability classification of Class 2.
8. In accordance with Section 1102.2, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 34 and is not capable of being modified.

228.0 – Z –
Zeotropic. Blends comprising multiple components of different volatilities that, when used in refrigeration cycles, change volumetric composition and saturation temperatures as they evaporate (boil) or condense at constant pressure. [ASHRAE 34:3]

SUBSTANTIATION:
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Table 1102.3 is being revised to the latest edition of ASHRAE 34-2019 which includes addendums to ASHRAE 15-2019 (a through y), as applicable.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appendix Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1102.3  Item #: 215
SUBMITTER: Emily Toto  ASHRAE

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

#TABLE 1102.3
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>CHEMICAL FORMULA</th>
<th>CHEMICAL NAME1 (COMPOSITION FOR BLENDS)</th>
<th>SAFETY GROUP7</th>
<th>OEL2 (ppm)</th>
<th>RCL (lb/Mcf)</th>
<th>LFL (lb/Mcf)</th>
</tr>
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<tbody>
<tr>
<td>R-415A</td>
<td>zeotrope</td>
<td>R-22/152a (82.0/18.0)</td>
<td>A2</td>
<td>1000</td>
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<tr>
<td>R-418A</td>
<td>zeotrope</td>
<td>R-290/22/152a (1.5/96.0/2.5)</td>
<td>A2</td>
<td>1000</td>
<td>4.8</td>
<td>19.2</td>
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<td>R-419A</td>
<td>zeotrope</td>
<td>R-125/134a/E170 (77.0/19.0/4.0)</td>
<td>A2</td>
<td>1000</td>
<td>4.2</td>
<td>16.7</td>
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<td>zeotrope</td>
<td>R-125/134a/E170 (48.5/48.0/3.5)</td>
<td>A2</td>
<td>1000</td>
<td>4.6</td>
<td>18.5</td>
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<td>R-440A</td>
<td>zeotrope</td>
<td>R-290/134a/152a (0.6/1.6/97.8)</td>
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<td>1000</td>
<td>1.9</td>
<td>7.8</td>
</tr>
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<td>R-446A</td>
<td>zeotrope</td>
<td>R-32/1234ze(E)/600 (68.0/29.0/3.0)</td>
<td>A2L</td>
<td>960</td>
<td>2.5</td>
<td>13.5</td>
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<td>R-447A</td>
<td>zeotrope</td>
<td>R-32/125/1234ze(E) (68.0/3.5/28.5)</td>
<td>A2L</td>
<td>960</td>
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<td>18.9</td>
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<td>Substance</td>
<td>Type</td>
<td>Composition</td>
<td>A2L</td>
<td>WCFF LFL</td>
<td>Notes</td>
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<td>R-451A</td>
<td>zeotrope</td>
<td>R-1234yf/134a (89.8/10.2)</td>
<td>A2L</td>
<td>530</td>
<td>5.0, 20.3, 11</td>
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<td>zeotrope</td>
<td>R-1234yf/134a (88.8/11.2)</td>
<td>A2L</td>
<td>530</td>
<td>5.0, 20.3, 11</td>
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<td>A2L</td>
<td>690</td>
<td>3.2, 18.3, 11</td>
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<td>R-32/1234yf (68.9/31.1)</td>
<td>A2L</td>
<td>850</td>
<td>3.1, 22.0, 11</td>
<td></td>
</tr>
<tr>
<td>R-454C</td>
<td>zeotrope</td>
<td>R-32/1234yf (21.5/78.5)</td>
<td>A2L</td>
<td>620</td>
<td>4.4, 18.0, 11</td>
<td></td>
</tr>
<tr>
<td>R-462A</td>
<td>zeotrope</td>
<td>R-32/125/134a/600 (9.0/42.0/2.0/44.0/3.0)</td>
<td>A2</td>
<td>1000</td>
<td>3.9, 16.6, 10</td>
<td></td>
</tr>
<tr>
<td>R-448B</td>
<td>=</td>
<td>R-32/125/1234yf/134a/1234ze(E) (21.0/21.0/20.0/31.0/7.0)</td>
<td>A1</td>
<td>850</td>
<td>22.0, =</td>
<td></td>
</tr>
<tr>
<td>R-468B</td>
<td>=</td>
<td>R-1132a/32/1234yf (6.0/13.0/81.0)</td>
<td>A2L</td>
<td>570</td>
<td>4.4, =</td>
<td></td>
</tr>
<tr>
<td>R-468C</td>
<td>=</td>
<td>R-1132a/32/1234yf (6.0/42.0/52.0)</td>
<td>A2L</td>
<td>710</td>
<td>4.3, =</td>
<td></td>
</tr>
<tr>
<td>R-472B</td>
<td>=</td>
<td>R-744/32/134a (58.0/10.0/32.0)</td>
<td>A1</td>
<td>2400</td>
<td>5.0, =</td>
<td></td>
</tr>
<tr>
<td>R-472C</td>
<td>=</td>
<td>R-32/125/143a/134a (25.0/25.0/10.0/40.0)</td>
<td>A1</td>
<td>1000</td>
<td>20.0, =</td>
<td></td>
</tr>
<tr>
<td>R-473A</td>
<td>=</td>
<td>R-1132a/23/744/125 (20.0/10.0/60.0/10.0)</td>
<td>A1</td>
<td>1700</td>
<td>4.8, =</td>
<td></td>
</tr>
<tr>
<td>R-475A</td>
<td>=</td>
<td>R-1234yf/134a/1234ze(E) (45.0/43.0/12.0)</td>
<td>A1</td>
<td>690</td>
<td>20.0, =</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1 pound = 0.453 kg, 1 cubic foot = 0.0283 m³

(portions of table not shown remains unchanged)

Notes:
1. The preferred chemical name is followed by the popular name in parenthesis.
2. The OELs are 8-hour TWAs; a "C" designation denotes a ceiling limit.
3. Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.
4. The exact composition of this azeotrope is in question and additional experimental studies are needed.
5. R-507, R-508, and R-509 are allowed alternative designations for R-507A, R-508A, and R-509A due to a change in designations after assignment of R-500 through R-509. Corresponding changes were not made for R-500 through R-506.
6. The RCL values for these refrigerant blends are approximated in the absence of adequate data for a component comprising less than 4 percent m/m of the blend and expected to have a small influence in an acute, accidental release.
7. Refrigerant flammability classification of Class 2L shall comply with the requirements for flammability classification of Class 2.
8. In accordance with Section 1102.2, ammonia refrigeration systems are not regulated by this chapter. R-717 (ammonia) is included in this table because the table is extracted from ASHRAE 34 and is not capable of being modified.
9. LFL is based on WCF @ 73.4°F (23°C) unless otherwise noted.
10. WCFF LFL @ 140°F (60°C).
11. WCFF LFL @ 73.4°F (23°C).
12. WCF LFL @ 212°F (100°C).

SUBSTANTIATION:
The above sections have been revised to correlate with ASHRAE 34-2019 (Addenda f, q, s, v, w, z, and aa) in accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines).
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 220.0, Table 1102.3  Item #: 215

SUBMITTER: Phillip H Ribbs, PHR Consultants; Randy Young, Northern California JATC  Comment #: 2

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

TABLE 1102.3
REFRIGERANT GROUPS, PROPERTIES, AND ALLOWABLE QUANTITIES8
[ASHRAE 34: TABLE 4-1, TABLE 4-2]

<table>
<thead>
<tr>
<th>REFRIGERANT</th>
<th>CHEMICAL FORMULA</th>
<th>CHEMICAL NAME1 (COMPOSITION FOR BLENDS)</th>
<th>SAFETY GROUP2</th>
<th>OEL2 (ppm)</th>
<th>RCL (lb/Mcf)</th>
<th>LFL (lb/Mcf)</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Notes:
1-6 (remaining text unchanged)
7. Refrigerant flammability classification of Class 2L shall comply with the requirements for flammability classification of Class 2.
   (renumber remaining items)

220.0 — R —

Refrigerant Safety Classifications. Made up of a letter (A or B), that indicates the toxicity class, followed by a number (1, 2L, 2, or 3), that indicates the flammability class. Refrigerant blends are similarly classified, based on the compositions at their worst cases of fractionation, as separately determined for toxicity and flammability. In some cases, the worst case of fractionation is the original formulation.

Flammability Classification. Refrigerants shall be classified for flammability in accordance with one of the following:
Class 1. Refrigerants that do not show flame propagation where tested in air at 14.7 pound-force per square inch absolute (psia) (101 kPa) and 140°F (60°C).
Class 2L. Refrigerants having a lower flammability limit (LFL) of more than 0.00625 pound per cubic foot (lb/ft^3) (0.10012 kg/m^3) at 140°F (60°C), 14.7 psia (101 kPa), a heat of combustion of less than 8169 British thermal units per pound (Btu/lb) (1.8988 E+07 J/kg), and a maximum burning velocity of 3.9 inches per second (10 cm/s) where tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa) in dry air.
Class 2. Refrigerants having a lower flammability limit (LFL) of more than 0.00625 pound per cubic foot (lb/ft^3) (0.10012 kg/m^3) at 140°F (60°C), 14.7 psia (101 kPa), and a heat of combustion of less than 8169 British thermal units per pound (Btu/lb) (1.8988 E+07 J/kg).
Class 3. Refrigerants that are highly flammable having a LFL of not more than 0.00625 lb/ft^3 (0.10012 kg/m^3) at 140°F (60°C) and 14.7 psia (101 kPa) or a heat of combustion not less than 8169 Btu/lb (1.8988 E+07 J/kg).

SUBSTANTIATION:
With the addition of Class 2L refrigerants into the code, a definition is needed. The current note (7) in Table 1102.3 states that "Refrigerant flammability classification of Class 2L shall comply with the requirements for flammability classification of Class 2." This is not accurate. Therefore, a Class 2L Flammability Classification definition is being added and is consistent with ASHRAE 34. A2L refrigerants are a product that will be permitted in the code soon and this definition aims to add to the safety for users of the product.
RECOMMENDATION:
Add new text

Request to accept the code change proposal as modified by this public comment.

220.0 – R –
Refrigerant. A chemical compound intended to be used for heat transfer in a refrigerating system.

SUBSTANTIATION:
A definition for “Refrigerant” is being added to Chapter 2 to coordinate with the uses in Table 1102.3 (Refrigerant Groups, Properties, and Allowable Quantities). The addition of the definition adds to the completeness of the code and ties up loose ends previously not addressed.

The proposed definition does not conflict with ASHRAE 15 or ASHRAE 34 definitions for refrigerant: the fluid used for heat transfer in a refrigerating system; the refrigerant absorbs heat and transfers it at a higher temperature and a higher pressure, usually with a change of state or phase.
1102.0 Refrigeration Systems.
1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and either ASHRAE 15 or ASHRAE 15.2, as applicable.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 15.2-2021 (Working Draft)</td>
<td>Refrigeration Systems in Residential Applications</td>
<td>Residential Refrigeration Systems</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASHRAE 15.2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
ASHRAE 15.2 has been developed as the installation standard for individual dwelling units. The user of the code is directed to whichever standard is applicable.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
ASHRAE 15.2 is a working draft and is not completed at the time of this monograph and is therefore being rejected.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appendixed Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1102.1, Table 1801.1  Item #: 216

SUBMITTER: Emily Toto  ASHRAE

RECOMMENDATION: Revise text

Request to replace the code change proposal by this public comment.
1102.0 Refrigeration Systems.
1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and either ASHRAE 15 or ASHRAE 15.2, as applicable.

TABLE 1801.1
REFERENCE STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 15.2-2022</td>
<td>Refrigeration Systems in Residential</td>
<td>Residential Refrigeration Systems</td>
<td>1102.1</td>
</tr>
<tr>
<td>(Working Draft)</td>
<td>Applications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASHRAE 15.2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
ASHRAE 15.2 has been developed as the installation standard for individual dwelling units in residential occupancies. This proposal would direct users to whichever standard is applicable for their purpose.

Item #216 was first considered at the Technical Committee meeting in May 2021. At the time, ASHRAE 15.2 was not finalized. Since that time, ASHRAE 15.2 has undergone additional improvements and is preparing for publication in 2022. ASHRAE 15.2 includes provisions that are the result of harmonization with UL 60335-2-40 4ed and ASHRAE 15. It is important to include this new reference to 15.2 in the UMC because ASHRAE 15 will now focus solely on commercial to prevent overlap between the two complementary standards.
Proposals

Item #: 217

UMC 2024  Section: 1102.1, 1102.2, Table 1701.1

SUBMITTER: Jeffrey Shapiro
   International Code Consultants
   Rep. IIAR

RECOMMENDATION:
Revised text

1102.0 Refrigeration Systems.
1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and ASHRAE 15. Refrigeration systems containing carbon dioxide as the refrigerant shall also comply with BSR/IIAR CO2.

1102.2 Ammonia Refrigeration Systems. Refrigeration systems using ammonia as the refrigerant shall comply with IIAR 2, IIAR 3, IIAR 4, and IIAR 5, and IIAR 6 and shall not be required to comply with this chapter.

<table>
<thead>
<tr>
<th>TABLE 1701.1 REFERENCE STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
</tr>
<tr>
<td>BSR/IIAR CO2-2021 (Working Draft)</td>
</tr>
</tbody>
</table>

(ports of table not shown remain unchanged)

Note: IIAR 6 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: BSR/IIAR CO2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
IIAR 6 is a new standard for maintenance and inspection of closed-circuit ammonia refrigeration systems that is part of the suite of IIAR standards regulating ammonia refrigeration systems. Because this standard addresses system maintenance, which is part of the UMC scope in Section 101.2 (Scope), it is important to have the standard referenced by the UMC to provide for proper compliance and enforcement of ammonia system regulations. Mandatory system maintenance regulations covering ammonia refrigeration systems in the UMC is important to safe operation of these systems in UMC jurisdictions.

BSR/IIAR CO2 is in the process of completion for issuance in 2021. It is a new standard governing refrigeration systems that use carbon dioxide as the refrigerant, and it is designed to be a companion to ASHRAE 15, providing additional design requirements that are unique to carbon dioxide systems to supplement ASHRAE 15 and going beyond the scope of ASHRAE 15 by regulating the complete life-cycle of carbon dioxide systems. Carbon dioxide has become increasingly popular as an industrial refrigerant because it is considered efficient and climate friendly. Including IIAR's new standard will assure that these systems are properly regulated.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:
1102.0 Refrigeration Systems.
1102.1 General. Refrigeration systems using a refrigerant other than ammonia shall comply with this chapter and ASHRAE 15. Refrigeration systems containing carbon dioxide as the refrigerant shall also comply with BSR/IIAR CO2.

1102.2 Ammonia Refrigeration Systems. Refrigeration systems using ammonia as the refrigerant shall comply with IIAR 2, IIAR 3, IIAR 4, IIAR 5, and IIAR 6 and shall not be required to comply with this chapter.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSR/IIAR CO2-2021 (Working Draft)</td>
<td>Safety Standard for Closed-Circuit Carbon Dioxide Refrigeration Systems</td>
<td>Carbon Dioxide Refrigeration Systems</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**COMMITTEE STATEMENT:**
The modification removes BSR/IIAR CO2 as it was a working draft at the time of this Monograph.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**
AFFIRMATIVE: 29   NOT RETURNED: 1   Heine

**EXPLANATION OF AFFIRMATIVE:**
BALLANCO: While I am voting affirmative, the proponent indicated that the standard was complete. Hence, this should be accepted as submitted.

### Table 1801.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIAR CO2-2021</td>
<td>Safety Standard for Closed-Circuit Carbon Dioxide Refrigeration Systems</td>
<td>Carbon Dioxide Refrigeration Systems</td>
<td>1102.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** IIAR CO2 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The above revision adds a reference to IIAR CO2, a new standard governing refrigeration systems that use carbon dioxide as the refrigerant. It is designed as a companion and supplement to ASHRAE 15, providing additional
requirements that are unique to carbon dioxide systems. IIAR CO2 goes beyond the scope of ASHRAE 15 by regulating the complete life-cycle of carbon dioxide systems.

Carbon dioxide has become increasingly popular as an industrial refrigerant because it is efficient and climate friendly. Including this new standard will improve the UMC by helping to assure that carbon dioxide refrigeration systems are properly and sufficiently regulated.

Although the standard was completed before the Technical Committee meeting, the final published text was only made available to the Technical Committee shortly before the meeting. The Technical Committee wanted the published version to be available for a longer period of time to allow for review prior to considering approval. It has now been available for several months and is attached to this public comment.
Proposals

Item #: 218
UMC 2024  Section: 1108.1

SUBMITTER: Mitch Pinsker
Affiliated Engineers Inc
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee

RECOMMENDATION:
Revise text

1108.0 Refrigeration Machinery Room Equipment and Controls.
1108.1 General. Equipment, piping, ducts, vents, or similar devices that are not essential for the refrigeration process, maintenance of the equipment, or for the illumination, ventilation, or fire protection of the room require access or maintenance by personnel not authorized to access the refrigeration machinery room in accordance with Section 1106.11 shall not be placed in or pass through a refrigeration machinery room.

(below shown for reference only)

1106.11 Restricted Access. Access to the refrigeration machinery room shall be restricted to authorized personnel. Doors shall be clearly marked or permanent signs shall be posted at each entrance to indicate this restriction. [ASHRAE 15:8.11.8]

SUBSTANTIATION:
The current wording of Section 1108.1 has been very inconsistently enforced and can be onerous. For instance, AHJs have at times disallowed the following from being inside refrigeration machinery (e.g. chiller) rooms:
1. Roof drain piping from a drain in the roof above the chiller room
2. Hot water piping passing through a corner of the chiller room from an adjacent boiler room
3. Electrical panels that include circuits serving equipment outside the chiller room in addition to equipment inside the room

Locating these elements in the chiller room poses no safety risk provided anyone accessing these elements, e.g. for maintenance, are authorized to access the room. Section 1106.11 says:

1106.11 Restricted Access. Access to the refrigeration machinery room shall be restricted to authorized personnel. Doors shall be clearly marked or permanent signs shall be posted at each entrance to indicate this restriction. [ASHRAE 15:8.11.8]

This proposal then disallows equipment and materials to be located inside the refrigeration room if the personnel required to maintain them are not authorized to access the room. For instance, this would disallow the following from being located in the chiller room:
1. Window washing equipment
2. Irrigation control panels and equipment
3. Cellular phone panels

Note that the blanket limitations in Section 1108.1 are unique to the UMC; neither ASHRAE Standard 15 (from which most of this chapter was extracted) nor the International Mechanical Code include a similar requirement. So even with the proposed revisions, the UMC would be more stringent than these other standards and codes.

COMMITTEE ACTION: REJECT
COMMITTEE STATEMENT:
The proposed change is not enforceable, poorly written, and the section already clearly states the intent of section. The proposal may also change the intent of the section.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1108.1

SUBMITTER: Mitch Pinsker AEI

RECOMMENDATION:
Revise text
Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
I support Item #218 as written.

The current wording of Section 1108.1 has been very inconsistently enforced and can be onerous. For instance, AHJs have at times disallowed the following from being inside refrigeration machinery (e.g. chiller) rooms:
1. Roof drain piping from a drain in the roof above the chiller room
2. Hot water piping passing through a corner of the chiller room from an adjacent boiler room
3. Electrical panels that include circuits serving equipment outside the chiller room in addition to equipment inside the room

Locating these elements in the chiller room poses no safety risk provided anyone accessing these elements, e.g. for maintenance, are authorized to access the room. Section 1106.11 says:

1106.11 Restricted Access. Access to the refrigeration machinery room shall be restricted to authorized personnel. Doors shall be clearly marked or permanent signs shall be posted at each entrance to indicate this restriction. [ASHRAE 15:8.11.8]

This proposal then disallows equipment and materials to be located inside the refrigeration room if the personnel required to maintain them are not authorized to access the room. For instance, this would disallow the following from being located in the chiller room:
1. Window washing equipment
2. Irrigation control panels and equipment
3. Cellular phone panels

Note that the blanket limitations in Section 1108.1 are unique to the UMC; neither ASHRAE Standard 15 (from which most of this chapter was extracted) nor the International Mechanical Code include a similar requirement. So even with the proposed revisions, the UMC would be more stringent than these other standards and codes.
1108.0 Refrigeration Machinery Room Equipment and Controls.
1108.1 General. Equipment, piping, ducts, vents, or similar devices that are not essential for the refrigeration process, maintenance of the equipment, or for the illumination, ventilation, or fire protection of the room shall not be placed in or pass through a refrigeration machinery room.

   Equipment essential to the refrigeration process permitted to be placed in or pass through a refrigeration machinery room shall include:
   (1) Refrigeration compressors.
   (2) Condensing units.
   (3) Pumps, associated piping and automatic control valves for refrigerant, condenser water, and brine or chilled water.
   (4) Refrigeration control devices and panels.
   (5) Machinery room ventilation equipment.
   (6) Refrigerant receivers and accumulators.
   (7) Refrigerant vapor-detection and alarm systems.
   (8) Machinery room fire sprinkler system.
   (9) Machinery room lighting and service receptacles.
   (10) Motor control centers and electrical panels for machinery room systems.

SUBSTANTIATION:
The proposed list may not be all-inclusive. The change does not provide clarity and the current language sufficiently addresses the intent of the section.

COMMITTEE STATEMENT:
The proposed list may not be all-inclusive. The change does not provide clarity and the current language sufficiently addresses the intent of the section.
Request to replace the code change proposal by this public comment.

1108.0 Refrigeration Machinery Room Equipment and Controls.

1108.1 General. Equipment, piping, ducts, vents, or similar devices that are not essential for the refrigeration process, maintenance of the equipment, or for the illumination, ventilation, or fire protection of the room shall not be placed in or pass through a refrigeration machinery room.

   Equipment essential to the refrigeration process permitted to be placed in or pass through a refrigeration machinery room may include:
(1) Refrigeration compressors.
(2) Condensing units.
(3) Pumps, associated piping and automatic control valves for refrigerant, condenser water, and brine or chilled water.
(4) Refrigeration control devices and panels.
(5) Machinery room ventilation equipment.
(6) Refrigerant receivers and accumulators.
(7) Refrigerant vapor-detection and alarm systems.
(8) Machinery room fire sprinkler system.
(9) Machinery room lighting and service receptacles.
(10) Motor control centers and electrical panels for machinery room systems.

SUBSTANTIATION:
The list of equipment being added to Section 1108.1 provides clarity as to which equipment may be allowed in the refrigeration machinery room. The proposed list was taken from the 2009 edition of the UMC. The language was removed in the 2012 UMC. Although the language was removed in the 2012 edition, there were multiple negative votes with comments stating, “Examples of equipment that essential to the refrigeration process are necessary to clarify the intent of the code for Inspectors and Building Officials.”
Proposals

Item #: 224

UMC 2024  Section: 218.0, 1109.1.5, Table 1701.1

SUBMITTER: Brad Campbell
Gastite

RECOMMENDATION:
Add new text

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials.

1109.1.5 Polyethylene of Raised Temperature-Aluminum-Polyethylene of Raised Temperature (PE-RT/AL/PE-RT) Linesets. PE-RT/AL/PE-RT linesets shall comply with ASTM FXXXX.

218.0 – P – PE-RT/AL/PE-RT. Polyethylene of raised temperature-aluminum-polyethylene of raised temperature.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM FXXXX-2021 (Working Draft)</td>
<td>Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems</td>
<td>PE-RT/AL/PE-RT</td>
<td>1109.1.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM FXXXX is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
PERT-AL-PERT pipe material is not listed in the UMC Section 1109.1 Refrigeration Piping Materials section. This type of composite pipe has primarily been used for water conveyance applications but if the pipe is designed and tested to the new ASTM FXXXX Standard for “Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems” will be a comparable line set option. Given previous requests to add PERT/AL/PERT pipe to Sections 1109.1.5 and 1109.2 (for refrigeration pipe material and joints), the definition of PERT/AL/PERT should be defined in Section 218.0. This new ASTM FXXXX standard will be finalized and published in the next 30 days.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
ASTM FXXXX was a working draft and was not completed at the time of this monograph.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 218.0, 1109.1.5, Table 1801.1  Item #: 224

SUBMITTER: Brad Campbell  Gastite  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials. (remaining text unchanged)

1109.1.5 Polyethylene of Raised Temperature-Aluminum-Polyethylene of Raised Temperature (PE-RT/AL/PE-RT) Linesets. PE-RT/AL/PE-RT linesets shall comply with ASTM F3506.

218.0 – P – PE-RT/AL/PE-RT. Polyethylene of raised temperature-aluminum-polyethylene of raised temperature.

TABLE 1801.1

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>ASTM F3506-2021</td>
<td>Polyethylene of Raised Temperature/Aluminum/Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems</td>
<td>PE-RT/AL/PE-RT</td>
<td>1109.1.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3506 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The referenced ASTM F3506-21 standard was in draft format when the proposal was submitted but was published in April 2021 before the Technical Meeting. The required ASTM F3506-21 standard is specific for PE-RT/AL/PE-RT multilayer Polyethylene / Aluminum pipes that are built per the standard specifically for Refrigeration Line Set Systems (which is defined in the title and scope of the standard). The standard tests and evaluates the pipe and approved fitting for use for Line Set extreme pressure and temperature applications, cycle testing, vibration testing, pipe and fitting pull testing. The standard material requirements call for the aluminum and PE-RT that is used to achieve the specified strength for the aluminum structure, the chemical resistance for the inner PE-RT layer, and the UV resistance for the outer PE-RT layer. This product has been evaluated for physical property degradation per ASHRAE G38 exposure testing to both A1 and A2L refrigerants. This specified product also has been flame evaluated per ASTM E84 with flame index numbers below 25.
1109.0 Refrigeration Piping, Containers, and Valves.

1109.2 Joints. Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press-connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories; Nonelectrical (with revisions through June 27, 2014)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Section 1109.2 of the UMC originally listed only those joint types for refrigeration piping which have been time tested for soundness. Fittings for each joining process were required to be manufactured in accordance with recognized ASME and ASTM Standards, with the intent of the code being a leak-free piping system installed to safely contain the refrigerant within it.

The use of press-connect technology on copper or copper alloy pipe joints of iron pipe size, as well as the use of press-connect technology on copper tubing joints and connections, was introduced into the 2018 UMC through ROP #154 and finally approved into the UMC as being tested per the industry standard, UL 207. It is my intention to substantiate that UL 207 was misapplied for the allowance of press-connect technology into this section of the 2021 UMC.

The Scope: Section 1.1 of the UL 207-2009 Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014) clearly states which nonelectrical refrigerant-containing components and accessories are covered by the requirements of the UL 207. The subsequent paragraph of the Scope; Section 1.2 (a), clearly states “These requirements do not apply to: Electrical valves and electric refrigeration controllers, hermetic refrigerant motor compressors, tubing fittings such as flare or compression type fittings, and the like, which are covered in or as part of separate, individual requirements.”

There is an existing ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings Standard listed in the 2021 UMC, but that standard does not include ASTM B280 copper and copper alloy piping or the use of press-connect technology as a joining process for refrigeration piping.
As press-connect technology for fittings would be covered by other recognized standards, such as the ASME B31.5 Refrigeration Piping and Heat Transfer Components, it is my opinion that the UL 207 was incorrectly substantiated by the Submitter of the original proposal.

Additionally, Section 1109.1 Materials, of the 2021 UMC clearly states "Refrigerant piping shall be metallic." As press-connect fittings rely upon a non-metallic elastomeric seal to contain refrigerant, press-connect technology for refrigerant piping applications would be considered as non-compliant with the requirements of the 2021 UMC.

As the UMC Technical Committee did not recognize the error in the Submitter’s substantiation, I am requesting the UMC Technical Committee to consider my substantiation for this proposal.

UL 207-2009, Refrigerant Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014), was incorrectly referenced for this section of the 2021 UMC. As there are no additional sections of the 2021 UMC that reference this standard, there is no reason to retain it in the code. Therefore, UL 207 should be deleted from Table 1701.1.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 17  NEGATIVE: 11  ABSTAIN: 1  NOT RETURNED: 1  Heine

Note: Item # 225 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF AFFIRMATIVE:

BENKOWSKI: A "low leakage rate" is technical justification enough to choose a method other than press-connect to join the piping that conveys a mildly flammable refrigerant.

BERGER: Extensive substantiation was submitted with this proposal and was approved by the TC to proceed. Perhaps a letter writing campaign is the way to go when you want to override the decision of the Technical Committee.


RIBBS: I agree with Don Taylor. I am voting yes to remove press-connect for refrigeration usage for any refrigerant not listed in the standard. A2L’s were not listed (and not tested) and until I see testing data showing press-connect passes for A2L refrigerants, I cannot support its usage.

TAYLOR: I am voting yes to remove press-connect for refrigeration usage for any refrigerant not listed in the standard. A2L’s were not listed (and not tested) and until I see testing data showing press-connect passes for A2L refrigerants, I cannot support its usage.

EXPLANATION OF NEGATIVE:

BALLANCO: The technical justification for removing press-connect, solder, and mechanical joints complying to UL 207 is not correct. UL 207 addresses fittings, contrary to what is stated in the substantiation. Press-connect fittings are proven joints used in refrigeration systems. The claim that they leak is incorrect. The ASHRAE study on refrigerant joints and connections identified press-connect fittings as one of the highest quality joints regardless of the level of expertise of the installer. Solder joints have long been used on industrial refrigeration systems. There is no justification for removing solder joints when the refrigeration system falls within the temperature and pressures of the refrigeration system. All of these joints proposed for deletion are accepted by ASHRAE 15.

CUDAHY: Overly restrictive. Joints proposed for deletion are accepted by ASHRAE 15.

FEEHAN: The proposal removes press-connect fittings without any technical justification.

GUNZNER: Press-connect fittings are specifically permitted by ASHRAE 15. AMCA supports consistency between related codes and standards where applicable. These modifications would cause confusion and other disruptions. AMCA supports the work of the UMC A2L Task Group.

KOERBER: No technical justification was provided for the removal of these joining methods.
MACNEVIN: This item should be rejected, as there was no evidence submitted to prohibit press-connect fittings. In fact, a previous report submitted to this TC showed that press-connect fittings are the most reliable joining technology overall.

TRAFTON, A: This proposal removes a joining method approved within the industry.

TRAFTON, P: The research sponsored by ASHRAE indicates that the press-fittings function well for this purpose and, as such, seem to meet the application. There may be some limitations that might be imposed to limit this to certain sizes pending further research. Further, it should be remembered that no matter the joining method, if it is not done correctly, leaks will occur.


WHITE: There is no technical justification for this proposal and should be rejected. Additional substantiation is not appropriate at this time but may be submitted during the public comment period.

WISEMAN: There is no technical justification for this change. It is not possible for a human to always make a proper weld. The truth is, there is not a perfect way to guarantee a 100% seal. Humans are fallible, and make mistakes. Even the best technicians make mistakes. Without technical justification, the code should not change.

EXPLANATION OF ABSTAIN:

TERZIGNI: I am still doing research on the various claims before casting my vote.

---

**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 1109.2, Table 1801.1  **Item #:** 225

**SUBMITTER:** Donald (DJ) Berger  
National ITC Corporation  
Self

**RECOMMENDATION:**

Revise text

Request to replace the code change proposal by this public comment.

**1109.0 Refrigeration Piping, Containers, and Valves.**

**1109.2 Joints.** Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press-connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 109 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. Additionally, all joints or connections listed and labeled as complying with UL 109 shall be required to be based on the pipe or tube size as specified in the "Gas fittings, all types" column of UL 109, Table 7.1 "Pull Strength Test." Refrigeration joints or connections not having male or female parts shall be affixed accordingly to allow for all performance testing specified in UL 109. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections. Exception: Copper tubing joints and connections for other than Group A1 refrigerant piping shall be connected by approved flared or brazed joints.

**TABLE 1801.1 REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>1109.1.6</td>
</tr>
<tr>
<td>UL-207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
</tbody>
</table>
Note: UL 109 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The UL 207-2009 Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014) is the referenced standard in Table 1701.1 of the 2018 UMC for mechanical joints complying with UL 207, as identified in Section 1109.2. The scope of the referenced UL 207-2009 Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014) clearly states in Section 1.2 "These requirements do not apply to: a) Electric valves and electric refrigeration controllers, hermetic refrigerant motorcompressors, tubing fittings such as flare or compression type fittings, and the like, which are covered in or as part of separate, individual requirements."

As the scope of the referenced UL 207-2009 (with revisions through June 27, 2014) excludes tube fittings from the standard, the UL 207-2009 (with revisions through June 27, 2014) should be removed from the 2018 UMC Table 1701.1 as a referenced standard as identified in Section 1109.2.

Although tubing fittings are excluded from the scope of the UL 207-2009, terminology for joints and fittings are included in the UL 207-2009 in regard to the design, construction, and testing of refrigerant containing component assemblies and accessories, as the joints and fittings are integral parts of such components. The type of joints identified in the UL 207-2009 are brazed, mechanical, soldered, and welded; all of which are defined to be gastight joints obtained by the joining of metal parts. The solder joining requiring a joining temperature above 400 °F but not exceeding 800 °F, while the braze joining requires a minimum joining temperature of 800 °F. However, the UL 207-2009 (with revisions through June 27, 2014) does not include the term of O-ring anywhere in the standard. As there is no existing terminology for any fitting that relies upon an O-ring for a seal in the UL 207-2009 (with revisions through June 27, 2014), it should be noted that the UL 207-2009 (with revisions through June 27, 2014) should have never been referenced for such fittings and should be removed as a referenced standard in Section 1109.2 of the 2018 UMC.

The UL 109 shall be added to Table 1701.1 to allow for the listing and labeling of other joints and connections employing an O-ring or elastomeric seal to remain in the 2018 UMC. As the UL 109 does not specifically identify any joints employing an O-ring for the sealing mechanism, all joints or connections listed and labeled as complying with UL 109 shall be required to be based on the pipe or tube size as specified in the "Gas fittings, all types" column of UL 109, Table 7.1 "Pull Strength Test." Refrigeration joints or connections not having male or female parts, shall be affixed according to allow for all performance testing specified in UL 109.

Approved flare joints and connections shall remain in Section 1109.2, as established standards exist for such mechanical joints and connections as listed in Table 526.1 of the ASME B31.5-2016 of 2018 UMC Table 1701.1.

Additionally, due to the additional safety hazards associated with annealed temper tubing and other classification groups of refrigerants, an exception shall be made for all copper tubing joints and connections allowed for other than Group Al refrigerant piping. The exception will be for joints and connections for copper tubing for other than Group Al refrigerant piping shall be required to be joined by approved flare or brazed joints.

The allowance for the joints and connections listed and labeled as complying with UL 207-2009 (with revisions through June 27, 2014) on refrigeration piping systems in the 2018 UMC poses the potential of compromised refrigeration piping systems due to the lack of an established referenced standard for the design, construction, and testing of such fittings employing a nonmetallic sealing mechanism for use on refrigeration piping systems.

Additionally, an Independent Tab Lab Report (RLS042721) including test results, has been provided to IAPMO and the UMC Technical Committee, documenting the failure of such joints and connections listed and labeled to the referenced UL 207.

As the submitted substantiation establishes, refrigeration piping systems must comply with ASME B31.5-2016, and 2018 UMC Section 1109.1 requires refrigeration piping shall be metallic, and the referenced UL 207 is not applicable to tube fittings, the allowance of such fittings in the 2018 UMC has created the potential for catastrophic failure of refrigeration piping systems that may have been installed or may be installed using a joint or connection that was designed, tested, listed, or labeled to a misapplied standard, thereby posing a safety and health risk to the public.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1109.2, Table 1801.1  Item #: 225

SUBMITTER: Donald (DJ) Berger  National ITC Corporation  Rep. Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Section 1109.2 of the UMC originally listed only those joint types for refrigeration piping which have been time tested for soundness. Fittings for each joining process were required to be manufactured in accordance with recognized ASME and ASTM Standards, with the intent of the code being a leak-free piping system installed to safely contain the refrigerant within it.

The use of press-connect technology on copper or copper alloy pipe joints of iron pipe size, as well as the use of press-connect technology on copper tubing joints and connections, was introduced into the 2018 UMC through ROP #154 and finally approved into the UMC as being tested per the industry standard, UL 207. It is my intention to substantiate that UL 207 was misapplied for the allowance of press-connect technology into this section of the 2021 UMC.

The Scope: Section 1.1 of the UL 207-2009 Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014) clearly states which nonelectrical refrigerant-containing components and accessories are covered by the requirements of the UL 207. The subsequent paragraph of the Scope; Section 1.2 (a), clearly states “These requirements do not apply to: Electrical valves and electric refrigeration controllers, hermetic refrigerant motor compressors, tubing fittings such as flare or compression type fittings, and the like, which are covered in or as part of separate, individual requirements.”

There is an existing ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings Standard listed in the 2021 UMC, but that standard does not include ASTM B280 copper and copper alloy piping or the use of press-connect technology as a joining process for refrigeration piping.

As press-connect technology for fittings would be covered by other recognized standards, such as the ASME B31.5 Refrigeration Piping and Heat Transfer Components, it is my opinion that the UL 207 was incorrectly substantiated by the Submitter of the original proposal.

Additionally, Section 1109.1 Materials, of the 2021 UMC clearly states “Refrigerant piping shall be metallic.” As press-connect fittings rely upon a non-metallic elastomeric seal to contain refrigerant, press-connect technology for refrigerant piping applications would be considered as non-compliant with the requirements of the 2021 UMC.

As the UMC Technical Committee did not recognize the error in the Submitter’s substantiation, I am requesting the UMC Technical Committee to consider my substantiation for this proposal.

UL 207-2009, Refrigerant Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014), was incorrectly referenced for this section of the 2021 UMC. As there are no additional sections of the 2021 UMC that reference this standard, there is no reason to retain it in the code. Therefore, UL 207 should be deleted from Table 1801.1.
PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 1109.2, Table 1801.1  Item #: 225

SUBMITTER: Joseph Freese, Parker Hannifin; Julius Ballanco, P.E., JB Engineering and Code Consulting, P.C.

RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Joseph Freese:
There is no substantiation in making the changes as proposed in this item. The proposal includes removing the ability to use press connect fittings in a refrigeration system. Press connect fittings have safely been used in refrigeration applications for over 5 years. During that timeframe, over 5 million press connect fittings have been sold into the market. There have been no documented safety issues with properly installed press connect fittings during that time. Press connect fittings meet all the safety requirements of UL 207 and are compliant with ASHRAE 15.

ASHRAE RP-1808 demonstrated that press fittings have the quickest assembly time, lowest assembly failure rate, and the highest durability with no observed failures during harshness testing.

This proposal also proposes to remove any mechanical joints that comply with UL 207 from the code. Mechanical joints approved by UL 207 have been used in refrigeration system for over 10 years without issue. There is also a contradiction by continuing to allow flare joints, but to remove the standard in which they are tested.

Julius Ballanco:
The substantiation statement in support of this change is incorrect and flawed. There is no technical justification for deleting UL 207 nor press connect, solder, or mechanical fittings for refrigeration systems.

During the review of the two TIAs to accomplish the same revision to the code as this proposal, one colleague on the Technical Committee stated that a number of questions were left unanswered. While I don’t believe that is accurate, I will still attempt to answer the questions.

The original proposal to modify UL 207 to add test requirements for press connect fittings was submitted by me. My client at the time was Cerro Flow Products. I developed the testing requirements for refrigerant press connect fittings. This was done without any input from my client. As a licensed professional engineer, I have written many standard requirements with the only goal being protection of public health and safety.

When I approached UL there was a discussion between modifying UL 109 or UL 207. It was decided that the more appropriate standard would be UL 207. Hence, the statement by the proponent of the change that UL 207 does not address press connect fittings is wrong. The standard was revised with extensive testing added for press connect fittings for refrigerant piping systems.

One of the follow up questions was why are there so few manufacturers in this market. That is easy to answer, the standard requirements are so robust it is difficult for a manufacturer to pass the tests. For example, a standard water press connect fitting cannot pass the standard requirements for refrigerant piping. Also, when a manufacturer figures out how to pass the testing requirements, they often patent the features in the fitting. Thus, with patented features, it becomes more difficult for other manufacturers to pass the requirements without violating patents.

The other questions asked during the TIA review related to the ASHRAE Research Report Project 1808-RP. As an ASHRAE member, I am very familiar with ASHRAE research projects, and the questions asked regarding this particular project.

All ASHRAE research projects are funded by ASHRAE. In 1960, ASHRAE created a research fund for performing necessary research in the area of HVACR. A research project originates from an ASHRAE Committee. That Committee requests that research be performed within a given area of the profession. That request if forwarded up the chain going through numerous reviews before the research project is approved.

Each research project has a project monitoring subcommittee or PMS. The PMS oversees the project and approves or disapproves the testing to be done for the research project. There is a constant back and forth between the
The PMS is required to report back to the ASHRAE membership on a periodic basis. The PMS is also involved in the peer review of the research project.

Each PMS is made of highly qualified individuals, the majority being engineers. There are often engineers that are working for manufacturers on the PMS. For this project, there were engineers from manufacturers on the PMS.

The Final Report is available from ASHRAE. Many of the remaining questions are answered in the Final Report.

The testing was for systems using Group A2L, A2, and A3 refrigerant. Since the long standing joining method has been brazed joints, it was decided to compare other joining methods to brazed joints. While colleagues assume that all brazed joints are supposed to be made by qualified brazers, they asked why joints were made by inexperienced individuals as a part of the research project. Unfortunately, there are no requirements in most states for technicians to be qualified brazers. Thus, joining by inexperience individuals (for all joining methods) was considered an important part of the research project.

The refrigerant that was used for leakage testing was R32. Other testing was done with nitrogen. The reason R32 is normally selected is because it is a pure refrigerant (not a blend) and is readily available. As a pure refrigerant it is possible to measure extremely low leakage rates with very sensitive equipment.

The Final Report listed the leakage rate of press connect fittings, compression fittings, and flare fittings. For leakage testing, R32 was pressurized to 350 psi. The sensitivity of the test equipment for measuring leakage was much higher than standard refrigerant leak test equipment. The normal sensitivity of high-quality refrigerant leak testers used in the field is 3 grams per year. If field test equipment was used only one fitting type would have been identified as having a leak. That would have been a compression fitting. The other fittings would have been identified as having zero leakage.

The average leak rate for press connect fittings ranged from 0.55 to 1.04 grams per year. The higher average rate being associated with larger diameter pipe. To put this leak rate into perspective, the average residential air conditioning system has a charge of 4.5 kg or 4,500 grams. That means that in order to leak that entire charge through a press connect fitting would take more than 8,000 years for the lowest rate and more than 4,000 years for the highest leak rate. Thus, the leakage rates identified in the Final Report are “de minimis.” While it is wonderful that we have the ability to measure such low values, the results have no impact on public health or safety.

One of the final questions was regarding missing data. There is no missing data in the Final Report. The report is very complete. Interestingly, the Executive Summary states that press connect fittings “have the quickest assembly time and lowest assembly failure rate.” Thus, the Final Report does the opposite of what was stated in the TIA voting in that it verifies that press connect fittings perform very well in refrigerant piping systems.

Some of the other comments listed by the proponent are misstatements and mischaracterizations of UL 207 and press connect fittings. There was no error in the original substantiation for the acceptance of press connect fittings. While I was not the proponent of the code change, I did analyze the change and substantiation. It accurately stated the testing and listing requirements, as well as the performance of the joining method.

On a final note, ASHRAE 15 recently issued an addendum on refrigerant piping. The entire section of piping, joints, connections, and testing was rewritten. Press connect, solder, and mechanical fittings are acceptable and UL 207 is referenced in the addendum.

It should be noted that I have no client interest in this item. This public comment is submitted in the interest of protection of public health and safety.
**Proposals**

**Item #: 228**

UMC 2024  Section: 1109.2

**SUBMITTER:** Brad Campbell  
Gastite

**RECOMMENDATION:**
Revise text

**1109.0 Refrigeration Piping, Containers, and Valves.**

**1109.2 Joints.** Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press-connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. PE-RT/AL/PE-RT pipe joints and connections shall be of approved mechanical or press-connect types. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections.

**SUBSTANTIATION:**
PERT-AL-PERT pipe joints are not listed in the UMC Section 1109.2 Joints section. This type of composite pipe has primarily been used for water conveyance applications but if the pipe is designed and tested to the new ASTM FXXXX Standard for “Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems” it will be a comparable Line set option. PERT/AL/PERT pipe can be mechanical or press-connected. This new ASTM FXXXX standard will be finalized and published in the next 30 days.

**COMMITTEE ACTION:** REJECT

**COMMITTEE STATEMENT:**
The substantiation speaks to ASTM FXXXX, a standard that was a working draft and not yet published at the time of this Monograph. Therefore, the proposal is being rejected.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**  
**AFFIRMATIVE:** 29  
**NOT RETURNED:** 1  
Heine

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**Appended Comments**

**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  
**Section #:** 1109.2  
**Item #: 228**

**SUBMITTER:** Brad Campbell  
Gastite

**Comment #: 1**

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal **as submitted** by this public comment.
PERT-AL-PERT pipe joints are not listed in the UMC Section 1109.2 Joints section. This type of composite pipe has primarily been used for water conveyance applications but if the pipe is designed and tested to the new ASTM F3506 Standard for “Polyethylene of Raised Temperature - Aluminum - Polyethylene of Raised Temperature (PERT/AL/PERT) Composite Pressure Pipe based on Inner Diameter (ID) for use in Air Conditioning and Refrigeration Line Set Systems” it will be a comparable Line set option. PERT/AL/PERT pipe can be mechanical or press-connected. This new ASTM F3506 standard is now finalized and published.
Proposals

Item #: 229
UMC 2024  Section: 1109.1.5, 1109.1.6, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Add new text

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials. (remaining text unchanged)

1109.1.5 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

1109.1.6 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 and UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
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<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>1109.1.6</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014 January 21, 2020)</td>
<td>Refrigeration Components</td>
<td>1109.1.5, 1109.1.6, 1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Sections are being added to Chapter 11 (Refrigeration) to address the safety standards for refrigerant-containing components, accessories, and fittings to aid the code official in verifying safe installation for such systems.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as it is poorly worded and UL 207 has been updated to include provisions from UL 109. There is concern whether UL 207 covers these type of refrigerant fittings. The Technical Committee would also like the submitter to come back with a public comment to modify the wording from “listed and labeled” to “comply with” for consistency throughout the code and to prevent overly restrictive language.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 21  NEGATIVE: 8  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted since it adds clarity to the code and is properly substantiated.

FEEHAN: This language and standard are necessary in the code.

KOERBER: The proposal and standards referenced are sound and should be accepted.

MACNEVIN: This proposal should be accepted as it adds safety to the code, and the UL standards are appropriate for this application.

TRAFTON, A: The language and standard are necessary.

VAN RITE: This proposal should be accepted and the reference to UL 207 is appropriate.

WHITE: The proposal should be accepted based on the substantiation.

WISEMAN: This language is necessary.

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**Appended Comments**

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 1109.1.5, 1109.1.6, Table 1801.1  
**SUBMITTER:** John Taecker  
UL LLC  
**RECOMMENDATION:**  
Add new text  
Request to replace the code change proposal by this public comment.

**1109.0 Refrigeration Piping, Containers, and Valves.**  
**1109.1 Materials.** (remaining text unchanged)

**1109.1.5 Refrigerant-Containing Components and Accessories.** Nonelectrical refrigerant-containing components and accessories shall comply with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

**1109.1.6 Refrigeration Fittings.** Refrigeration fittings, including press-connect, flared and threaded shall comply with UL 109 or UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 109-1997</td>
<td>Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use (with revisions through May 20, 2020)</td>
<td>Fittings</td>
<td>1109.1.6</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014-January 21, 2020)</td>
<td>Refrigeration Components</td>
<td>1109.1.5, 1109.1.6, 1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 109 and UL 207 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**  
Sections are being added to Chapter 11 (Refrigeration) to address the safety standards for refrigerant-containing components, accessories, and fittings to aid the code official in verifying safe installation for such systems.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require
materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO’s Manual of Style.

PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: 1109.1.5, 1109.1.6, Table 1801.1  Item #: 229
SUBMITTER: Emily Toto  ASHRAE  Comment #: 2
RECOMMENDATION:
Add new text
Request to replace accept the code change proposal by this public comment.

1109.0 Refrigeration Piping, Containers, and Valves.
1109.1 Materials. (remaining text unchanged)

1109.1.5 Refrigerant-Containing Components and Accessories. Nonelectrical refrigerant-containing components and accessories shall be listed and labeled in accordance with UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.
1109.1.6 Refrigeration Fittings. Refrigeration fittings, including press-connect, flared and threaded shall be listed and labeled in accordance with UL 109 or UL 207, and shall be installed in accordance with the manufacturer’s installation instructions.

<table>
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<td>1109.1.5, 1109.1.6, 1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This public comment is being submitted to reinforce the importance of including the applicable safety standards addressing the proper installation of refrigerant-containing components, accessories, and fittings. UL 109 and UL 207 both cover the requirements of Section 1109.1.6, therefore, a choice could be made to follow either standard.
Proposals

Item #: 230
UMC 2024  Section: 1109.7

SUBMITTER: Donald (DJ) Berger
Self

RECOMMENDATION:
Revise text

1109.0 Refrigeration Piping, Containers, and Valves.

1109.7 **Pipe Enclosure Protection of Piping.** Refrigerant piping and tubing shall be installed so that it is not subject to damage from an external source. Soft annealed copper tubing shall not exceed 1 3/8 inches (35 mm) nominal size. Mechanical joints, other than approved press-connect joints, shall not be made on tubing exceeding ¾ of an inch (20 mm) nominal size. Soft annealed copper tubing conveying refrigerant shall be enclosed in iron or steel piping and fittings, or in conduit, molding, or raceway that will protect the tubing against mechanical injury from an exterior source.

Exceptions:
(1) Tubing entirely within or tubing within 5 feet (1524 mm) of a refrigerant compressor where so located that it is not subject to external injury.
(2) Copper tubing serving a dwelling unit, where such tubing contains Group A1 refrigerant and is placed in locations not subject to damage from an external source.

SUBSTANTIATION:
Somewhere in the timeline of code development, language for the use of soft annealed copper was added to this section UMC in error. As this section of the 2021 UMC is for the protection requirements of all refrigeration piping, the size limitations of and methods of joining annealed temper copper tube do not belong in this section of the UMC.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

1109.0 Refrigeration Piping, Containers, and Valves.

1109.7 Protection of Piping. Refrigerant piping and tubing shall be installed so that it is not subject to damage from an external source. Soft annealed copper tubing conveying refrigerant shall be enclosed in iron or steel piping and fittings, or in conduit, molding, or raceway that will protect the tubing against mechanical injury from an exterior source.

Exceptions:
(1) Tubing entirely within or tubing within 5 feet (1524 mm) of a refrigerant compressor where so located that it is not subject to external injury.
(2) Copper tubing serving a dwelling unit, where such tubing contains Group A1 refrigerant and is placed in locations not subject to damage from an external source.

1109.1 Materials. Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, lubricant, or their combination in presence of air or moisture to a degree that poses a safety hazard. [ASHRAE 15:9.1.1] Refrigerant piping shall be metallic.

1109.2 Joints. Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press-connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections.
tubing exceeding \(\frac{3}{4}\) of an inch (20 mm) nominal size.

**TABLE 1701.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**COMMITTEE STATEMENT:**
The proposal is being amended by relocating the material portions to the correct section, Section 1109.1, and relocating the language pertaining to joints to Section 1109.2. The other revisions are to correlate with the action taken on Item # 225.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**
- **AFFIRMATIVE:** 17
- **NEGATIVE:** 11
- **ABSTAIN:** 1
- **NOT RETURNED:** 1 Heine

**Note:** Item # 230 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

**EXPLANATION OF AFFIRMATIVE:**

**BENKOWSKI:** A "low leakage rate" is technical justification enough to choose a method other than press-connect to join the piping that conveys a mildly flammable refrigerant.

**BERGER:** Extensive substantiation was provided on why this section of the UMC needs correction. This section describes requirements for the protection of piping and should have never had mention of diameters of annealed copper tubing or press-connect fittings in it. Relevant information being removed is being relocated to the correct sections of the chapter. However, this proposal was included in the letters recently sent to TC members. Perhaps a letter writing campaign is the way to go when you want to override the decision of the Technical Committee.


**EXPLANATION OF NEGATIVE:**

**BALLANCO:** This change should have been rejected. The substantiation does not justify the removal of press-connect fittings. The modification is completely inconsistent with the original change. Furthermore, the modification is not technically substantiated.

**CUDAHY:** Press-connect fittings seem a useful product for these applications.

**FEEHAN:** The proposal removes press-connect fittings without any technical justification.

**GUNZNER:** Press-connect fittings are specifically permitted by ASHRAE 15. AMCA supports consistency between related codes and standards where applicable. These modifications would cause confusion and other disruptions.

**KOERBER:** No valid substantiation was provided for this modification.

**MACNEVIN:** There was no evidence submitted to justify the removal of press-connect fittings or UL 207. In fact, a previous report submitted to this TC showed that press-connect fittings are the most reliable joining technology overall.

**TRAFTON, A:** Press-fit is a valid connector.

**TRAFTON, P:** Similar to Julius Ballanco's comment, this change is unjustified by removing press-connect fittings and should have been rejected.

**VAN RITE:** There is still no justification given for removing press-connect fittings.

**WHITE:** The changes to the proposal as amended change the intent of the proposal. Originally the proponent was trying to remove language that was not pertinent to the section title. This action expands the actions to interfere with other proposed changes. This should be rejected.

**WISEMAN:** Hearsay is not a reason to change the code. If there is a technical reason to make a change, then it needs to be submitted and properly reviewed. Human welds can fail also. There is not a way to 100% avoid leakage. Without a
technical justification, code should not change.

EXPLANATION OF ABSTAIN:

TERZIGNI: I am still collecting information on the claims made by those in support and those who oppose the proposal.

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Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1109.1, 1109.2, 1109.7, Table 1801.1  Item #: 230

SUBMITTER: Donald (DJ) Berger  National ITC Corporation  Rep. Self

RECOMMENDATION:

Revise text

Request to replace the code change proposal by this public comment.

1109.0 Refrigeration Piping, Containers, and Valves.

1109.1 Materials. Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, the lubricant, or their combination in the presence of air or moisture to a degree that poses a safety hazard. [ASHRAE 15:9.1.1]

Refrigerant piping shall be metallic. Materials for refrigerant piping, tubing, and fittings shall comply with the applicable standards in Table 1109.1. Soft annealed copper tubing shall not exceed 1 3/8 inches (35 mm) nominal size.

1109.2 Joints. Iron or steel pipe joints shall be of approved threaded, flanged, or welded types. Exposed threads shall be tinned or coated with an approved corrosion inhibitor. Copper or copper alloy pipe joints of iron pipe size shall be of approved threaded, flanged, press connect or brazed types. Copper tubing joints and connections shall be connected by approved flared, lapped, swaged, or brazed joints, soldered joints, or mechanical joints that comply with UL 207 either individually or as part of an assembly or a system by an approved nationally recognized laboratory. Piping and tubing shall be installed so as to prevent vibration and strains at joints and connections. Mechanical joints shall not be made on tubing exceeding ¾ of an inch (20 mm) nominal size.

1109.7 Pipe Enclosure Protection of Piping. Refrigerant piping and tubing shall be installed so that it is not subject to damage from an external source. Soft annealed copper tubing shall not exceed 1 3/8 inches (35 mm) nominal size. Mechanical joints, other than approved press connect joints, shall not be made on tubing exceeding ¾ of an inch (20 mm) nominal size. Soft annealed copper tubing conveying refrigerant shall be enclosed in iron or steel piping and fittings, or in conduit, molding, or raceway that will protect the tubing against mechanical injury from an exterior source.

Exceptions:

(1) Tubing entirely within or tubing within 5 feet (1524 mm) of a refrigerant compressor where so located that it is not subject to external injury.

(2) Copper tubing serving a dwelling unit, where such tubing contains Group A1 refrigerant and is placed in locations not subject to damage from an external source.

---

TABLE 1801.1

REFERENCED STANDARDS

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<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)
SUBSTANTIATION:
Somewhere in the timeline of code development, language for the use of soft annealed copper was added to this section UMC in error. As this section of the 2021 UMC is for the protection requirements of all refrigeration piping, the size limitations of and methods of joining annealed temper copper tube do not belong in this section of the UMC. The proposal is being amended by relocating the material portions to the correct section, Section 1109.1, and relocating the language pertaining to joints to Section 1109.2. The other revisions are to correlate with the action taken on Item #225.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1109.7  Item #: 230
SUBMITTER: Joseph Freese, Parker Hannifin; Julius Ballanco, P.E., JB Engineering and Code Consulting, P.C., Rep. Self  Comment #: 2
RECOMMENDATION:
Revise text

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Joseph Freese:
There is no substantiation in making the changes as proposed in this item. The proposal includes removing the ability to use press connect fittings in a refrigeration system. Press connect fittings have safely been used in refrigeration applications for over 5 years. During that timeframe, over 5 million press connect fittings have been sold into the market. There have been no documented safety issues with properly installed press connect fittings during that time. Press connect fittings meet all the safety requirements of UL 207 and are compliant with ASHRAE 15.

ASHRAE RP-1808 demonstrated that press fittings have the quickest assembly time, lowest assembly failure rate, and the highest durability with no observed failures during harshness testing.

This proposal also proposes to remove any mechanical joints that comply with UL 207 from the code. Mechanical joints approved by UL 207 have been used in refrigeration system for over 10 years without issue. There is also a contradiction by continuing to allow flare joints, but to remove the standard in which they are tested.

Julius Ballanco:
The substantiation for this proposal is incorrect. There was no error when this was added to the code. See my statement of problem to Item #225. The same statement applies to this item.
Proposals

Item #: 235

UMC 2024  Section: 218.0, 311.3, 402.4 - 402.4.5, 403.9, 502.2 - 502.2.3, 519.5, 1123.1, Table 1701.1

SUBMITTER: Mitch Pinsker
Affiliated Engineers Inc
Rep. ASHRAE Golden Gate Chapter Chair of Government Affairs Committee and Code Review Committee

RECOMMENDATION:
Revise text

218.0  – P –  Property Line. A line of record that divides one lot or parcel from another lot or parcel or from a public or private street or any other public space. For the purposes of separation distances for building openings and device terminations on walls abutting a public way, the effective property line shall be the centerline of the public way.

Public Way. A street (with or without a sidewalk), alley, or walkway not adjacent to a street, that is accessible to the general public.

311.0 Heating or Cooling Air System.

311.3 Prohibited Source. Outside or return air for a heating or cooling air system shall not be taken from the following locations:

(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet

(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway

(3) through (6) (remaining text unchanged)

402.0 Ventilation Air.

402.4 Outdoor Air Intake Protection. Required outdoor air intakes shall be covered with a screen having not less than ¼ of an inch (6.4 mm) openings, and shall have not more than ½ of an inch (12.7 mm) openings.

402.4.1 Weather Protections. Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment, to prevent rain intrusion, and manage water from snow in accordance with ASHRAE 62.1.

402.4 Outdoor Air Intakes. Ventilation system outdoor air intakes shall be designed in accordance with Section 402.4.1 through Section 402.4.5. [ASHRAE 62.1:5.5]

402.4.1 Location. Outdoor air intakes (including openings that are required as part of a natural ventilation system) shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source listed in Table 402.4.1 shall be equal to or greater than the following:

(1) The separation distance in Table 402.4.1 or

(2) The calculation methods in ASHRAE 62.1 Normative Appendix B and shall comply with all other requirements of this section. [ASHRAE 62.1:5.5.1]

402.4.1.1 Exhaust/Relief Outlets. Separation criteria for Class 2 and Class 3 exhaust/relief outlets apply to the distance from the outdoor air intakes for one ventilation system to the exhaust and relief outlets for any other ventilation system. [ASHRAE 62.1:5.5.1.1]

402.4.1.2 Fuel-Burning Equipment. The minimum distances relative to fuel-fired appliances shall be as required by ANSI Z223.1/NFPA 54 for fuel-gas-burning appliances and equipment, NFPA 31 for oil burning appliances and equipment, and NFPA 211 for other combustion appliances and equipment. [ASHRAE 62.1:5.5.1.2]

402.4.1.3 Roof, Landscaped Grade, or Another Surface Directly Below Intake. Where snow accumulation is expected, the surface of the snow at the expected average snow depth shall be considered to be a surface directly
below an intake. [ASHRAE 62.1:5.5.1.3] Exception: The minimum separation distance in Table 402.4.1 shall not apply where outdoor surfaces below the air intake are sloped more than 45 degrees from horizontal or where such surfaces are less than 1 inch (30 mm) in width. [ASHRAE 62.1:5.5.1.4]

402.4.2 Rain Entrainment. Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment in accordance with one or more of the following:

1. Limit water penetration through the intake to 0.07 oz/ft²·h (21.5 g/m²·h) of inlet area when tested using the rain test apparatus described in UL 1995.
2. Select louvers that limit water penetration to a maximum of 0.01 oz/ft² (3 g/m²) of louver free area at the maximum intake velocity. This water penetration rate shall be determined for a minimum 15 minute test duration when subjected to a water flow rate of 0.25 gal/min (16 mL/s) as described under the water penetration test in AMCA 500-L or equivalent. Manage the water that penetrates the louver by providing a drainage area or moisture removal devices.
3. Select louvers that restrict wind-driven rain penetration to less than 2.36 oz/ft²·h (721 g/m²·h) when subjected to a simulated rainfall of 3 inches (75 mm) per hour and a 29 mph (13 m/s) wind velocity at the design outdoor air intake rate with the air velocity calculated based on the louver face area. This performance corresponds to Class A (99 percent effectiveness) when rated according to AMCA 511 and tested per AMCA 500-L.
4. Use rain hoods sized for no more than 500 fpm (2.5 m/s) face velocity with a downward-facing intake such that all intake air passes upward through a horizontal plane that intersects the solid surfaces of the hood before entering the system.
5. Manage the water that penetrates the intake opening by providing a drainage area or moisture removal devices. [ASHRAE 62.1:5.5.2]

402.4.3 Rain Intrusion. Air-handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in UL 1995. [ASHRAE 62.1:5.5.3]

402.4.4 Snow Entrainment. Where climate dictates, outdoor air intakes that are part of the mechanical ventilation system shall be designed as follows to manage water from snow that is blown or drawn into the system:
1. Access doors to permit cleaning of wetted surfaces shall be provided.
2. Outdoor air ductwork or plenums shall pitch to drains designed in accordance with the requirements of ASHRAE 62.1. [ASHRAE 62.1:5.5.4]

402.4.5 Bird Screens. Outdoor air intakes shall include a screening device designed to prevent penetration by a 0.5 inch (13 mm) diameter probe. The screening device material shall be corrosion resistant. The screening device shall be located, or other measures shall be taken, to prevent bird nesting within the outdoor air intake. [ASHRAE 62.1:5.5.5]

### TABLE 402.4.1
AIR INTAKE MINIMUM SEPARATION DISTANCE
[ASHRAE 62.1:TABLE 5-1]

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MINIMUM DISTANCE (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2 air exhaust/relief outlet</td>
<td>10</td>
</tr>
<tr>
<td>Class 3 air exhaust/relief outlet</td>
<td>15</td>
</tr>
<tr>
<td>Class 4 air exhaust/relief outlet</td>
<td>30</td>
</tr>
<tr>
<td>Cooling tower exhaust</td>
<td>25</td>
</tr>
<tr>
<td>Cooling tower intake or basin</td>
<td>15</td>
</tr>
<tr>
<td>Driveway, street, or parking place</td>
<td>5</td>
</tr>
<tr>
<td>Garage entry, automobile loading area, or drive-in queue</td>
<td>15</td>
</tr>
<tr>
<td>Garbage storage/pick-up area, dumpsters</td>
<td>15</td>
</tr>
<tr>
<td>Plumbing vents terminating at least 3 ft (1000 mm) above the level of the outdoor air intake</td>
<td>3</td>
</tr>
<tr>
<td>Plumbing vents terminating less than 3 ft (1000 mm) above the level of the outdoor air intake</td>
<td>10</td>
</tr>
<tr>
<td>Roof, landscaped grade, or other surface directly below intake</td>
<td>1</td>
</tr>
<tr>
<td>Thoroughfare with high traffic volume</td>
<td>25</td>
</tr>
<tr>
<td>Truck loading area or dock, bus parking/idling area</td>
<td>25</td>
</tr>
<tr>
<td>Vents, chimneys, and flues from combustion appliances and equipment</td>
<td>15</td>
</tr>
</tbody>
</table>

For SI units: 1 foot = 304.8 mm

403.0 Ventilation Rates.
Air shall be classified as shown in Table 402.1, Table 403.7, or Table 403.9, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

### TABLE 403.9
**AIRSTREAMS OR SOURCES [ASHRAE 62.1:TABLE 6-3]**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

502.0 Termination.

#### 502.2 Termination of Exhaust Ducts.

- Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.3. Classes of air shall be as defined in Section 203.0 and classified in Section 403.9.

#### 502.2.1 Environmental Class 1 and Class 2 Air Ducts.

Environmental Class 1 and 2 air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1. The discharge of environmental dryer exhaust ducts shall not be directed onto a public walkway or over an area where condensate or vapor could create a nuisance or hazard.

#### 502.2.2 Class 3 Air Ducts.

Class 3 air duct exhaust shall terminate not less than 10 feet (3048 mm) from a property line, 3 feet (914 mm) from exterior walls or roofs, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1.

#### Exception: Type I Hood exhaust termination shall be in accordance with Section 510.9.1.

Other product conveying outlets

#### 502.2.2 Class 3 Air Ducts.

Class 3 air duct exhaust shall terminate not less than 10 feet (3048 mm) from a property line, 3 feet (914 mm) from exterior walls or roofs, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1.

519.0 Type II Hood Exhaust System Requirements.

#### 519.5 Termination of Type II Hood Exhaust System.

The exhaust system shall terminate as follows: in accordance with Section 502.2.2.

1. Rooftop terminations shall terminate not less than 10 feet (3048 mm) from a property line, and the exhaust flow shall be directed away from the roof surfaces of the roof, not less than within 40 inches (1016 mm).
2. Horizontal terminations shall terminate not less than 10 feet (3048 mm) from adjacent buildings, property lines,
operable openings, and from grade level. (3) The discharge outlet of moisture conveying exhaust ducts, such as dishwasher exhaust ducts, shall not be directed onto a public walkway or over an area where condensate or vapor could create a nuisance or hazard.

1123.0 Location.
1123.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be located such that their plumes cannot enter occupied spaces as required by Section 402.4.1. Plume discharges shall be not less than 25 feet (7620 mm) away from a ventilation inlet to a building. Location on the property shall be as required for buildings by the building code Section 502.2.3.

(below shown for reference only)

203.0 A – Air, Class 1. Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1:5.16.1]
Air, Class 2. Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1:5.16.1]
Air, Class 3. Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1:5.16.1]
Air, Class 4. Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered harmful. [ASHRAE 62.1:5.16.1]

510.9.1 Rooftop Terminations. Rooftop terminations shall be arranged with or provided with the following:
(1) A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.
(2) A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.
(3) A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.
(4) The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.
(5) A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.
(6) Listed grease collection systems that meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).
(7) A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.
(8) A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
(a) Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
(b) The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
(9) Other approved fan, provided it meets all of the following criteria:
(a) The fan meets the requirements of Section 510.9.1(3) and Section 511.1.3.
(b) Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.1.3)
(c) Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96:7.8.2.1]
510.9.1.1 Listed Vibration Isolation Connectors. Listed vibration isolation connectors shall be permitted to be used on exterior roof locations where required for proper equipment vibration isolation.
510.9.1.2 Inspection and Cleaning. Fans shall be provided with safe access and a work surface for inspection and cleaning. [NFPA 96:7.8.2.2]

802.6.1 Gas Vent Termination. The termination of gas vents shall comply with the following requirements:
(1) A gas vent shall terminate in accordance with one of the following:
(a) Gas vents that are 12 inches (300 mm) or less in size and located not less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 802.6.1 and Table 802.6.1.
(b) Gas vents that are over 12 inches (300 mm) in size or are located less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate not less than 2 feet (610 mm) above the highest point where they pass through the roof and not less than 2 feet (610 mm) above a portion of a building within 10 feet (3048 mm) horizontally.
(c) Industrial appliances as provided in Section 802.2.5.
(d) Direct vent systems as provided in Section 802.2.6.
(e) Appliances with integral vents as provided in Section 802.2.7.
(f) Mechanical draft systems as provided in Section 802.3.3 through Section 802.3.3.5.
(g) Ventilating hoods and exhaust systems as provided in Section 802.3.4.
(2) A Type B or a Type L gas vent shall terminate at least 5 feet (1524 mm) in vertical height above the highest connected appliance draft hood or flue collar.

(3) A Type B-W gas vent shall terminate at least 12 feet (3658 mm) in vertical height above the bottom of the wall furnace.

(4) A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below eaves or parapets, except as provided in Section 802.2.6 and Section 802.3.3 through Section 802.3.3.5.

(5) Decorative shrouds shall not be installed at the termination of gas vents except where such shrouds are listed for use with the specific gas venting system and are installed in accordance with the manufacturer’s installation instructions.

(6) All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.

(7) A gas vent shall terminate at least 3 feet (914 mm) above a forced air inlet located within 10 feet (3048 mm). [NFPA 54:12.7.3]

802.8 Through-the-Wall Vent Termination. A mechanical draft venting system shall terminate at least 3 feet (914 mm) above any forced air inlet located within 10 feet (3048 mm). (See Figure 802.8)

Exceptions:
(1) This provision shall not apply to the combustion air intake of a direct vent appliance.

(2) This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances. [NFPA 54:12.9.1]

802.8.1 Mechanical Draft Venting System. A mechanical draft venting system of other than direct vent type shall terminate not less than 4 feet (1219 mm) below, 4 feet (1219 mm) horizontally from, or 1 foot (305 mm) above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.2]

802.8.2 Direct Vent Appliance. The clearances for through-the-wall direct vent terminals shall be in accordance with Table 802.8.2. The bottom of the vent terminal and the air intake shall be located not less than 12 inches (305 mm) above finished ground level. [NFPA 54:12.9.3]

802.8.3 Category I through Category IV and Noncategorized Appliances. Through-the-wall vents for Category II and Category IV appliances and noncategorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment. Where local experience indicates that condensate is a problem with Category I and Category III appliances, this provision shall also apply.

Drains for condensate shall be installed in accordance with the appliance and the vent manufacturer’s installation instructions. [NFPA 54:12.9.4]

802.8.4 Annular Spaces. Where vents, including those for direct vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54:12.9.5]

802.8.5 Vent Terminals. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 feet (610 mm) or more above or 25 feet (7620 mm) or more below operable openings. [NFPA 54:12.9.6]

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tr>
<td>AMCA 511-2010 (R2016)</td>
<td>Certified Ratings Program Product Rating Manual for Air Control Devices</td>
<td>Air Control Devices</td>
<td>402.4.2 (3)</td>
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<tr>
<td>AMCA 500-L-2012 (R2015)</td>
<td>Laboratory Methods of Testing Louvers for Rating</td>
<td>Louvers</td>
<td>402.4.2(2), 402.4.2 (3)</td>
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<td>Laboratory Ventilation</td>
<td>Ventilation</td>
<td>402.4.1.4</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The AMCA, ASSP, ASHRAE, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The purpose of this proposed revision is to:

1. Consolidate exhaust air termination and outdoor air intake requirements which are currently addressed in several sections and not always consistently. For instance, the separation distance to an appliance vent is Section 311.3 is not consistent with those in Sections 802.6.1 and 802.8 for the same application.

2. Update separation distance requirements to meet the those in ASHRAE 62.1-2019 Ventilation and Acceptable Air Quality. Some separation requirements listed in ASHRAE 62.1-2019 are not listed in the UMC. For example, there is no requirement in the UMC that an outdoor intake be located a minimum of 15 feet from dumpsters. The separation requirements listed in Section 502.2.1 also do not distinguish requirements based on Class of Air as is the case in ASHRAE 62.1 2019. For example, the separation requirement between an outdoor air intake and general building relief is the same as the separation requirement for outdoor air intake and janitor closets (10 feet). ASHRAE 62.1 lists more stringent separation requirements for each subsequent Class of Air, which accurately pairs mitigation measures through separation distance with the intensity of contamination. The requirements listed in ASHRAE 62.1 represent the current standard of care for ventilation system design and should be reflected in the UMC.

3. Fully incorporate Standard 62.1 Classes of Air and use them to more clearly define separation distances and exhaust termination. Classes of Air have been included in Table 402.1 (Minimum Ventilation Rates), Table 403.7 (Minimum Exhaust Rates) for several code cycles but they are used only to limit recirculation. Standard 62.1 also includes Table 6-3 Airstreams or Sources (which is incorporated in this proposal as Table 403.9), to fully address all Classes of Air, and uses these Classes to more clearly define separation distances and exhaust termination requirements. Currently Section 502.2 termination requirements are split into three ill-defined categories that are open to interpretation causing confusion: “environmental air ducts,” “product conveying ducts conveying explosive or flammable vapors, fumes, or dusts,” and “other product conveying outlets.” “Environmental air ducts” are defined in Section 207.0 as, “ducting used for conveying air at temperatures not exceeding 250°F (121°C)...such as ventilation for human usage, domestic kitchen range exhaust, bathroom exhaust ducts, and domestic-type clothes dryer exhaust ducts.” Exhaust air can be comprised from many more sources than those currently listed in this definition, leading to an uncertainty of exactly which type of air is categorized as “environmental exhaust.” The term “other product conveying” is not defined anywhere in the UMC and thus is open to interpretation as to what source of exhaust qualifies as “other product conveying.” Using the Class of Air more clearly defines what the requirements are for all types of exhaust discharge.

4. Define terms that currently not well defined and thus subject to interpretation.

To resolve these issues, we propose revisions to multiple sections. Below, we provide rationale by section for each revision.

Section 218.0:
Explanation for Section 218.0 Revision:

Figure 1 Section 218.0 Revision:
The term “property line” is used in multiple sections of the UMC, including Section 502.2.1, yet is undefined. Defining “property line” in Section 218.0 provides specificity and ensures consistent application of the term. The definition is adapted from multiple administrative codes found online. On significant inclusion is how to define property lines for the purpose of separation distance requirements in cities where the legal property line is at the building edge. A common interpretation is that separation distances are to the centerline of the street or public way. This definition solidifies that interpretation.

The term “public way” or “public walkway” is used multiple times in the UMC along with references to streets, alleys, and sidewalks. None of these terms are defined and they appear to reference the same basic application. So we propose creating a single term to cover all of them.

Section 311.3:
Explanation for Section 311.3(1) Revision:

Figure 2 Section 311.3(1) Revision:
Separation requirements between appliance vent outlets are already prescribed in Section 802.6.1 and 802.8. Therefore, we propose to delete the separation requirement of “10 feet (3048 mm) in distance from an appliance
vent outlet” listed in Section 311.3(1) and instead refer to Sections 802.6.1 and 802.8 to eliminate redundant and conflicting requirements.

The separation requirements for “a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside air inlet” listed in Section 311.3(1) will be addressed in proposed Table 402.4.1 of Section 402.4.1. Therefore, these requirements are redundant and may be deleted.

Explanation for Section 311.3(2) Revision:

Figure 3 Section 311.3(2) Revision:
All separation requirements for outdoor air intakes will be prescribed in proposed Table 402.4.1 extracted from Standard 62.1. Therefore, we propose to delete the phrase, “10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway” and instead refer to Section 402.4. Note that Standard 62.1 separation requirements vary from the blanket 10 feet required here; some are shorter and some are longer, as determined by the ASHRAE 62.1 committee.

Section 402.4:
We propose to replace Section 402.4 in its entirety with verbatim language from ASHRAE 62.1-2019 prescribing outdoor air intake requirements.

Explanation for Section 402.4 Deletion:

Figure 4 Section 402.4 Revision:
We propose to remove this section because outdoor air intake protection will be described in proposed Section 402.4.5 per ASHRAE 62.1 verbatim language.

Explanation for Section 402.4.1 Deletion:

Figure 5 Section 402.4.1 Revision:
We propose to remove existing Section 402.4.1 because rain intrusion and snow entrainment requirements will be described in proposed Sections 402.4.2 through 402.4.4. The proposed section copies the existing ASHRAE 62.1 requirements that the UMC refers to in the 2021 edition. This does not change the content of the code requirement and is purely a clerical change allowing the reader to view rain and snow entrainment requirements directly in the UMC instead of needing to refer to ASHRAE 62.1.

Explanation for Section 402.4.1 Addition:

The proposed section is taken directly from ASHRAE 62.1 and will add specific requirements for separation distances between potential pollution sources and outdoor air intakes. The separation distances listed in this section and in Table 402.4.1 will update the UMC requirements for outdoor air separation to the latest Standard 62.1 requirements. The addition of this section will also consolidate outdoor air intake separation requirements into one section of the code making it easier to reference.

Note that Standard 62.1-2019 includes an alternative approach to separation distances in Normative Appendix B. This is a long and complex procedure that is not as commonly used as using the prescriptive Table 402.4.1, so rather than extract that entire appendix, we propose just referencing it. There is precedence of references to other ASHRAE documents in lieu of extraction already in the UMC, e.g. 102.3.1, 314.1, 402.1.2, 402.4.1, 510.5.6, 1013.3, 1102, 1106.1, and 1106.2, in addition to references to documents by ACCA, UL, ASME, NFPA, etc.

Section 403.9:

Explanation for Section 403.9 Revision:

Figure 6 Section 403.9 Revision:
The added phase indicates the tables where Classes of Air are defined, which makes the code easier to interpret. The current UMC makes no direct reference to the Classes of Air in existing Tables 402.1 and 403.7.

Explanation for Table 403.9 Addition:
ASHRAE classifies sources of air in Table 6-1, 6-2, and 6-3 in Standard 62.1-2019. The UMC currently includes the first two tables in Tables 402.1 and 403.7, but does not currently include Table 6-3 which leaves gaps in air classification. Adding this table to Section 403.9 remedies the issue.

Section 502.2:

Explanation for Section 502.2 Revision:

Figure 7 Section 502.2 Revision:
The added sentence makes it clear where Classes of Air are defined in the UMC.

Explanation for Section 502.2.1 Revision:

Figure 8 Section 502.2.1 Revision:
We propose to revise the title of the section to be more precise and refer to “Class 1 and Class 2” air ducts which are already defined and classified in Section 203.0 and Section 403.9. An “environmental air duct” is too broad of a description, does not align with the method for classifying air located elsewhere in the UMC, and has led to confusion over what types of air fall under this category.

We propose removing the phrase of “10 feet (3048 mm) from a forced air inlet,” because this requirement is prescribed in proposed Table 402.4.1 of Section 402.4.

The term “public walkway” is revised to “public way” to match the proposed definition in Section 213.0. This will provide further clarity and consistency to the term.

The addition of the phrase, “and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1” refers to the ASHRAE 62.1 separation requirements that are proposed be added as part of this proposal.

The phrase, “the discharge of environmental exhaust ducts shall not be directed onto a public walkway” is proposed to be limited to only dryer exhaust, which is the only Class 1 or 2 exhaust composed of near-saturated air. This air can condense in cold weather and drip onto the public way and potentially freeze in cold climates, creating a hazard. The words “directed onto” are revised to “terminate over” since the hazard can exist even if the air is discharged horizontally, and the limitation was expanded to include any area where condensation may be a hazard using the wording from Section 8.2.8.3 for condensing appliance vents. Other Type 1 and 2 exhaust are addressed by the requirements earlier in the section requiring that discharge be at least “10 feet (3048 mm) above a public way.” This allows for dilution to occur before the exhaust odors, if any, are a nuisance. Note that Type I grease exhaust terminations have no limitations relative to public walkways and that exhaust is much more likely to be a nuisance due to odors and smoke.

Explanation for Section 502.2.2 Revision:

Figure 9 Section 502.2.2 Revision:
We propose to split Section 502.2.2 into two sections. One section pertaining to “Class 3 Air” which will replace “other product conveying” air, and one section pertaining to “Flammable and Class 4 Air” in addition to “product conveying” air. (Note that proposed Sections 502.2.2 and 502.2.3 are shown out of order simply to make the proposed changes from the current wording clear. Logically “Class 3” air should be addressed before “Class 4” air; hence the proposed numbering. This is just editorial.)

We propose to replace the term “other product conveying” airstreams to “Class 3 Air” to provide a clear and consistent definition for the type of air that requirements previously listed under “other product conveying” in Section 502.2.2 apply to. The term “other product conveying” is not defined in the UMC, which makes it difficult to understand what type of air is classified as “other product conveying.” The definition and classification of “Class 3 Air” per Section 203.0 and Section 403.9 is consistent with the intent of the meaning of “other product conveying,” is already defined in the UMC, and matches Standard 62.1.

The addition of the phrase, “that are in the direction of the exhaust discharge” will further qualify the requirements of the location of “Class 3 Air” exhaust termination in relation to adjacent exterior walls and roofs. There is no known benefit to requiring a separation distance to a wall or roof if the exhaust stream is not discharging in the direction of that wall or roof. This will allow a side discharge of Class 3 air, which is very common.
The addition of the phrase, "and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1" to Section 502.2.2 refers to the ASHRAE 62.1 separation requirements that will be added as part of this proposal.

We propose to add the term phrase “Flammable and Class 4 Air” to “product conveying” airstreams to improve clarity and consistency with the air classification references used in the rest of Section 502.2.

The addition of the phrase, “that are in the direction of the exhaust discharge” will further qualify the requirements of the location of “Class 4 Air” exhaust termination in relation to adjacent exterior walls and roofs. There is no known benefit to requiring a separation distance to a wall or roof if the exhaust stream is not discharging in the direction of that wall or roof.

The addition of the phrase, "and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1" to proposed Section 502.2.3 refers to the ASHRAE 62.1 separation requirements that will be added as part of this proposal.

The exception to 502.2.3 for Type I grease exhaust termination is added to ensure there is only one section that applies. Section 510.9.1. is extract from NFPA which is the more definitive source.

Explanation for Section 519.5 Revision:

Figure 10 Section 519.5 Revision:
We propose that separation distances be those required of other Class 3 airstreams per Section 502.2.2. The 40-inch separation to the roof is retained but clarified. The limitation on moisture conveying ducts is the same as that proposed for dryer exhaust in Section 502.2.1. Other Type II hoods not conveying moisture, such as heat generating appliance vents, do not pose a nuisance risk for public ways because of the 10 foot separation above grade required by Section 502.2.2.

Explanation for Section 1123.1 Revision:

Figure 11 Section 1123.1 Revision:
Plume discharge separation requirements will be listed in Section 402.4.1 (Table 402.4.1); thus, we propose to replace the phrase, “Plume discharges shall be not less than 25 feet (7620 mm) away from a ventilation inlet to a building” with "as required by Section 402.4.1" for consistency.

Cooling tower discharge is considered “product conveying” air; thus, location on property is dictated by Section 502.2.3. We have therefore replaced “the building code” with “Section 502.2.3” to provide a more precise reference to location requirements.

**COMMITTEE ACTION:** REJECT

**COMMITTEE STATEMENT:**
The added language extracted from ASHRAE 62.1 that is being proposed in Section 402.4.2 regarding rain entrainment is not accurate. It is recommended to rework the section and submit a public comment.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

**Appended Comments**
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 218.0, 311.3, 402.4 - 402.4.5, 403.9, 502.2 - 502.2.3, 519.5, 1123.1, Table 1801.1

Item #: 235

SUBMITTER: Scott Wayland, P.E., Self;
Blaine Conner, Affiliated Engineers;
Mitch Pinsker, AEI

Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Scott Wayland:
I am writing in support of Mitch Pinsker's submission number 235 that attempts for the third time to fix what IAPMO has broken in the mechanical code.

I am disappointed and dissatisfied with IAPMO's inability to consider our proposals to fix this important matter, as well as others that we have put a great deal of effort to help you repair.

Simply put, we must have a definition of environmental air that can distinguish between air that may be objectionable and air that is not. We also must have a way for clean air to be allowed to be relived out the front façade of occupied space.

What IAPMO has placed in the code is unenforceable and unreasonable. When IAPMO put the language into UMC Section 502.2.1 that says, "The discharge of environmental exhaust ducts shall not be directed onto a public walkway," you created a situation that is impossible to deal with in many circumstances.

Just take this one example: mixed used multi-floor construction, new or existing. Far too often, a first floor suite has no access to the environment except for the front façade of the space. Where can you go for exhaust than out the front? There is no other place to relieve the air than to discharge it out the front of the suite.

I serve on the California Building Standards Commission on the Code Advisory Board. I am a past president of the Golden Gate Chapter of ASHRAE. California-based professionals and building occupants need this, including Engineers, Architects, developers, building owners, tenants, AHJs and Code Officials. We insist you take action on this matter without delay or obstruction this time.

UMC Section 502.2.1, "The discharge of environmental exhaust ducts shall not be directed onto a public walkway" is not enforceable and is unreasonable.

Blaine Conner:
I am writing the committee in support of Proposal Item #235 as written by Mitch Pinsker of Affiliated Engineers. The proposed language better defines the requirements around air discharges and is highly applicable buildings with zero lot line and negative easements, a staple of dense urban environments. The current language does not provide the same level of protection or guidance to Planners, Engineers, and City Officials as the proposed language does.

Mitch Pinsker:
Please accept as written. Section 402.4.2 (Rain Entrainment) is a direct extraction from ASHRAE 62.1.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 218.0, 311.3, 402.4 - 402.4.5, 403.9, 502.2 - 502.2.3, 519.5, 1123.1, Table 1801.1  Item #: 235

SUBMITTER: Amanda Hickman  Comment #: 2
The Hickman Group
Rep. Air Movement and Control Association, Inc. (AMCA)

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

218.0  – P –
Property Line. A line of record that divides one lot or parcel from another lot or parcel or from a public or private street or any other public space. For the purposes of separation distances for building openings and device terminations on walls abutting a public way, the effective property line shall be the centerline of the public way.

Public Way. A street (with or without a sidewalk), alley, or walkway not adjacent to a street, that is accessible to the general public.

311.0 Heating or Cooling Air System.

311.3 Prohibited Source. Outside or return air for a heating or cooling air system shall not be taken from the following locations:
(1) Less than 10 feet (3048 mm) in distance from an appliance vent outlet, a vent opening of a plumbing drainage system, or the discharge outlet of an exhaust fan, unless the outlet is 3 feet (914 mm) above the outside-air inlet the separation distances to vents required by Sections 802.6.1 and 802.8.
(2) Less than 10 feet (3048 mm) above the surface of an abutting public way, sidewalk, street, alley, or driveway the separation distances required by Section 402.4.
(3) through (6) (remaining text unchanged)

402.0 Ventilation Air.

402.4 Outdoor Air Intake Protection. Required outdoor air intakes shall be covered with a corrosion-resistant screen having not less than ¼ of an inch (6.4 mm) openings, and shall have not more than ½ of an inch (12.7 mm) openings.

402.4.1 Weather Protection. Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment, to prevent rain intrusion, and manage water from snow in accordance with ASHRAE 62.1.

402.4 Outdoor Air Intakes. Ventilation system outdoor air intakes shall be designed in accordance with Section 402.4.1 through Section 402.4.5. [ASHRAE 62.1:5.5]

402.4.1 Location. Outdoor air intakes (including openings that are required as part of a natural ventilation system) shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source listed in Table 402.4.1 shall be equal to or greater than the following:
(1) The separation distance in Table 402.4.1 or
(2) The calculation methods in ASHRAE 62.1 Normative Appendix B and shall comply with all other requirements of this section. [ASHRAE 62.1:5.5.1]

402.4.1.1 Exhaust/Relief Outlets. Separation criteria for Class 2 and Class 3 exhaust/relief outlets apply to the distance from the outdoor air intakes for one ventilation system to the exhaust and relief outlets for any other ventilation system. [ASHRAE 62.1:5.5.1.1]

402.4.1.2 Fuel-Burning Equipment. The minimum distances relative to fuel-fired appliances shall be as required by ANSI Z223.1/NFPA 54 for fuel-gas-burning appliances and equipment, NFPA 31 for oil burning appliances and equipment, and NFPA 211 for other combustion appliances and equipment. [ASHRAE 62.1:5.5.1.2]

402.4.1.3 Roof, Landscaped Grade, or Another Surface Directly Below Intake. Where snow accumulation is expected, the surface of the snow at the expected average snow depth shall be considered to be a surface directly below an intake. [ASHRAE 62.1:5.5.1.3]

Exception: The minimum separation distance in Table 402.4.1 shall not apply where outdoor surfaces below the air intake are sloped more than 45 degrees from horizontal or where such surfaces are less than 1 inch (30 mm) in width.

402.4.1.4 Laboratory Exhaust. Separation criteria for fume hood exhaust shall be in compliance with ANSI/ASSP Z9.5. [ASHRAE 62.1:5.5.1.4]

402.4.2 Rain Entrainment. Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment in accordance with one or more of the following:
(1) Limit water penetration through the intake to 0.07 oz/ft²-h (21.5 g/m²-h) of inlet area when tested using the rain test apparatus described in UL 1995.
(2) Select louvers that limit water penetration to a maximum of 0.01 oz/ft² (3 g/m²) of louver free area at the maximum free area intake velocity through the louver. This water penetration rate shall be determined when subjected to the water penetration test in AMCA 500-L or equivalent. Manage the water that penetrates the louver by providing a drainage area or moisture removal devices.

(3) Select louvers that are Class A when rated according to AMCA 511 and tested per the AMCA 500-L wind-driven rain test when subjected to a simulated rainfall of 3 inches (75 mm) per hour and a 29 mph (13 m/s) wind velocity. The maximum design core area velocity through the louver shall correlate to a Class A rating.

(4) Use rain hoods sized for no more than 500 fpm (2.5 m/s) face velocity with a downward-facing intake such that all intake air passes upward through a horizontal plane that intersects the solid surfaces of the hood before entering the system.

(5) Manage the water that penetrates the intake opening by providing a drainage area or moisture removal devices. (ASHRAE 62.1:5.5.2)

402.4.3 Rain Intrusion. Air-handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in UL 1995. [ASHRAE 62.1:5.5.3]

402.4.4 Snow Entrainment. Where climate dictates, outdoor air intakes that are part of the mechanical ventilation system shall be designed as follows to manage water from snow that is blown or drawn into the system:

(1) Access doors to permit cleaning of wetted surfaces shall be provided.

(2) Outdoor air ductwork or plenums shall pitch to drains designed in accordance with the requirements of ASHRAE 62.1. [ASHRAE 62.1:5.5.4]

402.4.5 Bird Screens. Outdoor air intakes shall include a screening device designed to prevent penetration by a 0.5 inch (13 mm) diameter probe. The screening device material shall be corrosion resistant. The screening device shall be located, or other measures shall be taken, to prevent bird nesting within the outdoor air intake. [ASHRAE 62.1:5.5.5]

### TABLE 402.4.1
AIR INTAKE MINIMUM SEPARATION DISTANCE
[ASHRAE 62.1:TABLE 5-1]

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</tr>
<tr>
<td>Class 3 air exhaust/relief outlet</td>
<td>15</td>
</tr>
<tr>
<td>Class 4 air exhaust/relief outlet</td>
<td>30</td>
</tr>
<tr>
<td>Cooling tower exhaust</td>
<td>25</td>
</tr>
<tr>
<td>Cooling tower intake or basin</td>
<td>15</td>
</tr>
<tr>
<td>Driveway, street, or parking place</td>
<td>5</td>
</tr>
<tr>
<td>Garage entry, automobile loading area, or drive-in queue</td>
<td>15</td>
</tr>
<tr>
<td>Garbage storage/pick-up area, dumpsters</td>
<td>15</td>
</tr>
<tr>
<td>Plumbing vents terminating at least 3 feet above the level of the outdoor air intake</td>
<td>3</td>
</tr>
<tr>
<td>Plumbing vents terminating less than 3 feet above the level of the outdoor air intake</td>
<td>10</td>
</tr>
<tr>
<td>Roof, landscaped grade, or other surface directly below intake</td>
<td>1</td>
</tr>
<tr>
<td>Thoroughfare with high traffic volume</td>
<td>25</td>
</tr>
<tr>
<td>Truck loading area or dock, bus parking/idling area</td>
<td>25</td>
</tr>
<tr>
<td>Vents, chimneys, and flues from combustion appliances and equipment</td>
<td>15</td>
</tr>
</tbody>
</table>

For SI units: 1 foot = 304.8 mm

403.0 Ventilation Rates.

403.9 Air Classification and Recirculation. Air shall be classified as shown in Table 402.1, Table 403.7, or Table 403.9, and its recirculation shall be limited in accordance with Section 403.9.1 through Section 403.9.4. [ASHRAE 62.1:5.18]

Recirculated air shall not be taken from prohibited locations in accordance with Section 311.3.

Air (return, transfer, or exhaust air) leaving each space or location shall be designated at an expected air-quality classification not less than that shown in Table 402.1, Table 403.7, or Table 403.9 or as approved by the Authority Having Jurisdiction. Air leaving spaces or locations that are not listed in Table 402.1, Table 403.7, or Table 403.9 shall be designated with the same classification as air from the most similar space or location listed in terms of occupant activities and building construction.

Exception: Air from spaces where environmental tobacco smoke (ETS) is present. (Classification of air from spaces where ETS is present is not addressed. Spaces that are expected to include ETS do not have a classification listed in Table 402.1.) [ASHRAE 62.1:5.18.1]
TABLE 403.9  
AIRSTREAMS OR SOURCES DESCRIPTION AIR CLASS  
[ASHRAE 62.1:TABLE 6-3]  

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AIR CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial kitchen grease hoods</td>
<td>4</td>
</tr>
<tr>
<td>Commercial kitchen hoods other than grease</td>
<td>3</td>
</tr>
<tr>
<td>Diazo printing equipment discharge</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic elevator machine room</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory hoods</td>
<td>4</td>
</tr>
<tr>
<td>Paint spray booths</td>
<td>4</td>
</tr>
<tr>
<td>Refrigerating machinery rooms</td>
<td>3</td>
</tr>
<tr>
<td>Residential kitchen hoods in transient occupancy</td>
<td>3</td>
</tr>
</tbody>
</table>

502.0 Termination.

502.2 Termination of Exhaust Ducts. Exhaust ducts shall terminate in accordance with Section 502.2.1 through Section 502.2.3. Classes of air shall be as defined in Section 203.0 and classified in Section 403.9.

502.2.1 Environmental Class 1 and Class 2 Air Ducts. Environmental Class 1 and 2 air duct exhaust shall terminate not less than 3 feet (914 mm) from a property line, 10 feet (3048 mm) from a forced air inlet, 10 feet (3048 mm) above a public walkway, and 3 feet (914 mm) from openings into the building, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1. The discharge of environmental dryer exhaust ducts shall not be directed onto or terminate over a public walkway or over an area where condensate or vapor could create a nuisance or hazard.

