Administrative Procedures – Final Proposed Rule Filing

Instructions:

In accordance with Title 3 Chapter 25 of the Vermont Statutes Annotated and the “Rule on Rulemaking” adopted by the Office of the Secretary of State, this filing will be considered complete upon filing and acceptance of these forms with the Office of the Secretary of State, and the Legislative Committee on Administrative Rules. All forms requiring a signature shall be original signatures of the appropriate adopting authority or authorized person, and all filings are to be submitted at the Office of the Secretary of State, no later than 3:30 pm on the last scheduled day of the work week. The data provided in text areas of these forms will be used to generate a notice of rulemaking in the portal of “Proposed Rule Postings” online, and the newspapers of record if the rule is marked for publication. Publication of notices will be charged back to the promulgating agency.

PLEASE REMOVE ANY COVERSHEET OR FORM NOT REQUIRED WITH THE CURRENT FILING BEFORE DELIVERY!

Certification Statement: As the adopting Authority of this rule (see 3 V.S.A. § 801 (b) (11) for a definition), I approve the contents of this filing entitled:

Vermont Residential Building Energy Standards (RBES)

______________________________, on ___________.

(signature) (date)

Printed Name and Title:
June Tierney, Commissioner, Vermont Department of Public Service

RECEIVED BY: ________
TITLE OF RULE FILING:
Vermont Residential Building Energy Standards (RBES)

1. PROPOSED NUMBER ASSIGNED BY THE SECRETARY OF STATE
   19P–041

3. ADOPTING AGENCY:
   Department of Public Service

4. PRIMARY CONTACT PERSON:
   (A PERSON WHO IS ABLE TO ANSWER QUESTIONS ABOUT THE CONTENT OF THE RULE).
   Name: Kelly Launder
   Agency: PSD
   Mailing Address: 112 State Street, Montpelier, VT 05620
   Telephone: 802 828 - 4039 Fax: -
   E-Mail: kelly.launder@vermont.gov
   Web URL (WHERE THE RULE WILL BE POSTED):
   http://publicservice.vermont.gov

5. SECONDARY CONTACT PERSON:
   (A SPECIFIC PERSON FROM WHOM COPIES OF FILINGS MAY BE REQUESTED OR WHO MAY
   ANSWER QUESTIONS ABOUT FORMS SUBMITTED FOR FILING IF DIFFERENT FROM THE
   PRIMARY CONTACT PERSON).
   Name: Allison Wannop
   Agency: PSD
   Mailing Address: 112 State Street, Montpelier, VT 05620
   Telephone: 802 828 - 5543 Fax: -
   E-Mail: allison.wannop@vermont.gov

6. RECORDS EXEMPTION INCLUDED WITHIN RULE:
   (DOES THE RULE CONTAIN ANY PROVISION DESIGNATING INFORMATION AS CONFIDENTIAL;
   LIMITING ITS PUBLIC RELEASE; OR OTHERWISE EXEMPTING IT FROM INSPECTION AND
   COPYING?)  No

   IF YES, CITE THE STATUTORY AUTHORITY FOR THE EXEMPTION:

   PLEASE SUMMARIZE THE REASON FOR THE EXEMPTION:

7. LEGAL AUTHORITY / ENABLING LEGISLATION:
30 V.S.A. § 51 RESIDENTIAL BUILDING ENERGY STANDARDS

8. EXPLANATION OF HOW THE RULE IS WITHIN THE AUTHORITY OF THE AGENCY:
   In accordance with 30 V.S.A. § 51(c), the Commissioner of the Department of Public Service is required to amend and update the RBES through administrative rules.

9. THE FILING HAS CHANGED SINCE THE FILING OF THE PROPOSED RULE.

10. THE AGENCY HAS INCLUDED WITH THIS FILING A LETTER EXPLAINING IN DETAIL WHAT CHANGES WERE MADE, CITING CHAPTER AND SECTION WHERE APPLICABLE.

11. SUBSTANTIAL ARGUMENTS AND CONSIDERATIONS WERE NOT RAISED FOR OR AGAINST THE ORIGINAL PROPOSAL.

12. THE AGENCY HAS INCLUDED COPIES OF ALL WRITTEN SUBMISSIONS AND SYNOPSES OF ORAL COMMENTS RECEIVED.

13. THE AGENCY HAS INCLUDED A LETTER EXPLAINING IN DETAIL THE REASONS FOR THE AGENCY’S DECISION TO REJECT OR ADOPT THEM.

14. CONCISE SUMMARY (150 WORDS OR LESS):
   The provisions of these standards regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, ventilation, electrical, service water-heating and illumination systems and equipment which will enable effective use of energy in residential building construction. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy.

15. EXPLANATION OF WHY THE RULE IS NECESSARY:
   The rule is necessary to achieve the effective utilization of energy in residential buildings. Per 30 V.S.A. § 51(c), the Commissioner of the Department of Public Service is required to amend the residential building energy standards after the issuance of updated
standards for residential construction under the International Energy Conservation Code (IECC).

16. EXPLANATION OF HOW THE RULE IS NOT ARBITRARY:
The Vermont Residential Building Energy Standards are based on the International Energy Conservation Code (IECC) and are reviewed and commented on by an Advisory Committee made up of Vermont builders, architects, Energy Efficiency Utilities, multi-family housing developers, and low-income housing advocates.

17. LIST OF PEOPLE, ENTERPRISES AND GOVERNMENT ENTITIES AFFECTED BY THIS RULE:
The Department of Public Service, State Historic Preservation Office/ACCD, Act 250 Commissions, new home owners/buyers, existing home owners, builders, building designers, home energy raters and municipalities.

18. BRIEF SUMMARY OF ECONOMIC IMPACT (150 WORDS OR LESS):
This rule is an update of an adopted residential building energy standard that has been in effect for all residential building construction since 1998. Adoption of the rule will have a modest cost impact on all of the parties involved in new home construction, purchase, and ownership, and existing home renovation. It will assure the economic benefits of reduced energy costs, reduced environmental impacts, and improved indoor air quality for the lifetime of the home.

19. A HEARING WAS HELD.

20. HEARING INFORMATION
(THE FIRST HEARING SHALL BE NO SOONER THAN 30 DAYS FOLLOWING THE POSTING OF NOTICES ONLINE).

IF THIS FORM IS INSUFFICIENT TO LIST THE INFORMATION FOR EACH HEARING PLEASE ATTACH A SEPARATE SHEET TO COMPLETE THE HEARING INFORMATION.
Date: 6/21/2019
Time: 09:00 AM
Street Address: 115 State Street, Montpelier, VT
Zip Code: 05633-5501

Date: 
Time: AM
21. DEADLINE FOR COMMENT (NO EARLIER THAN 7 DAYS FOLLOWING LAST HEARING):

   7/10/2019

   KEYWORDS (PLEASE PROVIDE AT LEAST 3 KEYWORDS OR PHRASES TO AID IN THE
   SEARCHABILITY OF THE RULE NOTICE ONLINE).

   residential building energy standards
   residential energy code
   RBES
Administrative Procedures – Adopting Page

Instructions:

This form must accompany each filing made during the rulemaking process:

Note: To satisfy the requirement for an annotated text, an agency must submit the entire rule in annotated form with proposed and final proposed filings. Filing an annotated paragraph or page of a larger rule is not sufficient. Annotation must clearly show the changes to the rule.

When possible, the agency shall file the annotated text, using the appropriate page or pages from the Code of Vermont Rules as a basis for the annotated version. New rules need not be accompanied by an annotated text.

TITLE OF RULE FILING:
Vermont Residential Building Energy Standards (RBES)

1. 

2. ADOPTING AGENCY:
Department of Public Service

3. TYPE OF FILING (PLEASE CHOOSE THE TYPE OF FILING FROM THE DROPDOWN MENU BASED ON THE DEFINITIONS PROVIDED BELOW):

   - AMENDMENT - Any change to an already existing rule, even if it is a complete rewrite of the rule, it is considered an amendment as long as the rule is replaced with other text.

   - NEW RULE - A rule that did not previously exist even under a different name.

   - REPEAL - The removal of a rule in its entirety, without replacing it with other text.

   This filing is AN AMENDMENT OF AN EXISTING RULE .

4. LAST ADOPTED (PLEASE PROVIDE THE SOS LOG#, TITLE AND EFFECTIVE DATE OF THE LAST ADOPTION FOR THE EXISTING RULE):

   SOS LOG #: 14-P36
   Title: Residential Building Energy Standards (RBES)
Effective Date: March 1, 2015
Instructions:
In completing the economic impact analysis, an agency analyzes and evaluates the anticipated costs and benefits to be expected from adoption of the rule; estimates the costs and benefits for each category of people enterprises and government entities affected by the rule; compares alternatives to adopting the rule; and explains their analysis concluding that rulemaking is the most appropriate method of achieving the regulatory purpose.

Rules affecting or regulating schools or school districts must include cost implications to local school districts and taxpayers in the impact statement, a clear statement of associated costs, and consideration of alternatives to the rule to reduce or ameliorate costs to local school districts while still achieving the objectives of the rule (see 3 V.S.A. § 832b for details).

Rules affecting small businesses (excluding impacts incidental to the purchase and payment of goods and services by the State or an agency thereof), must include ways that a business can reduce the cost or burden of compliance or an explanation of why the agency determines that such evaluation isn’t appropriate, and an evaluation of creative, innovative or flexible methods of compliance that would not significantly impair the effectiveness of the rule or increase the risk to the health, safety, or welfare of the public or those affected by the rule.

1. TITLE OF RULE FILING:
Vermont Residential Building Energy Standards (RBES)

2. ADOPTING AGENCY:
Department of Public Service

3. CATEGORY OF AFFECTED PARTIES:
LIST CATEGORIES OF PEOPLE, ENTERPRISES, AND GOVERNMENTAL ENTITIES POTENTIALLY AFFECTED BY THE ADOPTION OF THIS RULE AND THE ESTIMATED COSTS AND BENEFITS ANTICIPATED:

The substantive changes to be implemented by this rule in comparison to the existing statute are listed below along with their impacts on each category of affected parties.
Home Buyers
Economic Impact Analysis

Standard Code

While the cost of constructing an average Vermont home will increase with the new requirements in the 2019 RBES, the resulting energy savings will more than offset those increases, as the information below demonstrates.

Average Annual Weighted Savings $537
Improvement Package Costs $5,031
Simple Payback (years) 9.4
Return on Investment 11%
Annual Increased Mortgage Payment $309
Positive Cash Flow $228

For the average new Vermont home, the Standard Code improvements from the 2019 RBES compared to the 2015 RBES will result in $537/year energy cost savings. The incremental cost to achieve these savings will be about $5,031. This represents a 9.4-year payback or 11% return on investment. If financed in a 30-year mortgage at 4.5% interest, the annual increase in mortgage payments would be $309, but with $537/year savings, the home buyer would realize $228 in positive cash flow. The energy improvements more than pay for themselves.

The new “package plus points” approach included in the 2019 RBES allows for significant flexibility for builders in complying with the code. While the 2015 RBES and previous versions required builders to pick from a set of five “prescriptive packages”, the new “package plus points” approach requires builders to select from one of four base packages of insulation and fenestration requirements, and then to choose from a list of more than 20 efficiency options to arrive at a target number of points based on house size. The larger the home, the more points the builder would need to acquire. At the same time, this approach rewards
smaller homes by requiring fewer points, which will cost less to install.

A blower door air leakage testing by a certified professional is now required for all new homes (this was just required for the stretch code in the 2015 RBES). This will add about $200-$300 to the cost of a new home but will ensure that homes are constructed to the required tightness levels, drafts will be minimized to increase occupant comfort, building moisture damage through air leakage will be minimized and energy savings will be maximized. A survey of building performance professionals in Vermont found more than 100 qualified testers throughout the state had access to blower doors to conduct the air leakage testing. Air leakage reduction is one of the most cost-effective improvements in homes, resulting in significant energy cost savings.

Fenestration (window and door) upgrades to meet the 2019 RBES may cost in the $1,000 to $1,500 range, insulation R-value increases may cost $100 - $300, an increased percent of high-efficacy lamps may add about $20, and then measures from the points list could include an upgraded heating system ($500), pre-drywall air leakage testing ($250), solar-ready construction ($500), low-flow water fixtures ($200), a hot water recirculation system ($1,000) and more efficient water heater ($4,000).

For multifamily developments of 10 or more dwelling units, there is a requirement of one electric vehicle charging outlet (Level 1 (120V) or Level 2 (240 V)) adjacent to a parking space for buildings with 10 to 25 parking spaces. One additional EV charging outlet for another parking space is required for buildings with 26 to 50 parking spaces and for every 25 parking spots thereafter. The cost on average is expected to be $35 per dwelling unit.
All together this package could add about $5,000 to the cost of a typical new Vermont home, but will result in over $500 per year in energy cost savings. As stated above, if financed, the annual cost savings will more than offset the incremental mortgage cost.

Stretch Code

The Stretch Code applies to all Act 250 development projects and is also available for municipalities that choose to adopt a higher energy standard. While the Stretch Code has more stringent energy efficiency requirements, the resulting energy savings are significantly greater than the Standard Code, as the information below demonstrates.

Average Annual Weighted Savings $731
Improvement Package Costs $10,037
Simple Payback (years) 13.7
Return on Investment 7%
Annual Increased Mortgage Payment $616
Positive Cash Flow $114

For the average new Vermont home complying with the Stretch Code, the improvements from the 2019 RBES compared to the 2015 RBES will result in $731/year energy cost savings. The incremental cost to achieve these savings will be about $10,000. This represents a 13.7-year payback or 7% return on investment. If financed in a 30-year mortgage at 4.5% interest, the annual increase in mortgage payments would be $616, but with $731/year savings, the home buyer would realize $114 in positive cash flow. Like with the Standard Code, the Stretch Code energy improvements also more than pay for themselves.

Energy improvement measures in addition to those noted above to meet the Standard Code would include higher
insulation R-values that could add $1,000-$1,400 in cost, a fully ducted heat recovery ventilation system to provide fresh air throughout the house while exhausting stale air for about $3,500 to $4,000. With a few additional point items, the incremental cost of the Stretch Code home over the Standard Code home would be about $5,000, for a total improvement cost relative to the 2015 RBES Standard Code of about $10,000. However, as pointed out above, this incremental cost will be paid for with energy savings. If financed as part of the mortgage, the annual cost savings will more than cover the cost of these improvements and still provide more than $100 in positive cash flow.

Electric Vehicle (EV) Charging Capabilities. As described above, both Standard code and Stretch code require multifamily developments of 10 or more dwelling units to have a prescribed number of Level 1 (120V) or Level 2 (240 V) EV charger-equipped parking spaces (one EV charging space for multifamily buildings with 10 to 25 parking spaces, one additional EV charging space for buildings with 26 to 50 parking spaces, etc.).

However for Stretch code, in addition to that requirement, if a Level 1 charging outlet is provided, that parking space must also be "Level 2 ready." For single family Stretch Code, one accessible Level 1 charging socket is required.

This provision will add a very small cost for single family homes since providing a 120V Level 1 socket in a garage or next to a driveway is standard practice. For multifamily the EV charging requirement cost on average is expected to be $35 per dwelling unit. The cost of the multifamily stretch code requirement for "Level 2 ready" parking spaces is negligible, since the primary difference between Level 1 and "Level 2 ready" is the provision of extra space in the electrical panel for 240 V circuits which may or may not require a larger electric panel. Assuming that many of these multifamily buildings will provide Level 2 charging infrastructure by choice, the number of parking spaces which will need to be "Level 2 ready" under stretch code is small and the cost of those upgrades when spread over the large...
number of new construction units in a given year will be very small. These requirements will ensure that these housing projects are ready to accept electric vehicles as they become more commonplace.

Solar Ready. Stretch Code requires that each project consider a “solar ready” zone for the building. This means that the roof is engineered to hold solar panels, designed to maximize the roof area available for solar panels, that there is a means of running wire through a conduit to the electric service panel and that there is room left on the panel for circuit breakers for a future solar system. The costs of complying could be a few hundred dollars but will provide significant savings if the homeowner wants to add solar PV panels in the future.

4. IMPACT ON SCHOOLS:
   INDICATE ANY IMPACT THAT THE RULE WILL HAVE ON PUBLIC EDUCATION, PUBLIC SCHOOLS, LOCAL SCHOOL DISTRICTS AND/OR TAXPAYERS CLEARLY STATING ANY ASSOCIATED COSTS:
   No impact, as school buildings are not covered under RBES.

5. ALTERNATIVES: CONSIDERATION OF ALTERNATIVES TO THE RULE TO REDUCE OR AMELIORATE COSTS TO LOCAL SCHOOL DISTRICTS WHILE STILL ACHIEVING THE OBJECTIVE OF THE RULE.
   N/A

6. IMPACT ON SMALL BUSINESSES:
   INDICATE ANY IMPACT THAT THE RULE WILL HAVE ON SMALL BUSINESSES (EXCLUDING IMPACTS INCIDENTAL TO THE PURCHASE AND PAYMENT OF GOODS AND SERVICES BY THE STATE OR AN AGENCY THEREOF):
   No impact, as small businesses are not covered under RBES.

7. SMALL BUSINESS COMPLIANCE: EXPLAIN WAYS A BUSINESS CAN REDUCE THE COST/BURDEN OF COMPLIANCE OR AN EXPLANATION OF WHY THE AGENCY DETERMINES THAT SUCH EVALUATION ISN’T APPROPRIATE.
   N/A

8. COMPARISON:
COMPARE THE IMPACT OF THE RULE WITH THE ECONOMIC IMPACT OF OTHER
ALTERNATIVES TO THE RULE, INCLUDING NO RULE ON THE SUBJECT OR A RULE HAVING
SEPARATE REQUIREMENTS FOR SMALL BUSINESS:
An alternative to this rule would be to adopt the IECC 2018 code as is. The up-front cost of this alternative would likely be less than the proposed rule, though the energy savings would be lower, resulting in a higher cost to the homeowner in the long run through added energy costs. Adopting no rule would mean significant lost opportunities with each home being built if those additional savings weren’t captured through an improved energy code.

9. SUFFICIENCY: EXPLAIN THE SUFFICIENCY OF THIS ECONOMIC IMPACT ANALYSIS.
The cost - benefit analysis underlying this economic impact statement was prepared by the Department's contractor and has been extensively reviewed by stakeholders and experts including home builders, architects, developers, and affordable housing advocates. Feedback from these stakeholders and experts was incorporated into the estimates presented here.
Instructions:
In completing the environmental impact analysis, an agency analyzes and evaluates the anticipated environmental impacts (positive or negative) to be expected from adoption of the rule; compares alternatives to adopting the rule; explains the sufficiency of the environmental impact analysis.

Examples of Environmental Impacts include but are not limited to:

- Impacts on the emission of greenhouse gases
- Impacts on the discharge of pollutants to water
- Impacts on the arability of land
- Impacts on the climate
- Impacts on the flow of water
- Impacts on recreation
- Or other environmental impacts

1. TITLE OF RULE FILING:

Vermont Residential Building Energy Standards (RBES)

2. ADOPTING AGENCY:

Department of Public Service

3. GREENHOUSE GAS: explain how the rule impacts the emission of greenhouse gases (e.g. transportation of people or goods; building infrastructure; land use and development, waste generation, etc.):

The energy savings from homes built to the updated RBES will result in direct reductions in greenhouse gas emissions through reduced on-site fuel consumption and indirect greenhouse gas reductions through reduced electricity demand for the lifetime of the home.

4. WATER: explain how the rule impacts water (e.g. discharge / elimination of pollution into Vermont waters, the flow of water in the state, water quality etc.):

No impact

5. LAND: explain how the rule impacts land (e.g. impacts on forestry, agriculture etc.):

No impact
6. **RECREATION:** *EXPLAIN HOW THE RULE IMPACT RECREATION IN THE STATE:*
   No impact

7. **CLIMATE:** *EXPLAIN HOW THE RULE IMPACTS THE CLIMATE IN THE STATE:*
   The energy savings from homes built to the updated RBES will result in direct and indirect reductions in greenhouse gas emissions and minimize the other negative environmental impacts of energy use.

8. **OTHER:** *EXPLAIN HOW THE RULE IMPACT OTHER ASPECTS OF VERMONT’S ENVIRONMENT:*
   This rule promotes improved insulation and air sealing in new residential construction and renovations to reduce building heating and cooling demands. This rule also promotes the use of efficient appliances and mechanical systems, which will further reduce electricity and fuel consumption. Additionally, the rule will improve building durability, resident comfort and indoor air quality in new homes.

9. **SUFFICIENCY:** *EXPLAIN THE SUFFICIENCY OF THIS ENVIRONMENTAL IMPACT ANALYSIS.*
   This environmental impact analysis covers the full range of environmental and climate impacts of the RBES updates.
Administrative Procedures – Public Input

Instructions:

In completing the public input statement, an agency describes the strategy prescribed by ICAR to maximize public input, what it did do, or will do to comply with that plan to maximize the involvement of the public in the development of the rule.

This form must accompany each filing made during the rulemaking process:

1. TITLE OF RULE FILING:
   Vermont Residential Building Energy Standards (RBES)

2. ADOPTING AGENCY:
   Department of Public Service

3. PLEASE DESCRIBE THE STRATEGY PRESCRIBED BY ICAR TO MAXIMIZE PUBLIC INVOLVEMENT IN THE DEVELOPMENT OF THE PROPOSED RULE:

   ICAR suggested that the Department reach out to VSECU for input on the rule. VSECU was included on all stakeholder outreach and invited to all public stakeholder events before and during the public comment period.

4. PLEASE LIST THE STEPS THAT HAVE BEEN OR WILL BE TAKEN TO COMPLY WITH THAT STRATEGY:

   The Department of Public Service undertook a broad-based consensus building process to develop this rule. Between July and October 2018, the Department held one online webinar and 3 public meetings around the state to present information on proposed changes to RBES to interested stakeholders, which included builders, architects, multi-family housing developers, low-income housing advocates, electric and gas utilities, energy efficiency utilities, modular home manufacturers, and log home industry representatives.

   At each of the stakeholder meetings, the Department presented a draft of the proposed changes to the 2015 RBES. The Department also convened an Advisory
Committee as required by statute to delve deeper into the technical aspects of the code. The full Advisory Committee met in August and October of 2018 and a multifamily subcommittee met in early September. The Department modified the proposed RBES to incorporate changes recommended by the stakeholders and the Advisory Committee after each round of meetings. Participants and other stakeholders were also encouraged to comment on each version of the proposed RBES language posted on the PSD website.

After the Rule was accepted by ICAR, the Department convened public RBES technical trainings in Montpelier May 1st, and Burlington June 11th, and held a public hearing on the proposed rule at the State House on June 21st, 2019. Notices for all of these meetings were sent out to the broader stakeholder group, and were accompanied by a reminder that public comments would be accepted until July 10th at the provided email address.

PSD made changes to the proposed rule based on these meetings, public comments and other feedback.

