Board of Building Standards

CODE COMMITTEE MEETING
AGENDA

DATE: JUNE 23, 2022
TIME: 1:00 PM
LOCATION: TRAINING RM 3, 6606 TUSSING RD, REYNOLDSBURG, OH, 43068
Videoconference Link

Call to Order

Approval of Minutes
MIN-1 May 12, 2022 Code Committee Meeting Minutes

Petitions
P-1 Petition #22-02 OPC Chapters 2 and 6 - Larry Cormack, Jr., City of Columbus

Recommendations of the Residential Construction Advisory Committee

Old Business
OB-1 2020 NEC Proposed TIAs
OB-2 Commercial Energy Code Review
OB-3 OBC Draft Rule Review (Ch 3 and 4)

New Business

Adjourn

File Attachments for Item:

MIN-1 May 12, 2022 Code Committee Meeting Minutes

OHIO BOARD OF BUILDING STANDARDS
CODE COMMITTEE MINUTES
May 12, 2022

The Code Committee met on May 12, 2022 with the following members present: Mr. Denk, Ms. Cromwell (via MS Teams), Mr. Johnson, Mr. Miller, Mr. Pavlis, Mr. Samuelson, Mr. Stanbery, Mr. Tyler, and Mr. Yankie. Board Chairman, Tim Galvin, was also present.

The following staff members were present: Regina Hanshaw, Debbie Ohler (via MS Teams), Robert Johnson, and Jay Richards

Guest present: John Johnson III

CALL TO ORDER

The meeting was called to order by Mr. Denk at 1:07 P.M.

APPROVAL OF MINUTES

Mr. Miller made the motion to approve the minutes of the Code Committee meeting held on March 24, 2022. Mr. Stanbery seconded the motion. The motion passed unanimously.

PETITIONS

No items for consideration

RECOMMENDATIONS OF THE RESIDENTIAL CONSTRUCTION ADVISORY COMMITTEE

No items for consideration

OLD BUSINESS

Commercial Energy Code Review

Mr. Yankie reported that Mr. Setzekorn and Mr. Pavlis did not have the opportunity to coordinate the size of the pre-engineered metal building intended to be modeled. Mr. Setzekorn will present the results of his modeling at a future committee meeting.

The committee continued their discussions of the commercial energy codes, shared their concerns with specific provisions, and reviewed the current OBC Chapter 13 format. Mr. Johnson suggested starting with the 2019 and then adding any desired Ohio-izations. Mr. Pavlis moved that the committee accept the 2019 ASHRAE 90.1 and the 2021 IECC as the basis for the next commercial energy code adoption and further review and evaluate for any Ohio changes. Mr. Johnson seconded the motion. The committee members agreed to familiarize themselves with Chapters 4 and 5 of the 2019 ASHRAE 90.1 and be prepared to share any concerns at the June committee meeting. The motion passed unanimously.

NEW BUSINESS

No items for consideration

ADJOURN

Mr. Johnson made the motion to adjourn at 3:05 P.M. Mr. Stanbery seconded the motion. The motion passed unanimously.

File Attachments for Item:

P-1 Petition #22-02 OPC Chapters 2 and 6 - Larry Cormack, Jr., City of Columbus Plumbing Inspector

APPLICATION
FOR
RULE CHANGE

Pursuant to section 3781.12 of the Revised Code and rules adopted by the Board of Building Standards, application is herewith submitted to adopt, amend, or annul a rule adopted by the Board pursuant to section 3718.10 of the Revised Code.

BOARD OF BUILDING STANDARDS
6606 Tussing Road, P.O. Box 4009
Reynoldsburg, Ohio 43068-9009
(614) 644-2613
bbs@ohio.gov
www.com.state.oh.us/dico/bbs/default.aspx

For BBS use:
Petition #: 22-02
Date Recv'd: June 10, 2022

Submitter: Larry R Cormack Jr (Contact Name) City Of Columbus Building and Zoning (Organization/Company)

Address: 111 N front St (Include Room Number, Suite, etc.)

Columbus (City) Ohio (State) 43215 (Zip)

Telephone Number: 614-645-5771 **Fax Number:**

Date: 4/19/22 **E-mail Address:** lrcormack@columbus.gov

Code Section: 2 (Definitions) and 6 (Water Supply and Distribution)

General Explanation of Proposed Change (attach additional sheets if necessary):

Dead end water lines are currently allowed in the Ohio Plumbing Code. Dead end water lines present a serious hazard due to the lack of flow in these lines which allow the growth of harmful bacteria which could result in illness or death. It is the intent of this proposed change to prohibit Dead End water lines and eliminate the possibility of any future issues.

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BOARD OF BUILDING STANDARDS

Explanation of Cost Impact of Proposed Code Change*: On remodels and repairs there should be no cost change since lines will be capped closer to the main. On new builds it should be cheeper due to lines for future water will not be installed until needed.

*Attach additional cost information as necessary to justify any statement of cost increase or cost decrease.

Information on Submittal (attach additional sheets if necessary):	
1. Sponsor:	Organization sponsoring or requesting the rule change (if any)
2. Rule Title:	DEAD END WATERLINES PROHIBITED. Title of rule change
3. Purpose/ Objective:	Technical justification for the proposed rule change
4. Formatted Rule Language **(Using Strike-out for Deleted Text and Underline for Added Text)**	Chapter 2 DEAD END. A branch leading from a water disribution pipe and terminating at a developed lenght of 1 foot (305mm)or more by means of a plug, cap or other closed fitting. Chapter 6 Dead end water lines shall be prohibited. Use strike-out for deleted text and underline for added text
5. Notes:	1. To encourage uniformity among states using model codes, it is recommended that the submitter first submit any code change directly to ICC and participate in the national model code development process. 2. Please provide a copy of application and documentation. 3. Use a separate form for each code change proposal.

File Attachments for Item:

OB-1 2020 NEC Proposed TIAs

NFPA 70®-2020 Edition
National Electrical Code®
TIA Log No.: 1653
Reference: 210.8(F) and Exception No. 2(new)
Comment Closing Date: July 6, 2022
Submitter: William Koffel, Koffel Associates (Representing Leading Builders of America)
www.nfpa.org/70

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.