502.2.2 Product Conveying, Flammable, and Class 4 Air Ducts. Ducts conveying Class 4 air or explosive or flammable vapors, fumes, or dusts shall terminate not less than 30 feet (9144 mm) from a property line, 10 feet (3048 mm) from openings into the building, 6 feet (1829 mm) from exterior walls or roofs that are in the direction of the exhaust discharge, 30 feet (9144 mm) from combustible walls or openings into the building that are in the direction of the exhaust discharge, and 10 feet (3048 mm) above adjoining grade, and the minimum separation distance from ventilation system outdoor air intakes determined in accordance with Section 402.4.1.

(renumber remaining sections)

519.0 Type II Hood Exhaust System Requirements.

519.5 Termination of Type II Hood Exhaust System. The exhaust system shall terminate as follows: in accordance with Section 502.2.2.

(1) Rooftop terminations shall terminate not less than 10 feet (3048 mm) from a property line, and the exhaust flow shall be directed away from the roof surface of the roof, not less than within 40 inches (1016 mm).

(2) Horizontal terminations shall terminate not less than 10 feet (3048 mm) from adjacent buildings, property lines, operable openings, and from grade level.

(3) The discharge outlet of moisture conveying exhaust ducts, such as dishwasher exhaust ducts, shall not be directed onto or terminate over a public walkway or over an area where condensate or vapor could create a nuisance or hazard.

1123.0 Location.

1123.1 General. Cooling towers, evaporative condensers, and fluid coolers shall be located such that their plumes cannot enter occupied spaces as required by Section 402.4.1. Plume discharges shall be not less than 25 feet (7620 mm) away from a ventilation inlet to a building. Location on the property shall be as required for buildings by the building code Section 502.2.3.
203.0 – A –

Air, Class 1. Air with low contaminant concentration, low sensory-irritation intensity, and inoffensive odor. [ASHRAE 62.1:5.18.1]

Air, Class 2. Air with moderate contaminant concentration, mild sensory-irritation intensity, or mildly offensive odors. Class 2 air also includes air that is not necessarily harmful or objectionable, but that is inappropriate for transfer or recirculation to spaces used for different purposes. [ASHRAE 62.1:5.18.1]

Air, Class 3. Air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. [ASHRAE 62.1:5.18.1]

Air, Class 4. Air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases, at concentrations high enough to be considered as harmful. [ASHRAE 62.1:5.18.1]

510.9.1 Rooftop Terminations. Rooftop terminations shall be arranged with or provided with the following:

(1) A minimum of 10 feet (3048 mm) of horizontal clearance from the outlet to adjacent buildings, property lines, and air intakes.

(2) A minimum of 5 feet (1524 mm) of horizontal clearance from the outlet (fan housing) to any combustible structure.

(3) A vertical separation of 3 feet (914 mm) above any air intakes within 10 feet (3048 mm) of the exhaust outlet.

(4) The ability to drain grease out of any traps or low points formed in the fan or duct near the termination of the system into a collection container that is noncombustible, closed, rainproof, and structurally sound for the service to which it is applied and that will not sustain combustion.

(5) A grease collection device that is applied to exhaust systems that does not inhibit the performance of any fan.

(6) Grease collection systems that meet the requirements of Section 510.9.1(4) and Section 510.9.1(5).

(7) A listed grease duct complying with Section 507.4.7 or ductwork complying with Section 507.4.8.

(8) A hinged upblast fan supplied with flexible weatherproof electrical cable and service hold-open retainer to permit inspection and cleaning that is listed for commercial cooking equipment with the following conditions:
   (a) Where the fan attaches to the ductwork, the ductwork is a minimum of 18 inches (457 mm) away from any roof surface, as shown in Figure 510.9.1.
   (b) The fan discharges a minimum of 40 inches (1016 mm) away from any roof surface, as shown in Figure 510.9.1.
   (9) Other approved fan, provided it meets all of the following criteria:
      (a) The fan meets the requirements of Section 510.9.1(3) and Section 511.1.3.
      (b) Its discharge or its extended duct discharge meets the requirements of Section 510.9.1(2). (See Section 511.1.3)
      (c) Exhaust fan discharge is directed up and away from the roof surface. [NFPA 96:7.8.2.1]

510.9.1.1 Listed Vibration Isolation Connectors. Listed vibration isolation connectors shall be permitted to be used on exterior roof locations where required for proper equipment vibration isolation.

510.9.1.2 Inspection and Cleaning. Fans shall be provided with safe access and a work surface for inspection and cleaning. [NFPA 96:7.8.2.2]

802.6.1 Gas Vent Termination. The termination of gas vents shall comply with the following requirements:

(1) A gas vent shall terminate in accordance with one of the following:
   (a) Gas vents that are 12 inches (300 mm) or less in size and located not less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate above the roof in accordance with Figure 802.6.1 and Table 802.6.1.
   (b) Gas vents that are over 12 inches (300 mm) in size or located less than 8 feet (2438 mm) from a vertical wall or similar obstruction shall terminate not less than 2 feet (610 mm) above the highest point where they pass through the roof and not less than 2 feet (610 mm) above a portion of a building within 10 feet (3048 mm) horizontally.
   (c) Industrial appliances as provided in Section 802.2.5.
   (d) Direct vent systems as provided in Section 802.2.6.
   (e) Appliances with integral vents as provided in Section 802.2.7.
   (f) Mechanical draft systems as provided in Section 802.3.3 through Section 802.3.3.4.
   (g) Ventilating hoods and exhaust systems as provided in Section 802.3.4.

(2) A Type B or a Type L gas vent shall terminate at least 5 feet (1524 mm) in vertical height above the highest connected appliance draft hood or flue collar.

(3) A Type B-W gas vent shall terminate at least 12 feet (3658 mm) in vertical height above the bottom of the wall furnace.

(4) A gas vent extending through an exterior wall shall not terminate adjacent to the wall or below eaves or parapets, except as provided in Section 802.2.6 and Section 802.3.3 through Section 802.3.3.4.

(5) Decorative shrouds shall not be installed at the termination of gas vents except where such shrouds are listed for use with the specific gas venting system and are installed in accordance with the manufacturer’s installation instructions.

(6) All gas vents shall extend through the roof flashing, roof jack, or roof thimble and terminate with a listed cap or listed roof assembly.

(7) A gas vent shall terminate at least 3 feet (914 mm) above a forced air inlet located within 10 feet (3048 mm). [NFPA 54:12.7.3]
802.8 Through-the-Wall Vent Termination. Through-the-wall vent termination shall be in accordance with Section 802.8.1 through Section 802.8.3.

802.8.1 Clearance for Through-the-Wall Vent Termination. The clearance for through-the-wall direct vent and non-direct vent terminals shall be in accordance with Table 802.8.1 and Figure 802.8.1.

Exception: The clearances in Table 802.8.1 shall not apply to the combustion air intake of a direct vent appliance. [NFPA 54:12.9.1]

802.8.2 Annular Spaces. Where vents, including those for direct vent appliances or combustion air intake pipes, penetrate outside walls of buildings, the annular spaces around such penetrations shall be permanently sealed using approved materials to prevent entry of combustion products into the building. [NFPA 54:12.9.2]

802.8.3 Vent Terminals. Vent systems for Category IV appliances that terminate through an outside wall of a building and discharge flue gases perpendicular to the adjacent wall shall be located not less than 10 feet (3048 mm) horizontally from an operable opening in an adjacent building.

Exception: This shall not apply to vent terminals that are 2 feet (610 mm) or more above or 25 feet (7620 mm) or more below operable openings. [NFPA 54:12.9.3]

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCA 511-2010</td>
<td>Certified Ratings Program Product Rating Manual for Air Control Devices</td>
<td>Air Control Devices</td>
<td>402.4.2 (3)</td>
</tr>
<tr>
<td>AMCA 500-L-2012</td>
<td>Laboratory Methods of Testing Louvers for Rating</td>
<td>Louvers</td>
<td>402.4.2(2), 402.4.2 (3)</td>
</tr>
<tr>
<td>ANSI/ASSP Z9.5-2012</td>
<td>Laboratory Ventilation</td>
<td>Ventilation</td>
<td>402.4.1.4</td>
</tr>
</tbody>
</table>

(Note: The AMCA, ASSP, ASHRAE, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.)

**SUBSTANTIATION:**
Note that this public comment is intended to only make changes to Section 402.4.2 (Rain Entrainment), Options #2 and #3, under Item #235. AMCA International believes that this proposal makes necessary clarifications to these two options under the Rain Entrainment section of Outdoor Air Intakes (Section 402.4.2) that will more clearly address the indicated requirements from the AMCA test standards for louvers. This public comment’s proposed language clarifies and simplifies the language without changing or easing the requirements.
Proposals

Item #: 237
UMC 2024  Section: 1201.1

SUBMITTER: Lance MacNevin, P.Eng.
Plastics Pipe Institute

RECOMMENDATION:
Revise text

1201.0 General.
1201.1 Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, and ground source heat pump systems, and snow and ice melting systems. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.

SUBSTANTIATION:
The hydronic applications known as radiant heating, radiant cooling, and snow and ice melting are currently listed within Chapter 12 in Sections 1217.0 and 1220.0 but are missing from the Applicability. Therefore, these types of hydronic systems should be listed within the Applicability.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appendix Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1201.1  Item #: 237

SUBMITTER: Cary Smith
Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1201.0 General.
1201.1 Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, ground source heat pump systems, and snow and ice melting systems, and district ambient temperature loops. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.

SUBSTANTIATION:
District ambient temperature loops are large scale hydronic systems, which are referenced in Chapter 17 and including them here allows for hybrid system installations.
Proposals

Item #: 238
UMC 2024  Section: 1201.6 - 1201.9

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1201.0 General.

1201.6 Heat Emitters. Heat emitters shall be installed in accordance with the manufacturer's installation instructions.

1201.7 Mechanical Devices. Where listed mechanical devices are used, the manufacturer's installation instructions as to the location and method of installation shall be followed.

1201.8 Flexible Connectors. Listed flexible connectors shall be installed in readily accessible locations, unless otherwise listed.

1201.9 Freeze Protection. Hydronic systems and components shall be designed, installed, and protected from freezing.

SUBSTANTIATION:
Additional sections are being added to Chapter 12 (Hydronics) to address heat emitters, mechanical devices, and flexible connectors for hydronic applications. Section 1215.3 (Freeze Protection) is being relocated to the general section for clarity. The change correlates with the USHGC. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

1201.0 General.

1201.6 Heat Emitters. Heat emitters shall be installed in accordance with the manufacturer’s installation instructions.

1201.7 Mechanical Devices. Where listed mechanical devices are used, the manufacturer’s installation instructions as to the location and method of installation shall be followed.

1201.8 Flexible Connectors. Listed flexible connectors shall be installed in readily accessible locations, unless otherwise listed.

1201.9 Freeze Protection. Hydronic systems and components shall be designed, installed, and protected from freezing.

COMMITTEE STATEMENT:
The modification removes "unless otherwise listed" as the phrase is not necessary for enforcing flexible connectors.

Additionally, the Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1210.3  Item #: 238
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1210.0 Materials.

1210.3 Hangers and Supports. Pipe and tubing shall be supported in accordance with Section 313.0. Equipment that is part of the piping system shall be provided with additional support in accordance with this code and manufacturer’s installation instructions. Radiant systems utilizing heat emission or transfer plates shall have a gap of at least ¼ inch (6.4 mm) between adjacent plates.

SUBSTANTIATION:
Metal heat emission plates expand when heated due to thermal expansion coefficients of the material. Due to potential expansion of heat emission plates in under floor or above floor radiant systems, there must be a gap between adjacent plates of not less than ¼ of an inch to avoid unwanted contact.

Heat transfer or emission plates conduct heat energy from the tubing and spread that energy out laterally across the plate. The lateral thermal transfer eliminates hot spots directly over the tubing, improves acceleration and provides more consistent temperatures at the floor surface. The plates offer a medium by which conductive heat transfer can occur, much like a concrete slab.
Proposals

Item #: 239

UMC 2024  Section: 1201.6, Table 1701.1

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

1201.0 General.

1201.6 Heat Transfer Fluid Quality. Heat transfer fluid used in hydronic systems shall be in accordance with IAPMO H1001.1.

<table>
<thead>
<tr>
<th>TABLE 1701.1 REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD NUMBER</strong></td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO H1001.1 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The new standard for water quality for hydronic systems is being added to the General section of Chapter 12 (Hydronics).

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
IAPMO H1001.1 is a working draft and is not completed at the time of this monograph.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1201.6, 1201.6.1, Table 1801.1  Item #: 239

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Add new text
Request to replace the code change proposal by this public comment.

1201.0 General.

1201.6 Heat Transfer Fluid Quality. Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

   1201.6.1 Ethylene Glycol. Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

   (renumber remaining sections)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI H1001.1-2021</td>
<td>Quality of Heat Transfer Fluids Used in Hydronics Systems</td>
<td>Heat Transfer Fluid</td>
<td>1201.6, 1201.6.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI H1001.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed American National Standard, IAPMO/ANSI H1001.1 “Quality of Heat Transfer Fluids Used in Hydronics Systems,” is now complete and has been published.

The scope of the IAPMO/ANSI H1001.1 standard is as follows: This Standard is intended to provide minimum requirements for maintaining quality of liquid aqueous based heat transfer fluids over the life of the system and optimizing the life of system components in both residential and non-residential closed hydronic heating and cooling applications.

IAPMO/ANSI H1001.1 is unique in that it addresses both chemical and non-chemical treatment methods with focus on the importance of water treatment and corrosion prevention. These provisions are accompanied by recommended hydronic water quality parameters for systems with chemical additives, high purity water systems, and hybrid hydronic and ground source heat pump systems.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1201.6, Table 1801.1  Item #: 239

SUBMITTER: Lee H Stevens  LH Stevens Constructors LLC

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1201.0 General.

1201.6 Heat Transfer Fluid Quality. Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

(renumber remaining sections)
TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO/ANSI H1001.1-2021</td>
<td>Quality of Heat Transfer Fluids Used in Hydronics Systems</td>
<td>Heat Transfer Fluid</td>
<td>1201.6</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO/ANSI H1001.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
IAPMO H1001.1-2021 has completed the public review process and is now being published, thus negating the Committee statement re: Committee Action to Reject.

It is important to understand that this standard has been created out of a need to address the issue of corrosion failure in hydronic systems, specifically as it affects high-efficiency heat exchangers. Energy efficiency equipment and energy codes are now firmly established, and will not be abandoned. The issues that this standard addresses will therefore not disappear, but only become more widespread as aging equipment is replaced. Catastrophic hydronic system failure can render a structure uninhabitable, and can lead to further consequential damage that may make restoration of occupancy even more difficult. These water quality issues have been known and documented for some years at this point. There is no rationale for delaying consideration and implementation of this standard for another code development cycle.

It is also best to clearly specify that the application of this provision is only for closed-loop systems, as the fluid in open-loop systems is inherently governed by the nature and chemistry of the source fluid that is passed through those systems.

PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 1701.11, 1701.11.1, Table 1701.11.1, Table 1801.1  Item #: 239

SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 3

RECOMMENDATION:
Revise text
Request to replace the code change proposal by this public comment.

1701.11 Heat Transfer Fluid. The heat transfer fluid shall be compatible with the makeup fluid supplied to the system. 1701.11.1 Water Quality. The makeup water quality within the closed loop ground source heat pump system shall be in accordance with IAPMO/ANSI H1001.1, CSA/IGSHPA C448, or Table 1701.11.1. The quality of potable water shall be in accordance with the Authority Having Jurisdiction.

TABLE 1701.11.1 WATER QUALITY

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ACCEPTABLE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium</td>
<td>&lt; 2 ppm</td>
</tr>
<tr>
<td>Chlorides²</td>
<td>&lt; 125 ppm</td>
</tr>
<tr>
<td>(Free CO₂)³</td>
<td>&lt; 50 ppm</td>
</tr>
<tr>
<td>pH</td>
<td>7.0 – 8.5</td>
</tr>
<tr>
<td>Sulphates</td>
<td>&lt; 125 ppm</td>
</tr>
<tr>
<td>TDS</td>
<td>10 – 1000 ppm</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>&lt; 150 ppm</td>
</tr>
</tbody>
</table>
Notes:
1. Where chemical additives are used, the acceptable ranges provided shall be in accordance with the equipment manufacturer’s specifications, or this Table, whichever is more stringent.
2. The provided acceptable range for chlorides is dependent upon the system heat exchanger and piping materials. See the manufacturer’s specifications for equipment and materials used.
3. The limit provided pertains to makeup water.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
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<tbody>
<tr>
<td>IAPMO/ANSI H1001.1-2021</td>
<td>Quality of Heat Transfer Fluids Used in Hydronics Systems</td>
<td>Heat Transfer Fluid</td>
<td>1701.11.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The CSA/IGSHPA C448 and IAPMO/ANSI H1001.1 standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed standard, IAPMO H1001.1 “Quality of Heat Transfer Fluids Used in Hydronics Systems,” is now complete and has been published.

The requirements for water quality is particularly important in a closed loop system. However, we may be using wastewater or stock water in the open loop side of the heat exchanger and the quality is not relevant in that case.

The scope of the IAPMO/ANSI H1001.1 standard is as follows: This Standard is intended to provide minimum requirements for maintaining quality of liquid aqueous based heat transfer fluids over the life of the system and optimizing the life of system components in both residential and non-residential closed hydronic heating and cooling applications.

IAPMO/ANSI H1001.1 is unique in that it addresses both chemical and non-chemical treatment methods with focus on the importance of water treatment and corrosion prevention. These provisions are accompanied by recommended hydronic water quality parameters for systems with chemical additives, high purity water systems, and hybrid hydronic and ground source heat pump systems.

PUBLIC COMMENT 4

Code Year: 2024 UMC  Section #: 1701.11, 1701.11.2  Item #: 239

SUBMITTER: Cary Smith  
Sound Geothermal Corporation  Comment #: 4

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1701.11 Heat Transfer Fluid. The heat transfer fluid shall be compatible with the makeup fluid supplied to the system.

1701.11.2 Compatibility. System components shall be compatible with system fluids including, but not limited to, antifreeze. For systems utilizing chemical additives, system components and fluids shall be tested and approved for compatibility.

SUBSTANTIATION:
The proposal adds compatibility requirements since system components must be compatible with system fluids, such as antifreeze. For systems utilizing chemical additives, system components and fluids must be tested and approved for compatibility.
Proposals

Item #: 239.01
UMC 2024  Section: 1221.6

SUBMITTER: UMC Technical Committee Proposal

RECOMMENDATION:
Add new text

1221.6 Hydronic Fluid Disposal. Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with Department of Environmental Health or as required by the Authority Having Jurisdiction.

SUBSTANTIATION:
Currently, the code is silent as it pertains to disposal of used hydronic fluids. These fluids can be detrimental to the environment and to the health and safety of the public. The addition of this language will ensure that these used fluids are not poured down the drain and are properly disposed of. Additionally, these used fluids may be recycled.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The language is unenforceable since it would be difficult to enforce disposal of system fluids. Also, the approved manner of disposal is unclear. The disposal methods should be laid out and specified. The language needs additional work. There are environmental agencies that take care of such requirements, which makes the proposed language unnecessary. Each state has a unique name for the department which addresses such disposal of fluids.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1221.6  Item #: 239.01
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1221.0 Piping Installation.

1221.6 Hydronic Fluid Disposal. Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with Environmental Protection Agency (EPA), the Department of Health, or as required by the Authority Having Jurisdiction.

(renumber remaining sections)
SUBSTANTIATION:
Jurisdictions need to address this and this should be added to the code so that they need to address and enforce disposal of used hydronic fluids from such systems.

Currently, the code is silent as it pertains to disposal of used hydronic fluids. These fluids can be detrimental to the environment and to the health and safety of the public. The addition of this language will ensure that these used fluids are not poured down the drain and are properly disposed of. Additionally, these used fluids may be recycled.
Proposals

Item #: 239.02
UMC 2024  Section: 1214.4

SUBMITTER: UMC Technical Committee Proposal

RECOMMENDATION:
Revise text

1214.0 Pressure and Flow Controls.
1214.4 Automatic Makeup Fluid. Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed-loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location. **A potable water makeup supply shall not be provided for systems which use antifreeze as the heat transfer fluid.**

On systems using only water as a heat transfer medium, and where pressurization is achieved using a potable water supply. A pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 1202.0 to prevent contamination due to backflow.

Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Some examples of such systems shall include glycol feeders, limited-volume reservoir.

On systems using additives, such as glycol or corrosion inhibitors, the use of a system pressurization unit (also known as a glycol feeder) shall be required.

SUBSTANTIATION:
The use of system pressurization units, or glycol feeders, guarantees that there is no connection between the potable water line and system fluid. In an ordinary backflow prevention setup, protection of potable water is dependent only on mechanical components such as backflow preventers and pressure reducing valves. If these fail, then there is a direct connection between potable water and system fluid. The use of a glycol feeder ensures that there exists no connection between system fluid and the potable water line. The system pressurization unit regulates pressure in the system and automatically pumps in system fluid when necessary, directly from the feed tank, without any connection to the water line. System feeders also provide flood protection. If a leak occurs, only the contents of the tank can be pumped out, rather than unrestricted flow, as would occur with a potable water make-up supply that was not isolated. If the PRV is installed as per the manufacture's recommendations (make-up water isolated) then it is not automatic. It becomes a manual operation. Also, using a system feeder allows you to ensure a compatible fluid is used for make-up requirements.

The use of system feeders has gained wide acceptance over the last 15 years and it is now common practice in the US and Canada. There exist several competing companies who make these sorts of products in all sizes required for hydronic systems.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the potable water supply is commonly used to mix antifreeze as the heat transfer fluid, therefore, the provision may be overly stringent. It is recommended that the submitter rewrite the proposed language and resubmit as a public comment. There is also no mention of backflow prevention for public health and safety.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine
Appended Comments

PUBLIC COMMENT 1

Item #: 239.02

Code Year: 2024 UMC  Section #: 1214.4, 1214.4.1, 1214.4.2  
SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1214.0 Pressure and Flow Controls.

1214.4 Automatic Makeup Fluid. Automatic makeup fluid shall be in accordance with Section 1214.4.1 for potable water makeup fluid or Section 1214.4.2 for nonpotable makeup fluid.

1214.4.1 Potable Makeup Fluid. Where a potable water automatic makeup fluid supply fill device is used to maintain the fluid content of the heat-source unit, or any closed-loop in the system, the potable water makeup supply shall be located at the expansion tank connection or other approved location. A potable water makeup supply shall be decoupled and provided with a monitoring system. A potable water makeup supply shall not be required for systems which use antifreeze as the heat transfer fluid.

On systems using only water as a heat transfer medium, and where pressurization is achieved using a potable water supply, a pressure-reducing valve shall be installed on a potable water makeup feed line. The pressure of the feed line shall be set in accordance with the design of the system, and connections to potable water shall be in accordance with Section 1202.0 to prevent contamination due to backflow.

1214.4.2 Nonpotable Makeup Fluid. Makeup fluid systems that are designed to add pre-mixed antifreeze solutions shall be permitted. Such systems shall include, but not be limited to, glycol feeders and limited-volume reservoir systems.

SUBSTANTIATION:
The use of system pressurization units, or glycol feeders, guarantees that there is no connection between the potable water line and system fluid. In an ordinary backflow prevention setup, protection of potable water is dependent only on mechanical components such as backflow preventers and pressure reducing valves. If these fail, then there is a direct connection between potable water and system fluid. The use of a glycol feeder ensures that there exists no connection between system fluid and the potable water line. The system pressurization unit regulates pressure in the system and automatically pumps in system fluid when necessary, directly from the feed tank, without any connection to the water line. System feeders also provide flood protection. If a leak occurs, only the contents of the tank can be pumped out, rather than unrestricted flow, as would occur with a potable water make-up supply that was not isolated. If the PRV is installed as per the manufacturer’s recommendations (make-up water isolated) then it is not automatic. It becomes a manual operation. Also, using a system feeder allows you to ensure a compatible fluid is used for make-up requirements.

The use of system feeders has gained wide acceptance over the last 15 years and it is now common practice in the US and Canada. There exist several competing companies who make these sorts of products in all sizes required for hydronic systems.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1201.9.1  
Item #: 239.02

SUBMITTER: Cary Smith  
Sound Geothermal Corporation

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1201.9 Freeze Protection. (remaining text unchanged)

1201.9.1 Antifreeze Requirements. Antifreeze shall be added to a closed hydronic system where one or more of the following conditions exists:
(1) System component(s) are exposed to freezing conditions.
(2) The hydronic system serves as a snow and ice melt system in accordance with Section 1220.0.
(3) Where required by the equipment manufacturer.

Exception: Antifreeze shall not be required where a system is continuously monitored or specifically designed not to require antifreeze, and is subject to freezing as a result of either of the following:
(a) Loss of electrical power.
(b) Loss of a fuel source.

SUBSTANTIATION:
There are specific conditions best practices determine where Antifreeze is required.

PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 1201.9, Table 1201.9  
Item #: 239.02

SUBMITTER: Cary Smith  
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1201.9 Freeze Protection. Hydronic systems and components shall be designed, installed, and protected from freezing. The percent of glycol by volume shall be determined based on the freezing point of the solution and type of mixture in accordance with Table 1201.9 or the manufacturer’s specifications.

| TABLE 1201.9  
PERCENT GLYCOL MIXTURES  
FREEZING POINT, °F |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(% BY VOLUME)</td>
<td>ETHYLENE GLYCOL*</td>
<td>PROPYLENE GLYCOL</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>40</td>
<td>-12</td>
<td>-7</td>
</tr>
<tr>
<td>50</td>
<td>-35</td>
<td>-28</td>
</tr>
</tbody>
</table>

For SI units: °C = (°F-32)/1.8

Note:
* Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.
In systems where glycol is an additive, bacteria can be controlled by maintaining a percent by volume of at least 20. This percentage may vary based on manufacturer’s specifications; however, both propylene and ethylene glycol have been proven to inhibit the growth of most microbes at concentrations of 20 percent or more.

The percent by volume should also be determined given the freezing point of the glycol as depicted in Table 1201.9. Due to the toxicity of ethylene glycol, restriction for its use have been put in place. A lethal dose of ethylene glycol for humans by ingestion is about three ounces while propylene glycol is essentially nontoxic in small quantities.

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PUBLIC COMMENT 4

Code Year: 2024 UMC  Section #: 1220.4  Item #: 239.02
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 4

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1220.0 Snow and Ice Melt Systems.

1220.4 Snow and Ice Melt Controls. An automatic thermostatically operating control device that controls the supply hydronic solution fluid temperature to the snow and ice melt area shall be installed in the system. Snow and ice melt systems shall be protected from freezing with a mixture of propylene glycol or ethylene glycol, and water or other approved fluid. Automotive antifreeze shall not be used.

SUBSTANTIATION:
The term “thermostatically” is being deleted as this language is redundant and adds confusion – open to misinterpretation. The use of the word “fluid” is preferred to "solution."
Proposals

Item #: 241
UMC 2024  Section: 1202.2, Table 1701.1

SUBMITTER: Jeff Matson
Viega LLC

RECOMMENDATION:
Revise text

1202.0 Protection of Potable Water Supply.

1202.2 Chemical Injection. Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed or and labeled in accordance with ASSE 1013. Such additive or chemical shall be compatible with system components.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.1.2–2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Backflow Protection</td>
<td>1202.2</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASME A112.1.2 and ASME A112.1.3 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above proposed standards are included to provide specifications for air gaps. This modification will ensure that the end user is required to comply with industry standards.

ASME A112.1.2 identifies methods of providing protection against backsiphonage through means of an air gap and establishes physical requirements and methods of testing air gaps for plumbing fixtures and water receptors.

ASME A112.1.3 provides physical requirements and methods of testing for air gap fittings for protection against back siphonage and back pressure backflow.

Furthermore, the last sentence of Section 1202.2 has been relocated to the beginning of the section as this is more appropriate for the provision. This change correlates with changes made to the 2021 USHGC.

COMMITTEE ACTION: REJECT
COMMITTEE STATEMENT:
The proposal is being rejected with regards to the ASME standards for air gaps as there may be other standards that apply. Such provisions for backflow prevention should remain in the plumbing code.

Additionally, the Technical Committee disagrees with the substantiation reference regarding the need for correlation with the USHGC.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 1202.2, Table 1801.1  
**SUBMITTER:** Cary Smith  
Sound Geothermal Corporation  
**RECOMMENDATION:** 
Revise text

Request to replace the code change proposal by this public comment.

1202.0 Protection of Potable Water Supply.

1202.2 Chemical Injection. **Additives or chemicals shall be compatible with system components.** Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by **an air gap in accordance with ASME A112.1.2, an air gap fitting that complies with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly shall comply that complies with ASSE 1013.** Such additive or chemical shall be compatible with system components.

![Table 1801.1 Referenced Standards](image)

(portion of table not shown remain unchanged)

**Note:** ASME A112.1.2 and ASME A112.1.3 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

The above proposed standards are included to provide specifications for air gaps. This modification will ensure that the end user is required to comply with industry standards.

ASME A112.1.2 identifies methods of providing protection against backsiphonage through means of an air gap and establishes physical requirements and methods of testing air gaps for plumbing fixtures and water receptors.

ASME A112.1.3 provides physical requirements and methods of testing for air gap fittings for protection against back siphonage and back pressure backflow.

Furthermore, the last sentence of Section 1202.2 has been relocated to the beginning of the section as this is more appropriate for the provision.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1204.8

SUBMITTER: Cary Smith
            Sound Geothermal Corporation

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1204.0 Identification of Potable and Nonpotable Water Systems.

1204.8 Identification of Chemical Additives. In systems where chemical additives are used, documentation including the following information shall be readily accessible and maintained onsite:
(1) Concentrations
(2) Maintenance requirements
(3) Maintenance log
(4) Manufacturer’s material safety data sheet (MSDS)

SUBSTANTIATION:
Identification of fluids needs to be accessible to individuals who are working with the system and do not have access to full documentation, and should also be available to subcontractors who maintain the system.
Proposals

Item #: 247

UMC 2024  Section: 1204.7

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

1204.0 Identification of a Potable and Nonpotable Water Systems.

1204.7 Heat Transfer Fluid. Solar thermal piping shall be identified with an orange background with black uppercase lettering, with the words “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.” Each solar thermal system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 1204.3.

Each outlet on the solar thermal piping system shall be posted with black uppercase lettering as follows: “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.”

SUBSTANTIATION:
A section for heat transfer fluid identification is being added to assist in the requirements for marking such piping.

The change correlates with the USHGC Section 404.7. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

COMMITTEE STATEMENT:
The Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1204.7

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1204.0 Identification of Potable and Nonpotable Water Systems.
1204.7 Heat Transfer Fluid. Solar thermal Hydronic piping shall be identified with an orange background with black uppercase lettering, with the words “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.” Each solar thermal hydronic system shall be identified to designate the fluid being conveyed. The minimum size of the letters and length of the color field shall comply with Table 1204.3.

Each outlet on the solar thermal hydronic piping system shall be posted with black uppercase lettering as follows: “CAUTION: HEAT TRANSFER FLUID, DO NOT DRINK.”

SUBSTANTIATION:
The term “solar thermal” is being modified to “hydronic” throughout Section 1204.7 (Heat Transfer Fluid) since the heat transfer fluid identified refers to hydronic systems.
Proposals

Item #: 249

UMC 2024  Section: 1206.2, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1206.0 Pressure and Safety Devices.

1206.2 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:
(1) Equal Not less than to the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.
(8) The discharge termination point shall be readily observable.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.4.1-</td>
<td>Water Heater Relief Valve Drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009 (R2019)</td>
<td>Tubes</td>
<td>Discharge Piping</td>
<td>1206.2(2)</td>
</tr>
</tbody>
</table>

Note: ASME A112.4.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The revision to Section 1206.2 item (1) is needed as there are cases where PEX and PE-RT tubing require insert fittings to reduce inner diameters. Requiring the piping to be greater than the valve outlet prevents the PEX tubing inner diameter from being smaller than the valve outlet. ASME A112.4.1 is being included as it is applicable to discharge piping provisions and provides performance requirements and test methods applicable to water heater relief valve drain (or runoff) tubes for use with relief valves having a steam rating of 105,000 Btu/hr or less.

The addition of item (8) makes it clear that the termination point of the drainage line must be visible in order to detect leaks or failed valves. The change correlates with the actions taken by the UPC and USHGC Technical Committees. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC
Amend proposal as follows:

**1206.0 Pressure and Safety Devices.**

**1206.2 Discharge Piping.** The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:
(1) Not less than to the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.
(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.
(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.
(4) Discharge in such a manner that does not cause personal injury or structural damage.
(5) No part of such discharge pipe shall be trapped or subject to freezing.
(6) The terminal end of the pipe shall not be threaded.
(7) Discharge from a relief valve into a water heater pan shall be prohibited.

(8) The discharge termination point shall be readily observable.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>ASME A112.4.1-2009 (R2019)</td>
<td>Water Heater Relief Valve Drain Tubes</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**COMMITTEE STATEMENT:**
The modification clarifies that the discharge termination shall be readily "visible."

Additionally, the Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**  **AFFIRMATIVE:** 29  **NOT RETURNED:** 1  Heine

**EXPLANATION OF AFFIRMATIVE:**
**WHITE:** The UPC Section 608.5(8) uses the term "observable" not "visible."

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Appended Comments

**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 1005.2, 1206.2  **Item #:** 249

**SUBMITTER:** Cary Smith  
Sound Geothermal Corporation  
**Comment #:** 1

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal as modified by this public comment.

**1005.0 Safety or Relief Valve Discharge.**

**1005.2 Discharge Piping.** The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and provided with the following:
1206.0 Pressure and Safety Devices.

1206.2 Discharge Piping. The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall have no valves, obstructions, or means of isolation and be provided with the following:

(1) Equal to or less than the size of the valve outlet and shall discharge full size to the flood level of the area receiving the discharge and pointing down.

(2) Materials shall be rated at not less than the operating temperature of the system and approved for such use or shall comply with ASME A112.4.1.

(3) Discharge pipe shall discharge independently by gravity through an air gap into the drainage system or outside of the building with the end of the pipe not exceeding 2 feet (610 mm) and not less than 6 inches (152 mm) above the ground and pointing downwards.

(4) Discharge in such a manner that does not cause personal injury or structural damage.

(5) No part of such discharge pipe shall be trapped or subject to freezing.

(6) The terminal end of the pipe shall not be threaded.

(7) Discharge from a relief valve into a water heater pan shall be prohibited.

(8) Discharge to a termination point that is readily visible.

Note: ASME A112.4.1 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
ASME A112.4.1 is being included in Section 1005.2 (Discharge Piping) as it is applicable to discharge piping provisions and provides performance requirements and test methods applicable to water heater relief valve drain (or runoff) tubes for use with relief valves having a steam rating of 105,000 Btu/hr or less. Section 1206.2 (Discharge Piping) was previously updated with the ASME A112.4.1 standard. Additional changes are being made to Section 1005.2 (Discharge Piping) to correlate with Section 1206.2 (Discharge Piping).
Proposals

Item #: 251

UMC 2024  Section: 1207.5, Table 1701.1, Table 1701.2

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Add new text

1207.0 Heating Appliances and Equipment.

1207.5 Heat Pumps. Water source heat pumps shall comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Air source heat pumps shall comply with AHRI 210/240. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
</tr>
</tbody>
</table>

Note: AHRI 210/240, AHRI/ASHRAE/ISO 13256-1, and AHRI/ASHRAE/ISO 13256-2 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 1207.5 is being added to provide standards to address both water- and air-source heat pumps. Both standards provide detailed test methods, performance requirements and marking provisions for water-source heat pumps.
pumps. AHRI/ASHRAE/ISO 13256-1 specifically addresses water-to-water and brine-to-water heat pumps while AHRI/ASHRAE/ISO 13256-2 addresses water-to-air and brine-to-air heat pumps. AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2 have been used in the industry since 1998 and have been reaffirmed two times without substantive changes to the requirements. AHRI 210/240 covers air source heat pumps and their classifications, markings, as well as testing and rating requirements.

The inclusion of both water and air source heat pumps is applicable to Chapter 12 (Hydronics) as these heat pumps are used in hydronic space heating applications including radiant flooring and air heating.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed AHRI standards are performance standards, not safety standards. There is also concern that requiring a means to indicate that the compressor is locked out is overly stringent and is a service requirement; not related to safety. The proponent should come back with a public comment to reflect language as shown in Appendix F for heat pump specifications.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC Section #: 1207.5, Table 1801.1, Table 1801.2 Item #: 251
SUBMITTER: Cary Smith Sound Geothermal Corporation

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1207.0 Heating Appliances and Equipment.

1207.5 Heat Pumps. Heat pumps shall comply with UL 1995 or UL 60335-2-40. Air source heat pumps shall also comply with AHRI 210/240. In addition, ground-source heat pumps shall comply with AHRI/ASHRAE/ISO 13256-1 for water-to-air heat pumps and AHRI/ASHRAE/ISO 13256-2 for water-to-water heat pumps. Heat pumps shall be fitted with a means to indicate that the compressor is locked out.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

Note: AHRI 210/240, AHRI/ASHRAE/ISO 13256-1, AHRI/ASHRAE/ISO 13256-2, UL 1995, and UL 60335-2-40 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>
SUBSTANTIATION:
Section 1207.5 is being added to provide standards to address both water- and air-source heat pumps. Both standards provide detailed test methods, performance requirements and marking provisions for water-source heat pumps. AHRI/ASHRAE/ISO 13256-1 specifically addresses water-to-water and brine-to-water heat pumps while AHRI/ASHRAE/ISO 13256-2 addresses water-to-air and brine-to-air heat pumps. AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2 have been used in the industry since 1998 and have been reaffirmed two times without substantive changes to the requirements. AHRI 210/240 covers air source heat pumps and their classifications, markings, as well as testing and rating requirements.

The inclusion of both water and air source heat pumps is applicable to Chapter 12 (Hydronics) as these heat pumps are used in hydronic space heating applications including radiant flooring and air heating.
Proposals

Item #: 252
UMC 2024  Section: 1208.1, Table 1701.1

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Revise text

1208.0 Circulators and Pumps.
1208.1 General. Circulators and pumps shall be selected for their intended use based on the heat transfer fluid, intended operating temperature range and pressure. Circulators and pumps shall be installed to allow for service and maintenance. The manufacturer’s installation instructions shall be followed for correct orientation and installation. Motor Operated pumps rated 600V or less shall be listed and labeled in accordance with CSA C22.2 No. 108 or UL 778.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA C22.2 No. 108 –2014 (R2019)</td>
<td>Liquid Pumps</td>
<td>Pumps</td>
<td>1208.1</td>
</tr>
</tbody>
</table>

Note: CSA C22.2 No. 108 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Section 1208.1 is being modified to include CSA C22.2 No. 108 as the standard applies to liquid pumps. Various manufacturers are currently making condensate pumps which are being listed to this standard. The standard covers construction, markings, testing, bonding, and enclosures for liquid pumps including condensate pumps. Including this additional listing further enhances the code.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

1208.0 Circulators and Pumps.
1208.1 General. Circulators and pumps shall be selected for their intended use based on the heat transfer fluid, intended operating temperature range and pressure. Circulators and pumps shall be installed to allow for service and maintenance. The manufacturer’s installation instructions shall be followed for correct orientation and installation. Motor Operated pumps rated 600V or less shall be listed and labeled in accordance with CSA C22.2 No. 108 or UL 778.
TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA C22.2 No. 108 –2014 (R2019)</td>
<td>Liquid Pumps</td>
<td>Pumps</td>
<td>1208.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

COMMITTEE STATEMENT:
The proposed modification is being submitted to change “listed and labeled” to “comply with.” This is consistent with the other changes made by the Technical Committee on other items.

Additionally, the Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 1208.2  Item #: 252
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION: Revise text
Request to accept the code change proposal as modified by this public comment.

1208.0 Circulators and Pumps.

1208.2 Mounting. The circulator or pump shall be installed in such a way that strain from the piping is not transferred to the circulator or pump housing. The circulator or pump shall be permitted to be directly connected to the piping, provided the piping is supported on each side of the circulator or pump. Where the installation of a circulator or pump will cause strain on the piping, the circulator or pump shall be installed on a mounting bracket or base plate or securely fastened to or supported by the structure with approved fastening devices. Where means for controlling vibration of a circulator or pump is required, an approved means for support and restraint shall be provided.

SUBSTANTIATION:
Pumps should be secured in some fashion, and this gives the installing contractor the option to use the best solution.
Proposals

Item #: 253
UMC 2024  Section: 1209.1, 1209.3

SUBMITTER: Lance MacNevin, P.Eng.
Chair, USHGC Technical Committee

RECOMMENDATION:
Delete text without substitution

1209.0 Expansion Tanks.
1209.1 General. An expansion tank shall be installed in each closed hydronic system to control system pressure due to thermal expansion and contraction. Expansion tanks shall be of the closed or open type. Expansion tanks shall be rated for the pressure of the system.

1209.3 Open-Type Expansion Tanks. Open type expansion tanks shall be located not less than 3 feet (914 mm) above the highest point of the system. An overflow with a diameter of not less than one-half the size of the supply or not less than 1 inch (25 mm) in diameter shall be installed at the top of the tank. The overflow shall discharge through an air gap into the drainage system.

(remaining text unchanged)

SUBSTANTIATION:
Open type expansion tanks are no longer installed in any new or retrofit applications. These types of tanks are not capable of reaching high operating temperatures like that of closed expansion tanks. Open tanks allow for air to migrate into the system resulting in corrosion of components. Additionally, open expansion tanks must be located above the highest heating element, in general on the top of buildings, where they may be exposed to freezing conditions. For these reasons, open type expansion tanks and their listed provisions should be removed from the code.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

COMMITTEE STATEMENT:
The Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 28  NEGATIVE: 1  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
WHITE: These are probably not going in on new systems and people do not understand them on retrofits, but I disagree with the substantiation. There are many of these types of systems in use for maybe 100 years without corrosion failures. They are typically installed on systems that do not have high temperatures but can sustain temperatures just below boiling. If a system needs repair sufficient enough to require a permit, it is not always necessary to force removal of these devices. Also, these systems are lower pressure, limited to the elevation of the tank. Typically, pressure is measured in feet, not psi. Installing closed tanks can lead to excessive pressures in these legacy systems. No one puts them in new, but there is no harm in keeping this in the code.
Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1004.1, 1209.2  Item #: 253

SUBMITTER: Cary Smith  
Sound Geothermal Corporation  

Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1004.0 Expansion Tanks.

1004.1 General. An expansion tank shall be installed in a hot-water-heating system as a means for controlling increased pressure caused by thermal expansion. Expansion tanks shall be of the closed or open type and securely fastened to or supported by the structure. Tanks shall be rated for the pressure of the system. Supports shall be capable of carrying twice the weight of the tank filled with water without placing a strain on connecting piping.

Hot-water-heating systems incorporating hot water tanks or fluid relief columns shall be installed to prevent freezing under normal operating conditions.

1209.0 Expansion Tanks.

1209.1 General. (remaining text unchanged)

1209.2 Installation. Expansion tanks shall be accessible for maintenance and shall be installed in accordance with the manufacturer’s installation instructions. Each expansion tank shall be equipped with a shutoff device that will remain open during operation of the hydronic system. Valve handles shall be locked open or removed to prevent from being inadvertently shut off. Provisions shall be made for draining the tank without emptying the system. Expansion tanks shall be securely fastened to or supported by the structure. Supports shall be capable of carrying twice the weight of the tank filled with water without placing a strain on connecting piping.

Hot-water-heating systems incorporating hot water tanks or fluid relief columns shall be installed to prevent freezing under normal operating conditions.

SUBSTANTIATION:
This modification allows for different methods of support.
TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>PIPING/TUBING</th>
<th>FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>ASTM A269, ASTM A312, ASTM A554, ASTM A778</td>
<td>ASTM F1476, ASTM F1548, ASTM F3226, IAPMO IGC 353, IAPMO PS 117</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 353-2019</td>
<td>Branch Connectors</td>
<td>Branch Connectors</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 353 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The IAPMO IGC 353 Branch Connectors standard was developed for branch connectors NPS 1 1/2" - 6 inches. Branch connectors are defined within the standard as a permanent fitting or connection that allows a NPT threaded branch connection to be added to existing piping. Branch connectors covered by IAPMO IGC 353 shall include (a) Saddle like permanent connection mechanically fixed in place to the host pipe; and (b) leak tight seal realized through the compression of a sealing element between the outer surface of the pipe and body or flange of the branch connector. Note: One method of mechanically fixing the branch connection is via a swaging action which secures the fitting by mechanically deforming a flange of metal attached to the branch connector so that it matches the contour of the inside surface of a host pipe as indicated in Standard Section 1.1.2.

The body of branch connectors covered by this Standard shall be made of carbon steel, stainless steel, copper nickel or other materials with similar strength properties.

Branch connectors meet the current definition of Mechanical Joint as provided in the code: Joint, Mechanical. General form for gastight or liquid-tight joints obtained by the joining of parts through a positive holding mechanical construction.

The addition of this standard to the Materials for hydronic system piping, tubing and fittings table will provide a consensus standard listing requirement for these type of fittings that have been proven through the variety of testing that is mandatory to obtain the listing.
COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The standard is not applicable to potable water systems. Additionally, there is concern that fittings complying with the IAPMO IGC 353 standard will create turbulence within the system.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 28 NEGATIVE: 1 NOT RETURNED: 1 Heine

EXPLANATION OF NEGATIVE:

WHITE: The application for these is appropriate to hydronic piping, which is not potable, therefore the potable argument is moot. This should have been approved.

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: Table 1210.1, Table 1801.1

SUBMITTER: Jeff Matson Viega LLC

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The use of Branch Connectors in accordance with IAPMO IGC 353 has been accepted by the UMC TC for use in carbon steel piping systems (Item #259). This Standard also covers Branch Connectors for stainless steel piping and tubing, and adding this Standard to Table 1210.1 Fittings will allow those to be used under the Code. The TC previously Rejected this Proposal with a Committee Statement which included "The standard is not applicable to potable water systems." The Uniform Mechanical Code is not intended for potable applications, and Table 1210.1 is not intended to apply to potable water systems so such rationale is not valid. IAPMO IGC 353 Branch Connectors are used in hydronic system piping as covered in Table 1210.1 and this application is valid along with other materials already accepted by the TC.

PUBLIC COMMENT 2

Code Year: 2024 UMC Section #: 1211.14 - 1211.14.2, Table 1801.1

SUBMITTER: Arnie Rodio Self

RECOMMENDATION:
Add new text

Request to replace the code change proposal by this public comment.

1211.0 Joints and Connections.

1211.14 Stainless Steel Pipe and Joints. Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer’s installation instructions and shall comply with Section 1211.14.1 or Section 1211.14.2.

1211.14.1 Mechanical Joints. Mechanical joints shall be designed for their intended use. Such joints shall include compression, flanged, grooved, press-connect, and threaded.
1211.14.2 Welded Joints. Welded joints shall be either fusion or resistance welded based on the selection of the base metal. The chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping material.

(renumber remaining sections)

Note: AWS A5.9 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
New sections for stainless steel pipe and joints and dielectric unions are missing from the code and the additional language will greatly improve the code. The language correlates with the existing language found in the UPC. The proposed standard has been vetted and have also been previously accepted into the UPC.
Proposals

Item #: 258
UMC 2024  Section: Table 1210.1

SUBMITTER: Mark Fasel
Viega LLC

RECOMMENDATION:
Revise text

TABLE 1210.1
MATERIALS FOR HYDRONIC SYSTEM PIPING, TUBING, AND FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PIPING/TUBING</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM F3226 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
It was an oversight not to include ASTM F3226 Standard Specification for Metallic Press-Connect fittings for piping and tubing systems in the standards fittings column for steel fittings during the 2021 code development cycle as it is for stainless steel. The inclusion of ASTM F3226 will align this table with other codes including the 2021 IAPMO USHGC which references ASTM F3226 under fittings for steel material as this standard was developed for this type of technology and should be referenced here.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is no technical justification to warrant adding the ASTM standard to the fittings section for steel in the Hydronics table.

Additionally, the Technical Committee disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 28  NEGATIVE: 1  NOT RETURNED: 1  Heine

EXPLANATION OF NEGATIVE:
WHITE: The proposal should have been accepted based on the substantiation.

Appended Comments
RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
This public comment adds ASTM F3226 Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems into Table 1210.1 Materials for Hydronic System Piping, Tubing and Fittings in the standards column for fittings for Steel Materials. ASTM F3226 applies to systems of ASTM A53 steel pipe.

ASTM F3226 establishes performance characteristics required for metallic press connect fittings for use in piping and tubing systems rated to a maximum allowable working pressure of 300psi. ASTM F3226 includes the following materials: carbon steel, stainless steel, copper and copper alloy, copper nickel and brass.

Performance requirements to meet this standard include the following:
- Hydrostatic proof tested at 150% of the desired maximum allowable working pressure (M.A.W.P.) rating without leakage.
- Hydrostatic burst test requires a minimum 4 times M.A.W.P. rating without leakage.
- Pull Out Test fitting specimen filled with fluid while axial load applied must perform without leakage. Axial load shall be calculated by formula
- Vacuum Test shall be performed without loss of pressure at 183 ± 20, mb absolute.
- Vibration Tests conducted 3 times at different deflections and cycles per second (cps) for a total of 9,000,000 cycles:
  - 3,000,000 cycles at ± 0.002 in. @ frequency of 100 cps.
  - 3,000,000 cycles at ± 0.020 in. @ frequency of 45 cps.
  - 3,000,000 cycles at ± 0.060 in. @ frequency of 10 cps.
- Fire Endurance Testing pressurized at 500 kPa± 20 without leakage tested for 30 minutes at 1472°F. After completion, a Pressure Proof Test conducted at 150% of M.A.W.P.
- Impulse Pressure Testing introduces pressure pulses from 0 to 150% of design pressure at a rate of 30-100 cycles per minutes for a required 500,000 cycles.

The inclusion of ASTM F3226 into the steel fitting column will provide additional options for designers and installers for fittings used in steel piping. ASTM F3226 is also recognized in other IAPMO codes such as the Uniform Plumbing Code, Uniform Mechanical Code, and Uniform Solar, Hydronics and Geothermal Code. Thank you for your consideration.
1210.4 Oxygen Diffusion Corrosion. PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier with an oxygen permeation rate not to exceed $4.59 \times 10^{-4}$ grains per square foot per day ($0.32 \text{ mg/m}^2/\text{day}$) at $104^\circ\text{F} (40^\circ\text{C})$.

Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid.

The change correlates with the actions taken by the USHGC Technical Committee. This is necessary to ensure correlation between the codes.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed language is not enforceable and should reference the appropriate standard that provides the required oxygen permeation rate listed.

Additionally, the Technical Committee disagrees with the substantiation regarding the necessity for correlation with the USHGC.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1210.4  Item #: 261

SUBMITTER: Cary Smith  
Sound Geothermal Corporation  
Comment #: 1

RECOMMENDATION:

Revise text

Request to replace the code change proposal by this public comment.

1210.0 Materials.

1210.4 Oxygen Diffusion Corrosion. PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier.

Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid and the source side of closed loop geothermal systems shall not be required to contain an oxygen barrier.

SUBSTANTIATION:

PEX and PE-RT tubing used for hydronic applications requires an oxygen barrier to prevent diffusion of oxygen molecules into the water through the piping walls. An oxygen barrier also prevents corrosion of any cast iron components or parts such as circulator pumps, fill valves and boiler heating elements. The barrier allows for PEX and PE-RT use in hot water hydronic heating applications such as radiator heating, fan coils, and radiant floor heating. The revision of this section is necessary as it provides a maximum limit for oxygen permeation through the tubing. The exception for ground loops and nonferrous systems is needed otherwise the section would be overly restrictive.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1214.8  Item #: 261

SUBMITTER: Cary Smith  
Sound Geothermal Corporation  
Comment #: 2

RECOMMENDATION:

Add new text

Request to replace the code change proposal by this public comment.

1214.0 Pressure and Flow Controls.

1214.8 Manual Air Vents. Where hydronic piping has a diameter of 2 inches (50 mm) or greater, manually controlled air vents shall be installed at the high points in the system.

(renumber remaining sections)

SUBSTANTIATION:

Another method of corrosion prevention, in addition to oxygen barrier tubing, is to provide manual air vents to release oxygen that has been accumulated in high points in the system. Such vents should be installed regardless of the size of the hydronic piping, but 2 inches or greater gives a starting point for where manual air vents are required. Installing contractors or the AHJ may install air vents for smaller piping. This was proposed by the USHGC Hydronics Task Group.
Proposals

Item #: 262
UMC 2024 Section: 1211.12, Table 1701.1

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

1211.0 Joints and Connections.

1211.12 Polyvinyl Chloride (PVC) Pipe. (remaining text unchanged)
(1) (remaining text unchanged)
(2) Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color in accordance with ASTM F656. Primer shall be applied until the surface of the pipe and fitting is softened. Solvent cements in accordance with ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. **Two-step joining methods shall be in accordance with ASTM D2855.** Hold joint in place and undisturbed for 1 minute after assembly.
(3) (remaining text unchanged)

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2855-2020</td>
<td>The Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets</td>
<td>Miscellaneous</td>
<td>1211.12(2)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: ASTM D2855 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The standard for two step solvent cement joining is ASTM D2855, “Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.”

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the current code language provides the needed requirements for proper joining methods.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 22 NEGATIVE: 7 NOT RETURNED: 1 Heine

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted. The substantiation justifies the addition of this standard.

CUDAHY: The standard contains significantly more information than the code.

KOERBER: I vote to accept the change. The substantiation is sound.

MACNEVIN: This proposal should be accepted as it adds an important joining method, ASTM D2855, into the code, improving clarity.

TRAFTON, A; WISEMAN: The change should be accepted.

WHITE: The proposal should be accepted based on the substantiation.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1211.12, Table 1801.1  Item #: 262

SUBMITTER: Michael Cudahy  Comment #: 1

PPFA

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The standard for two step solvent cement joining is ASTM D2855, “Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.” Inclusion is useful to the code.
Proposals

Item #: 263
UMC 2024  Section: 1211.14.1

SUBMITTER: Pennie Feehan
          Pennie L Feehan Consulting
          Rep. Copper Development Association

RECOMMENDATION:
Revise text

1211.14.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe that is not copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

SUBSTANTIATION:
The original sentence is not clear and does not specify that the connection is from copper alloy pipe or tubing to threaded pipe of a different material. This proposal does not change the intent of the code section.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The language is not clear on its intent. It is requested that proponent come back with a public comment.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1211.14.1  Item #: 263

SUBMITTER: Pennie Feehan
          Pennie L Feehan Consulting
          Rep. Copper Development Association

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
The original sentence is not clear and does not specify that the connection is from copper alloy pipe or tubing to threaded pipe of a different material. This proposal does not change the intent of the code section.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 1211.14.1  Item #: 263
SUBMITTER: Pennie L Feehan  Comment #: 2
Pennie L Feehan Consulting
Rep. Copper Development Association

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1211.14.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe of a different material shall be made by the use of copper alloy adapter, copper alloy nipple (minimum 6 inches (152 mm)), dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

SUBSTANTIATION:
The original sentence is not clear and does not specify that the connection is from copper alloy pipe or tubing to threaded pipe of a different material. This proposal does not change the intent of the code section.

PUBLIC COMMENT 3

Code Year: 2024 UMC  Section #: 1211.14.1  Item #: 263
SUBMITTER: Pennie L Feehan  Comment #: 3
Pennie L Feehan Consulting
Rep. Copper Development Association

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1211.14.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe of a material other than copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple (minimum 6 inches (152 mm)), dielectric fitting, or dielectric union in accordance with ASSE 1079. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

SUBSTANTIATION:
The original sentence is not clear and does not specify that the connection is from copper alloy pipe or tubing to threaded pipe of a different material. This proposal does not change the intent of the code section.

PUBLIC COMMENT 4

Code Year: 2024 UMC  Section #: 1211.14.1, 1211.14.3, 1211.15, Table 1801.1  Item #: 263
SUBMITTER: Arnie Rodio  Comment #: 4
Self

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1211.0 Joints and Connections.
1211.14 Joints Between Various Materials. Joints between various materials shall be installed in accordance with the manufacturer’s installation instructions and shall comply with Section 1211.14.1 and Section 1211.14.2.

1211.14.1 Copper or Copper Alloy Pipe or Tubing to Threaded Pipe Joints. Joints from copper or copper alloy pipe or tubing to threaded pipe shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079 or IAPMO PS 66. The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

1211.14.2 Plastic Pipe to Other Materials. (remaining text unchanged)

1211.14.3 Stainless Steel to Other Materials. Where connecting stainless steel pipe to other types of piping, mechanical joints of the compression type, dielectric fitting, or dielectric union in accordance with ASSE 1079 or IAPMO PS 66 and designed for the specific transition intended shall be used.

1211.15 Dielectric Unions. Dielectric unions where installed at points of connection where there is a dissimilarity of metals shall be in accordance with ASSE 1079 or IAPMO PS 66.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
</table>

(ports of table not shown remains unchanged)

Note: The ASSE 1079 and IAPMO PS 66 standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed change correlates with the UPC regarding dielectric fittings found in the UMC Section 1211.14 (Joints Between Various Materials). The appropriate standards, ASSE 1079 or IAPMO PS 66, are being added for direction on dielectric fittings or unions.
Proposals

Item #: 264

UMC 2024  Section: 1211.14.2

SUBMITTER: Arnie Rodio
           Self

RECOMMENDATION:
Revise text

1211.0 Joints and Connections.

1211.14 Joints Between Various Materials. (remaining text unchanged)

1211.14.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of piping, approved types of adapter or transition fittings designed for the specific transition intended shall be used. Except as provided in the plumbing code, PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

SUBSTANTIATION:
The current language allows for a single transition from ABS to PVC or PVC to ABS exterior of the structure. Transition glue is not being represented to be allowable to make transition joints between ABS and PVC anywhere in the building. This code change clarifies that this practice is not approved. I have seen residences where the below slab plumbing was PVC and then the above slab plumbing all PVC with the joints being made with transition glue. This is an improper use of the product. While there is a code change to place this change in Chapter 3 as a prohibited practice it is also important that this be in this section as a prohibited practice to aid the end user and AHJ.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 264, Section 1211.14.2 (Plastic Pipe to Other Materials) and UPC Item # 179, Section 705.10.3 (Plastic Pipe to Other Materials) resulted in conflicting language between the codes. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

1211.14.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of plastic or other types of piping material; approved types of listed adapter or transition fittings designed for and listed for the specific transition intended shall be used. Except as provided in the plumbing code, PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

TCC ACTION: ACCEPT AS SUBMITTED
TCC STATEMENT:
The language in UMC Item # 264, Section 1211.14.2 (Plastic Pipe to Other Materials) is being revised to correlate
with the action taken by the UPC TC for Item # 179, Section 705.10.3 (Plastic Pipe to Other Materials) with regards
to adapters and transition fittings. Additionally, the TCC fixed an error by striking ABS as ABS is not listed as one of
the approved materials in Table 1210.1 (Materials for Hydronic System Piping, Tubing, and Fittings).

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for
actions taken for Section 1211.14.2 regarding with regards to adapters and transition fittings and the striking of ABS.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1211.1 - 1211.2.3, Table 1211.2.2  
SUBMITTER: Cary Smith  
Sound Geothermal Corporation  
RECOMMENDATION:  
Revise text

Request to accept the code change proposal as modified by this public comment.

1211.0 Joints and Connections.

1211.1 General. Joints and connections shall be of an approved type. Joints shall be gas and watertight and designed
for the pressure of the hydronic system. Changes in direction shall be made by the use of fittings or with pipe bends.
Pipe bends shall have a radius of not less than six times the outside diameter of the tubing or shall be in accordance
with the manufacturer's installation instructions. Joints between pipe and fittings shall be installed in accordance with the
manufacturer's installation instructions. Joints used underground shall be of an approved type for buried applications in
accordance with Section 1221.2.3.

1211.2 Pipe Bends. Pipe bends shall be formed in accordance with Section 1211.2.1 for PEX or Section 1211.2.2 for
PE.

1211.2.1 Crosslinked Polyethylene (PEX) Tubing. Crosslinked polyethylene (PEX) tubing bends shall have a bend
radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer's
installation instructions.

1211.2.2 Polyethylene (PE) Plastic Pipe/Tubing. Polyethylene pipe and tubing bends shall have a bend radius in
accordance with Table 1211.2.2. When a fitting or flange connection is present in the pipe bend, the minimum bend
radius shall be one hundred times the pipe outside diameter (OD) for a distance of five times the pipe diameter on either
side of the fitting location.

<table>
<thead>
<tr>
<th>DIMENSION RATIO (DR)</th>
<th>MINIMUM COLD BEND RADIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>20 x Pipe OD</td>
</tr>
<tr>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>25 x Pipe OD</td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>27 x Pipe OD</td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>34 x Pipe OD</td>
</tr>
<tr>
<td>32.5</td>
<td>42 x Pipe OD</td>
</tr>
<tr>
<td>41</td>
<td>52 x Pipe OD</td>
</tr>
<tr>
<td>Fitting or flange present in bend</td>
<td>100 x Pipe OD</td>
</tr>
</tbody>
</table>
**1211.2.3 Polyethylene of Raised Temperature (PE-RT) Tubing.** Polyethylene of raised temperature (PE-RT) tubing bends shall have a bend radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer’s installation instructions.

(below shown for reference only)

**1221.2.3 Plastics.** Plastic pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion methods or other approved fittings in accordance with Table 1210.1 and the manufacturer’s installation instructions. Solvent cement joints shall not be used in embedded applications.

**SUBSTANTIATION:**
The existing language in Section 1211.1 regarding pipe bends radius of not less than six times the OD is not correct for any of the plastic pipe materials found within Section 1211. The proposed new language for pipe/tubing bend radii are from various publications of The Plastics Pipe Institute (PPI). For PE pipe/tubing, the new language including Table 1210.2 is taken from the PPI “Handbook of Polyethylene Pipe, Second Edition” Ch. 7. For PEX tubing, the new language is taken from the “Design Guide – Residential PEX Water Supply Plumbing Systems” Ch. 9, a joint publication of PPI, PPFA, and the Home Innovation Research Labs. For PE-RT tubing, the new language is recommended by PPI.
Proposals

Item #: 267

UMC 2024  Section: 1217.3, 1217.3.1, 1217.4

SUBMITTER: Lance MacNevin, P.Eng.
Chair, UMC Radiant Cooling Working Group

RECOMMENDATION:
Revise text

1217.0 Radiant Heating and Cooling.

1217.3 Radiant Cooling Systems. Radiant cooling systems shall be designed to minimize the potential for condensation. To prevent condensation on any cooled radiant surface, the supply water temperature for a radiant cooling system shall be not less than 3°F (2°C) above the anticipated space dewpoint temperature, or in accordance with the manufacturer’s recommendation.  

1217.3.1 Minimum Floor Temperatures. The minimum floor surface temperature shall not be less than 66°F (19°C) in general occupied applications.

1217.4 Chilled Water Supply/Distribution Piping. Chilled water piping, valves, and fittings, and manifolds shall be insulated and vapor sealed to prevent surface condensation.

(renumber remaining sections)

SUBSTANTIATION:
The UMC Radiant Cooling Working Group was formed in January 2020 by members of ASHRAE TC 6.5, Radiant Heating and Cooling, to address concerns with existing UMC language in Section 1217.3. The working group met through a series of calls throughout 2020 to finalize the language submitted in this proposal.

Proposal 1: The UMC Radiant Cooling Working Group has identified that the current supply water temperature limitation in Section 1217.3 is overly restrictive and represents design guidance rather than a proper code minimum for health and safety.

The new Section 1217.3.1 is required based on ASHRAE Standard 55, “Thermal Environmental Conditions for Human Occupancy,” which defines the minimum acceptable temperature for a radiant floor of 66°F (19°C), which is well accepted in North America and internationally. This proposal, agreed upon by the UMC Radiant Cooling Working Group, improves the code by clarifying that water temps must be above dewpoint for health & safety while adding a clarifying section for cooling comfort temperature which incorporates the ASHRAE minimum similar to existing Section 1217.2 for Radiant Heating.

The requirements of the proposed Section 1217.4 were previously grouped into Section 1217.3 but have been separated for clarity. Manifolds are being added as another part of the distribution system which are common to radiant systems.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

1217.0 Radiant Heating and Cooling.

1217.3 Radiant Cooling Systems. Radiant cooling systems shall be designed to minimize the potential for
condensation. To prevent condensation on any cooled radiant surface, the supply water temperature for a radiant cooling system shall be above the space dewpoint temperature, or in accordance with the manufacturer’s recommendation.

**1217.3.1 Minimum Floor Temperatures.** The minimum floor surface temperature shall not be less than 66°F (19°C) in general occupied applications.

**1217.4 Chilled Water Supply/Distribution Piping.** Chilled water piping, valves, fittings, and manifolds shall be insulated and vapor sealed to prevent surface condensation.

**Exception:** Piping, valves, fittings, and manifolds used to supply radiant cooling systems and where the water temperature is above the space dewpoint temperature shall not require insulation.

(committee statement)

**COMMITTEE STATEMENT:**
The proposal is being modified to include the exception pertaining to insulation of chilled water supply piping, valves, fittings, and manifolds in this proposal from Item # 268.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:**
- **AFFIRMATIVE:** 29
- **NOT RETURNED:** 1

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**Appended Comments**

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** 1217.9.2.1, 1217.9.2.2  **Comment #:** 1  **Item #:** 267

**SUBMITTER:** Cary Smith  Sound Geothermal Corporation

**RECOMMENDATION:**

Add new text

Request to accept the code change proposal as modified by this public comment.

**1217.9 Radiant Heating and Cooling Panels.** (remaining text unchanged)

**1217.9.2 Radiant Wall and Ceiling Panels.** (remaining text unchanged)

**1217.9.2.1 Insulation.** Where a radiant plate wall system with insulation is installed with in an exterior wall, the insulating material shall have an R-value of 150 percent of the normal exterior wall, and a vapor barrier shall be installed between the insulation and the furring strips.

**1217.9.2.2 Maximum Surface Temperatures.** Surface temperatures shall not exceed the following for space heating applications:

1. 100°F (38°C) for a ceiling height of 8 feet (2438 mm)
2. 110°F (43°C) for a ceiling height of at least 9 feet (2743 mm)

**SUBSTANTIATION:**

For a radiant plate wall system in an exterior wall, the R-value is dependent upon the geographical location. For this reason, a percentage of 150 has been provided to ensure that heat transfer is directed towards the space intended to be heated or cooled. Heat loss through exterior walls can be 4 times greater than through the floor panel systems. A much higher insulation requirement is therefore needed to prevent such heat loss to the environment during extreme temperature gradients. A vapor barrier is also required to prevent water vapor from penetrating the exterior walls and condensation from forming on the internal surfaces of the exterior wall. If moisture accumulates, it can compromise structural integrity and sustainability. Wet insulation also reduces the R value of the insulation, ultimately effecting the heat loss from the exterior wall. A maximum temperature for surfaces is provided to prevent injury or hazard to the end user.
Proposals

Item #: 270

UMC 2024  Section: 1217.4

SUBMITTER: Lance MacNevin, P.Eng.
Plastics Pipe Institute

RECOMMENDATION:
Revise text

1217.4 Tube Placement. Hydronic radiant system tubing shall be installed in accordance with the manufacturer’s installation instructions and with the tube layout and spacing in accordance with the system design. Except for distribution mains, the individual loop lengths shall be installed with a variance of not more than ±10 percent from the design. The maximum loop length of continuous tubing from a supply-and-return manifold shall not exceed the lengths specified by the manufacturer or, in the absence of manufacturer’s specifications, the lengths specified in Table 1217.4. Actual loop lengths shall be determined by spacing, flow rate, and pressure drop requirements as specified in the system design.

For the purpose of system balancing, each individual loop shall have a tag or label securely affixed to the manifold to indicate the length of the loop and the room(s) and area(s) served.

SUBSTANTIATION:
Requiring installation of all radiant tube spacing at ± 10% of design is sometimes too restrictive, so “tube spacing” should be removed from the list as shown. For example, a tubing layout intended to be installed at 8 inch on-center spacing would allow a ± of only 0.8 inches (3/4 inch) throughout an entire area. In rooms with irregular shapes or holes or obstructions in the floor, it may be necessary to adjust tube spacing to allow the tubing to pass around such hole or obstruction. These holes or obstructions may be unknown to the designer of the radiant tubing design and, therefore, the installer must deviate from the tubing design to meet as-built conditions. The majority of the tube spacing may be exactly per design, but a portion of the tube spacing must be allowed to deviate from the design. The proposed deletion provides this practical flexibility.

Also, it is important for radiant tubing loops (circuits) to be tagged or labelled to help identify which circuit, attached to a central manifold, is connected to which room. The addition of "or label" provides the installer with flexibility to achieve this objective.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29    NOT RETURNED: 1    Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1217.5 - 1217.7, Table 1217.5, 1220.4.1 - 1220.4.3, Table 1220.4.1  
Item #: 270

SUBMITTER: Cary Smith
Sound Geothermal Corporation

Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1217.0 Radiant Heating and Cooling.

1217.5 Tube Placement. Hydronic radiant system tubing shall be installed in accordance with the manufacturer’s installation instructions and with the tube layout and spacing in accordance with the system design. Except for distribution mains, the individual loop lengths shall be installed with a variance of not more than ±10 percent from the design.

1217.6 Tube Length. The maximum loop length of continuous tubing from a supply-and-return manifold shall not exceed the lengths specified by the manufacturer or, in the absence of manufacturer’s specifications, the lengths specified in Table 1217.5 1217.6. Actual loop lengths shall be determined by spacing, flow rate, and pressure drop requirements as specified in the system design.

1217.7 Tube Identification. For the purpose of system balancing, each individual loop shall have a tag or label securely affixed to the manifold to indicate the length of the loop and the room(s) and area(s) served.

| TABLE 1217.5 1217.6 |
| MAXIMUM LENGTH OF CONTINUOUS TUBING FROM A SUPPLY-AND-RETURN MANIFOLD ARRANGEMENT |

(reportion of table not shown remains unchanged)

(renumber remaining sections)

1220.0 Snow and Ice Melt Systems.

1220.4 Snow and Ice Melt Controls. (remaining text unchanged)

1220.4.1 Tube Placement. Snow and ice melt tubing shall be installed in accordance with the manufacturer’s installation instructions and with the tube layout and spacing in accordance with the system design. Except for distribution mains, tube spacing and the individual loop lengths shall be installed with a variance of not more than ±10 percent from the design.

1220.4.2 Tube Length. The maximum loop length of continuous tubing from a supply-and-return manifold arrangement shall not exceed the lengths specified by the manufacturer or, in the absence of manufacturer’s specifications, the lengths specified in Table 1220.4.1 1220.4.2. Actual loop lengths shall be determined by spacing, flow rate, and pressure drop in accordance with the system design.

1220.4.3 Multizone Systems. In multizone systems, each zone shall have a tag or label securely affixed to the manifold to indicate the length of the loops and the area(s) served.

| TABLE 1220.4.1 1220.4.2 |
| MAXIMUM LOOP LENGTHS FOR SNOW AND ICE MELT SYSTEMS1,2 |

(reportion of table not shown remains unchanged)

SUBSTANTIATION:
Section 1217.5 is being split to differentiate between tube placement, tube length, and tube identification. Section 1220.4.1 is being split to differentiate between tube placement and tube length as well as add tube identification. For snow and ice melt systems, identification labels are only needed on large scale systems, particularly on systems with multiple activation sensors.
PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: 1217.6.1, 1217.6.2  Item #: 270
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 2

RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

1217.0 Radiant Heating and Cooling.

1217.6 Poured Floor Structural Concrete Slab Systems (Thermal Mass). (remaining text unchanged)
1217.6.1 Slab Penetration Tube and Joint Protection. Where embedded in or installed under a concrete slab, tubing shall be protected from damage at penetrations of the slab with protective sleeving approved recommended by the tubing manufacturer. The space between the tubing and sleeve shall be sealed with an approved sealant compatible with the tubing. The tubing at the location of an expansion joint in a concrete slab shall be encased in protective pipe sleeving that covers the tubing not less than 12 inches (305 mm) on either side of the expansion joint or the tubing shall be installed below the slab.

1217.6.2 Insulation. Where a poured concrete radiant floor system is installed in contact with the soil, insulation recommended by the manufacturer for such an application and with a minimum R-value of 5 shall be placed between the soil and the concrete; extend to the outside edges of the concrete; and be placed on all slab edges.

SUBSTANTIATION:
The manufacturer may or may not have a preference, however, the responsibility to approve the protective sleeving would be as required by the designer or the AHJ.

PUBLIC COMMENT 3
Code Year: 2024 UMC  Section #: 1217.8  Item #: 270
SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 3

RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

1217.0 Radiant Heating and Cooling.

1217.8 Wall and Ceiling Panels. Where piping radiant tubing is installed in the stud wall cavity or the ceiling joist cavity, the cavity shall be insulated with not less than R-12 material. The insulation shall be installed in such a manner as to prevent heating or cooling loss from the space intended to be controlled. An air space of not less than 1 inch (25.4 mm) and not more than 3 inches (76 mm) shall be maintained between the insulation and the interior surface of the panel unless a conductive plate is installed.

SUBSTANTIATION:
You would not want to condition a space that we do not intend to be conditioned. The use of radiant tubing with insulation provides the separation needed from one space to another.
Proposals

Item #: 273
UMC 2024  Section: 1221.2.3

SUBMITTER: Michael Cudahy
PPFA

RECOMMENDATION:
Revise text

1221.0 Piping Installation.

1221.2 Embedded Piping Materials and Joints. (remaining text unchanged)

1221.2.3 Plastics. Plastic pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion methods, solvent cement, or other approved fittings in accordance with Table 1210.1 and the manufacturer’s installation instructions.

Exception: Solvent-cement joints

SUBSTANTIATION:
Like welding for steel and brazing for copper, solvent cementing is the optimal joining method for PVC and CPVC plastic piping systems. While use of those materials in hydronics is less frequent than other piping materials, it should not be specifically excepted.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is concern that solvent cement fusion methods are not be applicable for embedded applications and are subject to failure.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 24  NEGATIVE: 5  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:
TRAFTON, P: I concur that there may be concern about this application in embedded locations.

EXPLANATION OF NEGATIVE:
BALLANCO: This change should have been accepted since there is no information provided that solvent cement joints do not perform properly (or fail) for embedded applications.

CUDAHY: There is concern that solvent cement fusion methods are not be applicable for embedded applications and are subject to failure, but never any proof. Solvent welding is the optimal joining method for several materials.

MACNEVIN: There is no need to prohibit solvent cemented joints in embedded applications. Solvent cement is not "glue," it actually welds pipes and fittings together in strong monolithic joints. They have been widely and successfully used in this installation type for many years, and are allowed in other codes. This exception is not justified.

WHITE: There is no reason to exclude solvent cement joints in this application. This should have been accepted.

WISEMAN: Further analysis is necessary.
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1221.2.3

SUBMITTER: Michael Cudahy
PPFA

Item #: 273
Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
Like welding for steel, brazing for copper, or heat fusion for olefin plastic pipes, solvent welding is the optimal joining method for CPVC which may occasionally be used in the hydronic imbedded piping application.
Proposals

Item #: 274

UMC 2024  Section: Chapter 13, Table 1701.1, Table 1701.2

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update

RECOMMENDATION:
Revise text

1308.2 Provision for Location of Point of Delivery. The location of the point of delivery shall be acceptable to the serving gas supplier. [NFPA 54:5.2]

(renumber remaining sections)

1308.3 Interconnections Between Gas Piping Systems Supplying Separate Users. Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators. [NFPA 54:5.3.1 – 5.2.1]

1308.3.1 Interconnections for Standby Fuels. Where a supplementary gas for standby use is connected downstream from a meter or a service regulator where a meter is not provided, equipment to prevent backflow shall be installed. A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used for this purpose. [NFPA 54:5.3.2 – 5.2.2]

1308.4 Sizing of Gas Piping Systems. Gas piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance. [NFPA 54:5.3.1 – 5.3.2.1 – 5.2.2.1]

1308.4.1 Maximum Gas Demand. The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served. The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m). [NFPA 54:5.3.2 – 5.2.2.2]

Exception: Where the input rating is not indicated, the gas supplier, appliance manufacturer, or a qualified agency shall be contacted or the rating from Table 1308.4.1 shall be used for estimating the volumetric flow rate of gas to be supplied. The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously.

1308.4.2 Sizing Methods. Gas piping shall be sized in accordance with one of the following:

(1) Pipe sizing tables or sizing equations in this chapter.
(2) Other approved engineering methods.
(3) Sizing tables included in a listed piping system manufacturer’s installation instructions.
(4) Engineering methods. [NFPA 54:5.4.3 – 5.3.3]

1308.4.3 Allowable Pressure Drop. The design pressure loss in any piping system under maximum probable flow conditions, from the point of delivery to the inlet connection of the appliance, all appliances served shall be such that the supply pressure at the each appliance inlet is greater than or equal to the minimum pressure required by the appliance. [NFPA 54:5.4.4 – 5.3.4]

1308.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of this chapter or be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.6.1.1]

1308.5.1 Used Materials. Pipe, fittings, valves, or other materials shall not be used again unless they are free of foreign materials and have been ascertained to be adequate for the service intended. [NFPA 54:5.6.1.2]

1308.5.1.1 Other Materials. Material not covered by the standards specifications listed herein shall meet the following criteria:

(1) Be investigated and tested to determine that it is safe and suitable for the proposed service.
(2) Be recommended for that service by the manufacturer.
(3) Be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.6.1.3]

1308.5.2 Metallic Pipe. Metallic pipe shall be in accordance with Section 1308.5.2.1 through Section 1308.5.2.4.

1308.5.2.1 Cast Iron. Cast-iron pipe shall not be used. [NFPA 54:5.6.2.1 – 5.5.2.1]
1308.5.2.4 Steel, Stainless Steel, and Wrought-Iron. Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 40 and shall comply with the dimensional standards of ASME B36.10M and one of the following:

(1) ASTM A53
(2) ASTM A106
(3) ASTM A312 [NFPA 54:5.6.2.2.5.5.2.2]

1308.5.2.3 Copper and Copper Alloy Pipe. Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet (scf) of gas (0.7 mg/100 L). [NFPA 54:5.6.2.2.5.5.2.3]

Threaded copper, copper alloy, or aluminum alloy pipe shall not be used with gases corrosive to such material. [NFPA 54:5.6.2.4 5.5.2.4]

1308.5.2.4 Aluminum Alloy Pipe. Aluminum alloy pipe shall comply with ASTM B241 (except that the use of alloy 5456 is prohibited), and shall be marked at each end of each length indicating compliance. Aluminum alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergents, or sewage. [NFPA 54:5.6.2.4 5.5.2.5]

Aluminum alloy pipe shall not be used in exterior locations or underground. [NFPA 54:5.6.2.4 5.5.2.6]

1308.5.3 Metallic Tubing. Tubing shall not be used with gases corrosive to the tubing material. [NFPA 54:5.6.3.4 5.5.3.1]

1308.5.3.1 Steel Tubing. Steel tubing shall comply with ASTM A254. [NFPA 54:5.6.3.2 5.5.3.2]

1308.5.3.2 Stainless Steel Tubing. Stainless steel tubing shall comply with one of the following:

(1) ASTM A268
(2) ASTM A269 [NFPA 54:5.6.3.3 5.5.3.3]

1308.5.3.3 Copper and Copper Alloy Tubing. Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L). Copper tubing shall comply with standard Type K or Type L of ASTM B88 or ASTM B280. [NFPA 54:5.5.3.4]

1308.5.3.4 Aluminum Alloy Tubing. Aluminum alloy tubing shall comply with ASTM B210 or ASTM B241. Aluminum alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergent, or sewage. Aluminum alloy tubing shall not be used in exterior locations or underground. [NFPA 54:5.6.3.4 5.5.3.5]

1308.5.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1. [NFPA 54:5.6.3.6 5.5.3.6]

1308.5.4 Plastic Pipe, Tubing, and Fittings. Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513. Pipe to be used shall be marked “gas” and “ASTM D2513.” [NFPA 54:5.6.4.1.4 5.5.4.1.1]

Polyamide pipe, tubing, and fittings shall be identified in accordance with ASTM F2945. Pipe to be used shall be marked “gas” and “ASTM F2945.” [NFPA 54:5.6.4.1.2 5.5.4.1.2] Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing, and fittings shall not be used to supply fuel gas. [NFPA 54:5.6.4.1.3 5.5.4.1.3]

1308.5.4.1 Regulator Vent Piping. Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651. PVC vent piping shall not be installed indoors. [NFPA 54:5.6.4.2 5.5.4.2]

1308.5.4.2 Anodeless Risers. Anodeless risers shall comply with Section 1308.5.4.2.1 through Section 1308.5.4.2.3. [NFPA 54:5.6.4.3]

1308.5.4.2.1 Factory-Assembled Anodeless Risers. Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak-tested by the manufacturer in accordance with written procedures. [NFPA 54:5.6.4.3.4 5.5.4.3(1)]

1308.5.4.2.2 Service Head Adapters and Field-Assembled Anodeless Risers. Service head adapters and field assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used and shall be design-certified to meet the requirements of Category I of ASTM D2513 and 49 CFR 192.281(e). The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b). [NFPA 54:5.6.4.3.2 5.5.4.3(2)]

1308.5.4.2.3 Undiluted Liquefied Petroleum Gas Piping. The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54:5.6.4.3.3 5.5.4.3(3)]

1308.5.5 Workmanship and Defects. Gas pipe, tubing, and fittings shall be clean and free from cutting burrs and defects in structure or threading; and shall be thoroughly brushed and chip and scale blown. Defects in pipe, tubing, and fittings shall not be repaired. Defective pipe, tubing, and fittings shall be replaced. [NFPA 54:5.6.6 5.5.5]

1308.5.6 Metallic Pipe Threads. Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ASME B1.20.1. [NFPA 54:5.6.6.1 5.5.6.1]

1308.5.6.1 Damaged Threads. Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used. [NFPA 54:5.6.6.2 5.5.6.2]

1308.5.6.2 Number of Threads. Field threading of metallic pipe shall be in accordance with Table 1308.5.6.2. [NFPA 54:5.6.6.3 5.5.6.3]

1308.5.6.3 Thread Joint Compounds- Sealing. Threaded joints shall be made using a thread joint sealing material. [NFPA 54:5.5.6.4.1] Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used. [NFPA 54:5.5.6.4.2] Thread joint compounds sealing materials shall be nonhardening and shall be resistant to the action of LP-Gas or to any other chemical constituents of the gases to be conducted through the
**1308.5.7 Metallic Piping Joints and Fittings.** The type of piping joint used shall be suitable for the pressure and temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to temperature expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents. [NFPA 54: 5.6.7.5.5.7]

**1308.5.7.1 Pipe Joints.** Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed to CSA LC 4.

1. Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C).
2. Brazing alloys shall not contain more than 0.05 percent phosphorus. (NFPA 54: 5.6.7.4.5.5.7.1)

**1308.5.7.2 Copper Tubing Joints.** Copper tubing joints shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to CSA LC 4. Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54: 5.6.7.2.5.5.7.2]

**1308.5.7.3 Stainless Steel Tubing Joints.** Stainless steel joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point in excess of 1000°F (538°C), or assembled with press-connect fittings listed to CSA LC 4. Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems. Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C). Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54: 5.6.7.3.5.5.7.3]

**1308.5.7.4 Flared Joints.** Flared joints shall be used only in systems constructed from nonferrous pipe and tubing where experience or tests have demonstrated that the joint is suitable for the conditions and where provisions are made in the design to prevent separation of the joints. [NFPA 54: 5.6.7.4.5.5.7.4]

**1308.5.7.5 Metallic Pipe Fittings.** Metallic fittings shall comply with the following:

1. Threaded fittings in sizes exceeding 4 inches (100 mm) shall not be used.
2. Fittings used with steel, stainless steel, or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron, or cast-iron.
3. Fittings used with copper or copper alloy pipe shall be copper or copper alloy.
4. Fittings used with aluminum alloy pipe shall be aluminum alloy.
5. Cast-iron fittings shall comply with the following:
   a. Flanges shall be permitted.
   b. Bushings shall not be used.
6. Fittings shall not be used in systems containing flammable gas-air mixtures.
7. Fittings in sizes 4 inches (100 mm) and larger shall not be used indoors unless approved by the Authority Having Jurisdiction.
8. Fittings in sizes 6 inches (150 mm) and larger shall not be used unless approved by the Authority Having Jurisdiction.
9. Aluminum alloy fitting threads shall not form the joint seal.
10. Zinc-aluminum alloy fittings shall not be used in systems containing flammable gas-air mixtures.
11. Special fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:
   a. Used within the fitting manufacturer’s pressure-temperature recommendations.
   b. Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction.
   c. Acceptable to the Authority Having Jurisdiction.
   d. When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with the following:
      a. The operation shall be performed on systems having operating pressures of 5 psi (34 kPa) or less.
      b. The operation shall be performed by the gas supplier or their designated representative.
      c. The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.
9. The fittings shall be located outdoors.
10. The tapped fitting assembly shall be inspected and proven to be free of leaks. [NFPA 54: 5.6.7.5.5.7.5]

**1308.5.8 Plastic Piping Joints and Fittings.** Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturer’s instructions. Section 1308.5.8.1 through Section 1308.5.8.4 shall be observed when making such joints. [NFPA 54: 5.6.8.5.5.8]

**1308.5.8.1 Joint Design.** The joint shall be designed and installed so that the longitudinal pullout resistance of the joint will be at least equal to the tensile strength of the plastic piping material. [NFPA 54: 5.6.8.1.5.5.8(1)]

**1308.5.8.2 Heat Fusion Joint.** Heat fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Heat Polyethylene heat fusion fittings shall be marked “ASTM D2513.” Polyamide heat fusion fittings shall be marked “ASTM F2945.” [NFPA 54: 5.6.8.2.5.5.8(2)]

**1308.5.8.3 Compression-Type Mechanical Joints.** Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting. The stiffener shall be flush with the end of the pipe or

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**NFPA 54: 5.6.6.4 5.5.6.4.3**

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**360**
tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. Split tubular stiffeners shall not be used. [NFPA 54:5.6.8(3) 5.5.8(3)]

1308.5.8.4 Liquefied Petroleum Gas Piping Systems. Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54:5.6.8(4) 5.5.8(4)]

1308.5.9 Flange Specifications. Cast iron flanges shall be in accordance with ASME B16.1. [NFPA 54:5.6.9.1 5.5.9.1.1]

1308.5.9.1 Steel Flanges. Steel flanges shall be in accordance with the following:
(1) ASME B16.5 or
(2) ASME B16.47. [NFPA 54:5.6.10.1 5.5.10.1]

1308.5.9.2 Non-Ferrous Flanges. Non-ferrous flanges shall be in accordance with ASME B16.24. [NFPA 54:5.6.9.1.3 5.5.9.1.3]

1308.5.9.3 Ductile Iron Flanges. Ductile iron flanges shall be in accordance with ASME B16.42. [NFPA 54:5.6.9.1.4 5.5.9.1.4]

1308.5.9.4 Dissimilar Flange Connections. Raised-face flanges shall not be joined to flat-faced cast iron, ductile iron or nonferrous material flanges. [NFPA 54:5.6.9.2 5.5.9.2]

1308.5.9.5 Flange Facings. Standard facings shall be permitted for use under this code. Where 150 psi (1034 kPa) steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed. [NFPA 54:5.6.9.3 5.5.9.3]

1308.5.9.6 Lapped Flanges. Lapped flanges shall be used only aboveground or in exposed locations accessible for inspection. [NFPA 54:5.6.9.4 5.5.9.4]

1308.5.10 Flange Gaskets. The material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system and the chemical constituents of the gas being conducted without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing the material. [NFPA 54:5.6.10.1 5.5.10.1]

1308.5.10.1 Flange Gasket Materials. Acceptable materials shall include the following:
(a) Metal (plain or corrugated)
(b) Composition
(c) Aluminum “O” rings
(d) Spiral-wound metal gaskets
(e) Rubber-faced phenolic
(f) Elastomeric [NFPA 54:5.6.10.1 5.5.10.1]

1308.5.10.2 Metallic Flange Gaskets. Metallic flange gaskets shall be in accordance with ASME B16.20. [NFPA 54:5.6.10.2 5.5.10.2]

1308.5.10.3 Non-Metallic Flange Gaskets. Non-metallic flange gaskets shall be in accordance with ASME B16.21. [NFPA 54:5.6.10.2.1 5.5.10.2.1]

1308.5.10.4 Full-Face Flange Gasket. Full-face flange gaskets shall be used with all non-steel flanges. [NFPA 54:5.6.10.3 5.5.10.3]

1308.5.10.5 Separated Flanges. When a flanged joint is separated, the gasket shall be replaced. [NFPA 54:5.6.10.4 5.5.10.4]

1308.6 Gas Meters. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop. [NFPA 54:5.7.1 5.6.1]

1308.6.1 Location. Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement, or necessary maintenance. [NFPA 54:5.7.2 5.6.2.1]

1308.6.1.1 Subject to Protection from Damage. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or where they will be subject to excessive corrosion or vibration. [NFPA 54:5.7.2.2 5.6.2.2]

1308.6.1.2 Extreme Temperatures. Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature or in areas where they are subjected to temperatures beyond those recommended by the manufacturer. [NFPA 54:5.7.2.3 5.6.2.3]

1308.6.2 Supports. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters. Where flexible connectors are used to connect a gas meter to downstream piping at mobile homes in mobile home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support. [NFPA 54:5.7.3 5.6.3]

1308.6.3 Meter Protection. Meters shall be protected against overpressure, backpressure, and vacuum. [NFPA 54:5.7.4 5.6.4]

1308.6.4 Identification. Gas piping at multiple meter installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied and attached by the installing agency. [NFPA 54:5.7.5 5.6.5]

1308.7 Gas Pressure Regulators. A line pressure regulator shall be installed where the gas supply pressure exceeds the maximum allowable inlet pressure of the appliance served. [NFPA 54:5.8.4 5.7.1]

1308.7.1 Listing. Line pressure regulators shall be listed in accordance with CSA Z21.80 where the outlet pressure is set to 2 psi (14 kPa) or less. [NFPA 54:5.8.25 5.7.2]
1308.7.2 Location. The gas pressure regulator shall be accessible for servicing. [NFPA 54:5.8.35.7.3]

1308.7.3 Regulator Protection. Pressure regulators shall be protected against physical damage. [NFPA 54:5.8.45.7.4]

1308.7.4 Regulator Vents Venting of Line Pressure Regulators. Regulator vents shall be in accordance with Section 1308.15. Line pressure regulators shall comply with the following:

(1) An independent vent to the exterior of the building, sized in accordance with the regulator manufacturer's instructions, shall be provided where the location of a regulator is such that a ruptured diaphragm will cause a hazard.

(a) Where more than one regulator is at a location, each regulator shall have a separate vent to the outdoors or, if approved by the Authority Having Jurisdiction, the vent lines shall be permitted to be manifolded in accordance with accepted engineering practices to minimize backpressure in the event of diaphragm failure.

(b) Materials for vent piping shall be in accordance with Section 1308.5 through Section 1308.5.10.5.

Exception: A regulator and vent limiting means combination listed as complying with CSA Z21.80 shall be permitted to be used without a vent to the outdoors.

(2) The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause leakage.

(3) The regulator vent shall terminate at least 3 feet (914 mm) from a source of ignition.

(4) At locations where regulators might be submerged during floods, a special antiflood type breather vent fitting shall be installed, or the vent line shall be extended above the height of the expected flood waters.

(5) A regulator shall not be vented to the appliance flue or exhaust system. [NFPA 54:5.8.5.4]

1308.7.5 Venting of Gas Appliance Pressure Regulators. For venting of gas appliance pressure regulators, see Section 902.15. [NFPA 54:5.8.5.2]

1308.7.6 Bypass Piping. Valved and regulated bypasses shall be permitted to be placed around gas line pressure regulators where continuity of service is imperative. [NFPA 54:5.8.6]

1308.7.7 Identification. Line pressure regulators at multiple regulator installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied. [NFPA 54:5.8.75.7.6]

1308.8 Overpressure Protection. Where the serving gas supplier delivers gas at a pressure greater than 2 psi for piping systems serving appliances designed to operate at a gas pressure of 14 inches water column or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 inches water column (3.5 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer's installation instructions. [NFPA 54:5.9.45.8.1]

1308.9 Pressure Limitation Requirements. Where piping systems serving appliances designed to operate with a gas supply pressure of 14 inches water column (3.5 kPa) or less are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance to 2 psi (14 kPa) or less upon a failure of the line pressure regulator. [NFPA 54:5.9.2.45.8.2.1]

1308.9.1 Overpressure Protection Required. Where piping systems serving appliances designed to operate with a gas supply pressure greater than 14 inches water column (3.5 kPa) are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance as required by the appliance manufacturer's installation instructions. [NFPA 54:5.9.2.25.8.2.2]

1308.9.2 Overpressure Protection Devices. Each overpressure protection device installed to meet the requirements of this section shall be capable of limiting the pressure to its connected appliance(s) as required by this section independently of any other pressure control equipment in the piping system. [NFPA 54:5.9.2.35.8.2.3]

1308.9.3 Detection of Failure. Each gas piping system for which an overpressure protection device is required by this section shall be designed and installed so that a failure of the primary pressure control device(s) is detectable. [NFPA 54:5.9.2.45.8.2.4]

1308.9.4 Flow Capacity. If a pressure relief valve is used to meet the requirements of this section, it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in Section 1308.9 under the following conditions:

(1) The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.

(2) The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure. [NFPA 54:5.9.2.55.8.2.5]

1308.10 Overpressure Protection Devices. Overpressure protection devices shall be one of the following:

(1) Pressure relief valve.

(2) Monitor regulator.

(3) Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section 1308.9 or less.

(4) Automatic shutoff device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by Section 1308.9 or less. This device shall be designed so that it will remain closed until manually reset. [NFPA 54:5.9.3.15.8.3.1]

1308.10.1 Separate Devices. The devices in Section 1308.10 shall be installed either as an integral part of the service or line pressure regulator or as separate units. Where separate overpressure protection devices are installed, they shall comply with Section 1308.10.2 through Section 1308.10.7. [NFPA 54:5.9.3.25.8.3.2]

1308.10.2 Construction and Installation. All overpressure protection devices shall meet the following requirements:

(1) Be constructed of materials so that the operation of the device is not impaired by corrosion of external parts by the atmosphere or of internal parts by the gas.
(2) Be designed and installed so they can be operated to determine whether the valve is free. The devices shall also be designed and installed so they can be tested to determine the pressure at which they operate and be examined for leakage when in the closed position. [NFPA 54:5.9.45.8.4]

1308.10.3 External Control Piping. External control piping shall be designed and installed so that damage to the control piping of one device does not render both the regulator and the overpressure protective device inoperative. [NFPA 54:5.9.9.65.8.5]

1308.10.4 Setting. Each pressure limiting or pressure relieving device shall be set so that the gas pressure supplied to the connected appliance(s) does not exceed the limits specified in Section 1308.9 and Section 1308.9.1. [NFPA 54:5.9.9.65.8.6]

1308.10.5 Unauthorized Operation. Where unauthorized operation of any shutoff valve could render a pressure relieving valve or pressure limiting device inoperative, one of the following shall be accomplished:

(1) The valve shall be locked in the open position. Instruct authorized personnel in the importance of leaving the shutoff valve open and of being present while the shutoff valve is closed so that it can be locked in the open position before leaving the premises.