Information is available on the Department of Public Service website at:

https://publicservice.vermont.gov/content/building-energy-standards-update

5. BEYOND GENERAL ADVERTISEMENTS, PLEASE LIST THE PEOPLE AND ORGANIZATIONS THAT HAVE BEEN OR WILL BE INVOLVED IN THE DEVELOPMENT OF THE PROPOSED RULE:

Kelly Launder, VT PSD;
Keith Levenson, VT PSD;
Barry Murphy, VT PSD;
Allison Wannop, VT PSD;
Gabrielle Stebbins, Energy Futures Group;
Richard Faesy, Energy Future Group;
Keith Downes, Navigant Consulting;
Stu Slote, Navigant Consulting;
Eveline Killian, Cx Associates;
Jen Chiodo, Cx Associates;
Jim Edelson, New Buildings Institute;
Eric Makela, New Buildings Institute;
Brian Just, Vt. Energy Investment Corp. (VEIC);
Chris Gordon, VEIC;
Jacob Racusin, New Frameworks Natural Design/Build, Home Builders & Remodelers Association (HBRA-VT);
Jeff Gephart, Vermont Energy Star Homes;
Jeremy King, Vermont Gas Systems;
Christina Rohrbacher, Northeast Energy Efficiency Partnership (NEEP);
Jason Webster, Huntington Homes, HBRA-VT;
Rob Picket, Connecticut Valley Home Builders Association, Log Homes Council;
Robert Schultz, PNNL;
Rosemarie Bartlett, PNNL;
Matt Sharpe, VEIC;
Carolyn Sarno, NEEP;
Joseph Benard, VT Dept. of Public Safety;
Leslie Badger, VEIC;
Dave Keefe, VEIC;
Chris Snyder, Snyder Homes, Inc., HBRA-VT;
Chris West, Eco Houses of Vermont, HBRA-VT;
Kathy Beyer, Housing Vermont;
Samantha Dunn, Housing Vermont;
Bob Duncan, Duncan-Wisniewski Architects;
Chris Burns, Burlington Electric Dept. (BED);
Brian Reilly, BED;
Craig Peltier, Vt. Housing Conservation Board;
Collin Frisbie, Sterling Homes, HBRA-VT;
Walt Adams, Walter M. Adams Consulting;
Bill Root, GWR Engineering, ASHRAE;
Matt Cota, Vermont Fuel Dealers Association;
Brad Cook, Building Performance Services LLC;
David H. Mann, American Chemistry Council;
Henri Fennell, Henri Fennell Consulting.
Administrative Procedures – Scientific Information

THIS FORM IS ONLY REQUIRED WHEN INCORPORATING MATERIALS BY REFERENCE. PLEASE REMOVE PRIOR TO DELIVERY IF IT DOES NOT APPLY TO THIS RULE FILING:

Instructions:

In completing the Scientific Information Statement, an agency shall provide a brief summary of the scientific information including reference to any scientific studies upon which the proposed rule is based, for the purpose of validity.

1. TITLE OF RULE FILING:
Vermont Residential Building Energy Standards (RBES)

2. ADOPTING AGENCY:
   Department of Public Service

3. BRIEF EXPLANATION OF SCIENTIFIC INFORMATION:
   30 V.S.A.§ 51 RESIDENTIAL BUILDING ENERGY STANDARDS, requires the update of the Standards after the issuance of updated standards for residential construction under the International Energy Conservation Code (IECC). This rule for RBES is based on the 2015 and 2018 edition of the International Energy Conservation Code which has been extensively vetted by an international committee of code professionals.

   The Vermont Legislature adopted Act 89 of 2013, and (Section 6 of 30 V.S.A.§ 51) which allowed the adoption of Vermont's first stretch code for application in proceedings under 10 V.S.A. chapter 151 (Act 250), and to be available for adoption by municipalities under 24 V.S.A. chapter 117.

   This rule is based on a review of current residential construction practices in Vermont and incorporates more stringent insulation and air sealing requirements as well as 2018 IECC requirements that are not included in
the 2015 RBES. The primary substantive differences between the 2018 RBES and the 2015 RBES is the adoption of a "Package Plus Points" compliance pathway, which allows builders to achieve roughly the same energy efficiency goal using combinations of prescriptive insulation levels, air sealing standards, and window R-values with required points awarded for upgrades to insulation, air sealing, windows, plumbing fixtures, heating and hot water equipment, renewable energy generation and storage systems. Each of these provisions has been reviewed by builders, architects and building scientists for technical feasibility and impacts on energy use, building durability and indoor air quality.

4. CITATION OF SOURCE DOCUMENTATION OF SCIENTIFIC INFORMATION:

Energy modeling was provided using REM/Rate version 15.7 software, published by NORESCO, LLC. The ventilation standard support was published in two papers; “Mechanical Ventilation for Residential New Construction in Vermont: A Review of Codes, Standards, and Research With Recommendations for a Vermont Ventilation Standard” (August 18, 1999) and “A Field Study of Exhaust Only Ventilation Systems Performance in Residential New Construction in Vermont” (August 26, 1999).

5. INSTRUCTIONS ON HOW TO OBTAIN COPIES OF THE SOURCE DOCUMENTS OF THE SCIENTIFIC INFORMATION FROM THE AGENCY OR OTHER PUBLISHING ENTITY:

REM/Rate software can be licensed and purchased at www.remrate.com. The ventilation studies are available by request to the DPS.
THIS FORM IS ONLY REQUIRED WHEN INCORPORATING MATERIALS BY REFERENCE. PLEASE REMOVE PRIOR TO DELIVERY IF IT DOES NOT APPLY TO THIS RULE FILING:

Instructions:
In completing the incorporation by reference statement, an agency describes any materials that are incorporated into the rule by reference and how to obtain copies.

This form is only required when a rule incorporates materials by referencing another source without reproducing the text within the rule itself (e.g. federal or national standards, or regulations).

Incorporated materials will be maintained and available for inspection by the Agency.

1. TITLE OF RULE FILING:
   Vermont Residential Building Energy Standards (RBES)

2. ADOPTING AGENCY:
   Department of Public Service

3. DESCRIPTION (DESCRIBE THE MATERIALS INCORPORATED BY REFERENCE):
   Chapter 6 of the proposed rule lists the full title, edition year and address of the promulgator for all standards that are referenced in the code. The section numbers in which the standards are referenced are also listed.

4. FORMAL CITATION OF MATERIALS INCORPORATED BY REFERENCE:
   see attached document '2020 RBES Incorporated by Reference'.

5. OBTAINING COPIES: (EXPLAIN WHERE THE PUBLIC MAY OBTAIN THE MATERIAL(S) IN WRITTEN OR ELECTRONIC FORM, AND AT WHAT COST):
   Links have been provided on the attached '2020 RBES Incorporated by Reference' document where copies of the texts can either be accessed or be purchased. The costs for obtaining these references range from $0 to $3,000.
6. MODIFICATIONS (PLEASE EXPLAIN ANY MODIFICATION TO THE INCORPORATED MATERIALS E.G., WHETHER ONLY PART OF THE MATERIAL IS ADOPTED AND IF SO, WHICH PART(S) ARE MODIFIED):

N/A
CHAPTER 6
REFERRED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

AAMA
American Architectural Manufacturers Association
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173-4268

<table>
<thead>
<tr>
<th>Standard reference number</th>
<th>Title</th>
<th>Referenced in code section number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAMA/WDMA/CSA 101/I.S.2/A</td>
<td>North American Fenestration Standard/ Specifications for Windows, Doors and Unit Skylights</td>
<td>R402.4.3</td>
</tr>
</tbody>
</table>

ACCA
Air Conditioning Contractors of America
2800 Shirlington Road, Suite 300
Arlington, VA 22206

<table>
<thead>
<tr>
<th>Standard reference number</th>
<th>Title</th>
<th>Referenced in code section number</th>
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<tbody>
<tr>
<td>Manual S—14</td>
<td>Residential Equipment Selection</td>
<td>R403.7</td>
</tr>
</tbody>
</table>

APSP
The Association of Pool and Spa Professionals
2111 Eisenhower Avenue
Alexandria, VA 22314

<table>
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<tr>
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<th>Title</th>
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ASHRAE
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329-2305
### ASHRAE

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<td>R402.1.5</td>
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<td>ASHRAE 62.2</td>
<td>Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings</td>
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<td>ASHRAE 193—2010 (RA2014)</td>
<td>Method of Test for Determining the Airtightness of HVAC Equipment</td>
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### ASTM

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<td>Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen</td>
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<td>Standard Test Method for Determining Air Leakage Rate by Fan Pressurization</td>
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### CSA

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<td><a href="https://www.csa.ca">CSA Group</a></td>
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</tr>
<tr>
<td></td>
<td>8501 East Pleasant Valley</td>
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</tr>
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<td></td>
<td>Cleveland, OH 44131-5575</td>
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| CBA                        | CSA Handbook of Fundamentals                                           |                                   |
|                           | Table 402.4.1.1                                                       |                                   |

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2020 RBES Incorporated by Reference
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<td>Test Method for measuring efficiency and pressure loss of drain water heat recovery units</td>
<td>R403.5.4</td>
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<td><strong>DASMA</strong></td>
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<td>1300 Sumner Avenue</td>
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<td>Test Method for Thermal Transmittance and Air Infiltration of Garage Doors</td>
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<td><strong>HVI</strong></td>
<td>Home Ventilating Institute</td>
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<td>Wauconda, IL 60084</td>
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</tr>
<tr>
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<td><strong>916—09</strong></td>
<td>Airflow Test Procedure</td>
<td>R406.2</td>
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<tr>
<td><strong>ICC</strong></td>
<td>International Code Council, Inc.</td>
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</tr>
<tr>
<td>500 New Jersey Avenue, NW</td>
<td>6th Floor</td>
<td>Washington, DC 20001</td>
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<tr>
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<td><strong>IBC—18</strong></td>
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<td>Table R403.6.1</td>
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<td><strong>ICC 400 1-17</strong></td>
<td>Standard on the Design and Construction of Log Structures</td>
<td>Table R402.1.5, Table 402.4.1.1</td>
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<td>2009 International Energy Conservation Code®</td>
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### 2020 RBES Incorporated by Reference

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#### IEEE

**The Institute of Electrical and Electronic Engineers, Inc.**
3 Park Avenue
New York, NY 1016-5997

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<thead>
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<th>Title</th>
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#### NFPA

**National Fire Protection Association.**
1 Batterymarch Park
Quincy, MA 02169-7471

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<td>National Fuel Gas Code</td>
<td>R305.1, R305.2, R305.3</td>
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### NFR
National Fenestration Rating Council, Inc.  
6305 Ivy Lane, Suite 140  
Greenbelt, MD 20770

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<td>100—2017</td>
<td>Procedure for Determining Fenestration Products (U)-factors</td>
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### RESNET
Residential Energy Services Network, Inc.  
P.O. Box 4561  
Oceanside, CA 92052-4561

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<td>127—11</td>
<td>Standard for Factory Built Fireplaces –</td>
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<td>Electrical Resistance Heat Tracing for</td>
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<td></td>
<td>Commercial and Industrial Applications</td>
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PREFACE

Introduction


This comprehensive energy conservation code establishes minimum regulations for energy efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy efficient designs.

The International Energy Conservation Code provisions provide many benefits, among which is the model code development process that offers an international forum for energy professionals to discuss performance and prescriptive code requirements. This model code also encourages international consistency in the application of provisions.

Development

This 2019 RBES is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Background

During the 1995 legislative session, there was consensus that a Task Force should be created to examine the issues related to developing an energy efficiency standard and address the concerns of interested parties. To this end, the Governor’s Task Force on Energy Efficiency Standards for New Residential Construction was created in September, 1995 and was charged with developing a legislative proposal prior to the 1996 session.

The Governor’s Task Force included stakeholders with many different perspectives on this issue. The Task Force reached a consensus that the legislature should adopt an energy code and that this code should include the following provisions:

- The code should be kept current by establishing a three-year cycle for revision and modification of the code through rule making;
- To demonstrate compliance, builders should be required to complete a form self-certifying that the energy efficiency requirements of the code have been met for each new home that is built;
- Owner/builders should be allowed to build a home that does not comply with the code as long as they disclose how that home is deficient to subsequent prospective buyers; and
• In order to address indoor air quality, a requirement for automatic, mechanical ventilation systems should be included in the first update of the code three years from adoption.

The Vermont Residential Building Energy Standards (RBES) was adopted by statute in 1997 and incorporated virtually all of the Task Force’s recommendations.

Act 89 passed in 2013, established a Stretch Code defined as a building energy code for residential buildings that achieves greater energy savings than the RBES. The stretch code shall be available for adoption by municipalities under 24 V.S.A. §117, and shall apply in proceedings under 10 V.S.A. §151 (Act 250).

Update Process

The Residential Building Energy Standards Statute (30 V.S.A. § 51) requires that revisions to the RBES are made promptly after the issuance of updated standards under the International Energy Conservation Code (IECC). The Department of Public Service (PSD) is required to convene stakeholders that include mortgage lenders, builders, building designers, utility representatives, and other persons with experience and expertise prior to the adoption of a revised RBES to provide recommendations.

The 2019 RBES is based on the language in the 2015 edition of the IECC and includes all of the efficiency improvements included in IECC 2018 as well as some of the improvements proposed for IECC 2021 to insure continued progression in efficiency in the Vermont RBES. The 2019 RBES also provides a new “Package Plus Points” approach to code compliance. (Previous code compliance was achieved through a “prescriptive package” approach). The addition of “points” provides builders and designers greater flexibility in complying with RBES. The Vermont PSD held a series of stakeholder meetings in 2018 and 2019 to gather feedback on proposed changes to RBES. The revisions presented in this document were modified based on input received from these meetings.

EFFECTIVE USE OF THE 2019 RESIDENTIAL BUILDING ENERGY STANDARDS

The 2019 Vermont Residential Building Energy Standards (RBES) is a code that regulates minimum energy conservation requirements for new buildings as well as additions, alterations, renovations, and repairs to existing buildings. The 2019 RBES addresses energy conservation requirements for all aspects of energy uses in residential construction, including heating and ventilating, lighting, water heating, and power usage for appliances and building systems.

The 2019 RBES is a design document. For example, before constructing a building, the designer must determine the minimum insulation $R$-values and fenestration $U$-factors for the building exterior envelope. The RBES sets forth minimum requirements for exterior envelope insulation, window and door $U$-factors and SHGC ratings, duct insulation, lighting and power efficiency, mechanical ventilation, and water distribution insulation.
Arrangement and Format of the 2019 RBES

The 2019 RBES, like other codes published by ICC, is arranged and organized to follow sequential steps that generally occur during a plan review or inspection. The 2019 RBES is divided into six different parts:

<table>
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<tr>
<th>Chapters</th>
<th>Subjects</th>
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<tr>
<td>1-2</td>
<td>Scope, Administration and Definitions</td>
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<tr>
<td>3</td>
<td>General Requirements</td>
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<td>4</td>
<td>Residential Energy Efficiency</td>
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<tr>
<td>5</td>
<td>Existing Buildings</td>
</tr>
<tr>
<td>6</td>
<td>Referenced Standards</td>
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</tbody>
</table>

Italicized Terms

Selected terms set forth in Chapter 2: Definitions, are italicized where they appear in code text. Such terms are not italicized where the definition set forth in Chapter 2 does not impart the intended meaning in the use of the term. The terms selected have definitions that the user should read carefully to facilitate better understanding of the code.

The following is a chapter-by-chapter synopsis of the scope and intent of the provisions of the 2019 Vermont Residential Building Energy Standards:

Chapter 1: Scope and Administration. This chapter contains provisions for the application, enforcement and administration of subsequent requirements of the code. In addition to establishing the scope of the code, Chapter 1 identifies which buildings and structures come under its purview. Chapter 1 is largely concerned with maintaining “due process of law” in enforcing the energy conservation criteria contained in the body of this code. Only through careful observation of the administrative provisions can the code official or other authority having jurisdiction, where one exists, reasonably expect to demonstrate that “equal protection under the law” has been provided.

Chapter 2 Definitions. Chapter 2 is the repository of the definitions of terms used in the body of the code. Codes are technical documents and every word, term and punctuation mark can impact the meaning of the code text and the intended results. The code often uses terms that have a unique meaning in the code and the code meaning can differ substantially from the ordinarily understood meaning of the term as used outside of the code.

The terms defined in Chapter 2 are deemed to be of prime importance in establishing the meaning and intent of the code text. The user of the code should be familiar with and consult this chapter because the definitions are essential to the correct interpretation of the code and the user may not be aware that a term is defined.

Where understanding of a term’s definition is especially key to or necessary for understanding of a particular code provision, the term is shown in italics wherever it appears in the code. This
is true only for those terms that have a meaning that is unique to the code. In other words, the generally understood meaning of a term or phrase might not be sufficient or consistent with the meaning prescribed by the code; therefore, it is essential that the code-defined meaning be known.

Guidance regarding tense, gender and plurality of defined terms as well as guidance regarding terms not defined in this code is provided.

**Chapter 3 General Requirements.** Chapter 3 provides interior design conditions that are used as a basis for assumptions in heating and cooling load calculations and provides basic material requirements for insulation materials and fenestration materials, and provides standards for residential mechanical ventilation and combustion safety.

**Chapter 4 Residential Energy Efficiency.** Chapter 4 contains the energy-efficiency-related requirements for the design and construction of residential buildings regulated under this code. It should be noted that the definition of a residential building in this code is unique for this code. In this code, a residential building is an R-2, R-3 or R-4 buildings three stories or less in height. All other R-1 buildings, including residential buildings greater than three stories in height, are regulated by the energy conservation requirements in the Vermont Commercial Building Energy Standards (CBES). The applicable portions of a residential building must comply with the provisions within this chapter for energy efficiency. This chapter defines requirements for the portions of the building and building systems that impact energy use in new residential construction and promotes the effective use of energy. The provisions within the chapter promote energy efficiency in the building envelope, the heating and cooling system, lighting and the service water heating system of the building. Vermont has adopted a two-tiered code structure with a "base code" that applies statewide, and a "Stretch Code" that is more stringent. The Stretch Code applies to all Act 250 development projects and is also available for municipalities that choose to adopt a higher energy standard.

**Chapter 5 Existing Buildings.** Chapter 5 of each set of provisions contains the technical energy efficiency requirements for existing buildings. Chapter 5 provisions address the maintenance of buildings in compliance with the code as well as how additions, alterations, repairs and changes of occupancy need to be addressed from the standpoint of energy efficiency. Specific provisions are provided for historic buildings.

**Chapter 6 Referenced Standards.** The code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 6 contains a comprehensive list of all standards that are referenced in the code. The standards are part of the code to the extent of the reference to the standard. Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal basis to the code official, or other authority having jurisdiction, where one exists, contractor, designer and owner.

Chapter 6 is organized in a manner that makes it easy to locate specific standards. It lists all of the referenced standards, alphabetically, by acronym of the promulgating agency of the standard. Each agency’s standards are then listed in either alphabetical or numeric order based upon the standard identification. The list also contains the title of the standard; the edition (date)
Marginal Markings

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2015 and 2018 edition. Vermont specific additions and changes are designated through dotted lines in the margin. Deletion indicators in the form of an arrow (➡️) are provided in the margin where an entire section, paragraph, exception or table has been deleted or an item in a list of items or a table has been deleted. Will be updated during publication.

Abbreviations and Notations

The following is a list of common abbreviations and units of measurement used in this code. Some of the abbreviations are for terms defined in Chapter 2. Others are terms used in various tables and text of the code.

- **AFUE**: Annual fuel utilization efficiency
- **bhp**: Brake horsepower (fans)
- **Btu**: British thermal unit
- **Btu/h-ft²**: Btu per hour per square foot
- **C-factor**: See Chapter 2—Definitions
- **CDD**: Cooling degree days
- **cfm**: Cubic feet per minute
- **cfm/ft²**: Cubic feet per minute per square foot
- **ci**: Continuous insulation
- **COP**: Coefficient of performance
- **DCV**: Demand control ventilation
- **°C**: Degrees Celsius
- **°F**: Degrees Fahrenheit
- **DWHR**: Drain water heat recovery
- **DX**: Direct expansion
- **Eₙ**: Combustion efficiency
- **Eᵥ**: Ventilation efficiency
- **Eₜ**: Thermal efficiency
- **EER**: Energy efficiency ratio
- **EF**: Energy factor
- **ERI**: Energy Rating index
- **F-factor**: See Chapter 2—Definitions
- **FDD**: Fault detection and diagnostics
- **FEG**: Fan efficiency grade
- **FL**: Full load
- **ft²**: Square foot
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<td>Gallons per minute</td>
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<td>HDD</td>
<td>Heating degree days</td>
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<tr>
<td>HERS</td>
<td>Home Energy Rating System</td>
</tr>
<tr>
<td>hp</td>
<td>Horsepower</td>
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<tr>
<td>HSPF</td>
<td>Heating seasonal performance factor</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, ventilating and air conditioning</td>
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<td>IEER</td>
<td>Integrated energy efficiency ratio</td>
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<td>IPLV</td>
<td>Integrated Part Load Value</td>
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<td>Kg/m²</td>
<td>Kilograms per square meter</td>
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<td>kW</td>
<td>Kilowatt</td>
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<td>Light power density (lighting power allowance)</td>
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<td>L/s</td>
<td>Liters per second</td>
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<td>Ls</td>
<td>Liner system</td>
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<td>square meters</td>
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<td>Pascal</td>
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<td>PF</td>
<td>Projection factor</td>
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<td>pcf</td>
<td>Pounds per cubic foot</td>
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<td>PSD</td>
<td>Department of Public Service (Vermont)</td>
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<td>psf</td>
<td>Pounds per square foot</td>
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<td>Packaged terminal air conditioner</td>
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<td>Packaged terminal heat pump</td>
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<td>R-value</td>
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<td>SCOP</td>
<td>Sensible coefficient of performance</td>
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<td>Seasonal energy efficiency ratio</td>
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<td>SHGC</td>
<td>Solar Heat Gain Coefficient</td>
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<td>Solar reflectance index</td>
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<td>Service water heat recovery factor</td>
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<td>Variable refrigerant flow</td>
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CHAPTER 1 [RE]
SCOPE AND ADMINISTRATION

PART 1—SCOPE AND APPLICATION

SECTION R101
SCOPE AND GENERAL REQUIREMENTS

R101.1 Title.
This code shall be known as the 2019 Vermont Residential Building Energy Standards (RBES) and shall be cited as such. It is referred to herein as “this code.”

R101.2 Scope.
This code applies to residential buildings and the building sites and associated systems and equipment, including one family dwellings, two family dwellings, and multi-family housing three stories or less in height.

While many sections of this code (e.g., inspections, review of construction documents, compliance, etc.) do not pertain to most of Vermont that lacks code officials, these sections are included to provide guidance for those jurisdictions that do have a code official or other authority having jurisdiction.

R101.3 Intent.
This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge building science or safety, health or environmental requirements contained in other applicable codes or ordinances.

R101.4 Applicability.
Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

R101.4.1 Mixed occupancy.
With respect to a structure that is three stories or less in height and is a mixed-use building that shares residential and commercial users, the term “residential building” shall include the living spaces in the structure and the nonliving spaces in the structure that serve only the residential users such as common hallways, laundry facilities, residential management offices, community rooms, storage rooms, and foyers. The “residential building” shall comply with all requirements of RBES, and all other aspects of the building shall comply with the Vermont Commercial Building Energy Standards (CBES).

R101.5 Compliance.
Residential buildings shall meet the provisions of Chapter 4.
R101.5.1 Compliance materials.
The code official or other authority having jurisdiction shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

R101.5.2 Exempt buildings.
The following buildings, or portions thereof, shall be exempt from the provisions of this code:

1. **Low Energy Use Buildings.** Those with a peak design rate of energy usage less than 3.4 Btu/h · ft$^2$ (10.7 W/m$^2$) or 1.0 watt/ft$^2$ (10.7 W/m$^2$) of floor area for space conditioning purposes.

2. **Unconditioned Buildings.** Those that do not contain conditioned space.

3. **Mobile homes.** Homes subject to Title VI of the National Manufactured Housing Construction and Safety Standards Act of 1974 (42 U.S.C. §§ 5401- 5426). On-site constructed basements and crawlspaces must comply with this code.

4. **Hunting camps.** Residential buildings shall not include hunting camps.

5. **Summer camps.** Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.

6. **Yurts** with only a biomass (wood) or other on-site renewable heating and hot water system.

7. **Owner-built homes.** Residential construction by an owner, if all of the following apply:

   7.1. The owner of the residential construction is the builder, as defined in 30 V.S.A § 51.(a)(1), and;

   7.2. The residential construction is used as a dwelling by the owner, and;

   7.3. The owner in fact directs the details of construction with regard to the installation of materials not in compliance with the RBES, and;

   7.4. The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with the RBES.

Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES and shall itemize which measures do not meet the RBES in effect at the time construction commenced. Any certificate given under this subsection shall be recorded in the land records where the property is located and sent to the Department of Public Service (PSD), within 30 days following sale of the property by the owner. A certificate that itemizes how the home does not comply with RBES is available from the PSD.
**R101.6 Authority having jurisdiction.**
In any instance where there is no state or local code official or other authority having jurisdiction, the PSD is not considered to be the “other authority having jurisdiction, where one exists,” and those sections of this code requiring involvement by that entity do not apply. All other code requirements still apply.

**R101.7 Base and Stretch Code.**
The “Base Code” is the RBES Energy Code that is applicable throughout Vermont, except for projects subject to 10 V.S.A. Chapter 151 (Act 250), and in any municipalities that have adopted the more stringent “Stretch Code.”