All outdoor outlets for dwellings, other than those covered in 210.8(A)(3), Exception to (3), that are supplied by single-phase branch circuits rated 150 volts to ground or less, 50 amperes or less, shall have ground-fault circuit-interrupter protection for personnel. ~~This requirement shall become effective on January 1, 2023, for mini-split-type heating/ventilating/air-conditioning (HVAC) equipment and other HVAC units employing power conversion equipment as a means to control compressor speed.~~

~~Informational Note: *Power conversion equipment* is the term used to describe the components used in HVAC equipment that is commonly referred to as a variable speed drive. The use of power conversion equipment to control compressor speed differs from multistage compressor speed control.~~

Exception No. 1: Ground-fault circuit-interrupter protection shall not be required on lighting outlets other than those covered in 210.8(C).
Exception No. 2: Ground-fault circuit-interrupter protection shall not be required for listed HVAC equipment. This exception shall expire September 1, 2026.

Substantiation: When the Standards Council issued TIA 1593, the Council acknowledged "the concerted and sustained effort by numerous stakeholders to find a mutually agreeable solution to the technical issues at hand." The Council directed that a Task Group of affected stakeholders be formed to evaluate and reach an informed, technically substantiated resolution to the issues raised. The Council further encouraged the Task Group to submit a TIA for processing to the current edition and in parallel to the work being done within the next edition of the NEC, if appropriate. This TIA is in response to the direction given to the Task Group. The Task Group consisted of representatives from home builder organizations, contractors, HVAC manufacturers, GFCI manufacturers, CMP2, electrical inspectors, CPSC, and testing laboratories.

Based upon the information submitted to and reviewed by the Task Group, the proposed TIA extends the date when the requirement for GFCI protection will be required and expands the application of the exemption for GFCI protection to all listed HVAC equipment. If GFCI protection is required while the incompatibility issue remains, there is a higher risk of people being adversely impacted by exposure to extreme temperatures due to nuisance tripping than the risk of people being exposed to a leakage current that could cause injury or harm. The issue of GFCI protection not being compatible with listed HVAC equipment was known at the time SR 7676-NFPA 70-2018 was approved by CMP-2. Three of the four negative ballots specifically

mentioned the concern with incompatibility associated with requiring GFCI protection for listed HVAC equipment.

The potential issue of GFCI protection not being compatible with listed HVAC equipment was known at the time SR 7676-NFPA 70-2018 was approved by CMP-2. Three of the four negative ballots specifically mentioned the concern with incompatibility associated with requiring GFCI protection for listed HVAC equipment. UL 943 (*Standard for Ground-Fault Circuit-Interrupters*) requires that Class A ground-fault circuit-interrupters are capable of tripping at a minimum of 6 mA and could be as low as 4 mA. UL 60335-2 (*Standard for Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air Conditioners and Dehumidifiers*) allows a maximum leakage current value of 10 mA for appliances accessible to the general public.

Data was submitted to the Task Group showing that listed HVAC equipment typically can have a leakage current higher than what would trip a Class A GFCI, but the touch current is well below levels that would injure or harm an individual. The number of potential deaths from electrocution involving HVAC equipment may be as high as four per year. However, the number of fatalities (no cooling during a heat wave period) due to nuisance trips associated with GFCI protection of HVAC equipment where no hazard exists may be as high as 750 per year.

Table 1: Loss of HVAC Operation – Potential Impact (From Reference 3 below)

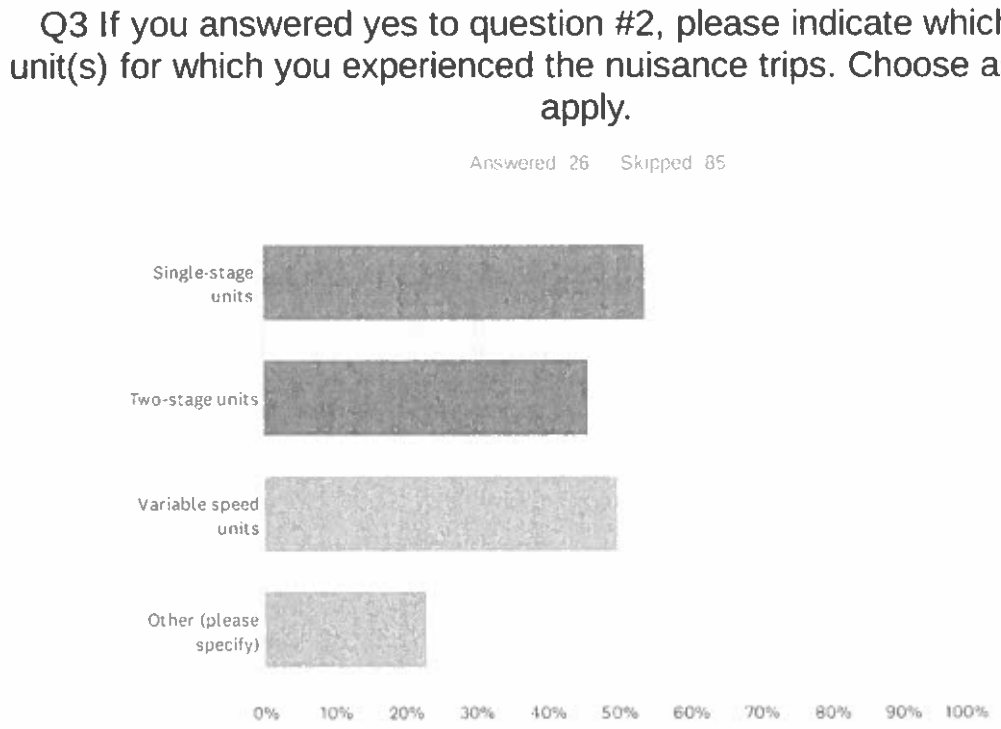
Estimates of HVAC Units and US At-Risk Populations	**Estimates**		**References**
Number of homes with HVAC systems in the US:	75,000,000	Approx	https://www.energy.gov/articles/history-air-conditioning
% of HVAC Fixed appliances that are Variable Speed:	50	%	https://www.achrnews.com/articles/134406-variable-speeds-impact-on-hvac#:~:text=For%20heat%20pumps%20alone%2C%2065%20percent%20of%20the,the%20mini%20splits%20we%20sold%20were%20variable%20speed.
Total number of variable speed HVAC Units	37,500,000	households	
Number of Households with people 65+	20.00	%	https://www.yardeni.com/pub/hseholdform.pdf
Number of Households with people 65+ with HVAC?	7,500,000		
Temperature at which injury can occur from heat exahustion/Stroke	104	F	
If only 10% of these homes are in climates with high heat:	750,000		
If Only 10% have compatibility issues:	75,000		
If 1% contain high risk occupants:	**750**	**per year**	estimated rate of annual deaths due to nusiance trips where no hazard existed to the end user.
Number of annual deaths from electrocution, without specific details, involving HVAC equipment	**4**	**per year**	

With respect to the extension of the date, the Task Group understands that there may not be a resolution to the incompatibility associated with listed Class A GFCIs and the leakage current permitted for listed HVAC equipment. However, the Task Group has included the date so that the exemption is not continued for an undefined period of time and to encourage the affected parties to continue to work together to resolve the incompatibility issue. The Task Group acknowledges that the date may need to be re-evaluated in the future if the incompatibility issues are not resolved.