(2) Duplicate relief valves shall be installed, each having adequate capacity to protect the system, and arrange the isolating valves or three-way valve so that only one relief valve can be rendered inoperative at a time. [NFPA 54:5.9.7.5.8.7]

1308.10.6 Discharge of Vents. The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage. The discharge stack or vent line shall be at least the same size as the outlet of the pressure relieving device. [NFPA 54:5.9.8.1, 5.9.8.25.8.8.1, 5.9.8.2]

1308.10.7 Size of Fittings, Pipe, and Openings. The fittings, pipe, and openings located between the system to be protected and the pressure relieving device shall be sized to prevent hammering of the valve and to prevent impairment of relief capacity. [NFPA 54:6.9-95.8.9]

1308.11 Backpressure Protection. Protective devices shall be installed as close to the equipment as practical where the design of equipment connected is such that air, oxygen, or standby gases could be forced into the gas supply system. Gas and air combustion mixers incorporating double diaphragm “zero” or “atmosphere” governors or regulators shall require no further protection unless connected directly to compressed air or oxygen at pressures of 5 psi (34 kPa) or more. [NFPA 54:5.40-1.1, 5.10-1.25.9.1.1, 5.9.1.2]

1308.11.1 Protective Devices. Protective devices shall include but not be limited to the following:

(1) Check valves.

(2) Three-way valves (of the type that completely closes one side before starting to open the other side).

(3) Reverse flow indicators controlling positive shutoff valves.

(4) Normally closed air-actuated positive shutoff pressure regulators. [NFPA 54:5.40.25.9.2]

1308.12 Low-Pressure Protection. A protective device shall be installed between the meter and the appliance or equipment if the operation of the appliance or equipment is such that it could produce a vacuum or a dangerous reduction in gas pressure at the meter. Such protective devices include, but are not limited to, mechanical, diaphragm-operated, or electrically operated low-pressure shutoff valves. [NFPA 54:5.11.1, 5.11.1.1]

1308.13 Shutoff Valves. Shutoff valves shall be approved and shall be selected giving consideration to pressure drop, service involved, emergency use, and reliability of operation in accordance with Table 1308.13. Shutoff valves of size 1 inch (25 mm) National Pipe Thread and smaller shall be listed and labeled. Where used outdoors, such use shall be in accordance with the manufacturer’s recommendation. [NFPA 54:5.425.11]

1308.14 Expansion and Flexibility. Piping systems shall be designed to prevent failure from thermal expansion or contraction. [NFPA 54:5.14.1, 5.13.1]

1308.14.1 Special Local Conditions. Where local conditions include earthquake, tornado, unstable ground, or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections. [NFPA 54:5.14.25.13.1]

1308.15 Pressure Regulator and Pressure Control Venting. The venting of the atmospheric side of diaphragms in line pressure regulators, gas appliance regulators, and gas pressure limit controls shall be in accordance with all of the following:

(1) An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. For devices other than appliance regulators, vents are not required to be independent where the vents are connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved.

Exceptions:

(1) A regulator and vent limiting means combination listed as complying with ANSI Z21.80/CSA 6.22, shall not be required to be vented to the outdoors.

(2) A listed gas appliance regulator factory equipped with a vent limiting device is not required to be vented to the outdoors.

(2) Materials for vent piping shall be in accordance with Section 1308.5 through Section 1308.5.10.5.

(3) The vent termination shall be designed to prevent the entry of water, insects, and other foreign matter that could cause
shall be installed in conduit or bridged (shielded) inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

1310.6 Maximum Operating Pressure in Buildings.

1310.4.5 Other Occupancies. In other than industrial occupancies and where approved by the Authority Having Jurisdiction, gas piping embedded in concrete floor slabs constructed with Portland cement shall be surrounded with a minimum of 1 1/2 inches (38 mm) of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. All piping, fittings, and risers shall be protected against corrosion in accordance with Section 1308.5.6. Piping shall not be embedded in concrete slabs containing quick-set quickset additives or cinder aggregate. [NFPA 54:7.3.5.2]

1310.6 Maximum Operating Pressure in Buildings. The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

1. The piping joints are welded or brazed.
The piping is joined by fittings listed to ANSI LC 4/CSA 6.32 and installed according to the manufacturer’s installation instructions.

The piping joints are flanged and all pipe-to-flange connections are made by welding or brazing.

The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.

The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
(a) Industrial processing or heating
(b) Research
(c) Warehousing
(d) Boiler or mechanical rooms

The piping is a temporary installation for buildings under construction.

The piping serves appliances or equipment used for agricultural purposes.

The piping is an LP-Gas piping system with an operating pressure greater than 20 psi (138 kPa) and complies with NFPA 58. [NFPA 54: 5.5.4, 5.4.4]

**1310.6.1 LP-Gas Systems Operating Below -5°F (-21°C).** LP-Gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-Gas or to prevent LP-Gas vapor from condensing back into a liquid. [NFPA 54: 5.5.5, 5.4.5]

**1310.11 Manual Gas Shutoff Valves.** An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator. [NFPA 54: 7.8.1, 7.8.2]

**1310.11.1 Shutoff Valves for Multiple House Lines.** In multiple-tenant buildings supplied through a master meter, through one service regulator where a meter is not provided, or where meters or service regulators are not readily accessible from the appliance or equipment location, an individual shutoff valve for each apartment or tenant line shall be provided at a convenient point of general accessibility. In a common system serving a number of individual buildings, shutoff valves shall be installed at each building. [NFPA 54: 7.8.2, 7.8.3.1]

**1310.11.2 Emergency Shutoff Valves.** An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided. The emergency shutoff valves shall be plainly marked as such and their locations posted as required by the Authority Having Jurisdiction. [NFPA 54: 7.8.2, 7.8.3.2]

**1310.11.3 Shutoff Valve for Laboratories.** Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory’s egress door, and identified. [NFPA 54: 7.8.2, 7.8.3.3]

**1310.11.4 System Shutoff Valves.** Where a system shutoff valve is installed, the valve shall comply with Section 1308.13. [NFPA 54: 7.8.4]

**TABLE 1308.13 MANUAL GAS VALVE STANDARDS**

<table>
<thead>
<tr>
<th>Shutoff Valve Application</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appliance shutoff valve up to 1/2 psi</td>
<td>ANSI Z21.15/CSA 9.1</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.44</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32</td>
</tr>
<tr>
<td>Valve up to 1/2 psi</td>
<td>ANSI/ASME B16.44</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32</td>
</tr>
<tr>
<td>Valve up to 2 psi</td>
<td>ANSI/ASME B16.44 labeled 2G</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B 16.44 labeled 2G or labeled 5G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G</td>
</tr>
<tr>
<td>Valve up to 5 psi</td>
<td>ANSI/ASME B16.44 labeled 5G</td>
</tr>
<tr>
<td></td>
<td>ANSI/ASME B16.33</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.44 marked 5G</td>
</tr>
<tr>
<td></td>
<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G</td>
</tr>
</tbody>
</table>
1310.14.5 Installation of Gas-Mixing Machines. Installation of gas-mixing machines shall comply with the following:
Section 1310.14.5.1 through 1310.14.5.5.

(1) **1310.14.5.1 Location.** The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with sound engineering principles. Such rooms or below-grade installations shall have adequate positive ventilation. [NFPA 54:7.11.5.1]

(2) **1310.14.5.2 Electrical Requirements.** Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with NFPA 70 for general service conditions unless other hazards in the area prevail. Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the electrical equipment and wiring shall be installed in accordance with NFPA 70 for hazardous locations (Articles 500 and 501, Class I, Division 2). [NFPA 54:7.11.5.2]

(3) **1310.14.5.3 Air Intakes.** Air intakes for gas-mixing machines using compressors or blowers shall be taken from outdoors whenever practical. [NFPA 54:7.11.5.3]

(4) **1310.14.5.4 Controls.** Controls for gas-mixing machines shall include interlocks and a safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in the event of high or low gas pressure. Except for open burner installations only, the controls shall be interlocked so that the blower or compressor stops operating following a gas supply failure. Where a system employs pressurized air, means shall be provided to shut off the gas supply in the event of air failure. [NFPA 54:7.11.5.4]

(5) **1310.14.5.5 Installation in Parallel.** Centrifugal gas-mixing machines in parallel shall be reviewed by the user and equipment manufacturer before installation, and means or plans for minimizing the effects of downstream pulsation and equipment overload shall be prepared and utilized as needed. [NFPA 54:7.11.5.5]

1311.0 Electrical Bonding and Grounding.

1311.4 Prohibited Use. Gas piping shall not be used as a grounding conductor or electrode. [NFPA 54:7.12.4 7.12.4.1]

1312.0 Appliance and Equipment Connections to Building Piping.

1312.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1312.6 through Section 1312.8 by one of the following:

(1) Rigid metallic pipe and fittings.

(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.

(3) A listed connector for gas appliances listed in compliance accordance with CSA Z21.24. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.

(4) A listed connector for outdoor gas appliances and manufactured homes listed in compliance accordance with CSA Z21.75. Only one connector shall be used per appliance.

(5) CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.

(6) Listed nonmetallic gas hose connectors in accordance with Section 1312.3.

(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1312.4. [NFPA 54:9.6.1]

1312.1.1 Commercial-Cooking Appliances Food Service Appliance Connectors. Connectors used with commercial cooking food service appliances that are moved for cleaning and sanitation purposes shall be installed in accordance with the connector manufacturer’s installation instructions. Such connectors shall be listed in accordance with CSA Z21.69. [NFPA 54:9.6.1.3]

1312.7 Quick-Disconnect Devices. Quick-disconnect devices used to connect appliances to the building piping shall be listed in accordance with CSA Z21.41. Where installed indoors, an approved manual shutoff valve with a nondisplaceable valve member shall be installed upstream of the quick-disconnect device. [NFPA 54:9.6.6 – 9.6.6.2]

**TABLE 1308.4.1**

APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES

[NFPA 54: TABLE A.5.4.2.4 A.5.3.2.1]

**TABLE 1308.5.6.2**

SPECIFICATIONS FOR THREADING METALLIC PIPE

[NFPA 54: TABLE 5.6.6.3 5.5.6.3]
### TABLE 1310.3.5.1
SUPPORT OF PIPING
[NFPA 54: TABLE 7.2.6.2]

<table>
<thead>
<tr>
<th>STEEL PIPE, NOMINAL SIZE OF PIPE (inches)</th>
<th>SPACING OF SUPPORTS (feet)</th>
<th>NOMINAL SIZE OF TUBING SMOOTH-WALL (inches O.D.)</th>
<th>SPACING OF SUPPORTS (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>6</td>
<td>1/2</td>
<td>4</td>
</tr>
<tr>
<td>3/4 or 1</td>
<td>8</td>
<td>5/8 or 3/4</td>
<td>6</td>
</tr>
<tr>
<td>1 1/4 or larger (horizontal)</td>
<td>10</td>
<td>7/8 or 1 (horizontal)</td>
<td>8</td>
</tr>
<tr>
<td>1 1/4 or larger (vertical)</td>
<td>Every floor level</td>
<td>1 or larger (vertical)</td>
<td>Every floor level</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

### TABLE 1313.6.1
SIZE AND LENGTH OF PIPING
[NFPA 54: TABLE 8.3.1]*
(portion of table not shown remains unchanged)

* CSST EHD size of 62 is equivalent to nominal 2 inches (50 mm) nominal size pipe or tubing size.

### TABLE 1315.2(27)
SCHEDULE 40 METALLIC PIPE [NFPA 54: TABLE 6.3.1(d)]

<table>
<thead>
<tr>
<th>GAS: UNDILUTED PROPANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INLET PRESSURE:</td>
</tr>
<tr>
<td>PRESSURE DROP:</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY:</td>
</tr>
</tbody>
</table>

INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (LOW-PRESSURE) REGULATOR AND APPLIANCE:

<table>
<thead>
<tr>
<th>PIPE SIZE (inch)</th>
<th>CAPACITY IN THOUSANDS OF BTU PER HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>NOMINAL INSIDE</td>
<td>1/2</td>
</tr>
<tr>
<td>ACTUAL ID:</td>
<td>0.622</td>
</tr>
<tr>
<td>LENGTH (feet)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>291</td>
</tr>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>160</td>
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<tr>
<td></td>
<td>137</td>
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<tr>
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<tr>
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<td>19</td>
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<td>14001600</td>
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<tr>
<td>14501700</td>
<td>18</td>
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<td>15001800</td>
<td>18</td>
</tr>
<tr>
<td>16001900</td>
<td>17</td>
</tr>
<tr>
<td>17002000</td>
<td>17</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8, 1000 British thermal units per hour = 0.293 kW, 1 inch water column = 0.249 kPa

* Table entries are rounded to 3 significant digits.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.33-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
<tr>
<td>ASME B16.44-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
<tr>
<td>ANSI Z21.15b/CSA 9.1b-2013 (R2014)</td>
<td>Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The ASME and CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

### TABLE 1701.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.33-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)</td>
<td>Valves</td>
</tr>
<tr>
<td>CSA Z21.15b-2013 (R2014)</td>
<td>Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves (same as CSA 9.1b)</td>
<td>Fuel-Gas</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Chapter 13 is being revised to the latest edition of NFPA 54-2021.

**COMMITTEE ACTION:** ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:
1308.3 Interconnections Supplying Separate Users. Where two or more meters, or two or more service regulators where meters are not provided, are located on the same premises and supply separate users, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators. [NFPA 54:5.2.1]

1308.3.1 Interconnections for Standby Fuels. Where a supplementary gas for standby use is connected downstream from a meter or a service regulator where a meter is not provided, equipment to prevent backflow shall be installed. A three-way valve installed to admit the standby supply and at the same time shut off the regular supply shall be permitted to be used for this purpose. [NFPA 54:5.2.1 – 5.2.2.2]

1308.4 Sizing of Gas Piping Systems. Gas piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance. [NFPA 54:5.3.1]

1308.4.1 Maximum Gas Demand. The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the appliances served. The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m). [NFPA 54:5.3.2.1 – 5.3.2.2] Where the input rating is not indicated, the gas supplier, appliance manufacturer, or a qualified agency shall be contacted or the rating from Table 1308.4.1 shall be used for estimating the volumetric flow rate of gas to be supplied.

The total connected hourly load shall be used as the basis for piping sizing, assuming all appliances are operating at full capacity simultaneously. Exception: Sizing shall be permitted to be based upon established load diversity factors. [NFPA 54:5.3.2.3]

1308.4.2 Sizing Methods. Gas piping shall be sized in accordance with one of the following:

(1) Pipe sizing tables or sizing equations in this chapter.
(2) Sizing tables included in a listed piping system manufacturer’s installation instructions.
(3) Engineering methods. [NFPA 54:5.3.3]

1308.4.3 Allowable Pressure Drop. The design pressure loss in a piping system from the point of delivery to the inlet connection of all appliances served shall be such that the supply pressure at each appliance inlet is greater than or equal to the minimum pressure required by the appliance. [NFPA 54:5.3.4]

1308.5 Acceptable Piping Materials and Joining Methods. Materials used for piping systems shall either comply with the requirements of this chapter or be acceptable to the Authority Having Jurisdiction. [NFPA 54:5.5.1.1]

1308.5.1 Used Materials. Pipe, fittings, valves, or other materials shall not be used again unless they are free of foreign materials and have been ascertained to be adequate for the service intended. [NFPA 54:5.5.1.2]

1308.5.2 Metallic Pipe. Metallic pipe shall be in accordance with Section 1308.5.2.1 through Section 1308.5.2.4.

1308.5.2.1 Cast Iron. Cast-iron pipe shall not be used. [NFPA 54:5.5.2.1]

1308.5.2.2 Steel, Stainless Steel, and Wrought-Iron. Steel, stainless steel, and wrought-iron pipe shall be at least Schedule 40 and shall comply with the dimensional standards of ASME B36.10M and one of the following:

(1) ASTM A53
(2) ASTM A106
(3) ASTM A312 {NFPA 54:5.5.2.2}

1308.5.2.3 Copper and Copper Alloy Pipe. Copper and copper alloy pipe shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet (scf) of gas (0.7 mg/100 L). [NFPA 54:5.5.2.3]

Threaded copper, copper alloy, or aluminum alloy pipe shall not be used with gases corrosive to such material. [NFPA 54:5.5.2.4]

1308.5.2.4 Aluminum Alloy Pipe. Aluminum alloy pipe shall comply with ASTM B241 (except that the use of alloy 5456 is prohibited), and shall be marked at each end of each length indicating compliance. Aluminum alloy pipe shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergents, or sewage. [NFPA 54:5.5.2.5]

Aluminum alloy pipe shall not be used in exterior locations or underground. [NFPA 54:5.5.2.6]

1308.5.3 Metallic Tubing. Tubing shall not be used with gases corrosive to the tubing material. [NFPA 54:5.5.3.1]

1308.5.3.1 Steel Tubing. Steel tubing shall comply with ASTM A254. [NFPA 54:5.5.3.2]

1308.5.3.2 Stainless Steel Tubing. Stainless steel tubing shall comply with one of the following:

(1) ASTM A268
(2) ASTM A269 [NFPA 54:5.5.3.3]

1308.5.3.3 Copper and Copper Alloy Tubing. Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 scf of gas (0.7 mg/100 L). Copper tubing shall comply with standard Type K or Type L of ASTM B88 or ASTM B280. [NFPA 54:5.5.3.4]

1308.5.3.4 Aluminum Alloy Tubing. Aluminum alloy tubing shall comply with ASTM B210 or ASTM B241. Aluminum alloy tubing shall be coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water, detergent, or sewage. Aluminum alloy tubing shall not be used in exterior locations or underground. [NFPA 54:5.5.3.5]

1308.5.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1. [NFPA 54:5.5.3.6]

1308.5.4 Plastic Pipe, Tubing, and Fittings. Polyethylene plastic pipe, tubing, and fittings used to supply fuel gas shall conform to ASTM D2513. Pipe to be used shall be marked “gas” and “ASTM D2513.” [NFPA 54:5.5.4.1.1] Polyamide
Pipe, tubing, and fittings shall be identified in and conform to ASTM F2945. Pipe to be used shall be marked “gas” and “ASTM F2945.” [NFPA 54: 5.5.4.1.2] Polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) plastic pipe, tubing, and fittings shall not be used to supply fuel gas. [NFPA 54: 5.5.4.1.3]

1308.5.4.1 Regulator Vent Piping. Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC conforming to UL 651. PVC vent piping shall not be installed indoors. [NFPA 54: 5.5.4.2]

1308.5.4.2 Anodeless Risers. Anodeless risers shall comply with Section 1308.5.4.2.1 through Section 1308.5.4.2.3.

1308.5.4.2.1 Factory-Assembled Anodeless Risers. Factory-assembled anodeless risers shall be recommended by the manufacturer for the gas used and shall be leak-tested by the manufacturer in accordance with written procedures. [NFPA 54: 5.5.4.3(1)]

1308.5.4.2.2 Service Head Adapters and Field-Assembled Anodeless Risers. Service head adapters and field assembled anodeless risers incorporating service head adapters shall be recommended by the manufacturer for the gas used and shall be design-certified to meet the requirements of Category I of ASTM D2513 and 49 CFR 192.281(e). The manufacturer shall provide the user qualified installation instructions as prescribed by 49 CFR 192.283(b). [NFPA 54: 5.5.4.3(2)]

1308.5.4.2.3 Undiluted Liquefied Petroleum Gas Piping. The use of plastic pipe, tubing, and fittings in undiluted LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54: 5.5.4.3(3)]

1308.5.5 Workmanship and Defects. Gas pipe, tubing, and fittings shall be clear and free from cutting burrs and defects in structure or threading, and shall be thoroughly brushed and chip and scale blown. Defects in pipe, tubing, and fittings shall not be repaired. Defective pipe, tubing, and fittings shall be replaced. [NFPA 54: 5.5.5]

1308.5.6 Metallic Pipe Threads. Metallic pipe and fitting threads shall be taper pipe threads and shall comply with ASME B1.20.1. [NFPA 54: 5.5.6.1]

1308.5.6.1 Damaged Threads. Pipe with threads that are stripped, chipped, corroded, or otherwise damaged shall not be used. Where a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used. [NFPA 54: 5.5.6.2]

1308.5.6.2 Number of Threads. Field threading of metallic pipe shall be in accordance with Table 1308.5.6.2. [NFPA 54: 5.5.6.3]

1308.5.6.3 Thread Joint Sealing. Threaded joints shall be made using a thread joint sealing material. [NFPA 54: 5.5.6.4.1] Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used. [NFPA 54: 5.5.6.4.2] Thread joint sealing materials shall be nonhardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping. [NFPA 54: 5.5.6.4.3]

1308.5.7 Metallic Piping Joints and Fittings. The type of piping joint used shall be suitable for the pressure and temperature conditions and shall be selected giving consideration to joint tightness and mechanical strength under the service conditions. The joint shall be able to sustain the maximum end force due to the internal pressure and any additional forces due to temperature expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents. [NFPA 54: 5.5.7]

1308.5.7.1 Pipe Joints. Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed to CSA LC 4.

(1) Where nonferrous pipe is brazed, the brazing materials shall have a melting point in excess of 1000°F (538°C).

(2) Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54: 5.5.7.1]

1308.5.7.2 Copper Tubing Joints. Copper tubing joints shall be assembled with approved gas tubing fittings, shall be brazed with a material having a melting point in excess of 1000°F (538°C), or shall be assembled with press-connect fittings listed to CSA LC 4. Brazing alloys shall not contain more than 0.05 percent phosphorus. [NFPA 54: 5.5.7.2]

1308.5.7.3 Stainless Steel Tubing Joints. Stainless steel joints shall be welded, assembled with approved tubing fittings, brazed with a material having a melting point in excess of 1000°F (538°C), or assembled with press-connect fittings listed to CSA LC 4. Brazing alloys and fluxes shall be recommended by the manufacturer for use on stainless steel alloys. [NFPA 54: 5.5.7.3]

1308.5.7.4 Flared Joints. Flared joints shall be used only in systems constructed from nonferrous pipe and tubing where experience or tests have demonstrated that the joint is suitable for the conditions and where provisions are made in the design to prevent separation of the joints. [NFPA 54: 5.5.7.4]

1308.5.7.5 Metallic Pipe Fittings. Metallic fittings shall comply with the following:

(1) Threaded fittings in sizes exceeding 4 inches (100 mm) shall not be used.

(2) Fittings used with steel, stainless steel, or wrought-iron pipe shall be steel, stainless steel, copper alloy, malleable iron, or cast-iron.

(3) Fittings used with copper or copper alloy pipe shall be copper or copper alloy.

(4) Fittings used with aluminum alloy pipe shall be aluminum alloy.

(5) Cast-iron fittings shall comply with the following:

(a) Flanges shall be permitted.

(b) Bushings shall not be used.

(c) Fittings shall not be used in systems containing flammable gas-air mixtures.

(d) Fittings in sizes 4 inches (100 mm) and larger shall not be used indoors unless approved by the Authority Having Jurisdiction.

(e) Fittings in sizes 6 inches (150 mm) and larger shall not be used unless approved by the Authority Having
(6) Aluminum alloy fitting threads shall not form the joint seal.
(7) Zinc-aluminum alloy fittings shall not be used in systems containing flammable gas-air mixtures.
(8) Special fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:
(a) Used within the fitting manufacturer’s pressure-temperature recommendations.
(b) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction.
(c) Acceptable to the Authority Having Jurisdiction.
(9) When pipe fittings are drilled and tapped in the field, the operation shall be in accordance with the following:
(a) The operation shall be performed on systems having operating pressures of 5 psi (34 kPa) or less.
(b) The operation shall be performed by the gas supplier or their designated representative.
(c) The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.
(d) The fittings shall be located outdoors.
(e) The tapped fitting assembly shall be inspected and proven to be free of leaks. [NFPA 54:5.5.7.5]

1308.5.8 Plastic Piping Joints and Fittings. Plastic pipe, tubing, and fittings shall be joined in accordance with the manufacturers’ instructions. Section 1308.5.8.1 through Section 1308.5.8.4 shall be observed when making such joints. [NFPA 54:5.5.8]

1308.5.8.1 Joint Design. The joint shall be designed and installed so that the longitudinal pullout resistance of the joint will be at least equal to the tensile strength of the plastic piping material. [NFPA 54:5.5.8(1)]

1308.5.8.2 Heat Fusion Joint. Heat fusion joints shall be made in accordance with qualified procedures that have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined. Joints shall be made with the joining method recommended by the pipe manufacturer. Polyethylene heat fusion fittings shall be marked “ASTM D2513.” Polyamide heat fusion fittings shall be marked “ASTM F2945.” [NFPA 54:5.5.8(2)]

1308.5.8.3 Compression-Type Mechanical Joints. Where compression-type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting. The stiffener shall be flush with the end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. Split tubular stiffeners shall not be used. [NFPA 54:5.5.8(3)]

1308.5.8.4 Liquefied Petroleum Gas Piping Systems. Plastic piping joints and fittings for use in LP-Gas piping systems shall be in accordance with NFPA 58. [NFPA 54:5.5.8(4)]

1308.5.9 Flange Specifications. Cast iron flanges shall be in accordance with ASME B16.1. [NFPA 54:5.5.9.1.1]

1308.5.9.1 Steel Flanges. Steel flanges shall be in accordance with the following:
(1) ASME B16.5 or
(2) ASME B16.47. [NFPA 54:5.5.9.1.2]

1308.5.9.2 Non-Ferrous Flanges. Non-ferrous flanges shall be in accordance with ASME B16.24. [NFPA 54:5.5.9.1.3]

1308.5.9.3 Ductile Iron Flanges. Ductile iron flanges shall be in accordance with ASME B16.42. [NFPA 54:5.5.9.1.4]

1308.5.9.4 Dissimilar Flange Connections. Raised-face flanges shall not be joined to flat-faced cast iron, ductile iron or nonferrous material flanges. [NFPA 54:5.5.9.2]

1308.5.9.5 Flange Facings. Standard facings shall be permitted for use under this code. Where 150 psi (1034 kPa) steel flanges are bolted to Class 125 cast-iron flanges, the raised face on the steel flange shall be removed. [NFPA 54:5.5.9.3]

1308.5.9.6 Lapped Flanges. Lapped flanges shall be used only aboveground or in exposed locations accessible for inspection. [NFPA 54:5.5.9.4]

1308.5.10 Flange Gaskets. The material for gaskets shall be capable of withstanding the design temperature and pressure of the piping system and the chemical constituents of the gas being conducted without change to its chemical and physical properties. The effects of fire exposure to the joint shall be considered in choosing the material. [NFPA 54:5.5.10]

1308.5.10.1 Flange Gasket Materials. Acceptable materials shall include the following:
(1) Metal (plain or corrugated)
(2) Composition
(3) Aluminum “O” rings
(4) Spiral-wound metal gaskets
(5) Rubber-faced phenolic
(6) Elastomeric [NFPA 54:5.5.10.1]

1308.5.10.2 Metallic Flange Gaskets. Metallic flange gaskets shall be in accordance with ASME B16.20. [NFPA 54:5.5.10.2.1]

1308.5.10.3 Non-Metallic Flange Gaskets. Non-metallic flange gaskets shall be in accordance with ASME B16.21. [NFPA 54:5.5.10.2.2]

1308.5.10.4 Full-Face Flange Gasket. Full-face flange gaskets shall be used with all non-steel flanges. [NFPA 54:5.5.10.3]

1308.5.10.5 Separated Flanges. When a flanged joint is separated, the gasket shall be replaced. [NFPA 54:5.5.10.4]
1308.6 Gas Meters. Gas meters shall be selected for the maximum expected pressure and permissible pressure drop. [NFPA 54:5.6.1]

1308.6.1 Location. Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement, or necessary maintenance. [NFPA 54:5.6.2.1]

1308.6.1.1 Protection from Damage. Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or where they will be subject to excessive corrosion or vibration. [NFPA 54:5.6.2.2]

1308.6.1.2 Extreme Temperatures. Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature or in areas where they are subjected to temperatures beyond those recommended by the manufacturer. [NFPA 54:5.6.2.3]

1308.6.2 Supports. Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters. Where flexible connectors are used to connect a gas meter to downstream piping at mobile homes in mobile home parks, the meter shall be supported by a post or bracket placed in a firm footing or by other means providing equivalent support. [NFPA 54:5.6.3]

1308.6.3 Meter Protection. Meters shall be protected against overpressure, backpressure, and vacuum. [NFPA 54:5.6.4]

1308.6.4 Identification. Gas piping at multiple meter installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied and attached by the installing agency. [NFPA 54:5.6.5]

1308.7 Gas Pressure Regulators. A line pressure regulator shall be installed where the gas supply pressure exceeds the maximum allowable inlet pressure of the appliance served. [NFPA 54:5.7.1]

1308.7.1 Listing. Line pressure regulators shall be listed in accordance with CSA Z21.80 where the outlet pressure is set to 2 psi (14 kPa) or less. [NFPA 54:5.7.2]

1308.7.2 Location. The gas pressure regulator shall be accessible for servicing. [NFPA 54:5.7.3]

1308.7.3 Regulator Protection. Pressure regulators shall be protected against physical damage. [NFPA 54:5.7.4]

1308.7.4 Regulator Vents. Regulator vents shall be in accordance with Section 1308.15. [NFPA 54:5.7.5]

1308.7.5 Identification. Line pressure regulators at multiple regulator installations shall be marked by a metal tag or other permanent means designating the building or the part of the building being supplied. [NFPA 54:5.7.6]

1308.8 Overpressure Protection. Where the serving gas supplier delivers gas at a pressure greater than 2 psi for piping systems serving appliances designed to operate at a gas pressure of 14 inches water column or less, overpressure protection devices shall be installed. Piping systems serving equipment designed to operate at inlet pressures greater than 14 inches water column (3.5 kPa) shall be equipped with overpressure protection devices as required by the appliance manufacturer’s installation instructions. [NFPA 54:5.8.1]

1308.9 Pressure Limitation Requirements. Where piping systems serving appliances designed to operate with a gas supply pressure of 14 inches water column (3.5 kPa) or less are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance to 2 psi (14 kPa) or less upon a failure of the line pressure regulator. [NFPA 54:5.8.2.1]

1308.9.1 Overpressure Protection Required. Where piping systems serving appliances designed to operate with a gas supply pressure greater than 14 inches water column (3.5 kPa) are required to be equipped with overpressure protection by Section 1308.8, each overpressure protection device shall be adjusted to limit the gas pressure to each connected appliance as required by the appliance manufacturer’s installation instructions. [NFPA 54:5.8.2.2]

1308.9.2 Overpressure Protection Devices. Each overpressure protection device installed to meet the requirements of this section shall be capable of limiting the pressure to its connected appliance(s) as required by this section independently of any other pressure control equipment in the piping system. [NFPA 54:5.8.2.3]

1308.9.3 Detection of Failure. Each gas piping system for which an overpressure protection device is required by this section shall be designed and installed so that a failure of the primary pressure control device(s) is detectable. [NFPA 54:5.8.2.4]

1308.9.4 Flow Capacity. If a pressure relief valve is used to meet the requirements of this section, it shall have a flow capacity such that the pressure in the protected system is maintained at or below the limits specified in Section 1308.9 under the following conditions:

1. The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.
2. The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure. [NFPA 54:5.8.2.5]

1308.10 Overpressure Protection Devices. Overpressure protection devices shall be one of the following:

1. Pressure relief valve.
3. Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section 1308.9 or less.
4. Automatic shut-off device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by Section 1308.9 or less. This device shall be designed so that it will remain closed until manually reset. [NFPA 54:5.8.3.1]

1308.10.1 Separate Devices. The devices in Section 1308.10 shall be installed either as an integral part of the service or line pressure regulator or as separate units. Where separate overpressure protection devices are installed, they shall
Comply with Section 1308.10.2 through Section 1308.10.7. [NFPA 54:5.8.3.2]

1308.10.2 Construction and Installation. All overpressure protection devices shall meet the following requirements:

1. Be constructed of materials so that the operation of the device is not impaired by corrosion of external parts by the atmosphere or of internal parts by the gas.
2. Be designed and installed so they can be operated to determine whether the valve is free. The devices shall also be designed and installed so they can be tested to determine the pressure at which they operate and be examined for leakage when in the closed position. [NFPA 54:5.8.4]

1308.10.3 External Control Piping. External control piping shall be designed and installed so that damage to the control piping of one device does not render both the regulator and the overpressure protective device inoperative. [NFPA 54:5.8.5]

1308.10.4 Setting. Each pressure limiting or pressure relieving device shall be set so that the gas pressure supplied to the connected appliance(s) does not exceed the limits specified in Section 1308.9 and Section 1308.9.1. [NFPA 54:5.8.6]

1308.10.5 Unauthorized Operation. Where unauthorized operation of any shutoff valve could render a pressure relieving valve or pressure limiting device inoperative, one of the following shall be accomplished:

1. The valve shall be locked in the open position. Instruct authorized personnel in the importance of leaving the shutoff valve open and of being present while the shutoff valve is closed so that it can be locked in the open position before leaving the premises.
2. Duplicate relief valves shall be installed, each having adequate capacity to protect the system, and arrange the isolating valves or three-way valve so that only one relief valve can be rendered inoperative at a time. [NFPA 54:5.8.7]

1308.10.6 Discharge of Vents. The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage. The discharge stack or vent line shall be at least as large as the outlet size of the pressure relieving device. [NFPA 54:5.8.8.1, 5.8.8.2]

1308.10.7 Size of Fittings, Pipe, and Openings. The fittings, pipe, and openings located between the system to be protected and the pressure relieving device shall be sized to prevent hammering of the valve and to prevent impairment of relief capacity. [NFPA 54:5.8.9]

1308.11 Backpressure Protection. Protective devices shall be installed as close to the equipment as practical where the design of equipment connected is such that air, oxygen, or standby gases could be forced into the gas supply system. Gas and air combustion mixers incorporating double diaphragm “zero” or “atmosphere” governors or regulators shall require no further protection unless connected directly to compressed air or oxygen at pressures of 5 psi (34 kPa) or more. [NFPA 54:5.9.1.1, 5.9.1.2]

1308.11.1 Protective Devices. Protective devices shall include but not be limited to the following:

1. Check valves.
2. Three-way valves (of the type that completely closes one side before starting to open the other side).
3. Reverse flow indicators controlling positive shutoff valves.
4. Normally closed air-actuated positive shutoff pressure regulators. [NFPA 54:5.9.2]

1308.12 Low-Pressure Protection. A protective device shall be installed between the meter and the appliance or equipment if the operation of the appliance or equipment is such that it could produce a vacuum or a dangerous reduction in gas pressure at the meter. Such protective devices include, but are not limited to, mechanical, diaphragm-operated, or electrically operated low-pressure shutoff valves. [NFPA 54:5.10]

1308.13 Shutoff Valves. Shutoff valves shall be selected in accordance with Table 1308.13. Shutoff valves of size 1 inch (25 mm) National Pipe Thread and smaller shall be listed and labeled. Where used outdoors, such use shall be in accordance with the manufacturer’s recommendation. [NFPA 54:5.11]

1308.14 Expansion and Flexibility. Piping systems shall be designed to prevent failure from thermal expansion or contraction. [NFPA 54:5.13.1]

1308.14.1 Special Local Conditions. Where local conditions include earthquake, tornado, unstable ground, or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections. [NFPA 54:5.13.2]

1308.15 Pressure Regulator and Pressure Control Venting. The venting of the atmospheric side of diaphragms in line pressure regulators, gas appliance regulators, and gas pressure limit controls shall be in accordance with all of the following:

1. An independent vent pipe to the outdoors, sized in accordance with the device manufacturer's instructions, shall be provided where the location of a device is such that a discharge of fuel gas will cause a hazard. For devices other than appliance regulators, vents are not required to be independent where the vents are connected to a common manifold designed in accordance with engineering methods to minimize backpressure in the event of diaphragm failure and such design is approved.

Exceptions:

1. A regulator and vent limiting means combination listed as complying with ANSI Z21.80/CSA 6.22, shall not be required to be vented to the outdoors.
2. A listed gas appliance regulator factory equipped with a vent limiting device is not required to be vented to the outdoors.
3. Materials for vent piping shall be in accordance with Section 1308.5 through Section 1308.5.10.5.
(3) The vent terminus shall be designed to prevent the entry of water, insects, and other foreign matter that could cause blockage.

(4) Vent piping shall be installed to minimize static loads and bending moments placed on the regulators and gas pressure control devices.

(5) Vents shall terminate not less than 3 feet (914 mm) from a possible source of ignition.

(6) At locations where a vent termination could be submerged during floods or snow accumulations, an antiflood-type breather vent fitting shall be installed, or the vent terminal shall be located above the height of the expected flood waters or snow.

(7) Vent piping from pressure regulators and gas pressure controls shall not be connected to a common manifold that serves a bleed line from a diaphragm-type gas valve. [NFPA 54:5.14]

1309.0 Excess Flow Valve.
1309.1 General. Where automatic excess flow valves are installed, they shall be listed in accordance with ANSI Z21.93/CSA 6.30 and shall be sized and installed in accordance with the manufacturers’ instructions. [NFPA 54:5.12]

1310.0 Gas Piping Installation.

1310.1 Piping Underground. Underground gas piping shall be installed with sufficient clearance from any other underground structure to avoid contact therewith, to allow maintenance, and to protect against damage from proximity to other structures. Underground plastic piping shall be installed with sufficient clearance or shall be insulated from any source of heat so as to prevent the heat from impairing the serviceability of the pipe. [NFPA 54:7.1.1.1, 7.1.1.2]

1310.1.1 Cover Requirements. Underground piping systems shall be installed with a minimum of 12 inches (305 mm) of cover. The minimum cover shall be increased to 18 inches (457 mm) if external damage to the pipe or tubing from external forces is likely to result. Where a minimum of 12 inches (305 mm) of cover cannot be provided, the piping shall be installed in conduit. [NFPA 54:7.1.2.1 – 7.1.2.1(B)]

1310.1.5 Piping Through Foundation Wall. Piping through a foundation wall shall comply with all of the following:

1. Underground piping, where installed through the outer foundation or basement wall of a building, shall be encased in a protective sleeve or protected by an approved device or method.

2. The spaces between the gas piping and the sleeve and between the sleeve and the wall shall be sealed to prevent entry of gas and water.

3. Sealing materials shall be compatible with the piping and sleeve. [NFPA 54:7.1.5]

1310.1.7 Connections of Plastic Piping. Plastic piping shall be installed outdoors, underground only. Exceptions:

(1) Plastic piping shall be permitted to terminate aboveground where an anodeless riser is used.

(2) Plastic piping shall be permitted to terminate with a wall head adapter aboveground in buildings, including basements, where the plastic piping is inserted in a piping material permitted for use in buildings. [NFPA 54:7.1.7.1]

1310.3 Installation of Aboveground Piping. Piping installed aboveground shall comply with all of the following:

1. Piping shall be securely supported and located where it will be protected from physical damage.

2. Where passing through an exterior wall, the piping shall also be protected from corrosion by coating or wrapping with an inert material approved for such applications.

3. The piping shall be sealed around its circumference at the point of the exterior penetration to prevent the entry of water, insects, and rodents.

4. Where piping is encased in a protective pipe sleeve, the annular spaces between the gas piping and the sleeve and between the sleeve and the wall opening shall be sealed.

5. Piping installed outdoors shall be elevated not less than $3\frac{3}{4}$ inches (89 mm) above the ground.

6. Sealing materials shall be compatible with the piping and sleeve. ([NFPA 54:7.2.1.1])

1310.3.5.3 Piping on Roofs. Gas piping installed on the roof surfaces shall be elevated above the roof surface and shall be supported in accordance with Table 1310.3.5.1. Gas piping shall be elevated not less than $3\frac{3}{4}$ inches (89 mm) above the roof surface. ([NFPA 54:7.2.6.4.1, 7.2.6.4.2])

1310.4.4 Industrial Occupancies. In industrial occupancies, gas piping in solid floors such as concrete shall be laid in channels in the floor and covered to permit access to the piping with a minimum of damage to the building. Where piping in floor channels could be exposed to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. [NFPA 54:7.3.5.1]

1310.4.5 Other Occupancies. In other than industrial occupancies and where approved by the Authority Having Jurisdiction, gas piping embedded in concrete floor slabs constructed with Portland cement shall be surrounded with a minimum of $1\frac{1}{2}$ inches (38 mm) of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. All piping, fittings, and risers shall be protected against corrosion in accordance with Section 1308.5.6. Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate. [NFPA 54:7.3.5.2]

1310.6 Maximum Operating Pressure in Buildings. The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

1. The piping joints are welded or brazed.
(2) The piping is joined by fittings listed to ANSI LC 4/CSA 6.32 and installed according to the manufacturer’s installation instructions.
(3) The piping joints are flanged and all pipe-to-flange connections are made by welding or brazing.
(4) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
(5) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
(a) Industrial processing or heating
(b) Research
(c) Warehousing
(d) Boiler or mechanical rooms
(6) The piping is a temporary installation for buildings under construction.
(7) The piping serves appliances or equipment used for agricultural purposes.
(8) The piping system is an LP-Gas piping system with an operating pressure greater than 20 psi (138 kPa) and complies with NFPA 58. [NFPA 54:5.4.4]

1310.6.1 LP-Gas Systems Operating Below -5°F (-21°C). LP-Gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-Gas or to prevent LP-Gas vapor from condensing back into a liquid. [NFPA 54:5.4.5]

1310.11 Manual Gas Shutoff Valves. An accessible gas shutoff valve shall be provided upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator. [NFPA 54:7.8.2]

1310.11.1 Accessibility of Gas Valves. System shutoff valves shall be readily accessible for operation and installed so as to be protected from physical damage. System shutoff valves shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified. [NFPA 54:7.8.1.1, 7.8.1.2]

1310.11.1.1 Shutoff Valves for Multiple House Lines. In multiple-tenant buildings supplied through a master meter, through one service regulator where a meter is not provided, or where meters or service regulators are not readily accessible from the appliance or equipment location, an individual shutoff valve for each apartment or tenant line shall be provided at a convenient point of general accessibility. In a common system serving a number of individual buildings, shutoff valves shall be installed at each building. [NFPA 54:7.8.3.1]

1310.11.2 Emergency Shutoff Valves. An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided. The emergency shutoff valves shall be plainly marked as such and their locations posted as required by the Authority Having Jurisdiction. [NFPA 54:7.8.3.2]

1310.11.3 Shutoff Valve for Laboratories. Each laboratory space containing two or more gas outlets installed on tables, benches, or in hoods in educational, research, commercial, and industrial occupancies shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be accessible, located within the laboratory or adjacent to the laboratory’s egress door, and identified. [NFPA 54:7.8.3.3]

1310.11.4 System Shutoff Valves. Where a system shutoff valve is installed, the valve shall comply with Section 1308.13. [NFPA 54:7.8.4]

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<th>TABLE 1308.13</th>
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<tbody>
<tr>
<td>MANUAL GAS VALVE STANDARDS</td>
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<tr>
<td>[NFPA 54: TABLE 5.11]</td>
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</tbody>
</table>

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<thead>
<tr>
<th>SHUTOFF VALVE APPLICATION</th>
<th>STANDARDS</th>
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</thead>
<tbody>
<tr>
<td>Appliance shutoff valve up to 1/2 psi</td>
<td>ANSI Z21.15/CSA 9.1</td>
</tr>
<tr>
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<td>ANSI/ASME B16.44</td>
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<tr>
<td></td>
<td>ANSI/ASME B16.33 marked 125 G</td>
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<td>ANSI LC 4/CSA 6.32</td>
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<tr>
<td>Valve up to 1/2 psi</td>
<td>ANSI/ASME B16.44</td>
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<td>ANSI/ASME B16.33 marked 125 G</td>
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<td></td>
<td>ANSI LC 4/CSA 6.32</td>
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<tr>
<td>Valve up to 2 psi</td>
<td>ANSI/ASME B16.44 labeled 2G</td>
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<td>ANSI/ASME B16.33 marked 125 G</td>
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<td>ANSI/ASME B16.44 labeled 5G</td>
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<td>ANSI LC 4/CSA 6.32 with ANSI/ASME B16.33 marked 125 G</td>
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<td>Valve up to 125 psi</td>
<td>ANSI/ASME B16.33 marked 125 G</td>
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1310.14.5 Installation of Gas-Mixing Machines. Installation of gas-mixing machines shall comply with Section 1310.14.5.1 through 1310.14.5.5.

1310.14.5.1 Location. The gas-mixing machine shall be located in a well-ventilated area or in a detached building or cutoff room provided with room construction and explosion vents in accordance with engineering methods. Such rooms or below-grade installations shall have adequate positive ventilation. [NFPA 54:7.11.5.1]

1310.14.5.2 Electrical Requirements. Where gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be in accordance with NFPA 70 for general service conditions unless other hazards in the area prevail. Where gas-mixing machines are installed in small detached buildings or cutoff rooms, the electrical equipment and wiring shall be installed in accordance with NFPA 70 for hazardous locations (Articles 500 and 501, Class I, Division 2). [NFPA 54:7.11.5.2]

1310.14.5.3 Air Intakes. Air intakes for gas-mixing machines using compressors or blowers shall be taken from outdoors whenever practical. [NFPA 54:7.11.5.3]

1310.14.5.4 Controls. Controls for gas-mixing machines shall include interlocks and a safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in the event of high or low gas pressure. Except for open burner installations only, the controls shall be interlocked so that the blower or compressor stops operating following a gas supply failure. Where a system employs pressurized air, means shall be provided to shut off the gas supply in the event of air failure. [NFPA 54:7.11.5.4]

1310.14.5.5 Installation in Parallel. Centrifugal gas-mixing machines in parallel shall be reviewed by the user and equipment manufacturer before installation, and means or plans for minimizing the effects of downstream pulsation and equipment overload shall be prepared and utilized as needed. [NFPA 54:7.11.5.5]

1311.0 Electrical Bonding and Grounding.
1311.4 Prohibited Use. Gas piping shall not be used as a grounding conductor or electrode. [NFPA 54:7.12.4.1]

1312.0 Appliance and Equipment Connections to Building Piping.
1312.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1312.6 through Section 1312.8 by one of the following:
1. Rigid metallic pipe and fittings.
2. Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
3. A connector for gas appliances listed in accordance with CSA Z21.24. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
4. A connector for outdoor gas appliances and manufactured homes listed in accordance with CSA Z21.75. Only one connector shall be used per appliance.
5. CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
6. Listed nonmetallic gas hose connectors in accordance with Section 1312.3.
7. Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1312.4. [NFPA 54:9.6.1]

1312.1.1 Food Service Appliance Connectors. Connectors used with food service appliances that are moved for cleaning and sanitation purposes shall be installed in accordance with the connector manufacturer’s installation instructions. Such connectors shall be listed in accordance with CSA Z21.69. [NFPA 54:9.6.1.3]

1312.7 Quick-Disconnect Devices. Quick-disconnect devices used to connect appliances to the building piping shall be listed in accordance with CSA Z21.41. Where installed indoors, an approved manual shutoff valve with a nondisplaceable valve member shall be installed upstream of the quick-disconnect device. [NFPA 54:9.6.6 – 9.6.6.2]

**TABLE 1308.4.1**
APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES
[NFPA 54: TABLE A.5.3.2.1]

**TABLE 1308.5.6.2**
SPECIFICATIONS FOR THREADING METALLIC PIPE
[NFPA 54: TABLE 5.5.6.3]

**TABLE 1310.3.5.1**
### SUPPORT OF PIPING

**[NFPA 54: TABLE 7.2.6.2]**

<table>
<thead>
<tr>
<th>STEEL PIPE, NOMINAL SIZE OF PIPE (inches)</th>
<th>SPACING OF SUPPORTS (feet)</th>
<th>NOMINAL SIZE OF TUBING SMOOTH WALL (inches O.D.)</th>
<th>SPACING OF SUPPORTS (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>6</td>
<td>1/2</td>
<td>4</td>
</tr>
<tr>
<td>3/4 or 1</td>
<td>8</td>
<td>5/8 or 3/4</td>
<td>6</td>
</tr>
<tr>
<td>1 1/4 or larger (horizontal)</td>
<td>10</td>
<td>7/8 or 1 (horizontal)</td>
<td>8</td>
</tr>
<tr>
<td>1 1/4 or larger (vertical)</td>
<td>Every floor level</td>
<td>1 or larger (vertical)</td>
<td>Every floor level</td>
</tr>
</tbody>
</table>

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

### TABLE 1313.6.1

**SIZE AND LENGTH OF PIPING**

**[NFPA 54: TABLE 8.3.1]**

*(portion of table not shown remains unchanged)*

* CSST EHD size of 62 is equivalent to 2 inch (50 mm) nominal size pipe or tubing.

### TABLE 1315.2(27)

**SCHEDULE 40 METALLIC PIPE**

**[NFPA 54: TABLE 6.3.1(d)]**

<table>
<thead>
<tr>
<th>GAS: UNDILUTED PROPANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INLET PRESSURE: 11.0 In. w.c.</td>
</tr>
<tr>
<td>PRESSURE DROP: 0.5 In. w.c.</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY: 1.50</td>
</tr>
</tbody>
</table>

**INTENDED USE: PIPE SIZING BETWEEN SINGLE- OR SECOND-STAGE (LOW-PRESSURE) REGULATOR AND APPLIANCE.**

<table>
<thead>
<tr>
<th>NOMINAL INSIDE</th>
<th>PIPE SIZE (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>3/4</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1 1/4</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1 1/2</td>
</tr>
<tr>
<td>2</td>
<td>2 1/2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<p>| ACTUAL: 0.622 0.824 1.049 1.380 1.610 2.067 2.469 3.068 4.026 |</p>
<table>
<thead>
<tr>
<th>CAPACITY IN THOUSANDS OF BTU PER HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>125 150 175 200 250 300 350 400 450 500</td>
</tr>
</tbody>
</table>
**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME B16.33-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 through NPS 2)</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
<tr>
<td>ASME B16.44-2012 (R2017)</td>
<td>Manually Operated Metallic Gas Valves for Use in Above Ground Piping Systems up to 5 psi</td>
<td>Valves</td>
<td>Table 1308.13</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**COMMITTEE STATEMENT:**

There is no technical justification provided for changing the gas piping elevation to 3-1/2 inches above the roof surface. For example, 2x4 lumber has been used for years to elevate gas piping on roofs and is considered acceptable by the industry.

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 274, Section 1308.5.4.1 (Regulator Vent Piping) and UPC Item # 246, Section 1208.6.6 (Regulator Vent Piping); UMC Item # 274, Section 1308.5.6.3 (Thread Joint Sealing) and UPC Item # 246, Section 1208.6.9.3 (Thread Joint Sealing); UMC Item # 274, Section 1310.3 (Installation of Aboveground Piping) and UPC Item # 246, Section 1210.3 (Installation of Aboveground Piping); UMC Item # 274, Section 1310.3.5.3 (Piping on Roofs) and UPC Item # 246, Section 1210.3.5.3 (Piping on Roofs); and UMC Item # 274, Section 1312.1 (Connecting Appliances and Equipment) and 1312.2 (Suspended Low-Intensity Infrared Tube Heaters) and UPC Section 1212.2 (Suspended Low-Intensity Infrared Tube Heaters) all resulted in conflicting language between the
codes. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

1308.5.4.1 Regulator Vent Piping. Plastic pipe and fittings used to connect regulator vents to remote vent terminations shall be PVC (Schedule 40 and 80) conforming to UL 651. PVC vent piping shall not be installed indoors. {{NFPA 54:5.5.4.2}}

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
</tr>
<tr>
<td>UL 651-2011</td>
<td>Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings (with revisions through June 15, 2016)</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

1308.5.6.3  Thread Joint Sealing. Threaded joints shall be made using a thread joint sealing material. [NFPA 54: 5.5.6.4.1] Thread joint sealing materials shall be compatible with the pipe and fitting material on which the compounds are used. [NFPA 54: 5.5.6.4.2] Thread joint sealing materials shall be nonhardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping. {{NFPA 54:5.5.6.4.3}}

1310.3 Installation of Aboveground Piping. Piping installed aboveground shall comply with all of the following:
(1) Piping shall be securely supported and located where it will be protected from physical damage.
(2) Where passing through an exterior wall, the piping shall also be protected from corrosion by coating or wrapping with an inert material approved for such applications.
(3) The piping shall be sealed around its circumference at the point of the exterior penetration to prevent the entry of water, insects, and rodents.
(4) Where piping is encased in a protective pipe sleeve, the annular spaces between the gas piping and the sleeve and between the sleeve and the wall opening shall be sealed.
(5) **Piping installed outdoors shall be elevated not less than 3½ inches (89 mm) above the ground.**

1310.3.5.3 Piping on Roofs. Gas piping installed on the roof surfaces shall be elevated above the roof surface and shall be supported in accordance with Table 1310.3.5.1. Gas piping shall be elevated not less than 3½ inches (89 mm) above the roof surface. {{NFPA 54-2018:7.2.6.4.1, 7.2.6.4.2}}

1312.1 Connecting Appliances and Equipment. Appliances and equipment shall be connected to the building piping in compliance with Section 1312.6 through Section 1312.8 by one of the following:
(1) Rigid metallic pipe and fittings.
(2) Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
(3) A connector for gas appliances listed in accordance with ANSI Z21.24/CSA 6.27 CSA-Z21.24. The connector shall be used in accordance with the manufacturer’s installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
(4) A connector for outdoor gas appliances and manufactured homes listed in accordance with ANSI Z21.75/CSA 6.27 CSA-Z21.75. Only one connector shall be used per appliance.
(5) CSST where installed in accordance with the manufacturer’s installation instructions. CSST shall not be directly routed into a metallic appliance enclosure where the appliance is connected to a metallic vent that terminates above a roofline. CSST shall connect only to appliances that are fixed in place.
(6) Listed nonmetallic gas hose connectors in accordance with Section 1312.3.
(7) Unlisted gas hose connectors for use in laboratories and educational facilities in accordance with Section 1312.4. [NFPA 54:9.6.1]

1312.2 Suspended Low-Intensity Infrared Tube Heaters. Suspended low-intensity infrared tube heaters shall be connected to the building piping system with a connector listed for the application in accordance with ANSI Z21.24/CSA 6.27 CSA-Z21.24 as follows:
(1) The connector shall be installed in accordance with the tube heater installation instructions, and shall be in the same room as the appliance.
(2) Only one connector shall be used per appliance. [NFPA 54:9.6.1.5]
TCC ACTION: ACCEPT AS SUBMITTED

TCC STATEMENT:
The language in UMC Item # 274, Section 1308.5.4.1 (Regulator Vent Piping) is being revised to correlate with the action taken by the UPC TC for Item # 246, Section 1208.6.6 (Regulator Vent Piping) with regards to the addition of "Schedule 40 and 80" and striking the UL 651 standard. Additionally, the UL 651 standard is being stricken from Table 1701.1 (Referenced Standards) for both the UPC and UMC.

The language in UMC Item # 274, Section 1308.5.6.3 (Thread Joint Sealing) is being revised to correlate with the action taken by the UPC TC for Item # 246, Section 1208.6.9.3 (Thread Joint Sealing) by striking the language pertaining to "nonhardening."

The language in UMC Item # 274, Section 1310.3 (Installation of Aboveground Piping) is being revised to correlate with the action taken by the UPC TC for Item # 246, Section 1210.3 (Installation of Aboveground Piping) with regards to elevating piping installed outdoors to not less than 3 ½ inches above the ground.

The language in UMC Item # 274, Section 1310.3.5.3 (Piping on Roofs) is being revised to correlate with the action taken by the UPC TC for Item # 246, Section 1210.3.5.3 (Piping on Roofs) with regards to elevating gas piping installed on roofs to not less than 3 ½ inches above the roof surface.

Lastly, the language in UMC Item # 274, Section 1312.1 (Connecting Appliances and Equipment) and 1312.2 (Suspended Low-Intensity Infrared Tube Heaters) and UPC Section 1212.2 (Suspended Low-Intensity Infrared Tube Heaters) are being revised to correlate with the action taken by the UPC TC for Item # 246, Section 1212.1 (Connecting Appliances and Equipment) regarding the designation of the CSA standards.

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section 1308.5.4.1 by adding "Schedule 40 and 80" and striking of the UL 651 standard; Section 1308.5.6.3 by striking the language pertaining to "nonhardening"; Section 1310.3 by modifying the text regarding elevating piping installed outdoors to not less than 3 ½ inches above the ground; Section 1310.3.5.3 by modifying the text regarding elevating gas piping installed on roofs to not less than 3 ½ inches above the roof surface; and Section 1312.1 and Section 1312.2 by updating the designation of the CSA standard.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1312.1.1
SUBMITTER: IAPMO Staff - Update Extracts
NFPA 54 Extract Update
Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1312.0 Appliance and Equipment Connections to Building Piping.
1312.1 Connecting Appliances and Equipment. (remaining text unchanged)

1312.1.1 Protection of Connectors. Connectors and tubing addressed in Section 1312.1(2), Section 1312.1(3), Section 1312.1(4), Section 1312.1(5), and Section 1312.1(6) shall be installed to be protected against physical and thermal damage. Aluminum alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as detergents, sewage, or water other than rainwater. [NFPA 54:9.6.1.1]

Materials addressed in Section 1312.1(2), Section 1312.1(3), Section 1312.1(4), Section 1312.1(5), and Section 1312.1(6) shall not be installed through an opening in an appliance housing, cabinet, or casing, unless the tubing or connector is protected against damage. [NFPA 54:9.6.1.2]
SUBSTANTIATION:
The above sections have been revised to correlate with NFPA 54-2021 (latest version) in accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines).
Proposals

Item #: 275

UMC 2024 Section: 1301.1, Table 1701.1

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

1301.0 Scope of Gas Piping.
1301.1 Applicability. The regulations of this chapter shall govern the installation of fuel gas piping in or in connection with a building, structure or within the property lines of premises up to 5 pounds-force per square inch (psi) (34 kPa) for natural gas and 10 psi (69 kPa) for undiluted propane, other than service pipe. Fuel oil piping systems shall be installed in accordance with NFPA 31 and the manufacturer’s installation instructions. Above-ground piping systems shall be listed and labeled in accordance with UL 1369. Metallic underground piping systems shall be listed and labeled in accordance with UL 971A. Non-metallic underground piping systems shall be listed and labeled in accordance with UL 971.

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 971-1995</td>
<td>Nonmetallic Underground Piping for Flammable Liquids (with revisions through March 2, 2006)</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
<tr>
<td>UL 971A-2006</td>
<td>Outline of Investigation for Metallic Underground Fuel Pipe</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
<tr>
<td>UL 1369-2018</td>
<td>Aboveground Piping for Flammable and Combustible Liquids (with revisions through August 25, 2020)</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: UL 1369 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

Note: UL 971 and UL 971A were not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION: Applicable standards for above ground and below ground piping are being added to Section 1301.1 to clarify the requirements for such applications to aid the code official in verifying safe installation for such systems.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT: The proposal is being rejected as the proposed gas piping standards for above-ground and underground piping are not needed for the enforcement of such systems.

TOTAL ELIGIBLE TO VOTE: 30
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1301.1, Table 1801.1
SUBMITTER: John Taecker  UL LLC

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1301.0 Scope of Gas Piping.

1301.1 Applicability. The regulations of this chapter shall govern the installation of fuel gas piping in or in connection with a building, structure or within the property lines of premises up to 5 pounds-force per square inch (psi) (34 kPa) for natural gas and 10 psi (69 kPa) for undiluted propane, other than service pipe. Fuel oil piping systems shall be installed in accordance with NFPA 31 and the manufacturer’s installation instructions. Above-ground piping systems shall comply with UL 1369. Metallic underground piping systems shall comply with UL 971A. Non-metallic underground piping systems shall comply with UL 971.

<table>
<thead>
<tr>
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<tr>
<td>UL 971-1995</td>
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<td>1301.1</td>
</tr>
<tr>
<td>UL 971A-2006</td>
<td>Metallic Underground Fuel Pipe</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
<tr>
<td>UL 1369-2018</td>
<td>Aboveground Piping for Flammable and Combustible Liquids (with revisions through August 25, 2020)</td>
<td>Gas Piping</td>
<td>1301.1</td>
</tr>
</tbody>
</table>

Note: UL 1369 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: UL 971 and UL 971A were not developed via an open process having a published development procedure in accordance with Section 3-3.7.1.2 of IAPMO’s Regulations Governing Committee Projects.
SUBSTANTIATION:
Applicable standards for above ground and below ground piping are being added to Section 1301.1 to clarify the requirements for such applications to aid the code official in verifying safe installation for such systems.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

In regards to IAPMO staff's note regarding the development of UL 971 and UL 971A, as stated in the Section 3-3.7.1.3, ‘IAPMO's Regulations Governing Committee Projects,’ the TC is permitted to allow standards that were not developed by an open consensus process. Such referenced standards are still required to be written in mandatory language in order to be enforceable. UL 8782 is written using mandatory language.

Sections below are taken from IAPMO's Regulations Governing Committee Projects for reference:

3-3.7.1.2 Mandatory standards referenced in IAPMO codes and standards shall be developed via an open process having a published development procedure. the development procedure shall include a means for obtaining divergent views, if any. the development procedure shall include a means of achieving consensus for the resolution of divergent views and objections.

3-3.7.1.3 Mandatory standards referenced in IAPMO codes and standards not complying with 3-3.7.1.2 are permitted. However, in such instances the TC shall determine that the mandatory standard is appropriate for reference. the TC shall verify the standard is written in mandatory language, is identifiable by title, date or edition, and developing organization, and that it is readily available. any mandatory standard proposed for reference on the basis of this paragraph shall be specifically identified as not complying with 3 3.7.1.2 in a ROP or ROC.

Per the TC recommendation, the term “listed and labeled” is being modified to “comply” in accordance with IAPMO's Manual of Style.
Proposals

Item #: 279

UMC 2024  Section: 1308.5.3.5, Table 1701.1

SUBMITTER: Robert Torbin
OmegaFlex

RECOMMENDATION:
Revise text

1308.5.2 Metallic Pipe.

1308.5.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1. [NFPA 54:5.6.3.6] Corrugated stainless steel tubing shall also comply with IAPMO IGC 201 when a listed encasement system is required.

TABLE 1701.1 REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAPMO IGC 201-2018</td>
<td>Polyethylene Sleeved-Corrugated Stainless-Steel Tubing for use in Fuel Gas Piping Systems</td>
<td>Gas Tubing</td>
<td>1308.5.3.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 201 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed standard covers polyethylene sleeved-corrugated stainless steel tubing (CSST) which is used in fuel gas systems. PE sleeved CSST have been tested and installed for over 10 years and continues to be installed today. Reference to the proper standard for this product will ensure public health and safety by clearly identifying products that are approved for this application assisting to the installers, inspectors, and other end users of the code.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposal is being rejected as the term "encasement" may be misinterpreted to be a conduit.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:
BALLANCO: This change has merit, however, it needs to be better worded to clarify when the standard applies.
PUBLIC COMMENT 1

Item #: 279
Code Year: 2024 UMC Section #: 1308.4.3.5, Table 1801.1

SUBMITTER: Phillip H Ribbs
PHR Consultants

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1308.4.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC-1 and IAPMO IGC 201. ([NFPA 54:5.5.3.6])

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
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<td>1308.4.3.5</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: IAPMO IGC 201 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed standard covers polyethylene sleeved-corrugated stainless steel tubing (CSST) which is used in fuel gas systems. PE sleeved CSST have been tested and installed for over 10 years. Reference to the proper standards for this product will ensure public health and safety by clearly identifying products that are approved for fuel gas piping systems.

PUBLIC COMMENT 2

Item #: 279
Code Year: 2024 UMC Section #: 1308.5.4.5, Table 1801.1

SUBMITTER: Robert N Torbin
OmegaFlex

RECOMMENDATION:
Revise text

Request to replace the code change proposal by this public comment.

1308.4.3.5 Corrugated Stainless Steel Tubing. Corrugated stainless steel tubing shall be listed in accordance with CSA LC 1. [NFPA 54:5.5.3.6] Corrugated stainless steel tubing shall also comply with IAPMO IGC 201 when installed in accordance with Section 1310.1.6(2).

(below shown for reference only)

1310.1.6 Piping Underground Beneath Buildings. Where gas piping is installed underground beneath buildings, the piping shall be either of the following:
(1) Encased in an approved conduit designed to withstand the imposed loads and installed in accordance with Section 1310.1.6.1 or Section 1310.1.6.2.
(2) A piping/encasement system listed for installation beneath buildings. [NFPA 54:7.1.6]

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>
Note: IAPMO IGC 201 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The proposed IAPMO standard covers polyethylene sleeved-corrugated stainless steel tubing (CSST) which is listed for use in fuel gas systems. PE sleeved CSST have been tested and listed by IAPMO R&T for over 10 years and is currently installed throughout the United States. Reference to the IAPMO standard for this product will ensure public health and safety by clearly identifying products that are approved for underground application assisting the installers, inspectors, and other end users of the code.
Chapter 17

Indoor Cannabis and Horticultural Facilities

1701.0 General.
1701.1 Indoor Spaces. Indoor spaces using environmental controls for cannabis and horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall comply with this section. Equipment and appliances shall be installed in accordance with the manufacturer’s installation instructions and this code. Piping, tubing, materials, and structures shall be protected in accordance with Section 316.0.

1702.0 Classification of Facilities.
1702.1 General. Facilities used for indoor cannabis and horticultural cultivation and processing shall be as classified in accordance with the building code, the electrical code, and the Authority Having Jurisdiction.
1702.2 Approved Locations. Facilities used for indoor cannabis and horticultural cultivation and processing shall be located in accordance with the building code and the Authority Having Jurisdiction.

1703.0 Documentation.
1703.1 General. Documentation for permitting shall be provided in accordance with the requirements of Section 104.0 and the Authority Having Jurisdiction. The documentation shall show compliance with this section and other requirements in accordance with the Authority Having Jurisdiction.

1704.0 Fire Protection.
1704.1 General. Fire protection shall be provided for indoor cannabis and horticultural facilities in accordance with the building code, fire code, Section 1704.1.1 through Section 1704.1.3, and the Authority Having Jurisdiction.
1704.1.1 Smoke Detectors and Fire Alarms. Smoke detectors, heat detectors, and fire alarms shall be provided in accordance with NFPA 72 and shall provide visible and audible notification. Smoke detectors shall comply with UL 268. In spaces where smoke detectors cannot be utilized due to ambient conditions, approved automatic heat detectors shall be permitted in lieu of smoke detectors in accordance with Section 1704.2.
1704.1.2 Heat Detectors. Where ambient conditions prohibit installation of smoke detectors, an automatic heat detector in accordance with UL 521 shall be permitted where approved by the Authority Having Jurisdiction.
1704.1.3 Fire Suppression. Where fire suppression is required, an automatic fire suppression system shall be provided within hoods, enclosures, and ductwork in accordance with the following:
(1) A carbon dioxide extinguishing system in accordance with NFPA 12.
(2) An automatic water sprinkler system in accordance with NFPA 13.
(3) A dry chemical extinguishing system in accordance with NFPA 17.

1705.0 Carbon Dioxide Detection System.
1705.1 General. A gas detection system shall be provided in indoor spaces using a carbon dioxide enrichment process.
in indoor spaces where carbon dioxide containers and/or generating systems are located, and in other adjoining indoor spaces where fugitive carbon dioxide is expected to accumulate. The gas detection system shall activate audible alarms distinguishable from the fire alarm system and visual alarms with visual notification and shall be calibrated for the types of fuels or gases used.

1705.1.1 Listings. The gas detection control units shall comply with UL 864 or UL 2017. Gas detectors shall comply with UL 2075.

1705.1.2 Carbon Dioxide Sensor Location. Carbon dioxide sensors shall be located not more than 12 inches (305 mm) above the finished floor.

1705.1.3 Activation. Activation of the gas detection system shall be in accordance with Section 1705.1.3.1 through Section 1705.1.3.2.

1705.1.3.1 Low-Level Activation. Upon detection of a carbon dioxide concentration of 5,000 ppm (9000 mg/m³), the following shall be automatically performed:
1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate an audible and visual supervisory alarm signal at an approved location within the facility.

1705.1.3.2 High-Level Activation. Upon detection of a carbon dioxide concentration of 30,000 ppm (54 000 mg/m³), the following shall be automatically performed:
1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate audible and visual alarms inside and outside of the indoor space using a carbon dioxide enrichment process, and inside and outside the space where carbon dioxide containers, generating systems, or both are located. Visual notification of the carbon dioxide alarms shall be colored as required by the Authority Having Jurisdiction.

1705.2 Carbon Dioxide Enrichment System. Indoor spaces using a carbon dioxide enrichment process shall have carbon dioxide detectors, audible and visual alarms, and mechanical purge ventilation with odor control which shall independently exhaust directly to the exterior. The design, installation, and maintenance of carbon dioxide enrichment systems with more than 100 pounds (45.4 kg) of carbon dioxide, and carbon dioxide enrichment systems with any quantity of carbon dioxide having a remote fill connection shall comply with Sections 1705.2.1 through 1705.2.3.

1705.2.1 Equipment. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use and handling of the carbon dioxide shall be in accordance with this section and NFPA 55.

1705.2.2 Carbon Dioxide Control. Indoor spaces using a carbon dioxide enrichment process shall be maintained with a negative pressure in relation to adjoining indoor spaces or with a positive pressure and intervening entrance/exit pressurization vestibules with the adjoining indoor spaces.

1705.2.3 Carbon Dioxide Supply Piping. Carbon dioxide supply piping shall be in accordance with ASME B31.3.

1706.0 Flammable Solvents.

1706.1 General. Processes using flammable solvents shall be provided with a flammable gas detection system in accordance with the fire code. The flammable gas detection system shall be installed in accordance with the manufacturer’s installation instructions and shall not be interlocked with other equipment. The flammable gas detection system shall be calibrated to detect gas levels of not more than 10 percent of the Lower Flammable Limit (LFL) and to activate audible and visual alarms of not more than 25 percent of the LFL.

1706.2 Control Area. Pumps, motors, chemical fume hoods, equipment, and wiring in control areas and containment booths used for flammable solvent processing shall be as Class 1/Division 1 location for potentially explosive gas and vapor Groups A, B, C, and D in accordance with NFPA 70. Containment booths shall be listed and labeled in accordance with UL 1389.

1706.3 Extraction Equipment. Extraction equipment using flammable solvents and located in an indoor space shall be listed for the intended use. Plant extraction booths shall comply with UL 1389. Extraction equipment using LPG, Butane or other volatile solvents shall be a closed-loop control system and shall comply with ASME BPVC Section VIII.1, ASME B31.3, and NFPA 58, as applicable.

1707.0 Ventilation and Exhaust System.

1707.1 General. The indoor air quality in indoor spaces using environmental controls for cannabis and horticultural cultivation, and processing shall comply with Chapter 4 and Section 1707.1.1. The ventilation and exhaust system shall comply with Section 1707.1.2 through Section 1707.1.6. Indoor spaces used for cannabis and horticultural cultivation shall have an independent ventilation system.

1707.1.1 Breathing Zone Outdoor Airflow Rate. The outdoor airflow required in the breathing zone \(V_{bz}\) of the occupiable space or spaces in a ventilation zone shall be not less than the value determined in accordance with Equation 1707.1.1.

\[
V_{bz} = Rp\cdot Pz + Ra\cdot Az \quad \text{(Equation 1707.1.1)}
\]

Where:
Particulates and odors from indoor cannabis and horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall be filtered and controlled so that it is not detectable above nuisance levels not exceeding applicable exposure limits at the exterior of the facility or at adjoining properties or as required by the Authority Having Jurisdiction. Odor control shall be required in the exhaust system and shall include, but not be limited to, one of the following types:

1. Charcoal filters shall be installed on the discharge of all exhaust ducts and shall be installed in accordance with the manufacturer’s installation instructions.
2. Ozone generators shall be installed in all exhaust ducts to neutralize odor by oxidizing such odors with ozone.

Sample Calculation: Determine the outdoor airflow required in the breathing zone (Vbz) of an indoor space used for cannabis cultivation with an occupiable floor area of 800 square feet and a maximum of 5 people expected to occupy the zone.

Sample Solution:

\[
V_{bz} = R_{p}P_{z} + R_{a}A_{z}
\]

\[
V_{bz} = (60 \text{ CFM/person} \times 5 \text{ people}) + (1 \text{ CFM} \times 800 \text{ SF})
\]

\[
V_{bz} = 1,100 \text{ CFM. The ventilation system shall be capable of providing not less than 1,100 CFM of outdoor air.}
\]

1707.1.2 Ventilation System Requirements. When activated by the gas detection system required by Section 1705.1, the mechanical purge ventilation system shall remain on until manually reset. The purge ventilation system ducting shall terminate outdoors in an approved location. The ventilation system shall be designed to operate at a negative pressure of 0.01 inches water column (0.02 kPa) in relation to the exhausted indoor space.

1707.1.3 Ventilation for Indoor Cultivation and Storage Spaces. Indoor spaces used for cannabis and horticultural cultivation and processing shall be provided with ventilation in accordance with Section 402.2. Where mechanical ventilation is provided, the systems shall be operational when the indoor space(s) are occupied. Air in indoor cultivation and storage spaces shall be classified as Class 2 Air in accordance with Section 403.9.2.

1707.1.4 Exhaust Ventilation Rate. The exhaust and ventilation system required in this section shall not create a lesser standard of installation than prescribed by the minimum safety standards adopted by the Authority Having Jurisdiction. Exhaust airflow shall be provided at not less than 0.2 CFM/ft² [0.001016 (m³/s)/m²] of floor area. Exhaust air shall not be used as makeup air, recirculated air, or transfer air. Makeup air shall be provided for more than 150 CFM exhaust.

1707.1.5 Exhaust System Requirements. An exhaust system shall be installed in accordance with Section 505.0 and the following requirements:

1. Exhaust outlet location(s) in accordance with Section 502.2.2 for product conveying ducts as classified in Section 505.8.
2. Exhaust air shall terminate directly to the outdoors.
3. The exhaust inlet shall be not less than 12 inches (305 mm) above the finished floor.
4. Chemical fume hoods shall be required for flammable solvent processing, shall be listed, and shall be installed in accordance with the manufacturer’s installation instructions.
5. Exhaust ducts shall be independent of all other exhaust systems.

1707.1.6 Automatic Shutoff. Automatic shutoff in air moving systems shall be provided in accordance with Section 608.0.

1708.0 Particulate and Odor Control.

1708.1 General. Particulates and odors from indoor cannabis and horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall be filtered and controlled so that it is not detectable above nuisance levels not exceeding applicable exposure limits at the exterior of the facility or at adjoining properties or as required by the Authority Having Jurisdiction. Odor control shall be required in the exhaust system and shall include, but not be limited to, one of the following types:

1. Charcoal filters shall be installed on the discharge of all exhaust ducts and shall be installed in accordance with the manufacturer’s installation instructions.
2. Ozone generators shall be installed in all exhaust ducts to neutralize odor by oxidizing such odors with ozone.
3. Ionizers shall be installed in accordance with the manufacturer’s installation instructions.
4. Photo-catalytic oxidation shall be installed in accordance with the manufacturer’s installation instructions.
5. Photo-hydroxyl oxidation shall be installed in accordance with the manufacturer’s installation instructions.
6. Carbon filtration shall be installed in accordance with the manufacturer’s installation instructions.
7. UV-C lights shall be installed in accordance with the manufacturer’s installation instructions.
8. Where approved by the Authority Having Jurisdiction, a plume discharge termination method shall be permitted to be used for odor control. The exhaust fan of such a system shall discharge exhaust air vertically into the outdoors. The plume heights shall be not less than 20 feet above the nozzle. Escaping air at the nozzle shall be no less than 3,000 feet per minute.

1708.2 Filters. Where filters are used, the minimum filtration rate shall be in accordance with Equation 1709.2. The design airflow velocity across the face area of the chemical absorption filter(s) shall not exceed 350 feet per minute (1.8 m/s).
Minimum Filtration Rate = (Room Volume)/3 \hspace{1cm} \text{(Equation 1709.2)}

1709.0 Duct Construction and Installation.
1709.1 General. Ducts shall be in accordance with Section 506.0 and Chapter 6. Ducts less than 18 inches (457 mm) in diameter shall be constructed of rigid metal with a thickness of not less than 0.018 of an inch (0.457 mm) (26 gauge). Ducts greater than 18 inches (457 mm) in diameter shall be constructed of rigid metal with a thickness of not less than 0.024 of an inch (0.508 mm) (24 gauge). All ducts and duct connections shall be mechanically fastened and supported in accordance with Chapter 6 at intervals not exceeding 12 feet (3658 mm). Where approved by the Authority Having Jurisdiction, flexible air ducts shall be permitted in accordance with Section 603.4.

1710.0 Motors and Fans.
1710.1 General. Motors and fans used shall comply with the applicable requirements in Section 503.0.

1711.0 Storage of Chemicals.
1711.1 General. Storage of chemicals shall comply with the building code and fire code, and NFPA 58 for liquid petroleum gas and NFPA 400 for the storage, use and handling of hazardous materials. Hazardous, combustible, and flammable materials shall not be stored in cultivation rooms.

1712.0 Walls and Ceilings.
1712.1 General. Walls and ceilings of indoor spaces used for cannabis and horticultural cultivation shall be in accordance with the following requirements:
(1) Be of corrosion resistant materials.
(2) Include air and vapor barriers.
(3) Be insulated in accordance with the building code.

1713.0 Dehumidification.
1713.1 General. Dehumidification shall be required to maintain humidity levels in accordance with the requirements of the Authority Having Jurisdiction, cultivator, and equipment listing. Dehumidification shall be permitted to be accomplished by means of standalone dehumidifiers, desiccant wheels, or reheat coils.

1714.0 Fumigation.
1714.1 General. Any cannabis or horticultural growing facility that is fumigated shall comply with Section 1714.1.1 through Section 1714.1.3 and the Authority Having Jurisdiction.
1714.1.1 Sources of Ignition. Areas intended to be fumigated shall not contained any open flames or any other sources of ignition.
1714.1.2 Fumigation Activity Warning. Areas and entrances to areas intended for fumigation, repellant, pesticide, or insecticide fogging operation shall be clearly marked to indicate fumigation activity.
1714.1.3 Ventilation. Areas intended for fumigation shall be continuously mechanically ventilated in accordance with Section 1707.0.

1715.0 Luminaires.
1715.1 General. Horticultural lighting equipment and systems used for indoor cannabis and horticultural cultivation shall be listed and labeled in accordance with UL 8800. Luminaires installed in ductwork shall be installed in accordance with NFPA 90A and the manufacturer’s installation instructions.

1716.0 Signage.
1716.1 General. Caution or warning signs complying with NFPA 704 shall be provided at the entrance of the facility and/or indoor spaces identifying hazards such as flammables, asphyxiants, and toxics.

205.0 – C –
Cannabis Facility. A business, facility, or establishment where retail Cannabis is grown, cultivated, tested, stored, dried, extracted, weighed, packaged, sold, or processed, including dispensaries, cultivators, manufacturers, distributors, or testing laboratories.
Cultivation Room. A room of any size where plants are grown under controlled conditions. Also known as a grow room.

207.0 – E –
Extraction Equipment. Equipment used to extract cannabinoids such as tetrahydrocannabinol (THC), cannabidiol (CBD), and terpenes from cannabis plants.
Extraction Equipment, Non-Volatile. Extraction equipment utilizing any solvent that is not considered volatile (i.e., carbon dioxide).
Extraction Equipment, Volatile. Extraction equipment utilizing any solvent that is considered flammable and hazardous
(i.e., Butane, propane, hexene, or ethanol).

209.0 – G –
Gas Detection Control Units. A digital or analog controller that continuously monitors the presence of toxic, anoxic, and explosive gases in the ambient air to prevent the risks of explosion linked to such gases.

211.0 – I –
Indoor Horticulture. The cultivation and processing of floricultural and horticultural plants, including cannabis, in an indoor space by controlling various interior environmental variables including, but not limited to, temperature, air quality, humidity, artificial lighting, nutrients, and carbon dioxide.

### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 55-2020</td>
<td>Compressed Gases and Cryogenic Fluids Code</td>
<td>Compressed Gases</td>
<td>1705.2.1</td>
</tr>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
<td>1704.1.1</td>
</tr>
<tr>
<td>NFPA 2001-2018</td>
<td>Clean Agent Fire Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>1704.1.3</td>
</tr>
<tr>
<td>UL 268-2016</td>
<td>Smoke Detectors for Fire Alarm Systems (with revisions through October 31, 2019)</td>
<td>Smoke Detectors</td>
<td>1704.1.1</td>
</tr>
<tr>
<td>UL 864-2014</td>
<td>Control Units and Accessories for Fire Alarm Systems (with revisions through May 7, 2020)</td>
<td>Control Units</td>
<td>1705.1.1</td>
</tr>
<tr>
<td>UL 1389-2019</td>
<td>Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations (with revisions through October 13, 2020)</td>
<td>Plant Oil Extraction</td>
<td>1706.2, 1706.3</td>
</tr>
<tr>
<td>UL 2017-2008</td>
<td>General-Purpose Signaling Devices and Systems (with revisions through December 14, 2018)</td>
<td>Signaling Devices</td>
<td>1705.1.1</td>
</tr>
<tr>
<td>UL 2075-2013</td>
<td>Gas and Vapor Detectors and Sensors (with revisions through December 21, 2017)</td>
<td>Gas Detectors</td>
<td>1705.1.1</td>
</tr>
<tr>
<td>UL 8800-2019</td>
<td>Horticultural Lighting Equipment and Systems</td>
<td>Electrical</td>
<td>1715.1</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASME, NFPA, and UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**SUBSTANTIATION:**
This code change adds requirements for controlling the indoor environment of cannabis and horticulture facilities, including ventilation and exhaust rates, filter requirements, odor control, humidity control, and duct requirements. These HVAC requirements have been used by jurisdictions for cannabis and horticulture facilities and are commonly used in the industry. Growing plants transpire water vapor, causing very high humidity if not controlled, and creates a conducive environment for mold and pathogenic organisms. The basic necessities of cannabis are light, air, water, nutrients, a growing medium, and heat to create the necessary energy to grow. When growing indoors, the requirements are the same, though it is necessary that the indoor environment remain safe for occupants. To maximize public health and safety, safe indoor air quality conditions must be maintained.

**COMMITTEE ACTION:** REJECT

**COMMITTEE STATEMENT:**
The Technical Committee Chair called for the formation of a Task Group to further address "indoor horticulture facilities." There are concerns with the current language as written. For example, carbon dioxide enrichment systems is inadequate and may create health and safety concerns for occupants. There is no mention of what type
of detectors to be used. The proposed ventilation requirements may be inadequate. There may also be requirements missing for certain necessary systems for removal of flammable solvents when they reach the LFL. The language should be reworked by a task group.

Additionally, some proposed language may be outside the scope of the mechanical code. For example, fire protection and storage of chemicals be be better suited in the fire code. The provisions may also conflict with the fire code. In addition, there is no technical justification provided for the values listed in the proposal. Data needs to be included for review and evaluation. NFPA has developed an ANSI standard for cannabis facilities and should be reviewed.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

EXPLANATION OF AFFIRMATIVE:

TRAFTON, P; YOUNG: As discussed at the TC Meeting, I wish to participate in this task group for cultivation and processing facilities.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Appendix K  Item #: 283
SUBMITTER: Randy Young  Chair, UMC Indoor Horticulture Facilities Task Group  Comment #: 1

RECOMMENDATION:
Add new text
Request to replace the code change proposal by this public comment.

Appendix K
Indoor Horticultural Facilities

K 101.0 General.
K 101.1 Indoor Spaces. Indoor spaces using environmental controls for horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall comply with this section.
   Equipment and appliances shall be installed in accordance with the manufacturer’s installation instructions and this code. Piping, tubing, materials, and structures shall be protected in accordance with Section 316.0.
K 101.2 Plumbing Systems. Indoor horticulture plumbing systems shall be in accordance with the plumbing code.
K 101.3 Mechanical Systems. Indoor horticulture mechanical systems shall be in accordance with this code.
K 101.4 Fire Suppression Systems. Fire suppression systems shall be in accordance with the building code and Section K 501.1.3.

K 201.0 Definitions.
K 201.1 General. For the purpose of this appendix, the following definitions shall apply:
Horticulture Facility. A business, facility, or establishment where retail indoor horticulture is grown, cultivated, stored, dried, extracted, weighed, packaged, sold, or processed.
Cultivation Room. A room of any size where plants are grown under controlled conditions. Also known as a grow room.
Extraction Equipment. Equipment used to extract compounds, oils, extracts and proteins from plants. The processes include, but not limited to, the extraction by a solvent, desolvantizing, and distillation of the solvent.
   Extraction Equipment, Non-Volatile. Extraction equipment utilizing any solvent that is not considered volatile (i.e., carbon dioxide).
   Extraction Equipment, Volatile. Extraction equipment utilizing any solvent that is considered flammable and hazardous (i.e., Butane, propane, hexene, or ethanol).
Gas Detection Control Units. A digital or analog controller that continuously monitors the presence of toxic, anoxic, and explosive gases in the ambient air to prevent the risks of explosion linked to such gases.
**Indoor Horticulture.** The cultivation and processing of floricultural and horticultural plants in an indoor space by controlling various interior environmental variables including, but not limited to, temperature, air quality, humidity, artificial lighting, nutrients, and carbon dioxide.

**K 301.0 Classification of Facilities.**

**K 301.1 General.** Facilities used for indoor horticultural cultivation and processing shall be in accordance with the applicable codes as mandated by the Authority Having Jurisdiction.

**K 301.2 Approved Locations.** Facilities used for indoor horticultural cultivation and processing shall be located in accordance with the building code and the Authority Having Jurisdiction.

**K 401.0 Documentation.**

**K 401.1 General.** Documentation for permitting shall be provided in accordance with the requirements of Section 104.0 and the Authority Having Jurisdiction. The documentation shall show compliance with this section and other requirements in accordance with the Authority Having Jurisdiction.

**K 501.0 Fire Protection.**

**K 501.1 General.** Fire protection shall be provided for indoor horticultural facilities in accordance with the building code, fire code, Section K 501.1.1 through Section K 501.1.3, and the Authority Having Jurisdiction.

**K 501.1.1 Smoke Detectors and Fire Alarms.** Smoke detectors, heat detectors, and fire alarms shall be provided in accordance with NFPA 72 and shall provide visible and audible notification. Smoke detectors installed within ducts shall comply with UL 268. In spaces where smoke detectors cannot be utilized due to ambient conditions, approved automatic heat detectors shall be permitted in lieu of smoke detectors in accordance Section K 501.1.2.

**K 501.1.2 Heat Detectors.** Where ambient conditions prohibit installation of smoke detectors, an automatic heat detector in accordance with UL 521 shall be permitted where approved by the Authority Having Jurisdiction.

**K 501.1.3 Fire Suppression.** Where fire suppression is required by the fire code, an automatic fire suppression system shall be provided within hoods, enclosures, and ductwork in accordance with one of the following:

1. A carbon dioxide extinguishing system in accordance with NFPA 12.
2. An automatic water sprinkler system in accordance with NFPA 13.
3. A dry chemical extinguishing system in accordance with NFPA 17.
5. A fire suppression system as approved by the Authority Having Jurisdiction.

**K 601.0 Carbon Dioxide Detection System.**

**K 601.1 General.** A gas detection system shall be provided in indoor spaces using a carbon dioxide enrichment process, in indoor spaces where carbon dioxide containers or generating systems are located. The gas detection system shall activate audible alarms distinguishable from the fire alarm system and alarms with visual notification. Such alarms shall be calibrated for the types of fuels or gases used.

**K 601.1.1 Listings.** The gas detection control units shall comply with UL 864 or UL 2017. Gas detectors shall comply with UL 2075.

**K 601.1.2 Carbon Dioxide Sensor Location.** Carbon dioxide sensors shall be located within the breathable zone between 4 feet (1219 mm) to 6 feet (1829 mm) above the finished floor.

**K 601.1.3 Activation.** Activation of the gas detection system shall be in accordance with Section K 601.1.3.1 through Section K 601.1.3.2.

**K 601.1.3.1 Low-Level Activation.** Upon detection of a carbon dioxide concentration of 5,000 ppm (9000 mg/m³), the following shall be automatically performed:

1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate an audible and visual supervisory alarm signal at an approved location within the facility.

**K 601.1.3.2 High-Level Activation.** Upon detection of a carbon dioxide concentration of 30,000 ppm (54,000 mg/m³), the following shall be automatically performed:

1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate audible and visual alarms inside and outside where the following exist:
   a. An indoor space using a carbon dioxide enrichment process.
   b. Where carbon dioxide containers, generating systems are located.

**K 601.2 Carbon Dioxide Enrichment System.** Indoor spaces using a carbon dioxide enrichment process shall have a mechanical purge ventilation system and shall independently exhaust directly to the exterior. The design, installation, and maintenance of carbon dioxide enrichment systems with more than 100 pounds (45.4 kg) of carbon dioxide, and carbon dioxide enrichment systems having a remote fill connection shall comply with Sections K 601.2.1 through K 601.2.3.
K 601.2.1 Carbon Dioxide Systems. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use, and handling of the carbon dioxide shall be in accordance with this section and NFPA 55.

K 601.2.2 Carbon Dioxide Control. Indoor spaces using a carbon dioxide enrichment process shall be maintained with a negative pressure in relation to adjoining indoor spaces or with a positive pressure and intervening entrance/exit pressurization vestibules with the adjoining indoor spaces.

K 601.2.3 Carbon Dioxide Supply Piping. Carbon dioxide supply piping shall be in accordance with ASME B31.3.

K 701.0 Flammable Solvents.

K 701.1 General. Processes using flammable solvents shall be provided with a flammable gas detection system in accordance with the fire code. The flammable gas detection system shall be installed in accordance with the manufacturer’s installation instructions and shall not be interlocked with other equipment. The flammable gas detection system shall be calibrated to detect gas levels of not more than 10 percent of the Lower Flammable Limit (LFL) and to activate audible and visual alarms of not more than 25 percent of the LFL.

K 701.2 Control Area. Pumps, motors, chemical fume hoods, equipment, and wiring in control areas and containment booths used for flammable solvent processing shall be as Class I/Division 1 location for potentially explosive gas and vapor Groups A, B, C, and D in accordance with NFPA 70. Containment booths shall be listed and labeled in accordance with UL 1389.

K 701.3 Extraction Equipment. Extraction equipment using flammable solvents and located in an indoor space shall be listed for the intended use. Plant extraction booths shall comply with UL 1389. Extraction equipment using LPG, Butane or other volatile solvents shall be a closed-loop control system and shall comply with ASME BPVC Section VIII.1, ASME B31.3, and NFPA 58, as applicable.

K 801.0 Ventilation and Exhaust System.

K 801.1 General. The indoor air quality in indoor spaces using environmental controls for horticultural cultivation, and processing shall comply with Chapter 4 and Section K 801.1.1. The ventilation and exhaust system shall comply with Section K 801.1.2 through Section K 801.1.6. Indoor spaces used for horticultural cultivation shall have an independent ventilation system.

All mechanical ventilation and exhaust systems shall be tested, balanced, and operated to demonstrate to the owner or designated representative and Authority Having Jurisdiction that the installation and performance of the systems conform to design intent. All testing and balancing shall be performed by a technician certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting and Balancing Bureau (TABB), or other equivalent approved agencies.

K 801.1.1 Breathing Zone Outdoor Airflow Rate. The outdoor airflow required in the breathing zone ($V_{bz}$) of the occupiable space or spaces in a ventilation zone shall be as shown in Table 402.1 and not less than the value determined in accordance with Equation K 801.1.1.

$$V_{bz} = R_p \cdot P_z + R_a \cdot A_z$$  (Equation K 801.1.1)

Where:
- $A_z =$ zone floor area, the net occupiable floor area of the ventilation zone, square feet ($m^2$).
- $P_z =$ zone population, the number of people in the ventilation zone during typical usage.
- $R_p =$ outdoor airflow rate required per person (CFM/person) in accordance with the following, as applicable:
  1. 60 CFM/person for cultivation, production, and processing facilities or factories.
  2. 15 CFM/person for centers and dispensaries.
- $R_a =$ outdoor airflow rate required per unit area, 1 CFM/ft$^2$ [0.00508 m$^3$/(s $\cdot$ m$^2$)]

Sample Calculation: Determine the outdoor airflow required in the breathing zone ($V_{bz}$) of an indoor space used for horticultural cultivation with an occupiable floor area of 800 square feet and a maximum of 5 people expected to occupy the zone.

Sample Solution:
- $V_{bz} = R_p \cdot P_z + R_a \cdot A_z$
- $V_{bz} = (60 \text{ CFM/person} \cdot 5 \text{ people}) + (1 \text{ CFM} \cdot 800 \text{ SF})$
- $V_{bz} = 1,100 \text{ CFM}$. The ventilation system shall be capable of providing not less than 1,100 CFM of outdoor air.

K 801.1.2 Ventilation System Requirements. When activated by the gas detection system required by Section K 601.1, the mechanical purge ventilation system shall remain on until manually reset. The purge ventilation system ducting shall terminate outdoors in an approved location. The ventilation system shall be designed to operate at a
negative pressure of 0.01 inches water column (0.02 kPa) in relation to the exhausted indoor space.

**K 801.1.3 Ventilation for Indoor Cultivation and Storage Spaces.** Indoor spaces used for horticultural cultivation and processing and storage shall be provided with ventilation in accordance with Section 402.2. Where mechanical ventilation is provided, the systems shall be operational when the indoor space(s) are occupied. Air in indoor cultivation and storage spaces shall be classified as Class 2 Air in accordance with Section 403.9.2.

**K 801.1.4 Exhaust Ventilation Rate.** The exhaust and ventilation system required in this section shall not create a lesser standard of installation than prescribed by the minimum safety standards adopted by the Authority Having Jurisdiction. Exhaust airflow shall be provided at not less than 0.2 CFM/ft² [0.001016 (m³/s)/m²] of floor area. Exhaust air shall not be used as makeup air, recirculated air, or transfer air. Makeup air shall be provided for more than 150 CFM exhaust.