**R101.8 Compliance options.**
There are three thermal efficiency compliance options:

1. **Package Plus Points:** For the Base Code, Table R402.2.1 lists the options for insulation and fenestration packages. Table R402.1.2.2 lists the additional points required for compliance based on building square footage, and Table R402.1.2.3 lists the components and respective point values to be used to meet the point requirement in Table R402.1.2.2. For the Stretch Code, Table R407.2.1.1 lists three options for insulation and fenestration packages, Table R407.2.1.2 lists the required additional points for compliance based on building square footage, and Table R407.2.1.3 lists the components and respective point values to be used to meet the point requirement in Table R407.2.1.2.

2. **REScheck**: The U.S. Department of Energy’s REScheck software.

3. **Home Energy Rating System (HERS):** A HERS energy rating that demonstrates compliance with Section 406.4 for the Base Code or Section 407.2.2 for the Stretch Code. (All HERS Index values in this code are based on REM/Rate version 15.7.)

**SECTION R102**
**ALTERNATIVE MATERIALS, DESIGN AND METHODS OF CONSTRUCTION AND EQUIPMENT**

**R102.1 General.**
The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. The code official or other authority having jurisdiction, where one exists, may approve an alternative material, design or method of construction upon application of the owner or the owner’s authorized agent. The code official or other authority having jurisdiction shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, performance, fire resistance, durability and safety. Where the alternative material, design or method of construction is not approved, the code official or other authority having jurisdiction shall respond to the applicant, in writing, stating the reasons why the alternative was not approved.

**R102.1.1 Above code programs.**
The code official or other authority having jurisdiction, where one exists, shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy-efficiency program,
official or authority shall be considered to be in compliance with this code. The requirements identified as “mandatory” in Chapter 4 shall be met.

PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION R103
CONSTRUCTION DOCUMENTS

R103.1 General.
Where required, construction documents, technical reports and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents and technical reports shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official or other authority having jurisdiction, where one exists, is authorized to require necessary construction documents to be prepared by a registered design professional.

Exception: The code official or other authority having jurisdiction, where one exists, is authorized to waive the requirements for construction documents or other supporting data if the code official or other authority having jurisdiction, where one exists, determines they are not necessary to confirm compliance with this code.

R103.2 Information on construction documents.
Where required, construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted where approved by the code official or other authority having jurisdiction, where one exists. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGC).
3. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
6. Equipment and system controls and control strategies.
7. Duct sealing, duct and pipe insulation and location.
8. Air sealing details.
R103.2.1 Building thermal envelope depiction.
The building thermal envelope shall be represented on the construction documents.

R103.3 Examination of documents.
The code official or other authority having jurisdiction, where one exists, shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances. The code official or other authority having jurisdiction, where one exists, is authorized to utilize a registered design professional, or other approved entity not affiliated with the building design or construction, in conducting the review of the plans and specifications for compliance with the code. Compliance with this code shall be certified by a builder, licensed professional engineer, licensed architect, or an accredited home energy rating organization by completing, signing, and posting a Vermont Residential Building Energy Standards (RBES) Certificate. The person certifying shall provide a copy of the certificate to the Department of Public Service and shall assure that a certificate is recorded and indexed in the town land records.

R103.3.1 Approval of construction documents.
When the code official or other authority having jurisdiction, where one exists, issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped “Reviewed for Code Compliance.” Such approved construction documents shall not be changed, modified or altered without authorization from the code official or other authority having jurisdiction, where one exists. Work shall be done in accordance with the approved construction documents.

One set of construction documents so reviewed shall be retained by the code official or other authority having jurisdiction, where one exists. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the code official or other authority having jurisdiction, where one exists, or a duly authorized representative.

R103.3.2 Previous approvals.
This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

R103.3.3 Phased approval.
The code official or other authority having jurisdiction, where one exists, shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or approved, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

R103.4 Amended construction documents.
Work shall be installed in accordance with the approved construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.

R103.5 Retention of construction documents.
One set of approved construction documents shall be retained by the code official or other
authority having jurisdiction, where one exists, for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

SECTION R104
INSPECTIONS

R104.1 General.
Where required, construction or work for which a permit is required shall be subject to inspection by the code official or other authority having jurisdiction, where one exists, or his or her designated agent, and such construction or work shall remain visible and able to be accessed for inspection purposes until approved. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

R104.2 Required inspections.
The code official or other authority having jurisdiction, where one exists, or his or her designated agent, upon notification, may make the inspections set forth in Sections R104.2.1 through R104.2.4.

R104.2.1 Footing and foundation inspection.
Inspections associated with footings and foundations shall verify compliance with the code as to R-value, location, thickness, depth of burial and protection of insulation as required by the code and approved plans and specifications.

R104.2.2 Framing and rough-in inspection.
Inspections at framing and rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper installation (both interior and exterior); fenestration properties such as U-factor and SHGC and proper installation; and air leakage controls as required by the code; and approved plans and specifications.

R104.2.3 Plumbing rough-in inspection.
Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection, and required controls.

R104.2.4 Mechanical rough-in inspection.
Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding R-value, system air leakage control, programmable thermostats, dampers, whole house ventilation, and minimum fan efficiency.

R104.3 Required approvals.
Work shall not be done beyond the point indicated in each successive inspection without first
obtaining the approval of the code official or other authority having jurisdiction, where one exists. The code official or other authority having jurisdiction, where one exists, upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the code official or other authority having jurisdiction, where one exists.

R104.3.1 Final inspection.
The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

R104.4 Reinspection.
A building shall be reinspected when determined necessary by the code official or other authority having jurisdiction, where one exists.

R104.5 Approved inspection agencies.
The code official or other authority having jurisdiction, where one exists, is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided such agencies are approved as to qualifications and reliability relevant to the building components and systems they are inspecting.

R104.6 Inspection requests.
It shall be the duty of the holder of the permit or their duly authorized agent to notify the code official or other authority having jurisdiction, where one exists, when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.

R104.7 Reinspection and testing.
Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made to achieve compliance with this code. The work or installation shall then be resubmitted to the code official or other authority having jurisdiction, where one exists, for inspection and testing.

R104.8 Approval.
After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the code official or other authority having jurisdiction, where one exists.

R104.8.1 Revocation.
The code official or other authority having jurisdiction, where one exists, is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.

SECTION R105
VALIDITY

R105.1 General.
If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

SECTION R106
REFERENCED STANDARDS

R106.1 Referenced codes and standards.
The codes and standards referenced in this code shall be those listed in Chapter 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections R106.1.1 and R106.1.2.

R106.1.1 Conflicts.
Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

R106.1.2 Provisions in referenced codes and standards.
Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

R106.2 Application of references.
References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

R106.3 Other laws.
The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.
CHAPTER 2 [RE]
DEFINITIONS

SECTION R201
GENERAL

R201.1 Scope.
Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

R201.2 Interchangeability.
Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

R201.3 Terms defined in other codes.
Terms that are not defined in this code but are defined in the International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code or the International Residential Code shall have the meanings ascribed to them in those codes.

R201.4 Terms not defined.
Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

SECTION R202
GENERAL DEFINITIONS

ABOVE-GRADE WALL. A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see “Readily accessible”).

ADDITION. An extension or increase in the conditioned space floor area, number of stories or height of a building or structure.

ADVANCED WOOD HEATING SYSTEM. A wood pellet fueled central heating system that meets the standards established by the Vermont Clean Energy Development Fund and Efficiency Vermont and is listed on the Eligible Equipment Inventory posted at http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei.

AIR BARRIER. An air barrier is a durable assembly that blocks air flow through the building thermal envelope and its assemblies. Air barriers must be continuous, sealed at all joints, penetrations, and interruptions using durable sealants intended for such use and compatible with all adjacent materials, and able to resist pressures without displacement or damage.
AIR-IMPERMEABLE INSULATION. An insulation that also functions as an air barrier material, having an air permeance equal to or less than 0.02 L / s-m² at 75 Pa pressure differential as tested in accordance with ASTM E 2178 or E 283.

ALTERATION. Any construction, retrofit or renovation to an existing structure other than repair or addition. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE). The ratio of annual output energy to annual input energy which includes any non-heating season pilot input loss, and for gas or oil-fired furnaces or boilers, does not include electrical energy.

APPROVED. Acceptable to the code official or other authority having jurisdiction, where one exists.

APPROVED AGENCY. An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the code official or other authority having jurisdiction, where one exists.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

BALANCED VENTILATION SYSTEM. See “Whole House Ventilation System, Balanced”.

BASE CODE. The standard RBES Energy Code, as distinct from the higher stringency Stretch Code.

BASEMENT WALL. A wall 50 percent or more below grade and enclosing conditioned space.

BATHROOM. A room containing a bathtub, shower, spa or similar bathing fixture.

BEDROOM. A room or space 70 square feet or greater, with egress window and closet, used or intended to be used for sleeping. A “den,” “library,” or “home office” with a closet, egress window, and 70 square feet or greater or other similar rooms shall count as a bedroom, but living rooms and foyers shall not. (Source: RESNET)

BIO DIESEL. Mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751.

BIOMASS. The vegetation removed from the forest, usually logging slash, small-diameter trees, tops, limbs, or trees. This includes wood logs, wood pellets and wood chips.

BTU. Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (0.454 kg) of water 1°F (0.56°C), (1 Btu = 1,055 J), or about the amount of energy in one wooden kitchen match burned end to end.
**BUILDER.** The general contractor or other person in charge of construction, who has the power to direct others with respect to the details to be observed in construction. (Source: VT 30 V.S.A. § 51)

**BUILDING.** Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

**BUILDING SITE.** A contiguous area of land that is under the ownership or control of one entity.

**BUILDING THERMAL ENVELOPE.** The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space. This boundary also includes the boundary between conditioned space and exempt or unconditioned space.

**CATEGORY I COMBUSTION APPLIANCE.** An appliance which operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY II COMBUSTION APPLIANCE.** An appliance which operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY III COMBUSTION APPLIANCE.** An appliance which operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY IV COMBUSTION APPLIANCE.** An appliance which operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent. (Source: NFPA 54)

**C-FACTOR (THERMAL CONDUCTANCE).** The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h · ft² · °F) [W/(m² · K)].

**CIRCULATING HOT WATER SYSTEM.** A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

**CLIMATE ZONE.** A geographical region based on climatic criteria as specified in this code.

**CODE OFFICIAL, VERMONT.** The officer or other designated authority charged with the administration and enforcement of this energy code, or a duly authorized representative. The Department of Public Service is not the code official and shall not be required to conduct inspections of construction or construction documents.

**COEFFICIENT OF PERFORMANCE (COP)—COOLING.** The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory-assembled equipment, as tested under a nationally recognized standard or designated operating conditions.
COEFFICIENT OF PERFORMANCE (COP)—HEAT PUMP—HEATING. The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions. Supplemental heat shall not be considered when checking compliance with the heat pump equipment.

COLD-CLIMATE HEAT PUMP. A heat pump with an inverter-driven, variable capacity compressor that is designed to provide full heating heat pump capacity and having a minimum COP of 1.75 or greater at an outside air temperature of 5°F.

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of “Residential building,” excluding mobile homes.

COMMERCIAL BUILDING ENERGY STANDARDS (CBES). The Vermont non-residential Energy Code, based on the IECC 2018.

CONDENSER. A heat exchanger designed to liquefy refrigerant vapor by removal of heat.

CONDENSING UNIT. A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the conditioned space. See also Finished Conditioned Floor Area.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling. See also Finished Conditioned Floor Area.

CONSTRUCTION DOCUMENTS. The physical drawings and specifications that outline the building.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

CRAWL SPACE WALL. The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

CUBIC FEET PER MINUTE (CFM). The quantity of air moved in 1 minute. A measurement typically applied to ventilation equipment.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DAYLIGHT ZONE.
1. **Under skylights.** The area under skylights whose horizontal dimension, in each direction, is equal to the skylight dimension in that direction plus either the floor-to-ceiling height or the dimension to a ceiling height opaque partition, or one-half the distance to adjacent skylights or vertical fenestration, whichever is least.

2. **Adjacent to vertical fenestration.** The area adjacent to vertical fenestration which receives daylight through the fenestration. For purposes of this definition and unless more detailed analysis is provided, the daylight zone depth is assumed to extend into the space a distance of 15 feet (4572 mm) or to the nearest ceiling height opaque partition, whichever is less. The daylight zone width is assumed to be the width of the window plus 2 feet (610 mm) on each side, or the window width plus the distance to an opaque partition, or the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

**DEADBAND.** The temperature range in which no heating or cooling is used.

**DEGREE DAY, COOLING.** A unit, based on temperature difference and time, used in estimating cooling energy consumption and specifying nominal cooling load of a building in summer. For any one day, when the mean temperature is more than 65°F, there are as many degree days as there are degrees Fahrenheit difference in temperature between the mean temperature for the day and 65°F. Annual cooling degree days (CDD) are the sum of the degree days over a calendar year.

**DEGREE DAY, HEATING.** A unit, based upon temperature difference and time, used in estimating heating energy consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F, there are as many degree days as there are degrees Fahrenheit difference in temperature between the mean temperature for the day and 65°F. Annual heating degree days are the sum of the degree days over a calendar year.

**DEMAND CONTROL VENTILATION (DCV).** A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

**DEMAND RECIRCULATION WATER SYSTEM.** A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe to the heated water fixture upon user demand via push-button at the fixture.

**DIRECT-VENT APPLIANCES.** Appliances that are constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere. See also Sealed Combustion Venting System.

**DUCT.** A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

**DUCT SYSTEM.** A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.
**DWELLING UNIT.** A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

**DYNAMIC GLAZING.** Any fenestration product that has the fully reversible ability to change its performance properties, including U-factor, solar heat gain coefficient (SHGC), or visible transmittance (VT).

**ECONOMIZER, AIR.** A duct and damper arrangement and automatic control system that allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

**ECONOMIZER, WATER.** A system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

**ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE).** Electrical infrastructure for charging electric vehicles. EVSE can be either Level 1 (120 V) or Level 2 (240 V).

**ENERGY ANALYSIS.** A method for estimating the annual energy use of the proposed design and standard reference design based on estimates of energy use.

**ENERGY COST.** The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

**ENERGY EFFICIENCY RATIO (EER).** The ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When consistent units are used, this ratio becomes equal to COP (see also “Coefficient of performance”).

**ENERGY RECOVERY VENTILATION SYSTEM (ERV).** Systems that employ air-to-air heat exchangers to recover sensible and latent energy from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

**ENERGY SIMULATION TOOL.** An approved software program or calculation-based methodology that projects the annual energy use of a building.

**ENTRANCE DOOR.** Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware and automatic closers and contain over 50-percent glass specifically designed to withstand heavy use and possibly abuse.

**ERI REFERENCE DESIGN.** A version of the rated design that meets the minimum requirements of the 2006 International Energy Conservation Code.

**EVAPORATOR.** That part of the system in which liquid refrigerant is vaporized to produce refrigeration.

**EXTERIOR ENVELOPE.** See “Building Thermal Envelope."

**EXTERIOR WALL.** Walls that are part of the Building Thermal Envelope, including both above-grade walls and basement walls.
FAN BRAKE HORSEPOWER (BHP). The horsepower delivered to the fan’s shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

FAN SYSTEM BHP. The sum of the fan brake horsepower 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 space(s) and return it to the source or exhaust it to the outdoors.

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate to conditioned spaces served by the system.

FAN SYSTEM MOTOR NAMEPLATE HP. The sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

FENESTRATION. Products classified as either vertical fenestration or skylights.

FENESTRATION PRODUCT, SITE-BUILT. A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls and atrium roof systems.

F-FACTOR. The perimeter heat loss factor for slab-on-grade floors (Btu/h · ft · °F) [W/(m · K)].

FINISHED AREA. An enclosed area in a house that is suitable for year-round use, embodying walls, floors, and ceilings that are similar to the rest of the house.

FINISHED CONDITIONED FLOOR AREA (FCFA). The floor area in square feet of a home that is within the conditioned space of the building, and also is finished area, as measured in accordance with ANSI Standard Z765-2003 (with the exception that floor areas with ceiling heights of less than 5 feet will be included in finished square footage).

FURNACE DUCT. A furnace normally installed in distribution ducts of air-conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

FURNACE, WARM AIR. A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

GROSS AREA OF EXTERIOR WALLS. The normal projection of all exterior walls, including the area of all windows and doors installed therein (see “Exterior wall”).

GROUND SOURCE HEAT PUMP. A heat pump that extracts heat from the ground or water within the ground.

HEAT. The form of energy that is transferred by virtue of a temperature difference or a change in state of a material.
HEAT CAPACITY (HC). The amount of heat necessary to raise the temperature of a given mass by 1°F (0.6°C). The heat capacity of a building element is the sum of the heat capacities of each of its components.

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.

HEAT RECOVERY VENTILATION SYSTEM (HRV). A factory-assembled device or combination of devices, including fans or blowers, designed to provide outdoor air for ventilation in which heat is transferred between two isolated intake and exhaust air streams.

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosyphoning of hot water during standby periods.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

HEATING SEASONAL PERFORMANCE FACTOR (HSPF). The total heating output of a heat pump during its normal annual usage period for heating, in Btus, divided by the total electric energy input during the same period, in watt hours, as determined by DOE 10 CFR Part 430, Subpart B, Test Procedures, and based on Region 4.

HEAT PUMP WATER HEATER. A water heater that uses electricity and a refrigeration cycle to move heat from the ambient air to heat water instead of directly heating water.

HIGH-EFFICACY LAMPS/ LIGHTING. Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of not less than 65 lumens per watt; or light fixtures of not less than 55 lumens per watt. In determining the number or percent of lamps, each replaceable lamp (or light string) connected to a permanently installed lighting fixture shall count as one lamp.

HISTORIC BUILDING. Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.

2. Designated as historic under an applicable state or local law.

3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.

HOME ENERGY RATING SYSTEM (HERS). A home energy rating system approved by the Vermont Department of Public Service that provides a numerical rating in compliance with 30 V.S.A. § 52. The purpose of this procedure is to ensure that accurate and consistent home energy ratings are performed by accredited HERS providers in Vermont and to promote an objective, cost-effective, sustainable home energy rating process as a compliance method for residential building energy codes; as qualification for energy programs designed to reach
specific energy-saving goals; and as a way to provide Vermont’s housing market the ability to differentiate residences based on their energy efficiency.

**HUMIDISTAT.** A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

**HVAC.** Heating, ventilating and air conditioning.

**HVAC SYSTEM.** The equipment, distribution network and terminals that provide either collectively or individually the processes of heating, ventilating or air conditioning to a building.

**HVAC SYSTEM COMPONENTS.** HVAC system components provide, in one or more factory-assembled packages, means for chilling or heating water, or both, with controlled temperature for delivery to terminal units serving the *conditioned spaces* of the building. Types of HVAC system components include, but are not limited to, water chiller packages, reciprocating condensing units and water source (hydronic) heat pumps (see “HVAC system equipment”).

**HVAC SYSTEM EQUIPMENT.** HVAC system equipment provides, in one (single package) or more (split system) factory-assembled packages, means for air circulation, air cleaning, air cooling with controlled temperature and dehumidification and, optionally, either alone or in combination with a heating plant, the functions of heating and humidifying. The cooling function is either electrically or heat operated and the refrigerant condenser is air, water or evaporatively cooled. Where the equipment is provided in more than one package, the separate packages shall be designed by the manufacturer to be used together. The equipment shall be permitted to provide the heating function as a heat pump or by the use of electric or fossil-fuel-fired elements. (The word “equipment” used without a modifying adjective, in accordance with common industry usage, applies either to HVAC system equipment or HVAC system components.)

**HUNTING CAMP.** A seasonal building used as a temporary residence only during hunting season.

**INfiltration.** The uncontrolled inward air leakage into a building through the building thermal envelope caused by the pressure effects of wind or differences in the indoor and outdoor air density or both.

**INSULATED SIDING.** A type of continuous insulation with manufacturer-installed insulating material as an integral part of the cladding product having a minimum \( R \)-value of R-2.

**INSULATING SHEATHING.** An insulating board with a core material having a minimum \( R \)-value of R-2.

**LABELED.** Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

**LEVEL 1 ELECTRIC VEHICLE CHARGING.** Level 1 charging uses a standard alternating current 120V outlet.
LEVEL 2 ELECTRIC VEHICLE CHARGING. Level 2 uses a 240V alternating current outlet.

LIGHTING. See “High-Efficacy Lamps/Lighting.”

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the code official or other authority having jurisdiction, where one exists, and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and where the listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LOCAL VENTILATION. A mechanical ventilation system including fans, controls and ducts, dedicated to exhausting moisture-laden and/or contaminated air to the outside of the building from a room or space in which the moisture or contamination is generated or supplying outdoor air to that space.

LOW-VOLTAGE LIGHTING. Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

MANUAL. Capable of being operated by personal intervention (see “Automatic”).

MECHANICAL VENTILATION. The mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space by powered fans. For purposes of this standard, mechanical ventilation does not include processes driven by wind, such as turbine ventilators.

MIXED-USE. With respect to a structure that is three stories or less in height and is a mixed-use building that shares residential and commercial users, the term "residential building" shall include the living spaces in the structure and the nonliving spaces in the structure that serve only the residential users such as common hallways, laundry facilities, residential management offices, community rooms, storage rooms, and foyers. (From Vermont 30 V.S.A. § 51.)

MULTIFAMILY DWELLING/BUILDING. For the purpose of determining the building type that must comply with RBES under Vermont statute, a multifamily building is a residential building or mixed use building with three or more dwelling units three stories or less in height. Multifamily buildings of four stories or more in height must comply with CBES. (From Vermont 30 V.S.A. § 51.) See R101.2 for scope. For the purpose of determining points in R402.1.2, a multifamily dwelling is a residential building containing units built one on top of another and those built side-by-side which do not have a ground-to-roof wall and/or have common facilities (i.e., attic, basement, heating plant, plumbing, etc.) (From www.census.gov).

NAMEPLATE HORSEPOWER. The nominal motor horsepower rating stamped on the motor nameplate.

OCCUPANCY. The purpose for which a building, or portion thereof, is utilized or occupied.

OCCUPANCY CLASSIFICATIONS. Residential Group R is the occupancy group used for buildings that include sleeping rooms and are not institutional and are not generally regulated by the International Residential Code. The IRC typically regulates single family homes and
duplexes, any structure with more than two units is in the International Building Code (IBC). There are four different occupancy groups within R.

Occupancy group **R-1**: transient uses like hotels, motels and boarding houses.

Occupancy group **R-2**: (most common) residences where occupants are primarily permanent, including apartments, dormitories, fraternities and sororities. It also includes vacation timeshares (with more than two units), convents and monasteries. Congregate living facilities with 16 or fewer occupants are in Group R-3.

Occupancy group **R-3**: permanent occupancies that aren’t R-1, R-2, R-4 or I, including buildings that are in the IBC but have no more than two units. Adult facilities and child care facilities that provide accommodation for five or less people less than 24 hours a day are R-3. Where these facilities are in a single family home they must comply with the IRC.

Occupancy group **R-4**: residential care/assisted living facilities including more than five and not more than 16 occupants.

**OPAQUE AREAS.** All exposed areas of a building envelope which enclose *conditioned space*, except openings for windows, skylights and building service systems. Doors are considered opaque when they are 50-percent or greater opaque in surface area.

**OUTDOOR AIR.** Air taken from the outdoors and, therefore, not previously circulated through the building.

**OWNER BUILDER.** If all of the following apply:

(A) The owner of the residential construction is the builder, as defined under this chapter.

(B) The residential construction is used as a dwelling by the owner.

(C) The owner in fact directs the details of construction with regard to the installation of materials not in compliance with RBES.

(D) The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with RBES. Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES, and shall itemize which measures do not meet the RBES standards in effect at the time construction commenced. Any certificate shall be recorded in the land records where the property is located, and sent to the Department of Public Service, within 30 days following sale of the property by the owner.

**PACKAGED TERMINAL AIR CONDITIONER (PTAC).** A factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies or sections (intended for mounting through the wall to serve a single room or zone). It includes heating capability by hot water, steam or electricity. (For the complete technical definition, see ARI 310/380.)
PACKAGED TERMINAL HEAT PUMP. A PTAC capable of using the refrigeration system in a reverse cycle or heat pump mode to provide heat. (For the complete technical definition, see ARI 310/380.)