AHRI has developed a testing program to identify the cause of interoperability issues. The study is scheduled to be completed by November 2023. The causes need to be defined before solutions can be proposed and tested. Product design and testing must follow. Industry standard revisions and related standardized test procedures are needed. Production tooling and supply chain modifications require additional time after the earlier steps are completed.

With respect to the expansion to all listed HVAC equipment, industry standards for power conversion equipment allow leakage currents above the trip current of Class A GFCI's. Residential air-conditioning (AC) and heat pump (HP) power conversion equipment for compressors have demonstrated leakage currents above Class A GFCI trip currents in lab measurements. Residential AC and HP electronically commutated outdoor fan motors have demonstrated leakage currents above the trip current of Class A GFCI's in lab measurements. Data was submitted based upon actual nuisance trips and a survey of air-conditioning contractors indicating that nuisance trips also occur with single-stage units. (Also see Source 3 listed below)

Figure 1: Texas Air Conditioning Contractor Association (TACCA) Survey (From Reference 5 below)



There are multiple reports of interoperability issues ('nuisance tripping') from AC and HP units that do not have power conversion equipment for the unit compressor which is the only current TIA exception. The cause(s) of this nuisance tripping remain unknown at this time. Furthermore, the presence of electronically commutated motors (ECM) is not currently documented on AC and HP nameplates or consumer/installer documents readily available to the code official. Therefore, an exception limited to ECM motors and/or other power conversion is not practical for the code official, builder or electrical contractor.

Conditions that affect interoperability include the following issues which have yet to be fully examined.

1) Residential AC and HP starting conditions distort circuit power supply conditions to such a great extent that other separate circuits in the building, such as lighting, experience power distortion that is well known to be noticed by occupants (through lights dimming). The appliances identified as comparable to AC and HP do not display and create distortion of this magnitude. There is no study to date to document that interoperability issues do not result from this startup power distortion.
2) A Class A GFCI's trip level amperage is based on the effects on humans of 60 hertz current. The higher frequency currents that create interoperability issues may not affect humans at the same current level. Evidence of safe use in Japan with a different means of protection has been documented.

3) AC and HP units include refrigeration devices that cause the direct drive compressor to start under conditions of existing high-pressure differential. This condition does not exist or is much less common in the refrigeration equipment that was cited in the 2020 code deliberations as a similar load.

4) AC and HP units operate under a much wider range of temperature conditions than the refrigeration equipment cited as similar in the 2020 code deliberations. The conductivity of the fluids surrounding the motor windings may increase as a result. The net result has not yet been tested to confirm this is not an interoperability issue.

5) Higher federal minimum energy standards have increased the use of power conversion equipment for compressors and high efficiency ECM fan motors. Standards again increase January 1, 2023, further increasing the portion of equipment that will contain features that have demonstrated measured interoperability problems.

In addition to some of the information sources cited above, the Task Group was presented with a significant amount of technical information that was considered in developing this TIA. The following is a bibliography of that information:

1. 2020 NEC Adoption/210.8(F)
2. AHRI Experts GFCI TG April 4, 2022 Powerpoint Presentation
3. AHRI 2020 NEC GFCI Summary Data Only 02-08-21
4. Assessment of Incompatibility of HVAC Equipment and GFCI Breakers, AHRI Project 8029 PowerPoint Presentation
5. GFCI Survey by TACCA
6. Minnesota April through September 2021 AC/HP Mini Split – Non GFCI Forms

Emergency Nature: The standard contains an error or an omission that was overlooked during the regular revision process. The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety)

justification of the action.

Almost every state that has adopted the 2020 Edition of the NEC have modified or deleted Section 210.8(F). NFPA is aware of at least six states that have deleted Section 210.8(F) in its entirety and two have delayed enforcement until January 1, 2023. In those eight states, GFCI protection has been deleted for outdoor outlets that do not serve listed HVAC equipment. As such, GFCI protection for equipment for which there is not a compatibility issue is lost (see Reference 1 above). It should also be noted that at the time the TIA was developed several other states were in the midst of adopting the 2020 Edition of the NEC with various amendments to Section 210.8(F) being proposed, some of which include deletion or delayed implementation.

The equipment incompatibility issues identified above will not be resolved by January 1, 2023. If GFCI protection is required while the incompatibility issue remains, there is a higher risk of people being adversely impacted by exposure to extreme temperatures due to nuisance tripping than the risk of people being exposed to a leakage current that could cause injury or harm. Data was submitted to the task group showing that listed HVAC equipment typically can have a leakage current higher than what would trip a Class A GFCI but the touch current is well below levels that would injure or harm an individual.

Anyone may submit a comment by the closing date indicated above. Please identify the TIA number and forward to the Secretary, Standards Council. SUBMIT A COMMENT

NFPA 70®-2020 Edition
National Electrical Code®
TIA Log No.: 1656
Reference: 210.8(F)
Comment Closing Date: July 6, 2022
Submitter: Dean Hunter, Minnesota Department of Labor & Industry
www.nfpa.org/70

1. Revise paragraph 210.8(F) to read as follows:

210.8(F) Outdoor Outlets.

All outdoor outlets for dwellings, other than those covered in 210.8(A)(3), Exception to (3), that are supplied by single-phase branch circuits rated 150 volts to ground or less, 50 amperes or less, shall have ground-fault circuit-interrupter protection for personnel. This requirement shall become effective on ~~January 1, 2023~~September 1, 2026, for mini-split-type heating/ventilating/air-conditioning (HVAC) equipment and other HVAC units employing power conversion equipment as a means to control compressor speed.