**K 801.1.5 Exhaust System Requirements.** An exhaust system shall be installed in accordance with Section 505.0 and the following requirements:

1. Exhaust outlet location(s) in accordance with Section 502.2.2 for product conveying ducts as classified in Section 505.8.
2. Exhaust air shall terminate directly to the outdoors and shall not be directed onto a public way.
3. The exhaust inlet shall be not less than 12 inches (305 mm) above the finished floor.
4. Chemical fume hoods shall be required for flammable solvent processing, shall be listed, and shall be installed in accordance with the manufacturer’s installation instructions.
5. Exhaust ducts shall be independent of all other exhaust systems.
6. The exhaust rate shall be in accordance with the applicable occupancy category as shown in Table 403.7.

**K 801.1.6 Automatic Shutoff.** Automatic shutoff in air moving systems shall be provided in accordance with Section 608.0.

**K 901.0 Particulate and Odor Control.**

**K 901.1 General.** Particulates and odors from indoor horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall be filtered and controlled so that it is not detectable above nuisance levels not exceeding applicable exposure limits at the exterior of the facility or at adjoining properties or as required by the Authority Having Jurisdiction. Odor control shall be required in the exhaust system and shall include, but not be limited to, one or more of the following types:

1. Charcoal filters shall be installed on the discharge of all exhaust ducts and shall be installed in accordance with the manufacturer’s installation instructions.
2. Ozone generators shall be installed in all exhaust ducts to neutralize odor by oxidizing such odors with ozone.
3. Ionizers shall be installed in accordance with the manufacturer’s installation instructions.
4. Photo-catalytic oxidation shall be installed in accordance with the manufacturer’s installation instructions.
5. Photo-hydroxyl oxidation shall be installed in accordance with the manufacturer’s installation instructions.
6. Carbon filtration shall be installed in accordance with the manufacturer’s installation instructions.
7. UV-C lights shall be installed in accordance with the manufacturer’s installation instructions.
8. Where approved by the Authority Having Jurisdiction, a plume discharge termination method shall be permitted to be used for odor control. The exhaust fan of such a system shall discharge exhaust air vertically into the outdoors. The plume heights shall be not less than 20 feet above the nozzle. Escaping air at the nozzle shall be no less than 3,000 feet per minute.

**K 901.2 Filters.** Where filters are used, the minimum filtration rate shall be in accordance with Equation K 901.2. The design airflow velocity across the face area of the chemical absorption filter(s) shall not exceed 350 feet per minute (1.8 m/s).

Minimum Filtration Rate = (Room Volume)/3    (Equation K 901.2)

**K 1001.0 Duct Construction and Installation.**

**K 1001.1 General.** Ducts shall be in accordance with Chapter 6 and SMACNA HVAC Duct Construction Standards – Metal and Flexible. Exhaust ducts shall be accordance with Section 506.0.

**K 1101.0 Hydronic Systems.**

**K 1101.1 General.** Hydronic systems used in indoor horticulture facilities shall be in accordance with Chapter 12 of this code or Chapter 4 the Uniform Solar, Hydronics and Geothermal Code (USHGC).

**K 1201.0 Motors and Fans.**

**K 1201.1 General.** Motors and fans used shall comply with the applicable requirements in Section 503.0.

**K 1301.0 Storage of Chemicals.**

**K 1301.1 General.** Storage of chemicals shall comply with the building code and fire code, and NFPA 58 for liquid petroleum gas and NFPA 400 for the storage, use and handling of hazardous materials. Hazardous, combustible, and flammable materials shall not be stored in cultivation rooms.
K 1401.0 Walls, Ceilings, and Floors.
K 1401.1 General. Walls, ceilings, and floors of indoor spaces used for horticultural cultivation shall be in accordance with the following requirements:
(1) Be of corrosion resistant materials.
(2) Include air and vapor barriers in accordance the building code.
(3) Be insulated in accordance with the building code.
(4) Concrete slab floors shall be permitted to be sealed below or above grade by a product approved the Authority Having Jurisdiction.

K 1501.0 Dehumidification and Humidification.
K 1501.1 General. Dehumidification and humidification shall be permitted to be accomplished by standalone dehumidifiers, humidifiers, desiccant wheels, or reheat coils.
K 1501.2 Protection. Plants shall not be stored or processed beneath pipes or mechanical equipment unless those areas are protected against leakage or condensation.
Exception: Piping used for fire suppression systems.

K 1601.0 Fumigation.
K 1601.1 General. Any horticultural growing facility that is fumigated shall comply with Section K 1601.1.1 through Section K 1601.1.3 and the Authority Having Jurisdiction.
K 1601.1.1 Sources of Ignition. Areas intended to be fumigated shall not contain any open flames or any other sources of ignition.
K 1601.1.2 Fumigation Activity. Areas intended for fumigation, repellant, pesticide, or insecticide fogging operation shall be clearly marked to indicate fumigation activity. Such areas intended for fumigation shall be continuously mechanically ventilated in accordance with Section K 801.0.

K 1701.0 Luminaires.
K 1701.1 General. Horticultural lighting equipment and systems used for indoor horticultural cultivation shall comply with UL 8800.

K 1801.0 UV and UV-C Devices.
K 1801.1 General. UV and UV-C devices installed in ductwork shall be installed in accordance with NFPA 90A and the manufacturer’s installation instructions.

K 1901.0 Signage.
K 1901.1 General. Caution or warning signs complying with NFPA 704 shall be provided at the entrance of the facility and/or indoor spaces identifying hazards such as flammables, asphyxiants, and toxics.

TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 55-2020</td>
<td>Compressed Gases and Cryogenic Fluids Code</td>
<td>Compressed Gases</td>
</tr>
<tr>
<td>NFPA 72-2019</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
</tr>
<tr>
<td>NFPA 2001-2018</td>
<td>Clean Agent Fire Extinguishing Systems</td>
<td>Fire Extinguishing</td>
</tr>
<tr>
<td>UL 268-2016</td>
<td>Smoke Detectors for Fire Alarm Systems (with revisions through October 31, 2019)</td>
<td>Smoke Detectors</td>
</tr>
<tr>
<td>UL 864-2014</td>
<td>Control Units and Accessories for Fire Alarm Systems (with revisions through May 7, 2020)</td>
<td>Control Units</td>
</tr>
<tr>
<td>UL 1389-2019</td>
<td>Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations (with revisions through October 13, 2020)</td>
<td>Plant Oil Extraction</td>
</tr>
<tr>
<td>UL 2017-2008</td>
<td>General-Purpose Signaling Devices and Systems (with revisions through December 14, 2018)</td>
<td>Signaling Devices</td>
</tr>
<tr>
<td>UL 2075-2013</td>
<td>Gas and Vapor Detectors and Sensors (with revisions through December 21, 2017)</td>
<td>Gas Detectors</td>
</tr>
<tr>
<td>UL 8800-2019</td>
<td>Horticultural Lighting Equipment and Systems</td>
<td>Electrical</td>
</tr>
</tbody>
</table>
The UMC Indoor Horticulture Facilities Task Group was formed during the last UMC TC meeting as the TC believed such provisions to be an important addition in the UMC and needed refinement and further expansion. The primary focus of the Task Group was to protect the health and safety of all occupants and the public. Each of the original proposed categories from UMC proposal Item # 283 were discussed in depth and expanded upon. The Task Group agreed with the TC recommendation to place these provisions in an appendix and agreed that the term “cannabis” should be removed as the provisions may also be applicable to other forms of indoor horticulture facilities. The Task Group also believed it was important to identify the different categories of “horticulture facilities” as they exist within current federal laws. This will minimize confusion and standardize such requirements and guidelines throughout the industry.

The UMC Indoor Horticulture Facilities Task Group communicated with the UPC Indoor Horticulture Facilities Task Group to harmonize text where applicable to both codes. Some Task Group Members participated on both the UPC and UMC Task Groups and were able to give additional insights to assist in correlation. The new provisions in Section K 301.0 (Classification of Facilities) will guide the end user in determining what is acceptable in their jurisdictions whether it be from the building code, fire code, or any other enforcement body. Additionally, Section K 401.0 (Documentation) was added to guide the user to the appropriate sections for requesting permits.

The Task Group spent many hours researching and identifying ventilation and exhaust rates permitted for indoor horticulture facilities and added the appropriate language and provisions to protect the indoor air quality. The language pertaining to ventilation, exhaust, and odor control was based on research of existing sources such as Federal Regulations, technical research documents, standards, local laws, and other regulations. The result was text that will unify with existing laws and regulations. Section K 801.1.1 (Breathing Zone Outdoor Airflow Rate) and K 801.1.5 (Exhaust System Requirements) were modified to reference the appropriate UMC ventilation and exhaust rate tables to ensure that these facilities are identified with an occupancy category in accordance the local jurisdiction. In summary, the UMC Indoor Horticulture Facilities Task Group has captured important minimum requirements that do not conflict with Federal Regulations and will ensure that local laws and guidelines are followed for the protection of the public.
Proposals

Item #: 286

UMC 2024  Section: D 107.1

SUBMITTER: IAPMO Staff - Update Extracts
NFPA 501A Extract Update

RECOMMENDATION:
Revise text

D 107.0 Required Gas Supply.
D 107.1 General. The minimum hourly volume of gas required at each manufactured home site outlet or any section of
the manufactured home community gas piping system shall be calculated as shown in Table D 107.1. [NFPA
501A:4.3.4.1]
In extreme climate areas, additional capacities other than those shown in Table D 107.1 shall be considered. [NFPA
501A:4.3.4.1, 4.3.4.2]

SUBSTANTIATION:
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Appendix D is being

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Appendix D  Item #: 286
SUBMITTER: IAPMO Staff - Update Extracts  Comment #: 1
NFPA 501 Extract Update

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

D 101.1 General. All fuel gas piping systems serving manufactured homes, accessory buildings, or structures and
communities shall be designed and constructed in accordance with any applicable provisions of Chapter 13 or NFPA
54 and NFPA 58. NFPA 31 shall apply to oil fuel-burning systems and shall conform to the criteria of the Authority
Having Jurisdiction. {NFPA 501A:4.1.1.1 – 4.1.1.2}

D 103.1 D 103.2 General Shutoff Valve Location. Each manufactured home site shall have a listed gas shutoff valve
installed upstream of the manufactured home site gas outlet. The gas shutoff valve shall be located on the outlet riser at
a height of not less than 6 inches (152 mm) above grade. A gas shutoff valve shall not be located under any
manufactured home. The outlet shall be equipped with a cap or plug to prevent discharge of gas whenever the
manufactured home site outlet is not connected to a manufactured home. [NFPA 501A:4.2.2.1 – 4.2.2.4]
**Exception: D 103.1 General.** Gas shutoff valves shall conform to Section D 403.4 D 103.2, except for manufactured homes located on foundations constructed in accordance with the local building code or, in the absence of a local code, with a recognized model building code. [NFPA 501A:4.2.2]

**D 110.3 Plastic Gas Piping.** Plastic gas piping shall be used only underground and shall be installed with an electrically conductive wire for locating the pipe. The wire used to locate the plastic pipe shall be copper, not smaller in size than 18 AWG, with insulation approved for direct burial. Every portion of a plastic gas piping system consisting of metallic pipe shall be cathodically protected against corrosion. [NFPA 501A:4.3.7.3.1 – 4.3.7.3.3]

**SUBSTANTIATION:**
The above sections have been revised to correlate with NFPA 501A-2021 in accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines).
E 605.1.3 Dwelling-Unit Ventilation. A Mechanical exhaust system, supply system, or combination thereof shall be installed designed and provided with the capacity to operate for each deliver outdoor air ventilation to the whole dwelling unit to provide at a continuous dwelling-unit ventilation with outdoor air at a rate not less than the rate that specified in Section E 605.1.3.1 through Section E 605.1.3.5. [ASHRAE 62.2:4.1]

E 605.1.3.2 Effective Annual Average Infiltration Rate ($Q_{inf}$) Using a Single-Point Envelope Leakage Test. Effective Annual Average Infiltration Rate ($Q_{inf}$) shall be calculated using Equation E 605.1.3.2: a single-point test at 50 Pa. The Effective Annual Average Infiltration Rate ($Q_{inf}$) shall be calculated using Equation 605.1.3.2:

\[
Q_{inf} (\text{CFM}) = \frac{(NL \times wsf \times A_{floor})}{(7.3)^{*}}
\]

Where:
- $NL$ = normalized leakage
- $wsf$ = weather and shielding factor from ASHRAE 62.2.
- $A_{floor}$ = floor area of residence, ft$^2$ (m$^2$)
- $*$ Replace 7.3 with 1.44 for metric units. [ASHRAE 62.2:4.1.2(e)]

\[
Q_{inf} = 0.052 \times Q_{50} \times wsf \times \left(\frac{H}{H_r}\right)^z
\]

Where:
- $Q_{inf}$ = estimated infiltration rate, cfm (L/s).
- $Q_{50}$ = leakage rate at 50 Pa depressurization or pressurization, cfm (L/s).
- $wsf$ = weather and shielding factor from ASHRAE 62.2.
- $H$ = vertical distance between the lowest and highest above-grade points within the pressure boundary, ft (m).
- $H_r$ = reference height, 8.2 ft (2.5 m).
- $z = 0.4$ for the purpose of calculating the Effective Annual Average Infiltration Rate. (ASHRAE 62.2:4.1.2.1)

E 605.1.3.3 Required Mechanical Ventilation Rate ($Q_{fan}$). If a blower door test has been performed, then a credit for estimated infiltration may be taken for detached dwelling units using either the procedure in Section E 605.1.3.2 or E 605.1.3.4. Attached dwelling units other than horizontally attached shall not be permitted to take an infiltration credit. Horizontally attached dwelling units shall be permitted to use a blower door test result to take this credit, subject to the reduction factor $A_{ext}$ in Equation E 605.1.3.3.

If this credit is taken, then the Required Mechanical Ventilation Rate ($Q_{fan}$) shall be calculated using Equation E 605.1.3.3:

\[
Q_{fan} = Q_{tot} - \Theta(Q_{inf} \times A_{ext})
\]
Where:

- \( Q_{fan} \) = required mechanical ventilation rate, CFM (L/s)
- \( Q_{tot} \) = total required ventilation rate, CFM (L/s)
- \( Q_{inf} \) = may be not greater than \( \frac{2}{3} \times Q_{tot} \) infiltration, cfm (L/s)

(see ASHRAE 62.2 for exceptions for existing buildings)

- \( A_{ext} \) = 1 for single-family detached homes detached dwelling units; otherwise, for horizontally attached dwelling units, or the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to total envelope surface area for single-family attached homes.
- \( \Phi = 1 \) for balanced ventilation systems, and \( Q_{inf} / Q_{tot} \) otherwise

**Exception:** Where \( Q_{fan} \), calculated for unbalanced ventilation, is less than or equal to 15 cfm (7 L/s), a dwelling-unit ventilation system is not required. [ASHRAE 62.2:4.1.2(f) 4.1.2]

**E 605.1.3.4 Effective Annual Average Infiltration Rate (Q_{inf}) Using a Multipoint Envelope Leakage Test.** Effective Annual Average Infiltration Rate (\( Q_{inf} \)) shall be calculated using the normalized leakage calculated from measurements of envelope leakage using a multipoint test from either ASTM E779 in accordance with Section E 605.1.3.4(A) or CGSB 149.10 in accordance with Section E 605.1.3.4(B).

**E 605.1.3.4(A) ASTM Procedure.** To calculate the effective leak area (\( ELA \)) from ASTM E779, the leakage area for pressurization and depressurization (using a 4 Pa reference pressure) shall be averaged using Equation E 605.1.3.4(A):

\[
ELA = \frac{L_{press} + L_{depress}}{2} \quad \text{[Equation E 605.1.3.4(A)]}
\]

Where:

- \( ELA \) = effective leakage area, \( \text{ft}^2 \ (\text{m}^2) \)
- \( L_{press} \) = leakage area from pressurization, \( \text{ft}^2 \ (\text{m}^2) \)
- \( L_{depress} \) = leakage area from depressurization, \( \text{ft}^2 \ (\text{m}^2) \)

**E 605.1.3.4(B) CGSB Procedure.** To calculate the \( ELA \) from CGSB 149.10, the following modifications to the test procedure must be made:

a. All vents and intentional openings must be in the same configuration as specified in ASTM E779 (i.e., HVAC dampers and registers should be in the normal operating position; fireplace and other dampers should be closed unless they are required for test operation).

b. Height and floor area must be reported consistently with the definitions of this standard.

c. The leakage area as calculated from the CGSB procedure must be converted using Equation E 605.1.3.4(B):

\[
ELA = 0.61 \times (0.4)^n - 0.5 \times L_{cgsb} \quad \text{[Equation E 605.1.3.4(B)]}
\]

Where:

- \( n \) = exponent measured from the CGSB 149.10
- \( L_{cgsb} \) = CGSB leakage area as modified above, \( \text{ft}^2 \ (\text{m}^2) \)

**E 605.1.3.4(C) Normalized Leakage.** Normalized leakage shall be calculated using Equation E 605.1.3.4(C):

\[
NL = 1000 \times \frac{ELA}{A_{floor}} \times \left( \frac{H}{H_r} \right)^z \quad \text{[Equation E 605.1.3.4(C)]}
\]

Where:

- \( NL \) = normalized leakage
- \( ELA \) = effective leakage area, \( \text{ft}^2 \ (\text{m}^2) \)
- \( A_{floor} \) = floor area of residence, \( \text{ft}^2 \ (\text{m}^2) \)
- \( H \) = vertical distance between the lowest and highest above-grade points within the pressure boundary, \( \text{ft} \ (\text{m}) \)
- \( H_r \) = reference height, 8.2 ft (2.5 m)
- \( z = 0.4 \) for the purpose of calculating the Effective Annual Infiltration Rate

**E 605.1.3.4(D) Effective Annual Average Infiltration Rate.** Effective Annual Average Infiltration Rate (\( Q_{inf} \)) shall be calculated using Equation E 605.1.3.4(D):
### E 605.1.3.4 605.1.3.5 Different Occupant Density. (remaining text unchanged)

#### E 605.1.4 System Type. The dwelling-unit mechanical ventilation system shall consist of one or more supply or exhaust fans and associated ducts and controls. Local exhaust fans shall be permitted to be part of a mechanical exhaust system. Where local exhaust fans are used to provide dwelling-unit ventilation, the local exhaust airflow shall be permitted to be credited toward the dwelling-unit ventilation airflow requirement. Outdoor air ducts connected to the return side of an air handler shall be permitted as supply ventilation where manufacturer’s requirements for return air temperature are met. See ASHRAE 62-2 Indoor Air Quality Guide for guidance on selection of methods. [ASHRAE 62.2:4.2]

#### E 605.1.5 Airflow Measurement. The airflow required by this section shall be the quantity of outdoor ventilation air supplied and/or indoor air exhausted by the mechanical ventilation system as installed and shall be measured according to the ventilation equipment manufacturer’s instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan’s inlet terminals/grilles, outlet terminals/grilles, or in the connected ventilation ducts. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows. Ventilation airflow of systems with multiple operating modes shall be tested in all modes designed to meet this section. [ASHRAE 62.2:4.3]

#### E 605.1.6 Control and Operation. A readily accessible manual ON-OFF control to the dwelling-unit occupant, including but not limited to a fan switch or a dedicated branch-circuit overcurrent device, shall be provided. Controls shall include text or an icon indicating the system’s function.

**Exception:** For multifamily dwelling units, the manual ON-OFF control shall not be required to be readily accessible to the dwelling-unit occupant. [ASHRAE 62.2:4.4]

#### E 605.1.6.1 Operation. The system shall be operated as designed. [ASHRAE 62.2:4.4.2]

#### E 605.1.7 Variable Mechanical Ventilation. Dwelling-unit mechanical ventilation systems designed to provide variable ventilation shall comply with Section E 605.1.7.1 or Section E 605.1.7.2 or Section E 605.1.7.3. Section E 605.1.7.2 and Section E 605.1.7.3 also require compliance with ASHRAE 62.2 and require verification with supporting documentation from the manufacturer, designer, or specifier of the ventilation control system that the system meets the requirements of these sections. Where the dwelling-unit ventilation rate varies based on occupancy, occupancy shall be determined by occupancy sensors or by an occupant-programmable schedule. **Operation shall comply with Section E 605.1.6.1.** [ASHRAE 62.2:4.5]

#### E 605.1.7.1 Short-Term Average Ventilation. To comply with this section, a variable ventilation system shall be installed to provide an average dwelling-unit ventilation rate over any period of three-hours period or less that is greater than or equal to the ventilation airflow as calculated using Section E 605.1.3.3, and shall not provide a ventilation rate of zero over any three-hour interval. [ASHRAE 62.2:4.5.1]

#### E 605.1.7.2 Scheduled Ventilation. This section shall only be used when one or more fixed patterns of designed ventilation are known at the time compliance to Section E 605.0 is being determined. Such patterns include those both clock-driven and driven by typical meteorological data. Compliance with this section shall be demonstrated with either Section E 605.1.7.2.1 or Section E 605.1.7.2.2. [ASHRAE 62.2:4.5.2]

#### E 605.1.7.2.1 Annual Average Schedule. An annual schedule of ventilation complies with this section when the annual average relative exposure during occupied periods is not more than one, and the peak relative exposure shall not exceed five for any time step as calculated in accordance with ASHRAE 62.2. [ASHRAE 62.2:4.5.2.1]

**E 605.1.7.2.2 Block Scheduling.** The schedule of ventilation complies with this section when it is broken into blocks of time and each block individually has an average relative exposure during occupied periods that is not more than one as calculated in ASHRAE 62.2. All blocks shall end with a relative exposure less than or equal to one. [ASHRAE 62.2:4.5.2.2]

#### E 605.1.7.3 Real-Time Control. A real-time ventilation controller complies with this section when it is designed to adjust the ventilation system based on real-time input to the ventilation calculations so that the average relative exposure during occupied periods is not more than one, and the peak relative exposure shall not exceed five for any time step as calculated in ASHRAE 62.2. The averaging period shall be not less than one day but not more than one year and shall be based on simple, recursive or running average, but not extrapolation.
For the purposes of calculating average relative exposure, a dwelling unit shall be permitted to be treated as unoccupied during a time step only if it is unoccupied for the entire time step. [ASHRAE 62.2:4.5.3]

### TABLE E 605.1.3.1
VENTILATION AIR REQUIREMENTS, (cubic foot per minute)
[ASHRAE 62.2:TABLE 4-1a 4-1a]

(portion of table not shown remains unchanged)

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>CAN/CGSB 149.10-2019</td>
<td>Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method</td>
<td>Ventilation</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**SUBSTANTIATION:**
In accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines), Appendix E is being revised to the latest edition of ASHRAE 62.2-2019 and Addendum x as published on March 2, 2020 to ASHRAE 62.2-2019.

**COMMITTEE ACTION:** ACCEPT AS SUBMITTED

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

**Appended Comments**

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** Appendix E  **Item #:** 288

**SUBMITTER:** Emily Toto ASHRAE  **Comment #:** 1

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal as modified by this public comment.

**E 605.1.6 Control and Operation.** An ON-OFF control available to the dwelling unit occupant manual ON-OFF control, including but not limited to a fan switch or a dedicated branch-circuit overcurrent device, shall be provided. Controls shall include text or an icon indicating the system’s function. Exception: For multifamily dwelling units, the manual ON-OFF control shall not be required to be readily accessible to the dwelling unit occupant. [ASHRAE 62.2:4.4, 4.4.1]

**E 605.1.7 Variable Mechanical Ventilation.** Dwelling-unit mechanical ventilation systems designed to provide variable ventilation shall comply with Section E 605.1.7.1 or Section E 605.1.7.2 or Section E 605.1.7.3. Section E 605.1.7.2 and Section E 605.1.7.3 also require compliance with ASHRAE 62.2 and require verification with supporting documentation from the manufacturer, designer, or specifier of the ventilation control system that the system meets the requirements of these sections. Where the dwelling unit ventilation rate varies based on occupancy, occupancy shall be determined by occupancy sensors or by an occupant-programmable schedule. Operation shall comply with Section E 605.1.6.1 Tracking or scheduling of occupancy shall be permitted. [ASHRAE 62.2:4.5]

**SUBSTANTIATION:**
The above sections have been revised to correlate with ASHRAE 62.2-2019 in accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines).
Item #: 289
UMC 2024  Section: Appendix E, Table 1701.2

SUBMITTER: IAPMO Staff - Update Extracts
ASHRAE 90.1 Extract Update

RECOMMENDATION:
Revise text

E 201.0 Definitions.

Fan, Embedded. A fan that is part of a manufactured assembly where the assembly includes functions other than air
movement. [ASHRAE 90.1:3.2]

Fan Array. Multiple fans in parallel between two plenum sections in an air distribution system. [ASHRAE 90.1:3.2]

Fan Nameplate Electrical Input Power. The nominal electrical input power rating stamped on a fan assembly
nameplate. [ASHRAE 90.1:3.2]

Fan Energy Index (FEI). The ratio of the electric input power of a reference fan to the electric input power of the actual
fan as calculated per AMCA 208. [ASHRAE 90.1:3.2]

Fan System Electrical Input Power. The sum of the fan electrical power of all fans that are required to operate at fan
system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to
the source or exhaust it to the outdoors. [ASHRAE 90.1:3.2]

On-Site Renewable Energy. Energy generated from renewable energy resources produced harvested at the building
site. [ASHRAE 90.1:3.2]

Site-Recovered Energy. Waste energy recovered at the building site that is used to offset consumption of purchased
fuel or electrical energy supplies. [ASHRAE 90.1:3.2]

Renewable Energy Resources. Energy from solar, wind, biomass or hydro, or extracted from hot fluid or steam heated
within the earth. [ASHRAE 90.1:3.2]

E 503.1.3 Alterations to Heating, Ventilating, Air-Conditioning, and Refrigeration in Existing Buildings. New
HVACR equipment as a direct replacement of existing HVACR equipment shall be in accordance with the following
sections as applicable for the equipment being replaced:

(1) Section E 503.3 “Simplified Approach Option for HVAC Systems”
(2) Section E 503.4 “Equipment Efficiencies, Verification, and Labeling Requirements”
(3) Section E 503.4.6 “Zone Thermostatic Controls”
(4) Section E 503.4.6.2 “Setpoint Overlap Restriction”
(5) Section E 503.4.6.3 “Off-Hour Controls”
(6) Section E 503.4.6.4 “Ventilation System Controls”
(7) Section E 503.4.6.8 “Freeze Protection and Snow or Ice Melting Systems”
(8) Section E 503.4.6.9 “Ventilation Controls for High-Occupancy Areas”
(9) Section E 503.4.6.11 “Heated or Cooled Vestibules”
(10) Section E 503.4.8 “Walk-In Coolers and Walk-In Freezers”
(11) Section E 503.5.1 “Air Economizers, Design Capacity”
(12) Section E 503.5.3 “Integrated Economizer Control”
(13) Section E 503.5.4 “Economizer Heating System Impact”
(14) Section E 503.5.6.1.2 “Fan Efficiency”
(15) Section E 503.5.6.2 “Supply Fan Airflow Control”
(16) Section E 503.5.6.5 “Fractional Horsepower Fan Motors”
(17) Section E 503.5.7 “Boiler Turndown”
(18) Section E 503.5.7.2 “Chiller and Boiler Isolation”
E 503.4.8 Walk-In Coolers and Walk-In Freezers. Site-assembled or site-constructed walk-in coolers and walk-in freezers shall conform to the following requirements:

1. Shall be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch (25.4 mm) of full closure.

2. Doorways shall have strip doors (curtains), spring-hinged doors, or other method of minimizing infiltration when doors are open.

3. Walk-in coolers shall contain wall, ceiling, and door insulation of at least R-25 and at least R-32 for walk-in freezers.

4. Walk-in freezers shall contain floor insulation of at least R-28.

5. Evaporator fan motors that are less than 1 hp and less than 460 V shall use electronically commutated motors (brushless direct-current motors) or three-phase motors.

6. Lights shall use light sources with an efficacy of 40 lm/W or more, including ballast losses (if any). Light sources with lower may be used in conjunction with a timer or device that turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer is not occupied by people.

7. Transparent reach-in doors for walk-in freezers, and windows in walk-in freezer doors, shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass or vacuum insulating glazing.

8. Transparent reach-in doors for walk-in coolers, and windows in walk-in cooler doors, shall be double-pane glass with heat-reflective treated glass and gas filled, or triple-pane glass, either filled with inert gas or with heat-reflective treated glass or vacuum insulating glazing.

9. Antisweat heaters without antisweat heater controls shall have a total door rail, glass, and frame heater power draw of not more than 7.1 W/ft² of door opening for walk-in freezers and 3.0 W/ft² of door opening for walk-in coolers.

10. Antisweat heater controls shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

11. Condenser fan motors that are less than 1 hp shall use electronically commutated motors, permanent split-capacitor-type motors, or three-phase motors.

12. All walk-in freezers shall incorporate temperature-based defrost termination control with a time limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.

13. Doors in walk-in coolers and walk-in freezers shall meet the requirements of ASHRAE 90.1. Walk-in cooler and walk-in freezer refrigeration systems, except for walk-in process cooling refrigeration systems as defined in 10 CFR 431.302, shall meet the requirements of ASHRAE 90.1. [ASHRAE 90.1:6.4.5]
(1) The system serves a single HVAC zone.

(2) The equipment shall comply with the variable flow requirements of Section E 503.5.6.2.

(3) Cooling (where any) shall be provided by a unitary packaged or split-system air conditioner that is either air-cooled or evaporatively cooled, with efficiency that is in accordance with the requirements shown in Table E 503.7.1(2) for air conditioners, Table E 503.7.1(2) for heat pumps, or Table E 503.7.1(4) for packaged terminal and room air conditioners and heat pumps for the applicable equipment category.

(4) The system shall have an air economizer in accordance with Section E 503.5 and Section E 503.4.6.13.

(5) Heating (where any) shall be provided by a unitary packaged or split-system heat pump that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(2) for heat pumps or Table E 503.7.1(4) for packaged terminal and room air conditioners and heat pumps, a fuel-fired furnace that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(5) for furnaces, duct furnaces, and unit heaters, an electric resistance heater, or a baseboard system connected to a boiler that is in accordance with the applicable efficiency requirements shown in Table E 503.7.1(6) for boilers.

(6) The system shall comply with the exhaust air energy recovery requirements in accordance with Section E 503.5.10.

(7) The system shall be controlled by a manual changeover or dual setpoint thermostat.

(8) Where a heat pump equipped with auxiliary internal electric resistance heaters is installed, controls shall be provided that prevent supplemental heater operation where the heating load is capable of being met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation shall be permitted during outdoor coil defrost cycles. The heat pump shall be controlled in accordance with one of the following:

(a) A digital or electronic thermostat designed for heat pump use that energizes auxiliary heat where the heat pump has insufficient capacity to maintain setpoint or to warm up the space at a sufficient rate.

(b) A multistage space thermostat and an outdoor air thermostat wired to energize auxiliary heat on the last stage of the space thermostat and where outdoor air temperature is less than 40°F (4°C).

**Exceptions:** Heat Pumps that comply with the following:

(1) Have a minimum efficiency regulated by NAECA.

(2) In accordance with the requirements shown in Table E 503.7.1(2).

(3) Include all usage of internal electric resistance heating.

(9) The system controls shall not permit reheat or other form of simultaneous heating and cooling for humidity control.

(10) Systems serving spaces other than hotel or motel guest rooms, and other than those requiring continuous operation, which have both a cooling or heating capacity more than 15,000 Btu/h (4.4 kW) and a supply fan motor power more than 0.75 horsepower (hp) (0.56 kW), shall be provided with a time clock that is in accordance with the following:

(a) Can start and stop the system under different schedules for seven different day-types per week.

(b) Is capable of retaining programming and time setting during a loss of power for a period of not less than 10 hours.

(c) Includes an accessible manual override that allows temporary operation of the system for up to 2 hours.

(d) Is capable of and configured with temperature setback down to 55°F (13°C) during off hours.

(e) Is capable of and configured with temperature setup to 90°F (32°C) during off hours.

(11) Systems serving hotel/motel guest rooms shall comply with Section E 503.4.6.3.5.

(12) Except for piping within manufacturer’s units, HVAC piping shall be insulated in accordance with Table E 503.7.3(1) and Table E 503.7.3(2). Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation.

(13) Ductwork and plenums shall be insulated in accordance with Table E 503.7.2 and shall be sealed in accordance with Section E 503.4.7.2.

(14) Construction documents shall require a ducted system to be air balanced in accordance with industry-accepted procedures.

(15) Outdoor air intake and exhaust systems shall comply with Section E 503.4.6.4 through Section E 503.4.6.5.

(16) Where separate heating and cooling equipment serves the same temperature zone, thermostats shall be interlocked to prevent simultaneous heating and cooling.

(17) Systems with a design supply air capacity more than 10,000 ft³/min (4.7195 m³/s) shall have optimum start controls.

(18) The system shall comply with the demand control ventilation requirements of Section E 503.4.6.9, occupied-stay controls in Section E 503.5.6.7, and the ventilation design requirements of Section E 503.5.6.6.

(19) The system shall comply with the door switch requirements of Section E 503.5.14. [ASHRAE 90.1:6.3.2]

**E 503.5.6.7 Occupied-Standby Controls.** Zones serving only rooms that are required to have automatic partial OFF or automatic full OFF lighting controls in accordance with ASHRAE 90.1, where the Chapter 4 or ASHRAE 62.1 occupancy category permits ventilation air to be reduced to zero when the space is in occupied-stay mode, and when using the Ventilation Rate Procedure, shall meet the following within 5 minutes of all rooms in that zone entering occupied-stay mode.

(1) Active heating set point shall be setback at least 1°F.

(2) Active cooling set point shall be setup at least 1°F.

(3) All airflow supplied to the zone shall be shut off whenever the space temperature is between the active heating and cooling set points.
Exception: Multiple zone systems without automatic zone flow control dampers. [ASHRAE 90.1:6.5.3.8]

E 503.4 Mandatory Provisions—Equipment Efficiencies, Verification, and Labeling Requirements. Equipment shown in Table E 503.7.1(1) through Table E 503.7.1(16) shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements unless otherwise exempted by footnotes in the table. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide service water-heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category.

Tables are as follows:
(1) Table E 503.7.1(1), "Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements"
(2) Table E 503.7.1 (2), "Electrically Operated Air-Cooled Unitary and Applied Heat Pumps—Minimum Efficiency Requirements"
(3) Table E 503.7.1 (3), "Water-Chilling Packages—Minimum Efficiency Requirements" (See Section E 503.4.1 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions.)
(4) Table E 503.7.1 (4), "Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements"
(5) Table E 503.7.1 (5), "Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum Efficiency Requirements"
(6) Table E 503.7.1 (6), "Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements"
(7) Table E 503.7.1 (7), "Performance Requirements for Heat-Rejection Equipment—Minimum Efficiency Requirements"
(8) Table E 503.7.1 (8), "Heat Transfer Equipment"
(9) Table E 503.7.1 (9), "Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements"
(10) Table E 503.7.1 (10), "Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum Efficiency Requirements"
(11) Table E 503.7.1 (11), "Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms"
(12) Table E 503.7.1 (12), "Commercial Refrigerators, Commercial and Freezers, and Refrigeration—Minimum Efficiency Requirements"
(13) Table E 503.7.1 (13), "Commercial Refrigeration Minimum Efficiency Requirements"
(14) Table E 503.7.1 (14), "Vapor-Compression-Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements"
(15) Table E 503.7.1 (15), "Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements"
(16) Table E 503.7.1 (16), "Electrically Operated Water-Source Heat Pumps—Minimum Efficiency Requirements"
(17) Table E 503.7.1 (17), "Ceiling-Mounted Computer-Room Air Conditioners—Minimum Efficiency Requirements"
(18) Table E 503.7.1 (18), "Walk-In Cooler and Freezer Display Door Efficiency Requirements"
(19) Table E 503.7.1 (19), "Walk-In Cooler and Freezer Nondisplay Door Efficiency Requirements"
(20) Table E 503.7.1 (20), "Walk-In Cooler and Freezer Refrigeration System Efficiency Requirements"

All furnaces with input ratings of 225 000 Btu/h (66 kW) or more, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating. Air conditioners primarily serving computer rooms and covered by ASHRAE 127 shall comply with the requirements in Table E 503.7.1(11). All other air conditioners shall meet the requirements in Table E 503.7.1(1). [ASHRAE 90.1:6.5.3.8]

E 503.4.1 Water-Cooled Centrifugal Chilling Packages. Equipment not designed for operation in accordance with AHRI 550/590 test conditions of 44.00°F (6.67°C) leaving and 54.00°F (12.22°C) entering chilled-fluid temperatures, and with 85.00°F (29.44°C) entering and 94.30°F (34.61°C) leaving condenser-fluid temperatures, shall have maximum full-load kW/ton (FL) and part-load rating requirements adjusted in accordance with Equation E 503.4.1(1) through Equation E 503.4.1(3):

\[
FL_{adj} = FL / K_{adj} \quad \text{[Equation E 503.4.1(1)]}
\]
\[
PLV_{adj} = IPLV/IP / K_{adj} \quad \text{[Equation E 503.4.1(2)]}
\]
\[
K_{adj} = A \times B \quad \text{[Equation E 503.4.1(3)]}
\]

Where:
FL = full-load kW/ton value from Table E 503.7.1(3)

\(FL_{adj}\) = maximum full-load kW/ton rating, adjusted for nonstandard conditions

IPLV/IP = IPLV/IP value from Table E 503.7.1(3)

\(PLV_{adj}\) = maximum NPLV rating, adjusted for nonstandard conditions

\[A = 0.00000014592 \times (LIFT)^4 - 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times (LIFT) + 3.93073\]

\[B = 0.0015 \times LvgEvap + 0.934\]

\[LIFT = LvgCond - LvgEvap\]

\(LvgCond\) = Full-load condenser leaving fluid temperature (°F)

\(LvgEvap\) = Full-load evaporator leaving temperature (°F)

The \(FL_{adj}\) and \(PLV_{adj}\) values shall only be applicable for centrifugal chillers meeting all of the following full-load design ranges:

(1) 36.00°F (2.22°C) = \(LvgEvap\) = 60.00°F (15.56°C)
(2) \(LvgCond\) = 115.00°F (46.11°C)
(3) 20.00°F (-6.67°C) = \(LIFT\) = 80.00°F (26.67°C)

Manufacturers shall calculate the \(FL_{adj}\) and \(PLV_{adj}\) before determining whether to label the chiller in accordance with Section E 503.4.4. Chillers that are in accordance with ASHRAE 90.1 shall be labeled on chillers in accordance with the scope of ASHRAE 90.1.

Centrifugal chillers designed to operate outside of these ranges shall not be covered under this appendix.

Example: Path A, 600 ton (600 000 kg) centrifugal chiller Table E 503.7.1(3) efficiencies.

\begin{align*}
FL &= 0.5600 \text{ kW/ton} \\
IPLV/IP &= 0.5000 \text{ kW/ton} \\
LvgCond &= 91.16°F \\
LvgEvap &= 42.00°F \\
LIFT &= 91.16°F - 42.00°F = 49.16°F \\
A &= 0.00000014592 \times (49.16)^4 - 0.0000346496 \times (49.16)^3 + 0.00314196 \times (49.16)^2 - 0.147199 \times (49.16) + 3.93073 = 1.02331 \\
B &= 0.0015 \times 42.00 + 0.934 = 0.99700 \\
K_{adj} &= A \times B = 1.02024 \\
FL_{adj} &= 0.5600/1.02024 = 0.5489 \text{ kW/ton} \\
PLV_{adj} &= 0.5000/1.02024 = 0.4901 \text{ kW/ton} \quad \text{[ASHRAE 90.1:6.4.1.2.1]} \\
\end{align*}

For SI units: 1 metric ton = 1000 kg, 1000 British thermal units per hour = 0.293 kW, 1 gallon per minute = 0.06 L/s, °C = (°F-32)/1.8

**E 503.4.2 Equipment not Listed.** Equipment not listed in the tables referenced in Section E 503.4 and Section E 503.4.1 shall be permitted to be used. [ASHRAE 90.1:6.4.1.3 6.4.1.4]

**E 503.4.3 Verification of Equipment Efficiencies.**

Equipment efficiency information supplied by manufacturers shall be verified in accordance with one of the following:

(1) Equipment covered under EPACT shall be in accordance with U.S. Department of Energy certification requirements.
(2) Where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program.
(3) Where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report.
(4) Where no certification program exists for a covered product, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.
(5) Where components such as indoor or outdoor coils from different manufacturers are used, the system designer shall specify component efficiencies whose combined efficiency is in accordance with the minimum equipment efficiency requirements in Section E 503.4 through Section E 503.4.1.
(6) Requirements for plate-type liquid-to-liquid heat exchangers are listed in Table E 503.7.1(8). [ASHRAE 90.1:6.4.1.4]

**E 503.4.9 Liquid-to-Liquid Heat Exchangers.** Plate-type liquid-to-liquid heat exchangers shall be rated in accordance with AHRI 400. [ASHRAE 90.1:6.4.7]

**E 503.4.4 Mechanical Equipment Labeling.** Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment is in accordance with the requirements of ASHRAE 90.1. [ASHRAE 90.1:6.4.4.5.4 6.4.1.6.1]

**E 503.4.4.1 Packaged Terminal Air Conditioners.** Nonstandard-size packaged terminal air conditioners and heat pumps with existing sleeves having an external wall opening of less than 16 inches (406 mm) high or less than 42
E 503.4.6.4.1 Shut off Damper Controls. Outdoor air intake and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation outdoor air and exhaust or relief dampers shall be capable of and configured to automatically shut off during preoccupancy building warm-up, cooldown, and setback, except when ventilation the supply of outdoor air reduces energy costs or when ventilation outdoor air shall be supplied to comply with the code requirements.

Exceptions:
1. Back-draft Nonmotorized (gravity back draft) (nonmotorized) dampers shall be permitted for exhaust and relief in buildings less than three stories in height and for ventilation outdoor air intakes and exhaust and relief dampers in buildings of any height located in Climate Zones 0, 1, 2, and 3. Back-draft Nonmotorized dampers for ventilation outdoor air intakes shall be protected from direct exposure to wind.
2. Back-draft gravity (nonmotorized) Nonmotorized dampers shall be permitted in systems with a design outdoor air intake or exhaust capacity of 300 ft³/min (0.142 m³/s) or less.
3. Dampers shall not be required in ventilation or exhaust systems serving unconditioned spaces.
4. Dampers shall not be required in exhaust systems serving Type 1 kitchen exhaust hoods.
5. Dampers are not required in systems intended to operate continuously. [ASHRAE 90.1:6.4.3.4.2]

E 503.4.6.4.2 Dampers Leakage. Where outdoor air supply, and exhaust or relief dampers are required in Section E 503.4.6.4, they shall have a maximum leakage rate in accordance with Table E 503.4.6.4.2 where tested in accordance with AMCA 500D. [ASHRAE 90.1:6.4.3.4.3]

E 503.4.6.7 Humidification and Dehumidification Control. Humidity control shall prevent the use of fossil fuel or electricity to produce relative humidity above 30 percent in the warmest zone served by the humidification system and to reduce relative humidity below 60 percent in the coldest zone served by the dehumidification system.

Humidification and dehumidification control shall be in accordance with Section E 503.4.6.7.1 through E 503.4.6.7.3. E 503.4.6.7.1 Dehumidification. Humidistatic controls shall not use mechanical cooling to reduce the humidity below the lower of a dew point of 55°F or relative humidity of 60 percent in the coldest zone served by the system.

Exceptions:
1. Lower humidity shall be permitted when operating mechanical cooling for temperature control.
2. Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.
3. Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5 percent relative humidity to comply with applicable codes or accreditation standards as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.1]

E 503.4.6.7.2 Humidification. Humidistatic controls shall not use fossil fuel or electricity to produce relative humidity above 30 percent in the warmest zone served by the system.

Exceptions:
1. Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.
2. Systems serving zones where humidity levels are required to be maintained with precision of not more than ±5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.2]

E 503.4.6.7.3 Control Interlock. Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of and configured to prevent simultaneous operation of humidification and dehumidification equipment.

Exceptions:
1. Zones served by desiccant systems, used with direct evaporative cooling in series.
2. Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or required by accreditation standards, and humidity where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.
3. Systems serving zones where humidity levels are required to be maintained with precision of not more than ± 5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.4.3.6.3]
E 201.6 Humidistatic Controls. Automatic controls used to maintain humidity at a fixed or adjustable set point. [ASHRAE 90.1:3.2]

E 503.4.7.1 Insulation. Insulation required by this section shall be installed in accordance with industry-accepted standards. These requirements shall not apply to HVAC equipment. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind, but not limited to the following:

(1) Insulation exposed to weather shall be suitable for outdoor service (e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover). Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that is capable of causing degradation of the material.

(2) Insulation covering chilled-water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed. [ASHRAE 90.1:6.4.4.1.1]

E 503.4.7.1.1 Duct and Plenum Insulation. Supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Table E 503.7.2.

Exceptions:

(1) Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Section E 503.4 through Section E 503.4.4.1.

(2) Ducts or plenums located in heated spaces, semi-heated spaces, or cooled spaces.

(3) For runouts less than 10 feet (3048 mm) in length to air terminals or air outlets, the rated R-value of insulation shall not be required to exceed R-3.5.

(4) Backs of air outlets and outlet plenums exposed to unconditioned space or indirectly conditioned spaces with face areas exceeding 5 square feet (0.5 m²) shall not be required to exceed R-2; those not exceeding 5 square feet (0.5 m²) shall not be required to be insulated. [ASHRAE 90.1:6.4.4.1.2]

E 503.4.7.1.3 Sensible Heating Panel Insulation. Thermally ineffective panel surfaces of sensible heating panels, including U-bends and headers, shall be insulated with a minimum of R-3.5. Adjacent building envelope insulation counts toward this requirement. [ASHRAE 90.1:6.4.4.1.4]

E 503.5 Prescriptive Compliance Path, Economizers. Each cooling systems shall include either an air economizer or fluid economizer in accordance with Section E 503.5.1 through Section E 503.5.4.1.

Exceptions: Economizers shall not be required for the following systems:

(1) Individual fan-cooling units with a supply capacity less than the minimum listed in Table E 503.5(1).

(2) Chilled-water cooling systems without a fan or that use induced airflow, where the total capacity of these systems is less than 1 000 000 Btu/h (293 kW) in Climate Zones 0, 1B, and 2 through 4; less than 1 400 000 Btu/h (410 kW) in Climate Zones 5 through 8; or any size in Climate Zone 1A.

(3) Systems that include nonparticulate air treatment in accordance with ASHRAE 62.1.

(4) In hospitals and ambulatory surgery centers, where more than 75 percent of the air designed to be supplied by the system is to spaces that are required to be humidified more than 35°F (2°C) dew-point temperature to comply with applicable codes or accreditation standards; in all other buildings, where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified more than 35°F (2°C) dew-point temperature to satisfy process application needs. This exception shall not apply to computer rooms.

(5) Systems that include a condenser heat recovery system with a minimum capacity in accordance with Section E 503.5.10.1.2.

(6) Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table E 503.5(1).

(7) Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F (16°C).

(8) Systems expected to operate less than 20 hours per week.

(9) Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

(10) For comfort cooling where the cooling efficiency is not less than the efficiency improvement requirements in accordance with Table E 503.5(2).

(11) Systems primarily serving computer rooms where in accordance with one of the following:

(a) The total design cooling load of all computer rooms in the building is less than 3 000 000 Btu/h (879 kW) and the building in which they are located is not served by a centralized chilled water plant.

(b) The room total design cooling load is less than 600 000 Btu/h (176 kW) and the building in which they are located is served by a centralized chilled water plant.

(c) The local water authority does not permit cooling towers.

(d) Less than 600 000 Btu/h (176 kW) of computer room cooling equipment capacity is being added to an existing building.
(12) Dedicated systems for computer rooms where a minimum of 75 percent of the design load serves one of the following:
(a) Spaces classified as an essential facility.
(b) Spaces having a design of Tier IV in accordance with TIA 942.
(c) Spaces classified as Critical Operations Power Systems (COPS) in accordance with NFPA 70.
(d) Spaces where core clearing and settlement services are performed such that their failure to settle pending financial transactions is capable of systemic risk in accordance with “The Interagency Paper on Sound Practices to Strengthen the Resilience of the US Financial System” (April 7, 2003). [ASHRAE 90.1:6.5.1]

**E 201.12 Process Application.** A manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning spaces and maintaining comfort and amenities for the occupants of a building. [ASHRAE 90.1:3.2]

(renumber remaining sections)

**E 503.5.1.3 Dampers.** Return, exhaust or exhaust or relief, and outdoor air dampers shall comply with meet the requirements of Section Table E 503.4.6.4.2. Return dampers shall meet the requirements of motorized exhaust or relief dampers in Table E 503.4.6.4.2. **Exception:** Exhaust or relief and outdoor air intake dampers on systems intended to operate continuously. [ASHRAE 90.1:6.5.1.1.4]

**E 503.5.5 Simultaneous Heating and Cooling Limitation, Zone Controls.** Zone thermostatic controls shall prevent the following:
(1) Reheating.
(2) Recooling.
(3) Mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems.
(4) Other simultaneous operation of heating and cooling systems to the same zone.

**Exceptions:**
(1) Zones for which the volume of air that is reheated, recooled, or mixed is less than the larger of the following:
(a) Twenty percent for systems without DDC, 30 percent of the zone design peak supply for systems with DDC and 30 percent for other systems.
(b) The outdoor airflow rate required to be in accordance with the For systems with DDC, the minimum primary airflow rate required to meet the Simplified Procedure ventilation requirements of Chapter 4 or ASHRAE 62.1 for the zone, permitted to be the average airflow rate as allowed by Chapter 4 or ASHRAE 62.1.
(c) Any higher rate that can be demonstrated, to the satisfaction of the Authority Having Jurisdiction, to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system.
(d) The airflow rate required to be in accordance with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.
(2) Zones with DDC that comply with the following:
(a) The airflow rate in dead band between heating and cooling does not exceed the larger of the following:
(1) Twenty percent of the zone design peak supply rate.
(2) The outdoor airflow rate required to be in accordance with the For systems with DDC, the minimum primary airflow rate required to meet the Simplified Procedure ventilation requirements of Chapter 4 or ASHRAE 62.1 for the zone, permitted to be the average airflow rate as allowed by Chapter 4 or ASHRAE 62.1.
(3) A higher rate that can be demonstrated, to the satisfaction of the Authority Having Jurisdiction, to reduce overall system annual energy use by offsetting reheat/recool energy losses through a reduction in outdoor air intake.
(4) The airflow rate required with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.
(b) The airflow rate that is reheated, recooled, or mixed shall be less than 50 percent of the zone design peak supply rate.
(c) The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the dead band flow rate.
(d) The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.
(3) Laboratory exhaust systems that comply with Section E 503.5.11.3.
(4) Zones where at least 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from site-recovered energy (including condenser heat) or on-site solar renewable energy. [ASHRAE 90.1:6.5.2.1]

**E 503.5.5.3 Dehumidification.** Where humidity controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.
Exceptions:
(1) The system is capable of and configured to supply air volume to 50 percent or less of the design airflow rate or the minimum outdoor air ventilation rate in accordance with Chapter 4 or ASHRAE 62.1 or other applicable federal, state, or local code or recognized standard, whichever is larger before simultaneous heating and cooling takes place.
(2) The individual fan cooling unit has a design cooling capacity of not more than 65 000 Btu/h (19 kW) and is capable of and configured to unload to 50 percent capacity before simultaneous heating and cooling takes place.
(3) The individual mechanical cooling unit has a design cooling capacity of not more than 40 000 Btu/h (11.7 kW). An individual mechanical cooling unit is a single system composed of a fan or fans and a cooling coil capable of providing mechanical cooling.
(4) Systems serving spaces where specific humidity levels are required to satisfy process application needs, such as vivariums, museums, surgical suites, pharmacies, and buildings with refrigerating systems, such as supermarkets, refrigerated warehouses, and ice arenas, and where the building includes site-recovered energy or on-site solar renewable energy that provide energy equal to 75 percent or more of the annual energy for reheating or for providing warm air in mixing systems. This exception shall not apply to computer rooms.
(5) Not less than 90 percent of the annual energy for reheating or for providing warm air in mixing systems is provided from site-recovered energy (including condenser heat) or on-site solar renewable energy.
(6) Systems where the heat added to the airstream is the result of the use of a desiccant system and 75 percent of the heat added by the desiccant system is removed by a heat exchanger, either before or after the desiccant system with energy recovery. [ASHRAE 90.1:6.5.2.3]

E 503.5.6.1.1 Motor Nameplate Horsepower Fan Motor Selection. Fan motor selection shall be in accordance with the following:
(1) Except for each fan less than 6 bhp (4.5 kW), the selected fan motor shall not have a nameplate rating greater than 1.5 times the bhp.
(2) Systems that are in accordance with Section E 503.5.6.1, Option 1.
(3) Fans with motor nameplate horsepower of less than 1 hp (0.7 kW).
(4) Fans with motor nameplate horsepower a fan nameplate electrical input power of less than 4 hp (0.7 0.89 kW). [ASHRAE 90.1:6.5.3.1.2]

E 503.5.6.1.2 Fan Efficiency. Fans Each fan and fan array shall have a fan efficiency grade (FEG) of 67 or more, based on manufacturers’ certified data in accordance with AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan energy index (FEI) of 1.00 or higher. Each fan and fan array used for a variable-air-volume system that meets the requirements of Section E 503.5.6.2 shall have an FEI of 0.95 or higher. The FEI for fan arrays shall be calculated in accordance with AMCA 208.

Exceptions:
(1) Individual Fans that are not embedded fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less that are not part of a group operated as the functional equivalent of a single fan less than 1.0 hp (0.7 kW) or with a fan nameplate electrical input power of less than 0.89 kW.
(2) Multiple Embedded fans in series or parallel (e.g., and fan arrays) that have-with a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan or with a fan system electrical input power of 4.1 kW or less.
(3) Embedded Fans that are part of equipment listed under Section E 503.4.
(4) Embedded Fans included in equipment bearing a third-party-certified seal for air or energy performance of the equipment package.
(5) Powered wall/roof ventilators (PRV)-Ceiling fans.
(6) Fans used for moving gases at temperatures above 482°F (250 °C).
(7) Fans used for operation in explosive atmospheres.
(8) Reversible fans used for tunnel ventilation.
(9) Fans outside the scope of AMCA 205-208.
(10) Fans that are intended to only operate during emergency conditions. [ASHRAE 90.1:6.5.3.1.3]

E 503.5.6.3 Multiple-Zone VAV System Ventilation Optimization Control. Multiple-zone VAV systems with DDC of
individual zone boxes reporting to a central control panel shall include means to automatically reduce outdoor air intake flow below design rates in response to changes in system ventilation efficiency in accordance with Section 404.0 or ASHRAE 62.1.

Exceptions:
(1) VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units.
(2) Systems where total design exhaust airflow is more than 70 percent of total design outdoor air intake flow requirements. [ASHRAE 90.1:6.5.3.3]

E 503.5.6.4 Supply Air Temperature Reset Controls. Multiple zone HVAC systems shall include controls that are capable of and configured to automatically reset the supply air temperature in response to representative building loads, or to outdoor air temperature. The controls shall reset the supply air temperature to at least 25 percent of the difference between the design supply air temperature and the design room air temperature. Controls that adjust the reset based on zone humidity shall be permitted in Climate Zones 0B, 1B, 2B, 3B, 3C, and 4 through 8. HVAC zones that are expected to experience relatively constant loads, such as electronic equipment rooms, shall be have maximum airflow designed for to accommodate the fully reset supply air temperature. HVAC zones that are expected to experience relatively constant loads typically include electronic equipment rooms and interior zones.

Exceptions:
(1) Systems in Climate Zones 0A, 1A, 2A, and 3A with less than 3000 cubic feet per minute (1.4 m³/s) of design outdoor air.
(2) Systems in Climate Zone 2A with less than 10 000 cubic feet per minute (4.7 m³/s) of design outdoor air.
(3) Systems in Climate Zones 0A, 1A, 2A, and 3A with at least 80 percent outdoor air and employing exhaust air energy recovery complying with Section E 503.5.10.
(4) Systems that prevent reheating, recooling, or mixing of heated and cooled supply air.
(5) Systems where not less than in which at least 75 percent of the energy for reheating (on an annual basis) is from site recovered energy or on-site solar renewable energy. [ASHRAE 90.1:6.5.3.5]

E 503.5.7 Hydronic System Design and Control. Hydronic system design and control shall be in accordance with Section E 503.5.7.1 and Section E 503.5.7.2.

E 503.5.7.1 Boiler Turndown. Boiler systems with design input of 1 000 000 Btu/h (293 kW) or more shall comply with the turndown ratio in accordance with Table E 503.5.7. The system turndown requirement shall use multiple single-input boilers, one or more modulating boilers, or a combination of single-input and modulating boilers. Boilers shall comply with the minimum efficiency requirements in Table E 503.7.1(6). [ASHRAE 90.1:6.5.4.1]

(renumber remaining sections)

E 503.5.7.3 Chilled- and Hot-Water Temperature Reset Controls. Chilled- and hot-water systems with a design capacity exceeding 300 000 Btu/h (88 kW) supplying chilled or heated water to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outdoor air temperature. Where DDC is used to control valves, the set point shall be reset based on valve positions until one valve is nearly wide open or setpoint limits of the system equipment or application have been reached.

Exceptions:
(1) Where chilled-water supply is already cold, such as chilled water supplied from a district cooling or thermal energy storage system, such that blending would be required to achieve the reset chilled-water supply temperature.
(2) Where a specific temperature is required for a process application.
(3) Water temperature reset is not required where valve position is used to comply with Section E 503.5.7. [ASHRAE 90.1:6.5.4.4]

E 503.5.7.4 Hydronic (Water Loop) Heat Pump and Water-Cooled Unitary Air Conditioners. Hydronic heat pumps and water-cooled unitary air-conditioners shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

Exception: Units employing water-fluid economizers. [ASHRAE 90.1:6.5.4.5.1]

E 503.5.10 Energy Recovery. Energy recovery shall be in accordance with Section E 503.5.10.1, through Section E 503.5.10.3.

E 503.5.10.1 Exhaust Air Energy Recovery. Exhaust air energy recovery shall be in accordance with Section E 503.5.10.1.1 through Section E 503.5.10.1.2.

E 503.5.10.1.1 Exhaust Air Energy Recovery for Nontransient Dwelling Units. Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems. For nontransient dwelling units, energy recovery systems shall result in an enthalpy recovery ratio of at least 50 percent at cooling design condition and at least 60 percent at heating design condition. The energy recovery system shall provide the required enthalpy recovery ratio at both heating
and cooling design conditions, unless one mode is not required for the climate zone by the exceptions below.

**Exceptions:**
(1) Nontransient dwelling units in Climate Zone 3C.
(2) Nontransient dwelling units with no more than 500 ft$^2$ (46.45 m$^2$) of conditioned floor area in Climate Zone 0, 1, 2, 3, 4C, and 5C.
(3) Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
(4) Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, 8, 9 [ASHRAE 90.1:6.5.6.1.1]

E 503.5.10.1.2 Exhaust Air Energy Recovery for Spaces Other than Nontransient Dwelling Units. Each fan system serving spaces other than nontransient dwelling units shall have an energy recovery system where the design supply fan airflow rate exceeds the value listed in Table E 503.5.10(1) and Table E 503.5.10(2), based on the climate zone and percentage of outdoor air at design airflow conditions. Table E 503.5.10(1) shall be used for all ventilation systems that operate less than 8000 hours per year and Table E 503.5.10(2) shall be used for all ventilation systems that operate 8000 or more hours per year.

**Energy Recovery Systems**
(1) Nontransient dwelling units in Climate Zone 3C.
(2) Nontransient dwelling units with no more than 500 ft$^2$ (46.45 m$^2$) of conditioned floor area in Climate Zone 0, 1, 2, 3, 4C, and 5C.
(3) Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
(4) Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, 8, 9 [ASHRAE 90.1:6.5.6.1.1]

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**Energy Recovery Systems**
(1) Nontransient dwelling units in Climate Zone 3C.
(2) Nontransient dwelling units with no more than 500 ft$^2$ (46.45 m$^2$) of conditioned floor area in Climate Zone 0, 1, 2, 3, 4C, and 5C.
(3) Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
(4) Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, 8, 9 [ASHRAE 90.1:6.5.6.1.1]

E 503.5.10.1.2 Exhaust Air Energy Recovery for Spaces Other than Nontransient Dwelling Units. Each fan system serving spaces other than nontransient dwelling units shall have an energy recovery system where the design supply fan airflow rate exceeds the value listed in Table E 503.5.10(1) and Table E 503.5.10(2), based on the climate zone and percentage of outdoor air at design airflow conditions. Table E 503.5.10(1) shall be used for all ventilation systems that operate less than 8000 hours per year and Table E 503.5.10(2) shall be used for all ventilation systems that operate 8000 or more hours per year.

**Energy Recovery Systems**
(1) Nontransient dwelling units in Climate Zone 3C.
(2) Nontransient dwelling units with no more than 500 ft$^2$ (46.45 m$^2$) of conditioned floor area in Climate Zone 0, 1, 2, 3, 4C, and 5C.
(3) Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
(4) Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, 8, 9 [ASHRAE 90.1:6.5.6.1.1]

E 503.5.10.1.2 Exhaust Air Energy Recovery for Spaces Other than Nontransient Dwelling Units. Each fan system serving spaces other than nontransient dwelling units shall have an energy recovery system where the design supply fan airflow rate exceeds the value listed in Table E 503.5.10(1) and Table E 503.5.10(2), based on the climate zone and percentage of outdoor air at design airflow conditions. Table E 503.5.10(1) shall be used for all ventilation systems that operate less than 8000 hours per year and Table E 503.5.10(2) shall be used for all ventilation systems that operate 8000 or more hours per year.
**E 503.5.10.1.2** Capacity. The required heat recovery system shall have the capacity to provide the smaller of:
(1) Sixty percent of the peak heat-rejection load at design conditions or
(2) Preheat of the peak service hot-water draw to 85°F (29°C).

**Exceptions:**
(1) Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.
(2) Facilities that provide 60 percent of their service water heating from on-site solar renewable energy or site-recovered energy or from other sources. [ASHRAE 90.1:6.5.6.2.2]

**E 503.5.12 Radiant Heating Systems.** Radiant heating systems shall be in accordance with Section E 503.5.12.1 through Section E 503.5.12.2.

**E 503.5.12.1 Heating Unenclosed Spaces.** Radiant heating shall be used when heating is required for unenclosed spaces.

**Exception:** Loading docks equipped with air curtains. [ASHRAE 90.1:6.5.8.1]

**E 503.5.12.2 Heating Enclosed Spaces.** (remaining text unchanged)

**E 503.6.1 Construction Details.** Compliance documents shall show all the pertinent data and features of the building, equipment, and systems in sufficient detail to permit a determination of compliance by the building official and to indicate compliance with the requirements of this appendix. [ASHRAE 90.1:4.2.2.1]

**E 503.6.3.1 Required Information.** Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:
(1) Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance.
(2) Operation manuals and maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
(3) Names and addresses of not less than one qualified service agency.
(4) A complete narrative of how each system is intended to operate.

The Authority Having Jurisdiction shall only check to ensure that the construction documents require this information to be transmitted to the owner and should not expect copies of any of the materials. [ASHRAE 90.1:6.7.2.3.2]

**E 503.6.3.2 Lighting Manuals.** Construction documents shall require for all lighting equipment and lighting controls that an operating manual and maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall include, at a minimum, the following:
(1) Submittal data indicating all selected options for each piece of lighting equipment, including but not limited to lamps, ballasts, drivers, and lighting controls.
(2) Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified including, as a minimum, a recommended relamping or cleaning program and a schedule for inspecting and recalibrating all lighting controls.
(3) A complete narrative of how each lighting control system is intended to operate including recommended settings. [ASHRAE 90.1:6.7.2.3.2]

**E 503.6.5.1 Drawings.** Construction documents shall require that, within 90 days after the date of system acceptance, record drawings be provided to the building owner or the designated representative of the building owner. Record drawings shall include, as a minimum, the location and performance data on each piece of equipment, general configuration of the duct and pipe distribution system including sizes, and the terminal air or water design flow rates. [ASHRAE 90.1:6.7.2.1]

**E 503.6.5.2 Manuals.** Construction documents shall require that an operating manual and a maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:
(1) Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
(2) Operation manuals and maintenance manuals for each piece of equipment and system requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
(3) Names and addresses of not less than one service agency.
(4) HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
(5) A complete narrative of how each system is intended to operate, including suggested setpoints. [ASHRAE 90.1:6.7.2.3.2]

**E 503.6.5.3 System Balancing.** Construction documents shall require that HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 square feet (464.52 m²). [ASHRAE 90.1:6.7.2.3.1]
E 503.6.5.3.1 Air System Balancing. Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 1 hp (0.7 kW), fan speed shall be adjusted to meet design flow conditions. [ASHRAE 90.1: 6.7.2.3.2, 6.7.3.2.4]

E 503.6.5.4 System Commissioning. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 square feet (4645.15 m²) conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems shall be provided by the designer in plans and specifications. [ASHRAE 90.1: 6.7.2.4]

E 503.8 Alternative Compliance Path, Computer Room Systems. HVAC systems only serving the heating, cooling, or ventilation-ventilating needs of a computer room with IT equipment load greater than 13.4 hp (10 kW) shall be in accordance with Section E 503.1, Section E 503.4, Section E 503.8.1 or Section E 503.8.2, Section E 502.7 through Section E 502.7.2, and Section E 502.7.3. [ASHRAE 90.1: 6.6.1.2]

E 503.8.1 Computer Room (PUE₁). The computer room PUE₁ shall be not more than the values listed in Table E 503.8.1. Hourly simulation of the proposed design, for purposes of calculating PUE₁, shall be in accordance with ASHRAE 90.1.

Exception: The compliance path shall not be permitted for a proposed computer room design utilizing a combined heat and power system. [ASHRAE 90.1: 6.6.1.1.1]

E 503.8.2 Computer Room (PUE₀). The computer room PUE₀ is less than or equal to the values listed in Table E 503.8.1, shall be the highest value determined at outdoor cooling design temperatures, and shall be limited to systems only using electricity for an energy source. PUE₀ shall be calculated for two conditions:

1. One hundred percent design IT equipment energy and
2. Fifty percent design IT equipment energy. [ASHRAE 90.1: 6.6.1.2]

E 503.8.3 Documentation. Documentation on the following components shall be provided, including a breakdown of energy consumption or demand:

1. IT equipment
2. Power distribution losses external to the IT equipment
3. HVAC systems
4. Lighting [ASHRAE 90.1: 6.6.1.3]

### TABLE E 503.4.6.4.2

MAXIMUM DAMPER LEAKAGE

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>VENTILATION-OUTDOOR AIR INTAKE (CFM/ft²)</th>
<th>EXHAUST/RELIEF (CFM/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONMOTORIZED</td>
<td>MOTORIZED</td>
</tr>
<tr>
<td>0, 1, 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aAny height</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aAny height</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>4, 5bB, 5cC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less Fewer than 3 stories</td>
<td>not-allowed-20</td>
<td>10</td>
</tr>
<tr>
<td>3 stories or more stories</td>
<td>not-allowed-20</td>
<td>10</td>
</tr>
<tr>
<td>5aA, 6, 7, 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less Fewer than 3 stories</td>
<td>not-allowed-20</td>
<td>4</td>
</tr>
<tr>
<td>3 stories or more stories</td>
<td>not-allowed-20</td>
<td>4</td>
</tr>
</tbody>
</table>

For SI units: 1 cubic foot per minute = 0.00047 m³/s, 1 square foot = 0.0929 m², 1 inch water gauge = 0.249 kPa

Notes:
1. When tested in accordance with AMCA 500D.
2. Dampers smaller than 24 inches (610 mm) in either dimension shall be permitted to have leakage of 40 ft³/min per square foot [0.203 (m³/s)/m²].
3. Nonmotorized dampers smaller than 24 inches (610 mm) in height, width, or diameter shall be permitted to have a...
leakage rate of 40 CFM/ft² [0.203 (m³/s)/m²].

4 Where permitted by Section E 503.4.6.4.1, exception 2.

<table>
<thead>
<tr>
<th>CONTROL TYPE</th>
<th>ALLOWED ONLY IN CLIMATE ZONE AT LISTED SETPOINT</th>
<th>REQUIRED HIGH LIMIT (ECONOMIZER OFF WHERE):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed dry-bulb temperature</td>
<td>0B, 1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8</td>
<td>$T_{OA} &gt; 75^\circ F$</td>
</tr>
<tr>
<td></td>
<td>5A, 6A</td>
<td>$T_{OA} &gt; 70^\circ F$</td>
</tr>
<tr>
<td></td>
<td>0A, 1A, 2A, 3A, 4A</td>
<td>$T_{OA} &gt; 65^\circ F$</td>
</tr>
<tr>
<td>Differential dry-bulb temperature</td>
<td>0B, 1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 7, 8</td>
<td>$T_{OA} &gt; T_{RA}$</td>
</tr>
<tr>
<td>Fixed enthalpy with fixed dry-bulb temperature</td>
<td>All</td>
<td>$h_{OA} &gt; 28 \text{ Btu/lb}$ or $T_{OA} &gt; 75^\circ F$</td>
</tr>
<tr>
<td>Differential enthalpy with fixed dry-bulb temperature</td>
<td>All</td>
<td>$h_{OA} &gt; h_{RA}$ or $T_{OA} &gt; 75^\circ F$</td>
</tr>
</tbody>
</table>

For SI units: °C = (°F-32)/1.8, 1 British thermal unit per pound = 2326 J/kg

Notes:
1 At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 75°F (24°C) and 50 percent relative humidity. As an example, at approximately 6000 feet (1829 m) elevation, the fixed enthalpy limit shall be approximately 30.7 Btu/lb (71 408 J/kg).

2 Devices with selectable rather than adjustable setpoints shall be capable of being set to within 2°F (1°C) and 2 Btu/lb (4649 J/kg) of the setpoint listed.

| TABLE E 503.5.2 WATER-FLUID ECONOMIZER SIZING DRY-BULB AND WET-BULB REQUIREMENTS FOR COMPUTER ROOMS* [ASHRAE 90.1: TABLE 6.5.1.1.3] |

(portions of table not shown remain unchanged)

| TABLE E 503.5.6.1(1) FAN POWER LIMITATION* [ASHRAE 90.1: TABLE 6.5.3.1-1] |

<table>
<thead>
<tr>
<th>LIMIT</th>
<th>CONSTANT VOLUME</th>
<th>VARIABLE VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: Fan system motor nameplate (hp)</td>
<td>Allowable motor nameplate (hp) $hp = CFMS \cdot 0.0011$</td>
<td>$hp = CFMS \cdot 0.0015$</td>
</tr>
<tr>
<td>Option 2: Fan system (bhp)</td>
<td>Allowable fan system (bhp) $bhp = CFMS \cdot 0.00094 + A$</td>
<td>$bhp = CFMS \cdot 0.0013 + A$</td>
</tr>
</tbody>
</table>

For SI units: 1 horsepower = 0.746 kW, 1 cubic foot per minute = 0.00047 m³/s

*Where:
$CFMS$ = the maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute (m³/s)
$hp$ = the maximum combined motor nameplate horsepower (kW)
$bhp$ = the maximum combined fan-brake horsepower (kW)
$A$ = sum of $(PD \times CFMD/4131)$
$PD$ = each applicable pressure drop adjustment from Table E 503.5.6.1(2) in inch water column (kPa)
\[ CFMD = \text{the design airflow through each applicable device from Table E 503.5.6.1(2) in cubic feet per minute (m}^3/\text{s}) \]

### TABLE E 503.5.6.1(2)
**FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT**
[ASHRAE 90.1: TABLE 6.5.3.1-2]

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>ADJUSTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms</td>
<td>0.5 in. ( \text{w.e.-of water} ), (2.15 in. ( \text{w.e.-of water} ) for laboratory and vivarium systems)</td>
</tr>
<tr>
<td>Return, and/or exhaust, or both airflow control devices</td>
<td>0.5 in. ( \text{w.e.-of water} )</td>
</tr>
<tr>
<td>Exhaust filters, scrubbers, or other exhaust treatment</td>
<td>The pressure drop of device calculated at fan system design condition</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 9 through 12</td>
<td>0.5 in. ( \text{w.e.-of water} )</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 13 through 15</td>
<td>0.9 in. ( \text{w.e.-of water} )</td>
</tr>
<tr>
<td>Particulate Filtration Credit: MERV 16 and greater, and electronically enhanced filters</td>
<td>Pressure drop calculated at 2x clean filter pressure drop at fan system design condition</td>
</tr>
<tr>
<td>Carbon and other gas-phase air cleaners</td>
<td>Clean filter pressure drop at fan system design condition</td>
</tr>
<tr>
<td>Biosafety cabinet</td>
<td>Pressure drop of device at fan system design condition</td>
</tr>
<tr>
<td>Energy recovery device, other than coil runaround loop</td>
<td>For each airstream ([(2.2 \times \text{e-Enthalpy rRecovery rRatio}) - 0.5] \text{ in. w.e.-of water} )</td>
</tr>
<tr>
<td>Coil runaround loop</td>
<td>0.6 in. ( \text{w.e.-of water} ), for each airstream</td>
</tr>
<tr>
<td>Evaporative humidifier and/or cooler in series with another cooling coil</td>
<td>Pressure drop of device at fan system design condition</td>
</tr>
<tr>
<td>Sound attenuation section (fans serving spaces with design back- ground noise goals below NC35)</td>
<td>0.15 in. ( \text{w.e.-of water} )</td>
</tr>
<tr>
<td>Exhaust system serving fume hoods</td>
<td>0.35 in. ( \text{w.e.-of water} )</td>
</tr>
<tr>
<td>Laboratory and vivarium exhaust systems in high-rise buildings</td>
<td>0.25 in. ( \text{w.e.-of water/ per 100 feet}^2 ) of vertical duct exceeding 75 ft</td>
</tr>
</tbody>
</table>

**DEDUCTIONS**

Systems without central cooling device | −0.6 in. \( \text{w.e.-of water} \)
Systems without central heating device | −0.3 in. \( \text{w.e.-of water} \)
Systems with central electric resistance heat | −0.2 in. \( \text{w.e.-of water} \)

For SI units: 1 inch water column = 0.249 kPa, 1 foot = 304.8 mm

### TABLE E 503.5.6.5(1)
**MINIMUM AVERAGE FULL-LOAD EFFICIENCY FOR POLYPHASE SMALL ELECTRIC MOTORS**
[ASHRAE 90.1: TABLE 10.8-3]

<table>
<thead>
<tr>
<th>NUMBER OF POLES</th>
<th>OPEN MOTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>SYNCHRONOUS SPEED (RPM rpm)</td>
<td>3600</td>
</tr>
<tr>
<td>MOTOR HORSEPOWER SIZE (hp)</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
</tr>
</tbody>
</table>
*Average full-load efficiencies shall be established in accordance with 10 CFR 431.

**TABLE E 503.5.6.5(2)**
MINIMUM AVERAGE FULL-LOAD EFFICIENCY FOR CAPACITOR-START CAPACITOR-RUN AND CAPACITOR-START INDUCTION-RUN SMALL ELECTRIC MOTORS*
[ASHRAE 90.1: TABLE 10.8-4]

<table>
<thead>
<tr>
<th>NUMBER OF POLES</th>
<th>OPEN MOTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYNCHRONOUS SPEED</td>
<td>6</td>
</tr>
<tr>
<td>RPM (rpm)</td>
<td>2</td>
</tr>
<tr>
<td>3600</td>
<td>1800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOTOR HORSEPOWER SIZE (hp)</th>
<th>EFFICIENCY,%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>66.6</td>
</tr>
<tr>
<td>0.33</td>
<td>70.5</td>
</tr>
<tr>
<td>0.50</td>
<td>72.4</td>
</tr>
<tr>
<td>0.75</td>
<td>76.2</td>
</tr>
<tr>
<td>1</td>
<td>80.4</td>
</tr>
<tr>
<td>1.5</td>
<td>81.5</td>
</tr>
<tr>
<td>2</td>
<td>82.9</td>
</tr>
<tr>
<td>3</td>
<td>84.1</td>
</tr>
</tbody>
</table>

*Average full-load efficiencies shall be established in accordance with 10 CFR 431.

**TABLE E 503.5.10(1)**
EXHAUST AIR ENERGY RECOVERY REQUIREMENTS FOR VENTILATION SYSTEMS OPERATING LESS THAN 8000 HOURS PER YEAR*
[ASHRAE 90.1: TABLE 6.6.1-1 6.5.6.1.2-1]

(portions of table not shown remain unchanged)

**TABLE E 503.5.10(2)**
EXHAUST AIR ENERGY RECOVERY REQUIREMENTS FOR VENTILATION SYSTEMS OPERATING NOT LESS GREATER THAN OR EQUAL TO 8000 HOURS PER YEAR*
[ASHRAE 90.1: TABLE 6.6.1-2 6.5.6.1.2-2]

(portions of table not shown remain unchanged)

**TABLE E 503.8.1**
POWER USAGE EFFECTIVENESS (PUE) MAXIMUM
[ASHRAE 90.1: TABLE 6.6.1]

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>PUE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0A</td>
<td>1.64</td>
</tr>
<tr>
<td>0B</td>
<td>1.62</td>
</tr>
<tr>
<td>1A</td>
<td>1.61</td>
</tr>
<tr>
<td>1B</td>
<td>1.53</td>
</tr>
<tr>
<td>2A</td>
<td>1.49</td>
</tr>
<tr>
<td>2B</td>
<td>1.45</td>
</tr>
<tr>
<td>3A</td>
<td>1.41</td>
</tr>
<tr>
<td>3B</td>
<td>1.42</td>
</tr>
</tbody>
</table>
*PUE0 and PUE1 shall not include energy for battery charging.

### TABLE E 503.7.1(1)

**ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-1]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through the wall Space constrained, air cooled</td>
<td>&lt;=30 000 Btu/h2</td>
<td>All</td>
<td>Split system, three phase and applications outside U.S. single phase &amp;</td>
<td>14.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single package, three phase and applications outside U.S. single phase &amp;</td>
<td>12.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.7 SEER2 after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td>Small duct, high velocity, air cooled</td>
<td>&lt;=65 000 Btu/h2</td>
<td>All</td>
<td>Split system, three phase and applications outside U.S. single phase &amp;</td>
<td>11.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single package, three phase and applications outside U.S. single phase &amp;</td>
<td>12.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.0 SEER2 after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td>Air conditioners, air cooled</td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>Split system and single package</td>
<td>11.2 EER</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.9 IEER before 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.8 IEER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.8 IEER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.0 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.7 IEER before 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.6 IEER after 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.0 EER</td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY</td>
<td>HEATING SECTION TYPE</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
<td>TEST PROCEDURE¹</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------</td>
<td>----------------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Air conditioners, water cooled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;65 000 Btu/h</td>
<td>12.1 EER</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.3 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;/=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>12.1 EER</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.9 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;/=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>11.9 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.7 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;/=240 000 Btu/h and &lt;760 000 Btu/h</td>
<td>12.3 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.7 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;/=760 000 Btu/h</td>
<td>12.2 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.5 IEER</td>
<td></td>
</tr>
</tbody>
</table>

TABLE E 503.7.1(1) (continued)
ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS—MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-1]
<table>
<thead>
<tr>
<th>Air conditioners, evaporatively cooled</th>
<th>&lt;65 000 Btu/h2</th>
<th>All</th>
<th>Split system and single package</th>
<th>12.1 EER</th>
<th>12.3 IEER</th>
<th>AHRI 210/240</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All other</td>
<td>12.1 EER</td>
<td>12.3 IEER</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>&gt;=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All other</td>
<td>12.0 EER</td>
<td>12.2 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=240 000 Btu/h and &lt;760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All other</td>
<td>11.9 EER</td>
<td>12.1 IEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>All other</td>
<td>11.7 EER</td>
<td>11.9 IEER</td>
<td></td>
</tr>
<tr>
<td>Condensing units, air cooled</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>10.5 EER</td>
<td>11.8 IEER</td>
<td>AHRI 365</td>
</tr>
<tr>
<td>Condensing units, water cooled</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>13.5 EER</td>
<td>14.0 IEER</td>
<td>AHRI 365</td>
</tr>
<tr>
<td>Condensing units, evaporatively</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>13.5 EER</td>
<td>14.0 IEER</td>
<td>AHRI 365</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2 Single-phase, U.S. air-cooled air conditioners less than 65 000 Btu/h (19 kW) are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER and SEER2 values for single-phase products are set by the U.S. Department of Energy.
<p>| Through the wall, Space constrained, air cooled (cooling mode) | &lt;=30 000 Btu/h | All | Split system, three phase and applications outside U.S. single phase² | 12.0 SEER before 1/1/2023 11.7 SEER² after 1/1/2023 | AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023 |
| Small duct, high velocity, air cooled (cooling mode) | &lt;65 000 Btu/h | All | Split System, three phase and applications outside U.S. single phase² | 11.0 SEER 12.0 SEER² before 1/1/2023 12.0 SEER² after 1/1/2023 | AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023 |
| Air cooled (cooling mode) | &gt;=65 000 Btu/h and &lt;135 000 Btu/h | Electric resistance (or none) | | 11.0 EER 12.2 IEER before 1/1/2023 14.1 IEER after 1/1/2023 | |
|  | All other | | | | |
|  | &gt;=135 000 Btu/h and &lt;240 000 Btu/h | Electric resistance (or none) | | 10.6 EER 11.6 IEER before 1/1/2023 13.5 IEER after 1/1/2023 | AHRI 340/360 |
|  | All other | | | | |
|  | &gt;=240 000 Btu/h | Electric resistance (or none) | | 9.5 EER 10.6 IEER before 1/1/2023 12.5 IEER after 1/1/2023 | |
| Water to air, water | &lt;17 000 Btu/h | All | 86°F entering water | 12.2 EER | ISO-13256-1 |</p>
<table>
<thead>
<tr>
<th>System Type</th>
<th>Cooling Capacity</th>
<th>EER</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loop (cooling mode)</td>
<td>=17 000 Btu/h and &lt;65 000 Btu/h</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>Water-to-air, groundwater (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>59°F entering water</td>
</tr>
<tr>
<td>Brine-to-air, ground loop (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>77°F entering water</td>
</tr>
<tr>
<td>Water-to-water, water loop (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>86°F entering water</td>
</tr>
<tr>
<td>Water-to-water, groundwater (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>59°F entering water</td>
</tr>
<tr>
<td>Brine-to-water, ground loop (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>77°F entering water</td>
</tr>
<tr>
<td>Air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h² (cooling capacity)</td>
<td>Split system, three phase and applications outside U.S. single phase²</td>
<td>8.2 HSPF before 1/1/2023 7.5 HSPF² after 1/1/2023</td>
</tr>
<tr>
<td>Through the wall, Space constrained, air cooled (heating mode)</td>
<td>&lt;=30 000 Btu/h² (cooling capacity)</td>
<td>Split system, three phase and applications outside U.S. single phase²</td>
<td>7.4 HSPF before 1/1/2023 6.3 HSPF² after 1/1/2023</td>
</tr>
<tr>
<td>Small duct high velocity, air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h²</td>
<td>Split system, three phase and applications outside U.S. single phase²</td>
<td>6.8 HSPF before 1/1/2023 6.1 HSPF² after 1/1/2023</td>
</tr>
</tbody>
</table>
**TABLE E 503.7.1(2) (continued)**

**ELECTRICALLY OPERATED **AIR-COOLED UNITARY AND APPLIED** HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS**  
[ASHRAE 90.1: TABLE 6.8.1-2]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled (heating mode)</td>
<td>/=65,000 Btu/hc and &lt;135,000 Btu/hc (cooling capacity)</td>
<td>–</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.3 COPH before 1/1/2023 3.40 COPH before 1/1/2023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.25 COPH</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>/=135,000 Btu/hc (cooling capacity) and &lt;240,000 Btu/h</td>
<td>–</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.20 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.05 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>/=240,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.20 COPH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.05 COPH</td>
<td></td>
</tr>
<tr>
<td>Water-to-air, water loop (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Water-to-air, groundwater (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>60°F entering water</td>
<td>3.7 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Brine-to-air, ground loop (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>32°F entering fluid</td>
<td>3.2 COPH</td>
<td>ISO-13256-1</td>
</tr>
<tr>
<td>Water-to-water, water loop (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>68°F entering water</td>
<td>3.7 COPH</td>
<td>ISO-13256-2</td>
</tr>
<tr>
<td>Water-to-water, groundwater (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>60°F entering water</td>
<td>3.1 COPH</td>
<td>ISO-13256-2</td>
</tr>
<tr>
<td>Brine-to-water, groundwater loop (heating mode)</td>
<td>&lt;135,000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>32°F entering fluid</td>
<td>2.5 COPH</td>
<td>ISO-13256-2</td>
</tr>
</tbody>
</table>
For SI units: 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:
1. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2. Single-phase, U.S. air-cooled heat pumps less than <65 000 Btu/h (19 kW) are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER, SEER2, and HSPF values for single-phase products are set by the U.S. Department of Energy.

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### TABLE E 503.7.1(4)
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE-PACKAGE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-4]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTAC (cooling mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td><strong>13.8</strong> (0.300 × Cap/1000)³ (before 1/1/2015) 11.9 EER</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>14.0 – (0.300 × Cap/1000)³ EER⁵ (as of 1/1/2015)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>9.5 EER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTAC (cooling mode) nonstandard size¹</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>9.4 EER</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>10.9 – (0.213 × Cap/1000)³ EER⁵</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>7.7 EER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTHP (cooling mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>11.9 EER</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>14.0 – (0.300 × Cap/1000)³ EER⁵</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>9.5 EER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTHP (cooling mode) nonstandard size²</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>9.3 EER</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>10.8 – (0.213 × Cap/1000)³ EER⁵</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>7.6 EER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTHP (heating mode) standard size</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>47°F db/43°F wb outdoor air²</td>
<td><strong>3.3</strong> COPH</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>47°F db/43°F wb outdoor air²</td>
<td>3.7 – (0.052 × Cap/1000)³ COPH⁵</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>2.90 COPH</td>
<td></td>
<td></td>
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<tr>
<td>PTHP (heating mode) nonstandard size²</td>
<td>All capacities &lt;7000 Btu/h</td>
<td>47°F db/43°F wb outdoor air²</td>
<td><strong>2.7</strong> COPH</td>
<td>AHRI 310/ 380</td>
</tr>
<tr>
<td></td>
<td>&gt;=7000 Btu/h and &lt;=15 000 Btu/h</td>
<td>47°F db/43°F wb outdoor air²</td>
<td>2.9 – (0.026 × Cap/1000)³ COPH⁵</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;15 000 Btu/h</td>
<td>2.5 COPH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPVAC (cooling mode) single and three phase</td>
<td>&lt;65,000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td><strong>10.0</strong> 11.0 EER</td>
<td>AHRI 390</td>
</tr>
<tr>
<td></td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air²</td>
<td>10.0 EER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=135 000 Btu/h</td>
<td>10.0 EER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY (INPUT)</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
<td>TEST PROCEDURE</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------</td>
<td>----------------------------------</td>
<td>--------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Room air conditioners without louvered sides</td>
<td>&lt;8000-6000 Btu/h and &lt;8000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>9.0 10.0 CEER</td>
<td>AHAM RAC-1</td>
</tr>
<tr>
<td></td>
<td>&gt;/=8000 Btu/h and &lt;20 000 Btu/h</td>
<td>95°F db/75°F wb outdoor air</td>
<td>8.5 9.6 CEER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;/=20 000 Btu/h</td>
<td>47°F db/43°F wb outdoor air</td>
<td>8.5 9.4 CEER</td>
<td></td>
</tr>
</tbody>
</table>

TABLE E 503.7.1(4) (continued)

ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE-PACKAGE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS, AND ROOM AIR CONDITIONER HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-4]
Room air conditioners, heat pumps with reverse cycle, with louvered sides, for applications outside U.S.  
- <20 000 Btu/h | – | 9.0 9.8 CEER | AHAM RAC-1  
- >/=20 000 Btu/h | – | 8.5 9.3 CEER  

Room air conditioners, heat pumps with reverse cycle without louvered sides, for applications outside U.S.  
- <14 000 Btu/h | – | 8.5 9.3 CEER | AHAM RAC-1  
- >/=14 000 Btu/h | – | 8.0 8.7 CEER  

Room air conditioners, casement only, for applications outside U.S.  
- All capacities | – | 8.7 9.5 CEER | AHAM RAC-1  

Room air conditioners, casement slider, for applications outside U.S.  
- All capacities | – | 9.5 10.4 CEER | AHAM RAC-1  

For SI units: 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2 Nonstandard size units must be factory labeled as follows: “MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW STANDARD PROJECTS.” Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16 inch (406 mm) high or less than 42 inch (1067 mm) wide and having a cross-sectional area less than 670 square inches (0.432 m2).
3 “Cap” means the rated cooling capacity of the product in Btu/h (kW). If the unit’s capacity is less than 7000 Btu/h (2.05 kW), use 7000 Btu/h (2.05 kW) in the calculation. Where the unit’s capacity is more than 15 000 Btu/h (4.4 kW), use 15 000 Btu/h (4.4 kW) in the calculation.
4 The cooling-mode wet bulb temperature requirement only applies for units that reject condensate to the condenser coil.
4 Room air conditioners are regulated as consumer products by 10 CFR 430. For U.S. applications of room air conditioners, refer to Informative Appendix F, Table F-3, for the USDOE minimum efficiency requirements for U.S. applications.
5 “Cap” in EER and COPH equations for PTACs and PTHPs means cooling capacity in Btu/h at 95°F outdoor dry-bulb temperature.

**TABLE E 503.7.1(5)**  
WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS - MINIMUM EFFICIENCY REQUIREMENTS  
[ASHRAE 90.1: TABLE 6.8.1-5]
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Thermal Capacity</th>
<th>AFUE Requirements</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-air furnace, oil fired for application outside the U.S.</td>
<td>&lt;225 000 Btu/h</td>
<td>78% AFUE or 80% $E_t$</td>
<td>Appendix N of 10 CFR 430 or Section 42, Combustion, UL 727</td>
</tr>
<tr>
<td>Warm-air furnace, oil fired</td>
<td>&lt;225 000 Btu/h</td>
<td>78% AFUE or 80% $E_t$</td>
<td>DOE 10 CFR Part 430 or Section 42, Combustion, UL 727</td>
</tr>
<tr>
<td>Warm-air furnace, oil fired</td>
<td>&gt;=225 000 Btu/h</td>
<td>83% AFUE (nonweatherized) or 78% AFUE (weatherized), 80% $E_t$</td>
<td>Section 42, Combustion, UL 727</td>
</tr>
<tr>
<td>Electric furnaces for applications outside the U.S.</td>
<td>&lt;225 000 Btu/h</td>
<td>All</td>
<td>96% AFUE</td>
</tr>
<tr>
<td>Warm-air duct furnaces, gas fired</td>
<td>All capacities</td>
<td>Maximum capacity</td>
<td>80% $E_c$</td>
</tr>
<tr>
<td>Warm-air unit heaters, gas fired</td>
<td>All capacities</td>
<td>Maximum capacity</td>
<td>80% $E_c$</td>
</tr>
<tr>
<td>Warm-air unit heaters, oil fired</td>
<td>All capacities</td>
<td>Maximum capacity</td>
<td>80% $E_c$</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

Notes:
1. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2. Combination units (i.e., furnaces contained within the same cabinet as an air conditioner) not covered by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430 (i.e., three-phase power or with cooling capacity greater than or equal to 65 000 Btu/h (19 kW)) may comply with either rating. All other units greater than 225 000 Btu/h (66 kW) sold in the U.S. must meet the AFUE standards for consumer products and test using USDOE’s AFUE test procedure at 10 CFR 430, Subpart B, Appendix N.
3. Compliance of multiple firing rate units shall be at the maximum firing rate.
4. $E_t$ = thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
5. $E_c$ = combustion efficiency (100 percent less flue losses). See test procedure for detailed discussion.
6. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
7. For U.S. applications of federal covered greater than 225 000 Btu/h (66 kW) products, see Informative Appendix F.
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>SIZE CATEGORY (INPUT)</th>
<th>MINIMUM EFFICIENCY</th>
<th>EFFICIENCY AS OF 3/2/2022</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers, hot water</td>
<td>Gas fired</td>
<td>&lt;300 000 Btu/h&lt;sup&gt;6,7&lt;/sup&gt; for applications outside U.S.&lt;sup&gt;9&lt;/sup&gt;</td>
<td>82% AFUE</td>
<td>82% AFUE</td>
<td>Appendix N of 10 CFR Part 430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=300 000 Btu/h and &lt;/=2 500 000 Btu/h&lt;sup&gt;4&lt;/sup&gt;</td>
<td>80% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>80% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2 500 000 Btu/h&lt;sup&gt;1,4&lt;/sup&gt;</td>
<td>82% Ec&lt;sup&gt;2&lt;/sup&gt;</td>
<td>82% Ec&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Boilers, hot water</td>
<td>Oil fired</td>
<td>&lt;300 000 Btu/h&lt;sup&gt;6,7&lt;/sup&gt; for applications outside U.S.&lt;sup&gt;9&lt;/sup&gt;</td>
<td>84% AFUE</td>
<td>84% AFUE</td>
<td>Appendix N of 10 CFR Part 430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=300 000 Btu/h and &lt;/=2 500 000 Btu/h&lt;sup&gt;4&lt;/sup&gt;</td>
<td>82% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>82% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2 500 000 Btu/h&lt;sup&gt;1,4&lt;/sup&gt;</td>
<td>84% Ec&lt;sup&gt;2&lt;/sup&gt;</td>
<td>84% Ec&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Boilers, steam</td>
<td>Gas fired</td>
<td>&lt;300 000 Btu/h&lt;sup&gt;6&lt;/sup&gt; for applications outside U.S.&lt;sup&gt;9&lt;/sup&gt;</td>
<td>80% AFUE</td>
<td>80% AFUE</td>
<td>Appendix N of 10 CFR Part 430</td>
</tr>
<tr>
<td></td>
<td>Gas fired—all, except natural draft</td>
<td>&gt;/=300 000 Btu/h and &lt;/=2 500 000 Btu/h&lt;sup&gt;4&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2 500 000 Btu/h&lt;sup&gt;1,4&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Boilers, steam</td>
<td>Gas fired—natural draft</td>
<td>&gt;/=300 000 Btu/h and &lt;/=2 500 000 Btu/h&lt;sup&gt;4&lt;/sup&gt;</td>
<td>77% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2 500 000 Btu/h&lt;sup&gt;1,4&lt;/sup&gt;</td>
<td>77% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td>79% Et&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Boilers, steam</td>
<td>Oil fired</td>
<td>&lt;300 000 Btu/h&lt;sup&gt;6&lt;/sup&gt; for applications outside U.S.&lt;sup&gt;9&lt;/sup&gt;</td>
<td>82% AFUE</td>
<td>82% AFUE</td>
<td>Appendix N of 10 CFR Part 430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;/=300 000 Btu/h and &lt;/=2 500 000 Btu/h&lt;sup&gt;4&lt;/sup&gt;</td>
<td>81% Et&lt;sup&gt;2&lt;/sup&gt;</td>
<td>81% Et&lt;sup&gt;2&lt;/sup&gt;</td>
<td>10 CFR Part 431.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;2 500 000 Btu/h&lt;sup&gt;1,4&lt;/sup&gt;</td>
<td>81% Et&lt;sup&gt;2&lt;/sup&gt;</td>
<td>81% Et&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW

Notes:
1 These requirements apply to boilers with rated input of 8 000 000 Btu/h (2343 kW) or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged
2 Ec = combustion efficiency (100 percent less flue losses). See reference document for detailed information.
3 Et = thermal efficiency. See reference document for detailed information.
4 Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit’s controls.
5 Includes oil-fired (residual).
6 Boilers shall not be equipped with a constant burning pilot light.
7 A boiler not equipped with a tankless domestic water-heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.
8 For new construction, refer to Section E 503.4 for additional system compliance requirements.
9 See Informativ Appendix F, Table F-4 of ASHRAE 90.1, for U.S. minimum efficiencies for residential products covered by USDOE requirements for U.S. applications.