POSITIVE COOLING SUPPLY. Mechanical cooling deliberately supplied to a space, such as through a supply register.

Additionally, mechanical cooling indirectly supplied to a space through uninsulated surfaces of space-cooling components, such as evaporator coil cases and cooling distribution systems which continually maintain air temperatures within the space of 85°F (29°C) or lower during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of this code.

POSITIVE HEAT SUPPLY. Heat deliberately supplied to a space by design, such as a supply register, radiator or heating element. Additionally, heat indirectly supplied to a space through uninsulated surfaces of service water heaters and space-heating components, such as furnaces, boilers and heating and cooling distribution systems which continually maintain air temperature within the space of 50°F (10°C) or higher during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of this code.

POWER-VENTED APPLIANCE. Appliances that operate with a positive vent static pressure (Category III) and utilize a mechanical fan to exhaust combustion gases from the appliance to the outside atmosphere.

PRIMARY SHOWERS. The one or two showers in the dwelling that will be used the most.

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

RATED CAPACITY. In terms of ventilation, the volume of air (in cfm) that the fan can move against a given static pressure (in inches or water gage). Prescriptive compliance with the Vermont Residential Building Energy Standards requires that all fan capacities be rated at 0.1 inch (25 Pa) of water gage.

RATED DESIGN. A description of the proposed building used to determine the energy rating index.

RBES. Vermont Residential Building Energy Standards.

READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see “Accessible”).

REFRIGERANT. A substance utilized to produce refrigeration by its expansion or vaporization or absorption.

RENEWABLE ENERGY SOURCES. Means energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to solar hot water, solar hot air, solar photovoltaics, wind, and hydro.
(A) Methane gas and other flammable gases produced by the decay of sewage treatment plant wastes or landfill wastes and anaerobic digestion of agricultural products, byproducts, or wastes shall be considered renewable energy resources, but no form of solid waste, other than agricultural or silvicultural waste, shall be considered renewable.

(B) The only portion of electricity produced by a system of generating resources that shall be considered renewable is that portion generated by a technology that qualifies as renewable.

(C) The following fuels shall not be considered renewable energy sources: coal, oil, propane, and natural gas.

(D) Biomass is considered renewable.

(E) Biodiesel is considered renewable.

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

REROOFING. The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings, multifamily housing and multiple single-family dwellings (townhouses as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane. (See “Occupancy Classifications”).

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. A roof assembly can be part of the building thermal envelope if it also includes insulation and an air barrier. A roof assembly includes the roof covering, underlayment, roof deck, structural members, and if it is part of the thermal envelope, insulation, air barrier, vapor retarder and interior finish. The gross area of a roof assembly consists of the total interior surface of all roof/ceiling components, including opaque surfaces, dormer and bay window roofs, trayed ceilings, overhead portions of an interior stairway to an unconditioned attic, doors and hatches, glazing and skylights exposed to conditioned space, that are horizontal or sloped at an angle less than 60 degrees (1.1 rad) from the horizontal (see “Exterior wall”). A roof assembly that is part of the thermal envelope, or portions thereof, having a slope of 60 degrees (1.1 rad) or greater from horizontal shall be considered in the gross area of exterior walls and thereby excluded from consideration in the roof assembly. Skylight shaft walls 12 inches (305 mm) in depth or greater (as measured from the ceiling plane to the roof deck) shall be considered in the gross area of exterior walls and are thereby excluded from consideration in the roof assembly.

ROOF RECOVER. The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.
ROOM AIR CONDITIONER. An encased assembly designed as a unit for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and shall be permitted to also include means for ventilating and heating.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area \((h \cdot \text{ft}^2 \cdot \text{°F/Btu}) \) \([(m^2 \cdot K)/W]\).

SASH CRACK. The sum of all perimeters of all window sashes, based on overall dimensions of such parts, expressed in feet. If a portion of one sash perimeter overlaps a portion of another sash perimeter, only count the length of the overlapping portions once.

SCREW LAMP HOLDERS. A lamp base that requires a screw-in-type lamp, such as a compact-fluorescent, incandescent, or tungsten-halogen bulb.

SEALED COMBUSTION VENTING SYSTEM. A venting system designed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere. (See also “Direct-vent Appliances.”)

SEASONAL ENERGY EFFICIENCY RATIO (SEER). The total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/h, divided by the total electric energy input during the same period, in watt-hours, as determined by DOE 10 CFR Part 430, Subpart B, Test Procedures.

SENSIBLE RECOVERY EFFICIENCY (SRE): The net sensible energy recovered by the supply airstream as adjusted by electric consumption, case heat loss or heat gain, air leakage, airflow mass imbalance between the two airstreams and the energy used for defrost (when running the Very Low Temperature Test), as a percent of the potential sensible energy that could be recovered plus the exhaust fan energy.

SERVICE SYSTEMS. All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

SERVICE WATER HEATING. Supply of hot water for purposes other than comfort heating.

SKYLIGHT. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees \((1.05 \text{ rad})\) from horizontal.

SINGLE-FAMILY DWELLING. Fully detached, semidetached (semiattached, side-by-side), row houses, and townhouses. In the case of attached units, each must be separated from the adjacent unit by a ground-to-roof wall in order to be classified as a single-family structure. Also, these units must not share heating/air-conditioning systems or utilities. (From www.census.gov).

SIMULATION TOOL. An approved software program or calculation-based methodology that projects the hour-by-hour loads and annual energy use of a building.
SLAB-ON-GRADE EDGE INSULATION. Insulation around, or underneath, the perimeter of the floor slab when the top edge of the floor perimeter slab is above the finished grade or 12 inches (305 mm) or less below the finished grade.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

SOLAR ENERGY SOURCE. Source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation that is then reradiated, conducted or convected into the space.

SONE. A subjective unit of loudness for an average listener equal to the loudness of a 1,000-hertz (cycles per second) sound that has an intensity 40 decibels above the listener’s own threshold of hearing.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

STANDARD TRUSS. Any construction that does not permit the roof/ceiling insulation to achieve the required R-value over the exterior walls.

STOREFRONT. A nonresidential system of doors and windows mulled as a composite fenestration structure that has been designed to withstand heavy use. Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.

STRETCH CODE. A building energy code that achieves greater energy savings than the base RBES. The Stretch Code is required for Act 250 projects and may be adopted by municipalities.

SUMMER CAMPS. Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.

SUNROOM. A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure’s exterior walls and roof.

SYSTEM. A combination of central or terminal equipment or components or controls, accessories, interconnecting means and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

THERMAL CONDUCTANCE, OVERALL (U₀). The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/h · ft² · °F) [W/(m² · K)].
The $U_t$-factor applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.

**THERMAL ISOLATION.** Physical and space conditioning separation between conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

**THERMAL RESISTANCE ($R$).** The reciprocal of thermal conductance \((h \cdot \text{ft}^2 \cdot °\text{F}/\text{Btu})\) \([\text{m}^2 \cdot \text{K})/\text{W}]\).

**THERMAL RESISTANCE, OVERALL ($R_o$).** The reciprocal of overall thermal conductance \((h \cdot \text{ft}^2 \cdot °\text{F}/\text{Btu})\) \([\text{m}^2 \cdot \text{K})/\text{W}]\). The overall thermal resistance of the gross area or individual component of the exterior building envelope (such as roof/ceiling, exterior wall, floor, crawl space wall, foundation, window, skylight, door, opaque wall, etc.), which includes the area-weighted $R$-values of the specific component assemblies (such as air film, insulation, drywall, framing, glazing, etc.).

**THERMAL TRANSMITTANCE ($U$).** (See thermal conductance).

The $U$-factor applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity airspaces and surface air films on both sides of a building element.

**THERMOSTAT.** An automatic control device used to maintain temperature at a fixed or adjustable set point.

**TOILET ROOM.** A room containing a water closet and, frequently, a lavatory, but not a bathtub, shower, spa or similar bathing fixture.

**U-FACTOR (THERMAL CONDUCTANCE).** The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films \((\text{Btu/h} \cdot \text{ft}^2 \cdot °\text{F})\) \([\text{W}/(\text{m}^2 \cdot \text{K})]\).

**UNITARY COOLING AND HEATING EQUIPMENT.** One or more factory-made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and which shall be permitted to include a heating function as well. When heating and cooling equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

**UNITARY HEAT PUMP.** One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. When heat pump equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

**UNUSUALLY TIGHT CONSTRUCTION.** Construction meeting the following requirements:

1. Storm windows or weatherstripping on openable windows and doors; and
2. Caulking or sealants applied to areas, such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at penetrations for plumbing, electrical and gas lines, and at other openings.

3. Buildings constructed in compliance with the RBES shall be considered built of unusually tight construction.

**VAPOR RETARDER.** A vapor-resistant material, membrane or covering such as foil, plastic sheeting or insulation facing with a permeance rating of less than 10. Vapor retarders limit the amount of moisture vapor that passes through a material or wall assembly.

**VAPOR RETARDER CLASS.** A measure of the ability of a material or assembly to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be based on the manufacturer’s certified testing of a tested assembly and defined using the desiccant method with Procedure A of ASTM E96 as follows:

**VAPOR RETARDER CLASSES AND EXAMPLES**

<table>
<thead>
<tr>
<th>Vapor Retarder Class¹</th>
<th>Perm Rating (Dry Cup)</th>
<th>Description</th>
<th>Examples of Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>0.1 perm or less</td>
<td>Vapor impermeable or “Vapor Barrier”</td>
<td>Rubber membrane, sheet polyethylene, glass, foils</td>
</tr>
<tr>
<td>Class</td>
<td>Range</td>
<td>Description</td>
<td>Vapor Open Description</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>--------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Class II</td>
<td>0.1 – 1.0 perm</td>
<td>Vapor semi-impermeable</td>
<td>Oil-based paint, Kraft-faced batt, vinyl wall coverings, stucco</td>
</tr>
<tr>
<td>Class III</td>
<td>1.0 – 10 perm</td>
<td>Vapor semi-permeable</td>
<td>Plywood, OSB, EPS, XPS, most latex paints, heavy asphalt-impregnated building paper, wood board sheathing</td>
</tr>
<tr>
<td>Vapor open</td>
<td>&gt; 10 perm</td>
<td>Vapor permeable</td>
<td>Unpainted gypsum board, unfaced fiberglass, cellulose, many &quot;housewraps&quot;</td>
</tr>
</tbody>
</table>

1. Test Procedure for vapor retarders: ASTM E-96 Test Method A (the desiccant method or dry cup method)

**VENTING SYSTEM.** A continuous open passageway from the flue collar or draft hood of a solid fuel, gas-burning, kerosene or oil-burning appliance to the outside atmosphere for the purpose of removing flue or vent gases. A venting system is usually composed of a vent or a chimney and vent connector, if used, assembled to form the open passageway.

**Mechanical draft venting system.** A venting system designed to remove flue or vent gases by mechanical means, that consists of an induced draft portion under nonpositive static pressure or a forced draft portion under positive static pressure.

1. Forced-draft or power venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure.

2. Induced draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under nonpositive static vent pressure.

**Natural draft venting system.** A venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.

**Sealed combustion venting system.** A venting system designed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere.

**VENTILATION.** The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

**VENTILATION AIR.** That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

**VERTICAL FENESTRATION.** Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of a least 60 degrees (1.05 rad) from horizontal.
VISIBLE TRANSMITTANCE [VT]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light, Visible Transmittance, includes the effects of glazing material and frame and is expressed as a number between 0 and 1.

WHOLE HOUSE MECHANICAL VENTILATION SYSTEM. An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation requirements.

WHOLE HOUSE VENTILATION SYSTEM, BALANCED. Balanced systems provide outdoor air for ventilation such that supply and exhaust air quantities are of equal capacity to achieve pressure equalization, such as heat recovery ventilator, an air-to-air heat exchanger or any other system that is designed to provide mechanical supply as well as mechanical exhaust.

WHOLE HOUSE VENTILATION SYSTEM, EXHAUST ONLY. Exhaust only systems exhaust stale indoor air via a single fan, multiple fans or the installation of dual-purpose fans (i.e., serving both localized and whole house ventilation functions). Fresh incoming air may be provided by installed inlet ports or from typical leaks in the building envelope. Exhaust only systems may depressurize the indoor environment.

WHOLE HOUSE VENTILATION SYSTEM, MULTI-PORT. A whole house ventilation system that has more than one exhaust or supply port inside the house.

WHOLE HOUSE VENTILATION SYSTEM, SINGLE-PORT. A whole house ventilation system that has only one connection to the conditioned space and one connection to outdoor air.

WINDOW PROJECTION FACTOR. A measure of the portion of glazing that is shaded by an eave or overhang.

YURT. A circular tent on a wooden framework used as a residential building.

ZONE. A space or group of spaces within a building’s thermal envelope with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.
CHAPTER 3 [RE]
GENERAL REQUIREMENTS

SECTION R301
[RESERVED]

SECTION R302
DESIGN CONDITIONS

R302.1 Interior design conditions.
The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

R302.2 Climatic data.
The following design parameters in Table 302.2 shall be used for calculations required under this code.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter $^a$, Design Dry-Bulb</td>
<td>-11°F</td>
</tr>
<tr>
<td>Summer $^a$, Design Dry-Bulb</td>
<td>84°F</td>
</tr>
<tr>
<td>Summer, Design Wet Bulb</td>
<td>69°F</td>
</tr>
<tr>
<td>Degree Days Heating $^b$</td>
<td>7,665</td>
</tr>
<tr>
<td>Degree Days Cooling $^b$</td>
<td>489</td>
</tr>
</tbody>
</table>

For SI: °C = (°F - 32)/1.8.

a. The outdoor design temperature is selected from the columns of 97-percent values for winter and 2-percent values for summer from tables in the ASHRAE Handbook of Fundamentals. Adjustments shall be permitted to reflect local climates which differ from the tabulated temperatures, or local weather experience determined by the code official or other authority having jurisdiction, where one exists.

b. The degree days heating (base 65°F) and cooling (base 65°F) are from the NOAA “Annual Degree Days to Selected Bases Derived from the 1971-2000 Normals” for Burlington International Airport.

Adjustments may be made only in the following cases:

1. Winter heating design temperatures for projects either:
   i. Located at an elevation of 1,500 feet or higher, or
ii. Located in Caledonia, Essex or Orleans counties.

iii. Adjustments shall be made as listed in the National Climate Data Center for the specific weather station: http://www.ncdc.noaa.gov/cdo-web/.

2. As approved by the code official or other authority having jurisdiction.

SECTION R303
MATERIALS, SYSTEMS AND EQUIPMENT

R303.1 Identification.
Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

R303.1.1 Building thermal envelope insulation.
An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and R-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be listed on the certification. For insulated siding, the R-value shall be labeled on the product’s package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

R303.1.1.1 Blown or sprayed roof and ceiling insulation.
The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam minimum thickness and installed R-value shall be listed on certification provided by the insulation installer.

R303.1.2 Insulation mark installation.
Insulating materials shall be installed such that the manufacturer’s R-value mark is readily observable upon inspection.

R303.1.3 Fenestration product rating.
U-factors of fenestration products (windows, doors and skylights shall be determined in accordance with NFRC 100.

Exception: Where required, garage door U-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.
Products lacking such a labeled $U$-factor shall be assigned a default $U$-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products windows, glazed doors and skylights shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

### TABLE R303.1.3(1)
**DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT U-FACTORS**

<table>
<thead>
<tr>
<th>FRAME TYPE</th>
<th>WINDOW AND GLASS DOOR</th>
<th>SKYLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single pane</td>
<td>Double pane</td>
</tr>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
<td>0.65</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
<td>0.55</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
<td>0.60</td>
</tr>
</tbody>
</table>

### TABLE R303.1.3(2)
**DEFAULT OPAQUE DOOR U-FACTORS**

<table>
<thead>
<tr>
<th>DOOR TYPE</th>
<th>OPAQUE U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninsulated Metal</td>
<td>1.20</td>
</tr>
<tr>
<td>Insulated Metal</td>
<td>0.60</td>
</tr>
<tr>
<td>Wood</td>
<td>0.50</td>
</tr>
<tr>
<td>Insulated, nonmetal edge, max 45% glazing, any glazing double pane</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### TABLE R303.1.3(3)
**DEFAULT GLAZED FENESTRATION SHGC AND VT**

<table>
<thead>
<tr>
<th></th>
<th>SINGLE GLAZED</th>
<th>DOUBLE GLAZED</th>
<th>GLAZED BLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clear</td>
<td>Tinted</td>
<td>Clear</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>VT</td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**R303.1.4 Insulation product rating.**
The thermal resistance, $R$-value, of insulation shall be determined in accordance with Part 460 of US-FTC CFR Title 16 in units of $h \cdot ft^2 \cdot ^\circ F/Btu$ at a mean temperature of 75°F (24°C).

**R303.1.4.1 Insulated siding.**
The thermal resistance $R$-value, of insulated siding shall be determined in accordance
with ASTM C1363. Installation for testing shall be in accordance with the manufacturer’s
instructions.

R303.2 Installation.
Materials, systems and equipment shall be installed in accordance with the manufacturer’s
instructions and the *International Building Code* or the *International Residential Code*, as
applicable.

R303.2.1 Protection of exposed foundation insulation.
Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of
slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to
prevent the degradation of the insulation’s thermal performance. The protective covering shall
cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below
grade.

R303.3 Maintenance information.
Maintenance instructions shall be furnished for equipment and systems that require preventive
maintenance. Required regular maintenance actions shall be clearly stated and incorporated on
a readily *accessible* label. The label shall include the title or publication number for the operation
and maintenance manual for that particular model and type of product.

SECTION R304
DESIGN CRITERIA FOR RESIDENTIAL VENTILATION SYSTEMS

R304.1 Scope.
This section shall govern ventilation of the dwelling unit(s) within Type R-1 residential buildings,
Type R-2 residential buildings and multiple single-family attached dwellings (townhouses) not
more than three stories in height.

R304.1.1 Compliance.
Compliance with Section 304 shall be achieved by meeting Section R304.2 through
R304.11 or demonstrating compliance with one of the following alternatives:
1. ASHRAE Standard 62.2-2016 (Ventilation and Acceptable Indoor Air Quality in Low-Rise
   Residential Buildings)
2. BSC Standard 01-2015 (Ventilation for New Low-Rise Residential Buildings)
3. Passive house ventilation requirements (PHI or PHIUS)

Exception
*Whole house balanced ventilation systems* that are controlled using user-settable closed-loop
feedback based on pollutant levels (e.g. carbon dioxide or volatile organic compounds) are not
subject to run-time ventilation rate minimums in standards referenced above, or Section
R304.6.1.1.

R304.2 Local ventilation.
Ventilation fans in bathrooms containing a bathtub, shower, spa or similar bathing fixture and
not included in the whole house ventilation system shall be sized to meet the net capacity rates
as required in Table 304.2. Whole house ventilation fans serving both localized and whole
house ventilation functions shall be sized to meet the net capacity rates as required by Section 304.6 and must meet all other requirements listed in Section 304.3, as applicable.

### TABLE 304.2
MINIMUM REQUIRED LOCAL EXHAUST

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>MECHANICAL EXHAUST CAPACITY (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathrooms</td>
<td>50 cfm intermittent or 20 cfm continuous</td>
</tr>
</tbody>
</table>

**R304.3 Whole house ventilation (MANDATORY).**
Every home and dwelling unit built to RBES shall be mechanically ventilated by a whole house ventilation system as defined in Chapter 2. The whole house ventilation system shall be one of two types: “exhaust only” or “balanced.”

**R304.4 Whole house air circulation.**
Provisions shall be made to allow air flow to all finished living spaces by installation of distribution ducts, undercutting doors, installation of grilles, transoms or equivalent means. Door undercuts shall be at least ½ inch (12.7 mm) above the surface of the finished floor covering.

**R304.5 Fan motor requirements.**
Fans installed for the purpose of providing whole house ventilation must meet the minimum requirements as specified in this section.

**Exception:** Fans installed exclusively for local ventilation purposes are exempt from meeting the fan motor requirements listed in Section R304.5.

**R304.5.1 Fan durability.** Whole house ventilation fan motors shall be rated for “continuous duty” and have manufacturer flow ratings as listed in HVI 911.

**R304.5.2 Fan power consumption.**
Single-port whole house ventilation equipment shall not exceed 50 watts as listed by the manufacturer on the fan motor or as listed in accordance with HVI 911. Power used for lights, sensors, heaters, timers or night lights shall not be included in the determination of power consumption.

**R304.5.3 Fan noise.**
Whole house ventilation equipment located less than 4 feet (1219 mm) from louvers, grilles or openings shall have a sound rating no greater than 1.5 sones as determined in accordance with HVI 911.

**R304.5.4 Performance verification.**
In-field measurements of exhaust fan flows shall be conducted using a manufactured flow-measuring device in accordance with the manufacturer’s instructions. Acceptable devices include a calibrated orifice combined with a digital manometer or a flow hood. All measuring devices shall be accurate to within 10 percent of measured flow.

**R304.6 Net capacity requirements.**
Whole house ventilation system fans shall be installed according to the manufacturer’s installation instructions and shall have the manufacturer’s fan flow ratings as listed in
accordance with HVI 911. Unless the whole house system is tested according to procedures in Section 304.6.1, the minimum continuous flow rate that the ventilation system must be capable of supplying during its operation shall be based on the rate per bedroom as specified in Table 304.6.

### TABLE R304.6
PRESCRIPTIVE FAN CAPACITY REQUIREMENTS

<table>
<thead>
<tr>
<th>NUMBER OF BEDROOMS</th>
<th>MINIMUM NOMINAL RATED TOTAL FAN CAPACITY (\text{a} ) (at 0.1 inches w.g.)</th>
<th>MINIMUM NUMBER OF FANS TO MEET WHOLE HOUSE AIRFLOW RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 cfm</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>75 cfm</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>100 cfm</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>125 cfm</td>
<td>All other systems—2 or more, or Centrally ducted systems—1</td>
</tr>
<tr>
<td>5</td>
<td>150 cfm</td>
<td>All other systems—2 or more, or Centrally ducted systems—1</td>
</tr>
<tr>
<td>Homes &gt; 3,000 ft²</td>
<td>cfm = 0.05 ft²</td>
<td>All other systems—2 or more, or Centrally ducted systems—1</td>
</tr>
</tbody>
</table>

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 cubic foot per minute per square foot = 0.00508 m³/(s • m²).

\(\text{a} \) Represents the total installed rated capacity of all fans designed for whole house ventilation.

**R304.6.1 Testing option.**
Testing may be done to verify that the whole house ventilation system satisfies the ventilation requirements of this section in accordance with Sections R304.1.1, R304.6.1.1 and R304.6.1.2.

**R304.6.1.1 Minimum outdoor air.**
Automatic operation of the ventilation system shall not reduce the minimum continuous ventilation rate below 15 cfm of outdoor air per bedroom plus 15 cfm during occupancy.

**Exception:** Whole house approach in accordance using one of the compliance alternatives in Section R304.1.1.

**R304.6.1.2 Performance verification.**
In-field measurements of exhaust fan flows shall be conducted using a manufactured flow-measuring device in accordance with the manufacturer’s instructions. Acceptable devices include a calibrated orifice combined with a digital manometer or a flow hood. All measuring devices shall be accurate to within 10 percent of measured flow.

**R304.7 Ventilation required during periods of occupancy.**
Ventilation shall be provided continuously or intermittently during the period that the building is occupied.

**R304.8 Controls.**
*Whole house ventilation systems* (balanced or exhaust-only ventilation) shall be capable of being set remotely for continuous operation or shall be provided with an automatic control for intermittent operation. All whole house ventilation controls shall be readily accessible.

**Exception:** Fans installed expressly for local ventilation purposes.
R304.8.1 Intermittent operation.
Intermittently operated whole house ventilation systems shall be capable of being set remotely for continuous operation; or shall be provided with an automatic control capable of operating without the need for occupant intervention, such as a time switch or some other control device. Twist or crank-style timers are prohibited as control devices for whole house ventilation systems. Operation controlled solely by a humidity sensor (humidistat or dehumidistat) does not qualify.

R304.8.2 Continuous operation.
Continuously operated whole house ventilation systems shall not be provided with local controls unless that control only operates the whole house ventilation system both intermittently at high speed and continuously at low speed.