Informational Note: *Power conversion equipment* is the term used to describe the components used in HVAC equipment that is commonly referred to as a variable speed drive. The use of power conversion equipment to control compressor speed differs from multistage compressor speed control.

Exception: Ground-fault circuit-interrupter protection shall not be required on lighting outlets other than those covered in 210.8(C).

Substantiation: This expansion of GFCI protection in the 2020 NEC, for the purpose of covering exterior outlets through 250-volts at dwelling units, is a necessary enhancement for electrical safety. Code Making Panel 2 supported the expansion of GFCI protection to cover these outdoor outlets based on the electrocution of a young boy who came into contact with the energized enclosure of an outdoor HVAC unit.

The purpose of this TIA is to extend the enforcement date in TIA 1593 to the 2020 NEC beyond the date originally support by the HVAC industry and CMP-2 to provide the industry additional time to address the installation of HVAC equipment protected by GFCI with power conversion equipment used to control compressor speed.

In the state of Minnesota, we began enforcing Section 210.8(F) on April 5, 2021 before the existing TIA 1593 was published. We documented many cases of operational tripping occurrences, which was difficult for inspectors and electricians to resolve. As a result of our findings and documentation, we submitted the TIA that is currently supported by CMP-2 today as TIA 1593. I oversee over 70 municipal inspections areas (around 850 electrical inspections a day) in the state and since the publication and implementation of the TIA in September 2021, we have not experienced compatibility issues and we have inspected the installation of multiple brands of HVAC equipment.

There are many other states that currently enforce the 2020 NEC and/or TIA language. Eleven States have removed 210.8(F) and fourteen states have adopted the 2020 NEC without amending or have included the TIA 1593 language. Eleven of those states are successfully enforcing and the GFCI protection is working in those states. Here is a list of states, currently, that enforce the 2020 NEC and/or TIA 1593 language.

Alabama – TIA Language
Alaska – No Amendments
Colorado – TIA Language
Delaware – No Amendments
Minnesota – TIA Language
North Dakota – TIA Language
Maine – (Heat Pumps not Required)
Rhode Island – No Amendments
Vermont – TIA Language
West Virginia – TIA Language
Wyoming – TIA Language

Emergency Nature: The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification of the action.

The extension of the January 1, 2023 sunset date in TIA 1593 is necessary to permit additional time for the industry to address the issue addressed by TIA 1593. Without this date extension the potential for GFCI tripping from leakage current on HVAC units employing power conversion equipment as a means to control compressor speed may exist. The date has been extended to September 1, 2026 to support industry resolution.

Anyone may submit a comment by the closing date indicated above. Please identify the TIA number and forward to the Secretary, Standards Council. SUBMIT A COMMENT

File Attachments for Item:

OB-2 Commercial Energy Code Review

Significant changes 2013-2016 ASHRAE 90.1 Commercial Provisions

[Sources: ASHRAE 90.1-2016 and PNNL-SA-127543]

- Standard reformatted for ease of use
- New Climate maps (to align with ASHRAE 169) [5.1.4.1]
    - 16 Ohio counties will change from Zone 5A to Zone 4A [Annex 1]
- Adds a new path to demonstrate compliance – Performance Rating Method [4.2.1.1 (c) and Appendix G]

Building Envelope

- Air Leakage Verification requirements added [5.4.3.1.3 and 5.9.2.2]
    - Whole building pressurization test for air leakage
    - Continuous air barrier installation inspection and verification during construction
- Increased testing requirements for air leakage of overhead coiling doors [A7.1]
- Increased stringency requirements for fenestration and opaque doors [Table 5.5-4, Table 5.5-5, and 5.5.3.6]
- Clarified topics such as building orientation [5.5.4.5], default assumptions for the effective R-value of air spaces [A9.4.2], and calculation procedures for insulating metal building walls [A3.2.2, Table A3.2.3, A9.4.6]

Mechanical

- Increased equipment efficiencies for chillers, heat pumps, computer room AC, Dedicated Outdoor Air Systems (DOAS), Rooftop AC, Cooling Towers, and Variable Refrigerant Flow
- Clarified that control must be “configured to” meet the requirements, not just be “capable of” meeting the requirements [throughout]
- New HVAC set point and fan control requirements for hotel and motels with greater than 50 guest rooms [6.4.3.3.5]
- Adds HVAC control requirements for cooled vestibules [6.4.3.9]
- Large, electric-driven chilled-water plants are required to be monitored for electric energy use and efficiency [6.4.3.11]
- Air-cooled DX cooling units with economizers are required to have a Fault Detection and Diagnostics (FDD) monitoring system to determine that the air economizer is working properly [6.4.3.12]
- Adds control requirements for return and relief fans [6.5.3.2.4]
- Adds control requirements for parallel-flow fan-powered VAV air terminals [6.5.3.4]
- Dedicated outdoor air systems (DOAS) now include both efficiency and rating requirements for compliance [6.5.3.7]
- Adds pump flow control requirements for chilled and hot water hydronic piping distribution systems [6.5.4.2]
- Adds new requirements for the selection of chilled-water cooling coils [6.5.4.7]
- Prescribes motor fan speed controls for heat-rejection devices [6.5.5.2]
- Adds new requirements for transfer air delivered to a space having mechanical exhaust [6.5.7]

Service Water Heating

- Adds a new requirement for insulation of the first 8 ft of branch piping connections to recirculated, heat traced, or impedance heated service hot-water piping systems [7.4.3]

Power

- Limits the combined voltage drop of feeder conductors and branch circuits to 5% [8.4.1]
- Increased three-phase transformer efficiencies [Table 8.4.4]

Lighting

- Interior and exterior lighting power allowance have been modified (reduced) to reflect new lighting levels in the IES lighting handbook and to recognize LED technology [9.2.2.3 and 9.4.2]
- Lighting control requirements have been modified to add additional controls in some space types and options to others to allow easier application of advanced controls [9.4.1]
    - Reduce exterior lighting power by 50% (previously was 30%) during periods of inactivity or after business hours [9.4.1.4]
    - Certain outdoor parking areas required to reduce power by 50% during periods of inactivity [9.4.1.4]
- Adds a requirement that 75% of permanently installed dwelling unit lighting fixtures use high efficacy lamps [9.4.4]