**TABLE E 503.7.1(7)**

**PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT—MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-7]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>TOTAL SYSTEM HEAT-REJECTION CAPACITY AT RATED CONDITIONS</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>PERFORMANCE REQUIRED</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propeller or axial fan open-circuit cooling towers</td>
<td>All</td>
<td>95°F entering water 85°F leaving water 75°F entering wb</td>
<td>&gt;=40.2 gpm/hp</td>
<td>CTI ATC-105 and CTI STD-201 RS</td>
</tr>
<tr>
<td>Centrifugal fan open-circuit cooling towers</td>
<td>All</td>
<td>95°F entering water 85°F leaving water 75°F entering wb</td>
<td>&gt;=20.0 gpm/hp</td>
<td>CTI ATC-105 and CTI STD-201 RS</td>
</tr>
<tr>
<td>Propeller or axial fan closed-circuit cooling towers</td>
<td>All</td>
<td>102°F entering water 90°F leaving water 75°F entering wb</td>
<td>&gt;=16.1 gpm/hp</td>
<td>CTI ATC-105S and CTI STD-201 RS</td>
</tr>
<tr>
<td>Centrifugal closed-circuit cooling towers</td>
<td>All</td>
<td>102°F entering water 90°F leaving water 75°F entering wb</td>
<td>&gt;=7.0 gpm/hp</td>
<td>CTI ATC-105S and CTI STD-201 RS</td>
</tr>
<tr>
<td>Propeller or axial fan dry coolers (air-cooled fluid coolers)</td>
<td>All</td>
<td>115°F entering water 105°F leaving water 95°F entering wb</td>
<td>&gt;=4.5 gpm/hp</td>
<td>CTI ATC-105DS</td>
</tr>
<tr>
<td>Propeller or axial fan evaporative condensers</td>
<td>All</td>
<td>R-507A R-448A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb</td>
<td>&gt;=157 000 Btu/h·hp</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Propeller or axial fan evaporative condensers</td>
<td>All</td>
<td>Ammonia test fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb</td>
<td>&gt;=134 000 Btu/h·hp</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Centrifugal fan evaporative condensers</td>
<td>All</td>
<td>R-507A R-448A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb</td>
<td>&gt;=135 000 Btu/h·hp</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>Centrifugal fan evaporative</td>
<td>All</td>
<td>Ammonia test fluid 140°F entering gas</td>
<td>&gt;=110 000 Btu/h·hp</td>
<td>CTI ATC-106</td>
</tr>
<tr>
<td>condensers</td>
<td>temperature 96.3°F condensing temperature 75°F entering wb</td>
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</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------</td>
<td></td>
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</tr>
<tr>
<td>Air cooled condensers</td>
<td>125°F condensing temperature 190°F entering gas temperature 15°F subcooling 95°F entering db</td>
<td>&gt;/=176 000 Btu/h·hp</td>
<td>AHRI 460</td>
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</tbody>
</table>

For SI units: °C = (°F-32)/1.8, 1 gallon per minute per horsepower = 0.085 [(L/s)/kW], 1000 British thermal units per hour = 0.293 kW, 1 horsepower = 0.746 kW

Notes:
1. For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table E 503.7.1(7) divided by the fan motor nameplate power.

2. For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the thermal rating condition listed in Table E 503.7.1(7) divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

3. For purposes of this table, dry-cooler performance is defined as the process water flow rating of the unit at the thermal rating condition listed in this table divided by the total fan motor nameplate power of the unit, and air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the total fan motor nameplate power of the unit.

4. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

5. The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field-erected cooling towers.

6. All cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.

7. For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table, divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

8. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A-448A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A-448A must meet the minimum efficiency requirements listed above with R-507A-448A as the test fluid. For ammonia, the condensing temperature is defined as the saturation temperature corresponding to the refrigerant pressure at the condenser entrance. For R-448A, which is a zeotropic refrigerant, the condensing temperature is defined as the arithmetic average of the dew point and the bubble point temperatures corresponding to the refrigerant pressure at the condenser entrance.

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**TABLE E 503.7.1(8)**
**HEAT TRANSFER EQUIPMENT - MINIMUM EFFICIENCY REQUIREMENTS**
{ASHRAE 90.1: TABLE 6.8.1-8}

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY</th>
<th>MINIMUM EFFICIENCY¹</th>
<th>TEST PROCEDURE²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid to liquid heat exchangers</td>
<td>Plate type</td>
<td>NR</td>
<td>AHRI 400</td>
</tr>
</tbody>
</table>

Notes:
1. NR = No Requirement
2. ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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**TABLE E 503.7.1(9) 503.7.1(8)**
**ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AIR CONDITIONERS - MINIMUM EFFICIENCY REQUIREMENTS**
{ASHRAE 90.1: TABLE 6.8.1-9 6.8.1-8}

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>SIZE</th>
<th>HEATING</th>
<th>SUBCATEGORY OR MINIMUM</th>
<th>TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>CATEGORY</td>
<td>SECTION TYPE</td>
<td>RATING CONDITION</td>
<td>EFFICIENCY</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>--------------</td>
<td>------------------</td>
<td>------------</td>
</tr>
<tr>
<td>VRF air conditioners, air cooled</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system</td>
<td>13.0 SEER</td>
</tr>
<tr>
<td></td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>11.2 EER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.1 IEER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=135 000 Btu/h and &lt;240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>11.0 EER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=240 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>VRF multisplit system</td>
<td>10.0 EER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VRF water source (cooling mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system 86°F entering water</td>
<td>12.0 EER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW
### TABLE E 503.7.1(10) (continued)

**ELECTRICALLY OPERATED VARIABLE-REFRIGERANT-FLOW AND APPLIED HEAT PUMPS - MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-10 6.8.1-9]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRF groundwater source (cooling mode)</td>
<td>&lt;135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 59°F entering water</td>
<td>16.2 EER</td>
<td>AHRI 1230</td>
</tr>
<tr>
<td>VRF ground source (cooling mode)</td>
<td>&gt;/=135 000 Btu/h</td>
<td>All</td>
<td>VRF multisplit system with heat recovery 59°F entering water</td>
<td>16.0 EER</td>
<td></td>
</tr>
<tr>
<td>VRF Air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h (cooling capacity)</td>
<td>—</td>
<td>VRF Multi-split system</td>
<td>7.7 HSPF</td>
<td>AHRI 1230</td>
</tr>
<tr>
<td></td>
<td>&gt;/=65 000 Btu/h and</td>
<td>—</td>
<td>VRF Multi-split system 47°F db/43°F wb</td>
<td>3.3 COPH</td>
<td></td>
</tr>
</tbody>
</table>
### VRF Water source (heating mode)

<table>
<thead>
<tr>
<th>Cooling Capacity</th>
<th>Type</th>
<th>Net Sensible Cooling Capacity</th>
<th>Standard Model</th>
<th>Minimum Net Sensible COPc</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;135 000 Btu/h</td>
<td>—</td>
<td>—</td>
<td>17°F db/15°F wb outdoor air</td>
<td>2.25 COPH</td>
<td></td>
</tr>
<tr>
<td>&gt;=135 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 47°F db/43°F wb outdoor air</td>
<td>3.2 COPH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;240 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 68°F entering water</td>
<td>4.2 COPH (before 1/1/2018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;=240 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 68°F entering water</td>
<td>4.0 COPH (as of 1/1/2018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;=135 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 68°F entering water</td>
<td>3.9 COPH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### VRF Groundwater source (heating mode)

<table>
<thead>
<tr>
<th>Cooling Capacity</th>
<th>Type</th>
<th>Net Sensible Cooling Capacity</th>
<th>Standard Model</th>
<th>Minimum Net Sensible COPc</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;135 000 Btu/h</td>
<td>—</td>
<td>—</td>
<td>50°F entering water</td>
<td>3.6 COPH</td>
<td>AHRI 1230</td>
</tr>
<tr>
<td>&gt;=135 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 50°F entering water</td>
<td>3.3 COPH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;135 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 32°F entering water</td>
<td>3.1 COPH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;=135 000 Btu/h</td>
<td>—</td>
<td>VRF Multi-split system 32°F entering water</td>
<td>2.8 COPH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW, °C=(*F-32)/1.8
<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>NET SENSIBLE COOLING CAPACITY</th>
<th>STANDARD MODEL</th>
<th>MINIMUM NET SENSIBLE COPc</th>
<th>RETURN DRY-BULB TEMPERATURE/DEW-POINT TEMPERATURE</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycol-cooled</td>
<td>&lt;65,000-Btu/h</td>
<td>Downflow unit</td>
<td>2.30</td>
<td>75°F/52°F/95°F/52°F</td>
<td>AHRI-1360</td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-ducted</td>
<td>2.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-nonducted</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Horizontal-flow unit</td>
<td>2.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>=65,000-Btu/h and &lt;240,000-Btu/h</td>
<td>Downflow unit</td>
<td>2.06</td>
<td>85°F/52°F/95°F/52°F</td>
<td>AHRI-1360</td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-ducted</td>
<td>2.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-nonducted</td>
<td>1.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Horizontal-flow unit</td>
<td>2.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>=240,000-Btu/h</td>
<td>Downflow unit</td>
<td>1.95</td>
<td>75°F/52°F/95°F/52°F</td>
<td>AHRI-1360</td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-ducted</td>
<td>1.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-nonducted</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Horizontal-flow unit</td>
<td>2.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>&lt;65,000-Btu/h</td>
<td>Downflow unit</td>
<td>2.25</td>
<td>85°F/52°F/95°F/52°F</td>
<td>AHRI-1360</td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Upflow unit-ducted</td>
<td>2.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol-cooled</td>
<td>Horizontal-flow unit</td>
<td>2.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE E 503.7.1(11) (continued)**

**AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-11]
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Standard Model</th>
<th>Net Sensible Cooling Capacity</th>
<th>Minimum Net Sensible COP</th>
<th>Rating Conditions Return air (dry bulb/dew point)</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled</td>
<td>Downflow</td>
<td>&lt;80,000 Btu/h</td>
<td>2.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.58</td>
<td></td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—ducted</td>
<td>&lt;80,000 Btu/h</td>
<td>2.67</td>
<td>85°F/52°F (Class 2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—nondonducted</td>
<td>&lt;65,000 Btu/h</td>
<td>2.16</td>
<td>75°F/52°F (Class 1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.04</td>
<td></td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>1.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
<td>&lt;65,000 Btu/h</td>
<td>2.65</td>
<td>95°F/52°F (Class 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air cooled with fluid economizer</td>
<td>Downflow</td>
<td>&lt;80,000 Btu/h</td>
<td>2.70</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upflow—ducted</td>
<td>&lt;80,000 Btu/h</td>
<td>2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.55</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW, °C=(°F-32)/1.8
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Standard Model</th>
<th>Net Sensible Cooling Capacity</th>
<th>Minimum Net Sensible COP</th>
<th>Rating Conditions Return air (dry bulb/dew point)</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downflow</td>
<td></td>
<td>&lt;80,000 Btu/h</td>
<td>2.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.73</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upflow—ducted</td>
<td></td>
<td>&lt;80,000 Btu/h</td>
<td>2.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>2.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.32</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upflow—nonducted</td>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>2.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.68</td>
<td>95°F/52°F (Class 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>2.71</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.54</td>
<td>95°F/52°F (Class 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=240,000 Btu/h</td>
<td>2.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downflow</td>
<td></td>
<td>&lt;80,000 Btu/h</td>
<td>2.77</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.68</td>
<td>85°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.61</td>
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<td></td>
</tr>
<tr>
<td>Upflow—ducted</td>
<td></td>
<td>&lt;80,000 Btu/h</td>
<td>2.74</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>&gt;=80,000 Btu/h and &lt;295,000 Btu/h</td>
<td>2.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=295,000 Btu/h</td>
<td>2.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;65,000 Btu/h</td>
<td>2.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;=65,000 Btu/h and &lt;240,000 Btu/h</td>
<td>2.24</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
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<td>Minimum Net Sensible COP</td>
<td>Rating Conditions Return air (dry bulb/dew point)</td>
<td>Test Procedure</td>
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<td>Upflow, nonducted</td>
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<td>Upflow, nonducted</td>
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<td>2.00</td>
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<td>&gt;=65 000 Btu/h and &lt;240 000 Btu/h</td>
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<td>&gt;=240 000 Btu/h</td>
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</table>

**TABLE E 503.7.1(12)**

**COMMERCIAL REFRIGERATOR AND FREEZERS—MINIMUM EFFICIENCY REQUIREMENTS**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>APPLICATION</th>
<th>ENERGY USE LIMITS, KWH/DAY*</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator with solid doors</td>
<td>Holding temperature</td>
<td>0.10 × V + 2.04</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Refrigerator with transparent doors</td>
<td>Holding temperature</td>
<td>0.12 × V + 3.34</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Freezers with solid doors</td>
<td>Holding temperature</td>
<td>0.40 × V + 1.38</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Freezers with transparent doors</td>
<td>Holding temperature</td>
<td>0.75 × V + 4.40</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Refrigerators/freezers with solid doors</td>
<td>Holding temperature</td>
<td>the greater of 0.12 × V + 3.34 or 0.70</td>
<td>AHRI 1200</td>
</tr>
<tr>
<td>Commercial refrigerators</td>
<td>Pulldown</td>
<td>0.126 × V + 3.54</td>
<td>AHRI 1200</td>
</tr>
</tbody>
</table>
For SI units: 1000 British thermal units per hour per day = 0.293 kW/day

*V* = the chiller or frozen compartment volume (ft³) as defined in Association of Home Appliance Manufacturers.

<table>
<thead>
<tr>
<th>EQUIPMENT CATEGORY</th>
<th>CONDENSING UNIT CONFIGURATION</th>
<th>EQUIPMENT FAMILY</th>
<th>RATING TEMP., °F</th>
<th>OPERATING TEMP., °F</th>
<th>EQUIPMENT CLASSIFICATION</th>
<th>MAXIMUM DAILY ENERGY CONSUMPTION, KWH/DAY</th>
<th>TEST STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote condensing commercial refrigerators and commercial freezers</td>
<td>Remote (RC)</td>
<td>Vertical open (VOP)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VOP.RC.M</td>
<td>0.64 × TDA + 4.07</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VOP.RC.L</td>
<td>2.20 × TDA + 6.85</td>
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<td></td>
<td>Semivertical open (SVO)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>SVO.RC.M</td>
<td>0.66 × TDA + 3.18</td>
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<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>SVO.RC.L</td>
<td>2.20 × TDA + 6.85</td>
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<tr>
<td></td>
<td></td>
<td>Horizontal open (HZO)</td>
<td>38 (M)</td>
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<td>HZO.RC.M</td>
<td>0.35 × TDA + 2.88</td>
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<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HZO.RC.L</td>
<td>0.55 × TDA + 6.88</td>
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<td></td>
<td>Vertical closed transparent (VCT)</td>
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<td>VCT.RC.M</td>
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<td>0 (L)</td>
<td>&lt;32</td>
<td>VCT.RC.L</td>
<td>0.49 × TDA + 2.61</td>
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<tr>
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<td>Horizontal closed transparent (HCT)</td>
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<td>&gt;/=32</td>
<td>HCT.RC.M</td>
<td>0.16 × TDA + 0.13</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HCT.RC.L</td>
<td>0.34 × TDA + 0.26</td>
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<td></td>
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<td>Vertical closed solid (VCS)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VCS.RC.M</td>
<td>0.10 × V + 0.26</td>
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<tr>
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<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>VCS.RC.L</td>
<td>0.21 × V + 0.54</td>
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<td>Horizontal closed solid (HCS)</td>
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<td>&gt;/=32</td>
<td>HCS.RC.M</td>
<td>0.10 × V + 0.26</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0 (L)</td>
<td>&lt;32</td>
<td>HCS.RC.L</td>
<td>0.21 × V + 0.54</td>
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<td>Service over counter (SOC)</td>
<td>38 (M)</td>
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<td>SOC.RC.M</td>
<td>0.44 × TDA + 0.11</td>
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<td>0 (L)</td>
<td>&lt;32</td>
<td>SOC.RC.L</td>
<td>0.93 × TDA + 0.22</td>
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<td>Self-contained commercial refrigerators and commercial freezers with and without doors</td>
<td>Self-contained (SC)</td>
<td>Vertical open (VOP)</td>
<td>38 (M)</td>
<td>&gt;/=32</td>
<td>VOP.SC.M</td>
<td>1.69 × TDA + 4.71</td>
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<td>0 (L)</td>
<td>&lt;32</td>
<td>VOP.SC.L</td>
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<td>1.70 × TDA + 4.59</td>
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<td>SVO.SC.L</td>
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<td>VCT.SC.M</td>
<td>0.10 × V + 0.86</td>
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<td>EQUIPMENT CATEGORY</td>
<td>CONDENSING UNIT CONFIGURATION</td>
<td>EQUIPMENT FAMILY</td>
<td>RATING TEMP., °F</td>
<td>OPERATING TEMP., °F</td>
<td>EQUIPMENT CLASSIFICATION</td>
<td>MAXIMUM DAILY ENERGY CONSUMPTION, KWH/DAY</td>
<td>TEST STANDARD</td>
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<td>Commercial ice-cream freezers</td>
<td>Remote (RC)</td>
<td>Vertical Open (VOP)</td>
<td>−15 (I)</td>
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<td>Service Over (SOC)</td>
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**TABLE E 503.7.1(11)**

COMMERCIAL REFRIGERATORS, COMMERCIAL FREEZERS, AND REFRIGERATION—MINIMUM EFFICIENCY REQUIREMENTS (Continued)

[ASHRAE 90.1: TABLE 6.8.1-11]
### Notes:

1. The meaning of the letters in this column is indicated in the columns to the left.
2. "Ice-cream freezer" is defined in 10 CFR 431.62 as a commercial freezer that is designed to operate at or below –5°F and that the manufacturer designs, markets, or intends for the storing, displaying, or dispensing of ice cream.
3. Equipment class designations consist of a combination (in sequential order separated by periods (AAA).(BB).(C)) of the following:
   a. (AAA)—An equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical closed transparent doors, VCS = vertical closed solid doors, HCT = horizontal closed transparent doors, HCS = horizontal closed solid doors, and SOC = service over counter);
   b. (BB)—An operating mode code (RC = remote condensing and SC = self-contained); and
   c. (C)—A rating temperature code (M = medium temperature [38°F], L = low temperature [0°F], or I = ice cream temperature [–15°F]). For example, "VOP.RC.M" refers to the "vertical open, remote condensing, medium temperature" equipment class.
4. V is the volume of the case (ft³) as measured in AHRI 1200, Appendix C.
5. TDA is the total display area of the case (ft²) as measured in AHRI 1200, Appendix D.

### TABLE E 503.7.1(13)
**COMMERCIAL REFRIGERATION – MINIMUM EFFICIENCY REQUIREMENTS**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>ENERGY USE LIMITS</th>
<th>TEST PROCEDURE</th>
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<tr>
<td></td>
<td>KWH/DAY</td>
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<td><strong>FAMILY CODE</strong></td>
<td><strong>OPERATING MODE</strong></td>
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<td>VOP.RC.M</td>
<td>Vertical open</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>SVO.RC.M</td>
<td>Semivertical open</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>HZO.RC.M</td>
<td>Horizontal open</td>
<td>Remote condensing</td>
</tr>
<tr>
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<td>Door Type</td>
<td>Condensing Type</td>
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<td>Vertical-open</td>
<td>Remote condensing</td>
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<td>HZO.RC.L</td>
<td>Horizontal-open</td>
<td>Remote condensing</td>
</tr>
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<td>VCT.RC.M</td>
<td>Vertical-transparent door</td>
<td>Remote condensing</td>
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<td>Vertical-transparent door</td>
<td>Remote condensing</td>
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<td>SOC.RC.M</td>
<td>Service-over counter</td>
<td>Remote condensing</td>
</tr>
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<td>VOP.SC.M</td>
<td>Vertical-open</td>
<td>Self-contained</td>
</tr>
<tr>
<td>SVO.SC.M</td>
<td>Semivertical-open</td>
<td>Self-contained</td>
</tr>
<tr>
<td>HZO.SC.M</td>
<td>Horizontal-open</td>
<td>Self-contained</td>
</tr>
<tr>
<td>HZO.SC.L</td>
<td>Horizontal-open</td>
<td>Self-contained</td>
</tr>
<tr>
<td>VCT.SC.I</td>
<td>Vertical-transparent door</td>
<td>Self-contained</td>
</tr>
<tr>
<td>VCS.SC.I</td>
<td>Vertical-solid-door</td>
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</tr>
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<td>HCT.SC.I</td>
<td>Horizontal-transparent-door</td>
<td>Self-contained</td>
</tr>
<tr>
<td>SVO.RC.L</td>
<td>Semivertical-open</td>
<td>Remote condensing</td>
</tr>
<tr>
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<td>Remote condensing</td>
</tr>
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<td>HZO.RC.I</td>
<td>Horizontal-open</td>
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</tr>
<tr>
<td>VCT.RG.I</td>
<td>Vertical-transparent door</td>
<td>Remote condensing</td>
</tr>
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<td>HCT.RC.M</td>
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<td>Remote condensing</td>
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<tr>
<td>VCS.RC.M</td>
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<td>Remote condensing</td>
</tr>
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<td>VCS.RG.L</td>
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</tr>
<tr>
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<td>Horizontal-solid door</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>HGS.RG.L</td>
<td>Horizontal-solid door</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>HCS.RC.I</td>
<td>Horizontal-solid door</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>HCS.RG.I</td>
<td>Horizontal-solid door</td>
<td>Remote condensing</td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Subcategory or Rating Condition</td>
<td>Minimum Efficiency</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Single package indoor (with or without economizer)</td>
<td>Rating Conditions: A or C</td>
<td>3.5 MRE</td>
</tr>
<tr>
<td>Single package indoor water-cooled (with or without economizer)</td>
<td>Rating Conditions: A, B, or C</td>
<td>3.5 MRE</td>
</tr>
<tr>
<td>Split system indoor air-cooled (with or without economizer)</td>
<td>Rating Conditions: A, B, or C</td>
<td>3.5 MRE</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour per day = 0.293 kW/day, °C = (°F - 32)/1.8

Notes:
1. Equipment class designations consist of a combination [in sequential order separated by periods (AAA).(BB).(C)] of the following:
   (a) (AAA) — An equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical transparent doors, VCS = vertical solid doors, HCT = horizontal transparent doors, HCS = horizontal solid doors, and SOC = service over counter).
   (b) (BB) — An operating mode code (RC = remote condensing and SC = self contained).
   (c) (C) — A rating temperature code (M = medium temperature [38°F], L = low temperature [0°F], or I = ice cream temperature [15°F]). For example, “VOP.RC.M” refers to the “vertical open, remote condensing, medium temperature” equipment class.
2. V is the volume of the case (ft) as measured in accordance with AHRI 1200.
3. TDA is the total display area of the case (ft) as measured in accordance with AHRI 1200.
### WITHOUT ENERGY RECOVERY – MINIMUM EFFICIENCY REQUIREMENTS


<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled (dehumidification mode)</td>
<td>–</td>
<td>4.0 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Air source heat pumps (dehumidification mode)</td>
<td>–</td>
<td>4.0 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water cooled (dehumidification mode)</td>
<td>Cooling tower condenser water</td>
<td>4.9 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Chilled Water</td>
<td>6.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Air source heat pump (heating mode)</td>
<td>–</td>
<td>2.7 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water source heat pump (dehumidification mode)</td>
<td>Ground source, closed loop</td>
<td>4.8 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>5.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>4.0 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Water source heat pump (heating mode)</td>
<td>Ground source, closed loop</td>
<td>2.0 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>3.2 ISCOP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>3.5 ISCOP</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE E 503.7.1(16) 503.7.1(14)
ELECTRICALLY OPERATED DX-DOAS UNITS, SINGLE-PACKAGE AND REMOTE
CONDENSER,
WITH ENERGY RECOVERY – MINIMUM EFFICIENCY REQUIREMENTS


<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled (dehumidification mode)</td>
<td>–</td>
<td>5.2 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Air source heat pumps (dehumidification mode)</td>
<td>–</td>
<td>5.2 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water cooled (dehumidification mode)</td>
<td>Cooling tower condenser water</td>
<td>5.3 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Chilled Water</td>
<td>6.6 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Air source heat pump (heating mode)</td>
<td>–</td>
<td>3.3 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td>Water source heat pump (dehumidification mode)</td>
<td>Ground source, closed loop</td>
<td>5.2 ISMRE</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>5.8 ISMRE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>4.8 ISMRE</td>
<td></td>
</tr>
<tr>
<td>Water source heat pump (heating mode)</td>
<td>Ground source, closed loop</td>
<td>3.8 ISCOP</td>
<td>AHRI 920</td>
</tr>
<tr>
<td></td>
<td>Ground-water source</td>
<td>4.0 ISCOP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water source</td>
<td>4.8 ISCOP</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE E 503.7.1(15)
ELECTRICALLY OPERATED WATER-SOURCE HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS

[ASHRAE 90.1: TABLE 6.8.1-15]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-to-air, water loop (cooling mode)</td>
<td>&lt;17 000 Btu/h</td>
<td>All</td>
<td>86°F entering water</td>
<td>12.2 EER</td>
</tr>
<tr>
<td></td>
<td>&gt;=17 000 Btu/h and</td>
<td></td>
<td></td>
<td>13.0 EER</td>
</tr>
</tbody>
</table>

1. ISO 13256-1
2. ASHRAE 90.1: TABLE 6.8.1-15
### TABLE E 503.7.1(16)
**HEAT-PUMP AND HEAT RECOVERY CHILLER PACKAGES—MINIMUM EFFICIENCY REQUIREMENTS**

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>COOLING-ONLY OPERATION COOLING EFFICIENCY&lt;sup&gt;1&lt;/sup&gt; AIR SOURCE EER (FL/IPLV), Btu/ton</th>
<th>HEATING OPERATION</th>
<th>HEAT PUMP HEATING FULL-LOAD EFFICIENCY (COP&lt;sub&gt;H&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;, WW</th>
<th>HEAT TRANSFER EFFICIENCY (COP)H&lt;sub&gt;2C&lt;/sub&gt;</th>
<th>CHILLER HEATING FULL-LOAD EFFICIENCY (COP&lt;sub&gt;HR&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;, WW</th>
<th>HEATING FULL-LOAD EFFICIENCY (COP&lt;sub&gt;SH&lt;/sub&gt;)&lt;sup&gt;2&lt;/sup&gt;</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air source</td>
<td>All sizes</td>
<td>&gt;9.595 FL/FL IPLV/IPLV</td>
<td>47 db</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>2.5 COPH</td>
<td>ISO 13256-1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;9.02 FL/FL IPLV/IPLV</td>
<td>43 db</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>2.5 COPH</td>
<td>ISO 13256-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;9.02 FL/FL IPLV/IPLV</td>
<td>43 db</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>2.5 COPH</td>
<td>ISO 13256-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;9.595 FL/FL IPLV/IPLV</td>
<td>17 db</td>
<td>68°F entering water</td>
<td>4.3 COPH</td>
<td>2.5 COPH</td>
<td>ISO 13256-1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Section 12 of ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2. Single-phase, U.S. air-cooled heat pumps less than 19 kW are regulated as consumer products by 10 CFR 430. SCOP<sub>C</sub>, SCOP<sub>2C</sub>, SCOP<sub>H</sub> and SCOP<sub>2H</sub> values for single-phase products are set by the USDOE. See Informative Appendix F for the USDOE minimum.
**TABLE E 503.7.1(17)**

**CEILING-MOUNTED COMPUTER-ROOM AIR CONDITIONERS—MINIMUM EFFICIENCY REQUIREMENTS**

[ASHRAE 90.1: TABLE 6.8.1-17]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>NET SENSIBLE COOLING CAPACITY</th>
<th>MINIMUM NET SENSIBLE COP</th>
<th>RATING CONDITIONS RETURN AIR (DRY BULB/DEW POINT)</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air cooled with free air discharge condenser</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.05</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td>&gt;=29 000 Btu/h and</td>
<td>2.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;65 000 Btu/h</td>
<td>1.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;=65 000 Btu/h</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
1. Cooling-only rating conditions are standard rating conditions defined in AHRI 550/590, Table 1.
2. Heating full-load rating conditions are at rating conditions defined in AHRI 550/590, Table 1.
3. For water-cooled heat recovery chillers that have capabilities for heat rejection to a heat recovery condenser and a tower condenser, the COP<sub>HR</sub> applies to operation at full load with 100 percent heat recovery (no tower rejection). Units that only have capabilities for partial heat recovery shall meet the requirements of Table E 503.7.1(3).
4. Outdoor air entering dry-bulb (db) temperature and wet-bulb (wb) temperature.
5. Source-water entering and leaving water temperature.
### TABLE E 503.7.1(17)
**CEILING-MOUNTED COMPUTER-ROOM AIR CONDITIONERS—MINIMUM EFFICIENCY REQUIREMENTS (CONTINUED)**

[ASHRAE 90.1: TABLE 6.8.1-17]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>STANDARD MODEL</th>
<th>NET SENSIBLE COOLING CAPACITY</th>
<th>MINIMUM NET SENSIBLE COP</th>
<th>RATING CONDITIONS RETURN AIR (DRY BULB/DEW POINT)</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water cooled with fluid economizer</td>
<td>Ducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.33</td>
<td>75°F/52°F (Class 1)</td>
<td>AHRI 1360</td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>2.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ducted</td>
<td>&gt;=65 000 Btu/h</td>
<td>2.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonducted</td>
<td>&lt;29 000 Btu/h</td>
<td>2.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nonducted</td>
<td>&gt;=29 000 Btu/h and &lt;65 000 Btu/h</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Descriptor</td>
<td>Class</td>
<td>Maximum Energy Consumption, kWh/day*</td>
<td>Test Procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>--------------------------------------</td>
<td>----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display door, medium temperature</td>
<td>DD, M</td>
<td>$0.04 \times A_{dd} + 0.41$</td>
<td>10 CFR 431</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display door, low temperature</td>
<td>DD, L</td>
<td>$0.15 \times A_{dd} + 0.29$</td>
<td>10 CFR 431</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $A_{dd}$ is the surface area (ft$^2$) of the display door.

<table>
<thead>
<tr>
<th>Class Descriptor</th>
<th>Class</th>
<th>Maximum Energy Consumption, kWh/day*</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passage door, medium temperature</td>
<td>PD, M</td>
<td>$0.05 \times A_{nd} + 1.7$</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Passage door, low temperature</td>
<td>PD, L</td>
<td>$0.14 \times A_{nd} + 4.8$</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Freight door, medium temperature</td>
<td>FD, M</td>
<td>$0.04 \times A_{nd} + 1.9$</td>
<td>10 CFR 431</td>
</tr>
<tr>
<td>Freight door, low temperature</td>
<td>FD, L</td>
<td>$0.12 \times A_{nd} + 5.6$</td>
<td>10 CFR 431</td>
</tr>
</tbody>
</table>

* $A_{nd}$ is the surface area (ft$^2$) of the non-display door.

<table>
<thead>
<tr>
<th>Class Descriptor</th>
<th>Class</th>
<th>Minimum Annual Walk-In Energy Factor AWEF, Btu/W·h*</th>
<th>Test Procedure</th>
<th>Compliance Date: Equipment Manufactured Starting On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedicated condensing, medium temperature, indoor system</td>
<td>DC, M, I</td>
<td>5.61</td>
<td>AHRI 1250</td>
<td>June 5, 2017</td>
</tr>
<tr>
<td>Dedicated condensing, medium temperature, outdoor system</td>
<td>DC, M, O</td>
<td>7.60</td>
<td>AHRI 1250</td>
<td>June 5, 2017</td>
</tr>
<tr>
<td>Dedicated condensing, low temperature, indoor system, net</td>
<td>DC, L, I</td>
<td>$9.091 \times 10^{-5} \times q_{net} + 1.81$</td>
<td>AHRI 1250</td>
<td>July 10, 2020</td>
</tr>
<tr>
<td>DOCUMENT NUMBER</td>
<td>DOCUMENT TITLE</td>
<td>APPLICATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHRI 550/590-2020</td>
<td>Performance Rating of Water-Chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle</td>
<td>Water-Chilling and Water-Heating Packages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHRI 1200-2013</td>
<td>Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets</td>
<td>Commercial Refrigerators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHRI 1250-2020</td>
<td>Performance Rating of Walk-in Coolers and Freezers</td>
<td>Walk-in Coolers and Freezers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA 208-2018</td>
<td>Calculation of the Fan Energy Index</td>
<td>Fan Energy Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA 500D-2018</td>
<td>Laboratory Methods of Testing Dampers for Rating</td>
<td>Dampers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASHRAE 90.4-2019</td>
<td>Energy Standard for Data Centers</td>
<td>Data Centers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 CFR 430</td>
<td>Energy Conservation Program for Consumer Products</td>
<td>Energy Conservation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 CFR 431</td>
<td>Energy Efficiency Program for Certain Commercial and Industrial Equipment</td>
<td>Energy Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 CFR 431.62</td>
<td>Definitions Concerning Commercial Refrigerators, Freezers and Refrigerator-Freezers</td>
<td>Commercial Refrigerators, Freezers and Refrigerator-Freezers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 CFR 431.302</td>
<td>Definitions Concerning Walk-In Coolers and Walk-In Freezers</td>
<td>Walk-in Coolers and Freezers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $q_{net}$ is net capacity (Btu/h) as determined in accordance with AHRI 1250.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHRI 550/590-2020</td>
<td>Performance Rating of Water-Chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle</td>
<td>Water-Chilling and Water-Heating Packages</td>
</tr>
<tr>
<td>AHRI 1200-2013</td>
<td>Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets</td>
<td>Commercial Refrigerators</td>
</tr>
<tr>
<td>AHRI 1250-2020</td>
<td>Performance Rating of Walk-in Coolers and Freezers</td>
<td>Walk-in Coolers and Freezers</td>
</tr>
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<td>Fan Energy Index</td>
</tr>
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<td>Dampers</td>
</tr>
<tr>
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<td>Data Centers</td>
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<td>Energy Conservation</td>
</tr>
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<td>Energy Efficiency</td>
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<tr>
<td>10 CFR 431.62</td>
<td>Definitions Concerning Commercial Refrigerators, Freezers and Refrigerator-Freezers</td>
<td>Commercial Refrigerators, Freezers and Refrigerator-Freezers</td>
</tr>
<tr>
<td>10 CFR 431.302</td>
<td>Definitions Concerning Walk-In Coolers and Walk-In Freezers</td>
<td>Walk-in Coolers and Freezers</td>
</tr>
</tbody>
</table>

(Portion of table not shown remains unchanged)

**SUBSTANTIATION:**
In accordance with IAPMO's Regulations Governing Committee Projects (Extract Guidelines), Appendix E is being revised to the latest edition of ASHRAE 90.1-2019 with Addenda by, ck, and cp published on August 3, 2020.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

The TCC has the responsibility to resolve conflicts and achieve correlation among the recommendations of the Technical Committee. The TCC has the authority to choose between alternative text recommended by the Technical Committee, but only as necessary for correlation, consistency, and the correction of errors and omissions in accordance with Section 3-4 of the Regulations Governing Committee Projects.

Actions taken on UMC Item # 009, Section E 503.6.5.3 (System Balancing) and UMC Item # 289, Section E 503.6.5.3 (System Balancing) resulted in conflicting language within the code. In order to correlate the language, the Technical Correlating Committee proposed the following modifications to the UMC:

**E 503.6.5.3 System Balancing.** Construction documents shall require that HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned space or zone exceeding 5000 square feet (464.52 m$^2$). {{ASHRAE 90.1: 6.7.3.3.1}}

**TCC ACTION:** ACCEPT AS SUBMITTED

**TCC STATEMENT:**
The language in UMC Item # 289, Section E 503.6.5.3 (System Balancing) is being revised to correlate with the action taken by the UMC TC for Item # 009, Section E 503.6.5.3 (System Balancing) regarding the reference to conditioned “space or zone.” Additionally, the TCC further modified UMC Item # 289 by striking out the phrase “zones with” to correct a grammatical error in redundancy.

The action moves forward as approved by the TCC and supersedes the recommendation from the UMC TC for actions taken for Section E 503.6.5.3 regarding the reference to conditioned “space or zone” and striking out the phrase “zones with.”

---

**Appended Comments**

**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** Appendix E, Table 1801.2  **Item #:** 289  **Comment #:** 1

**SUBMITTER:** Emily Toto  
ASHRAE

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal as modified by this public comment.

**E 201.0 Definitions.**

**Fan System Electrical input Power.** The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors. [ASHRAE 90.1:3.2]

**Integrated Part-Load Value (IPLV, I-P).** A single-number figure of merit based on part-load EER, COPC, or kW/kW expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment. [ASHRAE 90.1:3.2]
On-Site Renewable Energy. Energy generated from renewable energy resources produced at the building site. [ASHRAE 90.1:3.2]

Parking Garage Section. A part of a parking garage where airflow is restricted from other parts of the garage by solid walls. [ASHRAE 90.1:3.2]

E 502.10.4 Freeze Protection Systems and Snow/Ice Melting. Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls capable of and configured to shut off the systems where outdoor air temperatures are above 40° F (4°C) or where the conditions of the protected fluid will prevent freezing. Snow- and ice-melting systems shall include automatic controls capable of and configured to shut off the systems where the pavement temperature is above 50° F (10°C) and no precipitation is falling, and an automatic or manual control that will allow shutoff where the outdoor temperature is above 40° F (4°C) so that the potential for snow or ice accumulation is negligible. [ASHRAE 90.1:6.4.3.7]

E 503.1.1 New Buildings. Mechanical equipment and systems serving the heating, cooling, ventilating, or refrigeration needs of new buildings shall be in accordance comply with the requirements of this section as described in Section E 503.2. [ASHRAE 90.1:6.1.1.1]

E 503.1.3 Alterations to Heating, Ventilating, Air-Conditioning, and Refrigeration in Existing Buildings. New HVAC equipment as a direct replacement of existing HVAC equipment shall be in accordance comply with the following sections as applicable for the equipment being replaced:

(1) Section E 503.3 “Simplified Approach Option for HVAC Systems”
(2) Section E 503.4 “Equipment Efficiencies, Verification, and Labeling Requirements”
(3) Section E 503.4.6 “Zone Thermostatic Controls”
(4) Section E 503.4.6.2 “Setpoint Overlap Restriction Restrictions”
(5) Section E 503.4.6.3.1 “Off-Hour Controls” except for Section E 503.4.6.3.4, “Zone Isolation”
(6) Section E 503.4.6.4.1 “Ventilation System Controls”
(7) Section E 503.4.6.8 “Freeze Protection and Snow or Ice Melting Systems”
(8) Section E 503.4.9.8 “Ventilation Controls for High-Occupancy Areas” only for single-zone equipment
(9) Section E 503.4.6.11 “Heated or Cooled Vestibules”
(10) Section E 503.4.8 “Walk-In Coolers and Walk-In Freezers”
(11) Section E 503.5.1 “Air Economizers, Design Capacity,” for units located outdoors
(12) Section E 503.5.3 “Integrated Economizer Control”
(13) Section E 503.5.4 “Economizer Heating System Impact”
(14) Section E 503.5.6.1.2 “Fan Efficiency”
(15) Section E 503.5.6.2 “Supply Fan Airflow Control”
(16) Section E 503.5.6.5 “Fractional Horsepower (Kilowatt) Fan Motors”
(17) Section E 503.5.7 “Boiler Turndown”
(18) Section E 503.5.7.3 “Chiller and Boiler Isolation”
(19) Section E 503.5.8.1 “Fan Speed Control”. [ASHRAE 90.1:6.1.1.3.1]

E 503.3 Criteria. The HVAC system shall comply with all of the following criteria:
(1) – (9) (remaining text unchanged)
(10) Systems serving spaces other than hotel or motel guest rooms, and other than those requiring residential spaces, that do not require continuous operation, which have both with a cooling or heating capacity more than 15,000 7000 Btu/h (4.4 2.1 kW) and a supply fan motor power more than 0.75 horsepower (hp) (0.56 kW), shall be provided comply with the following:

(a) Can start and stop the system under different schedules for seven different day-type weeks.
(b) Is capable of retaining programming and time setting during a loss of power for a period of not less than 10 hours.
(c) Includes an accessible manual override that allows temporary operation of the system for up to 2 hours.
(d) Is capable of and configured with temperature setback down to 55°F (13°C) during off-hours.
(e) Is capable of and configured with temperature setup to 90°F (32°C) during off-hours.
(11) Systems serving residential spaces other than hotel/motel guest rooms shall comply with Section E 503.4.6.3.1 and Section E 503.4.6.3.2 except for electric resistance heaters rated at 1.5 kW or less with a readily accessible manual control that lowers the set point or turns the unit off.
(12) Systems serving hotel/motel guest rooms shall comply with Section E 503.4.6.3.5. (renumber remaining items)

E 503.4 Equipment Efficiencies, Verification, and Labeling Requirements. Equipment shown in Table E 503.7.1(1) through Table E 503.7.1(20) shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements unless otherwise exempted by footnotes in the table. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide service water-heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category.

Tables are as follows:
(1) through (20) (remain unchanged)
E 503.4.6.3 Off-Hour Controls. HVAC systems shall have the off-hour controls required by Section E 503.4.6.3.1 through Section E 503.4.6.3.4.

Exceptions:

(1) HVAC systems intended to operate continuously.

(2) HVAC systems serving residential spaces and having a design heating capacity and cooling capacity less than or equal to 45 000 Btu/h (4.4 kW) and that are equipped with readily accessible manual ON/OFF controls. [ASHRAE 90.1:6.4.3.3]

E 503.4.6.3.1 Automatic Shutdown.

HVAC systems shall be equipped with not less than one of the following:

(1) Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of not less than 4 hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to 2 hours.

(2) An occupant occupancy sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes.

(3) A manually operated timer capable of being adjusted to operate the system for up to 2 hours.

(4) An interlock to a security system that shuts the system off when the security system is activated.

Exception:

(1) Systems serving residential occupancies shall be permitted to use controls that can start and stop the system under at least two different time schedules per week.

(2) Systems serving non-residential occupancies with heating or cooling capacity less than or equal to 15 000 Btu/h (4.4 kW) with controls that can start and stop the system under not less than two different time schedules per week. [ASHRAE 90.1:6.4.3.3.1]

E 503.4.6.3.3 Optimum Start Controls. Individual heating and cooling systems with setback controls and DDC shall have optimum start controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied set point, the outdoor temperature, and the amount of time prior to scheduled occupancy. Residential spaces are not required to have optimum start controls. [ASHRAE 90.1:6.4.3.3.3]

E 503.4.6.4 Stair and Elevator Shaft Vents and Dampers. Where stairs and elevator shafts have vents, they shall be equipped with motorized dampers that are capable of and configured to automatically close during normal building operation and are interlocked to only open as required by fire and smoke detection systems, or by thermostatic control systems.

Exception: Nonmotorized gravity back draft dampers are acceptable in buildings less than three stories in height and for buildings of any height located in Climate Zones 0, 1, 2, and 3. [ASHRAE 90.1:6.4.3.4.1]

E 503.4.6.7.3 Control Interlock. Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of and configured to prevent simultaneous operation of humidification and dehumidification equipment.

Exceptions:

(1) Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the Authority Having Jurisdiction or accredited by standards, and where humidistatic controls are capable of and configured to maintain a dead band of at least 10 percent relative humidity where no active humidification or dehumidification takes place.

(2) Systems serving zones where humidity levels are required to be maintained with precision of not more than ± 5 percent relative humidity to comply with applicable codes or accreditation standards or as approved by the Authority Having Jurisdiction. [ASHRAE 90.1:6.4.3.6.3]

E 503.4.6.11 Heated or Cooled Vestibules or Air Curtains with Integral Heating. Heating systems for vestibules and for air curtain units with integral heating shall include automatic controls capable of and configured to shut off the heating system when outdoor air temperatures are more than 45°F (7.2°C). Vestibule heating and cooling systems shall be controlled by a thermostat in the vestibule capable of and configured to limit heating to a maximum of 60°F (15.5°C) and cooling to a minimum of 85°F (29.4°C).

Exception: Heating or cooling provided by site-recovered energy or by transfer air that would otherwise be exhausted. [ASHRAE 90.1:6.4.3.9]

E 503.4.6.11.1 Air Curtains. Air curtain unit performance shall be tested in accordance with ANSI/AMCA 220 or ISO 27327-1 and shall have a jet speed of not less than 6.6 feet per second at 6.0 inches above the floor. Automatic controls shall be provided that will operate the air curtain unit with the opening and closing of the door and comply with Section E 503.4.6.11. To ensure proper operation, each air curtain unit shall be commissioned in accordance with the manufacturer’s instructions, including airstream split location and direction. [ASHRAE 90.1: 10.4.5]
E 503.5.1.4 Relief of Excess Outdoor Air. Relief of excess outdoor air shall be in accordance with the following:

(1) Systems shall provide one of the following means to relieve excess outdoor air during air economizer operation to prevent over-pressurizing the building:
   (a) Return or relief fan(s) meeting the requirements of Section E 503.5.6.2.3.
   (b) Barometric or motorized damper relief path with a total pressure drop at design relief airflow rate less than 0.10 in. of water (25 Pa) from the occupied space to outdoors. Design relief airflow rate shall be the design supply airflow rate minus any continuous exhaust flows, such as toilet exhaust fans, whose makeup is provided by the economizer system.

(2) The relief air outlet shall be located so as to avoid recirculation into the building. [ASHRAE 90.1:6.5.1.1.5]

E 503.5.5.5.6 Ventilation Air Heating Control. Units that provide ventilation air to multiple zones and operate in conjunction with zone heating and cooling systems shall not use heating or heat recovery to warm supply air above 60°F (16°C) when representative building loads or outdoor air temperature indicate that the majority of zones require cooling. Exception: Units that heat the airstream using only series energy recovery when representative building loads or outdoor air temperature indicate that the majority of zones require cooling in Climate Zones 0A, 1A, 2A, 3A, and 4A. [ASHRAE 90.1:6.5.2.6]

E 503.5.7.6 Chilled-Water Coil Selection. Chilled-water cooling coils shall be selected to provide a 15°F (8°C) or higher temperature difference between leaving and entering water temperatures and a minimum of 57°F (14°C) leaving water temperature at design conditions.

Exceptions:
(1) Chilled-water cooling coils that have an air-side pressure drop exceeding 0.70 inch of water (0.2 kPa) when rated at 500 feet per minute (2.54 m/s) face velocity and dry conditions (no condensation).
(2) Individual fan-cooling units with a design supply airflow rate 5000 cubic feet per minute (ft³/min) (2.36 m³/s) and less,
(3) Constant-air-volume systems.
(4) Coils selected at the maximum temperature difference allowed by the chiller.
(5) Passive coils (no mechanically supplied airflow).
(6) Coils with design entering chilled-water temperatures of 50°F (10°C) and higher.
(7) Coils with design entering air dry-bulb temperatures of 65°F (18°C) and lower. [ASHRAE 90.1:6.5.4.7]

E 503.5.10.1.2(A) Minimum Enthalpy Recovery Ratio. Energy recovery systems required by this section shall result in an enthalpy recovery ratio of at least 50 percent. A 50 percent enthalpy recovery ratio shall mean a change in the enthalpy of the outdoor air supply equal to 50 percent of the difference between the outdoor air and entering exhaust air enthalpies at design conditions. The energy recovery system shall provide the required enthalpy recovery ratio at both heating and cooling design conditions unless one mode is not required for the climate zone by the exception in Section E 503.5.10.1.2(B). [ASHRAE 90.1:6.5.6.1.2.1]

E 503.5.10.1.2(B) Provision for Air Economizer or Bypass Operation. Provision shall be made for both outdoor air and exhaust air to bypass or control the energy recovery system to enable economizer operation as required by Section E 503.5.1. The bypass or control shall meet the following criteria:
   a. For energy recovery systems where the transfer of energy cannot be stopped, bypass provision shall prevent the total airflow rate of either outdoor air or exhaust air through the energy recovery exchanger from exceeding 10 percent of the full design airflow rate.
   b. The pressure drop of the outdoor air through the energy recovery exchanger shall not exceed 0.4 in. of water (100 Pa); the pressure drop of the exhaust air through the energy recovery exchanger shall not exceed 0.4 in. of water (100 Pa).

Exception: Energy recovery systems with 80 percent or more outdoor air at full design airflow rate and not exceeding 10,000 CFM (4.72 m³/s). [ASHRAE 90.1:6.5.6.1.2.2]

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### TABLE E 503.5(2)

<table>
<thead>
<tr>
<th>CLIMATE ZONES</th>
<th>EFFICIENCY IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>17%</td>
</tr>
<tr>
<td>2B</td>
<td>21%</td>
</tr>
<tr>
<td>3A</td>
<td>27%</td>
</tr>
<tr>
<td>3B</td>
<td>32%</td>
</tr>
<tr>
<td>3C</td>
<td>65%</td>
</tr>
<tr>
<td>4A</td>
<td>42%</td>
</tr>
<tr>
<td>4B</td>
<td>49%</td>
</tr>
<tr>
<td>4C</td>
<td>64%</td>
</tr>
</tbody>
</table>
Notes:
1 Where a unit is rated with an annualized or part-load metric IPLV, IEER, or SEER, then to eliminate the required economizer, the only the annualized or part-load minimum cooling efficiency of the HVAC unit shall be increased by the percentage shown. Where the HVAC unit is rated with a full load metric like EER cooling, these shall be increased by the percentage shown. To determine the efficiency required to eliminate the economizer when the unit equipment efficiency is rated with an energy-input divided by a thermal-output metric, the metric shall first be converted to COP by the efficiency improvement percentage shown. The COP shall then be converted back to the original rated metric to establish the efficiency required to eliminate the economizer.
2 Some examples of annualized or part-load metrics are: IPLV, IP, IEER, and SEER.

E 503.5.6.2.3 Return and Relief Fan Control. Return and relief fans used to meet Section E 503.5.1.4 shall comply with all of the following:
(1) Relief air rate shall be controlled to maintain building pressure either directly, or indirectly through differential supply-return airflow tracking. Systems with constant speed or multispeed supply fans shall also be allowed to control the relief system based on outdoor air damper position.
(2) Fans shall have variable-speed control or other devices that will result in total return/relief fan system demand of no more than 30 percent of total design power at 50 percent of total design fan flow.

Exceptions:
(1) Return or relief fans with total motor size less than or equal to 0.5 hp (0.37 kW).
(2) Staged relief fans with a minimum of four stages. [ASHRAE 90.1:6.5.3.2.4]

<table>
<thead>
<tr>
<th>EQUIPMENT TYPE</th>
<th>SIZE CATEGORY</th>
<th>HEATING SECTION TYPE</th>
<th>SUBCATEGORY OR RATING CONDITION</th>
<th>MINIMUM EFFICIENCY</th>
<th>TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioners, air cooled</td>
<td>&lt;65 000 Btu/h²</td>
<td>All</td>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>13.0 SEER before 1/1/2023 13.4 SEER2 after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single package, three phase and applications outside U.S. single phase2</td>
<td>14.0 SEER before 1/1/2023 13.4 SEER2 after 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td>Space constrained, air cooled</td>
<td>&lt;=30 000 Btu/h²</td>
<td>All</td>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>12.0 SEER before 1/1/2023 11.7 SEER2 after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single package, three phase and applications</td>
<td>12.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY</td>
<td>HEATING SECTION TYPE</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
<td>TEST PROCEDURE</td>
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</tr>
<tr>
<td>Air conditioners, aircooled (continued)</td>
<td>&gt;=760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>Split system and single package</td>
<td>9.7 EER 11.2 IEER before 1/1/2023 12.5 IEER after 1/1/2023</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>Split system and single package</td>
<td>12.1 EER 12.3 IEER after 1/1/2023</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td>Air conditioners, aircooled</td>
<td>&gt;=760 000 Btu/h</td>
<td>Electric resistance (or none)</td>
<td>Split system and single package</td>
<td>10.8 EER 12.2 IEER before 1/1/2023 14.0 IEER after 1/1/2023</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td></td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>Split system and single package</td>
<td>9.8 EER 11.4 IEER before 1/1/2023 13.0 IEER after 1/1/2023</td>
<td>AHRI 210/240</td>
</tr>
<tr>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>12.0 SEER before 1/1/2023 12.0 SEER after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023</td>
<td>11.7 SEER2 after 1/1/2023</td>
<td></td>
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<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY</td>
<td>HEATING SECTION TYPE</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
<td>TEST PROCEDURE</td>
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<tr>
<td>Condensing units, aircooled</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>10.5 EER 11.8 IEER</td>
<td>AHRI 365</td>
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<tr>
<td>Condensing units, water cooled</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>13.5 EER 14.0 IEER</td>
<td>AHRI 365</td>
</tr>
<tr>
<td>Condensing units, evaporatively cooled</td>
<td>&gt;=135 000 Btu/h</td>
<td>–</td>
<td>–</td>
<td>13.5 EER 14.0 IEER</td>
<td>AHRI 365</td>
</tr>
</tbody>
</table>
For SI units: 1000 British thermal units per hour = 0.293 kW

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2 Single-phase, U.S. air-cooled air conditioners less than 65 000 Btu/h (19 kW) are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER and SEER2 values for single-phase products are set by the U.S. Department of Energy.

| EQUIPMENT TYPE | SIZE CATEGORY | HEATING SECTION TYPE | SUBCATEGORY OR RATING CONDITION | MINIMUM EFFICIENCY | TEST PROCEDURE
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
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<tbody>
<tr>
<td>Air cooled (cooling mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>Single package, three phase and applications outside U.S. single phase 2</td>
<td>14.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
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<td>Space constrained, air cooled (cooling mode)</td>
<td>&lt;=30 000 Btu/h</td>
<td>All</td>
<td>Single package, three phase and applications outside U.S. single phase 2</td>
<td>12.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
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<td>Small duct, high velocity, air cooled (cooling mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>All</td>
<td>Single package, three phase and applications outside U.S. single phase 2</td>
<td>12.0 SEER before 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023</td>
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<tr>
<td>Air cooled (cooling mode)</td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h Electric resistance (or none)</td>
<td>All other</td>
<td>Split system and single package</td>
<td>10.8 EER 12.0 IEER before 1/1/2023 13.9 IEER after 1/1/2023</td>
<td>AHRI 340/360</td>
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TABLE E 503.7.1(2) (continued)
ELECTRICALLY OPERATED AIR-COOLED UNITARY HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS
[ASHRAE 90.1: TABLE 6.8.1-2]

| EQUIPMENT TYPE | SIZE CATEGORY | HEATING SECTION TYPE | SUBCATEGORY OR RATING CONDITION | MINIMUM EFFICIENCY | TEST PROCEDURE
<table>
<thead>
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<th></th>
</tr>
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<tbody>
<tr>
<td>Air cooled (cooling mode) (continued)</td>
<td>&gt;=65 000 Btu/h and &lt;135 000 Btu/h</td>
<td>All other</td>
<td>Electric resistance</td>
<td>10.8 EER 12.0 IEER before 1/1/2023 13.9 IEER after 1/1/2023</td>
<td>AHRI 340/360</td>
</tr>
<tr>
<td>EQUIPMENT TYPE</td>
<td>SIZE CATEGORY</td>
<td>HEATING SECTION TYPE</td>
<td>SUBCATEGORY OR RATING CONDITION</td>
<td>MINIMUM EFFICIENCY</td>
<td>TEST PROCEDURE</td>
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<td>---------------------------------</td>
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<td>----------------</td>
</tr>
<tr>
<td>Air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>8.2 HSPF before 1/1/2023, 7.5 HSPF2 after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023, AHRI 210/240-2023 after 1/1/2023</td>
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<tr>
<td>Space constrained, air cooled (heating mode)</td>
<td>&lt;=30 000 Btu/h (cooling capacity)</td>
<td>–</td>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>7.4 HSPF before 1/1/2023, 6.3 HSPF2 after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023, AHRI 210/240-2023 after 1/1/2023</td>
</tr>
<tr>
<td>Small duct high velocity, air cooled (heating mode)</td>
<td>&lt;65 000 Btu/h</td>
<td>–</td>
<td>Split system, three phase and applications outside U.S. single phase2</td>
<td>7.2 HSPF before 1/1/2023, 6.1 HSPF2 after 1/1/2023</td>
<td>AHRI 210/240-2017 before 1/1/2023, AHRI 210/240-2023 after 1/1/2023</td>
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**TABLE E 503.7.1(2) (continued)**

ELECTRICALLY OPERATED AIR-COOLED UNITARY HEAT PUMPS—MINIMUM EFFICIENCY REQUIREMENTS

[ASHRAE 90.1: TABLE 6.8.1-2]
<table>
<thead>
<tr>
<th>Heating Capacity</th>
<th>Cooling Capacity</th>
<th>COPH</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=65000 Btu/h and &lt;135000 Btu/h (cooling capacity)</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.3 COPH before 1/1/2023 3.40 COPH before 1/1/2023</td>
<td>2.25 COPH</td>
</tr>
<tr>
<td>&gt;=135000 Btu/h (cooling capacity) and &lt;240000 Btu/h</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.20 COPH before 1/1/2023 3.30 COPH after 1/1/2023</td>
<td>2.05 COPH</td>
</tr>
<tr>
<td>&gt;=240000 Btu/h (cooling capacity)</td>
<td>47°F db/43°F wb outdoor air</td>
<td>3.20 COPH</td>
<td>2.05 COPH</td>
</tr>
</tbody>
</table>

For SI units: 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

Notes:
1 ASHRAE 90.1 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
2 Single-phase, U.S. air-cooled heat pumps <65 000 Btu/h (19 kW) are regulated as consumer products by the U.S. Department of Energy Code of Federal Regulations 10 CFR 430. SEER, SEER2, and HSPF values for single-phase products are set by the U.S. Department of Energy.

**TABLE 1801.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
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<tr>
<td>ANSI/AMCA 220-2021</td>
<td>Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating.</td>
<td>Air Curtain Units</td>
</tr>
<tr>
<td>ISO 27327-1-2009</td>
<td>Fans — Air curtain units — Part 1: Laboratory methods of testing for aerodynamic performance rating.</td>
<td>Air Curtain Units</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

Note: ISO 27327-1 was not provided at the time of this monograph.

**SUBSTANTIATION:**
The above sections have been revised to correlate with ASHRAE 90.1-2019 and Addenda cd, c, f, g, m, r, ao, n to ASHRAE 90.1-2019 in accordance with IAPMO’s Regulations Governing Committee Projects (Extract Guidelines).
Proposals

Item #: 290

UMC 2024  Section: 210.0, E 201.0

SUBMITTER: Phil Pettit
Control Air Conditioning Corporation
Rep. Self

RECOMMENDATION:
Revise text

E 201.0 Definitions.

Packaged Terminal Air Conditioner (PTAC). A self-contained unit used to heat or cool a conditioned space with a combination of heating and cooling components, assemblies, or sections and typically installed through an external wall.

Packaged Terminal Heat Pump (PTHP). A self-contained refrigerating system similar to a packaged terminal air conditioner (PTAC) that uses reverse cycle refrigeration to provide heat to a conditioned space.

210.0 – H – Heat Pump. A refrigeration system that extracts heat from one substance and transfers it to another portion of the same substance or to a second substance at a higher temperature for a beneficial purpose.

SUBSTANTIATION:
Definitions for “Packaged Terminal Air Conditioner” and “Packaged Terminal Heat Pump” are recommended. Packaged Terminal Air Conditioners (PTACs) and Packaged Terminal Heat Pumps (PTHPs) provide both heating and cooling from one unit and are commonly installed in commercial and institutional spaces such as hotel rooms, senior living facilities, hospital rooms, apartment complexes, etc. PTACs utilize electric resistance heat, while PTHPs utilize heat pump heating along with back-up electric resistance heat. When a PTHP is heating in heat pump mode, the coolant reverses with the use of a reversing valve. Minimum efficiency requirements for PTACs and PTHPs are found in Table E 503.7.1(4) of the 2021 UMC.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
The proposed definitions are inconsistent with the definitions used by DOE, AHRI and the California Energy Commission. The definitions should be consistent with at least one of these organizations and be resubmitted as a public comment.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29   NOT RETURNED: 1   Heine

Appended Comments
E 201.0 Definitions.

**Packaged Terminal Air Conditioner (PTAC).** A wall sleeve and a separate unencased combination of heating and cooling assemblies specified by the manufacturer and intended for mounting through the wall. It includes refrigeration components, separable outdoor louvres, forced ventilation, and heating availability by purchaser’s choice of hot water, steam, or electrical resistance heat.

**Packaged Terminal Heat Pump (PTHP).** A separate unencased refrigeration system installed in a cabinet having a function and configuration similar to that of a packaged terminal air-conditioner. It uses reverse cycle refrigeration as its prime heat source and should have other supplementary heat source(s) available to purchasers with the choice of hot water, steam, or electric resistance heat.

**210.0 – H –**

**Heat Pump.** A refrigeration system that extracts heat from one substance and transfers it to another portion of the same substance or to a second substance at a higher temperature for a beneficial purpose.

**SUBSTANTIATION:**
The definitions are being resubmitted as a public comment. The proposed PTAC and PTHP definitions are consistent with the definitions used by AHRI 310/380/CSA C744, Packaged terminal air-conditioners and heat pumps.
Proposals

Item #: 299

UMC 2024  Section: F 101.1, F 102.0

SUBMITTER:  Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Revise text

APPENDIX F
GEOTHERMAL ENERGY SYSTEMS AND DISTRICT AMBIENT TEMPERATURE LOOPS

Part I – General.

F 101.0 General.
F 101.1 Applicability. Part I of this appendix shall apply to all geothermal energy systems such as, but not limited to, building systems coupled with a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well). The regulations of this appendix shall govern the construction, location and installation of geothermal energy systems. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section F 104.4 and Chapter 12.

F 101.1.1 Prior to Construction. Documents for permits shall be submitted prior to the construction of a building system, ground-heat exchanger, submerged heat exchanger, or water well. Permits shall be issued by the Authority Having Jurisdiction.

F 101.1.2 Equipment, Accessories, Components, and Materials. The mechanical equipment, accessories, components, and materials used shall be of the type and rating approved for the specific use.

F 101.1.3 Indoor Piping. Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section F 104.4 and Chapter 12.

F 102.0 Definitions.
Ambient Temperature Loop (ATL). A closed loop piping system with central pumping that includes various heat sources and heat sinks to hold the loop fluid near the long-term average ambient air temperature. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g., a cooling tower) and further can include opportunistic, or unique locally available waste or byproduct heat sources (e.g., data center, industrial process). The closed loop piping system typically controls or engages these sources/sinks to maintain the loop temperature to meet the seasonal requirements as well as specific building needs.

SUBSTANTIATION:
Section F 101.1 has been updated to clarify that Part I applies to all geothermal energy systems. The included paragraph expands the applicability of Part I to all ambient temperature loop systems and further describes the nature of the ambient temperature central systems. The paragraph further details that the ambient loop may consist of multiple sources and sinks as well as other district geothermal distribution systems. Finally, the Indoor piping
clause has been relocated to Section F 101.1 sub paragraphs for continuity and separation of other applicable components.

In addition, since the revision to F 101.1 includes district ambient temperature loop, the title of the Appendix F has been revised to address such system. With the addition of Geothermal district energy systems, the name of the section will reflect the inclusion of code language for ambient temperature loops and district systems.

Lastly, the definition for "ambient temperature loop (ATL)" was added to define such system. An ATL system is a closed loop piping system that includes various heat sources and heat sinks. There are installations for such systems and should be defined in Appendix F.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 203.0, 210.0, 1201.1, 1701.1 Item #: 299

SUBMITTER: Lee H Stevens LH Stevens Constructors LLC

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

CHAPTER 17
GEOTHERMAL ENERGY SYSTEMS, AND DISTRICT AMBIENT TEMPERATURE LOOPS


203.0 – A –
Ambient Temperature Loop (ATL). A closed loop piping system with central pumping that includes various heat sources and heat sinks to hold the loop fluid near the longterm average ambient air temperature. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g. a cooling tower) and further can include, opportunistic, or unique locally available waste or by product heat sources (e.g., data center, industrial process). The closed loop piping system typically controls or engages these sources/sinks to maintain the loop temperature to meet the seasonal requirements as well as specific building needs.

210.0 – H –
Hydronic System. Relating to, or being a system of, heating or cooling that involves the transfer of heat by a circulating fluid in a liquid state (such as water) or a gaseous state (such as steam vapor).

Hydronic System, Ambient Temperature Loop (ATL). An endless closed loop system comprised of centralized pumping for the circulation of the contained fluid between multiple heat exchange devices installed on the loop.

Hydronic System, District Ambient Temperature Loop. An endless closed loop system comprised of centralized pumping for the circulation of the contained fluid between multiple heat exchange devices installed on the loop. The endless loop may run exterior to conditioned spaces in order to serve multiple structures and the heat exchange devices installed within.

1201.0 General.
1201.1 Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, ground source heat pump systems, and snow and ice melting systems, ambient temperature loops (ATL), and district ambient temperature loops. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.
1701.0 General.
1701.1 Applicability. Part I of this chapter shall apply to geothermal energy systems such as, but not limited to, building systems coupled with a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well). The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.

Part I through Part V of this chapter shall apply to geothermal energy systems and district thermal ambient temperature loop systems that circulate ground-ambient-temperature water to be used in end-use buildings as a thermal source or sink via water source heat pump or reversing chiller. The systems shall operate to permit independent and bi-directional heating and cooling for comfort and water heating such as, but not limited to, building systems coupled with ground ambient district ambient temperature loops, a ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, or groundwater (well), or such local resources to the advantage of the district. Central district auxiliary components shall add or reject heat to benefit district ability to reduce both power consumption and demand combined with energy sharing. The regulations of this chapter shall govern the construction, location and installation of ground temperature thermal distribution districts from 100 percent geothermal energy system to multiple hybrid district systems.

SUBSTANTIATION:
Item # 299, accepted as submitted, inserts a definition that does not specifically address the possibility of an ATL within a single structure, and also a District ATL, that may connect with multiple structures and/or sources and sinks. The accepted definition is long and highly descriptive, which does not well serve the purpose of a strict definition and simple categorization of what an ATL is. Being overly descriptive lays open the possibility of omitting a desired configuration from applicability. With Appendix F now accepted as Section 17, it is important that definitions will categorize the various types of hydronic systems in a technically correct and unambiguous manner, which does not rely on prior assumed knowledge.

Application of code provisions would be best served by clearly delineating the variations of closed loop hydronic systems as sub-definitions under the umbrella of the definition of “Hydronic System.” This approach puts all the defined variations of closed loop hydronic systems in one place within Section 2, to simplify the search for the proper definition and application thereof.

The value of differentiating ATL’s and District ATL’s is the presumption that there will ultimately be code provisions for addressing potential freeze-ups of District ATL’s, which can be routed out of conditioned spaces and thus have a greater set of issues and potential paths for compliance.

It is also recommended to modify the core definition of “Hydronic System” to bring clarity to the fact that this definition can cover both fluid water and steam systems.
Proposals

Item #: 300
UMC 2024  Section: F 501.0 - F 501.2

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

Part V – District Ambient Temperature Loop (ATL) Geothermal

**F 501.0 Ambient Temperature Loop (ATL) Distributed Energy Systems.**

**F 501.1 General.** An Ambient Temperature Loop (ATL) distributed energy system shall be installed in accordance with Section F 501.2 through Section F 501.6.2 and Section F 502.0. ATL systems shall comply with Part I through Part IV of this appendix, as applicable.

**F501.1.1 Fourth Generation (4G) System Configuration.** A fourth-generation system configuration shall be a district geothermal energy system distributing hot water, cold water, or both to the conditioned space or building for a specific use. Where a geothermal energy source is used, such system shall comply with Part I through Part IV of this appendix, Chapter 11, and Chapter 12.

**F 501.1.2 Fifth Generation (5G) System Configurations.** An advanced Ambient Temperature Loop (ATL) System or fifth generation (5G) ATL system shall also be capable of interacting with the electric utility system as well as other utility systems and systems components. The system components shall include, but not limited to, the following:

1. Thermally diverse buildings with independent hydronic systems
2. Circulation loop
3. Global control system
4. Segment isolation capability

The system components may include, but not limited to, the following:

1. Electric grid-interactive enabled buildings
2. Hybrid components
3. Other renewable systems

**F 501.2 Permitting.** Permits required for the installation and application of an ATL distributed energy system shall be obtained as required by the Authority Having Jurisdiction.

**F 102.0 Definitions.**

**Ambient Temperature Loop (ATL).** A closed loop piping system with central pumping that includes various heat sources and heat sinks to hold the loop fluid near the long-term average ambient air temperature. The sources/sinks can be passive (e.g., a ground loop, a body of water, sewer effluent) or active (e.g., a cooling tower) and further can include, opportunistic, or unique locally available waste or byproduct heat sources (e.g., data center, industrial process). The closed loop piping system typically controls or engages these sources/sinks to maintain the loop temperature to meet the seasonal requirements as well as specific building needs.

**Fifth Generation (5G) System Configurations.** An advanced ambient temperature (ATL) system that distributes near-ambient-temperature water among and between end-use buildings that are equipped with water-source heat pumps or other water-source HVAC equipment. Such systems stand in contrast to fourth generation (4G) systems that distribute hot water or chilled water to buildings to serve facility loads.

**Fourth Generation (4G) System Configurations.** A district geothermal energy system that distributes hot water and cold water for direct use in the conditioned space.
SUBSTANTIATION:
This section is being added in response to the attention drawn to ambient temperature loop district systems in many state due to carbon reduction plans and non-combustion alternatives. Ambient Temperature loops are high efficiency systems that recover wasted energy that is normally rejected to the atmosphere. The current language in Appendix F does not address these systems. The provisions in proposed Section F 501.0 through Section F 501.3 will address the general requirements for fourth generation systems and fifth generation systems; along with permitting requirements.

The definitions for "fourth generation (4G) system configuration" and "fifth generation (5G) system configuration" are included as such systems are not currently defined in the code. The definition for "ambient temperature loop (ATL)" was also added to define such system. ATL systems is a closed loop piping system that includes various heat sources and heat sinks.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 210.0
SUBMITTER: Lee H Stevens  LH Stevens Constructors LLC
RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

210.0 – H –
Hydronic System. (remaining text unchanged)

Hydronic System, Fourth Generation (4G) System Configurations. A district geothermal energy system that distributes hot water and cold water for direct use in the conditioned space.

Hydronic System, Fifth Generation (5G) System Configurations. An advanced ambient temperature (ATL) system that distributes near-ambient-temperature water among and between end-use buildings that are equipped with water-source heat pumps or other water-source HVAC equipment. Such systems stand in contrast to fourth generation (4G) systems that distribute hot water or chilled water to buildings to serve facility loads.

SUBSTANTIATION:
The new 4G and 5G definitions are being relocated to consolidate all types of hydronics under one prime definition for user friendliness.
Proposals

Item #: 301

UMC 2024 Section: F 501.3 - F 501.5, Table 1701.2

SUBMITTER: Cary Smith (Sound Geothermal Corporation); Garen Ewbank (GreyEdge Group, LLC); Hugh Henderson (Owahgena Consulting, Inc.); Richard Bostian (Water Furnace International)

RECOMMENDATION:
Add new text

F 501.3 Ambient Loop Temperature Range. The operating loop temperature range of an ambient temperature loop (ATL) system shall be not less than the freeze point of the circulating fluid and not more than the maximum temperature as required by the manufacturer’s installation instructions for the attached heat pump equipment in accordance with Section F 501.3.1 and Section F 501.3.2. The ATL system shall use treated water as the heat transfer medium.

F 501.3.1 ATL Operating Temperature. For equipment listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be not less than 7°F (4°C) above the freeze point of the transport fluid and 10°F (6°C) below the (collective) heat pump lowest maximum inlet supply temperature as recommended by the manufacturer's instructions.

Exception: Equipment that is not listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be in accordance with Section F 501.4 for minimum and maximum temperatures.

F 501.3.2 ATL Operating Temperature Range for Mixed Equipment Certifications. The source inlet temperature range of any attached equipment shall govern the design operating temperature range. Such equipment shall be identified in the design documentation. In any case the most restrictive minimum and maximum inlet supply temperatures, as recommended by the manufacturer’s instructions, shall determine the System Operating temperature range.

F 501.4 Shutoff Valve. An automatic shutoff valve shall be provided for each individual building or facility transferring energy to or from an ATL distribution system. The automatic shutoff valve shall automatically shutoff upon operating command.

F 501.4.1 Shutoff Valve Operation. The operation of the automatic shutoff valve shall be in accordance with the system operating procedures. Where the operation of a shutoff valve was due to an emergency response, an auxiliary heating or cooling methodology shall be provided in accordance with Section F 502.1.2.

F 501.5 Bypass. The ATL distributed energy system shall be provided with bypass path(s) to reroute the circulating fluid when necessary.

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**TABLE 1701.2**
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
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</table>

(portions of table not shown remain unchanged)
SUBSTANTIATION:
Section F 501.3 through Section F 501.5 further address the characteristics and required components of an ATL system that include system safety and appropriate minimum emergency or operational temperatures. The section also recognizes that there may be equipment attached to the loop with unique operation limits and that this will govern the temperature limits for standard operation of the ATL.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC Section #: 1212.2, 1212.12 Item #: 301
SUBMITTER: Cary Smith Sound Geothermal Corporation Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

1212.0 Valves.

1212.2 Where Required. Valves shall be installed in hydronic piping systems in accordance with Section 1212.3 through Section 1212.11. Full open valves and shutoff valves shall be readily accessible.

1212.12 District Energy and Central Utility Systems. Isolation valves shall be installed on the building supply and return of a district energy or central utility system.

SUBSTANTIATION:
Isolation valves must also be required on the building supply and return of a district energy or central utility system in case there are any issues and for maintenance and repair. On that note, all shutoff valves shall be readily accessible.

PUBLIC COMMENT 2
Code Year: 2024 UMC Section #: 1201.10 Item #: 301
SUBMITTER: Cary Smith Sound Geothermal Corporation Comment #: 2

RECOMMENDATION:
Add new text

Request to accept the code change proposal as modified by this public comment.

1201.0 General.

1201.10 Documentation. The hydronic system as-built installation drawings and instructions shall be provided to the building owner or designated agent.

SUBSTANTIATION:
Construction documents shall be required for the hydronic system.
Proposals

Item #: 306

UMC 2024  Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 102.0 Definitions.

**Geothermal Energy System, Closed-Loop System.**
(1) A hydronic system where the fluid is enclosed in piping that is not vented to the atmosphere. The system at any point, is typically under pressure that is greater than the ambient pressure.
(2) In a geothermal system, a liquid-source heat pump system using a continuous, sealed, underground, or submerged heat exchanger through which a heat-transfer fluid passes to and returns from a heat pump. The system at any point, is typically under pressure that is greater than the ambient pressure.

SUBSTANTIATION:
The definition of closed-loop system is being modified as the current definition may be true in some HVAC circulating systems, but I am not sure that “not vented to the atmosphere” is a clear and definitive characteristic of all HVAC closed-loop systems. The differentiation is typically that the fluid is or is NOT under “ambient” pressure. The change clarifies that there are 2 different applications for a closed-loop system. In definition (1), we account for things like drain down systems or recirculating through a storage vessel. The storage system may or may not be directly vented to the atmosphere and is typically held at ambient pressure. In definition (2), we use the “specific technology” application of the term.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 205.0, 209.0  Item #: 306

SUBMITTER: Lee H Stevens
LH Stevens Constructors LLC

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

205.0  – C –

Closed-Loop System.
(1) A hydronic system where the fluid is enclosed in piping that is not vented to the atmosphere. The system at any point, is typically under pressure that is greater than the ambient pressure.
(2) In a geothermal system, a liquid-source heat pump system using a continuous, sealed, underground, or submerged heat exchanger through which a heat-transfer fluid passes to and returns from a heat pump. The system at any point, is typically under pressure that is greater than the ambient pressure.

209.0  – G –
Geothermal Energy System. A system that exchanges uses thermal energy between the earth, subsurface water, and/or bodies of water, for the purposes of space heating and cooling, and/or water heating.

Geothermal Energy System, Closed-Loop. A closed loop hydronic geothermal system that uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels.

SUBSTANTIATION:
This revised definition is ambiguous and technically imprecise. “Closed-Loop System” by itself has no antecedent, so that it is indeterminate as to application; as an example, it could refer to an electrical grounding system, and vice versa.

In standard engineering practice, a closed loop (heat transfer) system is characterized SOLELY as embodying a fixed fluid mass circulating within the confines of the system. Energy transfer into or out of the system is via exchange of thermal energy ONLY, and there is no fluid mass transport into or out of the system to effect this energy transport. The circulating fluid mass transfers thermal energy between the heat exchangers installed on the circulation loop, which in turn transfer thermal energy into or out of the fluid mass contained within the closed system. There are un-pressurized, gravity convective fluid flow heat transfer systems that employ a fixed fluid mass, and are therefore “closed loop.”

In (1) as accepted, an open-loop system can meet the definition. Once taken into the piping, the fluid is enclosed, cannot be vented to the atmosphere, and is under pressure greater than atmospheric. Failure to meet those conditions would mean that the system fluid could not be pumped through or discharged back out into the atmosphere.

Additionally, a true closed loop system that uses a pressure relief valve to an overflow tank, with a mechanical pump-back system to manage system pressure, could be categorized as an open-loop system.

In (2) as accepted, the comma after underground implies “using a continuous, sealed, underground [heat exchanger]” OR a “submerged [heat exchanger].” This definition sidesteps the true nature of a closed-loop system, wherein pressure is not the defining characteristic, and therefore clouds the issue. Furthermore, the definition should not be implicitly limited to only a singular heat exchanger or heat pump.

This creates ambiguity in how to apply sections of the UMC, such as Section 17 Part II – Closed-Loop Systems and Part III – Open-Loop Systems.

PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: 205.0, 210.0, 1210.4, 1210.4.1, 1210.4.2, 1710.1  Item #: 306
SUBMITTER: Lee H Stevens
LH Stevens Constructors LLC
Comment #: 2
RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

205.0  – C –
Closed-Loop System:
(1) A hydronic system where the fluid is enclosed in piping that is not vented to the atmosphere. The system at any point, is typically under pressure that is greater than the ambient pressure.

(2) In a geothermal system, a liquid-source heat pump system using a continuous, sealed, underground, or submerged heat exchanger through which a heat-transfer fluid passes to and returns from a heat pump. The system at any point, is typically under pressure that is greater than the ambient pressure.
Hydronic System. Relating to, or being a system of, heating or cooling that involves the transfer of heat by a circulating fluid in a liquid state (such as water) or a gaseous state (such as steam vapor).

Hydronic System, Closed-Loop. A hydronic system that uses a captive installed fluid mass that is circulated to transfer thermal energy between heat exchange sources and emitters installed on the system loop.

Hydronic System, Vented Closed-Loop. A hydronic system wherein the system volume is occupied in part by a gas, such as air. The gaseous content is vented so as to modulate or regulate the gas pressure and/or the system fluid pressure.

Hydronic System, Non-Oxygen Barrier Closed-Loop. A hydronic system constructed all or in part with pipe or tubing that permit the diffusion of oxygen into the system fluid.

Hydronic System, Geothermal Closed-Loop. A closed loop hydronic geothermal system that uses one or more heat exchangers submerged in a body of water or buried in the ground, fluidly coupled to one or more heat exchangers or heat pumps serving one or more conditioned spaces or thermal storage vessels.

1210.0 Materials.

1210.4 Oxygen Diffusion Corrosion. PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier.

Exception: Closed hydronic systems without ferrous components in contact with the hydronic fluid.

1210.4.1 Vented Closed-Loop Systems. All components installed in a vented closed-loop system shall be constructed of non-ferrous or other corrosion resistant materials.

1210.4.2 Non-Oxygen Barrier Closed-Loop Systems. All components installed in a non-oxygen barrier system shall be constructed of non-ferrous or other corrosion resistant materials.

1710.0 General.

1710.1 Applicability. Part II of this chapter shall apply to geothermal energy closed-loop systems such as, but not limited to, building systems coupled with a closed-loop system using water-based fluid as a heat transfer medium.

SUBSTANTIATION:

Item # 306, accepted as submitted, both clouds the essential characteristic of a closed loop heat transfer system, and creates ambiguity in how to apply sections of the UMC, such as Section 17 Part II – Closed-Loop Systems and Part III – Open-Loop Systems. With Appendix F now accepted as Section 17, it is important that definitions will categorize the various types of hydronic systems in a technically correct and unambiguous manner, which does not rely on prior assumed knowledge.

Application of code provisions would be best served by clearly delineating the variations of closed loop hydronic systems as sub-definitions under the umbrella of the definition of “Hydronic System.” This approach puts all the defined variations of closed loop hydronic systems in one place within Section 2, to simplify the search for the proper definition and application thereof.

In actual hydronic industry practice, there is a possibility of muddling the definition and its application. Virtually all hydronic systems have some fluid volume loss and thus require some volume of makeup fluid for continued operation. This fluid introduction is incidental to the thermal energy transfer and should be treated as such. Virtually all hydronic systems have an initial air or gas content in the fluid and employ air separators and vents to remove this air or gas. Again, this gas transport is incidental to the process of thermal energy transport and needs to be treated as such. Non-oxygen-barrier systems allow gas transport into the system by diffusion, but this is incidental to the thermal transport. It is critical as far as provisions for maintaining water quality and limiting corrosion within the system components. Particularly on large pressurized systems, thermal expansion of the fluid may be accommodated by discharge of some portion of the fluid to a tank, and then that same fluid may be re-introduced to offset thermal contraction. This is still, and should be treated as, a closed loop system, particularly as regards oxygenation and corrosion issues.

It is also recommended to modify the core definition of “Hydronic System” to bring clarity to the fact that this definition can cover both fluid water and steam systems.
Proposals

Item #: 308
UMC 2024  Section: E 201.0, F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

E 201.0 Definitions.
E 201.4 Geothermal. Renewable energy generated by deep-earth.

F 102.0 Definitions.
Geothermal. Renewable energy generated by deep-earth conduction.

SUBSTANTIATION:
The definition of “Geothermal” in Appendix E (Sustainable Practices) must be relocated to Appendix F (Geothermal Energy Systems) as geothermal provisions are no longer located in Appendix E. Geothermal requirements have been relocated to Appendix F. In addition, there are both solar and deep earth influences on GX systems.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 209.0
SUBMITTER: Lee H Stevens
LH Stevens Constructors LLC

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

209.0   – G –
Geothermal. Renewable energy generated by deep-earth conduction.
Geothermal Energy System. A system that exchanges uses thermal energy between the earth, subsurface water, and/or bodies of water, for the purposes of space heating and cooling, and/or water heating.

SUBSTANTIATION:
The term “Geothermal” as a standalone definition is unnecessary, as it does not actually refer to any mechanical system, which is the purview of the code. This definition also fails to account for use of the earth as a sink. “Geothermal Energy System” is defined but fails to explicitly specify the key characteristic. It should be noted that all hydronic systems use “thermal energy” for space heating and cooling, and the unique characteristic of a geothermal...
system is that it uses the earth or its water as a renewable energy source or sink, as opposed to relying on direct use of non-renewable electricity or fossil fuels.
Proposals

Item #: 309

UMC 2024  Section: F 102.0

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 102.0 Definitions.

**Geothermal Energy System:** **Open-Loop System.**
(1) A hydronic system where the fluid is enclosed in piping that is vented to the atmosphere, or is replaced, all or in part, during every circulation of the system.
(2) In a geothermal system, a liquid-source heat pump system, inclusive of heat pump systems, that uses ground water or surface water to extract or reject heat.

SUBSTANTIATION:
The definition of open-loop system is being modified as the current definition may be true in some HVAC circulating systems, but I am not sure that “vented to the atmosphere” is a clear and definitive characteristic of all HVAC open-loop systems. The differentiation is typically that the fluid is or is NOT under “ambient” pressure. Even an open system can be continuously recirculated if it is circulated through a vented tank but the vent may be normally closed. The change clarifies that there are 2 different applications for an open-loop system. In definition (1), we account for things like drain down systems or recirculating through a storage vessel. The storage system may or may not be directly vented to the atmosphere and is typically held at ambient pressure. In definition (2), we use the “specific technology” application of the term.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 209.0, 217.0  Item #: 309

SUBMITTER: Lee H Stevens
LH Stevens Constructors LLC

RECOMMENDATION:
Revise text

Request to accept the code change proposal **as modified** by this public comment.

217.0  – O –

**Open-Loop System.**
(1) A hydronic system where the fluid is enclosed in piping that is vented to the atmosphere, or is replaced, all or in part, during every circulation of the system.
(2) In a geothermal system, a liquid-source system, inclusive of heat pump systems, that use ground water or surface...
SUBSTANTIATION:
This revised definition is ambiguous and technically imprecise. “Open-Loop System” by itself has no antecedent, so that it is indeterminate as to application; as an example, it could refer to an electrical grounding system, and vice versa. This definition would be better as a sub-definition under the existing geothermal energy definition.

In standard engineering practice, an open-loop (heat transfer) system is characterized SOLELY as one in which fluid mass is transported into or out of the confines of the system for the purpose of transferring thermal energy into or out of the remainder of the system confines.

In (1) as accepted, a true closed loop system that manages system pressure by the use of a pressure relief valve to an overflow tank coupled with a mechanical makeup fluid pump-back system could be categorized as an open-loop system.

In (2) as accepted, any closed-loop geothermal system in which a heat exchanger is immersed in surface or ground water also automatically and explicitly meets this definition as written. As a further technical point, the water does not “extract or reject heat”; rather, the pumping action of system components moves fluid through the system to facilitate heat flow from high to low temperature.

The ramification of the dual definition as accepted is to exempt numerous closed-loop systems from any water quality or corrosion-resistant materials requirements. This creates ambiguity in how to apply sections of the UMC, such as Section 17 Part II – Closed-Loop Systems and Part III – Open-Loop Systems.

It could also be argued that this proposed revision is incomplete, as there is deep-earth energy extraction, as well as deep-earth energy STORAGE (typical in a cooling mode).

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: 210.0, 217.0, 1712.1  Item #: 309
SUBMITTER: Lee H Stevens  LH Stevens Constructors LLC  Comment #: 2

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

217.0  – O –
Open-Loop System.
(1) A hydronic system where the fluid is enclosed in piping that is vented to the atmosphere, or is replaced, all or in part, during every circulation of the system.
(2) In a geothermal system, a liquid-source system, inclusive of heat pump systems, that use ground water or surface water to extract or reject heat.

210.0  – H –
Hydronic System. Relating to, or being a system of, heating or cooling that involves the transfer of heat by a circulating fluid in a liquid state (such as water) or a gaseous state (such as steam vapor).

Hydronic System, Open-Loop. A hydronic system that takes in a fluid mass from an external source, transfers thermal energy into or out of the fluid by means of one or more heat exchangers, and then returns the fluid mass all or in part to the external source.
**Hydronic System, Geothermal Open-Loop.** An open loop geothermal energy system draws in surface or groundwater, passes it through one or more heat exchangers and/or heat pumps, and then discharges the water back into the environment.

1712.0 General.  
1712.1 Applicability. Part III of this chapter shall apply to geothermal energy open-loop systems such as, but not limited to, building systems coupled with a groundwater (well) or surface water open-loop system using water-based fluid as a heat transfer medium. The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.

Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 1703.4 and Chapter 12. Components installed in a geothermal open-loop system shall be constructed of non-ferrous or other corrosion resistant materials.

**SUBSTANTIATION:**  
Item # 309, accepted as submitted, both clouds the essential characteristic of an open-loop heat transfer system, and creates ambiguity in how to apply sections of the UMC, such as Section 17 Part II – Closed-Loop Systems and Part III – Open-Loop Systems. With Appendix F now accepted as Section 17, it is important that definitions will categorize the various types of hydronic systems in a technically correct and unambiguous manner, which does not rely on prior assumed knowledge.

Application of code provisions would be best served by clearly delineating the variations of open-loop hydronic systems as sub-definitions under the umbrella of the definition of “Hydronic System.” This approach puts all the defined variations of open-loop hydronic systems in one place within Section 2, to simplify the search for the proper definition and application thereof. Acceptance of this comment along with the comment on Item #306 would complete the goal of consolidating all defined variations of hydronic systems in one place in Section 2.

It is also recommended to modify the core definition of “Hydronic System” to bring clarity to the fact that this definition can cover both fluid water and steam systems.
Proposals

Item #: 312
UMC 2024  Section: Table F 104.2, Table F 104.3

SUBMITTER: Cary Smith  
Sound Geothermal Corporation

RECOMMENDATION: Revise text

### TABLE F 104.2
**PLASTIC GROUND SOURCE LOOP PIPING**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-linked polyethylene (PEX)</td>
<td>ASTM F876, CSA B137.5, CSA/IGSHPA C448, NSF 358-3</td>
</tr>
<tr>
<td>High Density Polyethylene (HDPE)</td>
<td>ASTM D2737, ASTM D3035, ASTM F714, AWWA C901, CSA B137.1, CSA/IGSHPA C448, NSF 358-1</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>ASTM F2389, CSA B137.11, NSF 358-2</td>
</tr>
<tr>
<td>Polyethylene Raised Temperature (PE-RT)</td>
<td>ASTM F2623, ASTM F2769, CSA B137.18, CSA/IGSHPA C448, NSF 358-4</td>
</tr>
</tbody>
</table>

### TABLE F 104.3
**GROUND SOURCE LOOP PIPE FITTINGS**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Density Polyethylene (HDPE)</td>
<td>ASTM D2683, ASTM D3261, ASTM F1055, CSA B137.1, CSA/IGSHPA C448, NSF 358-1</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>ASTM F2389, CSA B137.11, NSF 358-2</td>
</tr>
</tbody>
</table>

(below shown for reference only)

### TABLE 1701.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/IGSHPA C448-2016</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)
Note: CSA/IGSHPA C448 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
This code change adds IGSHPA to the CSA C448 standard as it is a harmonized standard. Table 1701.2 already shows the standard correctly. This also correlates with the action taken by the USHGC Technical Committee.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

COMMITTEE STATEMENT:
The Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: 1703.4.2, 1703.4.2.1  Item #: 312
SUBMITTER: Lance MacNevin  Plastic Pipe Institute  Comment #: 1

RECOMMENDATION:
Add new text

Request to accept the code change proposal as modified by this public comment.

1703.0 Design of Systems.

1703.4 Underground Piping and Submerged Materials. (remaining text unchanged)

1703.4.2 Polyethylene of Raised Temperature (PE-RT). Polyethylene of raised temperature tubing shall be manufactured in accordance with the standards listed in Table 1703.2. Tubing shall have a minimum wall thickness equal to SDR 9 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).
Polyethylene of raised temperature tubing shall be manufactured from a PE compound that has a pipe material designation code of PE 2708, PE 3608, or PE 4710 as defined in the applicable standards referenced in Table 1703.2, with a cell classification in accordance with ASTM D3350 appropriate for the material designation code.

1703.4.2.1 Joining Methods for Polyethylene of Raised Temperature (PE-RT). Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed in accordance with the manufacturer’s installation instructions and the appropriate standards listed in accordance with Table 1703.3.

(renumber remaining sections)

Note: ASTM D3350 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
Polyethylene of Raised Temperature (PE-RT) tubing and fittings are already included within Tables F 104.2 and F 104.3 (which are being renumbered as Tables 1703.2 and 1703.3), and are approved for ground loop piping applications. This public comment provides missing information about the use of PE-RT tubing and fittings for geothermal applications in the form of proposed new sections 1703.4.2 and 1703.4.2.1. The new language is consistent with existing language in Section 1703.4.1 (formerly F 104.4.1) for PE and Section 1703.4.2 (formerly F 104.4.2) for PEX.
Proposals

Item #: 317

UMC 2024 Section: F 108.18.8, Table 1701.2

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 108.0 Installation Practices.

F 108.18 Trenches, Excavation, and Backfill. (remaining text unchanged)

F 108.18.8 Tracer and Warning Markings. Means shall be provided for underground detection or utility location of the buried pipe system. This shall include, but is not limited to, metallic detectable tape, with a thickness of not less than 11/64 of an inch (4.4 mm) and a width of 6 inches (152 mm), or non-metallic warning tape used in conjunction with tracer wire that is listed and labeled in accordance with UL 2989. Tracer and warning markings shall be permanent, conspicuous and resistant to the environmental conditions and shall be placed within 1 foot to 2 feet (305 mm to 610 mm) on top of the horizontal piping of the heat exchanger installation.

### TABLE 1701.2

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2989-2016</td>
<td>Outline of Investigation for Tracer Wire</td>
<td>Tracer Wire</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Tracer wire that is listed and labeled in accordance with UL 2989 has undergone specific testing to determine its suitability for use underground as a detectable tracer wire. The tests include:

- Physical Properties of Insulation
- Mechanical Water Absorption
- Cold-Bend Test
- Crushing Resistance
- Impact Resistance
- Unwinding of Low Temperature
- Dielectric-Voltage Withstand

Including the use of listed tracer wire in conjunction with a non-metallic warning tape in Section F 108.18.8 provides an alternative to metallic detectable warning tape. UL currently has 15 manufacturers that have tracer wire listed to UL 2989. This also correlates with the action taken by the USHGC Technical Committee.