R304.8.2.1 On/off switch for continuous operation.
An on/off switch for continuously operated whole house ventilation systems shall be remotely installed and appropriately labeled.

R304.9 Installation requirements.
Ventilation equipment shall be installed according to the manufacturer’s instructions and in accordance with Sections R304.9.1 through R304.9.8.

R304.9.1 Fan housings.
Fan housings for single-port exhaust only systems must be sealed to the ceiling or wall.

R304.9.2 Inlet grills.
Inlet grills for multiport exhaust ventilation systems or balanced whole house ventilation systems must be sealed to the ceiling or wall.

R304.9.3 Ducts.
Smooth wall ducts (e.g. metal or composite) must be used for all duct runs longer than 8 feet (2438 mm). Ducts shall be insulated when installed in an unheated location or outside the building thermal envelope.

R304.9.4 Fasteners.
Mechanical fasteners must be used to connect all ducts to the fan(s) without impeding the operation of the fan or any internal backdraft damper.

R304.9.5 Joints and connections.
All joints, seams and connections shall be securely fastened and sealed with welds, gaskets, o-rings, mastics (adhesives), mastic embedded fabric systems or approved tapes.

R304.9.6 Noise abatement.
Remote whole house ventilation fans shall be acoustically isolated from the structural elements of the building and from attached ducts using at least 1 foot (305 mm), but not more than 2 feet (610 mm) of insulated flexible duct.

R304.9.7 Intake openings.
Mechanical and gravity outside air intake openings for balanced whole house systems, integrated supply systems or heat recovery ventilating systems that are installed in accordance with Section 304 shall be located a minimum of 10 feet (3048 mm) from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, fuel fills and
vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code.

The bottom of the intake termination shall be located at least 12 inches (305 mm) above the normally expected snow accumulation level.

R304.9.8 Outside opening protection.
Air exhaust and intake openings located in exterior walls shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of ¼ inch (6.4 mm) and a maximum opening size of ½ inch (12.7 mm), in any dimension. Openings shall be protected against local weather conditions.

R304.10 Clothes dryer exhaust.
Clothes dryers shall be exhausted in accordance with the manufacturer’s instructions. Dryer exhaust systems shall be independent of all other systems and shall convey the moisture and any products of combustion to the outside of the building.

Exception: This section shall not apply to listed and labeled condensing (ductless) clothes dryers

R304.11 Makeup air required.
Exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute (0.19 m$^3$/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.

SECTION R305
COMBUSTION SAFETY (MANDATORY)

R305.1 General.
The provisions of this section shall govern the requirements for combustion and dilution air for fuel-burning appliances in every new home built to RBES, whenever a new heating system is installed, or whenever alteration, renovation or repair work creates unusually tight construction as defined in NFPA 54 and NFPA 31.

R305.2 Unusually tight construction.
For the purpose of applying the provisions of Section 305 to fuel gas, kerosene and oil-burning equipment, buildings constructed in compliance with the RBES shall be considered of unusually tight construction as defined in NFPA 54 and NFPA 31.

R305.3 Fuel gas, kerosene and oil-burning equipment.
Every new home built to the RBES that contains Category I or II natural draft venting fuel-burning appliances shall be provided with combustion and dilution air as required by NFPA 54 for fuel-gas utilization equipment or NFPA 31 for oil-burning equipment. Direct vent appliances that do not draw combustion air from inside of the building are not required to be considered in the determination of the combustion and dilution air requirements.
Exception: Where all combustion devices in the home have a sealed combustion venting system, a mechanical draft venting system or are direct-vent appliances, then the combustion and dilution air requirements of this section do not apply.

R305.3.1 Crawl space and attic space.
For the purposes of applying the provisions of Section 305, an opening to a naturally ventilated crawl space or attic space is not considered equivalent to an opening outdoors and is therefore prohibited for the purposes of supplying combustion and dilution air.

R305.3.2 Unvented room heaters.
Unvented fuel-fired heaters, including room heaters and unvented fireplaces are prohibited.

R305.4 Solid fuel-burning appliances and fireplaces.
All solid fuel-burning appliances and fireplaces shall meet the provisions of this section.

R305.4.1 Gasketed doors.
All solid fuel-burning appliances and fireplaces shall have tight-fitting (defined as gasketed doors with compression closure or compression latch system) metal glass or ceramic doors.

Exception: Any home certified to have passed the Appendix RA – Recommended Procedure for Worst-Case Testing of Atmospheric Venting Systems” is not required to have tight-fitting doors.

R305.4.2 Spillage testing.
All chimney-vented equipment shall establish complete draft without spillage under “worst-case” conditions within two minutes. If any chimney-vented equipment fails this requirement, mechanically induced pressure relief shall be provided such that the requirement is met.

R305.4.3 Exterior air supply requirements.
Solid fuel-burning appliances and fireplaces shall be equipped with an exterior air supply according to the provisions of Sections R305.4.3.1 through R305.4.3.7. Factory-built fireplaces, masonry fireplaces and solid fuel-burning appliances that list exterior air supply ducts as optional or required for proper installation are permitted to be installed with those exterior air supply ducts according to the manufacturer’s installation instructions in place of sections R305.4.3.1 through R305.4.3.7. This is not an exemption from the exterior air supply requirements.

R305.4.3.1 Combustion air shall not be taken from within the garage, attic, or basement.

R305.4.3.2 The exterior air inlet shall not terminate to the exterior higher than the firebox and the combustion air duct shall not rise vertically within 18 inches of the firebox.

Exception: Where woodstove or fireplace is installed below grade (in a basement), air intake is permitted to terminate above the firebox if the combustion air supply point is below the firebox and the combustion air intake point is greater than 15 inches (381 mm) below the top of the chimney.
R305.4.3.3
The exterior air intake must deliver combustion air to the firebox.

**Exception:** For older woodstoves and cookstoves where direct connection of combustion air is not possible, combustion air may be delivered within 24 inches (610 mm) of the stove’s air intake opening.

R305.4.3.4
The air inlet shall be screened with ¼ inch (6 mm) mesh.

R305.4.3.5
The air inlet shall be closable and designed to prevent debris from dropping into the air intake.

R305.4.3.6
The exterior air inlet shall be installed so as to remain free of obstruction from snow.

R305.4.3.7 Passageway.
The combustion air passageway for unlisted exterior air supply ducts shall be a minimum of 6 square inches (3870 mm$^2$) and not more than 55 square inches (0.035 m$^2$). The passageway shall be non-combustible, masonry or 30 gauge (or thicker) metal, have 1 inch clearance to combustibles for the length of the combustion air intake. Combustion air systems for listed fireplaces shall be constructed according to the fireplace manufacturer’s instructions.

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

SECTION R401
GENERAL

R401.1 Scope.
This chapter applies to residential buildings.

R401.2 Compliance.
Projects shall comply with one of the following:


2. “REScheck$^\text{TM}$ software”: Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”


R401.3 Certificate of Compliance (Mandatory).
A certification may be issued and signed by a builder, a licensed professional engineer, a licensed architect or an accredited home energy rating organization. If certification is not issued by a licensed professional engineer, a licensed architect or an accredited home energy rating
organization, it shall be issued by the builder. Any certification shall certify that residential construction meets the RBES. The Department of Public Service will develop and make available to the public a certificate that lists key features of the RBES. Any person certifying shall use this certificate or one substantially like it to certify compliance with the RBES. Certification shall be issued by completing and signing a certificate and affixing it to the electrical service panel, without covering or obstructing the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall certify that the residential building has been constructed in compliance with the requirements of the RBES. The person certifying under this subsection shall provide a copy of the certificate to the Department of Public Service and shall assure that a certificate is recorded and indexed in the town land records. A builder may contract with a licensed professional engineer, a licensed architect or an accredited home energy rating organization to issue certification and to indemnify the builder from any liability to the owner of the residential construction caused by noncompliance with the RBES.

SECTION R402
BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive). The building thermal envelope shall meet the requirements of Sections R402.1.1 through R402.1.6.

Exceptions:

The following buildings, or portions thereof separated from the remainder of the building by building thermal envelope assemblies complying with this section shall be exempt from the building thermal envelope provisions of Section R402.

1. Low Energy Use Buildings. Those with a peak design rate of energy usage less than 3.4 Btu/h per square foot of floor space for space conditioning purposes (10.7 W/m² or 1.0 watt/ft²).

2. Unconditioned Buildings. Those that do not contain conditioned space.


4. Hunting camps. Residential buildings shall not include hunting camps.

5. Summer camps. Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.

6. Yurts with only a biomass (wood) or other on-site renewable heating and hot water system.

7. Owner-built homes. Residential construction by an owner, if all of the following apply:
7.1. The owner of the residential construction is the builder, as defined in 30 V.S.A. § 51, and;

7.2. The residential construction is used as a dwelling by the owner, and;

7.3. The owner in fact directs the details of construction with regard to the installation of materials not in compliance with the RBES, and;

7.4. The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with the RBES. Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES, and shall itemize which measures do not meet the RBES in effect at the time construction commenced.

R402.1.1 Vapor retarder.
Wall assemblies and roof or ceiling assemblies which are part of the building thermal envelope shall comply with the vapor retarder requirements of Section R702.7 of the International Residential Code or Section 1405.3 of the International Building Code, as applicable, or with R402.2.15 in this document.

R402.1.2 Insulation and fenestration criteria.
The building thermal envelope shall comply with one of the following only:
1. Package Plus Points Approach: tables R402.1.2.1, R402.1.2.2 and R402.1.2.3; or
2. U-Factor Alternative Approach: R402.1.4; or
3. Total UA Approach; R402.1.5; or

Building science principles should be applied in all circumstances. Consult with a building science professional and refer to the Vermont Residential Energy Code Handbook for additional guidance and details.

R402.1.2.1 Package Plus Points Approach – Base.
Projects shall comply with items 1 to 3:
1. Select one of the five base packages listed in Table R402.1.2.1; and
2. Determine the number of points needed to comply with Table R402.1.2.2 based on building size; and
3. Incorporate a sufficient number of points from Table R402.1.2.3 to meet the points requirements from Table R402.1.2.2.
# Table R402.1.2.1

**Insulation and Fenestration Requirements by Component for Base Packages**

<table>
<thead>
<tr>
<th>Component*</th>
<th>Package 1</th>
<th>Package 2</th>
<th>Package 3</th>
<th>Package 4</th>
<th>Package 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Standard”</td>
<td>“SIPS”</td>
<td>“Thick Wall”</td>
<td>“Cavity Only”</td>
<td>“Log Homes”</td>
</tr>
<tr>
<td>Ceiling R-Value</td>
<td>R-49†</td>
<td>R-28 cont.</td>
<td>R-49†</td>
<td>R-60 attic / R-49 slope</td>
<td>Construct log home to ICC 400-2017 “Standard on the Design and Construction of Log Structures” OR Table R402.1.6</td>
</tr>
<tr>
<td>Wood Frame Wall R-Value</td>
<td>R-20+15† OR 13+10†</td>
<td>R-21 cont.</td>
<td>R-20+12†</td>
<td>R-20 cavity</td>
<td></td>
</tr>
<tr>
<td>Common Wall Insulation</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
<td></td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td></td>
</tr>
<tr>
<td>Basement/Crawl Space Wall R-Value</td>
<td>R-15 (continuous) OR 20 (cavity) OR R13+5</td>
<td>R-15 (continuous) OR 20 (cavity) OR R13+5</td>
<td>R-20 (continuous) OR R-13†+10‡</td>
<td>R-20 (continuous) OR R-13†+10‡</td>
<td></td>
</tr>
<tr>
<td>Slab Edge R-Value</td>
<td>R-15, 4 ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4 ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-10, 4 ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4 ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td></td>
</tr>
<tr>
<td>Heated Slab R-Value</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
</tr>
<tr>
<td>Fenestration (Window and Door) max U-Value</td>
<td>U-0.30</td>
<td>U-0.30</td>
<td>U-0.30</td>
<td>U-0.30</td>
<td>U-0.28</td>
</tr>
<tr>
<td>Skylight max U-Value</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>≤3.0 ACH50* tested</td>
<td>≤3.0 ACH50* tested</td>
<td>≤3.0 ACH50* tested</td>
<td>≤3.0 ACH50* tested</td>
<td>≤3.0 ACH50* tested</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>Inside thermal boundary</td>
<td>Inside thermal boundary</td>
<td>4 CFM25 per 100 sq. ft. of CFA</td>
<td>Inside thermal boundary</td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td>Percent High Efficiency Lamps</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table. See R402.1.4 for alternative compliance methods.

b. The fenestration U-factor row excludes skylights.

c. The continuous portion of basement and crawlspace insulation can be met through interior, exterior or combination.

d. “4 ft” can be horizontal or vertical coverage including slab edge. “Edge and under” requires complete coverage. Up to 8 lineal feet of exposed slab edge may be insulated to R-10. “Heated slab” are those with embedded radiation.

e. The first value is cavity insulation, the second value is continuous insulation, so “13+10” means R-13 cavity insulation plus R-10 continuous insulation. When used, continuous insulation values shall be at least R-5.

f. Installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. (See Section R402.2.1). Multifamily buildings using continuous insulation with a maximum U-factor of 0.023 for the ceiling assembly satisfies this requirement.

g. Installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the
wall top plate at the eaves. (See Section R402.2.1.)

h. “ACH50” = air changes per hour at 50 Pascals building pressure as measured with a blower door

i. “CFA” = conditioned floor area

j. See Table R402.4.1.1 for further details.

Insulation systems complying with Table R402.1.4 shall be deemed to comply with the R-value requirements of Table 402.1.2.1.

**R402.1.2.2 Required Points by Building Size.**

Determine the number of points required by building size from Table R402.1.2.2. Building size for this table is determined by the finished conditioned floor area per dwelling unit within the building thermal envelope, including unfinished basements and storage/utility spaces. The Multifamily < 2000 square feet point requirement cannot be used for semidetached (semiattached, side-by-side), row houses, and townhouses, as defined as single-family dwellings in Definitions R202. Multifamily dwelling unit size is based on the average dwelling size for the building.

**TABLE R402.1.2.2**

**REQUIRED POINTS BY BUILDING SIZE**

<table>
<thead>
<tr>
<th>Building/Dwelling Size</th>
<th>Required Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily &lt; 2000 square feet</td>
<td>4 points</td>
</tr>
<tr>
<td>&lt;2000 square feet</td>
<td>5 points</td>
</tr>
<tr>
<td>2000 to 4000 square feet</td>
<td>7 points</td>
</tr>
<tr>
<td>&gt;4000 square feet</td>
<td>10 points</td>
</tr>
</tbody>
</table>

**R402.1.2.3 Points by Component.**

After determining the number of points required using Table R402.1.2.2, select the components from Table 402.1.2.3 to accumulate the required number of points. The total number of points selected from Table 402.1.2.3 must meet or exceed the required points from Table 402.1.2.2.

**TABLE R402.1.2.3**

**POINTS BY COMPONENT**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope</td>
<td>Slab R-10 below entire slab</td>
<td>1</td>
</tr>
<tr>
<td>Walls - Upgraded</td>
<td>Above grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Not available for base package 3) OR&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2</td>
</tr>
<tr>
<td>Walls – High-R</td>
<td>Above grade walls ≥ R-40(cavity and continuous) (or U-factor maximum 0.025 wall assembly)</td>
<td>3</td>
</tr>
<tr>
<td>Ceiling</td>
<td>R-80 attic flat / R-60 sloped, vaulted and cathedral</td>
<td>1</td>
</tr>
<tr>
<td>Windows</td>
<td>Average U-factor ≤ 0.27 OR&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Average U-factor ≤ 0.22</td>
<td>2</td>
</tr>
<tr>
<td>Air Leakage and Ventilation</td>
<td>Pre-Drywall ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered OR&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1</td>
</tr>
<tr>
<td>Category</td>
<td>Tight</td>
<td>Very Tight</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Tight</strong></td>
<td>ACH50 ≤ 2.0 and balanced ventilation with ECM(e) fans and ≥ 70% SRE(d) for HRV(c), ≥65% SRE(d) for ERV(c) <strong>OR</strong> (b)</td>
<td>ACH50 ≤ 1.0 and balanced ventilation with ECM(e) fans and ≥ 80% SRE(d) for HRV(c), ≥75% SRE(d) for ERV(c)</td>
</tr>
<tr>
<td><strong>Very Tight</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heating and Cooling(a)</th>
<th>Basic</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENERGY STAR basic: (1) Gas/propane furnace ≥95 AFUE, Oil furnace ≥85 AFUE, (2) Gas/Propane Boiler ≥90 AFUE, Oil Boiler ≥87 AFUE, (3) Heat pump HSPF ≥9.0; PLUS any AC is SEER ≥14.5 <strong>OR</strong> (b)</td>
<td>Whole building heat/cool is (1) NEEP-listed air source heat pump combination(i), (2) GSHP(i), closed loop and COP ≥ 3.3, (3) ATWHP(f) COP ≥2.5 and 120F design temp, (4) Advanced wood heating system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water</th>
<th>Basic</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for &gt; 55 gal] <strong>OR</strong> (b)</td>
<td>ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥2.20 for &gt; 55 gal]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low Flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All showerheads ≤ 1.75 gpm(g), all lav. faucets ≤ 1.0 gpm(g), and all toilets ≤ 1.28 gpf(h) <strong>OR</strong> (b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Certified(k)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drain Heat Recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User-Demand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewables</th>
<th>On-Site Generation</th>
<th>Solar Hot Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site</td>
<td>Solar hot water system designed to meet at least 50% of annual hot water load</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Measures</th>
<th>Monitoring</th>
<th>EV Ready</th>
<th>Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data</td>
<td>Level 2 electric vehicle charger-ready per R407.4</td>
<td>Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.  
\(a\). Heating and cooling system points are only available if all components of primary systems comply  
\(b\). "**OR**" indicates that points are not additive; one component **OR** the following one can be selected, but not both.  
\(c\). "H/ERV" = Heat or Energy Recovery Ventilation  
\(d\). "SRE" = System Recovery Efficiency  
\(e\). "ECM" = Electronically Commutated Motor  
\(f\). "ATWHP" = Air-to-Water Heat Pump  
\(g\). "gpm" = gallons per minute  
\(h\). "gpf" = gallons per flush. Applies to new construction only.  
\(i\). "GSHP" = ground-source heat pump
R402.1.3 R-value computation.
Insulation material used in layers, such as framing cavity insulation or continuous insulation, shall be summed to compute the corresponding component R-value. The manufacturer’s settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer’s labeled R-value for insulated siding shall be reduced by R-0.6.

R402.1.4 U-factor alternative.
An assembly with a U-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative to the R-values in Table R402.1.2.1. The building must still comply with Table R402.1.2.2 and Table R402.1.2.3.

An assembly with a U-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative compliance method with no Table R402.1.2.3 points required, provided that (a) airtightness is ≤ 2.0 ACH50 tested, and (b) ventilation system is: Balanced; with ECM fan(s) plus ≥ 70% SRE for HRV, or ≥ 65% SRE for ERV.

<table>
<thead>
<tr>
<th>TABLE R402.1.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EQUIVALENT U-FACTOR</strong></td>
</tr>
<tr>
<td>** fenestration U-FACTOR**</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>0.27</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.
b. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.057.
c. Airtightness of ≤ 2.0 ACH50 tested and balanced ventilation system with ECM fan(s) plus ≥ 70% SRE for HRV, or ≥ 65% SRE for ERV are required, OR the building must comply with Table R402.1.2.2 and Table R402.1.2.3.

R402.1.5 Total UA alternative.
Where the total building thermal envelope UA, the sum of U-factor times assembly area, is less than or equal to the total UA resulting from multiplying the U-factors in Table R402.1.4 by the same assembly area as in the proposed building, the building shall be considered to be in compliance. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met.

R402.1.6 Log homes.
Projects shall comply by doing all 3 steps below.
1. Design log home in accordance with ICC 400-2017 or to the requirements of Table R402.1.6.
2. Determine the number of points needed to comply, using Table R402.1.2.2 based on building size; AND
3. Incorporate a sufficient number of points from Table R402.1.2.3 to meet the points requirement from Table R402.1.2.2.

**TABLE R402.1.6**

<table>
<thead>
<tr>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>MAXIMUM GLAZING AREA</th>
<th>CEILING R-VALUE</th>
<th>LOG WALL</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT/ CRAWL SPACE WALL U-VALUE</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
<th>HEATED SLAB R-VALUE</th>
<th>HEATING SYSTEM AFUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>0.55</td>
<td>20%</td>
<td>49</td>
<td>≥ 5&quot; Log</td>
<td>38</td>
<td>15/20</td>
<td>15, 4 ft.</td>
<td>15 edge and under</td>
<td>90% gas/LP, 85% oil</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. U-factors are maximums, R-values are minimums.
b. The fenestration U-factor column excludes skylights.
c. Glazing area includes window and skylight opening area, plus actual glazed area of glass in doors, as a percentage of wall area. Sunrooms are exempt from this requirement.
d. Log walls must comply with ICC 400 with an average minimum average wall thickness of 5" or greater. Non-log exterior walls shall be insulated in accordance with Table 402.2.1.
e. Or insulation sufficient to fill the framing cavity, with R-38 as the absolute maximum.
f. Basement walls shall be R-15 continuous insulation or R-20 cavity full basement height.
g. Heated slabs shall be completely insulated around the perimeter and under the entire slab.
h. Boilers must have an outdoor temperature reset or thermal purge control.

**R402.2 Specific insulation requirements (Prescriptive).**

In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.15.

**R402.2.1 Ceilings with attic spaces.**

Where Section R402.1.2 would require R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 would require R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

**R402.2.2 Ceilings without attic spaces.**

Where Section R402.1.2 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. Insulation shall
extend over the top of the wall plate to the outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m$^2$) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the $U$-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

402.2.2.1 Unvented attic assemblies.
Unvented attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) shall be permitted in one- and two-family dwellings and multiple single-family dwellings (townhouses) if all the following conditions are met:

1. The unvented attic space is completely contained within the building thermal envelope.

2. No interior vapor retarders (Class I or II) are installed on the ceiling side (attic floor) of the unvented attic assembly.

3. Where wood shingles or shakes are used, a minimum 1/4 inch (6 mm) vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.

4. Any air-impermeable (e.g., spray foam) insulation shall be a Class II vapor retarder, or shall have a vapor retarder coating, or covering in direct contact with the underside of the insulation.

5. Either Item 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.

5.1. Air-impermeable (e.g., spray foam) insulation only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.

5.2. Air-permeable (e.g., fiberglass or cellulose) insulation only. In addition to the air-permeable insulation installed directly below the structural sheathing, rigid board sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R402.4.1.1 for condensation control.

5.3. Air-impermeable and air-permeable insulation. The air-impermeable (e.g., spray foam) insulation shall be applied in direct contact with the underside of the structural roof sheathing as specified in Table R402.4.1.1 for condensation control. The air-permeable (e.g., fiberglass or cellulose) insulation shall be installed directly under the air-impermeable (e.g., spray foam) insulation.

R402.2.3 Eave baffle.
For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the net free area of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.
R402.2.4 Access hatches and doors.
Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood-framed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

Exception: Vertical doors that provide access from conditioned spaces to unconditioned spaces shall be permitted to meet the fenestration requirements of Table R402.1.2.

R402.2.5 Mass walls.
Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and, solid timberlogs, or any other walls having a heat capacity greater than or equal to 6 Btu/ft\(^2\) • °F (123 kJ/m\(^2\) • K).

R402.2.6 Steel-frame ceilings, walls and floors.
Steel-frame ceilings, walls, and floors shall meet the insulation requirements of Table R402.2.6 or shall meet the U-factor requirements of Table R402.1.4. The calculation of the U-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.
### TABLE R402.2.6
STEEL-FRAME CEILING, WALL
AND FLOOR INSULATION R-VALUE

<table>
<thead>
<tr>
<th>WOOD FRAME R-VALUE REQUIREMENT</th>
<th>COLD-FORMED STEEL EQUIVALENT R-VALUE&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel Truss Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 or R-30 + 3 or R-26 + 5</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 or R-38 + 3</td>
</tr>
<tr>
<td>R-49</td>
<td>R-38 + 5</td>
</tr>
<tr>
<td><strong>Steel Joist Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td><strong>Steel-Framed Wall, 16” on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5</td>
</tr>
<tr>
<td>R-20 + 5 or R-25</td>
<td>R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7</td>
</tr>
<tr>
<td><strong>Steel Framed Wall, 24” on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9</td>
</tr>
<tr>
<td><strong>Steel Joist Floor</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td>R-19</td>
<td>R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> The first value is cavity insulation R-value, and the second value is continuous insulation R-value. For example, “R-30+3” means R-30 cavity insulation plus R-3 continuous insulation.