Other Equipment

- Updates electric motor terminology, adds exceptions, and adds efficiency tables consistent with federal regulations [10.4.1]
- Elevator efficiency specifications are required to be provided on design documents, including both usage category and energy efficiency class. While a minimum threshold is not listed, the first step is taken toward including minimum elevator efficiency requirements in a future standard [10.4.3.4]

Energy Cost Budget Method (ECB)

No significant changes

Performance Rating Method (Appendix G)

- Appendix G now can be used as a path for compliance with the standard. Previously, Appendix G was used only to rate beyond-code performance of buildings
- The proposed design requires computation of a new metric, Performance Cost Index (PCI), and demonstration that it is less than that shown in Table 4.2.1.1, based on building type and climate zone
- The baseline design is now fixed at a certain level of performance, the stringency or baseline of which is expected not to change with subsequent versions of the standard. In this way, a building of any era can be rated using the same method
- Other modifications to Appendix G include changes to elevator, motor, and refrigeration baselines; changes to the baseline for existing building projects; and changes to specific opaque assemblies for the baseline envelope model. Modeling rule changes were made to heat pump auxiliary heat, economizer shutoff, lighting controls, humidification systems, cooling towers, and the simulation of preheat coils

ASHRAE 90.1-2019

The 2019 edition includes various modifications and clarifications to improve internal consistency and to standardize the structure and language of the document.

Significant changes to requirements include the following

Administration and Enforcement

- New commissioning requirements in accordance with ASHRAE/IES Standard 202 [4.2.5 and Appendix H]

Building Envelope

- Combined categories of “nonmetal framed” and “metal framed” products for vertical fenestration [Tables 5.5-0 through 5.5-8]
- Upgraded minimum criteria for SHGC and U-factor across all climate zones [Tables 5.5-0 through 5.5-8]
- Revised air leakage section to clarify compliance [5.4.3 and 5.9]
- Refined exceptions related to vestibules, added new option and associated criteria for using air curtains [5.4.3.3]

Mechanical

- New requirements to allow the option of using ASHRAE Standard 90.4 instead of ASHRAE Standard 90.1 in computer rooms that have an IT equipment load larger than 10 kW [6.6.1]
- Added pump definitions [3.2], requirements [10.4.7], and efficiency tables [10.8.6] to the standard for the first time
- New equipment efficiency requirement tables and changes to existing tables [Tables 6.8.1-1 to 6.8.1-20]
- Replaced fan efficiency grade (FEG) efficiency metric with fan energy index (FEI) [6.5.3.1.3]
- New requirements for reporting fan power for ceiling fans and updated requirements for fan motor selections to increase design options for load-matching variable-speed fan applications [6.5.3.1.2]
- New energy recovery requirements for high-rise residential building [3.2 and 6.5.6]
- New requirement for condenser heat recovery for acute care inpatient hospitals [6.5.6.3]

Lighting

- Modified lighting power allowances for Space-by-Space Method and the Building Area Method [Tables 9.6.1 and 9.5.1]
- New simplified method for lighting for contractors and designers of renovated office buildings and retail buildings up to 25,000 ft2 (2300 m2). [9.3 and Table 9.3.1-1]
- Updated lighting control requirements for parking garages to account for the use of LEDs [9.4.1.2]
- Updated daylight responsive requirements, added definition for “continuous dimming” based on NEMA LSD-64-2014 [3.2 and 9.4.1.1]
- Clarified side-lighting requirements and associated exceptions [9.4.1.1]

Energy Cost Budget (ECB) Method (Section 11)

- Numerous changes to ensure continuity
- Set baseline for on-site electricity generation systems [11.4.3.1 and 11.4.3.2]

Performance Rating Method (Appendix G)

- Clarified Appendix G rules and corresponding baseline efficiency requirement when combining multiple thermal zones into a single thermal block
- New explicit heating and cooling COPs without fan for baseline packaged cooling equipment
- New rules for modeling impact of automatic receptacle controls [Table G3.1 #12]
- Set more specific baseline rules for infiltration modeling
- Clarified how plant and coil sizing should be performed
- Updated building performance factors

Both Compliance Paths

- Clearer, more specific rules for treatment of renewables [G2.4.1]
- New updates to rules for lighting modeling

Significant changes 2012→2015 IECC Commercial Provisions

(Sources: PNNL-SA-107200 and ESL-TR-14-11-02 Texas A&M Energy Systems Laboratory)

Definitions

- Adds or modifies definitions of “Air Curtain”, “Alteration”, “Approved Agency”, “Boiler, Modulating”, “Boiler System”, “Bubble Point”, “Circulating Hot Water System”, “Computer Room”, “Condensing Unit”, “Conditioned Space”, “Continuous Insulation”, “Daylight Responsive Control”, “Daylight Zone”, “Fan Efficiency Grade”, “Fenestration”, “Floor Area, Net”, “General Purpose Electric Motor”, “Greenhouse”, “Hight Speed Door”, “Historic Building”, “Liner System” , “Low Sloped Roof”, “Low-voltage Dry-Type Distribution Transformer”, “Occupant Sensor Control”, “Opaque Door”, “Powered Roof/Wall Ventilator”, “Radiant Heating System”, “Refrigerant Dew Point”, “Refrigerated Warehouse Cooler”, “Refrigerated Warehouse Freezer”, “Refrigeration System”, “Repair”, “Reroofing”, “Roof Recover”, “Roof Replacement”, “Rooftop Monitor”, “Saturated Condensing Temperature”, “Small Electric Motor”, “Time-Switch Control”, “Variable Refrigerant Flow System”, “Walk-in Cooler”, “Walk-in Freezer”, “Wall, Above-grade”, “Wall, Below-Grade”, “Water Heater”

Building Envelope

- Adds an exception for greenhouses [C402.1.1]
- Increased stringency for roof insulation installed entirely above roof deck [Table C402.1.3]
- Increased stringency for SHGC of vertical fenestration [C402.4.3]
- Expanded requirements to calculate U-factors of walls with cold-formed steel, aged roof reflectance and provisions for rooms containing fuel burning appliances [C402.5]
- Mandatory skylight threshold reduced from 10K to 2.5K square feet [C402.4.2]