COMMITTEE ACTION: REJECT

COMMITTEE STATEMENT:
There is concern that the current code references 14 AWG and the UL 2989 standard references 18 AWG, which may create a conflict. The Technical Committee recommends the submitter to come back with a public comment after additional research and review has been done.
Additionally, the Technical Committee disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: 1707.18.8, Table 1801.2  Item #: 317

SUBMITTER: Cary Smith  Sound Geothermal Corporation  Comment #: 1

RECOMMENDATION:
Revise text
Request to replace the code change proposal by this public comment.

1707.0 Installation Practices.

1707.18 Trenches, Excavation, and Backfill. (remaining text unchanged)

1707.18.8 Tracer and Warning Markings. Means shall be provided for underground detection or utility location of the buried pipe system. This shall include, but is not limited to, metallic detectable tape, with a thickness of not less than 11/64 of an inch (4.4 mm) and a width of 6 inches (152 mm), or non-metallic warning tape used in conjunction with tracer wire that complies with UL 2989. The tracer wire diameter shall be in accordance with the Authority Having Jurisdiction.

Tracer and this warning marking shall be permanent, conspicuous and resistant to the environmental conditions and shall be placed within 1 foot to 2 feet (305 mm to 610 mm) on top of the horizontal piping of the heat exchanger installation. Tracer wire shall be permitted to be installed at buried pipe grade.

TABLE 1801.2

STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 2989-2016</td>
<td>Tracer Wire</td>
<td>Tracer Wire</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Tracer wire that is listed and labeled in accordance with UL 2989 has undergone specific testing to determine its suitability for use underground as a detectable tracer wire. The tests include:

• Physical Properties of Insulation
• Mechanical Water Absorption
• Cold-Bend Test
• Crushing Resistance
• Impact Resistance
• Unwinding of Low Temperature
• Dielectric-Voltage Withstand

Including the use of listed tracer wire in conjunction with a non-metallic warning tape in Section 1707.18.8 provides an alternative to metallic detectable warning tape. UL currently has 15 manufacturers that have tracer wire listed to UL 2989.

Due to potential conflicts in UL 2989 and other references in the code, the AHJ shall dictate the minimum wire diameter.
Proposals

Item #: 319

UMC 2024  Section: F 110.1, F 201.6, F 201.6.2, F 401.4

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

F 110.0 Decommissioning and Abandonment.
F 110.1 General. Decommissioning of geothermal systems shall comply with CSA/IGSHPA C448. Prior to the abandonment or decommissioning of geothermal systems, the owner shall obtain the necessary permits from the Authority Having Jurisdiction.

F 201.0 General.
F 201.6 Vertical Bores. Vertical bores shall be drilled to a depth to provide complete insertion of the u-bend pipe to its specified depth. The borehole diameter shall be sized for the installation and placement of the heat exchange u-bend and the tremie used to place the grouting material. CSA/IGSHPA C448 shall be used for vertical loop depth and borehole diameter sizing guidance. The u-bend joint and pipe shall be visually inspected for integrity in accordance with the manufacturer’s installation instructions. The u-bend joint and pipe shall be pressurized to not less than 100 psi (689 kPa), not to exceed the pressure rating of the pipe at the test temperature, for 1 hour to check for leaks before insertion into the borehole.

F 201.6.2 U-Bends and Headers. Headers, u-bends and ground loop pipes shall be pressure-tested in accordance with CSA/IGSHPA C448, or as required by the Authority Having Jurisdiction. Before testing, heat fusion joints shall be cooled to ambient temperature. Mechanical joints shall be completely assembled. Flushing and purging to remove air and debris shall be completed before testing. The assembly shall be filled with water (or water/antifreeze solution) and purged at a minimum flow rate of 2 feet per second (0.6 m/s) to remove air, but not more than the maximum flow velocity recommended by the pipe and fittings manufacturer to remove debris.

F 401.0 Direct Exchange (DX) Systems.
F 401.4 DX System Testing. For direct exchange (DX) systems, each u-bend shall be tested and proved tight with an inert gas at not less than 315 psi (2172 kPa) and maintained for 15 minutes without pressure drop. The pressure reading after tremie grouting of the boreholes shall be maintained in the ground-heat exchanger for not less than 2 hours, in accordance with CSA/IGSHPA C448.

(below shown for reference only)

<table>
<thead>
<tr>
<th>TABLE 1701.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES</td>
</tr>
<tr>
<td>DOCUMENT NUMBER</td>
</tr>
<tr>
<td>CSA/IGSHPA C448-2016</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
This code change adds IGSHPA to the CSA C448 standard as it is a harmonized standard. Table 1701.2 already shows the standard correctly. This also correlates with the action taken by the USHGC Technical Committee.

COMMITTEE ACTION: ACCEPT AS SUBMITTED
COMMITTEE STATEMENT:
The Technical Committee agrees with the proposal but disagrees with the substantiation reference regarding the need for correlation with the USHGC.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: 1708.7, Table 1801.1

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

1708.0 System Start-Up.

1708.7 System Start-Up. System start-up shall be in accordance with CSA/IGSHPA C448.1, CSA.C448.2, and Section 1708.0.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA/IGSHPA C448-2016</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Ground-Source Heat Pumps</td>
<td>Table 1703.2, Table 1703.3, 1708.7, 1709.1, 1710.6, 1710.6.2, 1715.4</td>
</tr>
<tr>
<td>(R2021)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSA.C448.2-2016</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Ground-Source Heat Pumps</td>
<td>1708.7</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

Note: The CSA/IGSHPA C448 standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
CSA C448.1 and CSA C448.2 are different chapters of CSA/IGSHPA C448. It would be more appropriate to reference the main standard rather than different chapters of the CSA/IGSHPA C448 standard.
Proposals

Item #: 321
UMC 2024  Section: Appendix F

SUBMITTER: Cary Smith
Sound Geothermal Corporation

RECOMMENDATION:
Revise text

APPENDIX F Chapter 17
GEOTHERMAL ENERGY SYSTEMS
(renumber remaining chapters)

SUBSTANTIATION:
Geothermal energy systems are commonly used. Therefore, requirements for these systems should be in the body of the UMC and not in the appendix. Appendices are only enforceable is adopted. Currently, there is no geothermal code in the U.S. Therefore, relocating Appendix F to Chapter 17 will aid users of the UMC and the Authority Having Jurisdiction in enforcing the installation requirement of geothermal energy systems.

COMMITTEE ACTION: ACCEPT AS SUBMITTED
TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine
EXPLANATION OF AFFIRMATIVE:
BALLANCO: While I am voting affirmative, I have concerns that still need to be addressed. Currently, the requirements in the Appendix have been extracted from the Uniform Solar, Hydronics, and Geothermal Code. There needs to be a correlation between the USHGC and the UMC. Who will be responsible for reviewing code changes? If two committees review the changes, how will the two codes be correlated? Also, there are definitions that only apply to geothermal systems. If these definitions are added to Chapter 2 there may be conflicts with other sections of the code. I think there needs to be a subcommittee that develops the complete proposal and method of correlating the requirements between the two codes.

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Appendix F  Item #: 321
SUBMITTER: Daryn Cline
EVAPCO, Inc.  Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to accept the code change proposal as modified by this public comment.
THE SAFE OPERATION, CLOSURE, AND RESTARTING OF COOLING TOWERS

F-101.0 General.
F-101.1 Applicability. The provisions of this appendix address risk management practices of mechanical systems for safe operation during normal operation, interruption to normal operation (system shutdown), and restarting of cooling towers.
F-101.2 Building Water Systems. This appendix shall be applicable to building water systems for cooling towers.
F-101.3 Building Types. This appendix shall be applicable to the following building types:
   (1) Non-residential (low- and high-rise)
      (a) Office buildings
      (b) Mercantile (seasonal retail)
      (c) School/dormitories
      (d) Hotels/motels
      (e) Assemblies
      (f) Healthcare facilities
   (2) Residential
      (a) All except single and double family residence

F-201.0 Definitions.
F-201.1 General. For the purpose of this appendix, the following definitions shall apply:
Building Water. Water collected, conveyed, circulated, stored, drained, or discharged by building plumbing systems for use in and around buildings.
Building Water Systems. Potable and non-potable water systems in the building, or on-site.
Disinfectant. Chemical agent or physical treatments used to kill or inactivate pathogens.
Disinfection. The process of killing or inactivating pathogens.
Legionella. The name of the genus of bacteria that can cause a pneumonia called Legionnaires’ disease or a flu like illness called Pontiac fever when inhaled, aspirated or directly introduced into the lungs of susceptible individuals. It is a common aquatic bacteria found in natural and building water systems, as well as in some soils.
Legionellosis. The term used to describe Legionnaires’ disease, Pontiac fever, and any illness caused by exposure to Legionella bacteria.
Monitoring. Conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures.
Normal Operation. The state of a building water system when the building is open and being used as intended. This includes the normal hours of operation and the number of people that occupy the building.
Risk. The potential for harm to humans resulting from exposure to Legionella.
Risk Management. Systematic activities to reduce risk.
System Reopening. The set of actions that should be taken to ready a building for normal operations after an extended period of no or limited operations.
System Restarting. The set of actions that should be taken to ready a mechanical system for normal operations after an extended period of no or limited operations.
Water Management Program (WMP). A risk management plan to help building managers identify risks to water quality and establish clear guidelines for managing these risks at various points in the building lifecycle, including start up, normal operation, under occupancy, water system shutdown, and water system restart. Such programs are often focused on Legionella risk prevention and are required in some states for certain building types to combat waterborne pathogens such as Legionellosis.

F-301.0 Normal Operation, Cooling Towers.
F-301.1 Legionella. Section F 301.2 through Section F 301.4.1.1 shall apply to cooling towers under normal operation.
Note: Water based mechanical system are generally closed and pressurized and have no potential to affect the health of occupants, except at the cooling tower. Cooling towers can carry Legionella on aerosolized water droplets and infect occupants in and outside of the building.
F-301.2 Water Management Program, Cooling Towers. For each cooling tower system, the owner shall have a maintenance program and plan prepared by a qualified person in accordance with ASHRAE 188, the manufacturer’s instructions, and the requirements of this section.
The plan shall be kept current and amended by a qualified person or building owner designee as needed to reflect any changes in the management and maintenance team, system design, operation or system control requirements for the cooling tower system. The plan shall be kept in the building where a cooling tower or cooling tower system is located, or in an adjacent building or structure on the same location and shall be made available to the Authority Having Jurisdiction for inspection.
The water management program shall include, but not be limited to, the following:
   (1) Management and maintenance team. Identification, including names and contact information (such as mail, email
prior to changing an existing chemical treatment system or introducing a new chemical treatment agent,
water management program, and performed accordingly, based on the microbial activity of the system
automated dosing system, where possible, at regular intervals. The frequency and quantity of chemical dosing shall be
F 301.3.3 Water Treatment Chemicals.
(2) Emergency disinfection.
(1) Online disinfection.
(3) The requirements for documenting system water treatment.
(2) The required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(1) Equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The requirements for documenting system water treatment.
F 301.3.2 Disinfection. The responsible person for initiating disinfection shall be identified in the water management program documents and the disinfection process shall include the following:
(1) Online disinfection.
(2) Emergency disinfection.
F 301.3.3 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system, where possible, at regular intervals. The frequency and quantity of chemical dosing shall be defined in the water management program, and performed accordingly, based on the microbial activity of the system and the chemical parameters of the circulating water. Prior to changing an existing chemical treatment system or introducing a new chemical treatment agent, cooling tower
design, installation, operation, and maintenance shall be evaluated by a qualified person or building owner desigee to ensure compatibility between the chemicals and the cooling tower system’s materials, and to minimize microbial growth and the release of aerosoles.

The evaluation shall describe the optimum level of chemicals required to achieve the desired result in a manner which can be used as a system performance measure.

1. Daily automatic treatment while in operation. Water in a cooling tower system shall be treated at least once a day when the system is in operation and such treatment shall be automated, unless the water management program and plan explicitly state how manual or less frequent biocide additions will provide effective control of Legionella growth.

2. Recirculating system. A cooling tower system shall be operated and programmed to continually recirculate the water, irrespective of the building’s cooling demand of the system.

Exception: Where the water management program specifies in detail how the intended water treatment schedule will be carried out, and how effective biofilm and microorganism control will be achieved when the whole or a part of the system is idle during the scheduled chemical injection.

(3) Chemicals and biocides. Chemicals and biocides shall be used in quantities and combinations sufficient to control the presence of Legionella, minimize biofilms, and prevent scaling and corrosion that may facilitate microbial growth. It is recommended that oxidizing chemicals be used as the primary biocide control. For systems where oxidizing chemicals cannot be used as the primary biocide to control the presence of Legionella, building owners shall submit an alternative plan for effective bacteriological control for approval by the Authority Having Jurisdiction.

(a) Biocide applications. Any person who performs cleaning and disinfection or applies biocides in a cooling tower system shall be a certified person as required by the Authority Having Jurisdiction.

(b) Registered biocides. Only biocide products registered with the Authority Having Jurisdiction may be used to meet the disinfection requirements of this Appendix.

(c) Records. Water treatment records shall be kept for all chemicals and biocides added, noting the purpose of their use, the manufacturer’s name, the brand name, the safety data sheet, the date and time of each addition, and the amount added each week.

(d) Chemical and biocide additions. Chemicals and biocides shall be added in accordance with this appendix and the procedures described in the water management program addressing, as applicable, feeding mechanism, feeding location, frequency, set timer, duration, triggering events, control procedures, and target biocide residuals. Water treatment chemicals and biocides shall be used in accordance with the product label and manufacturer’s instructions.

F 301.4 Water Quality Monitoring. Water quality in the cooling tower shall be monitored as follows:

1. Water quality parameters, including but not limited to pH, temperature, conductivity and biocidal indicators, shall be measured and recorded as specified in the water management program and plan as follows:

(a) Manual measurements as required by the manufacturer’s recommendation and the Authority Having Jurisdiction.

(b) When continuous, automated and/or remote measurements and recordings are used, the water management program and plan shall show how effective measurements of system process control are being monitored.

2. A bacteriological indicator to estimate microbial content of recirculating water shall be collected and interpreted in accordance with Table F 301.4(2) at least once each week while the cooling tower system is operating. Indicators shall be taken at times and from water sampling points, as detailed in the water management program, that will be representative of water microbial content. Indicators may be taken at any time from constant chemical treatment systems. Indicators from systems that use intermittent biocide applications shall be taken before biocide application and reflect normal cooling tower operating conditions.

3. Legionella culture testing shall be conducted not less than every 90 days during cooling tower system operation. A Legionella sample shall be analyzed by an accredited laboratory where Legionella appears on the laboratory’s scope of accreditation, or other laboratory approved by the Authority Having Jurisdiction. When required, the test results of all Legionella bacteria at or above the magnitude of 1000 CFU/mL as indicated in Table F 301.4(1) shall be reported to the Authority Having Jurisdiction within 24 hours of receiving the test results.

Additional emergency Legionella sampling shall be conducted if any of the following occur:

(a) Power failure, system shutdown, or equipment failure of sufficient duration to allow for growth of bacteria.

(b) Loss of biocide treatment sufficient to allow for growth of bacteria.

(c) Failure of conductivity controls to maintain proper cycles of concentration.

(d) At the request of the Authority Having Jurisdiction upon a determination that one or more cases of legionellosis is or may be associated with the cooling tower, based on epidemiological data or laboratory testing.

(e) Any time two consecutive bacteriological indicator sample results are above 1000 CFU/mL as indicated in Table J301.4(1).

(f) Any other conditions specified by the Authority Having Jurisdiction.

4. System monitoring and sampling locations shall be representative of the entire cooling tower system. The system shall be operating with water circulating in the system for at least one hour prior to water quality measurements or collection of samples.

5. The maintenance program and plan shall identify the procedures, responsible parties, required response time(s) and notification protocol for corrective actions and shall include, at a minimum, corrective actions that shall be implemented according to the result levels in Table F 301.4(1).

F 301.4.1 Water Sampling. An analysis of water samples from a location capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of
organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table F 301.4(1).

**F 301.4.1.1 Legionella Test Levels.** A means of controlling Legionella shall be established in accordance with applicable levels in accordance with the following:

1. **Levels Less than 10 CFU/mL.** Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment program in accordance with Table F 301.4(1).

2. **Levels Between 10 CFU/mL and 1000 CFU/mL.** Water samples containing Legionella levels greater than 10 CFU/mL but less than 1000 CFU/mL shall require the water treatment program to be reviewed, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table F 301.4(1).

3. **Levels Greater than 1000 CFU/mL.** Water samples containing Legionella levels greater than 1000 CFU/mL shall require the water treatment program to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table F 301.4(1).

**F 401.0 Interruption to Normal Operation.**

**F 401.1 Shutdown Date.** When an interruption to normal operation occurs (system shutdown), a shutdown date shall be established prior to shutting down a cooling tower. A shutdown date of a cooling tower shall be a date after which the cooling tower is unlikely to be restarted for the season. Where shutdown of the cooling tower is required, a shutdown date shall be determined, and the requirements of Section F 401.1.1 through Section 401.1.4 shall be completed.

**F 401.1.1 Reduce Solids and Sterilize the System.** The cooling tower shall be drained prior to system shutdown. Biocide shall be applied in accordance with the manufacturer’s instructions to kill any bacteria or contaminants.

**F 401.1.2 Drain, Inspect and Clean the System.** When an interruption to normal operation occurs, the following actions shall be performed:

1. The cooling tower fill, sump, heat exchangers, chillers, and piping shall be drained.
2. The system shall be cleaned as required by the manufacturer’s instructions.
3. The system shall be inspected, and maintenance shall be performed as required by the manufacturer.
4. The controllers shall be taken offline.
5. The protective probes shall be removed.
6. The tower fill and sump shall be drained.
7. The heat exchangers, chillers and piping shall be drained and protected in accordance with the manufacturer’s instructions.

**F 401.1.3 Refill, Flush and Drain the Cooling Tower System.** Where an interruption to normal operation occurs, the following additional actions shall be performed:

1. The system shall be refilled.
2. A nonoxidizing biocide shall be added and recirculated in accordance with the manufacturer’s instructions.
3. The cooling tower system shall be fully drained.

**Note:** It is possible that the cooling tower equipment is drained, but the cooling tower system remains in operation. A system operating on standby mode is not considered shut down. If water remains in the cooling tower system, the system is not considered shut down and water must circulate with regular biocide additions and active management.

**F 401.1.4 Records.** Records of all procedures and actions performed shall be kept.

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**TABLE F 301.4(1)**

**LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>=10 and &lt;100</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>=100 and &lt;1000</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>=1000</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td></td>
<td>If the results of a retest are still =1000 CFU/mL, carry out system decontamination.</td>
</tr>
<tr>
<td>LEVEL</td>
<td>HETEROBROPHIC PLATE COUNT AND DIP SLIDE RESULT (CFU/mL)</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>&lt;10,000</td>
</tr>
<tr>
<td>2</td>
<td>=10,000 to &lt;100,000</td>
</tr>
<tr>
<td>3</td>
<td>=100,000 to &lt;1,000,000</td>
</tr>
<tr>
<td>4</td>
<td>=1,000,000</td>
</tr>
</tbody>
</table>

**Notes:**
1. Performed by an accredited laboratory
2. At a minimum, dose the cooling water system with 5 ppm to 10 ppm free halogen residual for at least 1 hour; pH 7.0 to 7.6

**Note:** There is no evidence that HPC values alone directly relate to human health risk, based on epidemiological studies and a lack of correlation with the occurrence of waterborne pathogens. Threshold concentrations of HPC were selected based on interference with the coliform test and not health-related considerations. HPC is an analytic method used to measure the variety of heterotrophic bacteria that are common in water. Legionella require specialized culture media for isolation and detection, do not grow on the media used for HPC testing, and their presence is not correlated with HPC values. HPC is a useful tool for monitoring the efficiency of the water treatment process, measuring bacterial regrowth, and evaluating the function of disinfection systems.
F.501.0 System Shutdown.

F.501.1 General. Cooling towers that are in shutdown mode shall comply with the following:

(1) Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three days, including idling or low circulation while not being fully drained.

(2) Specific, detailed seasonal and temporary shutdown and start up procedures.

F.501.2 Shutdown Procedures. System start up and shutdown procedures shall include, but not be limited to, the following:

(1) Management of hazardous conditions associated with untreated water, including the following:
   (a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than three days, or the duration specified by the water management program.
   (b) Start up from a drained system shall be in accordance with manufacturer’s recommendations.
   (c) Start up from an undrained or stagnant system that exceeds three days, or the number of idle days specified by the water management program or the manufacturer’s recommendations.

F.501.3 Legionella Prevention. The mechanical hydronic system shall be checked that it is safe to use after a prolonged shutdown to minimize the risk of Legionnaires’ disease and other diseases associated with water.

Note: Stagnant or standing water in a mechanical hydronic system can increase the risk for growth and spread of Legionella and other biofilm associated bacteria. When water is stagnant, hot water temperatures can decrease to the Legionella growth range 77 °F (25°C) through 110°F (43°C). Stagnant water can also lead to low or undetectable levels of disinfectant, such as chlorine.

F.501.3.1 Maintenance Personnel. Personal protective equipment shall be provided for maintenance personnel. Maintenance personnel shall wear personal protective equipment in accordance with the facilities’ risk assessment. Respiratory protection may be appropriate in enclosed spaces where aerosol generation is likely. Personal protective equipment shall be used in accordance with all local state and Federal requirements. Where respirators are used, a respiratory protection program in accordance with 29 CFR 1910.134 shall be required.

Note: Maintenance personnel at increased risk of developing Legionnaires’ disease, such as those with weakened immune systems, should consult with a medical provider regarding participation in flushing, cooling tower cleaning, or other activities that may generate aerosols.

F.601.0 System Restart.

F.601.1 Startup Procedures. When a cooling tower has been shut down or left untreated for five or more days, a full startup procedure shall be completed before startup or continuing operation. The startup procedure shall be completed as follows:

(1) Clean the cooling tower through power washing and/or scrubbing, not more than 15 days before the first use, to remove biofilm, scale or other debris. Once cleaned, disinfect with an approved biocide(s) to kill pathogens, such as Legionella.

(2) Enlist a qualified person or building owner designee to conduct and document the pre-startup inspection. The required inspection shall be as follows:
   (a) Visually assessing the cooling tower system.
   (b) Inspecting all components for the presence of contaminants and other adverse conditions.
   (c) Checking that the water treatment equipment is working properly.
   (d) Records of the procedure shall be completed.

(3) Once disinfected, the cooling tower system shall be filled with water and begin circulating biocides and chemicals, as specified in the water management program. At this point, the system shall be considered operational and shall meet the requirements of the Authority Having Jurisdiction.

(4) Collect and analyze a water sample for the presence of Legionella. The sample shall be analyzed by a laboratory approved by the Authority Having Jurisdiction. The results shall be interpreted and the actions described in Table F 301.4(2) shall be performed.

(5) Startup records of all procedures and actions performed shall be kept on file. Startup records shall include, but not be limited to, the following:
   (a) Cooling tower system ID
   (b) System startup date
   (c) Individual cooling tower startup date (if different than the system startup date)
   (d) Dates and procedures for startup cleaning and disinfection
   (e) Service provider
   (f) Pre-startup inspection
   (g) Legionella sampling and test results
   (h) Disinfection dose and circulation time
   (i) Water monitoring
   (j) Treatment logs
SUBSTANTIATION:
Appendix F just appears in the ROP with no proposal item number, I selected Item # 321, because this item made the suggestion of changing Appendix F to Chapter 17 for geothermal, but no formal submission was used to substantiate Appendix F changing to Safe Operation, Closure, and Restarting of Cooling Towers, the language in Appendix F also closely mirrors Appendix J, but is not exact, it was previously recommended that Appendix J be deleted in its entirety, due to its conflicts with ASHRAE and CTI recommendations. Recommended Appendix F be deleted.
**APPENDIX H**

**IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH**

**Part I – General**

**H 101.0 General.**

**H 101.1 Applicability.** Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella.

**Note:** Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

Published documents which address professional qualifications for Legionella risk assessment include ASSE Series 12000.

There are additional factors associated with the potential for scalding and Legionella growth other than temperature.

For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

**H 102.0 Definitions.**

**H 102.1 General.** For the purpose of this appendix, the following definitions shall apply.

**Biofilm.** Microorganisms and the slime they secrete that grow on any continually moist surface.

**Control.** The management to maintain compliance with established criteria.

**Disinfection.** Chemical or physical control measures or procedures used to kill or inactivate pathogens.

**Disinfection, Online.** The procedure while the equipment is in operation.

**Disinfection, Offline.** The procedure while the equipment is not in operation.

**Halogenation.** A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.

**Hazard.** See Risk.

**Legionella Concentrations.** The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).

**Legionella Growth Potential.** The likelihood that Legionella bacteria will reproduce.

**Monitor.** Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.

**Nutrient.** Any element or compound essential as a raw material for an organism’s growth and development.

**Risk.** The potential to cause harm resulting from exposure.

**Test.** The measurement of the physical, chemical, or microbial characteristics or quality of water.

**Water Management Plan.** A comprehensive risk management plan for controlling Legionella growth in building water systems.
H 103.0 Building Water Systems and System Equipment Documentation.
H 103.1 Design Documentation. Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.
H 103.2 Onsite Documentation. Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

H 104.0 Potential Exposure.
H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.
H 104.2 Scald Potential. Where the water system's temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

**FIGURE H 104.1**
WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL*

For SI units: °C = (°F-32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

H 105.0 Disinfection.
H 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.
H 105.1.1 Copper-Silver Ionization. Copper-silver ionization methods and procedures shall include the following documentation.
1. Copper and silver ionization concentrations.
2. Methods and documentation for monitoring ion levels.
3. Electrode cleaning cycles and methods.
H 105.1.2 Ultraviolet Light. Ultraviolet light methods shall include the following documentation:
1. Locations of ultraviolet light units.
2. Cleaning cycles and methods of the quartz sleeves and housing.
H 105.2 Chemical Disinfection. Chemical biocide treatment shall be permitted to be used in accordance with the following:
1. Oxidizing biocides in accordance with manufacturer’s guidelines.
2. Non-oxidizing biocides in accordance with manufacturer’s guidelines.
3. Alternating the use of different types of biocides, dose, and frequency is recommended.
4. These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.
H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.
H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and shall be performed before the chemical disinfection methods in Section 105.1 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.
H 105.4 Inspection and Maintenance. The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.
H 105.5 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.
H 105.6 Control Measures. Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

Part II – Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.

H 201.0 General.
H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.
H 201.2 Water Management Plan, Where Required. A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.
H 201.3 Water Management Plan, Where Implemented. Where a water management plan is implemented, the plan shall be in accordance with the following:
(1) Determine a water management plan team.
(2) Provide description of the building’s water system.
(3) Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
(4) Determine applicable control measures and monitoring procedures.
(5) Ensure the water management plan is effective and operating as designed.
(6) Document and communicate all the activities of the water management plan.
H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.
H 201.5 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.4.
H 201.5.1 Levels Less than 10 CFU/ML. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.
H 201.5.2 Levels Between 10 CFU/ML and 100 CFU/ML. Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
H 201.5.3 Levels Between 100 CFU/ML and 1000 CFU/ML. Water samples containing Legionella levels greater than 100 CFU/mL but less than 1,000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
H 201.5.4 Levels Greater than 1000 CFU/ML. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

| TABLE H 201.5 |

495
## Legionella Remediation Actions for Cooling Towers

<table>
<thead>
<tr>
<th>Legionella Concentrations in Colony Forming Units (CFU/mL)</th>
<th>Remediation Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>(\geq 10 \text{ and } &lt; 100)</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>(\geq 100 \text{ and } &lt; 1000)</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL. <em>The emergency response plan for cooling towers is addressed in Section H 202.14.</em></td>
</tr>
<tr>
<td>(\geq 1000)</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination. If retest (\geq 1000) CFU/mL, repeat system decontamination.</td>
</tr>
</tbody>
</table>

### H 201.6 Air Sampling
Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

### H 202.0 Cooling Towers

#### H 202.1 General
Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

#### H 202.2 Risk Factors
The following risk factors shall be identified, assessed, controlled, and monitored:
(1) Stagnant water due to dead legs, intermittent operation, or seasonal usage.
(2) The presence of nutrients or biofilm.
(3) Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
(4) Water exposed to direct sunlight which promotes algae growth.
(5) Water quality, including, but not limited to, the following factors:
   (a) System cleanliness
   (b) pH levels
   (c) Presence of corrosion
   (d) Presence of scale and biofouling
   (e) Conductivity levels
   (f) Dissolved and suspended solids
   (g) Control of water treatment chemicals
   (h) Control of bleed-off or blowdown
   (6) System size
   (7) Physical condition of system
   (8) Aerosol generation, dispersion, and drift elimination
   (9) System site location
   (10) Access for inspection, cleaning, and maintenance
   (11) Concentration of Legionella as specified in Table H 201.5.

#### H 202.3 Water Temperature
The system shall be designed to maintain low sump-water operating temperatures.

#### H 202.4 Drift Eliminators
Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

#### H 202.5 Side Stream Filtration
When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

#### H 202.6 Equipment Site Location
The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:
(1) Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.
(2) Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.

#### H 202.7 System Commissioning
System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

#### H 202.8 System Start-Up and Shutdown
System start-up and shutdown procedures shall include, but not be limited to the following:
(1) Management of hazardous conditions associated with untreated water, including the following:
(a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
(b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
(c) Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

**H 202.9 System Maintenance and Inspection.** System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

1. Water treatment system
2. Louvers
3. Piping dead legs
4. Cold water basins
5. Crossflow hot water basin
6. Counterflow spray system
7. Drift eliminators
8. Fill material and fill air entrance and exit surfaces
9. Purging of stagnant water or low-flow zones within the basin

**H 202.10 Water Treatment.** Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

1. All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
2. The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
3. The minimum requirements for documenting system water treatment.

**H 202.11 Disinfection.** Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:

1. Online disinfection.
2. Emergency disinfection.

**H 202.12 Water Treatment Chemicals.** Water treatment chemicals, such as biocides, shall be applied using an automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

**H 202.13 Makeup Valves.** The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.

**H 202.14 Emergency Response Plan.** An emergency response plan shall be provided when required by with the Authority Having Jurisdiction and shall include, but not be limited to, the following:

1. Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
2. Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
3. Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
4. Procedures for emergency disinfection.
5. Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

**H 202.15 Control of Bleed-Off.** An automated bleed-off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the return line of the cooling water system to the cooling tower. Bleed-off shall only occur while chemical dosing is turned off.

**H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.

**H 203.0 Other Mechanical Systems.**

**H 203.1 General.** Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.

**H 203.2 Sand Filters.** Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.

**H 203.3 Water Softeners.** Water softeners shall be installed and maintained in accordance with the plumbing code.

**H 203.4 Dehumidifiers.** Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.

**H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers.** Misters, atomizers, air washers, nebulizers, and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.6.
### TABLE H 203.6
LEGIONELLA REMEDIATION ACTIONS IN HUMIDIFIERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;/=1 and &lt;10</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>&gt;/=10</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
</tr>
</tbody>
</table>

**H 203.7 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.

**H 203.8 Ice Machines.** Ice machines not used for human consumption shall be flushed and maintained in accordance with ASHRAE 188.

**H 203.9 Spas and Hot Tubs.** Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer’s recommendations.

**H 203.10 Decorative Water Features.** Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer’s instructions and the Authority Having Jurisdiction.

**H 203.11 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

### TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.1.2-2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Fittings</td>
</tr>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
<td>Risk Management</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**SUBSTANTIATION:**

The purpose of the new Appendix H is to establish minimum Legionellosis risk management requirements for building mechanical systems. Cooling towers’ potential for spreading Legionella bacteria is especially pressing given the associated diseases’ symptomatic similarities to COVID-19 and the propensity they have for exacerbating respiratory illnesses.

**COMMITTEE ACTION:** ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

**APPENDIX H
IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH

Part I – General

**H 101.0 General.**

**H 101.1 Applicability.** Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella.

**Note:** Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

Published documents which address professional qualifications for Legionella risk assessment include ASSE Series 12000.

There are additional factors associated with the potential for scalding and Legionella growth other than temperature.
For scalding potential, other factors include, but are not limited to, user age, health, body part, length of contact time, and water source.

For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

H 102.0 Definitions.
H 102.1 General. For the purpose of this appendix, the following definitions shall apply.

Biofilm. Microorganisms and the slime they secrete that grow on any continually moist surface.

Control. The management to maintain compliance with established criteria.

Disinfection. Chemical or physical control measures or procedures used to kill or inactivate pathogens.

Disinfection, Online. The procedure while the equipment is in operation.

Disinfection, Offline. The procedure while the equipment is not in operation.

Halogenation. A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.

Hazard. See Risk.

Legionella Concentrations. The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).

Legionella Growth Potential. The likelihood that Legionella bacteria will reproduce.

Monitor. Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.

Nutrient. Any element or compound essential as a raw material for an organism’s growth and development.

Risk. The potential to cause harm resulting from exposure.

Test. The measurement of the physical, chemical, or microbial characteristics or quality of water.


H 103.0 Building Water Systems and System Equipment Documentation.
H 103.1 Design Documentation. Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.
H 103.2 Onsite Documentation. Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

H 104.0 Potential Exposure.
H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.
H 104.2 Scald Potential. Where the water system’s temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

**FIGURE H 104.1 WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL**

For SI units: °C = (°F-32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth
temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

H 105.0 Disinfection.
H 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.
H 105.1.1 Copper-Silver Ionization. Copper-silver ionization methods and procedures shall include the following documentation.
(1) Copper and silver ionization concentrations.
(2) Methods and documentation for monitoring ion levels.
(3) Electrode cleaning cycles and methods.
H 105.1.2 Ultraviolet Light. Ultraviolet light methods shall include the following documentation:
(1) Locations of ultraviolet light units.
(2) Cleaning cycles and methods of the quartz sleeves and housing.
H 105.2 Chemical Disinfection. Chemical biocide treatment shall be permitted to be used in accordance with the following:
(1) Oxidizing biocides in accordance with manufacturer’s guidelines.
(2) Non-oxidizing biocides in accordance with manufacturer’s guidelines.
(3) Alternating the use of different types of biocides, dose, and frequency is recommended.
(4) These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.
H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.
H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and shall be performed before the chemical disinfection methods in Section 105.1 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.
H 105.4 Inspection and Maintenance. The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.
H 105.5 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.
H 105.6 Control Measures. Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

Part II – Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.

H 201.0 General.
H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.
H 201.2 Water Management Plan, Where Required. A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.
H 201.3 Water Management Plan, Where Implemented. Where a water management plan is implemented, the plan shall be in accordance with the following:
(1) Determine a water management plan team.
(2) Provide description of the building’s water system.
(3) Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
(4) Determine applicable control measures and monitoring procedures.
(5) Ensure the water management plan is effective and operating as designed.
(6) Document and communicate all the activities of the water management plan.
H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms
present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.

**H 201.5 Legionella Test Levels.** A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.4.

**H 201.5.1 Levels Less than 10 CFU/ML.** Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.

**H 201.5.2 Levels Between 10 CFU/ML and 100 CFU/ML.** Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

**H 201.5.3 Levels Between 100 CFU/ML and 1000 CFU/ML.** Water samples containing Legionella levels greater than 100 CFU/mL but less than 1,000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 202.14.

**H 201.5.4 Levels Greater than 1000 CFU/ML.** Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

**TABLE H 201.5
LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>&gt;=10 and &lt;100</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>&gt;=100 and &lt;1000</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL. *The emergency response plan for cooling towers is addressed in Section H 202.14.</td>
</tr>
<tr>
<td>&gt;=1000</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination. If retest &gt;=1000 CFU/mL, repeat system decontamination.</td>
</tr>
</tbody>
</table>

**H 201.6 Air Sampling.** Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

**H 202.0 Cooling Towers.**

**H 202.1 General.** Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

**H 202.2 Risk Factors.** The following risk factors shall be identified, assessed, controlled, and monitored:

1. Stagnant water due to dead legs, intermittent operation, or seasonal usage.
2. The presence of nutrients or biofilm.
3. Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
4. Water exposed to direct sunlight which promotes algae growth.
5. Water quality, including, but not limited to, the following factors:
   a. System cleanliness
   b. pH levels
   c. Presence of corrosion
   d. Presence of scale and biofouling
   e. Conductivity levels
   f. Dissolved and suspended solids
   g. Control of water treatment chemicals
   h. Control of bleed-off or blowdown
   i. System size
   j. Physical condition of system
   k. Aerosol generation, dispersion, and drift elimination
   l. System site location
   m. Access for inspection, cleaning, and maintenance
H 202.3 Water Temperature. The system shall be designed to maintain low sump-water operating temperatures.

H 202.4 Drift Eliminators. Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

H 202.5 Side Stream Filtration. When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

H 202.6 Equipment Site Location. The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

1. Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.
2. Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.

H 202.7 System Commissioning. System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

H 202.8 System Start-Up and Shutdown. System start-up and shutdown procedures shall include, but not be limited to the following:

1. Management of hazardous conditions associated with untreated water, including the following:
   a. Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
   b. Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   c. Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the water management plan or the manufacturer's recommendations.

H 202.9 System Maintenance and Inspection. System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

1. Water treatment system
2. Louvers
3. Piping dead legs
4. Cold water basins
5. Crossflow hot water basin
6. Counterflow spray system
7. Drift eliminators
8. Fill material and fill air entrance and exit surfaces
9. Purging of stagnant water or low-flow zones within the basin

H 202.10 Water Treatment. Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

1. All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
2. The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
3. The minimum requirements for documenting system water treatment.

H 202.11 Disinfection. Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

   The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:
   1. Online disinfection.
   2. Emergency disinfection.

H 202.12 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

H 202.13 Makeup Valves. The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.

H 202.14 Emergency Response Plan. An emergency response plan shall be provided when required by with the Authority Having Jurisdiction and shall include, but not be limited to, the following:

1. Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
2. Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
3. Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
4. Procedures for emergency disinfection.
5. Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

H 202.15 Control of Bleed-Off. An automated bleed-off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual
bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the return line of the cooling water system to the cooling tower. Bleed-off shall only occur while chemical dosing is turned off. **H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.

**H 203.0 Other Mechanical Systems.**
**H 203.1 General.** Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.
**H 203.2 Sand Filters.** Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.
**H 203.3 Water Softeners.** Water softeners shall be installed and maintained in accordance with the plumbing code.
**H 203.4 Dehumidifiers.** Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.
**H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers.** Misters, atomizers, air washers, nebulizers, and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.6.

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**H 203.7 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.

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**H 203.11 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

**Table 1701.2 Standards, Publications, Practices, and Guides**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 188-2018</td>
<td>Legionellosis: Risk Management for Building Water Systems</td>
</tr>
<tr>
<td>ASHRAE Guideline 12-2020</td>
<td>Managing the Risk of Legionellosis Associated with Building Water Systems</td>
</tr>
<tr>
<td>ASME A112.1.2-2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)</td>
</tr>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**Committee Statement:**
Section H 203.8 is being revised to remove the phrase “not used for human consumption” as all ice machines must be flushed and maintained, not only those that are not used for human consumption.

**Total Eligible to Vote:** 30

**Voting Results:** Affirmative: 29   Not Returned: 1   Heine

Appended Comments
APPENDIX H
IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH

Part I – General

H 101.0 General.
H 101.1 Applicability. Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code. This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella. Where required by the Authority Having Jurisdiction, Legionella risk management shall be in accordance with ASHRAE 188 and ASHRAE Guideline 12.

Note: Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12. Published documents which address professional qualifications for Legionella risk assessment include ASSE Series 12000.

There are additional factors associated with the potential for scalding and Legionella growth other than temperature.

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For Legionella growth potential other factors include, but are not limited to, water source and plumbing system: size, design, circulation rate, water age, disinfectant residual, piping material and component complexity.

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Biofilm. Microorganisms and the slime they secrete that grow on any continually moist surface.
Control. The management To manage the conditions of an operation in order to maintain compliance with established criteria. [ASHRAE 188:3]
Disinfection. Chemical or physical control measures or procedures used to kill or inactivate pathogens. The process of killing or inactivating microorganism. [ASHRAE 188:3]
Disinfection, Online. The procedure while the equipment is in operation.
Disinfection, Offline. The procedure while the equipment is not in operation.
Halogenation. A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.
Hazard. See Risk.
Legionella Concentrations. The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).
Legionella Growth Potential. The likelihood that Legionella bacteria will reproduce.
Monitor. Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.
Nutrient. Any element or compound essential as a raw material for an organism’s growth and development.
Risk. The potential to cause harm resulting from exposure. potential for harm to humans resulting from exposure to Legionella. [ASHRAE 188:3]
Test. The measurement of the physical, chemical, or microbial characteristics or quality of water.

H 103.0 Building Water Systems and System Equipment Documentation.
H 103.1 Design Documentation. Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.
H 103.2 Onsite Documentation. Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

H 104.0 Potential Exposure.
H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.

H 104.2 Scald Potential. Where the water system’s temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

For SI units: °C = (°F - 32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

**FIGURE H 104.1**
WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL*

H 105.0 Disinfection.
H 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.

H 105.1.1 Copper-Silver Ionization. Copper-silver ionization methods and procedures shall include the following documentation.
(1) Copper and silver ionization concentrations.
(2) Methods and documentation for monitoring ion levels.
(3) Electrode cleaning cycles and methods.

H 105.1.2 Ultraviolet Light. Ultraviolet light methods shall include the following documentation:
(1) Locations of ultraviolet light units.
(2) Cleaning cycles and methods of the quartz sleeves and housing.

H 105.2 Chemical Disinfection. Chemical biocide treatment shall be permitted to be used in accordance with the following:

(1) Oxidizing biocides in accordance with manufacturer’s guidelines, or as required by the Authority Having Jurisdiction.
(2) Non-oxidizing biocides in accordance with manufacturer’s guidelines.
(3) Alternating the use of different types of biocides, dose, and frequency is recommended.
(4) These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.

H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with the manufacturer’s guidelines.

H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.

H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and
shall be performed before the chemical disinfection methods in Section H 105.2 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.

H 105.4 Inspection and Maintenance. The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.

H 105.5 Frequency of Cleaning and Disinfection. Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.

H 105.6 Control Measures. Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

Part II – Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.

H 201.0 General.

H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.

H 201.2 Water Management Plan, Where Required. A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.

H 201.3 Water Management Plan, Where Implemented. Where a water management plan is implemented, the plan shall be in accordance with the following:

1. Determine a water management plan team.
2. Provide description of the building’s water system.
3. Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
4. Determine applicable control measures and monitoring procedures.
5. Ensure the water management plan is effective and operating as designed.
6. Document and communicate all the activities of the water management plan.

H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.

H 201.5 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.4.

H 201.5.1 Levels Less than 10 CFU/mL. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.

H 201.5.2 Levels Between 10 CFU/mL and 100 CFU/mL. Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

H 201.5.3 Levels Between 100 CFU/mL and 1000 CFU/mL. Water samples containing Legionella levels greater than 100 CFU/mL but less than 1000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 202.14.

H 201.5.4 Levels Greater than 1000 CFU/mL. Water samples containing Legionella levels greater than 1000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
TABLE H 201.5
LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>( \geq 10 ) and (&lt; 100)</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 days to 7 days after decontamination disinfection.</td>
</tr>
<tr>
<td>( \geq 100 ) and (&lt; 1000)</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 days to 7 days after decontamination disinfection. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL.</td>
</tr>
<tr>
<td>( \geq 1000)</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 days to 7 days after decontamination disinfection. If the results of a retest are still ( \geq 1000) CFU/mL, repeat carry out system decontamination.</td>
</tr>
</tbody>
</table>

**H 201.6 Air Sampling.** Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

**H 202.0 Cooling Towers.**

**H 202.1 General.** Cooling towers shall be installed, maintained, and tested as required by this Appendix, this code, and the Authority Having Jurisdiction.

**H 202.2 Risk Factors.** The following risk factors shall be identified, assessed, controlled, and monitored:

1. Stagnant water due to dead legs, intermittent operation, or seasonal usage.
2. The presence of nutrients or biofilm.
3. Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
4. Water exposed to direct sunlight which promotes algae growth.
5. Water quality, including, but not limited to, the following factors:
   a. System cleanliness
   b. pH levels
   c. Presence of corrosion
   d. Presence of scale and biofouling
   e. Conductivity levels
   f. Dissolved and suspended solids
   g. Control of water treatment chemicals
   h. Control of bleed-off or blowdown
6. System size
7. Physical condition of system
8. Aerosol generation, dispersion, and drift elimination
9. System site location
10. Access for inspection, cleaning, and maintenance
11. Concentration of Legionella as specified in Table H 201.5.

**H 202.3 Water Temperature.** The system shall be designed to maintain low sump-water operating temperatures.

**H 202.4 Side Stream Filtration.** When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

**H 202.5 Equipment Site Location.** The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

1. Shall not be located where contamination from building systems or facility processes can be drawn into the
equipment. Equipment shall be installed not less than 40 25 feet (3048 7620 mm) away from building exhaust or plumbing vents.

(2) Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed not less than 40 25 feet (3048 7620 mm) away from building intakes or plumbing vents.

H 202.7 H 202.6 System Commissioning. System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 and shall be initiated once the system is charged with water.

H 202.8 System Start-Up and Shutdown (Interruption to Normal Operation). System start-up and shutdown procedures shall include, but not be limited to the following:

(1) Management of hazardous conditions associated with untreated water, including the following:
   (a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 5 days, or the duration specified by the water management plan.
   (b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   (c) Start-up from an undrained or stagnant system that exceeds 3 5 days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

H 202.9 H 202.7 System Maintenance and Inspection. System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

(1) Water treatment system
(2) Louvers
(3) Piping dead legs
(4) Cold water basins
(5) Crossflow hot water basin
(6) Counterflow spray system
(7) Drift eliminators
(8) Fill material and fill air entrance and exit surfaces
(9) Purging of stagnant water or low-flow zones within the basin

H 202.10 H 202.8 Water Treatment. Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

(1) All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The minimum requirements for documenting system water treatment.
(4) When an oxidant is used to control microbiological activity, it shall maintain a continuous free residual of 0.5 to 1.0 ppm.

H 202.11 H 202.9 Disinfection. Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall be identified in the water management plan and shall include the following:

(1) Online disinfection.
(2) Emergency disinfection.

H 202.12 H 202.10 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system in accordance with the water management plan at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

H 202.13 H 202.11 Makeup Valves. The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.

H 202.14 H 202.12 Emergency Response Plan Disinfection Procedure. An emergency response-plan disinfection procedure shall be provided when required by the Authority Having Jurisdiction and shall include, but not be limited to, the following:

(1) Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
(2) Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
(3) Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
(4) Procedures for emergency disinfection.
(5) Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

H 202.15 H 202.13 Control of Bleed-Off. An automated bleed-off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional
Manual bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the return line of the cooling water system to the cooling tower. The water management plan shall require that bleed-off only occur while chemical dosing is turned off. Manual bleed-off shall be permitted to be used to control scale or biofouling.

**H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.

**H 203.0 Other Mechanical Systems.**

**H 203.1 General.** Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.

**H 203.2 Sand Filters.** Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.

**H 203.3 Water Softeners.** Water softeners shall be installed and maintained in accordance with the plumbing code.

**H 203.4 Dehumidifiers.** Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer's instructions.

**H 203.5 H 203.2 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers.** Misters, atomizers, air washers, nebulizers, and humidifiers shall be maintained and disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.5.

**TABLE H 203.5 LEGIONELLA REMEDIATION ACTIONS IN HUMIDIFIERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY-FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=1 and &lt;10</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>&gt;=10</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
</tr>
</tbody>
</table>

**H 203.6 H 203.3 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer's instructions. When not in use, evaporative air coolers shall be completely drained.

**H 203.7 Ice Machines.** Ice machines shall be flushed and maintained in accordance with ASHRAE 188.

**H 203.8 Spas and Hot Tubs.** Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer's recommendations.

**H 203.9 H 203.4 Decorative Water Features.** Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer's instructions and the Authority Having Jurisdiction.

**H 203.10 H 203.5 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

**SUBSTANTIATION:**
Appendix H has been reviewed for accuracy and to assure that the provisions are enforceable. This appendix is not intended to supersede ASHRAE 188 and Guideline 12. We ask the UPC Committee to consider the following modifications:

- Definitions: The definitions were reviewed for accuracy and to cite ASHRAE 188 where necessary. The definition for “control,” “disinfection,” and “risk” were modified to be consistent with already accepted documents.
- Section 105.2 was revised to include requirements by the AHJ.
- Section 105.3.1 was revised as the manufacturer’s instructions will not contain requirements for thermal shock.
- Section 105.3.2 was revised to reference the correct Section.
- Section 105.4 and 105.6 are being deleted as such language is unenforceable. Furthermore, the initial procedures require 30 minutes for control measures so it should be deleted.
- Section 201.4 is being revised by removing the reference to Figure H 201.5 as there is no such figure in the appendix.
- In Table 201.5, “cooling tower” needs to be removed as such table can be used for all mechanical systems.
- Section 202.3 is being deleted as the term “low” is unenforceable.
- Section 202.4 is being revised as such provisions is already a requirement in the code.
- Section 202.6 is being revised to correlate with Chapter 11 of the UMC.
• The shutdown period is being revised from 3 days to 5 days to be consistent with accepted industry practices.
• Section 202.9 is being revised as the Committee determined that ASHRAE 188 and Guideline 12 cannot be enforced by AHJs as written.
• Section 202.10 is being revised by adding an additional requirement for microbiological control to be within 0.5 to 1.0 to be consistent with current acceptable practices. Sections 202.11, 202.12, 202.14, 202.15, and 203.5 are being revised as the current language goes beyond minimum code language and is enforceable.
• Sections 203.2, 203.3, 203.4, 203.7 and 203.8 are being revised as such requirements do not provide any additional requirements.

The remaining sections have been reviewed for accuracy and for enforcement. The UMC TC asked for such language to be provided and rightfully so. However, the language needed some improvements, and this comment makes the improvements needed. The Committee has previously requested for such an appendix because of issues with enforcing ASHRAE 188 and Guideline 12 as written. I believe that these modifications will be well received by the industry. Jurisdictions looking for the correlation between water temperature, CFU, and Legionella can obtain such provisions with the revised appendix, with using ASHRAE 188 and Guideline 12 if they chose to do so. This appendix can be utilized with those other recognized materials.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: H 101.1, Table 1801.2  Item #: 323
SUBMITTER: Daryn Cline  EVAPCO, Inc.

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

H 101.1 Applicability. Part I of this appendix provides guidelines on the impact of water temperature in minimizing Legionella growth potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella.

Note: Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
<td>Risk Management</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The ASSE Series 12000 professional qualifications has been deleted from this section. Requiring this certification is in direct conflict with ASHRAE Standard 188 which is also referenced in this same standard.

Per ASHRAE Standard 188-2021:

4. COMPLIANCE
The results of each Section 4 compliance determination and the associated building survey in Section 5 shall be documented and shall be physically or electronically on site for review by the authority having jurisdiction (AHJ). This standard does not use or require compliance, training, or certification in any additional hazard analysis, risk assessment, or risk management methodologies.
Okay to reference ASHRAE 188-2018 and ASHRAE Guideline 12-2020 but not in the same table with the ASSE Series 12000-2018, since ASHRAE 188 does not require certification requirements.

PUBLIC COMMENT 3
Code Year: 2024 UMC  Section #: H 104.1, Figure H 104.1, H 201.1
Item #: 323
SUBMITTER: Daryn Cline
EVAPCO, Inc.

RECOMMENDATION:
Delete text without substitution
Request to accept the code change proposal as modified by this public comment.

H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential:

(renumber remaining sections)

H 201.1 Applicability. Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems:

(renumber remaining sections)

For SI units: °C = (°F - 32) / 1.8
* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

FIGURE H 104.1
WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL*

SUBSTANTIATION:
Recommend deleting Section 104.1 Legionella Growth Potential in its entirety. This section assumes that if water is in the temperature range shown in Figure H 104.1 it will have legionella in it. Based on the Water Management Plan developed, which shall include municipal water quality that is supplying all the mechanical systems, testing may
need to be performed to verify.

Section H 201.1 does not cover all water using devices that could harbor legionella, notably missing showerheads and hot water heaters, and does not consider the incoming water quality as the source of the buildings legionella bacteria. The bundling of so many different water systems in this section shows a lack of discernment on the differences these systems represent in terms of actual risk. The risk of aspirating Legionella bacteria from an ice maker is fundamentally different than the risk of inhaling Legionella bacteria from a municipal wastewater treatment plant. Recommend deleting this section.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 4

Code Year: 2024 UMC  Section #: H 104.1  Item #: 323

SUBMITTER: Daryn Cline
EVAPCO, Inc.

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in the municipal or a building water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.

SUBSTANTIATION:
It is not clear what the definition is of a “water system.” I added municipal and building water system. Legionella can and does grow in the public water distribution system at the temperatures shown in Figure H 104.1.

[Supporting documentation is provided in KAVI for TC review]

PUBLIC COMMENT 5

Code Year: 2024 UMC  Section #: H 201.4  Item #: 323

SUBMITTER: Daryn Cline
EVAPCO, Inc.

RECOMMENDATION:
Delete text without substitution

Request to accept the code change proposal as modified by this public comment.

H 201.4 Water Sampling. An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.

SUBSTANTIATION:
Creates a very slippery slope for all building owners as it requires “samples from a source capable of being contaminated with Legionella bacteria…” Researchers in Japan have found Legionella bacteria in outdoor surface puddles following rain fall. Shall a building owner be required to test puddles in their parking lot? Municipal water supplies are known to be capable of being contaminated with Legionella bacteria. How many points in their treatment process and distribution system might be enough sampling for them? Produce misters in grocery stores are known to be capable of being contaminated with Legionella bacteria. Is the risk from this system the same as the risk from an ice machine serving immune compromised patients at a health care facility? Delete this section, sampling shall only be performed based on the requirements of the water management plan.
Appears to refer to any water source capable of being contaminated with Legionella bacteria. If this is the intent, Table H 201.5.1 is inadequate to cover all the possible water sources or even the water sources specifically noted in H 201.1. Additional sampling and testing for Legionella bacteria has failed to demonstrate a reduction in either risk or rates of Legionnaires’ disease in New York City since additional regulatory burdens were placed on building owners. While there is a clear commercial interest for CDC Elite laboratories and Consultants to promote more frequent testing, there is not clear evidence that adding additional sampling or testing requirement costs on building owners leads to a decrease in disease or outbreaks.

PUBLIC COMMENT 6

Code Year: 2024 UMC Section #: H 201.5 - H 201.5.4, Table H 201.5 Item #: 323

SUBMITTER: Daryn Cline
EVAPCO, Inc.

RECOMMENDATION:
Delete text without substitution

Request to accept the code change proposal as modified by this public comment.

H 201.5 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.4.
H 201.5.1 Levels Less than 10 CFU/ML. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.
H 201.5.2 Levels Between 10 CFU/ML and 100 CFU/ML. Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
H 201.5.3 Levels Between 100 CFU/ML and 1000 CFU/ML. Water samples containing Legionella levels greater than 100 CFU/mL but less than 1,000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.
H 201.5.4 Levels Greater than 1000 CFU/ML. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

(renumber remaining sections)

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>[=10 and &lt;100</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>[=100 and &lt;1000</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td></td>
<td>Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 202.14.</td>
</tr>
<tr>
<td>[=1000</td>
<td>Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td></td>
<td>If retest [=1000 CFU/mL, repeat system decontamination.</td>
</tr>
</tbody>
</table>

*The emergency response plan for cooling towers is addressed in Section H 202.14.*
SUBSTANTIATION:
Sections H 201.5 - H 201.5.4 offer a range of levels based on CFU/ml without specifying Legionella test method. It is well documented that test variation in terms of precision, accuracy, and repeatability exists between test methods and test laboratories. A Fall 2013 article by Dr. William F. McCoy, PhD (also a Member of your UMC Legionella Task Force) offers the following: “Quoting from Sutton: “Microbiology has a well-deserved reputation for being highly variable. Our lax attention to precision and accuracy in our measurements helps further this perception. We have allowed specifications for environmental monitoring, raw material bioburden, in-process bioburden, and finished product bioburden to be imposed by regulation without regard for the ability of the methods to support these specifications.”” Portions of H 201.5, as currently written, would perpetuate both the concern raised by Sutton and a trend of ‘making up’ simplified remediation action levels without regard to test method, water source, equipment design, or risk.

Table H 201.5, as proposed, is overly simplistic and demonstrates a clear lack of understanding regarding evaporative cooling equipment, Legionella bacteria testing capabilities, and risk. A technically defensible table would include differentiation in both CFU/ml and Remediation Action based on age of equipment, efficiency of drift eliminators, Legionella bacteria sero group, and possibly Legionella bacteria test method. As one example of a better approach, the committee should review Legionella Report Interpretations and Recommendations offered by Environmental Safety Technologies.

Dr. William McCoy’s Fall 2013 article referenced in an earlier comment helps to explain why Table H 201.5 will create unnecessary ‘do loop work’ for building owners without providing an actual reduction in risk. For Example “A facility manager was responsible for two cooling water systems, A and B.

The test result from System A indicated 121 CFU/ml Legionella. In response, the facility manager reacted aggressively. Upper management was notified about potentially hazardous conditions in system A. An expensive and disruptive “remediation” of the system was undertaken.

Meanwhile, the test result obtained from system B was 24 CFU/ml Legionella. In response, the facility manager took no action because the result was “well below” the action level trigger.

There was no scientifically defensible difference between test results from system A and system B. Therefore, based on a misunderstanding about the precision of the method, aggressive action was taken for one system while no action was taken for the other system.”

We recommend that this table be deleted.

Evapco has already submitted and recommended that this table be deleted from your code. We are providing the back up documentation which is an article authored by one of your UMC Legionella Task Force committee members, Dr. William McCoy, regarding the absurdity of using extremely low LB test results and the assumption that these are reliable enough to be placed into code to determine risk, using highly variable test methods. He makes a great point about finding legionella in various sources but the number of Legionnaires' disease cases do not correlate to the amount of legionella detected. This code has been written to benefit testing and certification agencies, not to reduce cases of Legionnaires' disease.

[Supporting documentation is provided in KAVI for TC review]
H 202.0 Cooling Towers.

H 202.1 General. Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

H 202.2 Risk Factors. The following risk factors shall be identified, assessed, controlled, and monitored:

(1) Stagnant water due to dead legs, intermittent operation, or seasonal usage.

(2) The presence of nutrients or biofilm.

(3) Water temperature within a range that supports microbial growth as specified in Figure H 104.1.

(4) Water exposed to direct sunlight which promotes algae growth.

(5) Water quality, including, but not limited to, the following factors:
   (a) System cleanliness
   (b) pH levels
   (c) Presence of corrosion
   (d) Presence of scale and biofouling
   (e) Conductivity levels
   (f) Dissolved and suspended solids
   (g) Control of water treatment chemicals
   (h) Control of bleed-off or blowdown

(6) System size

(7) Physical condition of system

(8) Aerosol generation, dispersion, and drift elimination

(9) System site location

(10) Access for inspection, cleaning, and maintenance

(11) Concentration of Legionella as specified in Table H 201.5.

H 202.3 Water Temperature. The system shall be designed to maintain low sump-water operating temperatures.

H 202.4 Drift Eliminators. Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

H 202.5 Side Stream Filtration. When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

H 202.6 Equipment Site Location. The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

(1) Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.

(2) Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.

H 202.7 System Commissioning. System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

H 202.8 System Start-Up and Shutdown. System start-up and shutdown procedures shall include, but not be limited to, the following:

(1) Management of hazardous conditions associated with untreated water, including the following:
   (a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
   (b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   (c) Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

H 202.9 System Maintenance and Inspection. System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

(1) Water treatment system

(2) Louvers

(3) Piping dead legs

(4) Cold water basins

(5) Crossflow hot water basin

(6) Counterflow spray system

(7) Drift eliminators

(8) Fill material and fill air entrance and exit surfaces

(9) Purging of stagnant water or low-flow zones within the basin

H 202.10 Water Treatment. Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

(1) All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The minimum requirements for documenting system water treatment.

**H 202.11 Disinfection.** Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:
1. Online disinfection.
2. Emergency disinfection.

**H 202.12 Water Treatment Chemicals.** Water treatment chemicals, such as biocides, shall be applied using an automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

**H 202.13 Makeup Valves.** The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.

**H 202.14 Emergency Response Plan.** An emergency response plan shall be provided when required by with the Authority Having Jurisdiction and shall include, but not be limited to, the following:
1. Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
2. Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
3. Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
4. Procedures for emergency disinfection.
5. Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

**H 202.15 Control of Bleed-Off.** An automated bleed-off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual bleed-off shall be permitted to be used to control scale or biofouling. The water for bleed-off shall be taken from the return line of the cooling water system to the cooling tower. Bleed-off shall only occur while chemical dosing is turned off.

(renumber remaining sections)

**SUBSTANTIATION:**
The focus on cooling towers to reduce cases of Legionnaires’ disease has not been successful in any jurisdiction where cooling towers have been registered and regulated, including Europe, New York State and New York City. Only a holistic approach to reducing legionella from source water to the treatment plant, the water distribution system, and finally all the water using devices in a building will result in a reduction of Legionnaires’ disease cases.

European and New York and New York City Rates are uploaded under a separate document.

[Supporting documentation is provided in KAVI for TC review]

**PUBLIC COMMENT 8**

**Code Year:** 2024 UMC  **Section #:** H 202.16  **Item #:** 323

**SUBMITTER:** Daryn Cline  
EVAPCO, Inc.

**RECOMMENDATION:**
Delete text without substitution

Request to accept the code change proposal as modified by this public comment.

**H 202.16 Alternative Systems.** Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.
SUBSTANTIATION:
This proposed section to recommend the user evaluate competitive alternatives to cooling towers is considered restraint of trade, and must be removed from the code.

Please provide IAPMO’s scientific basis for the statement that there is no risk using thermal storage (typically has water cooled chilled water loop) and geothermal (water temperature in the growth range of legionella) for no opportunity for legionella to grow.

PUBLIC COMMENT 9

Code Year: 2024 UMC  Section #: H 203.0 - H 203.10, Table H 203.5  Item #: 323

SUBMITTER: Daryn Cline
EVAPCO, Inc.

RECOMMENDATION:
Delete text without substitution

Request to accept the code change proposal as modified by this public comment.

H 203.0 Other Mechanical Systems:

H 203.1 General. Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.

H 203.2 Sand Filters. Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.

H 203.3 Water Softeners. Water softeners shall be installed and maintained in accordance with the plumbing code.

H 203.4 Dehumidifiers. Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.

H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers. Misters, atomizers, air washers, nebulizers, and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.5.

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \geq 1 ) and (&lt; 10 )</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>( \geq 10 )</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
</tr>
</tbody>
</table>

H 203.6 Evaporative Air Coolers. Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.

H 203.7 Ice Machines. Ice machines shall be flushed and maintained in accordance with ASHRAE 188.

H 203.8 Spas and Hot Tubs. Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer’s recommendations.

H 203.9 Decorative Water Features. Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer’s instructions and the Authority Having Jurisdiction.

H 203.10 Water Supply Systems. The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

SUBSTANTIATION:
There is minimal focus on Other Mechanical Systems, compared to cooling towers, but are more of a risk factor. This section has some good elements like referring to ASHRAE Standard 188, which we recommend using for the entire code.
APPENDIX H
IMPACT OF WATER TEMPERATURE ON THE POTENTIAL FOR LEGIONELLA GROWTH
MINIMUM REQUIREMENTS TO ADDRESS LEGIONELLA GROWTH IN MECHANICAL SYSTEMS

Part I—General

H 101.0 General.
H 101.1 Applicability. Part I of this Appendix provides minimum requirements to address guidelines on the impact of water temperature in minimizing Legionella growth in mechanical systems and shall apply to potential associated with occupiable commercial, institutional, multi-unit residential, and industrial building mechanical systems. Legionella control for plumbing systems shall be in accordance with the plumbing code.

This appendix shall not include single-family residential buildings. This appendix shall not be considered a risk management guidance document for scalding or Legionella.

Note: Published documents which address Legionella risk management include ASHRAE 188 or ASHRAE Guideline 12.

H 102.0 Definitions.
H 102.1 General. For the purpose of this Appendix, the following definitions shall apply.

Biofilm. Microorganisms and the slime they secrete that grow on any continually moist surface.

Control. The management to maintain compliance with established criteria.

Disinfection. Chemical or physical control measures or procedures used to kill or inactivate pathogens.

Disinfection, Online. The procedure while the equipment is in operation.

Disinfection, Offline. The procedure while the equipment is not in operation.

Halogenation. A chemical reaction that involves the addition of one or more halogens, including, but not limited to, chlorine, bromine, or iodine, commonly used to disinfect water systems.

Hazard. See Risk.

Legionella Concentrations. The extent of colonization of Legionella measured in Colony Forming Units per milliliter (CFU/mL).

Legionella Growth Potential. The likelihood that Legionella bacteria will reproduce.

Monitor. Observing and checking the progress or quality of (something) or measuring the physical and chemical characteristics of control measures.

Nutrient. Any element or compound essential as a raw material for an organism’s growth and development.

Risk. The potential to cause harm resulting from exposure.

Test. The measurement of the physical, chemical, or microbial characteristics or quality of water.

H 103.0 Building Water Systems and System Equipment Documentation.
H 103.1 Design Documentation. Construction documents shall be required for new construction, renovation, refurbishment, replacement, or repurposing of an occupiable building water system, including a water management plan, and shall be submitted to the Authority Having Jurisdiction.
H 103.2 Onsite Documentation. Documentation shall be maintained onsite and shall be readily accessible to the Authority Having Jurisdiction.

H 104.0 Potential Exposure.
H 104.1 Legionella Growth Potential. The Authority Having Jurisdiction shall have the authority to require documentation to address Legionella growth potential, where water temperatures in a water system are within ranges shown in Figure H 104.1 that pose a Legionella growth potential.
H 104.2 Scald Potential. Where the water system’s temperature(s) range pose(s) a scald potential, protection shall be provided in accordance with the plumbing code.

For SI units: °C = (°F - 32)/1.8

* Temperature ranges reported are experimentally determined in a laboratory setting in the absence of a realistic microbial community. Legionella can survive for longer periods of time at temperatures higher and lower than the growth temperature ranges indicated due to changes in their metabolic state and/or protection from thermal disinfection within biofilm or amoeba host organisms.

FIGURE H 104.1
WATER TEMPERATURE RANGES AND LEGIONELLA GROWTH POTENTIAL*

H 105.0 Disinfection.
H 105.1 Disinfection Documentation. Where required by the Authority Having Jurisdiction, documentation for disinfection of building mechanical systems shall be provided by the registered design professional in the construction documents.
H 105.1.1 Copper-Silver Ionization. Copper-silver ionization methods and procedures shall include the following documentation:
(1) Copper and silver ionization concentrations.
(2) Methods and documentation for monitoring ion levels.
(3) Electrode cleaning cycles and methods.
H 105.1.2 Ultraviolet Light. Ultraviolet light methods shall include the following documentation:
(1) Locations of ultraviolet light units.
(2) Cleaning cycles and methods of the quartz sleeves and housing.
H 105.2 Chemical Disinfection. Chemical biocide treatment shall be permitted to be used in accordance with the following:
(1) Oxidizing biocides in accordance with manufacturer’s guidelines.
(2) Non-oxidizing biocides in accordance with manufacturer’s guidelines.
(3) Alternating the use of different types of biocides, dose, and frequency is recommended.
(4) These treatment methods can be used for continuous, online disinfection or shock treatment online or offline.
H 105.3 Non-Chemical Treatment. Non-chemical treatment devices shall be permitted to be used in accordance with manufacturer’s guidelines.
H 105.3.1 Thermal Shock. Thermal treatment using heat shock at 158°F (70°C) for 30 minutes shall be permitted in accordance with applicable guidelines and the manufacturer’s instructions.
H 105.3.2 Physical Cleaning. When implemented, physical cleaning shall only be performed as an offline method and shall be performed before the chemical disinfection methods in Section 105.1 have been performed. Building outdoor air intakes shall be closed during physical cleaning prior to commencing. Physical cleaning shall be in accordance with the manufacturer’s instructions.
**H 105.4 Inspection and Maintenance.** The system shall be monitored and maintained to prevent scale buildup, sediment, corrosion, and biofouling.

**H 105.5 Frequency of Cleaning and Disinfection.** Where a water management plan is implemented, the frequency of cleaning and disinfection logs shall be readily accessible to the water management team and the Authority Having Jurisdiction.

**H 105.6 Control Measures.** Evaluation of control measures for Legionella shall consider potential unintended consequences of such measures that may affect overall health risk, including the formation of toxic disinfection byproducts (whether regulated or unregulated), resultant increase in other plumbing-associated pathogens, and scalding.

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**Part II—Minimizing Legionella Growth Potential in Cooling Towers and Other Mechanical Systems.**

**H 201.0 General.**

**H 201.1 Applicability.** Part II of this appendix applies to water sources that frequently provide optimal conditions for growth of Legionella organisms in accordance with Figure H 104.1, including, but not limited to, cooling towers, evaporative condensers, decorative water features, filters, ice makers, evaporative air coolers, fluid coolers that use evaporation to reject heat, industrial processes that use water to remove excess heat, industrial and municipal waste treatment plants, and other mechanical systems.

**H 201.2 Water Management Plan, Where Required.** A water management plan shall be established when required by the criteria of the Authority Having Jurisdiction.

**H 201.3 Water Management Plan, Where Implemented.** Where a water management plan is implemented, the plan shall be in accordance with the following:

1. Determine a water management plan team.
2. Provide description of the building’s water system.
3. Identify areas of Legionella growth potential in accordance with temperature ranges as shown in Figure H 104.1.
4. Determine applicable control measures and monitoring procedures.
5. Ensure the water management plan is effective and operating as designed.
6. Document and communicate all the activities of the water management plan.

**H 201.4 Water Sampling.** An analysis of water samples from a source capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table H 201.5 and Figure H 201.5.

**H 201.5 Legionella Test Levels.** A means of controlling Legionella shall be established in accordance with applicable levels as stated in Section H 201.5.1 through Section H 201.5.4.

**H 201.5.1 Levels Less than 10 CFU/mL.** Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment plan in accordance with Table H 201.5.

**H 201.5.2 Levels Between 10 CFU/mL and 100 CFU/mL.** Water samples containing Legionella levels greater than 10 CFU/mL but less than 100 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

**H 201.5.3 Levels Between 100 CFU/mL and 1000 CFU/mL.** Water samples containing Legionella levels greater than 100 CFU/mL but less than 1000 CFU/mL shall require the water treatment plan to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL in accordance with H 201.4.14.

**H 201.5.4 Levels Greater than 1000 CFU/mL.** Water samples containing Legionella levels greater than 1000 CFU/mL shall require the water treatment plan to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table H 201.5.

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**TABLE H 201.5**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment plan.</td>
</tr>
<tr>
<td>&gt;=10 and &lt;100</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination.</td>
</tr>
<tr>
<td>&gt;=100 and &lt;1000</td>
<td>Review water treatment plan, institute immediate online decontamination, and retest water 3 to 7 days after decontamination. Prepare to execute emergency response plan in case Legionella levels reach over 1000 CFU/mL.</td>
</tr>
</tbody>
</table>
The emergency response plan for cooling towers is addressed in Section H 202.14.

Review water treatment plan, notify Authority Having Jurisdiction (if required), institute immediate online disinfection, and retest water 3 to 7 days after decontamination.

If retest \( \geq 1000 \text{ CFU/mL} \), repeat system decontamination.

H 201.6 Air Sampling. Air sampling for Legionella shall not be used as a means of measuring potential Legionella exposure.

H 202.0 Cooling Towers.

H 202.1 General. Cooling towers shall be installed, maintained, and tested as required by this Appendix and the Authority Having Jurisdiction.

H 202.2 Risk Factors. The following risk factors shall be identified, assessed, controlled, and monitored:

1. Stagnant water due to dead legs, intermittent operation, or seasonal usage.
2. The presence of nutrients or biofilm.
3. Water temperature within a range that supports microbial growth as specified in Figure H 104.1.
4. Water exposed to direct sunlight which promotes algae growth.
5. Water quality, including, but not limited to, the following factors:
   a. System cleanliness
   b. pH levels
   c. Presence of corrosion
   d. Presence of scale and biofouling
   e. Conductivity levels
   f. Dissolved and suspended solids
   g. Control of water treatment chemicals
   h. Control of bleed-off or blowdown
6. System size
7. Physical condition of system
8. Aerosol generation, dispersion, and drift elimination
9. System site location
10. Access for inspection, cleaning, and maintenance
11. Concentration of Legionella as specified in Table H 201.5.

H 202.3 Water Temperature. The system shall be designed to maintain low sump-water operating temperatures.

H 202.4 Drift Eliminators. Drift eliminators shall be installed in accordance with Section 1126.0, Section E 403.2, and Section E 403.5.1; and shall be accessible to allow inspection, maintenance, and cleaning of internal components.

H 202.5 Side Stream Filtration. When suspended solids are visible in the cooling tower water system, side stream filtration shall be permitted to be used to control suspended solids in cooling tower circulating water. Makeup water quality, design of cooling tower fill, recirculation rate, and total system volume shall be included in the design of such equipment.

H 202.6 Equipment Site Location. The site location of new or replacement open- or closed-circuit cooling towers or evaporative condensers shall be in accordance with the following:

1. Shall not be located where contamination from building systems or facility processes can be drawn into the equipment. Equipment shall be installed no less than 10 feet (3048 mm) away from building exhaust or plumbing vents.
2. Shall not be located where equipment discharges into occupied spaces, roadways, walkways, outdoor air intakes, and building openings. Equipment shall be installed no less than 10 feet (3048 mm) away from building intakes or plumbing vents.

H 202.7 System Commissioning. System commissioning shall include procedures for cleaning of the cooling system. Ongoing water treatment in accordance with Section H 201.5 shall be initiated once the system is charged with water.

H 202.8 System Start-Up and Shutdown. System start-up and shutdown procedures shall include, but not be limited to the following:

1. Management of hazardous conditions associated with untreated water, including the following:
   a. Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than 3 days, or the duration specified by the water management plan.
   b. Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   c. Start-up from an undrained or stagnant system that exceeds 3 days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

H 202.9 System Maintenance and Inspection. System components requiring maintenance and inspection shall be accessible. A schedule for maintenance and inspection of system shall be included in the water management plan.
documents. Cooling tower maintenance and inspection shall include, but not be limited to, the following areas:

1. Water treatment system
2. Louvers
3. Piping dead legs
4. Cold water basins
5. Crossflow hot water basin
6. Counterflow spray system
7. Drift eliminators
8. Fill material and fill air entrance and exit surfaces
9. Purging of stagnant water or low-flow zones within the basin

H 202.10 Water Treatment. Water treatment shall control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

1. All equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
2. The minimum required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
3. The minimum requirements for documenting system water treatment.

H 202.11 Disinfection. Methods for disinfection of cooling towers shall include, but not be limited to, the halogenation methods and procedures for flushing and disinfection in accordance with Section 1122.0 and for reclaimed (recycled) and onsite treated nonpotable water in accordance with Section E 403.5.2.

The responsible person for initiating disinfection shall be identified in the water management plan documents and the disinfection process shall include the following:

1. Online disinfection.
2. Emergency disinfection.

H 202.12 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system at regular intervals. The frequency and quantity of chemical dosing shall be based on the microbial activity of the system and the chemical parameters of the circulating water.

H 202.13 Makeup Valves. The location of cooling tower makeup valves shall be in accordance with the registered design professional construction documents and approved by the Authority Having Jurisdiction. Makeup valves shall be provided with backflow prevention in accordance with ASME A112.1.2 for air gaps or backflow preventers in accordance with the plumbing code.

H 202.14 Emergency Response Plan. An emergency response plan shall be provided when required by the Authority Having Jurisdiction and shall include, but not be limited to, the following:

1. Procedures to be followed if there are cases of Legionellosis associated with the use of cooling towers or evaporative condensers.
2. Procedures to be followed if cooling towers or evaporative condensers reach Legionella levels of 1000 CFU/mL or greater.
3. Testing for Legionella shall be performed. Procedures shall include the type of tests to be performed, sampling, and the interpretation of test results.
4. Procedures for emergency disinfection.
5. Procedures for other actions identified by the water management plan to prevent exposure to contaminated water.

H 202.15 Control of Bleed-Off. An automated bleed off, or blowdown, system shall be used to remove water from the system and replace with makeup water to limit the concentration of dissolved and suspended solids. Additional manual bleed off shall be permitted to be used to control scale or biofouling. The water for bleed off shall be taken from the return line of the cooling water system to the cooling tower. Bleed off shall only occur while chemical dosing is turned off.

H 202.16 Alternative Systems. Alternative systems and technologies that do not pose microbial risk and do not provide the opportunity for Legionella bacteria to grow shall be evaluated, including but not limited to off-peak thermal storage and geothermal coupled options.

H 203.0 Other Mechanical Systems.

H 203.1 General. Other mechanical systems and portions thereof shall be installed, maintained, and tested as required by this section and the Authority Having Jurisdiction.

H 203.2 Sand Filters. Sand filters shall be maintained or replaced in accordance with applicable guidelines as determined by the Authority Having Jurisdiction.

H 203.3 Water Softeners. Water softeners shall be installed and maintained in accordance with the plumbing code.

H 203.4 Dehumidifiers. Dehumidifiers shall be required in enclosed areas with swimming pools, spas, and hot tubs. Dehumidifiers shall be maintained in accordance with ASHRAE 188 and the manufacturer’s instructions.

H 203.5 Misters, Atomizers, Air Washers, Nebulizers, and Humidifiers. Misters, atomizers, air washers, nebulizers, and humidifiers shall be disinfected in accordance with ASHRAE 188. The minimum remediation action for humidifiers shall be in accordance with Table H 203.5.
### TABLE H 203.5
LEGIONELLA REMEDIATION ACTIONS IN HUMIDIFIERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY-FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTION</th>
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</thead>
<tbody>
<tr>
<td>&gt;=1 and &lt;10</td>
<td>Prompt cleaning and/or biocide treatment of the system.</td>
</tr>
<tr>
<td>&gt;=10</td>
<td>Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.</td>
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</tbody>
</table>

**H 203.6 Evaporative Air Coolers.** Evaporative air coolers shall be completely drained and cleaned in accordance with the manufacturer’s instructions. When not in use, evaporative air coolers shall be completely drained.

**H 203.7 Ice Machines.** Ice machines shall be flushed and maintained in accordance with ASHRAE 188.

**H 203.8 Spas and Hot Tubs.** Spas and hot tubs shall be maintained and tested in accordance with ASHRAE Guideline 12 and cleaned and disinfected in accordance with the manufacturer’s recommendations.

**H 203.9 Decorative Water Features.** Decorative water features shall be maintained in accordance with ASHRAE 188. Decorative water features shall be drained, cleaned, and disinfected in accordance with the manufacturer’s instructions and the Authority Having Jurisdiction.

**H 203.10 Water Supply Systems.** The minimum remediation action for water supply systems shall be in accordance with the plumbing code.

### TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME A112.1-2012 (R2017)</td>
<td>Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)</td>
<td>Fittings</td>
</tr>
<tr>
<td>ASSE Series 12000-2018</td>
<td>Infection Control Risk Assessment for All Building Systems</td>
<td>Risk Management</td>
</tr>
</tbody>
</table>

(portion of table not shown remains unchanged)

**SUBSTANTIATION:**

Ken Mortensen:

Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in proposed Appendix H does not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.

The differences and additions to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements proposed in Appendix H will lead to user confusion and result in no benefit in Legionella reduction. These proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Among the many problems, Appendix H repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without permission. Appendix H causes confusion by “paraphrasing” ANSI/ASHRAE 188 and ASHRAE Guideline 12 language. Appendix H does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix H is overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix H also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX
Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.

These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.

Paul A Lindahl Jr:
Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in proposed Appendix H does not align with ANSI/ASHRAE Standard 188, Legionellosis: Risk Management for Building Water Systems and the supporting document, ANSI/ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems, nor does it align with CTI GDL-159. All of these standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including many who are members of the CTI and then regularly reviewed, updated, and republished as required. In addition, the current version of Standard 188 has been written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. Note also that Standard 188 is structured to allow UMC Appendix H to address legionella growth only in mechanical equipment/systems, separate from legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing Standard 188 and the associated Guideline 12, as well as the existing CTI GDL-159, and the proposed Appendix H will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix H repeats copyrighted Standard 188 and Guideline 12 content without notation as well as causes confusion by “paraphrasing” Standard 188 and Guideline 12 language. In addition, Appendix H does not include all of the mechanical equipment and systems that are covered by Standard 188 and Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed. We also feel that Appendix H is overly prescriptive, taking a “one size fits all” approach to the control of Legionella, including not accounting for regional climatic and regulatory differences in the design of building water systems while at the same time not providing adequate and correct guidance for system operators and local code officials. In addition, many of the requirements in Appendix H also conflict with Standard 188, Guideline 12, and GDL-159. Finally, the cooling tower requirements, many of which were extracted from existing local codes, have not proven successful in reducing cases of legionnaires’ disease in the areas where they have been adopted. This failure demonstrates that the primary causes of Legionellosis are not being addressed, including the quality of the incoming water from the utility and other sources of the bacteria.

This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]

Emily Toto:
The text in proposed Appendix H does not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is
structured to allow UMC Appendix H to address legionella growth only in mechanical equipment/systems, separate from legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix H will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix H:
1. repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
2. causes confusion by "paraphrasing" ANSI/ASHRAE 188 and ASHRAE Guideline 12 language;
3. does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed.
4. does not include adequate and proper guidance for the operators or AHJ;
5. contains requirements that are overly prescriptive;
6. contains guidance and requirements that are incorrect or incomplete;
7. contains requirements and guidance that conflict with ANSI/ASHRAE 188 or ASHRAE Guideline 12;
8. contains requirements and guidance that do not take into account regional climatic and regulatory differences in the design of cooling systems and their associated plumbing systems; and
9. contains cooling tower requirements that have been shown in at least one large jurisdiction to be ineffective in reducing cases of legionnaires' disease.

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix H into the UMC as originally proposed by the Legionella Task Group.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and Legionella Task Group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO on this important project.

PUBLIC COMMENT 11

Code Year: 2024 UMC  Section #: Appendix H, Table 1801.2  Item #: 323

SUBMITTER: Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires' Disease  Comment #: 11

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Greg Lowman:
See the attached letter dated January 3, 2022. The body of the letter is posted below for reference:

On behalf of Baltimore Aircoil Company, I'd like to register our objection to the proposed changes to the Uniform Plumbing Code and the Uniform Mechanical Code associated with legionella and evaporative heat rejection equipment.

After reviewing the proposed code changes and addendums to the code, our objections are based on the following:

• The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

• The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross
section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

- Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

- Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn’t just materialize, it is introduced predominantly through incoming water.

- The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’ disease by joining the growing number of organizations working to ensure legionella-free water is reliably and consistently delivered to all residents and users.

[Supporting documentation is provided in KAVI for TC review]

**Daryn Cline:**

The submitter’s Substantiation from the original proposal, as shown below, does not have sufficient justification to warrant the change:

“The purpose of the new Appendix H is to establish minimum Legionellosis risk management requirements for building mechanical systems. Cooling towers’ potential for spreading Legionella bacteria is especially pressing given the associated diseases’ symptomatic similarities to COVID-19 and the propensity they have for exacerbating respiratory illnesses.”

The substantiation provided to justify this Appendix H is based on opinion, not facts. It is extremely weak, and singling out cooling towers, while not looking at all water sources potential to spread legionella is placing the public health at risk. There is no correlation between cooling towers and the similarity of symptoms between Covid and Legionnaires' disease. There are many other exacerbating factors for respiratory illness including pollution, allergens, existing symptoms, weather and general health. Weak justification for this appendix.

**Marcy Savage:**

The Alliance to Prevent Legionnaires’ Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires' disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully
protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires' disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]
APPENDIX J
THE SAFE OPERATION, CLOSURE AND RESTARTING OF COOLING TOWERS

J 101.0 General.
J 101.1 Applicability. The provisions of this appendix address risk management practices of mechanical systems for safe operation during normal operation, interruption to normal operation (system shutdown), and restarting of cooling towers.
J 101.2 Building Water Systems. This appendix shall be applicable to building water systems for cooling towers.
J 101.3 Building Types. This appendix shall be applicable to the following building types:
(1) Non-residential (low- and high-rise)
   (a) Office buildings
   (b) Mercantile (seasonal retail)
   (c) Schools/dormitories
   (d) Hotels/motels
   (e) Assemblies
   (f) Healthcare facilities
(2) Residential
   (a) All except single and double family residence

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:
Building Water. Water collected, conveyed, circulated, stored, drained, or discharged by building plumbing systems for use in and around buildings.
Building Water Systems. Potable and non-potable water systems in the building, or on-site.
Normal Operation. The state of a building water system when the building is open and being used as intended. This includes the normal hours of operation and the number of people that occupy the building.
Risk. The potential for harm to humans resulting from exposure to Legionella.
Risk Management. Systematic activities to reduce risk.
System Restarting. The set of actions that should be taken to ready a mechanical system for normal operations after an extended period of no or limited operations.

SUBSTANTIATION:
General: The new appendix will identify the standards for risk management of building mechanical systems specifically associated with cooling towers. Legionnaires' disease linked to aerosolization of contaminated water vapor from cooling towers has increased in recent decades, and these standards are presented to provide reasonable control measures established for Legionella levels.

Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Appendix F  Item #: 324

SUBMITTER: Kristy Egg, Egg Geo; Dr. Janet E. Stout, PhD, Special Pathogens Laboratory; James Kemper, LADWP  Comment #: 1

RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

APPENDIX F
THE SAFE OPERATION, CLOSURE, AND RESTARTING OF COOLING TOWERS

F 101.0 General.
F 101.1 Applicability. The provisions of this appendix address risk management practices of mechanical systems for safe operation during the normal operation, interruption to normal operation (system shutdown), and restarting of cooling towers.
F 101.2 Building Water Systems. This appendix shall be applicable to building water systems for cooling towers.
F 101.3 Building Types. This appendix shall be applicable to the following building types:
(1) Non-residential (low- and high-rise)
(a) Office buildings
(b) Mercantile (seasonal retail)
(c) Schools/dormitories
(d) Hotels/motels
(e) Assemblies
(f) Healthcare facilities
(2) Residential
(a) All except single and double two-family residences

F 201.0 Definitions.
F 201.1 General. For the purpose of this appendix, the following definitions shall apply:
Building Water. Water collected, conveyed, circulated, stored, drained, or discharged by building plumbing systems for use in and around buildings.
Building Water Systems. Hot and cold potable water system and non-potable water systems in the building, or on-site. [ASHRAE 188:3]
Disinfectant. Chemical agent or physical treatments used to kill or inactivate pathogens microorganisms. [ASHRAE 188:3]
Disinfection. The process of killing or inactivating pathogens microorganisms. [ASHRAE 188:3]
Legionella. The name of the genus of bacteria that can cause a pneumonia called Legionnaires’ disease or a flu-like illness called Pontiac fever when inhaled, aspirated or directly introduced into the lungs of susceptible individuals. It is a common aquatic bacteria found in natural and building water systems, as well as in some soils.
Legionellosis. The term used to describe Legionnaires’ disease, Pontiac fever, and any illness caused by exposure to Legionella bacteria. [ASHRAE 188:3]
Monitoring. Conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures. [ASHRAE 188:3]
Normal Operation. The state of a building water system when the building is open and being used as intended. This includes the normal hours of operation and the number of people that occupy the building.
Risk. The potential for harm to humans resulting from exposure to Legionella. [ASHRAE 188:3]
Risk Management. Systematic activities to reduce risk. [ASHRAE 188:3]
System Reopening. The set of actions that should be taken to ready a building for normal operations after an extended period of no or limited operations.
System Restarting. The set of actions that should be taken to ready a mechanical system for normal operations after an extended period of no or limited operations.
Water Management Program Plan (WMP). A risk management plan to help building managers identify risks to water quality and establish clear guidelines for managing these risks at various points in the building lifecycle, including start up, normal operation, under occupancy, water system shutdown, and water system restart. Such programs are often focused
on Legionella risk prevention and are required in some states for certain building types to combat waterborne pathogens such as Legionellosis. A plan to reduce the risk of Legionella growth and spread.

F 301.0 Normal Operation, Cooling Towers.

F 301.1 General. The normal operation of cooling towers shall be in accordance with Appendix H of this code.

F 301.2 Water Management Program, Cooling Towers. For each cooling tower system, the owner shall have a maintenance program and plan prepared by a qualified person in accordance with ASHRAE 188, the manufacturer’s instructions, and the requirements of this section.

The plan shall be kept current and amended by a qualified person or building owner designee as needed to reflect any changes in the management and maintenance team, system design, operation or system control requirements for the cooling tower system. The plan shall be kept in the building where a cooling tower or cooling tower system is located, or in an adjacent building or structure on the same location and shall be made available to the Authority Having Jurisdiction for inspection.

The water management program shall include, but not be limited to, the following:
(1) Management and maintenance team. Identification, including names and contact information (such as mail, email addresses and telephone numbers) and description of the function of each person on the cooling tower system management and maintenance team, including:
(a) The owner of the building where each cooling tower system is located, and any manager or other person designated by the owner as responsible for compliance with the requirements of the Authority Having Jurisdiction.
(b) Person designated by the owner as a responsible person, as defined by the Authority Having Jurisdiction.
(c) Consultants, service company and qualified person who cleans, disinfects, delivers chemicals or services the cooling tower system.
(d) The purpose of the cooling tower system and seasonal or year round operation including start and end date, if applicable. For systems with multiple cooling towers, conditional operation, such as cycling or scaling related to cooling demand, shall also be noted.
(e) The identification and/or registration number for each cooling tower where required by the Authority Having Jurisdiction.
(f) The cooling tower manufacturer, model number and serial number, if applicable.
(g) Flow diagram or schematic of the cooling tower system, identifying all of the principal components and appurtenances of the cooling tower system including makeup water and waste stream plumbing locations.
(2) Risk management assessment. The assessment shall identify risk factors for Legionella proliferation and specify risk management procedures for all or parts of each cooling tower system, and anticipated conditions including:
(a) Any dead legs or stagnant water in the recirculation system.
(b) Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three days, including idling or low circulation while not being fully drained.
(c) System parts that require continual operation throughout the year making regular, periodic offline cleaning and disinfection difficult.
(d) Any components that may add additional risk factors for organic material buildup and microbial growth such as strainers and out-of-use filters.
(e) Sources of elevated organic contamination, including, but not limited to windblown debris, bird waste and plant material.
(f) Design configurations that present risk of direct sun exposure on basin, deck or fill.
(g) Ventilation intakes or other routes for human exposure to cooling tower aerosols.
(h) System components adversely affecting water quality management procedures.
(i) Other risks or limiting factors or constraints in the cooling tower system’s design and functioning.
(3) Cooling tower operation:
(a) Control measures, corrective actions, documentation, including a written checklist for routine monitoring, and reporting as required by the Authority Having Jurisdiction, and any routine maintenance activities recommended by the manufacturer’s instructions, including performance measures, which may sufficiently demonstrate adequate implementation of the operation requirements described in the maintenance program and plan. Where there is a conflict between the requirements of this section and the manufacturer’s instructions, the maintenance program and plan shall reflect the most stringent requirement.
(b) Specific, detailed seasonal and temporary shutdown and start up procedures.
(c) Notification and communication strategies among management and maintenance team members regarding the required corrective actions in response to process control activities, monitoring, sampling results and other actions taken to maintain the cooling tower system.

F 301.3 Water Treatment and Filtration Equipment. Water treatment and filtration of cooling towers shall be in accordance with Section F 301.3.1 through Section F 301.4.1.1.

F 301.3.1 Water Treatment. Water treatment shall be provided to control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:

(1) Equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The requirements for documenting system water treatment.

F 301.3.2 Disinfection. The responsible person for initiating disinfection shall be identified in the water management program and the disinfection process shall include the following:

(1) Online disinfection:
(2) Emergency disinfection.

F 301.3.3 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system, where possible, at regular intervals. The frequency and quantity of chemical dosing shall be defined in the water management program, and performed accordingly, based on the microbial activity of the system and the chemical parameters of the circulating water.

Prior to changing an existing chemical treatment system or introducing a new chemical treatment agent, cooling tower design, installation, operation, and maintenance shall be evaluated by a qualified person or building owner designer to ensure compatibility between the chemicals and the cooling tower system’s materials, and to minimize microbial growth and the release of aerosols.

The evaluation shall describe the optimum level of chemicals required to achieve the desired result in a manner which can be used as a system performance measure.

(1) Daily automatic treatment while in operation. Water in a cooling tower system shall be treated at least once a day when the system is in operation and such treatment shall be automated, unless the water management program and plan explicitly state how manual or less frequent biocide additions will provide effective control of Legionella growth.
(2) Recirculating system. A cooling tower system shall be operated and programmed to continually recirculate the water, irrespective of the building’s cooling demand of the system.

Exception: Where the water management program specifies in detail how the intended water treatment schedule will be carried out, and how effective biofilm and microorganism control will be achieved when the whole or a part of the system is idle during the scheduled chemical injection.

(3) Chemicals and biocides. Chemicals and biocides shall be used in quantities and combinations sufficient to control the presence of Legionella, minimize biofilms, and prevent scaling and corrosion that may facilitate microbial growth. It is recommended that oxidizing chemicals be used as the primary biocide control. For systems where oxidizing chemicals cannot be used as the primary biocide to control the presence of Legionella, building owners shall submit an alternative plan for effective bacteriological control for approval by the Authority Having Jurisdiction.

(a) Bioicide applications. Any person who performs cleaning and disinfection or applies biocides in a cooling tower system shall be a certified person as required by the Authority Having Jurisdiction.
(b) Registered biocides. Only biocide products registered with the Authority Having Jurisdiction may be used to meet the disinfection requirements of this Appendix.
(c) Records. Water treatment records shall be kept for all chemicals and biocides added, noting the purpose of their use, the manufacturer’s name, the brand name, the safety data sheet, the date and time of each addition, and the amount added each week.
(d) Chemical and biocide additions. Chemicals and biocides shall be added in accordance with this appendix and the procedures described in the water management program addressing, as applicable, feeding mechanism, feeding location, frequency, set timer, duration, triggering events, control procedures, and target biocide residuals. Water treatment chemicals and biocides shall be used in accordance with the product label and manufacturer’s instructions.

F 301.4 F 301.2 Water Quality Monitoring. The water management plan shall include water quality monitoring in the cooling tower shall be monitored as follows:

(1) Water quality parameters, including but not limited to pH, temperature, conductivity and biocidal indicators, shall be measured and recorded as specified in the water management program and plan as follows:

(a) Manual measurements as required by the manufacturer’s recommendation and the Authority Having Jurisdiction.
(b) When continuous, automated and/or remote measurements and recordings are used, the water management program and plan shall show how effective measurements of system process control are being monitored.