<sup>b</sup> Insulation exceeding the height of the framing shall cover the framing.

**R402.2.7 Walls with partial structural sheathing.**
Where Section R402.1.2 would require continuous insulation on exterior walls and structural sheathing covers 40 percent or less of the gross area of all exterior walls, the continuous insulation R-value shall be permitted to be reduced by an amount necessary to result in a consistent total sheathing thickness, but not more than R-3, on areas of the walls covered by structural sheathing. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.
R402.2.8 Floors.
Floor framing-cavity insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

Exception: The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall R-value in Table R402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.

R402.2.9 Basement walls.
Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

R402.2.10 Slab-on-grade floors.
Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the code official or other authority having jurisdiction, where one exists, as having a very heavy termite infestation.

R402.2.11 Crawl space walls.
As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

R402.2.12 Masonry veneer.
Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

R402.2.13 Sunroom insulation.
Sunrooms enclosing conditioned space shall meet the insulation requirements of this code.

Exception: For sunrooms with thermal isolation, and enclosing conditioned space, the following exceptions to the insulation requirements of this code shall apply:
1. The minimum ceiling insulation R-value shall be R-30.

2. The minimum wall insulation R-value shall be R-13. Walls separating a sunroom with a thermal isolation from conditioned space shall meet the building thermal envelope requirements of this code.

R402.2.14 Common, party, and fire walls.
Whenever continuity of the building thermal envelope is broken at walls separating dwelling units in Group R-2 building, including common, party, and fire walls, such walls shall be insulated to a minimum of R-10 on each side of the break in insulation continuity, and the walls shall be air sealed in accordance with Section R402.4.

R402.2.15 Frame walls.
Efforts must be made to protect insulated cavities from airborne water vapor and condensation. Air sealing the interior face of the assembly, controlled mechanical ventilation (targeting 30% relative humidity during the winter season), exterior continuous insulation and proper consideration of the vapor permeance of materials are all design elements that can contribute to this protection.

R402.2.15.1 Vapor retarders. Class I or II vapor retarders shall be provided on the interior side of frame walls. Exceptions:
   2. Below grade portion of any wall.
   3. Construction where moisture or its freezing will not damage the materials.

R402.2.15.2 Low permeability insulating sheathing. Where a Class II vapor retarder is used on the interior side of frame walls, in combination with a low permeability insulating sheathing installed as continuous insulation on the exterior side of frame walls, the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B). Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an engineered approved design.

R402.2.15.3 Class III vapor retarders. Class III vapor retarders on the interior side of frame walls shall be permitted where any one of the following conditions is met:
   1. Vented cladding over the following sheathing types:
      a. fiberboard;
      b. gypsum;
      c. plywood (CDX or comparable); or
      d. solid wood
   2. Insulated sheathing with R-value 7.5 minimum over 2 × 4 wall.
   3. Insulated sheathing with R-value 11.25 minimum over 2 × 6 wall.

R402.2.15.4 Material vapor retarder class. The vapor retarder class shall be based on the manufacturer’s certified testing of a tested assembly. See R202 General Definitions for vapor retarder classes and examples.
R402.3 Fenestration (Prescriptive).
In addition to the requirements of Section R402.1, fenestration shall comply with Sections R402.3.1 through R402.3.5.

R402.3.1 U-factor.
An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

R402.3.2 Glazed fenestration SHGC.
An area-weighted average of fenestration products more than 50-percent glazed shall be permitted to satisfy the SHGC requirements.

Dynamic glazing shall be permitted to satisfy the SHGC requirements of Table R402.1.2 provided that the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this section when both the lower and higher labeled SHGC already comply with the requirements of Table R402.1.1.

R402.3.3 Glazed fenestration exemption.
Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

R402.3.4 Opaque door exemption.
One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the U-factor requirement in Section R402.1.4. This exemption shall not apply to the U-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

R402.3.5 Sunroom fenestration.
Sunrooms enclosing conditioned space shall meet the fenestration requirements of this code.
Exception: For sunrooms with thermal isolation and enclosing conditioned space, the maximum fenestration U-factor shall be 0.45 and the maximum skylight U-factor shall not exceed 0.55.

New fenestration separating the sunroom with thermal isolation from conditioned space shall comply with the building thermal envelope requirements of this code.

R402.4 Air leakage (Mandatory).
The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.5.

R402.4.1 Building thermal envelope.
The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation.
The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction.
### TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATIONa

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>AIR BARRIER CRITERIA</th>
<th>INSULATION INSTALLATION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>General conditions and appropriate materials for air barriers</td>
<td>A continuous, durable air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous, durable air barrier. Breaks or joints in the air barrier shall be sealed. An air barrier is defined as any durable solid (non-porous) material that completely blocks air flow between conditioned space and unconditioned space, including necessary accessories to provide adequate support to resist positive and negative pressures without displacement or damage. The air barrier should be continuous and be durably connected to all penetrations, windows and other (structural) interruptions. Open-cell or closed-cell foam shall have a finished thickness $\geq 5.5$ in. or $1.5$ in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise. If flexible air barriers are used, they shall be fully sealed at all seams and edges and supported per manufacturer’s installation instructions. Flexible air barriers shall not be made of kraft paper, or other materials that are easily torn. If polyethylene is used, its thickness shall be $\geq 6$ mil. Materials meeting ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies are acceptable.</td>
<td>Air-permeable insulation shall not be used as a sealing material; when installed in vertical walls, sloped ceilings, and floors within the thermal envelope, it shall be enclosed on all six sides and in contact with a durable, air barrier.</td>
</tr>
<tr>
<td>Dropped ceilings/soffits</td>
<td>The air barrier in any dropped ceiling/soffit shall be aligned with (in contact with) the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed, insulated and gasketed.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with (in contact with) the air barrier and shall be enclosed on five sides and in contact with a durable, interior air barrier. A top-side air barrier is not required in a flat attic.</td>
</tr>
<tr>
<td>Framing junctions and cavities</td>
<td>The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior wall sheathing shall be sealed. Knee walls shall be air sealed. When part of the thermal envelope, knee wall insulation shall be enclosed on all six sides and in contact with a durable, interior air barrier.</td>
<td>Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Exterior thermal envelope insulation for framed walls shall be enclosed on all six sides and in contact with a durable, air barrier.</td>
</tr>
<tr>
<td>Windows, skylights and doors</td>
<td>The space between window/door jambs and framing, and skylights and framing shall be sealed with minimally-expanding foam.</td>
<td>—</td>
</tr>
<tr>
<td>Section</td>
<td>Requirements</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall include the air barrier. Junctions of the foundation and sill plate, sill plate and rim band, and rim band and subfloor shall be sealed. When air permeable insulation is installed, a durable, interior air barrier shall be installed at the rim joist. Rim joists shall be insulated and air sealed.</td>
<td></td>
</tr>
<tr>
<td>Floors (including above garage and cantilevered floors)</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td></td>
</tr>
<tr>
<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped. Where provided instead of floor insulation, vapor barrier shall be permanently attached to the crawlspace walls.</td>
<td></td>
</tr>
<tr>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed. Doors or hatches in knee walls opening to exterior or unconditioned space shall be insulated and gasketed.</td>
<td></td>
</tr>
<tr>
<td>Narrow cavities</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
<td></td>
</tr>
<tr>
<td>Recessed lighting and appliances</td>
<td>Recessed light fixtures and other appliances (speakers, exhaust fans, light shafts, etc.) installed in the building thermal envelope shall be ICAT (Insulation Contact and Air Tight) rated, airtight labeled (or &quot;Washington State Approved&quot;) and sealed with a gasket or caulk between the housing and the interior wall or ceiling cover. Fixtures and appliances shall maintain required clearances of not less than ⅜&quot; from combustible material and not less than 3” from insulation material, or as required by manufacturer’s installation requirements. Recessed light fixtures installed in the building thermal envelope shall be air tight and ICAT rated (ICAT rated indicates Insulation Contact and Air Tight and meets IC and air tightness requirement).</td>
<td></td>
</tr>
<tr>
<td>Plumbing and wiring</td>
<td>All plumbing and wiring penetrations shall be sealed to the air barrier.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insulation shall be placed between the exterior of the wall assembly and pipes. Insulation should not be installed on the interior of the piping. Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring and shall</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Requirement</td>
<td>Insulation Requirements</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shower/tub on exterior wall</td>
<td>Exterior walls adjacent to showers and tubs shall have insulation filling any gaps or voids between tub or shower walls and unconditioned space.</td>
<td>Exterior walls adjacent to showers and tubs shall have a rigid durable, air barrier separating the exterior wall from the shower and tubs and be insulated.</td>
</tr>
<tr>
<td>Electrical/phone box on exterior walls</td>
<td>The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.</td>
<td>Insulation completely fills voids between the box and exterior sheathing.</td>
</tr>
<tr>
<td>Common wall</td>
<td>Whenever continuity of the building thermal envelope is broken at walls separating dwelling units in Group R-2 building, including common, party, and fire walls, such walls shall be insulated to a minimum of R-10 on each side of the break in insulation continuity.</td>
<td>Air barrier shall be installed in common wall between dwelling units. Common walls shall be sealed at junctions with outside walls and at the top pressure plane of the house.</td>
</tr>
<tr>
<td>HVAC register boots</td>
<td>HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.</td>
<td></td>
</tr>
<tr>
<td>Concealed sprinklers</td>
<td>When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
<td></td>
</tr>
<tr>
<td>Fireplace</td>
<td>A durable air barrier shall be installed in contact with insulation. Fireplace shall have compression closure doors and combustion air supplied from the outdoors.</td>
<td></td>
</tr>
</tbody>
</table>

- In addition, inspection of log walls shall be in accordance with the provisions of ICC 400-2017.

**R402.4.1.2 Air Leakage Testing.**

The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding three (3) air changes per hour. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Testing and verification shall be conducted by an applicable Building Performance Institutes (BPI) Professional, a Home Energy Rating System (HERS) Energy Rater, HERS Field Inspector, or a Vermont Department of Public Service approved air leakage tester. A written report of the results of the test shall be signed by the party conducting the test. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.

6. Supply and return registers, where installed at the time of the test, shall be fully open.

7. Plumbing and drainage traps shall be filled with water as normally found, but not otherwise sealed.

**R402.4.1.3 Reporting.** Air leakage testing shall be reported on the RBES Certificate in units of air changes per hour at 50 Pascals (ACH50).

Exception: Report cubic feet per minute at 50 Pascals (CFM50) per square foot of building thermal shell area. Building thermal shell area shall include all six (6) sides of the building.

**R402.4.2 Fireplaces.**
New wood-burning fireplaces shall have tight-fitting doors and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

**R402.4.3 Fenestration air leakage.**
Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

**R402.4.4 Rooms containing fuel-burning appliances.**
Where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall R-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.

2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the International Residential Code.

**R402.4.5 Recessed lighting.**
Recessed luminaires installed in the building thermal envelope shall be sealed to limit air
leakage between conditioned and unconditioned spaces. All recessed luminaires shall be ICAT-rated (Insulation Contact and Air Tight) or IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

**R402.5 Maximum fenestration U-factor and SHGC (Mandatory).**
The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.30 for vertical fenestration, and 0.55 for skylights.

**R402.6 Vestibules.**
Multifamily buildings 3-stories or less built above a parking garage require a vestibule in accordance with C402.4.7 from the Vermont Commercial Building Energy Standards (CBES).

**SECTION R403 SYSTEMS**

**R403.1 Controls (Mandatory).**
At least one thermostat shall be provided for each separate heating and cooling system.

**R403.1.1 Programmable thermostat.**
The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed by the manufacturer with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C). Adjustments to these settings for elderly, disabled or those with special needs is permissible.

The following exceptions are allowed as long as 5-wire connection to thermostat location is provided:
1. Radiant floor, wall, ceiling and/or beam system on dedicated zone
2. **Cold-climate heat pump** not designed for setbacks
3. Wifi or “smart” Internet-connected thermostats

**R403.1.2 Heat pump supplementary heat**

Heat pumps shall not have integrated supplementary electric-resistance heat other than that provided for frost control. See R404.2 for guidance on electric resistance heating equipment other than heat pumps.

**R403.2 Hot water boiler outdoor temperature setback.**
Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.
R403.3 Ducts.
Ducts and air handlers for space conditioning shall be in accordance with Sections R403.3.1 through R403.3.5.

R403.3.1 Insulation (Prescriptive).
All supply and return ducts shall be insulated to meet the same R-value requirement that applies to immediately proximal surfaces.

**Exception:** Ducts or portions thereof located completely inside the *building thermal envelope*.

R403.3.2 Sealing (Mandatory).
Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable.

R403.3.2.1 Sealed air handler.
Air handlers shall have a manufacturer’s designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

R403.3.3 Duct testing
Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

**Exceptions:**
1. A structure where the ducts and air handlers are located entirely within the *building thermal envelope*.

2. Ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by an individual certified as either a Building Performance Institute (BPI) Heating Professional or Air Conditioning/Heat Pump Professional, a Home Energy Rating System (HERS) Energy Rater or HERS Field Inspector or a Vermont Department of Public Service approved duct leakage tester, and provided to the code official or other authority having jurisdiction, where one exists, and to the *Department of Public Service* along with the RBES certificate upon completion of the construction project.

R403.3.4 Duct leakage (Prescriptive).
The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:
1. Rough-in test: The total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area.

2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area.

**R403.3.5 Building cavities (Mandatory).**

Building framing cavities shall not be used as ducts or plenums.

**R403.3.6 Ducts buried within ceiling insulation.**

Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation $R$-value not less than R-8.

2. At all points along each duct, the sum of the ceiling insulation $R$-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-40, excluding the $R$-value of the duct insulation.

**R403.3.7 Ducts located in conditioned space.**

For ducts to be considered as inside a *conditioned space*, such ducts shall comply with either of the following:

1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.

2. The ducts shall be buried within ceiling insulation in accordance with Section R403.3.6 and all of the following conditions shall exist:

   2.1. The air handler is located completely within the *continuous air barrier* and within the building thermal envelope.

   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area served by the duct system.

   2.3. The ceiling insulation $R$-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation $R$-value, less the $R$-value of the insulation on the duct.

**R403.4 Mechanical system piping insulation (Mandatory).**

Mechanical system piping designed to carry fluids above 105°F (41°C) or below 55°F (13°C) shall be located within the building thermal envelope and insulated to a minimum of R-3.
**R403.4.1 Protection of piping insulation.**
Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

**R403.5 Service hot water systems.**
Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 and R403.5.4.

**R403.5.1 Heated water circulation and temperature maintenance systems (Mandatory).**
Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

**R403.5.1.1 Circulation systems.**
Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

**R403.5.1.2 Heat trace systems.**
Electric heat trace systems shall comply with IEEE 515.1 or UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

**R403.5.2 Demand recirculation systems.**
A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:

1. The controls shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.

2. The controls shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

**R403.5.3 Hot water pipe insulation (Prescriptive).**
Insulation for hot water pipe with a minimum thermal resistance, R-value, of R-3 shall be applied to the following:
1. Piping ¾ inch (19.1 mm) and larger in nominal diameter.

2. Piping serving more than one dwelling unit.

3. Piping located outside the *conditioned space*.

4. Piping from the water heater to a distribution manifold.

5. Piping located under a floor slab.


7. Supply and return piping in recirculation systems other than demand recirculation systems.

**R403.5.4 Drain water heat recovery units.**

Where installed, drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

**R403.6 Mechanical ventilation (Mandatory).**

The building shall be provided with ventilation that meets the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

**R403.6.1 Whole-house mechanical ventilation system fan efficacy.**

Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1. Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

**TABLE R403.6.1**

WHOLE HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE MINIMUM (CFM)</th>
<th>MINIMUM EFFICACY (CFM/WATT)</th>
<th>AIR FLOW RATE MAXIMUM (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV or ERV</td>
<td>Any</td>
<td>1.2 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

a. When tested in accordance with IBC-18

b. Standard 916.

For SI: 1 cfm = 28.3 L/min.

**Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.
R403.7 Equipment sizing and efficiency rating (Mandatory).
Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for Climate Zone 6.

R403.8 Systems serving multiple dwelling units (Mandatory).
Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the 2019 Vermont Commercial Building Energy Standards (CBES) in lieu of Section R403.

R403.9 Snow melt and ice system controls (Mandatory).
Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 45°F (10°C) and precipitation is falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4.8°C).

R403.10 Pools and permanent spa energy consumption (Mandatory).
The energy consumption of pools and permanent spas shall be in accordance with Sections R403.10.1 through R403.10.4.

R403.10.1 Residential pools and permanent residential spas.
Residential swimming pools and residential permanent spas that are accessory to detached one- and two-family dwellings and townhouses three stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP-15.

R403.10.2 Heaters.
The heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

R403.10.3 Time switches.
Time switches or other control methods that can automatically turn off and on according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.

2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

R403.10.4 Covers.
Outdoor heated pools and outdoor permanent spas shall be provided with an insulated vapor-retardant cover of at least R-12 or other approved vapor-retardant means.
**Exception:** Where more than 75 percent of the energy for heating, computed over an operation season, is from site-recovered energy, such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

**R403.11 Portable spas (Mandatory).**
The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

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**SECTION R404**

**ELECTRICAL POWER AND LIGHTING SYSTEMS**

**R404.1 Lighting equipment (Mandatory).**
Not less than 90 percent of the lamps (or “bulbs”) in permanently installed lighting fixtures shall be high-efficacy lamps. Where multiple replaceable lamps are connected to a permanently installed lighting fixture, the number of lamps is to be used in calculating the percentage.

**R404.1.1 Lighting equipment (Mandatory).**
Fuel gas lighting systems shall not have continuously burning pilot lights.

**R404.1.2 Lighting equipment for multifamily spaces (Mandatory).**
*Multifamily buildings* three-stories or less with parking garages and exterior parking areas and drives, must meet the lighting power density (LPD) specifications of the Vermont Commercial Building Energy Standards (CBES). For parking garages, see C405.3.2; for uncovered parking areas and drives, see C405.4.2.

**R404.2 Electric resistance heating equipment.**
Heat pumps having supplementary electric resistance heat shall be certified *cold-climate heat pumps* only and shall have controls that, except during defrost, prevent supplementary electric heat operation where the heat pump compressor can meet the heating load.

Building heating with electric resistance heating equipment is prohibited.

Exceptions*:
1. Replacement of existing electrical resistance units.
2. Limited areas where other heating sources are cost prohibitive or impractical (e.g., a small interior space such as a bathroom or stairwell, which is distant from the distribution system).
3. Buildings with Cold-Climate Heat Pump(s) as the primary heating system, provided:
   a. The supplemental electric resistance heat is controlled to prevent it from operating at an outside air temperature of 5°F or higher; and
   b. The building has a tested air tightness of ≤ 2.0 ACH50.
4. Multifamily buildings with heating loads ≤ 6.0 Btu/hour/square foot at design temperature.

*Buildings served by the Burlington Electric Department (BED) must also receive approval from BED before installing electric resistance heating equipment.
R404.3 Electric vehicle charging.
New parking lots serving multifamily developments of 10 or more dwelling units shall provide either level 1 or level 2 electrical service within 5 feet of the centerline of the parking space ("EV Charging Parking Space") with the capacity to serve the number of Electric Vehicle Charging Parking Spaces in Table R404.3. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service.

Exception: Parking spaces are not counted in Table R404.3 if one of the following conditions apply:
1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
2. Parking spaces are separated from the meter by a public right-of-way.
3. Parking spaces which are limited to parking durations of less than an hour.

Parking spaces with Electric Vehicle Supply Equipment ("EVSE") shall be marked for EV use only.

Exception: The number of parking spaces with EVSE that are marked for “EV use only” need not exceed the number of EV cars driven by occupants of the building. This exception does not reduce the number of EVSE spaces required, just the number that are marked for EV use only.

Level 1 Electric Vehicle Charging Parking requires one 120V 20 amp grounded AC receptacle, NEMA 5-20R or equivalent, within 5 feet of the centerline of each EV Charging Parking Space.

Level 2 Electric Vehicle Charging Parking requires one 208/240V 40 amp grounded connection for electric vehicle charging through dedicated EVSE with J1772 connector or AC receptacle, NEMA 14-50, or equivalent, within 5 feet of the centerline for each EV Charging Parking Space.

### Table R404.3

<table>
<thead>
<tr>
<th>NUMBER OF PARKING SPOTS</th>
<th>REQUIRED NUMBER OF EV CHARGING PARKING SPACES</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–25</td>
<td>1</td>
</tr>
<tr>
<td>26–50</td>
<td>2</td>
</tr>
<tr>
<td>51–75</td>
<td>3</td>
</tr>
<tr>
<td>76–100</td>
<td>4</td>
</tr>
<tr>
<td>&gt;100</td>
<td>4% of parking spots, rounded up to the nearest whole number</td>
</tr>
</tbody>
</table>
SECTION R405
ALTERNATIVE USING
RESCHECK™ SOFTWARE

R405.1 Scope.
This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling and service water heating energy only.

R405.2 Mandatory requirements.
Compliance with this section requires that the provisions in Sections R402.1.1, R403.3.1, R403.5.3 and the mandatory provisions identified in Sections R401.3, R402, R403 and R404 be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to meet the same R-value requirement that applies to immediately proximal surfaces.

R405.3 Performance-based compliance.
Compliance is based on documentation from REScheck™ modeling software that indicates the home meets or exceeds the target UA for that building.

SECTION R406
ENERGY RATING INDEX
COMPLIANCE ALTERNATIVE

R406.1 Scope.
This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis. This approach uses a Home Energy Rating System (HERS) Energy Rating provided by a Vermont Department of Public Service-approved accredited HERS provider. The “ERI” referenced herein is the same as the RESNET HERS Index.

R406.2 Mandatory requirements.
Compliance with this section requires that the provisions in Sections R402.1.1, R403.3.1, R403.5.3 and the mandatory provisions identified in Sections R401.3, R402, R403 and R404 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.2 of the 2009 International Energy Conservation Code for Climate Zone 6.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.3 Energy Rating Index.
The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the ERI reference design has an Index value of 100 and a residential building that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to the total energy use of the ERI reference design. The ERI shall consider all energy used in the residential building.

R406.3.1 ERI reference design.
The ERI reference design shall be configured such that it meets the minimum requirements of the 2006 International Energy Conservation Code prescriptive requirements.
The proposed *residential building* shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.

**R406.4 ERI-based compliance.**
Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to 61 when compared to the *ERI reference design*. Up to 5 ERI points can be earned with renewables. This includes all residential structures, including log homes. The ERI to be used to verify compliance is “HERS Index with IAF” using REM/Rate version 15.7. Up to 5 ERI points can be earned with renewables. If the HERS Index scale is revised, the Department of Public Service may update these Index points.

**R406.5 Verification by approved agency.**
Verification of compliance with Section R406 shall be completed by a certified HERS Rater working under the authority of a Vermont PSD-approved accredited HERS Provider.

**R406.6 Documentation.**
Documentation of the software used to determine the ERI and the parameters for the *residential building* shall be in accordance with Sections R406.6.1 through R406.6.3.

**R406.6.1 Compliance software tools.**
Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code official or other authority having jurisdiction, where one exists and be an approved Software Rating Tools in accordance with RESNET/ICC 301.

**R406.6.2 Compliance report.**
Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

**Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

**R406.6.3 Additional documentation.**
The code official or other authority having jurisdiction, where one exists, shall be permitted to require the following documents:
1. Documentation of the building component characteristics of the *ERI reference design*.

2. A certification signed by the builder providing the building component characteristics of the *rated design*.

3. Documentation of the actual values used in the software calculations for the *rated design*.

**R406.7 Calculation software tools.**

Calculation software, where used, shall be in accordance with Sections R406.7.1 through R406.7.3.

**R406.7.1 Minimum capabilities.**

Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. Computer generation of the *ERI reference design* using only the input for the *rated design*.

   The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.

2. Calculation of whole building, as a single *zone*, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.

3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.