Mechanical

- Improved efficiency requirements for HVAC equipment performance [Table C403.2.3(1)-C403.2.3(10)]
- Added efficiency requirements for air-conditioning units serving computer rooms [Table C403.2.3(9)]
- Elaborated and added provisions for HVAC system controls which include: requirement for zone isolation [C403.2.4.4]; and requirement of economizer fault detection [C403.2.4.7]
- Added specifications for hot water boiler outdoor temperature setback control [C403.2.5]
- Updated provisions for energy recovery ventilation systems whose requirements are now based on the number of hour’s ventilations systems operate [C403.2.7]
- Introduced specifications for kitchen exhaust systems [C403.2.8]
- Updated requirements for duct and plenum insulation and sealing [C403.2.9]
- Introduced fan efficiency requirements [C403.2.12.3]
- Added specifications for commercial refrigeration equipment [C403.2.15 and C403.5]
- Updated provisions for air and water economizers, which include added requirements for the efficient operation of these systems [C403.3]
- Updated provisions for complex mechanical systems serving multiple zones, which include updated specifications for fan controls, heat rejection equipment and hot gas bypass limitations [C403.4]

Service Water Heating

- Added performance efficiencies for certain categories of service hot water systems [Table C404.2]
- Revises and clarifies the requirements for insulation of piping [C404.4]

- Added information for implementation of efficient heated water supply piping, heated water circulating and temperature maintenance system, demand recirculation controls, drain water heat recovery systems and energy requirements of portable spas [C404.5]
- Improved specifications for energy consumption of pools and permanent spas [C404.9]
- Added commissioning requirements for hot water systems [C404.11]

Lighting and Power

- Additional provisions for lighting controls, which include the added requirement of occupant sensor controls [C405.2.1]
- New exterior and warehouse lighting control requirements [C405.2.1.2]
- Revised daylighting zone controls [C405.2.3]
- New Hotel/motel sleeping and guest suite lighting controls [C405.2.4 #3]
- Updated lighting power densities for different building area types [Tables C405.4.2]
- Specifies non-tradable components of exterior lighting [C405.5.1]
- Requires a separate meter for each Group R-2 dwelling unit [C405.6]
- Adds federal minimum efficiency requirements for electric transformers [C405.7]
- Adds federal minimum efficiency requirements for electric motors [C405.8]
- Regulates elevator cab luminaires, ventilation fans, and controls [C405.9.1]
- Requires automatic speed control and a variable frequency regenerative drive for escalators [C405.9.2]

Other Equipment

Additional Efficiency Package Options

- Adds new options for more efficient HVAC equipment performance, for reduced lighting power densities, for enhanced digital lighting controls, for dedicated outdoor air systems, and for reduced energy use in service water systems [C406.1]

Total Building Performance

- No significant changes made to this section

Commissioning

- Adds commissioning requirements and documentation submittal requirements for lighting control systems including occupant sensor controls, time control switches, and daylight responsive controls [C408.3.1]

Existing Buildings

- Moved all existing building requirements from Chapter [CE] 1 to a new Chapter [CE] 5
- Historic buildings now partially covered [C501.6]
- Replacement fenestration covered [C401.2.1]
- Requires full upgrade of roofing insulation when re-roofing [C503.1]
- Roof replacement exempt from air barrier requirements [C503.1 Exception 6]

Significant changes 2018-2021 IECC Commercial Provisions

[Sources: IECC 2021]

- Changes climate zone maps resulting in 15 Ohio counties moving from Climate Zone 5 to Climate Zone 4
- Requires an insulation certificate identifying the installed R-value of insulation when the insulation of the manufacturer is not readily observable upon inspection
- Requires that a Thermal Envelope Certificate be posted in an approved location
- Clarifies and relocates all "Mandatory" and "Prescriptive" labels to a table

Definitions

- Adds or modifies definitions of "Biogas", "Biomass", "Data Center", "Data Center Systems", "Direct Digital Control", "Enthalpy Recovery Ratio", "Embedded Fan", "Fan Array", "Fan Energy Index (FEI)", "Fan Nameplate Electrical Input Power", "Fan System Electrical Input Power", "Fault Detection and Diagnostics (FDD) System", "Information Technology Equipment (ITE)", "Internal Curtain System", "Large Diameter Ceiling Fan", "On-Site Renewable Energy", "Renewable Energy Resources", "Testing Unit Enclosure Area", "Thermal Distribution Efficiency (TDE)", "Vegetative Roof", "Visible Transmittance, Annual", and "Wall, Above-Grade"

Building Envelope

- Increased envelope stringency and clarity for conditioned greenhouses [C402.1.1.1]
- Allows certain electric equipment buildings up to 1200 ft^2 to be exempt from envelope requirements [C402.1.2]
- Recognizes and provides guidance for layered cavity insulation [C402.1.3]
- Increased stringency requirements for attic insulation, above-grade and below-grade walls, and unheated slabs [Tables C402.1.3 and C402.1.4]
- Clarifies U-factor and R-factor insulation requirements at roofs, particularly tapered above-deck insulation [C402.1.4.1 & C402.2.1]
- Adds limit of maximum of 25% glazing area for garage door [Table C402.1.4, note i]
- Increases stringency of U-values and SHGC for fenestration in CZ 4 and CZ 5 [Table C402.4]
- Clarifies skylight requirements [C402.4.2]
- Removes R-values for doors and prescribes maximum U-factors and glazing area for non-swinging doors [C402.4.5]
- Requires either air barrier inspection and commissioning or enclosure testing to verify envelope performance of buildings and provides testing methodologies [C402.5]
- Requires HVAC interlock with operable openings that are greater than 40 ft^2 and provides a few exceptions (separately zoned commercial kitchens, warehouses, and outside vestibule doors) [C402.5.11]

Mechanical

- Exempts data center systems from control and economizer requirements [C403.1]
- Requires that data center systems comply with ASHRAE 90.4 (with a few modifications) [C403.1.2]
- Requires large HVAC systems (serving $\geq$100,000 ft^2) in new buildings to provide a fault detection and diagnostics system [C403.2.3]
- Updates HVAC equipment efficiency tables (some efficiencies to go into effect on January 1, 2023) for air conditioners, heat pumps, furnaces, boilers, chillers, cooling towers, condensers, and computer room AC [Tables C403.3.2(1) - C403.3.2(16)]
- Clarifies heat pump control requirements [C403.4.1.1]