(2) A bacteriological indicator to estimate microbial content of recirculating water shall be collected and interpreted in accordance with Table F 301.4(2) at least once each week while the cooling tower system is operating. Indicators shall be taken at times and from water sampling points, as detailed in the water management plan, that will be representative of water microbial content. Indicators may be taken at any time from constant chemical treatment systems. Indicators from systems that use intermittent biocide applications shall be taken before biocide application and reflect normal cooling tower operating conditions.

(3) Legionella culture testing shall be conducted not less than every 90 days during cooling tower system operation. A Legionella sample shall be analyzed by an accredited laboratory where Legionella appears on the laboratory’s scope of
accreditation, or other laboratory approved by the Authority Having Jurisdiction. When required, the test results of all
Legionella bacteria at or above the magnitude of (1000 CFU/mL) as indicated in Table F 301.4(1) shall be reported to the
Authority Having Jurisdiction within 24 hours of receiving the test results.
Additional emergency Legionella sampling shall be conducted if any of the following occur:
(a) Power failure, system shutdown, or equipment failure of sufficient duration to allow for growth of bacteria.
(b) Loss of biocide treatment sufficient to allow for growth of bacteria.
(c) Failure of conductivity controls to maintain proper cycles of concentration.
(d) At the request of the Authority Having Jurisdiction upon a determination that one or more cases of legionellosis is or
may be associated with the cooling tower, based on epidemiological data or laboratory testing.
(e) Any time two consecutive bacteriological indicator sample results are above 1000 CFU/mL as indicated in Table
J301.4(1).
(f) Any other conditions specified by the Authority Having Jurisdiction.
(4) System monitoring and sampling locations shall be representative of the entire cooling tower system. The system
shall be operating with water circulating in the system for at least one hour prior to water quality measurements or
collection of samples.
(5) The maintenance program and water management plan shall identify the procedures, responsible parties, required
response time(s) and notification protocol for corrective actions and shall include, at a minimum, corrective actions that
shall be implemented according to the result levels in Table F 301.4(1) F 301.2(1).
F 301.4.1 Water Sampling. An analysis of water samples from a location capable of being contaminated with Legionella
bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms
present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action
shall be in accordance with Table F 301.4(1).
F 301.4.1.1 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with
applicable levels in accordance with the following:
(1) Levels Less than 10 CFU/mL. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to
maintain the established water treatment program in accordance with Table F 301.4(1).
(2) Levels Between 10 CFU/mL and 1000 CFU/mL. Water samples containing Legionella levels greater than 10 CFU/mL
but less than 1000 CFU/mL shall require the water treatment program to be reviewed, institute immediate online
decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table F 301.4(1).
(3) Levels Greater than 1000 CFU/mL. Water samples containing Legionella levels greater than 1000 CFU/mL shall
require the water treatment program to be reviewed, notify Authority Having Jurisdiction, institute immediate online
disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table F 301.4(1).

F 401.0 Interruption of Normal Operation.
F 401.1 Shutdown Date. When an interruption to normal operation occurs (system shutdown), a shutdown date shall be
established prior to shutting down a cooling tower. A shutdown date of a cooling tower shall be a date after which the
cooling tower is unlikely to be restarted for the season. Where shutdown of the cooling tower is required, a shutdown
date shall be determined, and the requirements of Section F 401.1.1 through and Section 401.1.4 F 401.1.2 shall be
completed.
F 401.1.1 Reduce Solids and Sterilize the System. The water management plan shall include procedures for draining,
inspection and cleaning of the system. Where an interruption to normal operation occurs, the following actions shall be
performed:
(1) The cooling tower fill, sump, heat exchangers, chillers, and piping shall be drained.
(2) The system shall be cleaned as required by the manufacturer's instructions.
(3) The system shall be inspected, and maintenance shall be performed as required by the manufacturer.
(4) The controllers shall be taken offline.
(5) The protective probes shall be removed.
(6) The tower fill and sump shall be drained.
(7) The heat exchangers, chillers and piping shall be drained and protected in accordance with the manufacturer's
instructions.
F 401.1.3 Refill, Flush and Drain the Cooling Tower System. Where an interruption to normal operation occurs, the
following additional actions shall be performed:
(1) The system shall be refilled.
(2) A nonoxidizing biocide shall be added and recirculated in accordance with the manufacturer's instructions.
(3) The cooling tower shall be fully drained.
Note: It is possible that the cooling tower equipment is drained, but the cooling tower system remains in operation. A
system operating on standby mode is not considered shut down. If water remains in the cooling tower system, the
system is not considered shut down and water must circulate with regular biocide additions and active management.
F 401.1.4 F 401.1.3 Records. Records of all procedures and actions performed shall be kept.
F 501.0 System Shutdown.
F 501.1 General. The water management plan shall include shutdown procedures in accordance Section F 501.2 and Legionella in accordance with Section F 501.3. Cooling towers that are in shutdown mode shall comply with the following:
1. Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three days, including idling or low circulation while not being fully drained.
2. Specific, detailed seasonal and temporary shutdown and start-up procedures.

F 501.2 Shutdown Procedures. System start-up and shutdown procedures shall include, but not be limited to, the following:
1. Management of hazardous conditions associated with untreated water, including the following:
   a. Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system drainage for shutdown periods longer than three five days, or the duration specified by the water management plan.
   b. Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
   c. Start-up from an undrained or stagnant system that exceeds three five days, or the number of idle days specified by the water management plan or the manufacturer’s recommendations.

F 501.3 Legionella Prevention. The mechanical hydronic system shall be checked that it is safe to use after a prolonged shutdown to minimize the risk of Legionnaires’ disease and other diseases associated with water.

Note: Stagnant or standing water in a mechanical hydronic system can increase the risk for growth and spread of Legionella and other biofilm-associated bacteria. When water is stagnant, hot water temperatures can decrease to the Legionella growth range 77 °F (25°C) through 110°F (43°C). Stagnant water can also lead to low or undetectable levels of disinfectant, such as chlorine.

F 501.3.1 Maintenance Personnel. When required, personal protective equipment (PPE) shall be provided for maintenance personnel. Maintenance personnel shall wear personal protective equipment in accordance with the facilities’ risk assessment. Respiratory protection may be appropriate in enclosed spaces where aerosol generation is likely. Personal protective equipment shall be used in accordance with all local state and Federal requirements. Where respirators are used, a respiratory protection program in accordance with 29 CFR 1910.134 shall be required.

Note: Maintenance personnel at increased risk of developing Legionnaires’ disease, such as those with weakened immune systems, should consult with a medical provider regarding participation in flushing, cooling tower cleaning, or other activities that may generate aerosols.

F 601.0 System Restart.
F 601.1 Startup Procedures. When a cooling tower has been shut down or left untreated for five or more days, a full startup procedure shall be completed before startup or continuing operation in accordance with the water management plan and shall include the following minimum requirements:
1. Clean the cooling tower through power washing and/or scrubbing, not more than 15 days before the first use, to remove biofilm, scale or other debris. Once cleaned, disinfect with an approved biocide(s) to kill pathogens, such as Legionella.
2. Enlist a qualified person or building owner designee to conduct and document the pre-startup inspection. The required inspection shall be as follows:
   a. Visually assessing the cooling tower system.
   b. Inspecting all components for the presence of contaminants and other adverse conditions.
   c. Checking that the water treatment equipment is working properly.
   d. Records of the procedure shall be completed.
3. Once disinfected, the cooling tower system shall be filled with water and begin circulating biocides and chemicals, as specified in the water management plan. At this point, the system shall be considered operational and shall meet the requirements of the Authority Having Jurisdiction.
4. Collect and analyze a water sample for the presence of Legionella. The sample shall be analyzed by a laboratory as approved by the Authority Having Jurisdiction. Prior to startup, the water quality requirements shall meet the requirements in Section F 301.2. The results shall be interpreted and the actions described in Table F 301.4(2) shall be performed.
5. Startup records of all procedures and actions performed shall be kept on file. Startup records shall include, but not be limited to, the following:
   a. Cooling tower system ID
   b. System startup date
   c. Individual cooling tower startup date (if different than the system startup date)
   d. Dates and procedures for startup cleaning and disinfection
   e. Service provider
   f. Pre-startup inspection
   g. Legionella sampling and test results
   h. Disinfection dose and circulation time
   i. Water monitoring
### Table F 301.4(1)

**LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS**

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment program plan.</td>
</tr>
<tr>
<td>&gt;/=10 and &lt;100</td>
<td>Review water treatment program plan, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection.</td>
</tr>
<tr>
<td>&gt;/=100 and &lt;1000</td>
<td>Review water treatment program plan, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection.</td>
</tr>
<tr>
<td>&gt;/=1000</td>
<td>Review water treatment program plan, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection. If the results of a retest are still &gt;/=1000 CFU/mL, carry out system decontamination.</td>
</tr>
</tbody>
</table>

### Table F 301.4(2)

**CORRECTIVE ACTIONS REQUIRED FOR BACTERIOLOGICAL INDICATOR RESULTS**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>HETEROOTROPIC PLATE COUNT AND DIP SLIDE RESULT (CFU/mL)</th>
<th>PROCESS TRIGGERED BY TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;10 000</td>
<td>Maintain water chemistry and biocide levels.</td>
</tr>
<tr>
<td>2</td>
<td>&gt;/=10 000 to &lt;100 000</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, review treatment program plan, retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this table until level 1 is reached.</td>
</tr>
<tr>
<td>3</td>
<td>&gt;/=100 000 to &lt;1 000 000</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, reviewing treatment program plan, performing visual inspection to evaluate need to perform cleaning and further disinfection. Retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.</td>
</tr>
<tr>
<td>4</td>
<td>&gt;/=1 000 000</td>
<td>Initiate immediate disinfection by increasing biocides within 24 hours. Within 48 hours perform remediation of the tower by hyperhalogenating(^2), cleaning, and flushing. Review treatment program plan, retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.</td>
</tr>
</tbody>
</table>

**Notes:**

1. Performed by an accredited laboratory
2. At a minimum, dose the cooling water system with 5 ppm to 10 ppm free halogen residual for at least 1 hour; pH 7.0 to 7.6

**Note:** There is no evidence that HPC values alone directly relate to human health risk, based on epidemiological studies and a lack of correlation with the occurrence of waterborne pathogens. Threshold concentrations of HPC were selected based on interference with the coliform test and not health-related considerations. HPC is an analytic method used to measure the variety of heterotrophic bacteria that are common in water. Legionella require specialized culture media for isolation and detection, do not grow on the media used for HPC testing, and their presence is not correlated with HPC values. HPC is a useful tool.
for monitoring the efficiency of the water treatment process, measuring bacterial regrowth, and evaluating the function of disinfection systems.

**SUBSTANTIATION:**
Appendix F has been reviewed for accuracy and to assure that the provisions are enforceable. This appendix is not intended to supersede ASHRAE 188 and Guideline 12. We ask the UMC Committee to consider the following modifications:

- **Section 101.1** is being revised for better code language and the title is being revised as the term “safe” is subjective. Furthermore, Section 101.3 is being revised to correlate with commonly used terminology when referencing two-family occupancies.

- **Definitions:** The definitions were reviewed for accuracy and to cite ASHRAE 188 where necessary. The definition for “building water system,” “disinfectant,” “disinfection,” “Legionellosis,” “monitoring,” “risk,” and “risk management” were modified to be consistent with already accepted documents. The term “water management program” was revised to “water management plan” as the program is unenforceable.

- **Section 301.0** should be revised to reference Appendix H for the normal operations of cooling towers. All other provision were found to be unenforceable. These are good for a guidance document but not for a code. However, Section 301.4 was not removed and revised as such requirement can be enforceable if included as part of the water management plan.

- **Sections 401.1 and 401.1.1** were revised by removing unenforceable language. The unenforceable language from Section 401.1.2 was removed. The AHJ will not be looking at operating configurations and conditions; nor be looking at specific details for temporary shutdown.

- **Section 501.3** is being deleted as such provision is unenforceable as the AHJ will not be checking the hydronic systems to minimize Legionellas disease. This should be part of the water management plan.

- **The shutdown period** is being revised from 3 days to 5 days to be consistent with accepted industry practices.

The remaining sections have been reviewed for accuracy and for enforcement. The UMC TC asked for enforceable language to be created. However, the language needed some improvements, and this comment makes the improvements needed. The Committee has previously requested for such an appendix because of issues with enforcing ASHRAE 188 and Guideline 12 as written. These modifications will be well received by Jurisdictions looking for the correlation between water temperature, CFU, and Legionella risk. Jurisdictions can obtain such provisions with the revised appendix, with using ASHRAE 188 and Guideline 12 if they chose to do so. This appendix can be utilized with those other recognized documents.

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**PUBLIC COMMENT 2**

**Code Year:** 2024 UMC  **Section #:** F 101.0 - F 201.1  **Item #:** 324  **Comment #:** 2  **SUBMITTER:** Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires’ Disease; Ken Mortensen, SPX Cooling Technologies

**RECOMMENDATION:** Delete text without substitution

Request to **reject** the code change proposal by this public comment.

**SUBSTANTIATION:**  **Emily Toto:**
Proposed Appendix J (referred to as Appendix F on Cooling Towers in the Pre-Print version) Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since ASHRAE has proposed revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using ANSI/ASHRAE 188, with practice informed by Guideline 12.

ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health
departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix F (formerly J):
1. Repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
2. Causes confusion by “paraphrasing” ANSI/ASHRAE 188 and ASHRAE Guideline 12 language;
3. Does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed.
4. Does not include adequate and proper guidance for the operators or AHJ;
5. Contains requirements that are overly prescriptive;
6. Contains guidance and requirements that are incorrect or incomplete;
7. Contains requirements and guidance that conflict with ANSI/ASHRAE 188 or ASHRAE Guideline 12;
8. Contains requirements and guidance that do not take into account regional climatic and regulatory differences in the design of cooling systems and their associated plumbing systems; and
9. Contains cooling tower requirements that have been shown in at least one large jurisdiction to be ineffective in reducing cases of legionnaires’ disease.

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix J items #324 through #329 into the UMC as originally proposed.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the mechanical systems working group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO this important project.

[Supporting documentation is provided in KAVI for TC review]

Paul A Lindahl Jr:
Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

Proposed Appendix J, also referred to as Appendix F on Cooling Towers in the Pre-Print version, Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE Standard 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ANSI/ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since the CTI has joined with other stakeholders to propose revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using Standard 188, with practice informed by Guideline 12.

Standard 188 and the latest version of Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. Standard 188 and Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. Standard 188 has been subject to continuous maintenance since it was first published in 2015 and Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published
on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of Standard 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. Standard 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing Standard 188 and the associated Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix J repeats copyrighted Standard 188 and Guideline 12 content without notation as well as causes confusion by “paraphrasing” Standard 188 and Guideline 12 language. Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed. We also feel that Appendix J is overly prescriptive, taking a “one size fits all” approach to the control of Legionella, including not accounting for regional climatic and regulatory differences in the design of building water systems while at the same time not providing adequate and correct guidance for system operators and local code officials. In addition, many of the requirements in Appendix J also conflict with Standard 188, Guideline 12, and GDL-159. Finally, the cooling tower requirements, many of which were extracted from existing local codes, have not proven successful in reducing cases of legionnaires’ disease in the areas where they have been adopted. This failure demonstrates that the primary causes of Legionellosis are not being addressed, including the quality of the incoming water from the utility as well as other sources of the bacteria.

This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]

**Greg Lowman:**
See attached letter dated January 3, 2022. Body of the letter posted below:

On behalf of Baltimore Aircoil Company, I’d like to register our objection to the proposed changes to the Uniform Plumbing Code and the Uniform Mechanical Code associated with legionella and evaporative heat rejection equipment.

After reviewing the proposed code changes and addendums to the code, our objections are based on the following:

- The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

- The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

- Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

- Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn’t just materialize, it is introduced predominantly through incoming water.

- The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’
[Supporting documentation is provided in KAVI for TC review]

**Daryn Cline:**
The submitter’s Substantiation from the original proposal, as shown below, does not have sufficient justification to warrant the change:

"General: The new appendix will identify the standards for risk management of building mechanical systems specifically associated with cooling towers. Legionnaires' disease linked to aerosolization of contaminated water vapor from cooling towers has increased in recent decades, and these standards are presented to provide reasonable control measures established for Legionella levels."

Delete Appendix J in its entirety, it is built upon requirements placed on cooling towers used in New York that have not reduced cases of Legionnaires' disease and uses copyrighted language developed by ASHRAE. Requirements are in conflict with ASHRAE developed code language and it will create confusion in the market place.

Please provide the scientific basis for this statement, "Legionnaires’ disease linked to aerosolization of contaminated water vapor from cooling towers has increased in recent decades." There are no studies to validate this statement that the cooling tower industry is aware of that has been independently peer-reviewed. While it is true LD rates have increased the CDC has published work that shows most cases of LD can be traced to potable water systems. 96% of LD cases are sporadic, and associated with potable water. We disagree with your substantiation, and therefore request you drop Appendix J, and focus on the proposals submitted by the Potable Water Working Group chair Gary Klein found in Appendix Q to the UPC which address potable water.

[Supporting documentation is provided in KAVI for TC review]

**Marcy Savage:**
The Alliance to Prevent Legionnaires’ Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires' disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires’ disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.
2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes
and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]

Ken Mortensen:
Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in these proposals for Appendix J do not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.

The differences and additions proposed in Appendix J compared to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements, include: 1) Applicability that is not the same as ASHRAE 188, which were specifically defined by committee experts, 2) Documentation for only one system covered by ASHRAE 188, punitive to evaporative cooling, and 3) Testing and operating procedures in conflict with ASHRAE Guide 12. These proposal will lead to user confusion and result in no benefit in Legionella reduction. Further, these proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Among other problems, Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix J operating procedures are overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix J also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.
These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
Proposals

Item #: 325

UMC 2024 Section: J 201.0 - J 201.1, J 301.0 - J 301.2, Table 1701.2

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

J 301.0 Normal Operation, Cooling Towers.

J 301.1 Legionella. Section J 301.2 through Section J 301.4.1.1 shall apply to cooling towers under normal operation.

Note: Water based mechanical system are generally closed and pressurized and have no potential to affect the health of occupants, except at the cooling tower. Cooling towers can carry Legionella on aerosolized water droplets and infect occupants in and outside of the building.

J 301.2 Water Management Program, Cooling Towers. For each cooling tower system, the owner shall have a maintenance program and plan prepared by a qualified person in accordance with ASHRAE 188, the manufacturer’s instructions, and the requirements of this section. The plan shall be kept current and amended by a qualified person or building owner designee as needed to reflect any changes in the management and maintenance team, system design, operation or system control requirements for the cooling tower system. The plan shall be kept in the building where a cooling tower or cooling tower system is located, or in an adjacent building or structure on the same location and shall be made available to the Authority Having Jurisdiction for inspection.

The water management program shall include, but not be limited to, the following:

1. Management and maintenance team. Identification, including names and contact information (such as mail, email addresses and telephone numbers) and description of the function of each person on the cooling tower system management and maintenance team, including:
   a. The owner of the building where each cooling tower system is located, and any manager or other person designated by the owner as responsible for compliance with the requirements of the Authority Having Jurisdiction.
   b. Person designated by the owner as a responsible person, as defined by the Authority Having Jurisdiction.
   c. Consultants, service company and qualified person who cleans, disinfects, delivers chemicals or services the cooling tower system.

2. Cooling tower system. Identification, specifications and description of each cooling tower system and all components located at a specific address, including:
   a. The number of cooling towers in the cooling tower system.
   b. The location of each cooling tower in relation to the building and the building address, block and lot number.
   c. The dimensions and characteristics of the cooling tower system including total recirculating water volume, cooling tower tonnage, biocide delivery method, flow rate and other key characteristics.
   d. The purpose of the cooling tower system and seasonal or year-round operation including start and end date, if applicable. For systems with multiple cooling towers, conditional operation, such as cycling or scaling related to cooling demand, shall also be noted.
   e. The identification and/or registration number for each cooling tower where required by the Authority Having Jurisdiction.
   f. The cooling tower manufacturer, model number and serial number, if applicable.
   g. Flow diagram or schematic of the cooling tower system, identifying all of the principal components and appurtenances of the cooling tower system including makeup water and waste stream plumbing locations.

3. Risk management assessment. The assessment shall identify risk factors for Legionella proliferation and specify risk management procedures for all or parts of each cooling tower system, and anticipated conditions including:
   a. Any dead legs or stagnant water in the recirculation system.
   b. Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three
days, including idling or low circulation while not being fully drained.
(c) System parts that require continual operation throughout the year making regular, periodic offline cleaning and disinfection difficult.
(d) Any components that may add additional risk factors for organic material buildup and microbial growth such as strainers and out-of-use filters.
(e) Sources of elevated organic contamination, including, but not limited to windblown debris, bird waste and plant material.
(f) Design configurations that present risk of direct sun exposure on basin, deck or fill.
(g) Ventilation intakes or other routes for human exposure to cooling tower aerosols.
(h) System components adversely affecting water quality management procedures.
(i) Other risks or limiting factors or constraints in the cooling tower system's design and functioning.

(4) Cooling tower operation:
(a) Control measures, corrective actions, documentation, including a written checklist for routine monitoring, and reporting as required by the Authority Having Jurisdiction, and any routine maintenance activities recommended by the manufacturer’s instructions, including performance measures, which may sufficiently demonstrate adequate implementation of the operation requirements described in the maintenance program and plan. Where there is a conflict between the requirements of this Section and the manufacturer’s instructions, the maintenance program and plan shall reflect the most stringent requirement.
(b) Specific, detailed seasonal and temporary shutdown and start-up procedures.
(c) Notification and communication strategies among management and maintenance team members regarding the required corrective actions in response to process control activities, monitoring, sampling results and other actions taken to maintain the cooling tower system.

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:
Water Management Program (WMP). A risk management plan to help building managers identify risks to water quality and establish clear guidelines for managing these risks at various points in the building lifecycle, including start-up, normal operation, under occupancy, water system shutdown, and water system restart. Such programs are often focused on Legionella risk prevention and are required in some states for certain building types to combat waterborne pathogens such as Legionellosis.
Legionella. The name of the genus of bacteria that can cause a pneumonia called Legionnaires’ disease or a flu-like illness called Pontiac fever when inhaled, aspirated or directly introduced into the lungs of susceptible individuals. It is a common aquatic bacteria found in natural and building water systems, as well as in some soils.
Legionellosis. The term used to describe Legionnaires’ disease, Pontiac fever, and any illness caused by exposure to Legionella bacteria.
Monitoring. Conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The new appendix will address the necessary risk management practices needed for mechanical systems such as cooling towers.

Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: F 201.0 - F 201.1, F 301.0 - F 301.2, Table 1801.2 Item #: 325

SUBMITTER: Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires' Disease; Ken Mortensen, SPX Cooling Technologies

Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Emily Toto:
Proposed Appendix J (referred to as Appendix F on Cooling Towers in the Pre-Print version) Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since ASHRAE has proposed revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using ANSI/ASHRAE 188, with practice informed by Guideline 12.

ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix F (formerly J):
1. Repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
2. Causes confusion by “paraphrasing” ANSI/ASHRAE 188 and ASHRAE Guideline 12 language;
3. Does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed.
4. Does not include adequate and proper guidance for the operators or AHJ;
5. Contains requirements that are overly prescriptive;
6. Contains guidance and requirements that are incorrect or incomplete;
7. Contains requirements and guidance that conflict with ANSI/ASHRAE 188 or ASHRAE Guideline 12;
8. Contains requirements and guidance that do not take into account regional climatic and regulatory differences in the design of cooling systems and their associated plumbing systems; and
9. Contains cooling tower requirements that have been shown in at least one large jurisdiction to be ineffective in reducing cases of legionnaires’ disease.

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix J items #324 through #329 into the UMC as originally proposed.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the mechanical systems working group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would
increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO this important project.

Paul A Lindahl Jr:
Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

Proposed Appendix J, also referred to as Appendix F on Cooling Towers in the Pre-Print version, Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE Standard 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ANSI/ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since the CTI has joined with other stakeholders to propose revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using Standard 188, with practice informed by Guideline 12.

Standard 188 and the latest version of Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. Standard 188 and Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. Standard 188 has been subject to continuous maintenance since it was first published in 2015 and Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of Standard 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. Standard 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing Standard 188 and the associated Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix J repeats copyrighted Standard 188 and Guideline 12 content without notation as well as causes confusion by “paraphrasing” Standard 188 and Guideline 12 language. Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed. We also feel that Appendix J is overly prescriptive, taking a “one size fits all” approach to the control of Legionella, including not accounting for regional climatic and regulatory differences in the design of building water systems while at the same time not providing adequate and correct guidance for system operators and local code officials. In addition, many of the requirements in Appendix J also conflict with Standard 188, Guideline 12, and GDL-159. Finally, the cooling tower requirements, many of which were extracted from existing local codes, have not proven successful in reducing cases of legionnaires’ disease in the areas where they have been adopted. This failure demonstrates that the primary causes of Legionellosis are not being addressed, including the quality of the incoming water from the utility as well as other sources of the bacteria.

This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]

Greg Lowman:
Please see letter dated January 3, 2022 attached. The body of the letter is posted below:

On behalf of Baltimore Aircoil Company, I’d like to register our objection to the proposed changes to the Uniform Plumbing Code and the Uniform Mechanical Code associated with legionella and evaporative heat rejection equipment.
After reviewing the proposed code changes and addendums to the code, our objections are based on the following:

• The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

• The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

• Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

• Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn’t just materialize, it is introduced predominantly through incoming water.

• The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’ disease by joining the growing number of organizations working to ensure legionella-free water is reliably and consistently delivered to all residents and users.

[Supporting documentation is provided in KAVI for TC review]

Daryn Cline:
This section makes statements that are not based on facts, but opinion (and not by a Subject Matter Expert). For example, "Water based mechanical system are generally closed and pressurized and have no potential to affect the health of occupants, except at the cooling tower." This is hearsay, and is unsubstantiated, every water using component or system has the potential to affect the health of occupants, leaks, pressure releases, chemicals. Strike this section.

In addition, cooling towers have been addressed in ASHRAE 188 and Guideline 12.

Marcy Savage:
The Alliance to Prevent Legionnaires’ Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:
1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires’ disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]

**Ken Mortensen:**
Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in these proposals for Appendix J do not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.

The differences and additions proposed in Appendix J compared to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements, include: 1) Applicability that is not the same as ASHRAE 188, which were specifically defined by committee experts, 2) Documentation for only one system covered by ASHRAE 188, punitive to evaporative cooling, and 3) Testing and operating procedures in conflict with ASHRAE Guide 12. These proposal will lead to user confusion and result in no benefit in Legionella reduction. Further, these proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.
Among other problems, Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix J operating procedures are overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix J also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.

These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
Proposals

Item #: 326

UMC 2024  Section: J 301.3 - J 301.4.1.1

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

J 301.3 Water Treatment and Filtration Equipment. Water treatment and filtration of cooling towers shall be in accordance with Section J 301.3.1 through Section J 301.4.1.1.

J 301.3.1 Water Treatment. Water treatment shall be provided to control microbiological activity, scale, corrosion, sediment, and solids in the system, and shall be in accordance with the following:
(1) Equipment and chemicals used shall be specified for the purpose of treating the open recirculating loop.
(2) The required schedule for inspection, maintenance, cleaning, and monitoring, and a corrective action plan.
(3) The requirements for documenting system water treatment.

J 301.3.2 Disinfection. The responsible person for initiating disinfection shall be identified in the water management program documents and the disinfection process shall include the following:
(1) Online disinfection.
(2) Emergency disinfection.

J 301.3.3 Water Treatment Chemicals. Water treatment chemicals, such as biocides, shall be applied using an automated dosing system, where possible, at regular intervals. The frequency and quantity of chemical dosing shall be defined in the water management program, and performed accordingly, based on the microbial activity of the system and the chemical parameters of the circulating water.
___ Prior to changing an existing chemical treatment system or introducing a new chemical treatment agent, cooling tower design, installation, operation, and maintenance shall be evaluated by a qualified person or building owner designee to ensure compatibility between the chemicals and the cooling tower system's materials, and to minimize microbial growth and the release of aerosols.
___ The evaluation shall describe the optimum level of chemicals required to achieve the desired result in a manner which can be used as a system performance measure.
(1) Daily automatic treatment while in operation. Water in a cooling tower system shall be treated at least once a day when the system is in operation and such treatment shall be automated, unless the water management program and plan explicitly state how manual or less frequent biocide additions will provide effective control of Legionella growth.
(2) Recirculating system. A cooling tower system shall be operated and programmed to continually recirculate the water, irrespective of the building's cooling demand of the system.

Exception: Where the water management program specifies in detail how the intended water treatment schedule will be carried out, and how effective biofilm and microorganism control will be achieved when the whole or a part of the system is idle during the scheduled chemical injection.
(3) Chemicals and biocides. Chemicals and biocides shall be used in quantities and combinations sufficient to control the presence of Legionella, minimize biofilms, and prevent scaling and corrosion that may facilitate microbial growth. It is recommended that oxidizing chemicals be used as the primary biocide control. For systems where oxidizing chemicals cannot be used as the primary biocide to control the presence of Legionella, building owners shall submit an alternative plan for effective bacteriological control for approval by the Authority Having Jurisdiction.
(a) Biocide applications. Any person who performs cleaning and disinfection or applies biocides in a cooling tower system shall be a certified person as required by the Authority Having Jurisdiction.
(b) Registered biocides. Only biocide products registered with the Authority Having Jurisdiction may be used to meet the disinfection requirements of this Appendix.
Records. Water treatment records shall be kept for all chemicals and biocides added, noting the purpose of their use, the manufacturer’s name, the brand name, the safety data sheet, the date and time of each addition, and the amount added each week.

Chemical and biocide additions. Chemicals and biocides shall be added in accordance with this appendix and the procedures described in the water management program addressing, as applicable, feeding mechanism, feeding location, frequency, set timer, duration, triggering events, control procedures, and target biocide residuals. Water treatment chemicals and biocides shall be used in accordance with the product label and manufacturer’s instructions.

J 301.4 Water Quality Monitoring. Water quality in the cooling tower shall be monitored as follows:

1. Water quality parameters, including but not limited to pH, temperature, conductivity and biocidal indicators, shall be measured and recorded as specified in the water management program and plan as follows:
   a. Manual measurements as required by the manufacturer’s recommendation and the Authority Having Jurisdiction.
   b. When continuous, automated and/or remote measurements and recordings are used, the water management program and plan shall show how effective measurements of system process control are being monitored.

2. A bacteriological indicator to estimate microbial content of recirculating water shall be collected and interpreted in accordance with Table J 301.4(2) at least once each week while the cooling tower system is operating. Indicators shall be taken at times and from water sampling points, as detailed in the water management program, that will be representative of water microbial content. Indicators may be taken at any time from constant chemical treatment systems. Indicators from systems that use intermittent biocide applications shall be taken before biocide application and reflect normal cooling tower operating conditions.

3. Legionella culture testing shall be conducted not less than every 90 days during cooling tower system operation. A Legionella sample shall be analyzed by an accredited laboratory where Legionella appears on the laboratory’s scope of accreditation, or other laboratory approved by the Authority Having Jurisdiction. When required, the test results of all Legionella bacteria at or above the magnitude of (1000 CFU/mL) as indicated in Table J 301.4(1) shall be reported to the Authority Having Jurisdiction within 24 hours of receiving the test results.

   a. Power failure, system shutdown, or equipment failure of sufficient duration to allow for growth of bacteria.
   b. Loss of biocide treatment sufficient to allow for growth of bacteria.
   c. Failure of conductivity controls to maintain proper cycles of concentration.
   d. At the request of the Authority Having Jurisdiction upon a determination that one or more cases of legionellosis is or may be associated with the cooling tower, based on epidemiological data or laboratory testing.
   e. Any time two consecutive bacteriological indicator sample results are above 1000 CFU/mL as indicated in Table J 301.4(1).
   f. Any other conditions specified by the Authority Having Jurisdiction.

4. System monitoring and sampling locations shall be representative of the entire cooling tower system. The system shall be operating with water circulating in the system for at least one hour prior to water quality measurements or collection of samples.

5. The maintenance program and plan shall identify the procedures, responsible parties, required response time(s) and notification protocol for corrective actions and shall include, at a minimum, corrective actions that shall be implemented according to the result levels in Table J 301.4(1).

J 301.4.1 Water Sampling. An analysis of water samples from a location capable of being contaminated with Legionella bacteria shall be performed as required by the Authority Having Jurisdiction to determine the number of organisms present in Colony Forming Units per milliliter (CFU/mL) of Legionella in the sample. The minimum remediation action shall be in accordance with Table J 301.4(1).

J 301.4.1.1 Legionella Test Levels. A means of controlling Legionella shall be established in accordance with applicable levels in accordance with the following:

1. Levels Less than 10 CFU/mL. Water samples containing Legionella levels less than 10 CFU/mL shall be permitted to maintain the established water treatment program in accordance with Table J 301.4(1).

2. Levels Between 10 CFU/mL and 1000 CFU/mL. Water samples containing Legionella levels greater than 10 CFU/mL but less than 1000 CFU/mL shall require the water treatment program to be reviewed, institute immediate online decontamination, and retesting of water 3 to 7 days after decontamination in accordance with Table J 301.4(1).

3. Levels Greater than 1000 CFU/mL. Water samples containing Legionella levels greater than 1,000 CFU/mL shall require the water treatment program to be reviewed, notify Authority Having Jurisdiction, institute immediate online disinfection, and retesting of water 3 to 7 days after decontamination in accordance with Table J 301.4(1).
### TABLE J 301.4(1)
LEGIONELLA REMEDIATION ACTIONS FOR COOLING TOWERS

<table>
<thead>
<tr>
<th>LEGIONELLA CONCENTRATIONS IN COLONY FORMING UNITS (CFU/mL)</th>
<th>REMEDIATION ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Maintain the established water treatment program</td>
</tr>
<tr>
<td>&gt;/=10 and &lt;100</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection.</td>
</tr>
<tr>
<td>&gt;/=100 and &lt;1000</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection.</td>
</tr>
<tr>
<td>&gt;/=1000</td>
<td>Review water treatment program, institute immediate online disinfection, and retest water 3 days to 7 days after disinfection. If the results of a retest are still &gt;/= 1000 CFU/mL, carry out system decontamination.</td>
</tr>
</tbody>
</table>

### TABLE J 301.4(2)
CORRECTIVE ACTIONS REQUIRED FOR BACTERIOLOGICAL INDICATOR RESULTS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>HETEROPTROPHIC PLATE COUNT AND DIP SLIDE RESULT (CFU/mL)</th>
<th>PROCESS TRIGGERED BY TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;10 000</td>
<td>Maintain water chemistry and biocide levels.</td>
</tr>
<tr>
<td>2</td>
<td>&gt;/=10 000 to &lt;100 000</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, review treatment program, retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this table until level 1 is reached.</td>
</tr>
<tr>
<td>3</td>
<td>&gt;/=100 000 to &lt;1 000</td>
<td>Initiate immediate disinfection by increasing biocide concentration or using a different biocide within 24 hours, reviewing treatment program, performing visual inspection to evaluate need to perform cleaning and further disinfection. Retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.</td>
</tr>
<tr>
<td>4</td>
<td>&gt;/=1 000 000</td>
<td>Initiate immediate disinfection by increasing biocides within 24 hours. Within 48 hours perform remediation of the tower by hyperhalogenating, cleaning, and flushing. Review treatment program, retest water within 3 days to 7 days. Subsequent test results shall be interpreted in accordance with this Table until level 1 is reached.</td>
</tr>
</tbody>
</table>

**Notes:**
1. Performed by an accredited laboratory
2. At a minimum, dose the cooling water system with 5 ppm to 10 ppm free halogen residual for at least 1 hour; pH 7.0 to 7.6

**Note:** There is no evidence that HPC values alone directly relate to human health risk, based on epidemiological studies and a lack of correlation with the occurrence of waterborne pathogens. Threshold concentrations of HPC were selected based on interference with the coliform test and not health-related considerations. HPC is an analytic method used to measure the variety of heterotrophic bacteria that are common in water. Legionella require specialized culture media for isolation and detection, do not grow on the media used for HPC testing, and their presence is not correlated with HPC values. HPC is a useful tool for monitoring the efficiency of the water treatment process, measuring bacterial regrowth, and evaluating the function of disinfection systems.
SUBSTANTIATION:
Legionella Monitoring: The verbiage and tables in this new appendix will clearly identify the standards for water treatment, sampling, and acceptable Legionella levels in cooling tower water systems.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: F 301.3 - F 301.4.1.1, Table F 301.4(1), Table F 301.4(2) Item #: 326

SUBMITTER: Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires’ Disease; Ken Mortensen, SPX Cooling Technologies

Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Emily Toto:
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Paul A Lindahl Jr:
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This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]

**Greg Lowman:**
Please see attached letter dated January 3, 2022. The body of the letter is also posted below:

On behalf of Baltimore Aircoil Company, I’d like to register our objection to the proposed changes to the Uniform Plumbing Code and the Uniform Mechanical Code associated with legionella and evaporative heat rejection equipment.

After reviewing the proposed code changes and addendums to the code, our objections are based on the following:

- The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

- The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

- Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

- Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn’t just materialize, it is introduced predominantly through incoming water.

- The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’ disease by joining the growing number of organizations working to ensure legionella-free water is reliably and consistently delivered to all residents and users.

[Supporting documentation is provided in KAVI for TC review]

**Daryn Cline:**
The problem with this section is that it is overly prescriptive, and results in onerous costs and labor to implement with the end result of reducing cases of Legionnaires’ disease. Recommend deleting and starting over with a stakeholder group that includes cooling tower manufacturers’ to help develop realistic requirements for reducing legionella. Many of these items will be addressed in a revised Appendix H. Also, this is written by a competing alternative cooling option, and lends itself to litigation for restraint of trade and bias.

**Marcy Savage:**
The Alliance to Prevent Legionnaires’ Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having
Legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires’ disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]

Ken Mortensen:
Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.
The text in these proposals for Appendix J do not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.

The differences and additions proposed in Appendix J compared to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements, include: 1) Applicability that is not the same as ASHRAE 188, which were specifically defined by committee experts, 2) Documentation for only one system covered by ASHRAE 188, punitive to evaporative cooling, and 3) Testing and operating procedures in conflict with ASHRAE Guide 12. These proposal will lead to user confusion and result in no benefit in Legionella reduction. Further, these proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Among other problems, Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix J operating procedures are overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix J also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.

These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
Proposals

Item #: 327
UMC 2024  Section: J 401.0 - J 401.1.3

SUBMITTER: Jay Egg
Egg Geothermal
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

J 401.0 Interruption to Normal Operation.

J 401.1 Shutdown Date. When an interruption to normal operation occurs (system shutdown), a shutdown date shall be established prior to shutting down a cooling tower. A shutdown date of a cooling tower shall be a date after which the cooling tower is unlikely to be restarted for the season. Where shutdown of the cooling tower is required, a shutdown date shall be determined, and the requirements of Section J 401.1.1 through Section 401.1.4 shall be completed.

J 401.1.1 Reduce Solids and Sterilize the System. The cooling tower shall be drained prior to system shutdown. Biocide shall be applied in accordance with the manufacturer’s instructions to kill any bacteria or contaminants.

J 401.1.2 Drain, Inspect and Clean the System. Where an interruption to normal operation occurs, the following actions shall be performed:

1. The cooling tower fill, sump, heat exchangers, chillers, and piping shall be drained.
2. The system shall be cleaned as required by the manufacturer’s instructions.
3. The system shall be inspected, and maintenance shall be performed as required by the manufacturer.
4. The controllers shall be taken offline.
5. The protective probes shall be removed.
6. The tower fill and sump shall be drained.
7. The heat exchangers, chillers and piping shall be drained and protected in accordance with the manufacturer’s instructions.

J 401.1.3 Refill, Flush and Drain the Cooling Tower System. Where an interruption to normal operation occurs, the following additional actions shall be performed:

1. The system shall be refilled.
2. A nonoxidizing biocide shall be added and recirculated in accordance with the manufacturer’s instructions.
3. The cooling tower system shall be fully drained.

Note: It is possible that the cooling tower equipment is drained, but the cooling tower system remains in operation. A system operating on standby mode is not considered shut down. If water remains in the cooling tower system, the system is not considered shut down and water must circulate with regular biocide additions and active management.

J 401.1.4 Records. Records of all procedures and actions performed shall be kept.

SUBSTANTIATION:
Building Closure / Reduced Operation Procedures: The building closure procedures section of this new appendix will identify the best practices for placing the building cooling tower water system on minimum or reduced capacity, while maintaining acceptable levels of Legionella in the cooling tower water system.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: F 401.0 - F 401.1.3  Item #: 327

SUBMITTER: Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires' Disease; Ken Mortensen, SPX Cooling Technologies

Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:

Emily Toto:

Proposed Appendix J (referred to as Appendix F on Cooling Towers in the Pre-Print version) Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since ASHRAE has proposed revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using ANSI/ASHRAE 188, with practice informed by Guideline 12.

ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix F (formerly J):
1. Repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
2. Causes confusion by “paraphrasing” ANSI/ASHRAE 188 and ASHRAE Guideline 12 language;
3. Does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed.
4. Does not include adequate and proper guidance for the operators or AHJ;
5. Contains requirements that are overly prescriptive;
6. Contains guidance and requirements that are incorrect or incomplete;
7. Contains requirements and guidance that conflict with ANSI/ASHRAE 188 or ASHRAE Guideline 12;
8. Contains requirements and guidance that do not take into account regional climatic and regulatory differences in the design of cooling systems and their associated plumbing systems; and
9. Contains cooling tower requirements that have been shown in at least one large jurisdiction to be ineffective in reducing cases of legionnaires’ disease.

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix J items #324 through #329 into the UMC as originally proposed.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the mechanical systems working group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with
IAPMO this important project.

**Paul A Lindahl Jr:**
Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

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[Supporting documentation is provided in KAVI for TC review]

**Daryn Cline:**
Shutdown procedures have been developed by and for the cooling tower industry, many developed by the Cooling Technology Institute and ASHRAE, and are incorporated into our operating and maintenance manuals. This section adds additional burdens on cooling tower operation, introduces new definitions, such as “sterilize” and is in conflict with the aforementioned standards organizations previously established procedures developed in a true ANSI process, and will only set up confusion in the market place of how to proceed with shutdowns. Recommend this section is deleted.

**Marcy Savage:**
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Ken Mortensen:
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and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
Proposals

Item #: 328

UMC 2024  Section: J 201.0 - J 201.1, J 501.0 - J 501.3.1, Table 1701.2

SUBMITTER:  Jay Egg
Egg Geothermal
Rep. Chair, Mechanical Systems Working Group

RECOMMENDATION:
Add new text

J 501.0 System Shutdown.
J 501.1 General. Cooling towers that are in shutdown mode shall comply with the following:
(1) Operating configurations and conditions that may occur after periods of extended inactivity lasting more than three
days, including idling or low circulation while not being fully drained.
(2) Specific, detailed seasonal and temporary shutdown and start-up procedures.
J 501.2 Shutdown Procedures. System start-up and shutdown procedures shall include, but not be limited to, the
following:
(1) Management of hazardous conditions associated with untreated water, including the following:
(a) Shutdown that includes all chemical pretreatment steps, pump cycling protocols, and procedures for system
drainage for shutdown periods longer than three days, or the duration specified by the water management program.
(b) Start-up from a drained system shall be in accordance with manufacturer’s recommendations.
(c) Start-up from an undrained or stagnant system that exceeds three days, or the number of idle days specified by the
water management program or the manufacturer’s recommendations.
J 501.3 Legionella Prevention. The mechanical hydronic system shall be checked that it is safe to use after a
prolonged shutdown to minimize the risk of Legionnaires’ disease and other diseases associated with water.
Note: Stagnant or standing water in a mechanical hydronic system can increase the risk for growth and spread
of Legionella and other biofilm-associated bacteria. When water is stagnant, hot water temperatures can decrease to
the Legionella growth range (77 °F (25°C) through 110°F (43°C). Stagnant water can also lead to low or undetectable
levels of disinfectant, such as chlorine.
J 501.3.1 Maintenance Personnel. Personal protective equipment shall be provided for maintenance personnel.
Maintenance personnel shall wear personal protective equipment in accordance with the facilities’ risk assessment.
Respiratory protection may be appropriate in enclosed spaces where aerosol generation is likely. Personal protective
equipment shall be used in accordance with all local state and Federal requirements. Where respirators are used, a
respiratory protection program in accordance with 29 CFR 1910.134 shall be required.
Note: Maintenance personnel at increased risk of developing Legionnaires’ disease, such as those with weakened
immune systems, should consult with a medical provider regarding participation in flushing, cooling tower cleaning, or
other activities that may generate aerosols.

J 201.0 Definitions.
J 201.1 General. For the purposes of this appendix, the following definitions shall apply:
Disinfectant. Chemical agent or physical treatments used to kill or inactivate pathogens.
Disinfection. The process of killing or inactivating pathogens.
System Reopening. The set of actions that should be taken to ready a building for normal operations after an extended
period of no or limited operations.
(portions of table not shown remain unchanged)

SUBSTANTIATION:
Cooling Tower Shutdown Procedures: The Cooling Tower Shutdown procedure section of this new appendix will identify the best practices for shutting down operation building Water Systems associated with cooling towers to minimize Legionella risk upon restart.

Definitions: The definitions in this new appendix have been added and are necessary for clarity and enforcement of standards Legionella levels in cooling towers.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: F 201.0 - F 201.1, F 501.0 - F 501.3.1, Table 1801.2 Item #: 328

SUBMITTER: Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires’ Disease; Ken Mortensen, SPX Cooling Technologies Comment #: 1

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Emily Toto:
Proposed Appendix J (referred to as Appendix F on Cooling Towers in the Pre-Print version) Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since ASHRAE has proposed revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using ANSI/ASHRAE 188, with practice informed by Guideline 12.

ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.
Appendix F (formerly J):
1. Repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
2. Causes confusion by “paraphrasing” ANSI/ASHRAE 188 and ASHRAE Guideline 12 language;
3. Does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed.
4. Does not include adequate and proper guidance for the operators or AHJ;
5. Contains requirements that are overly prescriptive;
6. Contains guidance and requirements that are incorrect or incomplete;
7. Contains requirements and guidance that conflict with ANSI/ASHRAE 188 or ASHRAE Guideline 12;
8. Contains requirements and guidance that do not take into account regional climatic and regulatory differences in the design of cooling systems and their associated plumbing systems; and
9. Contains cooling tower requirements that have been shown in at least one large jurisdiction to be ineffective in reducing cases of legionnaires’ disease.

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix J items #324 through #329 into the UMC as originally proposed.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the mechanical systems working group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO this important project.

Paul A Lindahl Jr:
Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

Proposed Appendix J, also referred to as Appendix F on Cooling Towers in the Pre-Print version, Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE Standard 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ANSI/ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since the CTI has joined with other stakeholders to propose revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using Standard 188, with practice informed by Guideline 12.

Standard 188 and the latest version of Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. Standard 188 and Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. Standard 188 has been subject to continuous maintenance since it was first published in 2015 and Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of Standard 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. Standard 188 is structured to allow UMC Appendix H to address Legionella growth only in mechanical equipment/systems, separate from Legionella growth in potable plumbing systems addressed by the plumbing code.

The duplication and differences between the existing Standard 188 and the associated Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix J repeats copyrighted Standard 188 and Guideline 12 content without notation as well as causes confusion by “paraphrasing” Standard 188 and Guideline 12 language. Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12. This may lead users to a false sense of security and to believe that Legionella growth and the risk of Legionellosis from mechanical systems have been completely addressed. We also feel that Appendix J is overly prescriptive, taking a
“one size fits all” approach to the control of Legionella, including not accounting for regional climatic and regulatory differences in the design of building water systems while at the same time not providing adequate and correct guidance for system operators and local code officials. In addition, many of the requirements in Appendix J also conflict with Standard 188, Guideline 12, and GDL-159. Finally, the cooling tower requirements, many of which were extracted from existing local codes, have not proven successful in reducing cases of legionnaires’ disease in the areas where they have been adopted. This failure demonstrates that the primary causes of Legionellosis are not being addressed, including the quality of the incoming water from the utility as well as other sources of the bacteria.

This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]

**Greg Lowman:**
Please see attached letter dated January 3, 2022. The body of the letter is also posted below:

On behalf of Baltimore Aircoil Company, I’d like to register our objection to the proposed changes to the Uniform Plumbing Code and the Uniform Mechanical Code associated with legionella and evaporative heat rejection equipment.

After reviewing the proposed code changes and addendums to the code, our objections are based on the following:

• The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

• The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

• Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

• Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn’t just materialize, it is introduced predominantly through incoming water.

• The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’ disease by joining the growing number of organizations working to ensure legionella-free water is reliably and consistently delivered to all residents and users.

[Supporting documentation is provided in KAVI for TC review]

**Daryn Cline:**
Recommend striking all language in this appendix section. As previously stated, there are well established protocols developed by the Cooling Tower Industry, through ASHRAE and the Cooling Technology Institute to address shut down procedures, this new IAPMO guide will only create confusion and has not been vetted by subject matter experts.

**Marcy Savage:**
The Alliance to Prevent Legionnaires’ Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting
public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires’ disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]
Ken Mortensen:
Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in these proposals for Appendix J do not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.

The differences and additions proposed in Appendix J compared to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements, include: 1) Applicability that is not the same as ASHRAE 188, which were specifically defined by committee experts, 2) Documentation for only one system covered by ASHRAE 188, punitive to evaporative cooling, and 3) Testing and operating procedures in conflict with ASHRAE Guide 12. These proposal will lead to user confusion and result in no benefit in Legionella reduction. Further, these proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Among other problems, Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix J operating procedures are overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix J also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.

These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
**J 601.0 System Restart.**

**J 601.1 Startup Procedures.** When a cooling tower has been shut down or left untreated for five or more days, a full startup procedure shall be completed before startup or continuing operation. The startup procedure shall be completed as follows:

1. Clean the cooling tower through power washing and/or scrubbing, not more than 15 days before the first use, to remove biofilm, scale or other debris. Once cleaned, disinfect with an approved biocide(s) to kill pathogens, such as *Legionella*.
2. Enlist a qualified person or building owner designee to conduct and document the pre-startup inspection. The required inspection shall be as follows:
   a. Visually assessing the cooling tower system.
   b. Inspecting all components for the presence of contaminants and other adverse conditions.
   c. Checking that the water treatment equipment is working properly.
   d. Records of the procedure shall be completed.
3. Once disinfected, the cooling tower system shall be filled with water and begin circulating biocides and chemicals, as specified in the water management program. At this point, the system shall be considered operational and shall meet the requirements of the Authority Having Jurisdiction.
4. Collect and analyze a water sample for the presence of *Legionella*. The sample shall be analyzed by a laboratory as approved by the Authority Having Jurisdiction. The results shall be interpreted and the actions described in Table J 301.4(2) shall be performed.
5. Startup records of all procedures and actions performed shall be kept on file. Startup records shall include, but not be limited to, the following:
   a. Cooling tower system ID
   b. System startup date
   c. Individual cooling tower startup date (if different than the system startup date)
   d. Dates and procedures for startup cleaning and disinfection
   e. Service provider
   f. Pre-startup inspection
   g. Legionella sampling and test results
   h. Disinfection dose and circulation time
   i. Water monitoring
   j. Treatment logs

**SUBSTANTIATION:**
Building and Cooling Tower Reopening Procedures: The cooling tower reopening procedure section of this new appendix will identify best practices by which a cooling tower that has been offline for an extended period may be restarted while maintaining acceptable levels of *Legionella* in the cooling tower water system.

**COMMITTEE ACTION:** ACCEPT AS SUBMITTED

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 29 NOT RETURNED: 1 Heine
Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: F 601.0 - F 601.1  Item #: 329

SUBMITTER: Emily Toto, ASHRAE; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Daryn Cline, EVAPCO, Inc.; Marcy Savage, Alliance to Prevent Legionnaires’ Disease; Ken Mortensen, SPX Cooling Technologies

RECOMMENDATION:
Delete text without substitution

Request to reject the code change proposal by this public comment.

SUBSTANTIATION:
Emily Toto:
Proposed Appendix J (referred to as Appendix F on Cooling Towers in the Pre-Print version) Items #324 through #329 and associated changes to Table 1701.2 do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. Further, the text proposed for deletion from Appendix J is unnecessary, since ASHRAE has proposed revisions to Appendix H to provide minimum requirements to address Legionella growth in all mechanical systems, including cooling towers, using ANSI/ASHRAE 188, with practice informed by Guideline 12.

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The duplication and differences between the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix F (formerly J):
1. Repeats copyrighted ANSI/ASHRAE 188 and ASHRAE Guideline 12 content without extraction references
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4. Does not include adequate and proper guidance for the operators or AHJ;
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Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Appendix J items #324 through #329 into the UMC as originally proposed.
ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the mechanical systems working group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO this important project.

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Reducing the risk of Legionella in Building Water Systems, especially evaporative heat rejection systems, is of paramount importance to the Cooling Technology Institute (CTI). As an organization, we support ASHRAE Standard 188 and Guideline 12. We have also published CTI Guideline (GDL) 159 on reducing the risk of Legionellosis associated with evaporative heat rejection systems.

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This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

[Supporting documentation is provided in KAVI for TC review]
Greg Lowman:
Please see attached letter dated January 3, 2022. The body of the letter is also posted below:

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• The complete lack of science or data justifying the increased burdens on owners and operators of heat rejection equipment and building water systems, with no meaningful expectation of a reduction of Legionnaires’ disease cases.

• The lack of a credible and responsible ANSI standard development process, failing to engage a meaningful cross section of stakeholders including subject matter experts such as heat rejection equipment manufacturers.

• Creates a conflict with the well-established ASHRAE Standard 188, developed over 12 years by a cross-section of expert stakeholders. Developed with the CDC’s involvement, ASHRAE S188 was further adopted by the CDC as the basis for their Legionella Toolkit and is increasingly being adopted by state and local jurisdictions.

• Fails to address broader system issues that drive legionella presence in our water systems, starting with source water treatment through delivery. Legionella doesn't just materialize, it is introduced predominantly through incoming water.

• The narrow and excessive focus on heat rejection equipment unsupported by science and data, with obvious omissions of other water-based building equipment.

We believe that ASHRAE Standard 188 offers substantial and credible guidance to building owners making the effort by IAPMO counterproductive. We’d encourage IAPMO to look for opportunities to truly prevent Legionnaires’ disease by joining the growing number of organizations working to ensure legionella-free water is reliably and consistently delivered to all residents and users.

[Supporting documentation is provided in KAVI for TC review]

Daryn Cline:
Recommend deleting this section, language is in conflict with established requirements developed by CTI and ASHRAE, and the cooling tower industry, which is included in Evapco's O and M's. Overly prescriptive, costly to owners, with no evidenced based data to back up its benefits to reducing Legionnaires’ disease, but only increases business to testing, certification and service groups. Four members of IAPMO have also recommended rejecting: Ballanco, Koerber, White and Wiseman.

Marcy Savage:
The Alliance to Prevent Legionnaires' Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO’s 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.
In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires' disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases — and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]

Ken Mortensen:
Reducing the risk of Legionella should be the goal of any Water Standards being discussed. To that end, SPX Cooling Technologies has participated in the creation of ASHRAE Standard 188 and Guideline 12 and supports their use as the definitive technical documents on reducing the risk in Building Water Systems, which serve as an element in such a risk reduction strategy. These works provide the best guidance for reducing the risk of Legionellosis associated with evaporative heat rejection systems.

The text in these proposals for Appendix J do not align with ANSI/ASHRAE 188, Legionellosis: Risk Management for Building Water Systems and supporting document, ASHRAE Guideline 12, Managing the Risk of Legionellosis Associated with Building Water Systems. ASHRAE standards and guidelines were developed over many years through consensus processes by teams of subject matter experts, including all major cooling tower manufacturers and designers, who know their products best. These standards and guidelines have subsequently been regularly reviewed, updated, and republished as required.
The differences and additions proposed in Appendix J compared to the existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 requirements, include: 1) Applicability that is not the same as ASHRAE 188, which were specifically defined by committee experts, 2) Documentation for only one system covered by ASHRAE 188, punitive to evaporative cooling, and 3) Testing and operating procedures in conflict with ASHRAE Guide 12. These proposals will lead to user confusion and result in no benefit in Legionella reduction. Further, these proposals are a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Among other problems, Appendix J does not include all of the mechanical equipment and systems that are covered by ANSI/ASHRAE 188 and ASHRAE Guideline 12 as a comprehensive approach would. Appendix J operating procedures are overly prescriptive adding requirements expressly rejected by ASHRAE experts. Other requirements in Appendix J also conflict with Standard 188 and Guideline 12. The specific cooling tower requirements have been shown to be statistically ineffective in reducing cases of legionnaires’ disease in the areas where they have been adopted. SPX Cooling interprets these proposals as punitive to a fundamental energy saving technology for building infrastructure.

These proposals do not address the leading cause of Legionellosis, the quality of the incoming water to buildings and homes resulting in an explosion of sporadic cases in the U.S.

This comment is submitted on behalf of SPX Cooling Technologies.
Proposals

Item #: 330

UMC 2024  Section: Appendix J, Table 1701.2

SUBMITTER: Jason M Shank
ASSE International

RECOMMENDATION:
Add new text

APPENDIX J
PROFESSIONAL QUALIFICATIONS

J 101.0 General.
J 101.1 Scope. The provisions of this appendix address minimum qualifications for installers, inspectors, or employers for systems covered within the scope of this code.

J 102.0 Qualifications.
J 102.1 General. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor or technician shall be licensed or certified to perform such work. Professional qualifications shall be required for an individual to demonstrate the required level of competency.

J 102.2 Inspectors and Plans Examiners. Professional qualification for mechanical system inspectors and mechanical plans examiners shall be in accordance with ASSE/IAPMO/ANSI Series 16000.
J 102.2.1 Qualification for Mechanical Inspector. Professional qualification for mechanical inspectors shall be in accordance with ASSE 16020.
J 102.2.2 Qualification for Mechanical Plan Examiner. Professional qualification for mechanical plan examiners shall be in accordance with ASSE 16020.
J 102.3 Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be in accordance with ASSE/IAPMO/ANSI Series 13000.
J 102.3.1 Qualification for Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be in accordance with ASSE 13020.
J 102.4 Hydronic Systems. Personnel qualification for installers and designers of hydronic heating and cooling systems, as well as installers of solar water heaters shall be in accordance with ASSE/IAPMO/ANSI Series 19000.
J 102.4.1 Qualification for Solar Water Heating System Installer. Professional qualification for solar water heating system installers shall be in accordance with ASSE 19110.
J 102.4.2 Qualification for Hydronic Heating and Cooling System Installer. Professional qualification for hydronic heating and cooling system installers shall be in accordance with ASSE 19210.
J 102.4.3 Qualification for Hydronic Heating and Cooling System Designer. Professional qualification for hydronic heating and cooling system designers shall be in accordance with ASSE 19220.
J 102.5 Water Management and Infection Control Risk Assessment for Building Systems. Professional qualification for construction and maintenance personnel and employers to identify and manage potentially hazardous exposure to bloodborne, waterborne and airborne pathogens. Also includes qualifications for members of a water safety team involved in the development of a risk assessment analysis, and water management and sampling plan, for protection from Legionella and other waterborne pathogens and persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella. Qualifications are in accordance with ASSE/IAPMO/ANSI Series 12000.
J 102.5.1 Qualification for Environment of Care, Infection Control and Construction Risk Assessment. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment procedures to protect facility operations, occupants, workers or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12010.
J 102.5.2 Qualification for Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment requirements and
procedures to protect facility operations, occupants, workers, or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12020. It also provides general knowledge of employer responsibilities to the worker and to the facility.

**J 102.5.3 Qualification for Water Quality Program, Pipefitters and HVAC Technicians.** Professional qualification for water quality program for pipefitters and HVAC technicians shall be in accordance with ASSE 12062.

**J 102.5.4 Legionella Water Safety and Management Personnel.** Professional qualification of persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella shall be in accordance with ASSE 12080.

---

**TABLE 1701.2**

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<th>DOCUMENT NUMBER</th>
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<td>and Plans Examiners</td>
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<td>ASSE 12080-2021</td>
<td>Professional Qualifications Standard for Legionella Water Safety and Management Specialist</td>
<td>Professional Qualifications</td>
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</tbody>
</table>

(portions of table not shown remain unchanged)

**Note:** The ASSE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**

By including these Professional Qualification Standards in the Appendix of this code it creates a base line for what an AHJ may or should expect from installers and inspectors of these systems.

**COMMITTEE ACTION:** ACCEPT AS SUBMITTED

---

**TOTAL ELIGIBLE TO VOTE:** 30

**VOTING RESULTS:** AFFIRMATIVE: 24 NEGATIVE: 4 ABSTAIN: 1 NOT RETURNED: 1 Heine
EXPLANATION OF NEGATIVE:

BALLANCO: This change should be rejected. This does not belong in the code. Furthermore, the charging statement does not address all of the listed qualification standards. Section J 102.1 states that applies to contractors, installers, and service technicians. Then the first section applies to plans examiners and inspectors. Yet, they are not included in the charging section. The Code should never be a licensing document. If ASSE wants to put this out as a separate document, they can do so. But this does not belong in the UMC.

KOERBER: Outside of the scope of the UMC and should be rejected.

WHITE: This is beyond the scope of the UMC and should be rejected.

WISEMAN: ACCA has never reviewed this document. We do not know what kind of qualifications are included and how they will impact the contractor. In addition, this seeks to supplant the current California licensing requirements for mechanical contractors. We should not have multiple and/or potentially conflicting or unnecessary requirements for qualifying contractors in jurisdictions. The new edition of the UMC eventually is considered as the basis for the California Mechanical Code.

EXPLANATION OF ABSTAIN:

MACNEVIN: I am abstaining because I have the ASSE 19210 certification and want to avoid the perception of conflict of interest.

APPENDIX J

PROFESSIONAL QUALIFICATIONS

J 101.0 General.
J 101.1 Scope. The provisions of this appendix address minimum qualifications for installers, inspectors, or employers for systems covered within the scope of this code.

J 102.0 Qualifications.
J 102.1 General. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor or technician shall be licensed or certified to perform such work. Professional qualifications shall be required for an individual to demonstrate the required level of competency.

J 102.2 Inspectors and Plans Examiners. Professional qualification for mechanical system inspectors and mechanical plans examiners shall be in accordance with ASSE/IAPMO/ANSI Series 16000.
J 102.2.1 Qualification for Mechanical Inspector. Professional qualification for mechanical inspectors shall be in accordance with ASSE 16020.

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J 102.3.1 Qualification for Residential Mechanical Service Technician. Professional qualification for residential mechanical service technicians shall be with accordance ASSE 13020.

J 102.4 Hydronic Systems. Personnel qualification for installers and designers of hydronic heating and cooling systems, as well as installers of solar water heaters shall be in accordance with ASSE/IAPMO/ANSI Series 19000.
J 102.4.1 Qualification for Solar Water Heating System Installer. Professional qualification for solar water heating system installers shall be in accordance with ASSE 19110.

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J 102.5 Water Management and Infection Control Risk Assessment for Building Systems. Professional qualification for construction and maintenance personnel and employers to identify and manage potentially hazardous exposure to bloodborne, waterborne and airborne pathogens. Also includes qualifications for members of a water safety team involved in the development of a risk assessment analysis, and water management and sampling plan, for protection from Legionella and other waterborne pathogens and persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella. Qualifications are in accordance with ASSE/IAPMO/ANSI Series 12000.

J 102.5.1 Qualification for Environment of Care, Infection Control and Construction Risk Assessment. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment procedures to protect facility operations, occupants, workers or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12010. It also provides general knowledge of employer responsibilities to the worker and to the facility.

J 102.5.2 Qualification for Environment of Care, Infection Control and Construction Risk Assessment Professional Qualification Standard for Construction and Maintenance Employers. Professional qualification for general knowledge of the environment of care, infection control and construction risk assessment requirements and procedures to protect facility operations, occupants, workers, or any individual who has the potential for harm caused by construction activities shall be in accordance with ASSE 12020. It also provides general knowledge of employer responsibilities to the worker and to the facility.

J 102.5.3 Qualification for Water Quality Program, Pipefitters and HVAC Technicians. Professional qualification for water quality program for pipefitters and HVAC technicians shall be in accordance with ASSE 12062.

J 102.5.4 Legionella Water Safety and Management Personnel. Professional qualification of persons who conduct a facility risk assessment and implement a water safety and management program to reduce the risk of infections due to Legionella shall be in accordance with ASSE 12080.

### TABLE 1801.2

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<th>DOCUMENT NUMBER</th>
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<tr>
<td>ASSE/IAPMO/ANSI Series 16000-2019</td>
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<td>ASSE-12062-2021</td>
<td>Water Quality Program Professional Qualifications Standard for</td>
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</tbody>
</table>
Pipefitters and HVAC Technicians Qualifications

ASSE-12080-2021 Professional Qualifications Standard for Legionella Water Safety and Management Specialist Professional Qualifications

(portions of table not shown remain unchanged)

SUBSTANTIATION:
Section J 102.5 and the related standards, publication, procedures, and guides in Table 1801.2 contained in proposed Appendix J do not align with the language contained in ANSI/ASHRAE 188 Legionellosis: Risk Management for Building Water Systems and the supporting document, ASHRAE Guideline 12 Managing the Risk of Legionellosis Associated with Building Water Systems. ANSI/ASHRAE 188 and ASHRAE Guideline 12 are written to be usable and implemented by a broad range of building owners without using or requiring compliance, training, or certification in any hazard analysis, risk assessment, or risk management methodologies (See ANSI/ASHRAE 188-2021 Section 4 Compliance and ASHRAE Guideline 12 Section 2 Scope, Item 2.3), such as those contained in Section J 102.5 of Item #330. Note that ASHRAE has proposed revisions to UPC Appendix H, Item #323 to replace the Legionella growth text with the minimum requirements to address Legionella growth in mechanical systems contained in ANSI/ASHRAE 188, with practice informed by ASHRAE Guideline 12 and in accordance with the applicable rules and regulations, the mechanical code, and the plumbing code.

ANSI/ASHRAE 188 and the latest version of ASHRAE Guideline 12, are the result of almost three decades of development. As background, there were multiple public reviews beginning in the early 1990s and numerous independent substantive reviews to gain input and consensus. ANSI/ASHRAE 188 and ASHRAE Guideline 12 contain extensive input from industry, academia, and healthcare and from city, state, and national public health departments and regulatory authorities. ANSI/ASHRAE 188 has been subject to continuous maintenance since it was first published in 2015 and ASHRAE Guideline 12 has been subject to continuous maintenance since the 2018 edition was published. Both are published on a three-year cycle to incorporate all accepted changes. To facilitate adoption, the current version of ANSI/ASHRAE 188 is written in code enforceable language with each requirement worded to enable yes/no compliance confirmation. ANSI/ASHRAE 188 is structured to allow UMC Appendix H and J to address Legionella growth only in mechanical systems, separate from Legionella growth in potable plumbing addressed by the plumbing code.

The differences between existing ANSI/ASHRAE 188 and the associated ASHRAE Guideline 12 and the proposed Appendix J Section J 102.5 and the related standards, publications, procedures, and guides in Table 1701.2 will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Appendix J:
1. contains requirements that are overly prescriptive;
2. contains requirements and guidance that conflict with ANSI/ASHRAE 188 and ASHRAE Guideline 12; and
3. contains requirements that unnecessarily burdens all buildings to take the same actions, even though the risk of legionellosis varies by factors such as plumbing system complexity, building occupancy/use, and many others.
   (ANSI/ASHRAE 188 requirements address these differences)

Note that the ASHRAE Standing Standard Project Committee (SSPC) 188 voted 22-0-1 to reject the inclusion of Section J 102.5 Water Management and Infection Control Risk Assessment for Building Systems and the related standards, publications, procedures, and guides in Table 1701.2 into the UPC as originally proposed.

ASHRAE SSPC 188 appreciates the time spent by the IAPMO Technical Committee and the Legionella Task Group to develop the proposed language. ASHRAE SSPC 188 invites the Technical Committee to engage in a collaborative revision of the proposed code language that could be incorporated into a future code revision. Such collaboration would ensure consistency among the standards, would lessen confusion for users, and would increase the probability of a positive public health and safety outcome. SSPC 188 looks forward to working with IAPMO this important project.
PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: Appendix J, Table 1801.2  Item #: 330
SUBMITTER:  David C. Bixby, Air Conditioning Contractors of America (ACCA); Daryn Cline, EVAPCO, Inc.; Ken Mortensen, SPX Cooling Technologies; Paul A Lindahl Jr, SPX CT, Rep. Cooling Technology Institute; Greg Lowman, Baltimore Aircoil Company; Julius Ballanco, P.E., JB Engineering and Code Consulting, P.C., Rep. Self; Marcy Savage, Alliance to Prevent Legionnaires' Disease
SUBMISSION:  David C. Bixby:
Section J 102.0 (Qualifications) includes Section J 102.3 and Section J 102.3.1 for Residential Mechanical Service Technicians, in accordance with ASSE Series 13000 and ASSE 13020, respectively. ACCA has not reviewed these standards. We do not know what kind of qualifications are included and how they will impact mechanical contractors. Although Appendix J is non-mandatory, it seeks to potentially supplant the current California licensing requirements for mechanical contractors, if it is adopted by a local jurisdiction as part of the California Mechanical Code. This could potentially create multiple and/or conflicting requirements for qualifying contractors in certain jurisdictions within the state. The process for qualifying and licensing contractors is already handled by state laws and regulations and does not need to be part of the UMC referencing ASSE standards that are unknown to most if not all mechanical contractors.

Daryn Cline:
In addition to a conflict with ASHRAE Standard 188 and Guideline 12, this language is overly prescriptive, in conflict with well established legionella management guidelines, and places unnecessary qualifications on personnel charged with managing water in a building. Recommend deleting this entire section.

Ken Mortensen:
Delete Appendix J as shown above.

Tester Certification requirements are in direct conflict with ANSI/ASHRAE Standard 188 and ANSI/ASHRAE Guideline 12. Both ASHRAE programs exclude additional compliance, training, or certification in risk assessment, or risk management. (reference Standard 188-2021 Section 4 Compliance and Guideline 12 Section 2 Scope, Item 2.3). Such differences between existing the Standard 188 and the associated Guideline 12 and the proposed Appendix J will lead user dilemma as to controlling requirements. That sort of problem is a direct violation of the ANSI Essential Requirements Document, specifically Section 2.4.

Code mandated Certifications from any single entity, as listed, potentially lead to many problems in the “restraint of trade” area. Any such requirements are best established at the local level where provision to avoid competitive issues can be made based on local supply and needs.

This comment is submitted on behalf of SPX Cooling Technologies.

Paul A Lindahl Jr:
The Cooling Technology Institute agrees with the Committee Members who voted against approval of Appendix P (24-4-1-1) as such requirements are outside the scope of the UMC. Additionally, only certifications from a single entity are listed which can potentially be considered a restraint of trade as this Appendix is written in code mandated language (i.e., “shall” as opposed to “should” or “may”). Furthermore, these requirements contradict the requirements of ANSI/ASHRAE Standard 188 and ANSI/ASHRAE Guideline 12, both of which the CTI supports, in regards to water management and infection control risk assessment for building water systems. Both documents state that no additional compliance, training, or certification in any hazard analysis, risk assessment, or risk management methodologies is required (reference Standard 188-2021 Section 4 Compliance and Guideline 12 Section 2 Scope, Item 2.3). Furthermore, the differences between existing the Standard 188 and the associated Guideline 12 and the proposed Appendix J Section J 102.5 and the related standards, publications, procedures, and guides in Table 1701.2 will lead to user confusion and is a violation of the ANSI Essential Requirements Document, specifically Section 2.4.
While the proposal states that the “ASSE standards listed meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects,” this does not mean that it is appropriate to list proprietary standards as the only qualifications required for each of the areas listed, excluding other potentially beneficial certifications as well as local requirements. Indeed, such requirements are best established at the local level.

This comment is submitted on behalf of the CTI Regulatory Committee which has been empowered by the CTI President and Board of Directors to respond to such proposals. Note that the Regulatory Committee voted unanimously to support this comment as submitted. The CTI represents many Owners and Operators, Suppliers, and Manufacturers of environmentally sustainable heat rejection solutions, none of whom to our knowledge were consulted in the development of this proposal.

**Greg Lowman:**
Section J 102.5 and the many of the documents referenced in Table 1801.2 contained in this proposed Appendix do not align with ASHRAE Standard 188 and ASHRAE Guideline 12, both of which do not require compliance, training, or certification in any hazard analysis, risk management methodologies. Reference Standard 188, Section 4 and Guideline 12 Scope, Item 2.3 for specific details.

Additionally, all of the requirements appear proprietary, are from a single entity, and listing them as the only requirements for each of the areas excludes other potential beneficial certifications and training as well as any that are established on the local level. We also note the comments of those on the IAPMO Committee who voted against this proposal, stating that such requirements do not belong in the Code and are best established at the local level.

**Julius Ballanco:**
This change should be rejected. Licensing and qualifications do not belong in the code. The scoping or charging statement is not consistent with the listed qualification standards. Section J 102.1 states that it applies to contractors, installers, and service technicians. Then the first section applies to plans examiners and inspectors. Additional section also address inspector qualification standards. Yet, inspectors are not included in the charging section. There is a long history of the UMC not including licensing requirements. This policy should remain.

ASSE can always develop and publish a separate document listing all their qualification standard.

Finally, there are additional qualification processes available besides ASSE. Yet, those process are not listed making this Appendix extremely proprietary.

**Marcy Savage:**
The Alliance to Prevent Legionnaires' Disease is a national non-profit organization comprised of public health and medical professionals, water utility experts, environmental advocates, engineers, water treatment professionals and manufacturers dedicated to reducing and eliminating the occurrence of Legionnaires’ disease (LD) by promoting public research, education and advocacy for its prevention. We appreciate the opportunity to comment in response to changes being considered for IAPMO's 2024 Uniform Mechanical and Plumbing Code and guidance language associated with legionella bacteria in building water systems.

The Alliance is focused on promoting policies and practices that prioritize the root causes of legionella origination, growth, and proliferation throughout water systems with a goal of significantly minimizing the risk of having legionella enter our homes, facilities, and workplaces. We are concerned that the efforts of the last four to five decades since Legionnaires’ disease was identified are reactionary and have been narrowly focused on end water use once the bacteria has infected homes and buildings and are only focused on LD outbreaks which account for only 4% of cases.

The ineffectiveness of this approach is evident in looking at the significant increase in case rates since 2000, for which we have seen a nearly five-fold increase in cases during this period. Put simply, a continued downstream focus on commercial buildings and equipment, and neglecting proper management of the public water system will not have a measurable impact on reducing Legionnaires’ disease.

In fact, we believe that the approach will be counterproductive and therefore we oppose the proposals submitted in the UMC/UPC Appendices F, H, J, N and P Section 102.7 in their entirety for the following reasons:

1. The proposed language does not address the root causes that result in the introduction of the bacteria into our homes, facilities, and water-based equipment and features. The failure to address these root cause issues results in
a costly reactive approach and gives the false impression to policy makers and the public that they are meaningfully protecting public health. Globally, there are no demonstrated examples of building-only regulations that have reduced the occurrence of Legionnaires’ disease. Such proposals, then, misdirect scarce legionella prevention resources and distract from more meaningful holistic solutions.

2. According to studies by the Centers for Disease Control (CDC), 96% of all LD cases are single and sporadic in nature. Ensuring that the water being delivered daily to our homes and buildings is properly managed and disinfected must be our priority if we are going to reduce LD cases, considering the volume of water used in homes and residences, where there can be the greatest exposure risks through showers and faucets.

3. The Alliance, along with the CDC endorses and supports the use of ASHRAE Standard 188 by building owners and operators. This standard, supported by ASHRAE’s Guideline 12, gives building owners a structured approach to develop water management plans designed for their specific facility to assist with legionella prevention. Further, it acknowledges the risks of incoming water quality that can result in building and residential water quality and bacterial issues. Pursuing strict regulatory requirements on building owners without ensuring that they and all residents receive legionella-free water consistently and reliably is counterproductive policy.

4. The proposed language, if adopted, would create conflicts, redundancy, and confusion with ASHRAE Standard 188 and further perpetuates the false perspective that Legionnaires’ disease is primarily a commercial building water issue.

5. The specific requirements of the proposed language were not presented with any scientific data demonstrating their efficacy in the fight against Legionnaires’ disease. Whereas, jurisdictions that have attempted to adopt such requirements have not shown a reduction in cases – in fact cases have continued to increase.

The Alliance firmly believes that any meaningful reduction in Legionnaires’ disease must address the root causes that are likely driving the 96% of individual Legionnaires’ cases – and likely lead to neighborhood outbreaks and the presence of legionella bacteria in facilities, especially when triggered by public water system upsets like water main breaks, construction, heavy rainfall and flooding among others, which release the bacteria from biofilm and push it into our homes and buildings.

We need all available resources to concentrate on preventing the presence of the bacteria in the public water system and its distribution into residences where our vulnerable populations are routinely exposed to water for showering, bathing, drinking and cleaning. These efforts would also reduce the introduction of the bacteria into facilities, buildings and water-based equipment and features.

The Alliance strongly urges IAPMO to help bring a focus on the root causes of Legionnaires’ disease by developing proposals and solutions designed to eliminate the presence of legionella in our drinking water supplies starting with the elimination of the bacteria, and the organic material that provide nutrients for it, from source through distribution.

[Supporting documentation is provided in KAVI for TC review]
Proposals

Item #: 331
UMC 2024  Section: Table 1701.1

SUBMITTER: Karl Best
AHRI

RECOMMENDATION:
Revise text

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</table>

(portion of table not shown remain unchanged)

Note: The AHRI standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revision reflect the latest update to the AHRI standard that is referenced in Table 1701.1.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30
VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.2  Item #: 331

SUBMITTER: Karl Best
Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.
### Table 1801.2

**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

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<th>DOCUMENT NUMBER</th>
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<th>APPLICATION</th>
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<tbody>
<tr>
<td>AHRI 390-2003-2021</td>
<td>Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps</td>
<td>Air Conditioners</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**Note:** The AHRI standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

**Substantiation:**

The above revisions reflect the latest updates to the AHRI standards that are referenced in Table 1801.2.
Proposals

Item #: 333
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Emily Toto
ASHRAE

RECOMMENDATION:
Revise text

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>ASHRAE 15-2016 2019</td>
<td>Safety Standard for Refrigeration Systems</td>
<td>Refrigeration Systems</td>
<td>1102.1, 1106.1, Table 1113.5</td>
</tr>
<tr>
<td>ASHRAE 34-2016 2019</td>
<td>Designation and Safety Classification of Refrigerants</td>
<td>Refrigeration Classifications</td>
<td>1102.3, 1103.1, Table 1102.3, Table 1106.2.5.2</td>
</tr>
<tr>
<td>ASHRAE 62.1-2016 2019</td>
<td>Ventilation for and Acceptable Indoor Air Quality</td>
<td>Indoor Air Quality Ventilation</td>
<td>402.4.1</td>
</tr>
<tr>
<td>ASHRAE 170-2017 2017</td>
<td>Ventilation of Health Care Facilities</td>
<td>Ventilation</td>
<td>402.1.2</td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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</thead>
<tbody>
<tr>
<td>ASHRAE 52.2-2017 2017</td>
<td>Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</td>
<td>Cleaning Devices</td>
</tr>
<tr>
<td>ASHRAE 62.2-2016 2019</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
</tr>
<tr>
<td>ASHRAE Handbook-2016 2020</td>
<td>HVAC Systems and Equipment</td>
<td>Design</td>
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</table>

(portion of table not shown remain unchanged)
SUBSTANTIATION:
The above revisions reflect the latest updates to the ASHRAE standards that are referenced in Table 1701.1 and Table 1701.2.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: Table 1801.1, Table 1801.2

SUBMITTER: Emily Toto ASHRAE

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 170-2017 2021</td>
<td>Ventilation of Health Care Facilities</td>
<td>Ventilation</td>
<td>402.1.2</td>
</tr>
<tr>
<td>ASHRAE Handbook-2017-2021</td>
<td>Fundamentals</td>
<td>Climatic Conditions</td>
<td>Figure 803.1.2(6)</td>
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</tbody>
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(portion of table not shown remain unchanged)

Note: The ASHRAE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>ASHRAE 55-2017 2020</td>
<td>Thermal Environmental Conditions for Human Occupancy</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>ASHRAE 127-2014 2020</td>
<td>Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners</td>
<td>Air Conditioners</td>
</tr>
<tr>
<td>ASHRAE 169-2020 2021</td>
<td>Climatic Data for Building Design Standards</td>
<td>Miscellaneous</td>
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(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASHRAE standards that are referenced in Table 1801.1 and Table 1801.2.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: Table 1801.1, Table 1801.2  Item #: 333

SUBMITTER: Emily Toto  ASHRAE

Comment #: 2

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

### TABLE 1801.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE 15-2022</td>
<td>Safety Standard for Refrigeration Systems</td>
<td>Refrigeration Systems</td>
<td>1102.1, 1106.1, Table 1113.5</td>
</tr>
<tr>
<td>ASHRAE 34-2022</td>
<td>Designation and Safety Classification of Refrigerants</td>
<td>Refrigeration Classifications</td>
<td>1102.3, 1103.1, Table 1102.3, Table 1106.2.5.2</td>
</tr>
<tr>
<td>ASHRAE 62.1-2022</td>
<td>Ventilation and Acceptable Indoor Air Quality</td>
<td>Indoor Air Quality Ventilation</td>
<td>402.4.1</td>
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</table>

(portion of table not shown remain unchanged)

Note: ASHRAE 15, ASHRAE 34, and ASHRAE 62.1 were not provided at the time of this monograph.

### TABLE 1801.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
</tr>
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<tbody>
<tr>
<td>ASHRAE 52.2-2022</td>
<td>Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</td>
<td>Cleaning Devices</td>
</tr>
<tr>
<td>ASHRAE 62.2-2022</td>
<td>Ventilation and Acceptable Indoor Air Quality in Residential Buildings</td>
<td>Ventilation</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: ASHRAE 52.2, ASHRAE 62.2, and ASHRAE/IES 90.1 were not provided at the time of this monograph.

**SUBSTANTIATION:**
Several of the ASHRAE standards listed are being updated in 2022; 15, 34, 52.2, 62.1, 62.2, and 90.1 are scheduled to publish in fall 2022. IAPMO should consider the latest standards for inclusion in the UMC references so that the 2024 code contains the most recent information.
Proposals

Item #: 334
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Carlton Ramcharran
ASME

RECOMMENDATION:
Revise text

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>ASME B1.20.1-2013 (R2018)</td>
<td>Pipe Threads, General Purpose (Inch)</td>
<td>Joints</td>
<td>1211.2(3), 1211.4(7), 1211.12(3), 1211.13(2), 1308.5.6</td>
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<tr>
<td>ASME B31.3-2018</td>
<td>Process Piping</td>
<td>Process Piping</td>
<td>1406.1</td>
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<tr>
<td>ASME B31.5-2019</td>
<td>Refrigeration Piping and Heat Transfer Components</td>
<td>Refrigeration Piping</td>
<td>1109.1.1, 1109.1.3</td>
</tr>
<tr>
<td>ASME BPVC Section I-2017</td>
<td>Rules for Construction of Power Boilers</td>
<td>Boilers</td>
<td>1002.1(1), Table 1003.2.1</td>
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<tr>
<td>ASME BPVC Section IV-2019</td>
<td>Rules for Construction of Heating Boilers</td>
<td>Boilers</td>
<td>1002.1(2)</td>
</tr>
<tr>
<td>ASME BPVC Section VIII.1-2019</td>
<td>Rules for Construction of Pressure Vessels Division 1</td>
<td>Pressure Vessels</td>
<td>1002.1, 1004.3, 1112.10.1, 1112.13, 1113.1, 1115.4, 1115.4.1, 1117.1(2), 1117.1(3), 1117.2, 1209.4</td>
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(portion of table not shown remain unchanged)

Note: The ASME standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
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<tbody>
<tr>
<td>ASME A13.1-2015</td>
<td>Scheme for the Identification of Piping Systems</td>
<td>Piping</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASME standards that are referenced in Table 1701.1 and Table 1701.2.

COMMITTEE ACTION: ACCEPT AS SUBMITTED
TOTAL ELIGIBLE TO VOTE: 30  
VOTING RESULTS:  
AFFIRMATIVE: 29  
NOT RETURNED: 1  
Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  
Section #: Table 1801.1, Table 1801.2  
SUBMITTER: Angel Guzman  
ASME  

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
<thead>
<tr>
<th>TABLE 1801.1</th>
<th>REFERENCED STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STANDARD NUMBER</strong></td>
<td><strong>STANDARD TITLE</strong></td>
</tr>
<tr>
<td>ASME B16.1-2015</td>
<td>Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250</td>
</tr>
<tr>
<td>ASME B16.5-2017</td>
<td>Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch</td>
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<tr>
<td>ASME B16.47-2017</td>
<td>Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch</td>
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<tr>
<td>ASME B31.3-2018</td>
<td>Process Piping</td>
</tr>
<tr>
<td>ASME BPVC Section I-2019-2021</td>
<td>Rules for Construction of Power Boilers</td>
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<tr>
<td>ASME BPVC Section IV-2019-2021</td>
<td>Rules for Construction of Heating Boilers</td>
</tr>
<tr>
<td>ASME BPVC Section VIII.1-2019-2021</td>
<td>Rules for Construction of Pressure Vessels Division 1</td>
</tr>
<tr>
<td>ASME CSD-1-2018</td>
<td>Controls and Safety Devices for Automatically Fired Boilers</td>
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</table>

Note: The ASME standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

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<th>TABLE 1801.2</th>
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<td><strong>DOCUMENT NUMBER</strong></td>
<td><strong>DOCUMENT TITLE</strong></td>
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<tr>
<td>ASME A112.18.6/CSA B125.6-2017</td>
<td>Flexible Water Connectors</td>
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</tbody>
</table>

Note: The above revisions reflect the latest updates to the ASME standards that are referenced in Table 1801.1 and Table 1801.2.
Proposals

Item #: 335
UMC 2024  Section: Table 1701.1

SUBMITTER: Terry Burger
ASSE

RECOMMENDATION:
Revise text

<table>
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<th>STANDARD NUMBER</th>
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<tr>
<td>ASSE 1061-2015</td>
<td>Push-Fit Fittings</td>
<td>Fittings</td>
<td>1211.2(1), 1211.4(5), Table 1210.1</td>
</tr>
<tr>
<td>ASSE 1079-2012</td>
<td>Dielectric Pipe Fittings</td>
<td>Fittings</td>
<td>1211.14.1</td>
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(portion of table not shown remain unchanged)

Note: The ASSE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 1701.1.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.1, Table 1801.2

SUBMITTER: Terry Burger
ASSE

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.
### TABLE 1801.1
REFERENCED STANDARDS

<table>
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<th>STANDARD NUMBER</th>
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<tr>
<td>ASSE 1013-2011</td>
<td>Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers Prevention Assemblies</td>
<td>Backflow Protection</td>
<td>1202.2</td>
</tr>
<tr>
<td>ASSE 1079-2012</td>
<td>Dielectric Pipe Fittings Unions</td>
<td>Fittings</td>
<td>1211.14.1</td>
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</table>

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**Note:** The ASSE standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

### TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

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<thead>
<tr>
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<tbody>
<tr>
<td>ASSE/IAPMO/ANSI 16020-2019</td>
<td>Professional Qualifications Standard for the Mechanical Inspector</td>
<td>Professional Qualifications</td>
</tr>
<tr>
<td>ASSE/IAPMO/ANSI 16050-2019</td>
<td>Professional Qualifications Standard for the Mechanical Plan Examiner</td>
<td>Professional Qualifications</td>
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(portion of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the ASSE standards that are referenced in Table 1801.1 and Table 1801.2.
**Proposals**

**Item #: 337**

UMC 2024  Section: Table 1701.1, Table 1701.2

**SUBMITTER:** Steve Mawn  
ASTM

**RECOMMENDATION:**  
Revise text

### TABLE 1701.1
**REFERRED STANDARDS**

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<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>ASTM A53/A53M-2018</td>
<td>Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless</td>
<td>Piping</td>
<td>1308.5.2.1(1), Table 1210.1</td>
</tr>
<tr>
<td>ASTM A106/A106M-2018</td>
<td>Seamless Carbon Steel Pipe for High-Temperature Service</td>
<td>Piping</td>
<td>1308.5.2.1(2), Table 1210.1</td>
</tr>
<tr>
<td>ASTM A126-2004 (R2019)</td>
<td>Gray Iron Castings for Valves, Flanges, and Pipe Fittings</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM A254/A254M-2012 (R2019)</td>
<td>Copper-Brazed Steel Tubing</td>
<td>Piping</td>
<td>1308.5.3.2, Table 1210.1</td>
</tr>
<tr>
<td>ASTM A268/A268M-2010 (R2014) 2020</td>
<td>Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service</td>
<td>Tubing</td>
<td>1308.5.3.1(1)</td>
</tr>
<tr>
<td>ASTM A269/A269M-2015a (R2019)</td>
<td>Seamless and Welded Austenitic Stainless Steel Tubing for General Service</td>
<td>Piping, Tubing</td>
<td>1308.5.3.1(2), Table 1210.1</td>
</tr>
<tr>
<td>ASTM A312/A312M-2018 (R2019)</td>
<td>Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes</td>
<td>Piping Ferrous</td>
<td>1308.5.2.1(3), Table 1210.1</td>
</tr>
<tr>
<td>ASTM A420/A420M-2014-2020</td>
<td>Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B32-2008 (R2014) 2020</td>
<td>Solder Metal</td>
<td>Joints</td>
<td>1211.4(6)</td>
</tr>
<tr>
<td>ASTM B42-2015a-2020</td>
<td>Seamless Copper Pipe, Standard Sizes</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B43-2014-2020</td>
<td>Seamless Red Brass Pipe, Standard Sizes</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B75/B75M-2014 2020</td>
<td>Seamless Copper Tube</td>
<td>Piping</td>
<td>Table 1210.1</td>
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<tr>
<td>ASTM B88-2016-2020</td>
<td>Seamless Copper Water Tube</td>
<td>Piping</td>
<td>1308.5.3.3, Table 1210.1</td>
</tr>
<tr>
<td>ASTM B210-2012-2019a</td>
<td>Aluminum and Aluminum-Alloy Drawn Seamless Tubes</td>
<td>Piping</td>
<td>1308.5.3.4</td>
</tr>
<tr>
<td>ASTM B280-2018-2020</td>
<td>Seamless Copper Tube for Air Conditioning and Refrigeration Field Service</td>
<td>Piping</td>
<td>1109.1.2, 1308.5.3.3</td>
</tr>
<tr>
<td>ASTM C411-2017-2019</td>
<td>Hot-Surface Performance of High-Temperature Thermal Insulation Duct Coverings and Linings</td>
<td>605.1.2</td>
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<tr>
<td>ASTM D1693-2015*1</td>
<td>Environmental Stress-Cracking of Ethylene Plastics</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM D2241-2015-2020</td>
<td>Poly-(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>STANDARD NUMBER</td>
<td>STANDARD TITLE</td>
<td>APPLICATION</td>
<td>REFERENCED SECTION</td>
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</tr>
<tr>
<td>ASTM D2467-2015-2020</td>
<td>Poly-(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM D2513-2018a 2020</td>
<td>Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings</td>
<td>Piping</td>
<td>1308.5.4, 1308.5.4.2.2, 1308.5.8.2, 1310.1.7.1(1), Table 1210.1</td>
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<tr>
<td>ASTM D2846/D2846M-2017b 2019a</td>
<td>Chlorinated Poly-(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems</td>
<td>Piping</td>
<td>1211.2(2), 1211.3(2), Table 1210.1</td>
</tr>
<tr>
<td>ASTM E84-2018b 2021</td>
<td>Surface Burning Characteristics of Building Materials</td>
<td>Miscellaneous</td>
<td>508.3.4, 602.2, 605.1.1, 605.1.2, 1201.2</td>
</tr>
<tr>
<td>ASTM E2231-2018-2019</td>
<td>Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics</td>
<td>Insulation of Ducts</td>
<td>605.1.2</td>
</tr>
<tr>
<td>ASTM E2336-2016-2020</td>
<td>Fire Resistant Grease Duct Enclosure Systems</td>
<td>Grease Ducts</td>
<td>507.4.2.2, 507.4.5</td>
</tr>
<tr>
<td>ASTM F439-2013-2019</td>
<td>Chlorinated Poly-(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F441/F441M-2016-2020</td>
<td>Chlorinated Poly-(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F442/F442M-2013b+ 2020</td>
<td>Chlorinated Poly-(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)</td>
<td>Piping</td>
<td>1210.1, 1211.2(2)</td>
</tr>
<tr>
<td>ASTM F493-2014-2020</td>
<td>Solvent Cements for Chlorinated Poly-(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings</td>
<td>Joints</td>
<td>1211.2(2), 1211.3(2)</td>
</tr>
<tr>
<td>ASTM F714-2013 2021</td>
<td>Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F876-2017-2020b</td>
<td>Crosslinked Polyethylene (PEX) Tubing</td>
<td>Piping</td>
<td>1211.5, Table 1210.1</td>
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<td>ASTM F877-2018a 2020</td>
<td>Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F1476-2007 (R2014) (R2019)</td>
<td>Performance of Gasketed Mechanical Couplings for Use in Piping Applications</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F1807-2018a 2019b</td>
<td>Metal Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps, for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F1960-2018a 2019a</td>
<td>Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F1970-2014b+ 2019</td>
<td>Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
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</table>
### TABLE 1701.1
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM F1974-2009 (R2014) (R2020)</td>
<td>Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Crosslinked Polyethylene/Aluminum/ Crosslinked Polyethylene Composite Pressure Pipe</td>
<td>Fittings</td>
<td>1211.6(1), 1211.9(1), Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2080-2018-2019</td>
<td>Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2159-2018a 2020</td>
<td>Plastic Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2389-2017a 2019</td>
<td>Pressure-Rated Polypropylene (PP) Piping Systems</td>
<td>Piping</td>
<td>1211.11(1), Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2434-2018-2019</td>
<td>Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing</td>
<td>Fittings</td>
<td>1211.6(1), Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2620-2013-2020</td>
<td>Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings</td>
<td>Joints</td>
<td>1211.8(1), 1211.8(3)</td>
</tr>
<tr>
<td>ASTM F2623-2014-2019</td>
<td>Polyethylene of Raised Temperature (PE-RT) SDR9 Tubing for Non-Potable Water Applications</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2855-2012-2019</td>
<td>Specification for Chlorinated Poly-(Vinyl Chloride)/Aluminum/Chlorinated Poly-(Vinyl Chloride) (CPVC-AL-CPVC) Composite Pressure Tubing</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F3226/F3226M-2014e2019</td>
<td>Metallic Press-Connect Fittings for Piping and Tubing Systems</td>
<td>Fittings</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F3253-2018-2019</td>
<td>Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot- and Cold-Water Hydronic Distribution Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**Note:** The ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

### TABLE 1701.2
**STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A568/A568M-2019a</td>
<td>Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for</td>
<td>Piping</td>
</tr>
<tr>
<td>ASTM A653/A653M-2014-2020</td>
<td>Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process</td>
<td>Piping, Ferrous</td>
</tr>
<tr>
<td>ASTM D93-2018-2020</td>
<td>Flash Point by Pensky-Martens Closed Cup Tester</td>
<td>Certification</td>
</tr>
<tr>
<td>ASTM D396-2018a</td>
<td>Fuel Oils</td>
<td>Boiler</td>
</tr>
</tbody>
</table>
### 2020

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<thead>
<tr>
<th>Item #</th>
<th>Comment #</th>
<th>ASTM E136-2016a 2019a</th>
<th>Behavior Assessing Combustibility of Materials in Using a Vertical Tube Furnace at 750°C</th>
<th>Furnace</th>
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</table>

(portion of table not shown remain unchanged)

### SUBSTANTIATION:
The above revisions reflect the latest updates to the ASTM standards that are referenced in Table 1701.1 and Table 1701.2.