4. Printed *code official or other authority having jurisdiction, where one exists*, inspection checklist listing each of the *rated design* component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

**R406.7.2 Specific approval.**

Performance analysis tools meeting the applicable sections of Section R406 shall be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The *code official or other authority having jurisdiction, where one exists*, shall approve tools for a specified application or limited scope.

**R406.7.3 Input values.**

Where calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source such as RESNET/ ICC 301.
SECTION R407
VERMONT STRETCH CODE

R407.1 Scope.
This section establishes criteria for compliance with Vermont’s “Stretch Code,” as defined in 30 V.S.A. § 51. Act 250 residential projects and residential buildings in municipalities that adopt the Stretch Code shall demonstrate compliance with R407.2. All other requirements in the RBES shall apply.

All Base Code requirements shall be met in addition to the requirements in this Stretch Code section R407 in order to be in compliance with the Stretch Code.

R407.2 Compliance.
Compliance for Stretch Code shall be documented through R407.2.1 Package Plus Points Approach or R407.2.2 ERI-based compliance for Stretch Code.

R407.2.1 Package Plus Points Approach.

R407.2.1.1 Projects shall comply by completing all three steps below:

1. Select one of the three base packages listed in Table R407.2.1.1; and
2. Determine the number of points needed to comply with Table R407.2.1.2. based on building size; and
3. Incorporate a sufficient number of points from Table R407.2.1.3 to meet the points requirements from Table R407.2.1.2.
### TABLE R407.2.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT FOR STRETCH PACKAGES

<table>
<thead>
<tr>
<th>Componenta</th>
<th>Package 1</th>
<th>Package 2</th>
<th>Package 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Standard”</td>
<td>“SIPS”</td>
<td>“Thick Wall”</td>
</tr>
<tr>
<td><strong>Envelope</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling R-Value</td>
<td>R-60° attic / R-49° slope</td>
<td>R-36 cont.</td>
<td>R-49f</td>
</tr>
<tr>
<td>Wood Frame Wall R-Value</td>
<td>R-20+5e OR R-21 cont.</td>
<td>R-20+12e</td>
<td></td>
</tr>
<tr>
<td>Common Wall Insulation</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
</tr>
<tr>
<td>Basement/Crawl Space Wall R-Value</td>
<td>R-20 (continuous) OR R-13+10e</td>
<td>R-20 (continuous) OR R-13+10e</td>
<td>R-20 (continuous) OR R-13+10e</td>
</tr>
<tr>
<td>Slab Edged R-Value</td>
<td>R-15, 4ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
</tr>
<tr>
<td>Heated Slabd R-Value</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
</tr>
<tr>
<td>Fenestrationb (Window and Door) max. U-Value</td>
<td>U-0.28</td>
<td>U-0.28</td>
<td>U-0.30</td>
</tr>
<tr>
<td>Skylightb max. U-Value</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
</tr>
<tr>
<td><strong>Air Leakage and Ventilation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Leakagei</td>
<td>≤3.0 ACH50h tested</td>
<td>≤3.0 ACH50h tested</td>
<td>≤3.0 ACH50h tested</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Balanced; ECM fan plus ≥ 70% SRE for HRV, ≥ 65% SRE for ERV</td>
<td>Balanced; ECM fan plus ≥ 70% SRE for HRV, ≥ 65% SRE for ERV</td>
<td>Balanced; ECM fan plus ≥ 70% SRE for HRV, ≥ 65% SRE for ERV</td>
</tr>
<tr>
<td><strong>Mechanicals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>Inside thermal boundary</td>
<td>Inside thermal boundary</td>
<td>Inside thermal boundary</td>
</tr>
<tr>
<td><strong>Lighting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent High Efficacy Lampsi</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

a. R-values are minimums. U-factors are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.

b. The fenestration U-factor row excludes skylights.

c. The continuous portion of basement and crawlspace insulation can be met through interior, exterior or a combination.

d. “4 ft” can be horizontal or vertical coverage including slab edge. “Edge and under” requires complete coverage. Up to 8 lineal feet of exposed slab edge may be insulated to R-10. “Heated slab” are those with embedded radiation.

e. The first value is cavity insulation, the second value is continuous insulation, so “13 + 10” means R-13 cavity insulation plus R-10 continuous insulation. These insulation requirements can be met through any combination of insulation R-values that yields an equivalent effective R-value using a series-parallel path calculation method.

f. Installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the
wall top plate at the eaves. (See Section R402.2.1.) Multifamily buildings using continuous insulation with a maximum U-factor of 0.023 for the ceiling assembly satisfies this requirement.
g. Installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. (See Section R402.2.1.)
h. “ACH50” = air changes per hour at 50 Pascals building pressure as measured with a blower door.
i. See Table R402.4.1.1 for further details.
j. “H/ERV” = Heat or Energy Recovery Ventilation
k. “SRE” = System Recovery Efficiency
l. “ECM” = Electronically Commutated Motor

R407.2.1.2 Required Points by Building Size.
Determine the number of points required by building size from Table R402.1.2.2. Building size for this table is determined by the finished conditioned floor area per dwelling unit within the building thermal envelope, including unfinished basements and storage/utility spaces. The Multifamily < 2000 square feet point requirement cannot be used for semidetached (semiaxhored, side-by-side), row houses, and townhouses, as defined as single-family dwellings in Definitions R202. Multifamily dwelling unit size is based on the average dwelling size for the building.

<table>
<thead>
<tr>
<th>Building/Dwelling Size</th>
<th>Required Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily &lt; 2000 square feet</td>
<td>6 points</td>
</tr>
<tr>
<td>average unit size</td>
<td></td>
</tr>
<tr>
<td>&lt;2000 square feet</td>
<td>7 points</td>
</tr>
<tr>
<td>2000 to 4000 square feet</td>
<td>9 points</td>
</tr>
<tr>
<td>&gt;4000 square feet</td>
<td>12 points</td>
</tr>
</tbody>
</table>

R407.2.1.3 Points by Component.
After determining the number of points required using Table R407.2.1.2, select the components from Table 407.2.1.3 to accumulate the required number of points. The total number of points selected from Table 407.2.1.3 must meet or exceed the required points from Table 407.2.1.2.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab</td>
<td>R-10 below entire slab</td>
<td>1</td>
</tr>
<tr>
<td>Walls-Upgraded</td>
<td>Above Grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Exception: not available for stretch package 3) ORb</td>
<td>2</td>
</tr>
<tr>
<td>Walls – High-R</td>
<td>Above Grade walls ≥ R-40 (cavity + continuous) (or U-factor maximum 0.025 wall assembly)</td>
<td>3</td>
</tr>
<tr>
<td>Ceiling</td>
<td>R-80 attic / R-60 sloped, vaulted and cathedral</td>
<td>1</td>
</tr>
<tr>
<td>Windows</td>
<td>Average U-factor ≤ 0.22</td>
<td>2</td>
</tr>
<tr>
<td><strong>Air Leakage and Ventilation</strong></td>
<td>Pre-Drywall</td>
<td>ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered OR</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tight</td>
<td>ACH50 ≤ 2.0 and balanced ventilation with ECM fans and ≥ 70% SRE for HRV, ≥ 65% SRE for ERV OR</td>
<td>1</td>
</tr>
<tr>
<td>Very Tight</td>
<td>ACH50 ≤ 1.0 and balanced ventilation with ECM fans and ≥ 80% SRE for HRV, ≥ 75% SRE for ERV</td>
<td>4</td>
</tr>
<tr>
<td><strong>Heating and Cooling</strong>a</td>
<td>Basic</td>
<td>ENERGY STAR basic: (1) Gas/propane furnace ≥ 95 AFUE, Oil furnace ≥ 85 AFUE, (2) Gas/Propane Boiler ≥ 90 AFUE, Oil Boiler ≥ 87 AFUE, (3) Heat pump HSPF ≥ 9.0; PLUS any AC is SEER ≥ 14.5 OR</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>Advanced: Whole building heat/cool is (1) NEEP-listed heat pump combination, (2) GSHP, closed loop and COP ≥ 3.3, (3) ATWHP COP ≥ 2.5 and 120F design temp, (4) Advanced wood heating system</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>Basic</td>
<td>ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for &gt; 55 gal] OR</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥ 2.20 for &gt; 55 gal]</td>
</tr>
<tr>
<td>Low Flow</td>
<td>All showerheads ≤ 1.75 gpm, all lav. faucets ≤ 1.0 gpm, and all toilets ≤ 1.28 gpf OR</td>
<td>1</td>
</tr>
<tr>
<td>Certified</td>
<td>Certified water efficient design per WERS, WaterSense, or RESNET2O (for new construction only)</td>
<td>2</td>
</tr>
<tr>
<td>Drain Heat Recovery</td>
<td>Drain water heat recovery system on primary showers and tubs</td>
<td>1</td>
</tr>
<tr>
<td>User-Demand</td>
<td>Controlled hot water recirculation system with user-demand via push-button for furthest fixtures</td>
<td>1</td>
</tr>
<tr>
<td><strong>Renewables</strong></td>
<td>On-Site Generation</td>
<td>Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site</td>
</tr>
<tr>
<td>Solar Hot Water</td>
<td>Solar hot water system designed to meet at least 50% of annual hot water load</td>
<td>2</td>
</tr>
<tr>
<td>Solar PV</td>
<td>Solar Photovoltaic (PV), 1 point per 1.5 kW per housing unit of renewable generation on site</td>
<td>1 per 1.5 kW, max. 4</td>
</tr>
<tr>
<td>Solar Ready for Multifamily</td>
<td>Multifamily building complies with Solar Ready Zone R.407.5.</td>
<td>1</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data</td>
<td>1</td>
</tr>
<tr>
<td><strong>Other Measures</strong></td>
<td>EV Ready</td>
<td>Level 2 electric vehicle charger-ready per 407.4</td>
</tr>
<tr>
<td></td>
<td>Battery</td>
<td>Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup</td>
</tr>
</tbody>
</table>
For SI: 1 foot = 304.8 mm.

a. Heating and cooling system points are only available if all components of primary systems comply
b. “OR” indicates that points are not additive; one component OR the following one can be selected, but not both.
c. “H/ERV” = Heat or Energy Recovery Ventilation
d. “SRE” = System Recovery Efficiency
e. “ECM” = Electronically Commutated Motor
g. “gpm” = gallons per minute
h. “gpf” = gallons per flush. Applies to new construction only.
i. “GSHP” = ground-source heat pump
j. https://neep.org/initiatives/high‐efficiency‐products/emergingtechnologies/ashp/cold‐climate‐air‐source‐heat‐pump
k. Points are limited to one per dwelling. Additional Level 2 charging equipment receives no more points.

**R407.2.2 ERI-based compliance for Stretch Code.** Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to 54 when compared to the *ERI reference design*. This includes all residential structures, including log homes. The ERI to be used to verify compliance is “HERS Index with IAF” using REM/Rate version 15.7. Up to 5 ERI points can be earned with renewables.

If the HERS Index scale is revised, the Department of Public Service may update these Index points.

**R407.3 Air Leakage Testing for Stretch Code.** In addition to the requirements in R402.1.2 for testing air leakage, air leakage testing shall be reported on the RBES Certificate in units of air changes per hour at 50 Pascals (ACH50) in addition to cubic feet per minute (cfm) at 50 Pascals (CFM50) per square foot of building thermal shell area. Building thermal shell area shall include all six (6) sides of the building.

**R407.4 Electric vehicle charging for Stretch Code.**
For single family housing, one Level 1 parking space is required with accessible socket.

Parking lots serving *multifamily* developments of 10 or more dwelling units shall provide level 1 or level 2 electrical service to the required number of Electric Vehicle Charging Parking Spaces in Table R404.3. If level 1 service is provided, the required EV Charging Parking Spaces shall also be “Level 2 ready” as defined below in this Section R407.4. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service.

**Exception:** Parking spaces are not counted in Table R404.3 if one of the following conditions apply:

1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
2. Parking spaces are separated from the meter by a public right-of-way.
3. Parking spaces which are limited to parking durations of less than an hour.

Parking spaces with *Electric Vehicle Supply Equipment* (“EVSE”) shall be marked for EV use only.
Exception: The number of parking spaces with EVSE that are marked for “EV use only” need not exceed the number of EV cars driven by occupants of the building. This exception does not reduce the number of EVSE spaces required, just the number that are marked for EV use only.

Level 1 Electric Vehicle Charging Parking requires one 120V 20 amp grounded AC receptacle, NEMA 5-20R or equivalent, within 5 feet of the centerline of each EV Charging Parking Space.

Level 2 Electric Vehicle Charging Parking requires one 208/240V 40 amp grounded connection for electric vehicle charging through dedicated EVSE with J1772 connector or AC receptacle, NEMA 14-50, or equivalent, within 5 feet of the centerline for each EV Charging Parking Space.

Level 2 “ready” includes space in the panel for at least one minimum 40-ampere branch circuit to be provided to garages and/or the exterior of the building to accommodate a future dedicated Society of Automotive Engineers (SAE) standard J1772-approved Level 2 EVSE. The circuits shall have no other outlets. The service panel shall provide sufficient capacity and space to accommodate the circuit and over-current protective device. A permanent and visible label stating “EV READY” shall be posted in a conspicuous place at both the service panel and the circuit termination point.

R407.5 Solar Ready Zone for Stretch Code.

R407.5.1 General.
New detached one- and two-family dwellings, and multiple single-family dwellings (townhouses) with not less than 600 ft² (55.74 m²) of roof area oriented between 110° and 270° of true north shall comply with sections 407.5.

EXCEPTIONS:
1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded for more than 70% of daylight hours annually.
3. Buildings and structures as designed and shown in construction documents that do not meet the conditions for a solar-ready zone area.
4. Buildings with possible location(s) for ground mounted systems identified in the submitted construction documents. Buildings claiming this exception must either install appropriate electrical conduit to the site of the proposed ground mounted solar array or include a solar site evaluation that supports the siting of the proposed ground mounting location.

R407.5.2 Construction Document Requirements for Solar Ready Zone
Construction documents shall indicate the solar ready zone where applicable.

R407.5.3 Solar-Ready Zone Area.
The total solar-ready zone area shall consist of an area not less than 300 ft² (27.87 m²) exclusive of mandatory access or set back areas. New multiple single-family dwellings (townhouses) three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 ft² (185.8 m²) per dwelling shall have a solar-ready zone area of
not less than 150 ft² (13.94 m²). Multifamily buildings should maximize the solar-ready zone by consolidating mechanicals, access, set back areas and other roof obstructions with a goal of 40% of the roof area available for the solar-ready zone. The solar-ready zone shall be composed of areas not less than five feet (1,524 mm) in width and not less than 80 ft² (7.44 m²) exclusive of access or required set back areas.

For ground-mounted systems, possible locations of the panels must be identified in the submitted construction documents and be supported by a solar site evaluation. At least one potential location must be identified in the construction documents for the future installation of the panels.

R407.5.4 Obstructions.
Solar-ready zones shall consist of an area free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R407.5.5 Roof Load Documentation.
The structural design loads for roof dead load and roof live load to support the solar system shall be clearly indicated on the construction documents.

R407.5.6 Interconnection Pathway.
Construction documents shall indicate pathways for routing of conduit (or plumbing for solar thermal systems) from the solar-ready zone to the electrical service panel or service hot water system. Alternatively, install two 1” minimum diameter EMT conduits from the main electrical panel location to the attic or other area easily accessible to the solar array’s proposed location. Conduits for future solar installations are to be capped, airtight and labeled at both ends.

R407.5.7 Electrical Service Reserved Space.
The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.” The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location. Note: this requirement is in addition to the electrical service reserved space for electric vehicle charging.
CHAPTER 5 (RE)  
EXISTING BUILDINGS

SECTION R501  
GENERAL

R501.1 Scope.  
The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

R501.1.1 Additions, alterations, or repairs: General.  
Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503 or R504. Unaltered portions of the existing building or building supply system shall not be required to comply with this code. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

R501.1.2 Compliance approaches.  
Thermal efficiency can be achieved through any of the compliance paths, including any one of the following approaches: prescriptive packages, REScheck™ software, or a Home Energy Rating System (HERS) rating.

R501.2 Existing buildings.  
Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

R501.3 Maintenance.  
Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this code shall be maintained in conformance to the code edition under which installed. The owner or the owner’s authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

R501.4 Compliance.  
R501.5 New and replacement materials.
Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided that hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not allow their use in buildings of similar occupancy, purpose and location.

R501.6 Historic buildings.
No provision of this code relating to the construction, repair, alteration, restoration and movement of structures, and change of occupancy shall be mandatory for historic buildings provided a “Historic Building Exemption Report” obtained from the State Historic Preservation Office has been submitted to the State Historic Preservation Office and signed by either the owner, an owner’s agent, a registered design professional, or a representative of the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic fabric or function of the building. The State Historic Preservation Office, upon receipt of the report, will review and validate the exemption request. Upon request, a copy of the report shall be provided to the local authority having jurisdiction.

SECTION R502
ADDITIONS

R502.1 General.
Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition does not use more energy than the existing building. Additions shall be in accordance with Section R502.1.1 or R502.1.2.

R502.1.1 Prescriptive compliance.
Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

R502.1.1.1 Building envelope.
New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: Where unconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the UA, as determined in Section 402.1.4, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to UA generated for the existing building.

R502.1.1.2 Heating and cooling systems.
New heating, cooling and duct systems that are part of the addition shall comply with Sections R403.1, R403.2, R403.3, R403.5, R403.6 and R404. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.
Exception: Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R502.1.1.3 Service hot water systems.
New service hot water systems that are part of the addition shall comply with Section R403.4. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

R502.1.1.4 Lighting.
New lighting systems that are part of the addition shall comply with Section R404.1.

R502.1.2 Existing plus addition compliance (Simulated Performance Alternative).
Where unconditioned space is changed to conditioned space, the addition shall comply where the annual energy cost or energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with any of the Chapter 4 compliance options in its entirety.

SECTION R503
ALTERATIONS

R503.1 General.
Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alteration.

Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

R503.1.1 Building envelope.
Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.13, R402.3.1, R402.3.2, R402.4.3 and R402.4.4. Uninsulated or under-insulated wall, floor and roof building cavities that are filled with insulation only need to fill that cavity with insulation, and are not required to meet the R-value requirements in Table R402.1.2.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.

2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.

4. Roof recover.

5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.

6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing or fenestration assembly to be replaced.

R503.1.1.1 Replacement fenestration.
Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for $U$-factor and SHGC as specified Table R402.1.2. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the $U$-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

R503.1.2 Heating and cooling systems.
New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3, R403.6 and R404. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R503.1.3 Service hot water systems.
New service hot water systems that are part of the alteration shall comply with Section R403.5.

R503.1.4 Lighting.
New lighting systems that are part of the alteration shall comply with Section R404.1.

Exception: Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

R503.2 Change in space conditioning.
Any unconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance (REScheck) option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.
SECTION R504
REPAIRS

R504.1 General.
Buildings, structures and parts thereof shall be repaired in compliance with Section R501.3 and this section. Work on nondamaged components necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section R501.3, ordinary repairs exempt from permit, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section and are exempt from meeting RBES requirements.

R504.2 Application.
For the purposes of this code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.

2. Roof repairs.

3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior lighting power.

SECTION R505
CHANGE OF OCCUPANCY OR USE

R505.1 General.
Spaces undergoing a change in use that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

R505.1.1 Hunting Camps and Summer Camps. Once a hunting camp or a summer camp changes occupancy and becomes a residence, or is converted from an unconditioned space to a conditioned space, it must then be upgraded to comply with the code.

R505.2 General.
Any space that is converted to a dwelling unit or portion thereof from another use shall comply with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.
CHAPTER 6
REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

| AAMA | American Architectural Manufacturers Association
| 1827 Walden Office Square
| Suite 550
| Schaumburg, IL 60173-4268
| Standard reference number | Title |
| | Referenced in code section number |
| R402.4.3 |

| ACCA | Air Conditioning Contractors of America
| 2800 Shirlington Road, Suite 300
| Arlington, VA 22206
| Standard reference number | Title |
| Manual S—14 | Residential Equipment Selection |
| | Referenced in code section number |
| R403.7 |

| APSP | The Association of Pool and Spa Professionals
| 2111 Eisenhower Avenue
| Alexandria, VA 22314
| Standard reference number | Title |
| | Referenced in code section number |
| R403.10.1, 403.11 |
| R403.12 |

| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
| 1791 Tullie Circle, NE
| Atlanta, GA 30329-2305
| Standard reference number | Title |
| ASHRAE—2017 | ASHRAE Handbook of Fundamentals |
| ASHRAE 62.2 | Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings |
| | Referenced in code section number |
| R402.1.5 |
| 303.1.1 |
**ASHRAE 193—2010 Method of Test for Determining the Airtightness of HVAC Equipment**

**ASTM International**
100 Barr Harbor Drive
West Conshohocken, PA 19428-2859

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<td>Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen</td>
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<td>Standard Test Method for Determining Air Leakage of Air Barrier Assemblies</td>
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**CSA Group**
8501 East Pleasant Valley
Cleveland, OH 44131-5575

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**DASMA**
Door and Access Systems Manufacturers Association
1300 Sumner Avenue
Cleveland, OH 44115-2851

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**HVI**
Home Ventilating Institute
1000 North Rand Road, Suite 214
Wauconda, IL 60084

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<td>Airflow Test Procedure</td>
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### ICC

**International Code Council, Inc.**  
500 New Jersey Avenue, NW  
6th Floor  
Washington, DC 20001

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### IEEE

**The Institute of Electrical and Electronic Engineers, Inc.**  
3 Park Avenue  
New York, NY 1016-5997

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<td>IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications</td>
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### NFPA

**National Fire Protection Association.**  
1 Batterymarch Park  
Quincy, MA 02169-7471

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**WDMA**
Window and Door Manufacturers Association
2025 M Street, NW Suite 800
Washington, DC 20036-3309
APPENDIX RA
RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 OR R405 CONDITIONS ≤ 5ACH\textsubscript{50}

(This appendix is informative and is not part of the code.)

SECTION RA101
SCOPE

RA101.1 General.
This appendix is intended to provide guidelines for worst-case testing of atmospheric venting systems. Worst-case testing is recommended to identify problems that weaken draft and restrict combustion air.

SECTION RA201
GENERAL DEFINITIONS

COMBUSTION APPLIANCE ZONE (CAZ). A contiguous air volume within a building that contains a Category I or II atmospherically vented appliance or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside the building or dwelling unit. The CAZ includes, but is not limited to, a mechanical closet, a mechanical room, or the main body of a house or dwelling unit.

DRAFT. The pressure difference existing between the appliance or any component part and the atmosphere that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

Mechanical or induced draft. The pressure difference created by the action of a fan, blower or ejector that is located between the appliance and the chimney or vent termination.

Natural draft. The pressure difference created by a vent or chimney because of its height and the temperature difference between the flue gases and the atmosphere.

SPILLAGE. Combustion gases emerging from an appliance or venting system into the combustion appliance zone during burner operation.

SECTION RA301
TESTING PROCEDURE

RA301.1 Worst-case testing of atmospheric venting systems.
Buildings or dwelling units containing a Category I or II atmospherically vented appliance; or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside of the building or dwelling unit, shall have the Combustion Appliance Zone (CAZ) tested for spillage,
acceptable draft and carbon monoxide (CO) in accordance with this section. Where required by the code official or other authority having jurisdiction, where one exists, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official or other authority having jurisdiction, where one exists. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope and prior to final inspection.

**Exception:** Buildings or dwelling units containing only Category III or IV direct-vent or integral vent appliances that do not draw combustion air from inside of the building or dwelling unit.

The enumerated test procedure as follows shall be complied with during testing:

1. Set combustion appliances to the pilot setting or turn off the service disconnects for combustion appliances. Close exterior doors and windows and the fireplace damper. With the building or dwelling unit in this configuration, measure and record the baseline ambient pressure inside the building or dwelling unit CAZ. Compare the baseline ambient pressure of the CAZ to that of the outside ambient pressure and record the difference (Pa).

2. Establish worst case by turning on the clothes dryer and all exhaust fans. Close all interior doors that make the CAZ pressure more negative. Turn on the air handler, where present, and leave on if, as a result, the pressure in the CAZ becomes more negative. Check interior door positions again, closing only the interior doors that make the CAZ pressure more negative. Measure net change in pressure from the CAZ to outdoor ambient pressure, correcting for the base ambient pressure inside the home. Record “worst case depressurization” pressure and compare to Table RA301.1(1).