- Clarifies that automatic stop controls are also required for HVAC systems [C403.4.2.3]
- Requires two-position valve for hydronic heat pump systems to be automatic and interlocked [C403.4.3.3.3]
- Adds a Variable Refrigerant Flow (VRF) exception to economizer requirements [C403.5]
- Requires Demand Control Ventilation (DCV) whenever economizers are required [C403.7.1]
- Increases number of enclosed parking garages that will require detection and controls [C403.7.2]
- Prescribes specific enthalpy recovery ratios for dwelling unit energy recovery systems [C403.7.4.1]
- Differentiates control requirements for hotel and motels (Group R-1) based upon occupancy status of rooms and changes time-out time from 30 minutes to 20 minutes [C403.7.6]
- Requires fans and fan arrays to have a Fan Energy Index (FEI) certified IAW AMCA 208 [C403.8.3]
- Prescribes minimum efficiencies of low-capacity residential-type fans [C403.8.5]
- Recognizes Large-diameter ceiling fans [C403.9]
- Adds performance requirements for commercial refrigerators, freezers, walk-in coolers, walk-in refrigerators and refrigeration equipment [C403.11]
- Clarifies insulation requirements for underground ducts [C403.12.1]
- Prescribes control system operation for operable opening interlocks [C403.14]

Service Water Heating

- Increases minimum efficiency for large (1 M Btu/h input) individual water heating equipment to 92% [C404.2.1]

Lighting

- Clarifies what is meant by “general lighting” [C405.1]
- Requires corridor lighting to be reduced to minimum levels (no more than 50% full power) when unoccupied [C405.2.1.1 & C405.2.1.4]
- Adds a section for “warehouse storage areas” and requires occupant sensor controls [C405.2.1.2]
- Clarifies intent of light reduction control requirements [C405.2.3]
- Adds additional control requirements for the secondary side lit daylight zone [C405.2.4.2]
- Adds control requirements for parking lot luminaires [C405.2.7.3]
- Adds control requirements for parking garage lighting [C405.2.8]
- Clarifies lighting power allowance calculations, especially for projects that involve only a portion of a building and for exterior lighting [C405.3.2 & C405.5.2]]
- Interior and exterior lighting power allowance have been modified to reflect new lighting levels in the IES lighting handbook and to recognize LED technology [Tables C405.3.2(1), C405.3.2(2), and C405.4.2(2)]
- Recognizes the high energy use of plant growth lighting and requires 95% of permanent luminaires to have a minimum photon efficiency of 1.6 m mol/J [C405.4]

Power

- Limits the combined voltage drop of customer-owned service conductors, feeder conductors and branch circuits to 5% [C405.10]
- Requires automatic receptacle control of at least 50% of 125V, 15 and 20 amp receptacles in offices, conference rooms, copy/print rooms, breakrooms, classrooms, and modular workstations and 25% of branch circuit feeders for modular furniture not shown on plans [C405.11]
- Requires new buildings with $\geq$ 25,000 ft^2 to be provided with an energy monitoring system [C405.12]

Other Equipment

- Requires that escalators be designed to recover more electrical energy than is consumed when resisting overspeed in the down direction [C405.9.2.1]

Additional Efficiency Requirements [C406]

- Requires at least 10 credits by adding additional energy efficient features to the building. The credits are determined from newly added tables arranged by occupancy classification [C406.1]
- Modifies more efficient HVAC option [C406.2]
- Modifies reduced lighting power option [C406.3]
- Modifies the basic renewable energy option [C406.5]
- Adds options for energy monitoring systems, if not otherwise required [C406.10]
- Adds options for fault detection system, if not otherwise required [C406.11]
- Adds options for efficient kitchen equipment [C406.12]

Total Building Performance

- Provides a new table that outlines the code requirements that must be met when using the Total Building Performance method [Table C407.2]

Commissioning

- Allows an "approved agency" or a qualified commissioning professional to perform the commissioning activities [C408.3.1]

Existing Buildings

- Reorganizes and clarifies requirements
- Clarifies that commissioning is required for new lighting and power systems [C502.3.6]

Significant changes 2010-2013 ASHRAE 90.1 Commercial Provisions

(Sources: ASHRAE 90.1-2013 and PNNL-SA-107200)

Building Envelope

- Modifies daylighting and several other definitions
- Limits the size of vestibules and adds specific vestibule requirements for large spaces [5.4.3.4]
- Increased stringency requirements for roofs, walls, below grade walls, slab-on-grade floors [Tables 5.5-4 and 5.5-5]
- Lowers fenestration U-factors about 18% [Tables 5.5-4 and 5.5-5]
- Limits skylight area to 3%, except to 6% if daylighting criteria are met [5.5.4.2.2]

Mechanical

- Increased equipment efficiencies for air conditioners, condensing units, heat pumps, water-chillers, boilers, cooling towers, refrigerators, and freezers [6.4.1 & Tables 6.8.1]
- Reduces occupancy threshold for demand-controlled ventilation from 40 people/1000 sq ft to 25 people/1000 sq ft [6.4.3.8]
- Adds vestibule heating controls [6.4.3.9]
- Adds direct digital control (DDC) and graphical display requirements [6.4.3.10 & Table 6.4.3.10.1]
- Adds control requirements for preheat coils [6.5.2.5]
- Adds requirements for fan efficiency and controls [6.5.3]
- Adds requirements for boiler turndown ratio and efficiency [6.5.4.1]
- Reduces system size and outdoor air thresholds for energy recovery [6.5.6]
- Adds requirements for walk-in coolers, freezers and refrigerated display cases [6.4.5 & 6.5.11]
- Adds requirements for Computer room HVAC systems and introduces the Power usage Effectiveness (PUE) [6.6]

Service Water Heating

- Increases efficiency of water-heating equipment 7.5.3 & Table 7.8]

Power

- Increases the spaces where and reduces the threshold for when plug receptacle shutoff control is required [8.4.2]
- Requires electrical energy monitoring and reporting for total electrical, HVAC systems, lighting, and receptacles [8.4.3]
- Requires separate electrical energy monitoring for buildings with tenants [8.4.3.1]
- Adds specific control requirements for guestroom switched receptacles [9.4.1.3]