### COMMITTEE ACTION: ACCEPT AS SUBMITTED

### TOTAL ELIGIBLE TO VOTE: 30

### VOTING RESULTS: AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

### Appended Comments

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### PUBLIC COMMENT 1

**Code Year:** 2024 UMC  **Section #:** Table 1801.1, Table 1801.2  **Item #:** 337  **SUBMITTER:** Steve Mawn American Society of Testing and Materials (ASTM)  **Comment #:** 1

**RECOMMENDATION:**
Revise text

Request to accept the code change proposal as modified by this public comment.

### TABLE 1801.1

### REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A53/A53M-2020</td>
<td>Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1, 1308.4.2.2(1)</td>
</tr>
<tr>
<td>ASTM A105/A105M-2021</td>
<td>Standard Specification for Carbon Steel Forgings for Piping Applications</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A106/A106M-2019a</td>
<td>Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1, 1308.4.2.2(2)</td>
</tr>
<tr>
<td>ASTM A181/A181M-2014 (R2020)</td>
<td>Standard Specification for Carbon Steel Forgings, for General-Purpose Piping</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A193/A193M-2020</td>
<td>Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications</td>
<td>Fittings</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A234/A234M-2019</td>
<td>Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service</td>
<td>Fittings</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A254/A254M-2012 (R2019)</td>
<td>Standard Specification for Copper-Brazed Steel Tubing</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1, 1308.4.3.1</td>
</tr>
<tr>
<td>ASTM A268/A268M-2020</td>
<td>Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service</td>
<td>Tubing</td>
<td>1308.4.3.2(1)</td>
</tr>
<tr>
<td>ASTM A269/A269M-2015a (R2019)</td>
<td>Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service</td>
<td>Piping, Tubing</td>
<td>Table 1210.1, 1308.4.3.2(2)</td>
</tr>
<tr>
<td>ASTM Standard Number</td>
<td>Standard Specification Description</td>
<td>Material Type</td>
<td>Table Numbers</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>ASTM A312/A312M-2019</td>
<td>Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes</td>
<td>Piping Ferrous</td>
<td>Table 1210.1, 1308.4.2.2(3)</td>
</tr>
<tr>
<td>ASTM A333/A333M-2018</td>
<td>Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A334/A334M-2004a</td>
<td>Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A420/A420M-2020</td>
<td>Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service</td>
<td>Fittings</td>
<td>Table 1109.1, Table 1210.1</td>
</tr>
<tr>
<td>ASTM A554-2946 2021</td>
<td>Standard Specification for Welded Stainless Steel Mechanical Tubing</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM A707/A707M-2019</td>
<td>Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service</td>
<td>Fittings</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM A778/A778M-2016 (R2021)</td>
<td>Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B42-2020</td>
<td>Standard Specification for Seamless Copper Pipe, Standard Sizes</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1</td>
</tr>
<tr>
<td>ASTM B43-2020</td>
<td>Standard Specification for Seamless Red Brass Pipe, Standard Sizes</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1</td>
</tr>
<tr>
<td>ASTM B68/B68M-2019</td>
<td>Standard Specification for Seamless Copper Tube, Bright Annealed</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM B75/B75M-2020</td>
<td>Standard Specification for Seamless Copper Tube</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1</td>
</tr>
<tr>
<td>ASTM B88-2020</td>
<td>Standard Specification for Seamless Copper Water Tube</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1, 1308.4.3.3</td>
</tr>
<tr>
<td>ASTM B135/B135M-2017</td>
<td>Standard Specification for Seamless Brass Tube</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B210-2019a</td>
<td>Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes</td>
<td>Piping</td>
<td>Table 1109.1, 1308.4.3.4</td>
</tr>
<tr>
<td>ASTM B241/B241M-2016</td>
<td>Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube</td>
<td>Piping</td>
<td>1308.4.2.4, 1308.4.3.4</td>
</tr>
<tr>
<td>ASTM B251/B251M-2017</td>
<td>Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B280-2020</td>
<td>Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service</td>
<td>Piping</td>
<td>Table 1109.1, 1109.1.2, 1308.4.3.3, 1715.3</td>
</tr>
<tr>
<td>ASTM B302-2017</td>
<td>Standard Specification for Threadless Copper Pipe, Standard Sizes</td>
<td>Piping</td>
<td>Table 1109.1, Table 1210.1</td>
</tr>
<tr>
<td>ASTM B361-2016</td>
<td>Standard Specification for Factory-Made Wrought Aluminum and Aluminum-Alloy Welding Fittings</td>
<td>Fittings</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM B447-2012a (R2021)</td>
<td>Standard Specification for Welded Copper Tube</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM B491/ASTM B491M-2015</td>
<td>Standard Specification for Aluminum and Aluminum-Alloy Extruded Round Tubes for General-Purpose Applications</td>
<td>Piping</td>
<td>Table 1109.1</td>
</tr>
<tr>
<td>ASTM Standard</td>
<td>Title</td>
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<td></td>
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<tr>
<td>---------------</td>
<td>-------</td>
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<tr>
<td>B819-2019</td>
<td>Standard Specification for Seamless Copper Tube for Medical Gas Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B828-2016</td>
<td>Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1003-2016</td>
<td>Standard Specification for Seamless Copper Tube for Linesets</td>
<td></td>
<td></td>
</tr>
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<td>D1693-2021</td>
<td>Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics</td>
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<tr>
<td>D1785-2021</td>
<td>Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2241-2020</td>
<td>Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2513-2020</td>
<td>Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2609-2021</td>
<td>Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2683-2020</td>
<td>Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2737-2021</td>
<td>Standard Specification for Polyethylene (PE) Plastic Tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3035-2021</td>
<td>Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3350-2021</td>
<td>Standard Specification for Polyethylene Plastics Pipe and Fittings Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E84-2021a</td>
<td>Standard Test Method for Surface Burning Characteristics of Building Materials</td>
<td></td>
<td></td>
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<td>Standard</td>
<td>Description</td>
<td>Section(s)</td>
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<tr>
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<td>-------------</td>
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<td>ASTM E779-2019</td>
<td>Standard Test Method for Determining Air Leakage Rate by Fan Pressurization</td>
<td>Air Ducts 405.2.1</td>
<td></td>
</tr>
<tr>
<td>ASTM E2231-2019</td>
<td>Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics</td>
<td>Insulation of Ducts 605.1.2</td>
<td></td>
</tr>
<tr>
<td>ASTM E2336-2020</td>
<td>Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems</td>
<td>Grease Ducts 507.4.2.2, 507.4.5</td>
<td></td>
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<tr>
<td>ASTM F438-2017</td>
<td>Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40</td>
<td>Fittings Table 1210.1</td>
<td></td>
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<tr>
<td>ASTM F441/F441M-2020</td>
<td>Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80</td>
<td>Piping Table 1210.1, 1211.2(2)</td>
<td></td>
</tr>
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<td>ASTM F442/F442M-2020</td>
<td>Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)</td>
<td>Piping Table 1210.1, 1211.2(2)</td>
<td></td>
</tr>
<tr>
<td>ASTM F714-2021a</td>
<td>Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter</td>
<td>Piping, Plastic Table 1210.1, Table 1703.2</td>
<td></td>
</tr>
<tr>
<td>ASTM F876-2020b</td>
<td>Standard Specification for Crosslinked Polyethylene (PEX) Tubing</td>
<td>Piping Table 1210.1, 1211.5, Table 1703.2</td>
<td></td>
</tr>
<tr>
<td>ASTM F877-2020</td>
<td>Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems</td>
<td>Piping Table 1210.1, Table 1703.3</td>
<td></td>
</tr>
<tr>
<td>ASTM F1055-2016a</td>
<td>Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing</td>
<td>Fittings Table 1210.1, Table 1703.3, 1703.4.1.1(3)</td>
<td></td>
</tr>
<tr>
<td>ASTM F1281-2017 (R2021)</td>
<td>Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe</td>
<td>Piping Table 1210.1</td>
<td></td>
</tr>
<tr>
<td>ASTM F1282-2017</td>
<td>Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe</td>
<td>Piping Table 1210.1</td>
<td></td>
</tr>
<tr>
<td>ASTM F1548-2001 (R2018)</td>
<td>Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications</td>
<td>Fittings Table 1210.1</td>
<td></td>
</tr>
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<td>Standard Specification</td>
<td>Description</td>
<td>Category</td>
<td>Tables</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>ASTM F1807-2019b</td>
<td>Metal Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps, for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1, Table 1703.3</td>
</tr>
<tr>
<td>ASTM F1960-2019a 2021</td>
<td>Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1, Table 1703.3</td>
</tr>
<tr>
<td>ASTM F1970-2019</td>
<td>Special Engineered Fittings, Appurtenances or Valves for Use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F1973-2013 (R2018)</td>
<td>Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems</td>
<td>Fuel Gas</td>
<td>1310.1.7.1(2)</td>
</tr>
<tr>
<td>ASTM F1974-2009 (R2020)</td>
<td>Metal Insert Fittings for Polyethylene/Aluminum/Poly-ethylene and Crosslinked Polyethylene/Aluminum/ Crosslinked Polyethylene Composite Pressure Pipe</td>
<td>Fittings</td>
<td>Table 1210.1, 1211.6(1), 1211.9(1)</td>
</tr>
<tr>
<td>ASTM F2080-2019</td>
<td>Cold-Expansion Fittings with Metal Compression- Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe</td>
<td>Fittings</td>
<td>Table 1210.1, Table 1703.3</td>
</tr>
<tr>
<td>ASTM F2098-2018</td>
<td>Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings</td>
<td>Joints</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2158-2008 (R2016)</td>
<td>Residential Central-Vacuum Tube and Fittings</td>
<td>Exhaust Systems</td>
<td>506.1(3), 506.2(2)</td>
</tr>
<tr>
<td>ASTM F2159-2020 2021</td>
<td>Plastic Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps for SDR9 Crosslinked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1, Table 1703.3</td>
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<tr>
<td>ASTM F2165-2019</td>
<td>Flexible Pre-Insulated Plastic Piping</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ASTM F2389-2049 2021</td>
<td>Pressure-Rated Polypropylene (PP) Piping Systems</td>
<td>Piping</td>
<td>Table 1210.1, 1211.11(1), Table 1703.2, Table 1703.3</td>
</tr>
<tr>
<td>ASTM F2434-2019</td>
<td>Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing</td>
<td>Fittings</td>
<td>Table 1210.1, 1211.6(1), Table 1703.3</td>
</tr>
</tbody>
</table>
### TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A568/A568M-2019</td>
<td><strong>Standard Specification for</strong> Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for</td>
<td>Piping</td>
</tr>
<tr>
<td>ASTM A653/A653M-2020</td>
<td><strong>Standard Specification for</strong> Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process</td>
<td>Piping, Ferrous</td>
</tr>
<tr>
<td>ASTM A733-2016</td>
<td><strong>Standard Specification for</strong> Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples</td>
<td>Piping, Ferrous</td>
</tr>
<tr>
<td>ASTM B370-2012 (R2019)</td>
<td><strong>Standard Specification for</strong> Copper Sheet and Strip for Building Construction</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>ASTM B687-1999 (R2016)</td>
<td><strong>Standard Specification for</strong> Brass, Copper, and Chromium-Plated Pipe Nipples</td>
<td>Piping, Copper Alloy</td>
</tr>
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</table>

Note: The ASTM standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
<table>
<thead>
<tr>
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<th></th>
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<tbody>
<tr>
<td>ASTM D93-2020</td>
<td><strong>Standard Test Methods for</strong> Flash Point by Pensky-Martens Closed Cup Tester</td>
<td>Certification</td>
</tr>
<tr>
<td>ASTM D396-2020 2021</td>
<td><strong>Standard Specification for</strong> Fuel Oils</td>
<td>Boiler</td>
</tr>
<tr>
<td>ASTM E96/E96M-2016</td>
<td><strong>Standard Test Methods for</strong> Water Vapor Transmission of Materials</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>ASTM E136-2019a</td>
<td><strong>Standard Test Method for</strong> Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C</td>
<td>Furnace</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the ASTM standards that are referenced in Table 1801.1 and Table 1801.2.
Proposals

Item #: 339
UMC 2024 Section: Table 1701.1

SUBMITTER: Paul Olson
AWWA

RECOMMENDATION:
Revise text

TABLE 1701.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
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<tr>
<td>AWWA C115-2019</td>
<td>Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Treaded Flanges</td>
<td>Piping</td>
<td>Table 1210.1</td>
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<tr>
<td>AWWA C153-2019</td>
<td>Ductile-Iron Compact Fittings</td>
<td>Fittings</td>
<td>Table 1210.1</td>
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</table>

(portion of table not shown remain unchanged)

Note: The AWWA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the AWWA standards that are referenced in Table 1701.1.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29 NOT RETURNED: 1 Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC Section #: Table 1801.1
Item #: 339

SUBMITTER: Paul Olson
AWWA

Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.
<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWWA C901-2017 2021</td>
<td>Polyethylene (PE) Pressure Pipe and Tubing, 3/4 in. (19 mm) Through 3 in. (76 mm) for Water Service</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**Note:** The AWWA standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**SUBSTANTIATION:**
The above revision reflects the latest updates to the AWWA C901 standard that is referenced in Table 1801.1.
## TABLE 1701.1
### REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA B137.1-2017</td>
<td>Polyethylene (PE) Pipe, Tubing, and Fittings for Cold-Water Pressure Services</td>
<td>Piping</td>
<td>Table 1210.1</td>
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<tr>
<td>CSA B137.5-2017</td>
<td>Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications</td>
<td>Piping</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>CSA B137.6-2017</td>
<td>Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>CSA B137.9-2017</td>
<td>Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure-Pipe Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
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<tr>
<td>CSA B137.10-2017</td>
<td>Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Composite Pressure-Pipe Systems</td>
<td>Piping</td>
<td>Table 1210.1</td>
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<tr>
<td>CSA B137.11-2017</td>
<td>Polypropylene (PP-R &amp; PP-RCT) Pipe and Fittings for Pressure Applications</td>
<td>Piping</td>
<td>1211.11(1), Table 1210.1</td>
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<tr>
<td>CSA B137.18-2017</td>
<td>Polyethylene of Raised Temperature Resistance (PE-RT) Tubing Systems for Pressure Applications</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>ANSI/CSA FC 1-2014</td>
<td>Fuel Cell Technologies— Part 3-100: Stationary Fuel Cell Power Systems— Safety</td>
<td>Fuel Gas</td>
<td>1308.5.3.5, 1310.4.1(4), 1311.3</td>
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<tr>
<td>ANSI/CSA Z21.10.1-2017</td>
<td>Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less (same as CSA 4.1)</td>
<td>Fuel Gas, Appliances</td>
<td>Table 1203.2</td>
</tr>
<tr>
<td>ANSI/CSA Z21.10.3-2017</td>
<td>Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous (same as CSA 4.3)</td>
<td>Fuel Gas, Appliances</td>
<td>Table 1203.2</td>
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<tr>
<td>ANSI/CSA Z21.24-2015</td>
<td>Connectors for Gas Appliances (same as CSA 6.10)</td>
<td>Fuel Gas</td>
<td>1312.1(3), 1312.2</td>
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<tr>
<td>ANSI/CSA Z21.41-2014</td>
<td>Quick Disconnect Devices for Use with Gas Fuel Appliances (same as CSA 6.9)</td>
<td>Fuel Gas</td>
<td>1312.7</td>
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<tr>
<td>CSA/ANSI Z21.11.2-2016</td>
<td>Gas-Fired Room Heaters, Volume II, Unvented Room Heaters</td>
<td>Room Heaters, Unvented Heaters</td>
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<tr>
<td>CSA ANSI Z21.15b-2013</td>
<td>Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves</td>
<td>Fuel Gas</td>
<td></td>
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<tr>
<td>CSA ANSI Z21.17a-2008</td>
<td>Domestic Gas Conversion Burners</td>
<td>Conversion Burner Installation, Gas Burners</td>
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<tr>
<td>CSA/ANSI Z21.18-2012</td>
<td>Gas Appliance Pressure Regulators</td>
<td>Appliance Regulators, Gas Refrigerators, Pressure Regulators</td>
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<tr>
<td>CSA ANSI Z21.42-2013</td>
<td>Gas-Fired Illuminating Appliances</td>
<td>Illuminating Appliances</td>
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<tr>
<td>CSA ANSI Z21.50-2016</td>
<td>Vented Decorative Gas Appliances</td>
<td>Appliances, Decorative Appliances</td>
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<tr>
<td>CSA ANSI Z21.88-2016</td>
<td>Vented Gas Fireplace Heaters</td>
<td>Fireplace Heaters</td>
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</table>

Note: The CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.
SUBSTANTIATION:
The above revisions reflect the latest updates to the CSA standards that are referenced in Table 1701.1 and Table 1701.2.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS: AFFIRMATIVE: 29
NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.1, Table 1801.2

SUBMITTER: Lauro Pilla, Canadian Standards Association (CSA); Nikki Kidd, Canadian Standards Association (CSA)

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tr>
<td>ANSI Z83.11-2016 (R2021)/CSA 1.8-2016 (R2021)</td>
<td>Gas Food Service Equipment</td>
<td>Fuel Gas, Appliances</td>
<td>917.1, 918.1, 921.1, 922.1</td>
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<tr>
<td>ANSI Z83.8-2016/CSA 2.6-2016 (R2021)</td>
<td>Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces</td>
<td>Fuel Gas Appliances</td>
<td>905.1, 916.1</td>
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<tr>
<td>ANSI Z21.5.2-2016 (R2021)/CSA 7.2-2016 (R2021)</td>
<td>Gas Clothes Dryers, Volume II, Type 2 Clothes Dryers</td>
<td>Fuel Gas, Appliances</td>
<td>908.1</td>
</tr>
<tr>
<td>CSA/ANSI Z21.15a-2021/CSA 9.1b-2043 (R2049)-2021</td>
<td>Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves</td>
<td>Valves</td>
<td>Table 1308.12</td>
</tr>
<tr>
<td>CSA B137.2-2017 2020</td>
<td>Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>CSA B137.3-2047 2020</td>
<td>Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications (with Update No. 1)</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>CSA B137.6-2020</td>
<td>Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems (with Update No. 1)</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
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<tr>
<td>ANSI/CSA/IGSHPA C448 Series-2016 (R2021)</td>
<td>Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings</td>
<td>Ground-Source Heat Pumps</td>
<td>Table 1703.2, Table 1703.3, 1709.1, 1710.6, 1710.6.2, 1715.4</td>
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<tr>
<td>DOCUMENT NUMBER</td>
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</tbody>
</table>

**Note:** The CSA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
Proposals

Item #: 341

UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Kyle Thompson
IAPMO

RECOMMENDATION:
Revise text

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>IAPMO PS 117-2017-2019</td>
<td>Press and Nail Connections</td>
<td>Fittings</td>
<td>Table 1210.1</td>
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</table>

(portion of table not shown remain unchanged)

Note: The IAPMO standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

**TABLE 1701.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
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<tr>
<td>IAPMO IGC 293-2012 (R2020)</td>
<td>Tubing and Fittings for Special Hydronic Radiant Drywall Panels</td>
<td>HVAC, Fittings, Tubing</td>
</tr>
<tr>
<td>IAPMO PS 120-2004 2019</td>
<td>Flashing and Stand Combination for Air Conditioning Units (Residential or Commercial Unit Curb)</td>
<td>Air Conditioning Flashing Stand</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the IAPMO standards that are referenced in Table 1701.1 and Table 1701.2.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.1  Item #: 341
SUBMITTER: Terry Burger  IAPMO
Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

| TABLE 1801.1 |
| REFERENCE STANDARD |
| STANDARD NUMBER | STANDARD TITLE | APPLICATION | REFERENCED SECTION |
| IAPMO PS 117-2019 2021 | Press Connections | Fittings | Table 1210.1 |

(portion of table not shown remain unchanged)

Note: The IAPMO standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revision reflects the latest update to the IAPMO standard that is referenced in Table 1801.1.
Proposals

Item #: 344
UMC 2024  Section: Table 1701.1

SUBMITTER: Eric Smith
IIAR

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
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<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
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</table>

<table>
<thead>
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<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
</table>

(portion of table not shown remain unchanged)

Note: IIAR 4 and IIAR 5 meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

Note: IIAR 2 is a working draft and is not completed at the time of this monograph.

SUBSTANTIATION:
The above revisions reflect the latest updates to the IIAR standards that are referenced in Table 1701.1.

COMMITTEE ACTION: ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

<table>
<thead>
<tr>
<th>TABLE 1701.1</th>
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<tbody>
<tr>
<td>REFERENCED STANDARDS</td>
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</table>

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
<tbody>
<tr>
<td>IIAR/ANSI 4-2020</td>
<td>Installation of Closed-Circuit Ammonia Refrigeration Systems</td>
<td>Ammonia Refrigeration Systems</td>
<td>1102.2</td>
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<tr>
<td>IIAR 5-2019</td>
<td>Startup of Closed-Circuit Ammonia Refrigeration Systems</td>
<td>Ammonia Refrigeration Systems</td>
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</table>

(portion of table not shown remain unchanged)
COMMITTEE STATEMENT:
IIAR 2-2021 was a working draft and was not completed at the time of this monograph. Therefore, IIAR 2 is being modified to remain as the 2014 edition.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

Appended Comments

PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.1  Item #: 344


RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
<thead>
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<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</table>

(portion of table not shown remain unchanged)

Note: IIAR 2 meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
Eric Smith: The above revision reflects the latest update to the IIAR standard that is referenced in Table 1801.1.

Jeffrey Shapiro: The above revision reflects the latest update to IIAR 2, which is referenced in Table 1801.1. Although the standard was completed before the Technical Committee meeting, the final published text was only made available to the Technical Committee shortly before the meeting. The Technical Committee wanted the published version to be available for a longer period of time to allow for review prior to considering approval. It has now been available for several months and is attached to this public comment. It is important for IAPMO to consider updating the referenced edition of IIAR 2 because the version referenced in the 2021 code is now two editions out of date.
PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: Table 1801.1  Item #: 344

SUBMITTER: Jeff Schools  NEBB  Comment #: 2

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
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<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</table>

(ports of table not shown remain unchanged)

Note: The NEBB standard meets the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revision reflects the latest update to the NEBB standard that is referenced in Table 1801.1.
Proposals

Item #: 345
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: Alex Ing
NFPA

RECOMMENDATION:
Revise text

<table>
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<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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</thead>
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<tr>
<td>NFPA 2-2016-2020</td>
<td>Hydrogen Technologies Code</td>
<td>Gaseous Hydrogen Systems</td>
<td>937.1</td>
</tr>
<tr>
<td>NFPA 17-2017 2021</td>
<td>Dry Chemical Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(3), 513.3.5</td>
</tr>
<tr>
<td>NFPA 17A-2017 2021</td>
<td>Wet Chemical Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(4), 513.2.5.6, 513.3.5</td>
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<td>NFPA 30A-2018 2021</td>
<td>Motor Fuel Dispensing Facilities and Repair Garages</td>
<td>Miscellaneous</td>
<td>303.11</td>
</tr>
<tr>
<td>NFPA 31-2016 2020</td>
<td>Installation of Oil-Burning Equipment</td>
<td>Fuel Gas, Appliances</td>
<td>301.5, 1002.2.2, 1301.1</td>
</tr>
<tr>
<td>NFPA 58-2017 2020</td>
<td>Liquefied Petroleum Gas Code</td>
<td>Fuel Gas</td>
<td>303.7, 516.2.1, 1308.5.4.2.3, 1308.5.8.4, 1310.6(7), 1312.11</td>
</tr>
<tr>
<td>NFPA 70-2017 2020</td>
<td>National Electrical Code</td>
<td>Miscellaneous</td>
<td>301.4(1), 301.4(3), 511.1.6, 512.2.5, 516.2.7, 516.2.9(4), 602.2.1, 905.8.2, 1104.4(5), 1107.1.7, 1107.1.8, 1217.8.1, 1310.14.5(2), 1311.2.4, 1311.7</td>
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<tr>
<td>NFPA 90A-2018 2021</td>
<td>Installation of Air-Conditioning and Ventilating Systems</td>
<td>HVAC</td>
<td>604.1</td>
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<tr>
<td>NFPA 90B-2018 2021</td>
<td>Installation of Warm Air Heating and Air-Conditioning Systems</td>
<td>HVAC</td>
<td>604.1</td>
</tr>
<tr>
<td>NFPA 654-2017 2020</td>
<td>Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids</td>
<td>Dust Explosion Prevention, Gutters</td>
<td>506.6, Table 505.9</td>
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<tr>
<td>NFPA 780-2017 2020</td>
<td>Installation of Lightning Protection Systems</td>
<td>Fuel Gas</td>
<td>1311.5</td>
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<tr>
<td>NFPA 853-2016</td>
<td>Installation of Stationary Fuel Cell Power</td>
<td>Fuel Cell Power</td>
<td>1601.1</td>
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</table>
**TABLE 1701.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td>NFPA 30-2018-2021</td>
<td>Flammable and Combustible Liquids Code</td>
<td>Combustible Liquids, Flammable Liquids</td>
</tr>
<tr>
<td>NFPA 91-2016-2020</td>
<td>Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids</td>
<td>Product Conveying Ducts</td>
</tr>
<tr>
<td>NFPA 221-2018-2021</td>
<td>High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls</td>
<td>Building Fire Walls, Fire Barrier</td>
</tr>
</tbody>
</table>

Substantiation:
The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 1701.1 and Table 1701.2.

Committee Action: Accept as Submitted

Total Eligible to Vote: 30

Voting Results: Affirmative: 29, Not Returned: 1

Heine

Appended Comments

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**PUBLIC COMMENT 1**

**Code Year:** 2024 UMC  **Section #:** Table 1801.1, Table 1801.2  **Item #:** 345

**Submitter:** Alex Ing

National Fire Protection Association (NFPA)

**Recommendation:**
Revise text

Request to accept the code change proposal as modified by this public comment.

**TABLE 1801.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>NFPA 10-2018-2022</td>
<td>Standard for Portable Fire Extinguishers</td>
<td>Fire Extinguishing</td>
<td>513.10, 513.10.1, 513.11, 517.7.4</td>
</tr>
<tr>
<td>NFPA 12-2018-2022</td>
<td>Standard on Carbon Dioxide Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(1)</td>
</tr>
<tr>
<td>NFPA 13-2019-2022</td>
<td>Standard for the Installation of Sprinkler Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(2), 517.7.6</td>
</tr>
<tr>
<td>NFPA 17-2021</td>
<td>Standard for Dry Chemical Extinguishing Systems</td>
<td>Fire Extinguishing</td>
<td>513.2.3(3), 513.3.5</td>
</tr>
<tr>
<td>Document Number</td>
<td>Document Title</td>
<td>Application</td>
<td></td>
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<tr>
<td>-----------------</td>
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<tr>
<td>NFPA 17A-2021</td>
<td>Standard for Wet Chemical Extinguishing Systems</td>
<td>Fire Extinguishing 513.2.3(4), 513.2.5.6, 513.3.5</td>
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</tr>
<tr>
<td>NFPA 30A-2021</td>
<td>Code for Motor Fuel Dispensing Facilities and Repair Garages</td>
<td>Miscellaneous 303.11.1</td>
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</tr>
<tr>
<td>NFPA 31-2020</td>
<td>Standard for the Installation of Oil-Burning Equipment</td>
<td>Fuel Gas, Appliances 301.5, 1002.2.2, 1301.1</td>
<td></td>
</tr>
<tr>
<td>NFPA 37-2018-2021</td>
<td>Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines</td>
<td>Generators 1602.1, 1602.3</td>
<td></td>
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<tr>
<td>NFPA 68-2018</td>
<td>Standard on Explosion Protection by Deflagration Venting</td>
<td>Product Conveying Ducts 505.3.3</td>
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</tr>
<tr>
<td>NFPA 69-2019</td>
<td>Standard on Explosion Prevention Systems</td>
<td>Explosion Prevention 505.3.1</td>
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<tr>
<td>NFPA 72-2019-2022</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms 513.6.1</td>
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</tr>
<tr>
<td>NFPA 82-2019</td>
<td>Standard for Incinerators and Waste and Linen Handling Systems and Equipment</td>
<td>Incinerator Chutes 802.2.8, Table 802.4, 924.1</td>
<td></td>
</tr>
<tr>
<td>NFPA 86-2019</td>
<td>Standard for Ovens and Furnaces</td>
<td>Product Conveying Ducts 505.3.2</td>
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<tr>
<td>NFPA 88A-2019</td>
<td>Standard for Parking Structures</td>
<td>Miscellaneous 303.11</td>
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<tr>
<td>NFPA 90A-2021</td>
<td>Standard for the Installation of Air-Conditioning and Ventilating Systems</td>
<td>HVAC 604.1</td>
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<tr>
<td>NFPA 90B-2021</td>
<td>Standard for the Installation of Warm Air Heating and Air-Conditioning Systems</td>
<td>HVAC 604.1</td>
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<tr>
<td>NFPA 105-2019</td>
<td>Standard for Smoke Door Assemblies and Other Opening Protectives</td>
<td>Miscellaneous 606.6</td>
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</tr>
<tr>
<td>NFPA 211-2019</td>
<td>Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances</td>
<td>Fuel Gas Appliances 303.10, 517.7, 517.7.1, 801.2, 801.3, 802.5.2, 802.5.3, 802.5.7.1, 802.5.7.3, 902.10</td>
<td></td>
</tr>
<tr>
<td>NFPA 409-2016-2022</td>
<td>Standard on Aircraft Hangars</td>
<td>Miscellaneous 303.12</td>
<td></td>
</tr>
<tr>
<td>NFPA 654-2020</td>
<td>Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids</td>
<td>Dust Explosion Prevention, Gutters Table 505.9, 506.6</td>
<td></td>
</tr>
<tr>
<td>NFPA 780-2020</td>
<td>Standard for the Installation of Lightning Protection Systems</td>
<td>Fuel Gas 1311.5</td>
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<tr>
<td>NFPA 1192-2018-2021</td>
<td>Standard on Recreational Vehicles</td>
<td>Fuel Gas Piping 1302.3(18)</td>
<td></td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The NFPA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.
<table>
<thead>
<tr>
<th>NFPA 221-2021</th>
<th>Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls</th>
<th>Building Fire Walls, Fire Barrier</th>
</tr>
</thead>
</table>

(portion of table not shown remain unchanged)

**SUBSTANTIATION:**

The above revisions reflect the latest updates to the NFPA standards that are referenced in Table 1801.1 and Table 1801.2.

Several NFPA standards were revised since the last edition of the UMC and we request updates to reflect the current editions years. Additionally, please note the correct full titles of the listed NFPA standards and codes.
Proposals

Item #: 346

UMC 2024 Section: Table 1701.1, Table 1701.2

SUBMITTER: Jeremy Brown
NSF

RECOMMENDATION:
Revise text

---

**TABLE 1701.1**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF/ANSI 358-1-2017</td>
<td>Polyethylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>NSF/ANSI 358-2-2017</td>
<td>Polypropylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
<tr>
<td>NSF/ANSI 358-3-2016</td>
<td>Cross-linked polyethylene (PEX) pipe and fittings for water-based ground-source (geothermal) heat pump systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The NSF standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

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**TABLE 1701.2**

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF/ANSI/CAN 60-2017 2019</td>
<td>Drinking Water Treatment Chemicals - Health Effects</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the NSF standards that are referenced in Table 1701.1 and Table 1701.2.

COMMITTEE ACTION: ACCEPT AS SUBMITTED

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 29  NOT RETURNED: 1  Heine

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Appended Comments
PUBLIC COMMENT 1
Code Year: 2024 UMC  Section #: Table 1801.1  Item #: 346
SUBMITTER: Jeremy Brown  NSF
RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF/ANSI/CAN 60-2019 2021</td>
<td>Drinking Water Treatment Chemicals - Health Effects</td>
<td>Water Treatment</td>
<td>1710.6.1</td>
</tr>
<tr>
<td>NSF/ANSI 358-1-2020 2021</td>
<td>Polyethylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1, Table 1703.2, Table 1703.3</td>
</tr>
<tr>
<td>NSF/ANSI 358-3-2016 2021</td>
<td>Cross-linked polyethylene (PEX) pipe and fittings for water-based ground-source (geothermal) heat pump systems</td>
<td>Piping, Plastic</td>
<td>Table 1210.1, Table 1703.2, Table 1703.3</td>
</tr>
</tbody>
</table>

Note: The NSF standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the NSF standards that are referenced in Table 1801.1.

PUBLIC COMMENT 2
Code Year: 2024 UMC  Section #: Table 1801.1  Item #: 346
SUBMITTER: Eli Howard  SMACNA
RECOMMENDATION:
Revise text
Request to accept the code change proposal as modified by this public comment.

TABLE 1801.1
REFERENCED STANDARDS

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMACNA-2003 2021</td>
<td>Fibrous Glass Duct Construction Standards, Seventh Eighth Edition</td>
<td>Fiberglass Ducts</td>
<td>602.4.4</td>
</tr>
<tr>
<td>SMACNA-2017 2020</td>
<td>HVAC Duct Construction Standards Metal and Flexible, 4th Edition</td>
<td>Ducts, Metal and Flexible</td>
<td>504.4.5, 506.2, 602.3, 603.3, 603.4, 603.7.1, 603.9, 603.11, 605.1</td>
</tr>
</tbody>
</table>

Note: The SMACNA standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

SUBSTANTIATION:
The above revisions reflect the latest updates to the SMACNA standards that are referenced in Table 1801.1.
Proposals

Item #: 347
UMC 2024  Section: Table 1701.1, Table 1701.2

SUBMITTER: John Taecker
UL LLC

RECOMMENDATION:
Revise text

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 127-2011</td>
<td>Factory-Built Fireplaces (with revisions through July 27, 2016 February 25, 2020)</td>
<td>Fireplaces</td>
<td>802.5.1.1, 913.1, 913.1.1</td>
</tr>
<tr>
<td>UL 197-2010</td>
<td>Commercial Electric Cooking Appliances (with revisions through January 26, 2018 July 10, 2020)</td>
<td>Appliances, Commercial Cooking, Electric Appliances</td>
<td>921.1</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014 January 21, 2020)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
</tr>
<tr>
<td>UL 268A-2008</td>
<td>Smoke Detectors for Duct Application (with revisions through August 12, 2016-August 18, 2020)</td>
<td>Smoke Detectors</td>
<td>609.1</td>
</tr>
<tr>
<td>UL 295-2017</td>
<td>Commercial-Industrial Gas Burners (with revisions through August 22, 2019)</td>
<td>Gas Burners</td>
<td>910.2</td>
</tr>
<tr>
<td>UL 296-2017</td>
<td>Oil Burners (with revisions through November 29, 2017 January 8, 2021)</td>
<td>Fuel Gas, Appliances</td>
<td>910.1</td>
</tr>
<tr>
<td>UL 300-2005 2019</td>
<td>Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment (with revisions through December 16, 2014)</td>
<td>Certification</td>
<td>513.2.2, 513.2.5, 517.3.1.1(6)</td>
</tr>
<tr>
<td>UL 391-2010</td>
<td>Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces (with revisions through June 12, 2014 August 28, 2019)</td>
<td>Furnaces, Solid Fuel</td>
<td>904.10</td>
</tr>
<tr>
<td>UL 441-2016</td>
<td>Gas Vents (with revisions through July 27, 2016 August 28, 2019)</td>
<td>Fuel Gas</td>
<td>802.1</td>
</tr>
<tr>
<td>UL 467-2013</td>
<td>Grounding and Bonding Equipment (with revisions through June 7, 2017)</td>
<td>Grounding and Bonding</td>
<td>1311.2.5</td>
</tr>
<tr>
<td>UL 471-2010</td>
<td>Commercial Refrigerators and Freezers (with revisions through November 8, 2018 September 12, 2019)</td>
<td>Freezers, Refrigerators</td>
<td>934.1</td>
</tr>
<tr>
<td>UL 555-2006</td>
<td>Fire Dampers (with revisions through October 24, 2016 October 9, 2020)</td>
<td>Dampers</td>
<td>606.2</td>
</tr>
<tr>
<td>UL 555S-2014</td>
<td>Smoke Dampers (with revisions through October 27, 2016 October 9, 2020)</td>
<td>Dampers</td>
<td>606.1</td>
</tr>
<tr>
<td>UL 651-2011</td>
<td>Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings (with revisions through June 15, 2016 March 24, 2020)</td>
<td>Piping, Plastic</td>
<td>1308.5.4.1</td>
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<tr>
<td>UL</td>
<td>Description</td>
<td>Standard</td>
<td>Power Ventilators</td>
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</tr>
<tr>
<td>705-2017</td>
<td>Power Ventilators (with revisions through August 30, 2019)</td>
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<td>504.4.2.3</td>
</tr>
<tr>
<td>710-2012</td>
<td>Exhaust Hoods for Commercial Cooking Equipment (with revisions through August 20, 2019)</td>
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<td>507.3.1, 508.2.1</td>
</tr>
<tr>
<td>710B-2011</td>
<td>Recirculating Systems (with revisions through August 14, 2014)</td>
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<td>508.1, 513.2.2, 516.2.2, 516.2.3</td>
</tr>
<tr>
<td>737-2011</td>
<td>Fireplace Stoves (with revisions through February 25, 2020)</td>
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<td>913.2</td>
</tr>
<tr>
<td>778-2016</td>
<td>Motor-Operated Water Pumps (with revisions through August 11, 2020)</td>
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<td>1208.1</td>
</tr>
<tr>
<td>795-2016</td>
<td>Commercial-Industrial Gas Heating Equipment (with revisions through September 29, 2020)</td>
<td></td>
<td>904.12</td>
</tr>
<tr>
<td>834-2004</td>
<td>Heating, Water Supply, and Power Boilers - Electric (with revisions through July 17, 2019)</td>
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<td>1002.3, Table 1203.2</td>
</tr>
<tr>
<td>858-2014</td>
<td>Household Electric Ranges (with revisions through September 12, 2019)</td>
<td></td>
<td>920.1</td>
</tr>
<tr>
<td>907-2016</td>
<td>Fireplace Accessories (with revisions through August 28, 2019)</td>
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<td>913.3</td>
</tr>
<tr>
<td>921-2016</td>
<td>Commercial Dishwashers (with revisions through September 20, 2017)</td>
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<td>519.1</td>
</tr>
<tr>
<td>923-2013</td>
<td>Microwave Cooking Appliances (with revisions through July 27, 2020)</td>
<td></td>
<td>920.3.2(3), 920.4.2(3)</td>
</tr>
<tr>
<td>959-2010</td>
<td>Medium Heat Appliance Factory-Built Chimneys (with revisions through August 28, 2019)</td>
<td></td>
<td>802.5.1</td>
</tr>
<tr>
<td>1240-2005</td>
<td>Electric Commercial Clothes-Drying Equipment (with revisions through March 25, 2019)</td>
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</tr>
<tr>
<td>1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through February 25, 2020)</td>
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<td>802.5.1.1, 916.3</td>
</tr>
<tr>
<td>1738-2010</td>
<td>Venting Systems for Gas-Burning Appliances, Categories II, III, and IV (with revisions through February 6, 2020)</td>
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<td>802.4.1, 802.4.2, 802.4.3</td>
</tr>
<tr>
<td>1777-2015</td>
<td>Chimney Liners (with revisions through April 11, 2019)</td>
<td></td>
<td>802.5.3(2), 803.1.11.2</td>
</tr>
<tr>
<td>1995-2015</td>
<td>Heating and Cooling Equipment (with revisions through August 17, 2018)</td>
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<td>903.1, 904.13</td>
</tr>
<tr>
<td>1996-2009</td>
<td>Electric Duct Heaters (with revisions through August 7, 2020)</td>
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<td>905.8</td>
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<tr>
<td>2158-2018</td>
<td>Electric Clothes Dryers (with revisions through September 20, 2019)</td>
<td></td>
<td>908.1</td>
</tr>
<tr>
<td>2162-2014</td>
<td>Commercial Wood-Fired Baking Ovens - Refractory Type (with revisions through August 1, 2019)</td>
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<td>921.2</td>
</tr>
<tr>
<td>2200-2012</td>
<td>Stationary Engine Generator Assemblies (with revisions through July 29, 2015)</td>
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<td>2790-2010</td>
<td>Commercial Incinerators (with revisions through October 8, 2014)</td>
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<td>925.2</td>
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</tbody>
</table>

(portion of table not shown remain unchanged)

Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO’s Regulations Governing Committee Projects.

TABLE 1701.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES
<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
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</thead>
<tbody>
<tr>
<td>UL 33-2010</td>
<td>Heat Responsive Links for Fire-Protection Service (with revisions through April 14, 2015 April 28, 2020)</td>
</tr>
<tr>
<td>UL 80-2007-2009</td>
<td>Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids (with revisions through January 16, 2014 April 26, 2019)</td>
</tr>
<tr>
<td>UL 125-2014-2020</td>
<td>Flow Control Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018)</td>
</tr>
<tr>
<td>UL 132-2015</td>
<td>Safety Relief Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018 January 16, 2020)</td>
</tr>
<tr>
<td>UL 144-2012</td>
<td>LP-Gas Regulators (with revisions through November 05, 2014 December 10, 2019)</td>
</tr>
<tr>
<td>UL 174-2004</td>
<td>Household Electric Storage Tank Water Heaters (with revisions through December 15, 2014 September 15, 2020)</td>
</tr>
<tr>
<td>UL 180-2012</td>
<td>Liquid Level Gauges for Oil Burner Fuels and other combustible liquids (with revisions through May 12, 2017)Combustible Liquid Tank Accessories (with revisions through May 8, 2020)</td>
</tr>
<tr>
<td>UL 429-2013</td>
<td>Electrically Operated Valves (with revisions through January 16, 2020)</td>
</tr>
<tr>
<td>UL 733-1999-2019</td>
<td>Oil-Fired Air Heaters and Oil-Fired Direct-Fired Heaters (with revisions through October 9, 2013)</td>
</tr>
<tr>
<td>UL 842-2045-2020</td>
<td>Valves for Flammable Fluids and Combustible Liquids (with revisions through October 27, 2017)</td>
</tr>
<tr>
<td>UL 984-1996</td>
<td>Hermetic Refrigerant Motor-Compressors (with revisions through September 23, 2005) (Withdrawn)</td>
</tr>
</tbody>
</table>

(portion of table not shown remain unchanged)

**SUBSTANTIATION:**
The above revisions reflect the latest updates to the UL standards that are referenced in Table 1701.1 and Table 1701.2.

**COMMITTEE ACTION:** ACCEPT AS AMENDED BY THE TC

Amend proposal as follows:

### TABLE 1701.1
**REFERRED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
</tr>
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<tbody>
<tr>
<td>UL 127-2011</td>
<td>Factory-Built Fireplaces (with revisions through February 25, 2020)</td>
</tr>
<tr>
<td>UL 197-2010</td>
<td>Commercial Electric Cooking Appliances (with revisions through July 10, 2020)</td>
</tr>
<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through January 21, 2020)</td>
</tr>
<tr>
<td>UL 268A-2008</td>
<td>Smoke Detectors for Duct Application (with revisions through August 18, 2020)</td>
</tr>
<tr>
<td>UL 295-2017</td>
<td>Commercial-Industrial Gas Burners (with revisions through August 22, 2019)</td>
</tr>
<tr>
<td>UL 296-2017</td>
<td>Oil Burners (with revisions through January 8, 2021)</td>
</tr>
<tr>
<td>UL 300-2019</td>
<td>Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment</td>
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<td>UL 391-2010</td>
<td>Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces (with revisions through August 28, 2019)</td>
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<td>UL 441-2016</td>
<td>Gas Vents (with revisions through August 28, 2019)</td>
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REFERENCES SECTION: 802.5.1.1, 913.1, 913.1.1, 910.2, 910.1, 513.2.2, 513.2.5, 517.3.1.1(6), 904.10, 802.1

620
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<th>UL Code</th>
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<tr>
<td>UL 467-2013</td>
<td>Grounding and Bonding Equipment (with revisions through June 7, 2017)</td>
<td>1311.2.5</td>
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<tr>
<td>UL 471-2010</td>
<td>Commercial Refrigerators and Freezers (with revisions through September 12, 2019)</td>
<td>934.1</td>
</tr>
<tr>
<td>UL 555-2006</td>
<td>Fire Dampers (with revisions through October 9, 2020)</td>
<td>606.2</td>
</tr>
<tr>
<td>UL 555S-2014</td>
<td>Smoke Dampers (with revisions through October 9, 2020)</td>
<td>606.1</td>
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<td>UL 651-2011</td>
<td>Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings (with revisions through March 24, 2020)</td>
<td>1308.5.4.1</td>
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<tr>
<td>UL 705-2017</td>
<td>Power Ventilators (with revisions through August 30, 2019)</td>
<td>504.4.2.3</td>
</tr>
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<td>UL 710-2012</td>
<td>Exhaust Hoods for Commercial Cooking Equipment (with revisions through August 20, 2019)</td>
<td>507.3.1, 508.2, 508.2.1</td>
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<td>UL 710B-2011</td>
<td>Recirculating Systems (with revisions through February 1, 2019)</td>
<td>508.1, 513.2.2, 516.2.2, 516.2.3</td>
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<tr>
<td>UL 737-2011</td>
<td>Fireplace Stoves (with revisions through February 25, 2020)</td>
<td>913.2</td>
</tr>
<tr>
<td>UL 778-2016</td>
<td>Motor-Operated Water Pumps (with revisions through August 11, 2020)</td>
<td>1208.1</td>
</tr>
<tr>
<td>UL 795-2016</td>
<td>Commercial-Industrial Gas Heating Equipment (with revisions through September 29, 2020)</td>
<td>904.12</td>
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<td>UL 834-2004</td>
<td>Heating, Water Supply, and Power Boilers - Electric (with revisions through July 17, 2019)</td>
<td>1002.3, Table 1203.2</td>
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<td>UL 858-2014</td>
<td>Household Electric Ranges (with revisions through September 12, 2019)</td>
<td>920.1</td>
</tr>
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<td>UL 907-2016</td>
<td>Fireplace Accessories (with revisions through August 28, 2019)</td>
<td>913.3</td>
</tr>
<tr>
<td>UL 921-2020</td>
<td>Commercial Dishwashers</td>
<td>519.1</td>
</tr>
<tr>
<td>UL 923-2013</td>
<td>Microwave Cooking Appliances (with revisions through August 27, 2020)</td>
<td>920.3.2(3), 920.4.2(3)</td>
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<td>UL 959-2010</td>
<td>Medium Heat Appliance Factory-Built Chimneys (with revisions through August 28, 2019)</td>
<td>802.5.1</td>
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<td>UL 1240-2005</td>
<td>Electric Commercial Clothes-Drying Equipment (with revisions through March 25, 2019)</td>
<td>908.1</td>
</tr>
<tr>
<td>UL 1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through February 25, 2020)</td>
<td>802.5.1.1, 916.3</td>
</tr>
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<td>UL 1738-2010</td>
<td>Venting Systems for Gas-Burning Appliances, Categories II, III, and IV (with revisions through February 6, 2020)</td>
<td>802.4.1, 802.4.2, 802.4.3</td>
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<td>UL 1777-2015</td>
<td>Chimney Liners (with revisions through April 11, 2019)</td>
<td>802.5.3(2), 803.1.11.2</td>
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<td>UL 1995-2015</td>
<td>Heating and Cooling Equipment (with revisions through August 17, 2018)</td>
<td>903.1, 904.13</td>
</tr>
<tr>
<td>UL 1996-2009</td>
<td>Electric Duct Heaters (with revisions through August 7, 2020)</td>
<td>905.8</td>
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<tr>
<td>UL 2158-2018</td>
<td>Electric Clothes Dryers (with revisions through September 20, 2019)</td>
<td>908.1</td>
</tr>
<tr>
<td>UL 2162-2014</td>
<td>Commercial Wood-Fired Baking Ovens – Refractory Type (with revisions through August 1, 2019)</td>
<td>921.2</td>
</tr>
<tr>
<td>UL 2200-2020</td>
<td>Stationary Engine Generator Assemblies</td>
<td>1602.3</td>
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<tr>
<td>UL 2790-2010</td>
<td>Commercial Incinerators (with revisions through June 18, 2019)</td>
<td>925.2</td>
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<th>DOCUMENT NUMBER</th>
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<tr>
<td>UL 33-2010</td>
<td>Heat Responsive Links for Fire-Protection Service (with revisions through April 28, 2020)</td>
<td>Fusible Links</td>
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<tr>
<td>UL 80-2009</td>
<td>Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids (with revisions through April 26, 2019)</td>
<td>Fuel Gas</td>
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<td>UL 125-2020</td>
<td>Flow Control Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 16, 2020)</td>
<td>Fuel Gas</td>
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<tr>
<td>UL 132-2015</td>
<td>Safety Relief Valves for Anhydrous Ammonia and LP-Gas (with revisions through April 26, 2019)</td>
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<tr>
<td>UL 144-2012</td>
<td>LP-Gas Regulators (with revisions through December 10, 2019)</td>
<td>Fuel Gas</td>
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<td>UL 174-2004</td>
<td>Household Electric Storage Tank Water Heaters (with revisions through September 15, 2020)</td>
<td>Appliances</td>
</tr>
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<td>UL 180-2019</td>
<td>Combustible Liquid Tank Accessories (with revisions through May 8, 2020)</td>
<td>Gauges, Level Gauges</td>
</tr>
<tr>
<td>UL 429-2013</td>
<td>Electrically Operated Valves (with revisions through January 16, 2020)</td>
<td>Valves</td>
</tr>
<tr>
<td>UL 733-2019</td>
<td>Oil-Fired Air Heaters and Oil-Fired Direct-Fired Heaters</td>
<td>Water Heaters, Direct Fired, Oil Fired</td>
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<td>UL 842-2020</td>
<td>Valves for Flammable and Combustible Liquids</td>
<td>Valves</td>
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</table>

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COMMITTEE STATEMENT:
The modification removes UL 207 based on the action take in Item # 225.

TOTAL ELIGIBLE TO VOTE: 30

VOTING RESULTS:  AFFIRMATIVE: 16  NEGATIVE: 12  ABSTAIN: 1  NOT RETURNED: 1  Heine

Note: Item # 347 failed to achieve the necessary 2/3 affirmative vote of return ballots. In accordance with Section 4-3.5.2 of the Regulations Governing Committee Projects, a public comment is requested for this proposal. The Technical Committee will reconsider this proposal as a public comment.

EXPLANATION OF NEGATIVE:

BALLANCO: UL 207 should not be stricken in the modification. The standard regulates many refrigerant components, including tubing and fittings. This change should have been accepted as submitted.

CUDAHY, TRAFTON, A; WISEMAN: UL 207 should remain.

FEEHAN, KREITENBERG: UL 207 needs to remain in the code.

GUNZNER: Similar reasons given for Item # 225 regarding UL 207.

KOERBER: UL 207 should not be stricken in the modification.

MACNEVIN: Item should have been accepted as submitted, with the inclusion of Item # 347, for reasons stated by others.

TRAFTON, P: I am in complete agreement with Julius Ballanco's comments and believe UL 207 belongs here.

VAN RITE: UL 207 should remain in the code.

WHITE: UL 207 is an important standard and should remain in the code.

EXPLANATION OF ABSTAIN:

TERZIGNI: I am waiting to see what happens with Item # 225.

Appended Comments
PUBLIC COMMENT 1

Code Year: 2024 UMC  Section #: Table 1801.1, Table 1801.2  Item #: 347

SUBMITTER: John Taecker, UL LLC; Emily Toto, ASHRAE  Comment #: 1

RECOMMENDATION:
Revise text

Request to accept the code change proposal as submitted by this public comment.

SUBSTANTIATION:
John Taecker:
The above revisions reflect the latest updates to the UL standards that are referenced in Table 1801.1 and Table 1801.2.

Standards are referenced in the codes to establish a uniform basis for evaluating, testing, and listing specific materials, equipment and devices, regardless of who performs such work. When the codes specifically require materials, equipment, and devices to comply with readily recognizable standards, the duplication of effort caused by having separate private sector and government-unique solutions is avoided. This enables the government to take advantage of private sector technology and expertise in establishing standards that are up-to-date and encompass the latest technology.

Emily Toto:
Proposal #347 should be reconsidered as it was originally submitted. The removal of UL 207-2009 is based on proposal #225 to remove press connect fittings as an option for refrigerant piping joints, which incorrectly states that fittings are outside of the scope of 207. The proposal did not obtain a 2/3 majority from the technical committee thus the reason for amending item 347 is no longer applicable and the original proposal should be reconsidered.

PUBLIC COMMENT 2

Code Year: 2024 UMC  Section #: Table 1801.1, Table 1801.2  Item #: 347

SUBMITTER: John Taecker  UL LLC  Comment #: 2

RECOMMENDATION:
Revise text

Request to accept the code change proposal as modified by this public comment.

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
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<tbody>
<tr>
<td>UL 17-2008</td>
<td>Vent or Chimney Connector Dampers for Oil-Fired Appliances (with revisions through September 25, 2013) WITHDRAWN</td>
<td>Vent Dampers</td>
<td>802.14.1</td>
</tr>
<tr>
<td>UL 103-2010</td>
<td>Factory-Built Chimneys for Residential Type and Building Heating Appliances (with revisions through March 15, 2017 - September 24, 2021)</td>
<td>Fuel Gas, Appliances</td>
<td>802.5.1, 802.5.1.1</td>
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<tr>
<td>UL 127-2011</td>
<td>Factory-Built Fireplaces (with revisions through July 27, 2016 - February 25, 2020)</td>
<td>Fireplaces</td>
<td>802.5.1.1, 913.1, 913.1.1</td>
</tr>
<tr>
<td>UL 181-2013</td>
<td>Factory-Made Air Ducts and Air Connectors (with revisions through April 18, 2017 - December 29, 2021)</td>
<td>Air Connectors, Air Ducts</td>
<td>602.3, 602.4.1, 602.4.5, 603.1.4, 603.1.5, 603.4, 603.9.1, Table 603.9.1, 605.1.1</td>
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<td>UL 181A-2013</td>
<td>Closure Systems for Use with Rigid Air Ducts (with revisions through March 22, 2017 December 29, 2021)</td>
<td>Air Ducts</td>
<td>603.9.1, Table 603.9.1</td>
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<tr>
<td>UL 181B-2013</td>
<td>Closure Systems for Use with Flexible Air Ducts and Air Connectors (with revisions through March 21, 2017 December 29, 2021)</td>
<td>Air Connectors, Air Ducts</td>
<td>603.9.1, Table 603.9.1</td>
</tr>
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<td>UL 197-2010</td>
<td>Commercial Electric Cooking Appliances (with revisions through January 26, 2018 July 10, 2020)</td>
<td>Appliances, Commercial Cooking, Electric Appliances</td>
<td>920.1</td>
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<tr>
<td>UL 207-2009</td>
<td>Refrigerant-Containing Components and Accessories, Nonelectrical (with revisions through June 27, 2014 January 21, 2020)</td>
<td>Refrigeration Components</td>
<td>1109.2</td>
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<tr>
<td>UL 268A-2008</td>
<td>Smoke Detectors for Duct Application (with revisions through August 12, 2016 August 18, 2020)</td>
<td>Smoke Detectors</td>
<td>609.1</td>
</tr>
<tr>
<td>UL 295-2017</td>
<td>Commercial-Industrial Gas Burners (with revisions through August 22, 2019)</td>
<td>Gas Burners</td>
<td>910.2</td>
</tr>
<tr>
<td>UL 296-2017</td>
<td>Oil Burners (with revisions through November 29, 2017 January 8, 2021)</td>
<td>Fuel Gas, Appliances</td>
<td>910.1</td>
</tr>
<tr>
<td>UL 300-2005-2019</td>
<td>Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment (with revisions through December 16, 2014)</td>
<td>Certification</td>
<td>513.2.2, 513.2.5, 517.3.1.1(6)</td>
</tr>
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<td>UL 391-2010</td>
<td>Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces (with revisions through June 12, 2014 August 28, 2019)</td>
<td>Furnaces, Solid Fuel</td>
<td>904.11</td>
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<td>UL 441-2016</td>
<td>Gas Vents (with revisions through July 27, 2016 August 28, 2019)</td>
<td>Fuel Gas</td>
<td>802.1</td>
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<tr>
<td>UL 467-2013</td>
<td>Grounding and Bonding Equipment (with revisions through June 7, 2017)</td>
<td>Grounding and Bonding</td>
<td>1311.2.5</td>
</tr>
<tr>
<td>UL 471-2010</td>
<td>Commercial Refrigerators and Freezers (with revisions through November 8, 2018 September 12, 2019)</td>
<td>Freezers, Refrigerators</td>
<td>933.1</td>
</tr>
<tr>
<td>UL 499-2014</td>
<td>Electric Heating Appliances (with revisions through February 23, 2017 October 22, 2021)</td>
<td>Kilns</td>
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<tr>
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<td>Fire Dampers (with revisions through October 21, 2016 October 9, 2020)</td>
<td>Dampers</td>
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<td>Ceiling Dampers (with revisions through May 4, 2017 January 21, 2021)</td>
<td>Dampers</td>
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<tr>
<td>UL 555S-2014</td>
<td>Smoke Dampers (with revisions through October 27, 2016 October 9, 2020)</td>
<td>Dampers</td>
<td>606.1</td>
</tr>
<tr>
<td>UL 705-2017</td>
<td>Power Ventilators (with revisions through October 8, 2018 August 24, 2021)</td>
<td>Power Ventilators</td>
<td>504.4.2.3, 511.1</td>
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<tr>
<td>UL 710-2012</td>
<td>Exhaust Hoods for Commercial Cooking Equipment (with revisions through June 25, 2018 February 16, 2021)</td>
<td>Exhaust Hoods, Hoods</td>
<td>507.3.1, 508.2, 508.2.1</td>
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<tr>
<td>UL 710A-2015</td>
<td>Rooftop Grease and Oil Collection and Containment Systems</td>
<td>Commercial Kitchens</td>
<td>510.9.1</td>
</tr>
<tr>
<td>UL 710B-2011</td>
<td>Recirculating Systems (with revisions through August 14, 2014 October 7, 2021)</td>
<td>Exhaust Hoods</td>
<td>508.1, 513.2.2, 516.2.2, 516.2.3</td>
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<tr>
<td>UL 731-2018</td>
<td>Oil-Fired Unit Heaters (with revisions through November 11, 2021)</td>
<td>Heaters, Oil Fired</td>
<td>916.7</td>
</tr>
<tr>
<td>UL 737-2011</td>
<td>Fireplace Stoves (with revisions through August 19, 2016 February 25, 2020)</td>
<td>Fireplace Stoves</td>
<td>913.2</td>
</tr>
<tr>
<td>UL 778-2016</td>
<td>Motor Operated Water Pumps (with revisions through October 20, 2017 June 29, 2021)</td>
<td>Pumps</td>
<td>1208.1</td>
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<tr>
<td>UL 791-2006</td>
<td>Residential Incinerators (with revisions through November 7, 2014 February 25, 2021)</td>
<td>Incinerators</td>
<td>924.3</td>
</tr>
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<td>-------------</td>
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<td>UL 834-2004</td>
<td>Heating, Water Supply, and Power Boilers - Electric (with revisions through September 24, 2018)</td>
<td>Appliances</td>
<td>1002.3, Table 1203.2</td>
</tr>
<tr>
<td>UL 858-2014</td>
<td>Household Electric Ranges (with revisions through June 4, 2018 September 12, 2019)</td>
<td>Electric Ranges, Ranges</td>
<td>919.2</td>
</tr>
<tr>
<td>UL 867-2011</td>
<td>Electrostatic Air Cleaners (with revisions through August 7, 2018 August 16, 2021)</td>
<td>Filters</td>
<td>935.1</td>
</tr>
<tr>
<td>UL 907-2016</td>
<td>Fireplace Accessories (with revisions through August 28, 2019)</td>
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<td>913.3</td>
</tr>
<tr>
<td>UL 921-2016</td>
<td>Commercial Dishwashers (with revisions through September 20, 2017)</td>
<td>Appliances</td>
<td>519.1</td>
</tr>
<tr>
<td>UL 923-2013</td>
<td>Microwave Cooking Appliances (with revisions through July 19, 2017 August 27, 2020)</td>
<td>Microwaves</td>
<td>919.4.2(3), 919.5.2(3)</td>
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<td>UL 959-2010</td>
<td>Medium Heat Appliance Factory-Built Chimneys (with revisions through June 42, 2014 August 28, 2019)</td>
<td>Fuel Gas, Appliances</td>
<td>802.5.1</td>
</tr>
<tr>
<td>UL 1240-2005</td>
<td>Electric Commercial Clothes-Drying Equipment (with revisions through March 16, 2018 September 14, 2021)</td>
<td>Clothes Dryers, Commercial</td>
<td>908.2</td>
</tr>
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<td>UL 1479-2015</td>
<td>Fire Tests of Penetration Firestops (with revisions through May 18, 2021)</td>
<td>Miscellaneous</td>
<td>507.4.4, 507.4.5</td>
</tr>
<tr>
<td>UL 1482-2011</td>
<td>Solid-Fuel Type Room Heaters (with revisions through August 19, 2018 February 25, 2020)</td>
<td>Room Heaters, Solid Fuel Heaters</td>
<td>802.5.1, 915.4</td>
</tr>
<tr>
<td>UL 1738-2010</td>
<td>Venting Systems for Gas-Burning Appliances Categories II, III, and IV (with revisions through November 7, 2014 August 26, 2021)</td>
<td>Fuel Gas, Appliances</td>
<td>802.4.1, 802.4.2, 802.4.3</td>
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<tr>
<td>UL 1777-2018</td>
<td>Chimney Liners (with revisions through April 11, 2019)</td>
<td>Chimneys, Liners</td>
<td>802.5.3(2), 803.1.11.2</td>
</tr>
<tr>
<td>UL 1820-2004</td>
<td>Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics (with revisions through July 13, 2017 September 24, 2021)</td>
<td>Surface Burning Test, Pneumatic Tubing</td>
<td>602.2.3</td>
</tr>
<tr>
<td>UL 1887-2004</td>
<td>Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics (with revisions through July 13, 2017 October 11, 2021)</td>
<td>Surface Burning Test, Fire Sprinkler Pipe</td>
<td>602.2.2</td>
</tr>
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<td>Grease Ducts (with revisions through April 28, 2017 October 11, 2021)</td>
<td>Ducts, Grease</td>
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</tr>
<tr>
<td>UL 1995-2015</td>
<td>Heating and Cooling Equipment (with revisions through August 17, 2018)</td>
<td>HVAC, Electric</td>
<td>903.1, 904.14, 1706.1</td>
</tr>
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<td>UL 1996-2009</td>
<td>Electric Duct Heaters (with revisions through July 16, 2016 September 29, 2021)</td>
<td>Duct Heaters</td>
<td>905.9</td>
</tr>
<tr>
<td>UL 2021-2015</td>
<td>Fixed and Location-Dedicated Electric Room Heaters (with revisions through December 14, 2016 February 2, 2021)</td>
<td>Product, Heating, Electric</td>
<td>915.2, 926.6</td>
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<tr>
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<td>Electric Clothes Dryers</td>
<td>Clothes Dryers, Electric</td>
<td>908.2</td>
</tr>
<tr>
<td>UL 2158A-2013</td>
<td>Clothes Dryer Transition Duct (with revisions through April 18, 2017 October 11, 2021)</td>
<td>Clothes Dryer Exhaust</td>
<td>504.4</td>
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<tr>
<td>UL 2162-2014</td>
<td>Commercial Wood-Fired Baking Ovens-Refractory Type (with revisions through August 1, 2019)</td>
<td>Baking Ovens 920.2</td>
<td></td>
</tr>
<tr>
<td>UL 2518-2016</td>
<td>Air Dispersion Systems (with revisions through June 8, 2021)</td>
<td>Duct Systems 602.4.3, 603.12</td>
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</tr>
<tr>
<td>UL 2790-2010</td>
<td>Commercial Incinerators (with revisions through October 8, 2014 June 18, 2019)</td>
<td>Incinerators 924.2</td>
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</tbody>
</table>

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Note: The UL standards meet the requirements for mandatory reference standards in accordance with Section 3-3.7.1 of IAPMO's Regulations Governing Committee Projects.

TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
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</tr>
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</tr>
<tr>
<td>UL 80-2007</td>
<td>Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids (with revisions through January 16, 2014 April 26, 2019)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 125-2014-2020</td>
<td>Flow Control Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018 August 26, 2021)</td>
<td>Fuel Gas</td>
</tr>
<tr>
<td>UL 132-2015-2021</td>
<td>Safety Relief Valves for Anhydrous Ammonia and LP-Gas (with revisions through January 12, 2018)</td>
<td>Fuel Gas</td>
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<td>UL 144-2012-2021</td>
<td>LP-Gas Regulators (with revisions through November 05, 2014 August 26, 2021)</td>
<td>Fuel Gas</td>
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<tr>
<td>UL 180-2012-2021</td>
<td>Liquid Level Gauges for Oil Burner Fuels and other combustible liquids Combustible Liquid Tank Accessories (with revisions through May 12, 2017-August 25, 2021)</td>
<td>Gauges, Level Gauges</td>
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<tr>
<td>UL 343-2008</td>
<td>Pumps for Oil-Burning Appliances (with revisions through December 14, 2017 December 6, 2021)</td>
<td>Fuel Gas, Appliances</td>
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<tr>
<td>UL 429-2013</td>
<td>Electrically Operated Valves (with revisions through March 19, 2021)</td>
<td>Valves</td>
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<tr>
<td>UL 443-2006</td>
<td>Steel Auxiliary Tanks for Oil-Burner Fuel (with revisions through March 8, 2013 May 31, 2018)</td>
<td>Fuel Gas</td>
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<tr>
<td>UL 733-1993-2019</td>
<td>Oil-Fired Air Heaters and Direct-Fired Heaters (with revisions through October 9, 2013)</td>
<td>Water Heaters, Direct Fired, Oil Fired</td>
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<tr>
<td>UL 842-2015 2020</td>
<td>Valves for Flammable Fluids and Combustible Liquids (with revisions through October 27, 2017)</td>
<td>Valves</td>
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</table>

(portions of table not shown remain unchanged)

SUBSTANTIATION:
The above revisions reflect the latest updates to the UL standards that are referenced in Table 1801.1 and Table 1801.2.
Task Group Reports
UMC Condensate Task Group Report
UMC Condensate Task Group Report

Roster:

<table>
<thead>
<tr>
<th>Member</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Julius Ballanco (Chair)</td>
<td>JB Engineering and Code Consulting, P.C.</td>
</tr>
<tr>
<td>Phil Trafton</td>
<td>ASHRAE</td>
</tr>
<tr>
<td>Richard Goldsmith</td>
<td>Sunbelt Marketing, Inc.</td>
</tr>
<tr>
<td>Gary Bonetti</td>
<td>UA Local 342</td>
</tr>
<tr>
<td>Gary Duren</td>
<td>Self</td>
</tr>
<tr>
<td>David Clayson</td>
<td>Wavin Limited</td>
</tr>
<tr>
<td>Trevor Meyer</td>
<td>UA Local 582</td>
</tr>
</tbody>
</table>

Overview:

During the May 17-21, 2021 virtual Technical Committee Meetings, the UMC TC Chair, Harvey Kreitenberg, approved the formation of a UMC Condensate Task Group. The topics of focus included addressing exposure risk to the public from multiple condensate drain lines interconnected through a common drain to provide guidance to assist in the control and intervention of health and safety concerns associated with airborne contaminants from condensate discharge from building mechanical systems and equipment between building spaces.

The scope of the Condensate Task Group is to evaluate provisions related to condensate discharge, drainage interconnections through a common drain, indirect connections, condensate traps, and protection of trap seals. Additionally, the task group will review the allowance for interconnecting condensate discharge between dwelling units and/or tenant spaces, to address any potential issues with biological aerosols passing through the condensate drainage systems. The recommendations provided by the task group will be forwarded to the UPC and UMC Technical Committees as a public comment for consideration in the development of the 2024 editions of the UPC and UMC.

The Task Group met three times via teleconference on October 5, 2021; October 25, 2021; and November 22, 2021. Proposed recommendations were obtained from members of the Task Group and any interested parties.

The Task Group generated recommendations for UMC Section 310.4 (Appliance Condensate Drains) and Section 310.5 (Point of Discharge) based on UMC Proposal Item # 074 with several modifications to address concerns regarding health and safety and enforceable code language. The Task Group generated recommendations as follows:
**UMC Condensate Task Group Recommendations**

310.0 Condensate Wastes and Control.

310.4 Appliance Condensate Drains. Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer’s instructions. Condensate drain lines serving more than one appliance shall be approved by the Authority Having Jurisdiction prior to installation connecting to a common indirect waste pipe shall have the connections to the indirect waste pipe protected by a sanitary waste valve complying with ASME A112.18.8, condensate trap complying with IAPMO IGC 196, or trap with a trap primer.

310.5 Point of Discharge. Air-conditioning condensate waste pipes shall connect indirectly to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, mop sinks, or leach pits. An individual condensate drain shall be trapped in accordance with the appliance manufacturer’s instructions or as approved in accordance with Section 310.4. Exception: Direct connections in accordance with Section 310.6.

**TABLE 1801.1**
**REFERENCED STANDARDS**

<table>
<thead>
<tr>
<th>STANDARD NUMBER</th>
<th>STANDARD TITLE</th>
<th>APPLICATION</th>
<th>REFERENCED SECTION</th>
</tr>
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<tbody>
<tr>
<td>ASME A112.18.8-2020</td>
<td>Sanitary Waste Valves for Plumbing Drainage Systems</td>
<td>Sanitary Waste Valves</td>
<td>310.4</td>
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<tr>
<td>IAPMO IGC 196-2018</td>
<td>Condensate Traps and Overflow Switches for Air-Conditioning Systems</td>
<td>Condensate Traps</td>
<td>310.4</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**SUBSTANTIATION:**
The primary concern with the connection to indirect waste pipe from multiple condensate drains is the free passage of air between spaces. Without a means of preventing the movement of air in the indirect waste pipe, biohazardous airborne materials can easily migrate between building spaces. This can result in a medical emergency from exposure to viruses, germs, or chemicals emanating into a space.

Since the connection of the condensate is indirect, there are no hard piping connections that close off the piping between different building spaces. There needs to be a means or mechanism that isolates the open piping while still allowing the pipe to serve as an indirect waste pipe. This mechanism would prevent the movement of contaminated air between different spaces in a building. Two currently available devices that would provide the isolation of air movement through an indirect waste pipe are sanitary waste valves and condensate traps. These devices are regulated by ASME A112.18.8 and IAPMO IGC 196 respectively. Both devices will isolate the air movement and are proven by testing and listing to the referenced standards.
To a lesser degree, a water seal trap could provide isolation of air movement. The problem with a trap is that if the trap loses the water seal, the trap provides no protection against air movement. Condensate drains may not operate for months, thus leaving the trap with no source of water for refilling due to evaporation. For that reason, the only possible means of accepting a water seal trap as an alternative to the two devices is to mandate a trap seal primer valve. While the alternative of a trap with trap seal primer is included in the acceptable means of protection from air movement, it is the poorest of the three methods identified.

This public comment is a life safety issue in protecting the public from transmission of airborne contaminants between building spaces. This concern has become more apparent with the current pandemic facing the world. It is imperative that the Plumbing Code and Mechanical Code address the issue with means of preventing a hazardous situation.

The UMC Condensate Task Group was appointed by the Chairs of the Plumbing Technical Committee and Mechanical Technical Committee. The Task Group met numerous times to develop this public comment.
UMC Indoor Horticulture Facilities Task Group Report
UMC Indoor Horticulture Facilities Task Group Report

Roster:

<table>
<thead>
<tr>
<th>Member</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randy Young (Chair)</td>
<td>Sacramento Joint Apprenticeship Training Committee</td>
</tr>
<tr>
<td>Cary Smith</td>
<td>Sound Geothermal Corp.</td>
</tr>
<tr>
<td>Phil Trafton</td>
<td>ASHRAE</td>
</tr>
<tr>
<td>Robert Vilches</td>
<td>United Association</td>
</tr>
<tr>
<td>Phil Ribbs</td>
<td>PHR Consultants</td>
</tr>
<tr>
<td>Misty Guard</td>
<td>Regulosity LLC</td>
</tr>
<tr>
<td>Trevor Meyer</td>
<td>UA Local 582</td>
</tr>
</tbody>
</table>

Overview:

During the May 17-21, 2021 virtual Technical Committee Meetings, the UMC TC Chair, Harvey Kreitenberg, approved the formation of a UMC Indoor Horticulture Facilities Task Group to further refine and develop "indoor horticulture facilities" in UMC Proposal Item # 283. The topics of focus included carbon dioxide enrichment systems, ventilation and exhaust rates, removal of flammable solvents, fire protection, storage of chemicals, and mechanical system installation requirements in the UMC. The goal was to provide guidance and assist in the control and intervention of health and safety concerns associated with indoor horticulture facilities.

The scope of the Uniform Mechanical Code (UMC) Indoor Horticulture Facilities Task Group is to review and develop recommendations on UMC Proposal Item No. 283 to determine applicability and accuracy of requirements for such facilities. These recommendations provided by the Task Group will be forwarded to the UMC Technical Committee as a public comment for consideration in the development of the 2024 edition of the UMC.

The Task Group met five times via teleconference on September 20, 2021; October 12, 2021; November 1, 2021; November 30, 2021; and December 15, 2021. Proposed recommendations were obtained from members of the task group and any interested parties.

The Task Group generated recommendations are based on UMC Proposal Item # 283 with several modifications to address the concerns of the committee regarding health and safety and enforceable code language. The Task Group generated a new appendix as follows:
UMC Indoor Horticulture Facilities Task Group Recommendations

Appendix K
Indoor Horticultural Facilities

K 101.0 General.
K 101.1 Indoor Spaces. Indoor spaces using environmental controls for horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall comply with this section.
Equipment and appliances shall be installed in accordance with the manufacturer's installation instructions and this code. Piping, tubing, materials, and structures shall be protected in accordance with Section 316.0.
K 101.2 Plumbing Systems. Indoor horticulture plumbing systems shall be in accordance with the plumbing code.
K 101.3 Mechanical Systems. Indoor horticulture mechanical systems shall be in accordance with this code.
K 101.4 Fire Suppression Systems. Fire suppression systems shall be in accordance with the building code and Section K 501.1.3.

K 201.0 Definitions.
K 201.1 General. For the purpose of this appendix, the following definitions shall apply:
Horticulture Facility. A business, facility, or establishment where retail indoor horticulture is grown, cultivated, stored, dried, extracted, weighed, packaged, sold, or processed.
Cultivation Room. A room of any size where plants are grown under controlled conditions. Also known as a grow room.
Extraction Equipment. Equipment used to extract compounds, oils, extracts and proteins from plants. The processes include, but not limited to, the extraction by a solvent, desolventizing, and distillation of the solvent.
Extraction Equipment, Non-Volatile. Extraction equipment utilizing any solvent that is not considered volatile (i.e., carbon dioxide).
Extraction Equipment, Volatile. Extraction equipment utilizing any solvent that is considered flammable and hazardous (i.e., Butane, propane, hexene, or ethanol).
Gas Detection Control Units. A digital or analog controller that continuously monitors the presence of toxic, anoxic, and explosive gases in the ambient air to prevent the risks of explosion linked to such gases.
Indoor Horticulture. The cultivation and processing of floricultural and horticultural plants in an indoor space by controlling various interior environmental variables including, but not limited to, temperature, air quality, humidity, artificial lighting, nutrients, and carbon dioxide.

K 301.0 Classification of Facilities.
K 301.1 General. Facilities used for indoor horticultural cultivation and processing shall be in accordance with the applicable codes as mandated by the Authority Having Jurisdiction.
K 301.2 Approved Locations. Facilities used for indoor horticultural cultivation and processing shall be located in accordance with the building code and the Authority Having Jurisdiction.

K 401.0 Documentation.
K 401.1 General. Documentation for permitting shall be provided in accordance with the requirements of Section 104.0 and the Authority Having Jurisdiction. The documentation shall show compliance with this section and other requirements in accordance with the Authority Having Jurisdiction.

K 501.0 Fire Protection.
K 501.1 General. Fire protection shall be provided for indoor horticultural facilities in accordance with the building code, fire code, Section K 501.1.1 through Section K 501.1.3, and the Authority Having Jurisdiction.
K 501.1.1 Smoke Detectors and Fire Alarms. Smoke detectors, heat detectors, and fire alarms shall be provided in accordance with NFPA 72 and shall provide visible and audible notification. Smoke detectors installed within ducts shall comply with UL 268. In spaces where smoke detectors cannot be utilized due to ambient conditions, approved automatic heat detectors shall be permitted in lieu of smoke detectors in accordance Section K 501.1.2.
K 501.1.2 Heat Detectors. Where ambient conditions prohibit installation of smoke detectors, an automatic heat detector in accordance with UL 521 shall be permitted where approved by the Authority Having Jurisdiction.

K 501.1.3 Fire Suppression. Where fire suppression is required by the fire code, an automatic fire suppression system shall be provided within hoods, enclosures, and ductwork in accordance with one of the following:

1. A carbon dioxide extinguishing system in accordance with NFPA 12.
2. An automatic water sprinkler system in accordance with NFPA 13.
3. A dry chemical extinguishing system in accordance with NFPA 17.
5. A fire suppression system as approved by the Authority Having Jurisdiction.

K 601.0 Carbon Dioxide Detection System.

K 601.1 General. A gas detection system shall be provided in indoor spaces using a carbon dioxide enrichment process, in indoor spaces where carbon dioxide containers or generating systems are located. The gas detection system shall activate audible alarms distinguishable from the fire alarm system and alarms with visual notification. Such alarms shall be calibrated for the types of fuels or gases used.

K 601.1.1 Listings. The gas detection control units shall comply with UL 864 or UL 2017. Gas detectors shall comply with UL 2075.

K 601.1.2 Carbon Dioxide Sensor Location. Carbon dioxide sensors shall be located within the breathable zone between 4 feet (1219 mm) to 6 feet (1829 mm) above the finished floor.

K 601.1.3 Activation. Activation of the gas detection system shall be in accordance with Section K 601.1.3.1 through Section K 601.1.3.2.

K 601.1.3.1 Low-Level Activation. Upon detection of a carbon dioxide concentration of 5,000 ppm (9000 mg/m³), the following shall be automatically performed:

1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate an audible and visual supervisory alarm signal at an approved location within the facility.

K 601.1.3.2 High-Level Activation. Upon detection of a carbon dioxide concentration of 30,000 ppm (54 000 mg/m³), the following shall be automatically performed:

1. Stop the flow of carbon dioxide to the supply piping system.
2. Activate the mechanical purge ventilation system.
3. Activate audible and visual alarms inside and outside where the following exist:
   a. An indoor space using a carbon dioxide enrichment process
   b. Where carbon dioxide containers, generating systems are located.

K 601.2 Carbon Dioxide Enrichment System. Indoor spaces using a carbon dioxide enrichment process shall have a mechanical purge ventilation system and shall independently exhaust directly to the exterior. The design, installation, and maintenance of carbon dioxide enrichment systems with more than 100 pounds (45.4 kg) of carbon dioxide, and carbon dioxide enrichment systems having a remote fill connection shall comply with Sections K 601.2.1 through K 601.2.3.

K 601.2.1 Carbon Dioxide Systems. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use, and handling of the carbon dioxide shall be in accordance with this section and NFPA 55.

K 601.2.2 Carbon Dioxide Control. Indoor spaces using a carbon dioxide enrichment process shall be maintained with a negative pressure in relation to adjoining indoor spaces or with a positive pressure and intervening entrance/exit pressurization vestibules with the adjoining indoor spaces.

K 601.2.3 Carbon Dioxide Supply Piping. Carbon dioxide supply piping shall be in accordance with ASME B31.3.

K 701.0 Flammable Solvents.

K 701.1 General. Processes using flammable solvents shall be provided with a flammable gas detection system in accordance with the fire code. The flammable gas detection system shall be installed in accordance with the
manufacturer's installation instructions and shall not be interlocked with other equipment. The flammable gas
detection system shall be calibrated to detect gas levels of not more than 10 percent of the Lower Flammable Limit
(LFL) and to activate audible and visual alarms of not more than 25 percent of the LFL.

K 701.2 Control Area. Pumps, motors, chemical fume hoods, equipment, and wiring in control areas and
containment booths used for flammable solvent processing shall be as Class I/Division 1 location for potentially
explosive gas and vapor Groups A, B, C, and D in accordance with NFPA 70. Containment booths shall be listed and
labeled in accordance with UL 1389.

K 701.3 Extraction Equipment. Extraction equipment using flammable solvents and located in an indoor space
shall be listed for the intended use. Plant extraction booths shall comply with UL 1389. Extraction equipment using
LPG, Butane or other volatile solvents shall be a closed-loop control system and shall comply with ASME BPVC
Section VIII.1, ASME B31.3, and NFPA 58, as applicable.

K 801.0 Ventilation and Exhaust System.
K 801.1 General. The indoor air quality in indoor spaces using environmental controls for horticultural cultivation,
and processing shall comply with Chapter 4 and Section K 801.1.1. The ventilation and exhaust system shall comply
with Section K 801.1.2 through Section K 801.1.6. Indoor spaces used for horticultural cultivation shall have an
independent ventilation system.

All mechanical ventilation and exhaust systems shall be tested, balanced, and operated to demonstrate to
the owner or designated representative and Authority Having Jurisdiction that the installation and performance of
the systems conform to design intent. All testing and balancing shall be performed by a technician certified by the
Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), the Testing, Adjusting
and Balancing Bureau (TABB), or other equivalent approved agencies.

K 801.1.1 Breathing Zone Outdoor Airflow Rate. The outdoor airflow required in the breathing zone (V_{bz})
of the occupiable space or spaces in a ventilation zone shall be as shown in Table 402.1 and not less than
the value determined in accordance with Equation K 801.1.1.

\[ V_{bz} = R_p \cdot P_z + R_a \cdot A_z \]  
(Equation K 801.1.1)

Where:

- \( A_z \) = zone floor area, the net occupiable floor area of the ventilation zone, square feet (m²).
- \( P_z \) = zone population, the number of people in the ventilation zone during typical usage.
- \( R_p \) = outdoor airflow rate required per person (CFM/person) in accordance with the following, as
applicable:
  
  (1) 60 CFM/person for cultivation, production, and processing facilities or factories.
  (2) 15 CFM/person for centers and dispensaries.
- \( R_a \) = outdoor airflow rate required per unit area, 1 CFM/ft² [0.00508 m³/(s • m²)]

Sample Calculation: Determine the outdoor airflow required in the breathing zone (V_{bz}) of an indoor space
used for horticultural cultivation with an occupiable floor area of 800 square feet and a maximum of 5
people expected to occupy the zone.

Sample Solution:

\[ V_{bz} = R_p \cdot P_z + R_a \cdot A_z \]

\[ V_{bz} = (60 \text{ CFM/person} \cdot 5 \text{ people}) + (1 \text{ CFM/ft}^2 \cdot 800 \text{ SF}) \]

\[ V_{bz} = 1,100 \text{ CFM}. \text{ The ventilation system shall be capable of providing not less than 1,100 CFM of outdoor}
air. \]

K 801.1.2 Ventilation System Requirements. When activated by the gas detection system required by
Section K 601.1, the mechanical purge ventilation system shall remain on until manually reset. The purge
ventilation system ducting shall terminate outdoors in an approved location. The ventilation system shall
be designed to operate at a negative pressure of 0.01 inches water column (0.02 kPa) in relation to the
exhausted indoor space.
**K 801.1.3 Ventilation for Indoor Cultivation and Storage Spaces.** Indoor spaces used for horticultural cultivation and processing and storage shall be provided with ventilation in accordance with Section 402.2. Where mechanical ventilation is provided, the systems shall be operational when the indoor space(s) are occupied. Air in indoor cultivation and storage spaces shall be classified as Class 2 Air in accordance with Section 403.9.2.

**K 801.1.4 Exhaust Ventilation Rate.** The exhaust and ventilation system required in this section shall not create a lesser standard of installation than prescribed by the minimum safety standards adopted by the Authority Having Jurisdiction. Exhaust airflow shall be provided at not less than 0.2 CFM/ft² [0.001016 (m³/s)/m²] of floor area. Exhaust air shall not be used as makeup air, recirculated air, or transfer air. Makeup air shall be provided for more than 150 CFM exhaust.

**K 801.1.5 Exhaust System Requirements.** An exhaust system shall be installed in accordance with Section 505.0 and the following requirements:

1. Exhaust outlet location(s) in accordance with Section 502.2.2 for product conveying ducts as classified in Section 505.8.
2. Exhaust air shall terminate directly to the outdoors and shall not be directed onto a public way.
3. The exhaust inlet shall be not less than 12 inches (305 mm) above the finished floor.
4. Chemical fume hoods shall be required for flammable solvent processing, shall be listed, and shall be installed in accordance with the manufacturer’s installation instructions.
5. Exhaust ducts shall be independent of all other exhaust systems.
6. The exhaust rate shall be in accordance with the applicable occupancy category as shown in Table 403.7.

**K 801.1.6 Automatic Shutoff.** Automatic shutoff in air moving systems shall be provided in accordance with Section 608.0.

**K 901.0 Particulate and Odor Control.**

**K 901.1 General.** Particulates and odors from indoor horticultural cultivation and processing of plants for human ingestion, inhalation, and topical application shall be filtered and controlled so that it is not detectable above nuisance levels not exceeding applicable exposure limits at the exterior of the facility or at adjoining properties or as required by the Authority Having Jurisdiction. Odor control shall be required in the exhaust system and shall include, but not be limited to, one or more of the following types:

1. Charcoal filters shall be installed on the discharge of all exhaust ducts and shall be installed in accordance with the manufacturer’s installation instructions.
2. Ozone generators shall be installed in all exhaust ducts to neutralize odor by oxidizing such odors with ozone.
3. Ionizers shall be installed in accordance with the manufacturer’s installation instructions.
4. Photo-catalytic oxidation shall be installed in accordance with the manufacturer’s installation instructions.
5. Photo-hydroxyl oxidation shall be installed in accordance with the manufacturer’s installation instructions.
6. Carbon filtration shall be installed in accordance with the manufacturer’s installation instructions.
7. UV-C lights shall be installed in accordance with the manufacturer’s installation instructions.
8. Where approved by the Authority Having Jurisdiction, a plume discharge termination method shall be permitted to be used for odor control. The exhaust fan of such a system shall discharge exhaust air vertically into the outdoors. The plume heights shall be not less than 20 feet above the nozzle. Escaping air at the nozzle shall be no less than 3,000 feet per minute.

**K 901.2 Filters.** Where filters are used, the minimum filtration rate shall be in accordance with Equation K 901.2. The design airflow velocity across the face area of the chemical absorption filter(s) shall not exceed 350 feet per minute (1.8 m/s).

Minimum Filtration Rate = (Room Volume)/3  \[(Equation \ K \ 901.2)\]

**K 1001.0 Duct Construction and Installation.**

**K 1001.1 General.** Ducts shall be in accordance with Section 506.0, Chapter 6, and SMACNA HVAC Duct Construction Standards – Metal and Flexible.

**K 1101.0 Hydronic Systems.**
K 1101.1 General. Hydronic systems used in indoor horticulture facilities shall be in accordance with Chapter 12 of this code or Chapter 4 the Uniform Solar, Hydronics and Geothermal Code (USHGC).

K 1201.0 Motors and Fans.
K 1201.1 General. Motors and fans used shall comply with the applicable requirements in Section 503.0.

K 1301.0 Storage of Chemicals.
K 1301.1 General. Storage of chemicals shall comply with the building code and fire code, and NFPA 58 for liquid petroleum gas and NFPA 400 for the storage, use and handling of hazardous materials. Hazardous, combustible, and flammable materials shall not be stored in cultivation rooms.

K 1401.0 Walls, Ceilings, and Floors.
K 1401.1 General. Walls, ceilings, and floors of indoor spaces used for horticultural cultivation shall be in accordance with the following requirements:
(1) Be of corrosion resistant materials.
(2) Include air and vapor barriers in accordance the building code.
(3) Be insulated in accordance with the building code.
(4) Concrete slab floors shall be permitted to be sealed below or above grade by a product approved the Authority Having Jurisdiction.

K 1501.0 Dehumidification and Humidification.
K 1501.1 General. Dehumidification and humidification shall be permitted to be accomplished by standalone dehumidifiers, humidifiers, desiccant wheels, or reheat coils.
K 1501.2 Protection. Plants shall not be stored or processed beneath pipes or mechanical equipment unless those areas are protected against leakage or condensation.
Exception: Piping used for fire suppression systems.

K 1601.0 Fumigation.
K 1601.1 General. Any horticultural growing facility that is fumigated shall comply with Section K 1601.1.1 through Section K 1601.1.3 and the Authority Having Jurisdiction.
K 1601.1.1 Sources of Ignition. Areas intended to be fumigated shall not contain any open flames or any other sources of ignition.
K 1601.1.2 Fumigation Activity. Areas intended for fumigation, repellent, pesticide, or insecticide fogging operation shall be clearly marked to indicate fumigation activity. Such areas intended for fumigation shall be continuously mechanically ventilated in accordance with Section K 801.0.

K 1701.0 Luminaires.
K 1701.1 General. Horticultural lighting equipment and systems used for indoor horticultural cultivation shall comply with UL 8800.

K 1801.0 UV and UV-C Devices.
K 1801.1 General. UV and UV-C devices installed in ductwork shall be installed in accordance with NFPA 90A and the manufacturer’s installation instructions.

K 1901.0 Signage.
K 1901.1 General. Caution or warning signs complying with NFPA 704 shall be provided at the entrance of the facility and/or indoor spaces identifying hazards such as flammables, asphyxiants, and toxics.
### TABLE 1801.2
STANDARDS, PUBLICATIONS, PRACTICES, AND GUIDES

<table>
<thead>
<tr>
<th>DOCUMENT NUMBER</th>
<th>DOCUMENT TITLE</th>
<th>APPLICATION</th>
</tr>
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<tbody>
<tr>
<td>NFPA 55-2020</td>
<td>Compressed Gases and Cryogenic Fluids Code</td>
<td>Compressed Gases</td>
</tr>
<tr>
<td>NFPA 72-2022</td>
<td>National Fire Alarm and Signaling Code</td>
<td>Fire Alarms</td>
</tr>
<tr>
<td>NFPA 2001-2018</td>
<td>Clean Agent Fire Extinguishing Systems</td>
<td>Fire Extinguishing</td>
</tr>
<tr>
<td>UL 268-2016</td>
<td>Smoke Detectors for Fire Alarm Systems (with revisions through October 31, 2019)</td>
<td>Smoke Extinguishing</td>
</tr>
<tr>
<td>UL 864-2014</td>
<td>Control Units and Accessories for Fire Alarm Systems (with revisions through May 7, 2020)</td>
<td>Control Units</td>
</tr>
<tr>
<td>UL 1389-2019</td>
<td>Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations (with revisions through October 13, 2020)</td>
<td>Plant Oil Extraction</td>
</tr>
<tr>
<td>UL 2017-2008</td>
<td>General-Purpose Signaling Devices and Systems (with revisions through December 14, 2018)</td>
<td>Signaling Devices</td>
</tr>
<tr>
<td>UL 2075-2013</td>
<td>Gas and Vapor Detectors and Sensors (with revisions through December 21, 2017)</td>
<td>Gas Detectors</td>
</tr>
<tr>
<td>UL 8800-2019</td>
<td>Horticultural Lighting Equipment and Systems</td>
<td>Electrical</td>
</tr>
</tbody>
</table>

(portions of table not shown remain unchanged)

**Substantiation:**

The UMC Indoor Horticulture Facilities Task Group was formed during the last UMC TC meeting as the TC believed such provisions to be an important addition in the UMC and needed refinement and further expansion. The primary focus of the Task Group was to protect the health and safety of all occupants and the public. Each of the original proposed categories from UMC proposal Item #283 were discussed in depth and expanded upon. The Task Group agreed with the TC recommendation to place these provisions in an appendix and agreed that the term “cannabis” should be removed as the provisions may also be applicable to other forms of indoor horticulture facilities. The Task Group also believed it was important to identify the different categories of “horticulture facilities” as they exist within current federal laws. This will minimize confusion and standardize such requirements and guidelines throughout the industry.

The UMC Indoor Horticulture Facilities Task Group communicated with the UPC Indoor Horticulture Facilities Task Group to harmonize text where applicable to both codes. Some Task Group Members participated on both the UPC and UMC Task Groups and were able to give additional insights to assist in correlation. The new provisions in Section K 301.0 (Classification of Facilities) will guide the end user in determining what is acceptable in their jurisdictions whether it be from the building code, fire code, or any other enforcement body. Additionally, Section K 401.0 (Documentation) was added to guide the user to the appropriate sections for requesting permits.
The Task Group spent many hours researching and identifying ventilation and exhaust rates permitted for indoor horticulture facilities and added the appropriate language and provisions to protect the indoor air quality. The language pertaining to ventilation, exhaust, and odor control was based on research of existing sources such as Federal Regulations, technical research documents, standards, local laws, and other regulations. The result was text that will unify with existing laws and regulations. Section K 801.1.1 (Breathing Zone Outdoor Airflow Rate) and K 801.1.5 (Exhaust System Requirements) were modified to reference the appropriate UMC ventilation and exhaust rate tables to ensure that these facilities are identified with an occupancy category in accordance the local jurisdiction. In summary, the UMC Indoor Horticulture Facilities Task Group has captured important minimum requirements that do not conflict with Federal Regulations and will ensure that local laws and guidelines are followed for the protection of the public.