Lighting

- Requires the use of certain lighting controls in more space types [9.4.1]
- Increases and clarifies requirements for daylighting and daylighting controls [9.4.1.1]
- Updates and reduces the interior and exterior lighting power densities [Table 9.5.1]
- Adds specific requirements for guest room and task lighting controls [9.4.1.3]
- Adds functional testing requirements for occupant sensors, automatic time switches, and daylight controls [9.4.3]

Other Equipment

- Adds requirements for the efficiency of general-purpose motors having power rating greater than 200 hp, but no more than 500 hp [10.4.1]
- Adds power limitations for elevator cab lighting [10.4.3.1]

- Requires escalators and moving walks to slow to minimum permitted speed when not conveying passengers [10.4.4]
- Requires whole-building energy monitoring and reporting [10.4.5.1]

Energy Cost Budget Method (ECB)

- Allows credit for on-site renewable energy but limits the credit to 5% of the calculated energy cost budget [11.4.3.1]

Appendix C (Envelope tradeoff)

- Completely revamps the methodology for the building envelope trade-off option allowed in Section 5.6

Performance Rating Method (Appendix G)- an above code program

- Numerous clarifications are added for modeling

Significant changes 2015-2018 IECC Commercial Provisions

[Sources: IECC 2018 and PNNL-SA-127543]

- Made several editorial changes to eliminate the use of the word “Accessible” (if not associated with the IBC Chapter 11 meaning of “Accessible”).
- Clarifies that commissioning is mandatory for all mechanical and hot water heating systems
- Adds additional as-built energy code documentation and owner training requirements for all buildings (typically part of the commissioning documents) …these documents must be submitted to the owner within 90 days of receipt of the Certificate of Occupancy
- Enhanced the section for required energy code inspections

Definitions

- Adds or modifies definitions of “Access (to)”, “Air Barrier”, “Captive Key Override”, “Computer Room”, “Demand Recirculation Water System”, “Group R”, “IEC Design H Motor”, “IEC Design N Motor”, “Isolation Devices”, “Luminaire-level Lighting Controls”, “NEMA Design A Motor”, “NEMA Design B Motor”, “NEMA Design C Motor”, “Networked Guestroom Control System”, “Ready Access (to)”, and “Voltage Drop”

Building Envelope

- Increased stringency requirements for heated slabs [Tables C402.1.3 and C402.1.4]
- Adds maximum U-values for garage door glazing [Table C402.1.4]
- Requires 2 staggered layers of insulation board when continuous roof insulation is installed. Also provides a new exceptions for around roof drains [C402.2.1]
- Clarifies requirements for mass walls and mass floors [C402.2.2 and C402.2.3]
- Restores section on below-grade walls [C402.2.5]
- Adds a section on airspaces [C402.2.7]
- Decreases the SHGC for fenestration in Climates zones 4 and 5 [Table C402.4]
- Raises the allowable skylight area from 5% to 6% with daylight controls [C402.4.1.2]
- Clarified topics such as sliding doors [Table C402.5.2], rooms containing fuel-burning appliances [C402.5.3], loading dock weather seals [C402.5.6]

Mechanical

- Section 403 (Building Mechanical Systems) reorganized for ease of use
- Clarifies that HVAC equipment shall not be oversized [C403.3.1]
- Eliminates outdated federal equipment efficiencies for air conditioners, heat pumps, furnaces, boilers, chillers, cooling towers, and computer room AC [Tables C403.3.2(1) - C403.3.2(10)]
- Clarified that control must be “configured to” meet the requirements, not just be “capable of” meeting the requirements [throughout]
- Clarifies that many controls requirements are “Mandatory” [throughout]
- Adds HVAC control requirements for heated or cooled vestibules [C403.4.1.4]
- Adds pump flow control requirements for chilled and hot water hydronic piping distribution systems [C403.4.3.3.2 and C403.4.4]
- Adds exceptions to economizer requirements [C403.5]
- Adds a section requiring VAV with zone controls for multiple-zone systems [C403.6.1]
- Adds control requirements for parallel-flow fan-powered VAV air terminals [C403.6.7]
- Increases the threshold design airflow rate at which energy recovery is required [Table C403.7.4(2)]
- New HVAC set point and fan control requirements for hotel and motels (Group R-1) with greater than 50 guest rooms [C403.7.6]

- Provides an allowable hp exception for fans less than or equal to 5 hp [C403.8.1]
- Prescribes motor fan speed controls for heat-rejection devices [C403.9]
- Adds federal efficiency requirements for walk-in coolers and freezers to be in effect in 2020 [C403.10.2.1]

Service Water Heating

- Increased federal water heater efficiencies [Table C404.2]

Lighting

- Adds a section for "open plan office areas" and requires occupant sensor controls [C405.2.1.3]
- Adds exceptions for lighting controls for dwelling units [C405.2.4 #3] and patient rooms [C 405.2.4 #2]
- Interior and exterior lighting power allowance have been modified (reduced) to reflect new lighting levels in the IES lighting handbook and to recognize LED technology [Tables C405.3.2(1), C405.3.2(2), and C405.4.2(2)]
- Lighting control requirements have been modified to add additional controls in some space types and options to others to allow easier application of advanced controls [C405.2]
    - Reduce exterior lighting power by 30% during periods of inactivity or after business hours [C405.2.6.3]
- Adds a requirement that 90% of permanently installed dwelling unit lighting fixtures use high efficacy lamps [C405.1]

Power

- Limits the combined voltage drop of feeder conductors and branch circuits to 5% [C405.9]

Other Equipment

- Updates electric motor terminology, adds exceptions, and adds efficiency tables consistent with federal regulations [C405.7]
- Adds an exception to allow a variable voltage drive in lieu of automatic speed control for escalators that are not conveying passengers [C405.8.2]

Additional Efficiency Package Options

- Adds options for enhanced envelope performance as determined by UA analysis [C406.8]
- Adds options for reduced air infiltration as determined by whole building air leakage testing [C406.9]

Total Building Performance

- Limits the amount of credit allowed for on-site renewable energy [C407.3]
- Limits the amount of credit allowed for renewable energy purchased from off-site sources [C407.3]

Commissioning

- Requires that building operations and maintenance documents be provided to the owner
- Requires a completed "Commissioning Compliance Checklist" with the "Preliminary Commissioning Report"

Existing Buildings

- Provides exceptions for Changes in Space Conditioning and for Changes of Occupancy