Where CAZ depressurization limits are exceeded under worst-case conditions in accordance with Table A301.1(1), additional combustion air shall be provided or other modifications to building air-leakage performance or exhaust appliances such that depressurization is brought within the limits prescribed in Table RA301.1(1).

3. Measure worst-case spillage, acceptable draft and carbon monoxide (CO) by firing the fuel-fired appliance with the smallest Btu capacity first.
   
   a. Test for spillage at the draft diverter with a mirror or smoke puffer. An appliance that continues to spill flue gases for more than 60 seconds fails the spillage test.

   b. Test for CO measuring undiluted flue gases in the throat or flue of the appliance using a digital gauge in parts per million (ppm) at the 10-minute mark. Record CO ppm readings to be compared with Table RA301.1(3) upon completion of Step 4. Where the spillage test fails under worst case, go to Step 4.

   c. Where spillage ends within 60 seconds, test for acceptable draft in the connector not less than 1 foot (305 mm), but not more than 2 feet (610 mm) downstream of the draft diverter. Record draft pressure and compare to Table RA301.1(2).
d. Fire all other connected appliances simultaneously and test again at the draft diverter of each appliance for spillage, CO and acceptable draft using procedures 3a through 3c.

4. Measure spillage, acceptable draft, and carbon monoxide (CO) under natural conditions—without clothes dryer and exhaust fans on—in accordance with the procedure outlined in Step 3, measuring the net change in pressure from worst case condition in Step 3 to natural in the CAZ to confirm the worst-case depressurization taken in Step 2. Repeat the process for each appliance, allowing each vent system to cool between tests.

5. Monitor indoor ambient CO in the breathing zone continuously during testing and abort the test where indoor ambient CO exceeds 35 ppm by turning off the appliance, ventilating the space, and evacuating the building. The CO problem shall be corrected prior to completing combustion safety diagnostics.

6. Make recommendations based on test results and the retrofit action prescribed in Table RA301.1(3).

<table>
<thead>
<tr>
<th>TABLE RA301.1(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAZ DEPRESSURIZATION LIMITS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VENTING CONDITION</th>
<th>LIMIT (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category I, atmospherically vented water heater</td>
<td>–2.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented boiler or furnace common-vented with a Category I atmospherically vented water heater</td>
<td>–3.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented boiler or furnace, equipped with a flue damper, and common vented with a Category I atmospherically vented water heater</td>
<td>–5.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented boiler or furnace alone</td>
<td>–5.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented, fan-assisted boiler or furnace common vented with a Category I atmospherically vented water heater</td>
<td>–5.0</td>
</tr>
<tr>
<td>Decorative vented, gas appliance</td>
<td>–5.0</td>
</tr>
<tr>
<td>Power-vented or induced-draft boiler or furnace alone, or fan-assisted water heater alone</td>
<td>–15.0</td>
</tr>
<tr>
<td>Category IV direct-vent ed appliances and sealed combustion appliances</td>
<td>–50.0</td>
</tr>
</tbody>
</table>

For SI: 6894.76 Pa = 1.0 psi.

<table>
<thead>
<tr>
<th>TABLE RA301.1(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCEPTABLE DRAFT TEST CORRECTION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTSIDE TEMPERATURE (°F)</th>
<th>MINIMUM DRAFT PRESSURE REQUIRED (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>–2.5</td>
</tr>
<tr>
<td>10 – 90</td>
<td>(Outside Temperature ÷ 40) – 2.75</td>
</tr>
<tr>
<td>&gt; 90</td>
<td>–0.5</td>
</tr>
</tbody>
</table>

For SI: 6894.76 Pa = 1.0 psi.
### TABLE RA301.1(3)
**ACCEPTABLE DRAFT TEST CORRECTION**

<table>
<thead>
<tr>
<th>CARBON DIOXIDE LEVEL (ppm)</th>
<th>AND OR</th>
<th>SPILLAGE AND ACCEPTABLE DRAFT TEST RESULTS</th>
<th>RETROFIT ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 25</td>
<td>and</td>
<td>Passes</td>
<td>Proceed with work</td>
</tr>
<tr>
<td>25 ( &lt; x \leq 100 )</td>
<td>and</td>
<td>Passes</td>
<td>Recommend that CO problem be resolved</td>
</tr>
<tr>
<td>25 ( &lt; x \leq 100 )</td>
<td>and</td>
<td>Fails in worst case only</td>
<td>Recommend an appliance service call and repairs to resolve the problem</td>
</tr>
<tr>
<td>100 ( &lt; x \leq 400 )</td>
<td>or</td>
<td>Fails under natural conditions</td>
<td>Stop! Work shall not proceed until appliance is serviced and problem resolved</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>and</td>
<td>Passes</td>
<td>Stop! Work shall not proceed until appliance is serviced and problem resolved</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>and</td>
<td>Fails under any condition</td>
<td>Emergency! Shut off fuel to appliance and call for service immediately</td>
</tr>
</tbody>
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PREFACE

Introduction

Internationally, code officials recognize the need for a modern, up-to-date energy conservation code addressing the design of energy-efficient building envelopes and installation of energy-efficient mechanical, lighting and power systems through requirements emphasizing performance. The 20152019 Vermont Residential Building Energy Standards (RBES) is based on the International Energy Conservation Code® 2015 edition, with 2018 updates, and is designed to meet these needs through model code regulations that will result in the optimal utilization of fossil fuel and nondepletable resources in all communities, large and small.

This comprehensive energy conservation code establishes minimum regulations for energy efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy efficient designs.

The International Energy Conservation Code provisions provide many benefits, among which is the model code development process that offers an international forum for energy professionals to discuss performance and prescriptive code requirements. This forum provides an excellent arena to debate proposed revisions. This model code also encourages international consistency in the application of provisions.

Development

This 20152019 RBES is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Background

During the 1995 legislative session, there was a consensus that a Task Force should be created to examine the issues related to developing an energy efficiency standard and address the concerns of interested parties. To this end, the Governor’s Task Force on Energy Efficiency Standards for New Residential Construction was created in September, 1995 and was charged with developing a legislative proposal prior to the 1996 session.

The Governor’s Task Force included stakeholders from with many different perspectives on this issue. The Task Force reached a consensus that the legislature should adopt an energy code and that this code should include the following provisions:

- The code should be kept current by establishing a three-year cycle for revision and modification of the code through rule making;
• Compliance with the residential stretch code should be given the presumption of compliance with 10 V.S.A. Chapter 151 (Act 250) Sub-Criterion 9(f), Energy Conservation;

• To demonstrate compliance, builders should be required to complete a form self-certifying that the energy efficiency requirements of the code have been met for each new home that is built;

• Owner/builders should be allowed to build a home that does not comply with the code as long as they disclose how that home is deficient to subsequent prospective buyers; and

• In order to address indoor air quality, a requirement for automatic, mechanical ventilation systems should be included in the first update of the code three years from adoption.

The Vermont Residential Building Energy Standards (RBES) was adopted by statute in 1997 and incorporated virtually all of the Task Force’s recommendations. Since that time, an Energy Code Assistance Center has been established to provide builders and consumers with information on the code and answers to their questions. Workshops have also been held throughout the state to train builders, architects and trade allies about the code requirements and how to comply.

Act 89 passed in 2013, established a Stretch Code defined as a building energy code for residential buildings that achieves greater energy savings than the RBES. The stretch code shall be available for adoption by municipalities under 24 V.S.A. §117, and shall apply in proceedings under 10 V.S.A. §151 (Act 250).

Update Process

The Residential Building Energy Standards Statute (30 V.S.A. § 51) requires that revisions to the RBES are made promptly after the issuance of updated standards for residential construction under the International Energy Conservation Code (IECC). The Department of Public Service (PSD) is required to convene stakeholders that include mortgage lenders, builders, building designers, utility representatives, and other persons with experience and expertise prior to the adoption of a revised RBES to provide recommendations.

The 2019 RBES is based on the language in the 2015 edition of the IECC and includes all of the efficiency improvements included in IECC 2018 as well as some of the improvements proposed for IECC 2021 to insure continued progression in efficiency in the Vermont DPSRBES. The 2019 RBES also provides a new “Package Plus Points” approach to code compliance. (Previous code compliance was achieved through a “prescriptive package” approach). The addition of “points” provides builders and designers greater flexibility in complying with RBES. The Vermont PSD held a series of stakeholder meetings in 2014-2018 and 2019 to gather feedback on proposed changes to RBES. The revisions to the 2015 edition of the International Energy Conservation Code presented in this document were drafted/modified based on input received from these meetings.
EFFECTIVE USE OF THE
20152019 RESIDENTIAL BUILDING ENERGY STANDARDS

The 20152019 Vermont Residential Building Energy Standards (RBES) is a code that regulates minimum energy conservation requirements for new buildings as well as additions, alterations, renovations, and repairs to existing buildings. The 20152019 RBES addresses energy conservation requirements for all aspects of energy uses in residential construction, including heating and ventilating, lighting, water heating, and power usage for appliances and building systems.

The 20152019 RBES is a design document. For example, before constructing a building, the designer must determine the minimum insulation R-values and fenestration U-factors for the building exterior envelope. The RBES sets forth minimum requirements for exterior envelope insulation, window and door U-factors and SHGC ratings, duct insulation, lighting and power efficiency, mechanical ventilation, and water distribution insulation.

Arrangement and Format of the 20152019 RBES

Before applying the requirements of the 2015 RBES it is beneficial to understand its arrangement and format. The 20152019 RBES, like other codes published by ICC, is arranged and organized to follow sequential steps that generally occur during a plan review or inspection. The 20152019 RBES is divided into six different parts:

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Italicized Terms

Selected terms set forth in Chapter 2: Definitions, are italicized where they appear in code text. Such terms are not italicized where the definition set forth in Chapter 2 does not impart the intended meaning in the use of the term. The terms selected have definitions that the user should read carefully to facilitate better understanding of the code.

The following is a chapter-by-chapter synopsis of the scope and intent of the provisions of the 20152019 Vermont Residential Building Energy Standards:

Chapter 1: **Scope and Administration**. This chapter contains provisions for the application, enforcement and administration of subsequent requirements of the code. In addition to establishing the scope of the code, Chapter 1 identifies which buildings and structures come
under its purview. Chapter 1 is largely concerned with maintaining “due process of law” in enforcing the energy conservation criteria contained in the body of this code. Only through careful observation of the administrative provisions can the code official or other authority having jurisdiction, where one exists, reasonably expect to demonstrate that “equal protection under the law” has been provided.

**Chapter 2 Definitions.** Chapter 2 is the repository of the definitions of terms used in the body of the code. Codes are technical documents and every word, term and punctuation mark can impact the meaning of the code text and the intended results. The code often uses terms that have a unique meaning in the code and the code meaning can differ substantially from the ordinarily understood meaning of the term as used outside of the code.

The terms defined in Chapter 2 are deemed to be of prime importance in establishing the meaning and intent of the code text. The user of the code should be familiar with and consult this chapter because the definitions are essential to the correct interpretation of the code and the user may not be aware that a term is defined.

Where understanding of a term’s definition is especially key to or necessary for understanding of a particular code provision, the term is shown in *italics* wherever it appears in the code. This is true only for those terms that have a meaning that is unique to the code. In other words, the generally understood meaning of a term or phrase might not be sufficient or consistent with the meaning prescribed by the code; therefore, it is essential that the code-defined meaning be known.

Guidance regarding tense, gender and plurality of defined terms as well as guidance regarding terms not defined in this code is provided.

**Chapter 3 General Requirements.** Chapter 3 provides interior design conditions that are used as a basis for assumptions in heating and cooling load calculations and provides basic material requirements for insulation materials and fenestration materials, and provides standards for residential mechanical ventilation and combustion safety.

**Chapter 4 Residential Energy Efficiency.** Chapter 4 contains the energy-efficiency-related requirements for the design and construction of residential buildings regulated under this code. It should be noted that the definition of a *residential building* in this code is unique for this code. In this code, a *residential building* is an R-2, R-3 or R-4 buildings three stories or less in height. All other R-1 buildings, including residential buildings greater than three stories in height, are regulated by the energy conservation requirements in the Vermont Commercial Building Energy Standards (CBES). The applicable portions of a residential building must comply with the provisions within this chapter for energy efficiency. This chapter defines requirements for the portions of the building and building systems that impact energy use in new residential construction and promotes the effective use of energy. The provisions within the chapter promote energy efficiency in the building envelope, the heating and cooling system, lighting and the service water heating system of the building. Vermont has adopted a two-tiered code structure with a “base code” that applies statewide, and a “Stretch Code” that is more stringent. The *Stretch Code* applies to all Act 250 development projects and is also available for municipalities that choose to adopt a higher energy standard.

**Chapter 5 Existing Buildings.** Chapter 5 of each set of provisions contains the technical energy efficiency requirements for existing buildings. Chapter 5 provisions address the
maintenance of buildings in compliance with the code as well as how additions, alterations, repairs and changes of occupancy need to be addressed from the standpoint of energy efficiency. Specific provisions are provided for historic buildings.

**Chapter 6 Referenced Standards.** The code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 6 contains a comprehensive list of all standards that are referenced in the code. The standards are part of the code to the extent of the reference to the standard. Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal basis to the code official, or other authority having jurisdiction, where one exists, contractor, designer and owner.

Chapter 6 is organized in a manner that makes it easy to locate specific standards. It lists all of the referenced standards, alphabetically, by acronym of the promulgating agency of the standard. Each agency’s standards are then listed in either alphabetical or numeric order based upon the standard identification. The list also contains the title of the standard; the edition (date) of the standard referenced; any addenda included as part of the ICC adoption; and the section or sections of this code that reference the standard.

**Marginal Markings**

Solid vertical lines in the margins within the body of the code indicate a technical change from the requirements of the 2015 and 2018 edition. Vermont specific additions and changes are designated through *xxxx markings dotted lines* in the margin. Deletion indicators in the form of an arrow (енного) are provided in the margin where an entire section, paragraph, exception or table has been deleted or an item in a list of items or a table has been deleted. Will be updated during publication

**Abbreviations and Notations**

The following is a list of common abbreviations and units of measurement used in this code. Some of the abbreviations are for terms defined in Chapter 2. Others are terms used in various tables and text of the code.

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<td>AFUE</td>
<td>Annual fuel utilization efficiency</td>
</tr>
<tr>
<td>bhp</td>
<td>Brake horsepower (fans)</td>
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<tr>
<td>Btu</td>
<td>British thermal unit</td>
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<tr>
<td>Btu/h-ft²</td>
<td>Btu per hour per square foot</td>
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<tr>
<td>C-factor</td>
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<tr>
<td>CDD</td>
<td>Cooling degree days</td>
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<tr>
<td>cfm</td>
<td>Cubic feet per minute</td>
</tr>
<tr>
<td>cfm/ft²</td>
<td>Cubic feet per minute per square foot</td>
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<tr>
<td>ci</td>
<td>Continuous insulation</td>
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<tr>
<td>COP</td>
<td>Coefficient of performance</td>
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DCV  Demand control ventilation
°C  Degrees Celsius
°F  Degrees Fahrenheit
DWHR  Drain water heat recovery
DX  Direct expansion
\( E_c \)  Combustion efficiency
\( E_v \)  Ventilation efficiency
\( E_t \)  Thermal efficiency
EER  Energy efficiency ratio
EF  Energy factor
ERI  Energy Rating index
F-factor  See Chapter 2—Definitions
FDD  Fault detection and diagnostics
FEG  Fan efficiency grade
FL  Full load
\( \text{m}^2 \)  Square foot
ft  Gallons per minute
HDD  Heating degree days
HERS  Home Energy Rating System
hp  Horsepower
HSPF  Heating seasonal performance factor
HVAC  Heating, ventilating and air conditioning
IEER  Integrated energy efficiency ratio
IPLV  Integrated Part Load Value
\( \text{Kg/m}^2 \)  Kilograms per square meter
kW  Kilowatt
LPD  Light power density (lighting power allowance)
L/s  Liters per second
Ls  Liner system
\( \text{m}^2 \)  square meters
MERV  Minimum efficiency reporting value
NAECA  National Appliance Energy Conservation Act
NPLV  Nonstandard Part Load Value
Pa  Pascal
PF  Projection factor
pcf  Pounds per cubic foot
PSD  Department of Public Service
psf  Pounds per square foot
PTAC  Packaged terminal air conditioner
PTHP  Packaged terminal heat pump
\( R \)-value  See Chapter 2—Definitions
SCOP  Sensible coefficient of performance
SEER  Seasonal energy efficiency ratio
SHGC  Solar Heat Gain Coefficient
SPVAC  Single packaged vertical air conditioner
SPVHP  Single packaged vertical heat pump
SRI    Solar reflectance index
SWHF   Service water heat recovery factor
U-factor See Chapter 2—Definitions
VAV    Variable air volume
VRF    Variable refrigerant flow
VT     Visible transmittance
W      Watts
w.c.   Water column
w.g.   Water gauge
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CHAPTER 1 [RE]

SCOPE AND ADMINISTRATION

PART 1—SCOPE AND APPLICATION

SECTION R101

SCOPE AND GENERAL REQUIREMENTS

R101.1 Title.
This code shall be known as the 2015, 2019 Vermont Residential Building Energy Standards (RBES) and shall be cited as such. It is referred to herein as “this code.”

R101.2 Scope.
This code applies to residential buildings and the building sites and associated systems and equipment, including one family dwellings, two family dwellings, and multi-family housing three stories or less in height.

While many sections of this code (e.g., inspections, review of construction documents, compliance, etc.) do not pertain to most of Vermont that lacks code officials, these sections are included to provide guidance for those jurisdictions that do have a code official or other authority having jurisdiction.

R101.3 Intent.
This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge building science or safety, health or environmental requirements contained in other applicable codes or ordinances.

R101.4 Applicability.
Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

R101.4.1 Mixed occupancy.
With respect to a structure that is three stories or less in height and is a mixed-use building that shares residential and commercial users, the term “residential building” shall include the living spaces in the structure and the nonliving spaces in the structure that serve only the residential users such as common hallways, laundry facilities, residential management offices, community rooms, storage rooms, and foyers. The “residential building” shall comply with all requirements of RBES, and all other aspects of the building shall comply with the Vermont Commercial Building Energy Standards (CBES).

R101.5 Compliance.
Residential buildings shall meet the provisions of Chapter 4.
R101.5.1 Compliance materials.
The code official or other authority having jurisdiction shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

R101.5.2 Exempt buildings.
The following buildings, or portions thereof, shall be exempt from the provisions of this code:

1. **Low Energy Use Buildings.** Those with a peak design rate of energy usage less than 3.4 Btu/h · ft² (10.7 W/m²) or 1.0 watt/ft² (10.7 W/m²) of floor area for space conditioning purposes.

2. **Unconditioned Buildings.** Those that do not contain conditioned space.

3. **Mobile homes.** Homes subject to Title VI of the National Manufactured Housing Construction and Safety Standards Act of 1974 (42 U.S.C. §§ 5401-5426). On-site constructed basements and crawlspaces must comply with this code.

4. **Hunting camps.** Residential buildings shall not include hunting camps.

5. **Summer camps.** Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.

66. **Yurts** with only a biomass (wood) or other on-site renewable heating and hot water system.

7. **Owner-built homes.** Residential construction by an owner, if all of the following apply:

   67.1. The owner of the residential construction is the builder, as defined in 30 V.S.A § 51.(a)(1), and;

   67.2. The residential construction is used as a dwelling by the owner, and;

   67.3. The owner in fact directs the details of construction with regard to the installation of materials not in compliance with the RBES, and;

   67.4. The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with the RBES.

Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES, and shall itemize which measures do not meet the RBES in effect at the time construction commenced. Any certificate given under this subsection shall be recorded in the land records where the property is located, and sent to the Department of Public Service Department (PSD), within 30 days following sale of the property by the owner. A certificate that itemizes how the home does not comply with RBES is available from the PSD.
**R101.6 Authority having jurisdiction.**
In any instance where there is no state or local code official or other authority having jurisdiction, the PSD is not considered to be the “other authority having jurisdiction, where one exists,” and those sections of this code requiring involvement by that entity do not apply. All other code requirements still apply.

**R101.7 Base and Stretch Code.**
The “Base Code” is the RBES Energy Code that is applicable throughout Vermont, except for projects subject to 10 V.S.A. Chapter 151 (Act 250), and in any municipalities that have adopted the more stringent “Stretch Code.”

**R101.8 Compliance options.**
There are three thermal efficiency compliance options:

1. **Prescriptive Packages**
   - **Package Plus Points:** For the Base Code, Table R402.2.1 lists the options for insulation and fenestration packages. The accompanying 2015 Handbook includes alternative packages. Table R402.1.2.2 lists the additional points required for compliance based on building square footage, and Table R402.1.2.3 lists the components and respective point values to be used to meet the point requirement in Table R402.1.2.2. For the Stretch Code, Table R407.2.1.1 lists three options for insulation and fenestration packages. Table R407.42.1.2 lists the required additional points for compliance based on building square footage, and Table R407.2.1.3 lists the components and respective point values to be used to meet the point requirement in Table R407.2.1.2. The 2015 Handbook includes alternative packages in the accompanying 2015 Handbook.

2. **REScheck™**
   - The U.S. Department of Energy’s REScheck™ software.

3. **Home Energy Rating System (HERS):** A HERS energy rating that demonstrates compliance with Table Section 406.4 for the Base Code or Table Section 407.2.2 for the Stretch Code. (All HERS Index values in this code are based on REM/Rate version 1415.7.)

**SECTION R102**
**ALTERNATIVE MATERIALS, DESIGN AND METHODS OF CONSTRUCTION AND EQUIPMENT**

**R102.1 General.**
The provisions of this code are not intended to prevent the installation of any material, or to prohibit any design or method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the code official or other authority having jurisdiction, where one exists, as meeting the intent of this code. The code official or other authority having jurisdiction shall first find that the proposed design is satisfactory and complies with the intent of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, performance, fire resistance, durability and safety. Where the alternative material, design or method of construction is not approved, the code official or other authority having jurisdiction shall respond to the applicant, in writing, stating the reasons why the alternative was not approved.
R102.1.1 Above code programs.
The code official or other authority having jurisdiction, where one exists, shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy-efficiency program, official or authority shall be considered to be in compliance with this code. The requirements identified as “mandatory” in Chapter 4 shall be met.

PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION R103
CONSTRUCTION DOCUMENTS

R103.1 General.
Where required, construction documents, technical reports and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents and technical reports shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official or other authority having jurisdiction, where one exists, is authorized to require necessary construction documents to be prepared by a registered design professional.

Exception: The code official or other authority having jurisdiction, where one exists, is authorized to waive the requirements for construction documents or other supporting data if the code official or other authority having jurisdiction, where one exists, determines they are not necessary to confirm compliance with this code.

R103.2 Information on construction documents.
Where required, construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted where approved by the code official or other authority having jurisdiction, where one exists. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, the following as applicable:

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGC).
3. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
6. Equipment and system controls and control strategies.
7. Duct sealing, duct and pipe insulation and location.
8. Air sealing details.

R103.2.1 Building thermal envelope depiction.
The building's thermal envelope shall be represented on the construction documents.

R103.3 Examination of documents.
The code official or other authority having jurisdiction, where one exists, shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances. The code official or other authority having jurisdiction, where one exists, is authorized to utilize a registered design professional, or other approved entity not affiliated with the building design or construction, in conducting the review of the plans and specifications for compliance with the code. Compliance with this code shall be certified by a builder, licensed professional engineer, licensed architect, or an accredited home energy rating organization by completing, signing, and posting a Vermont Residential Building Energy Standards (RBES) Certificate. The person certifying shall provide a copy of the certificate to the Department of Public Service and shall assure that a certificate is recorded and indexed in the town land records.

R103.3.1 Approval of construction documents.
When the code official or other authority having jurisdiction, where one exists, issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped “Reviewed for Code Compliance.” Such approved construction documents shall not be changed, modified or altered without authorization from the code official or other authority having jurisdiction, where one exists. Work shall be done in accordance with the approved construction documents.

One set of construction documents so reviewed shall be retained by the code official or other authority having jurisdiction, where one exists. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the code official or other authority having jurisdiction, where one exists, or a duly authorized representative.

R103.3.2 Previous approvals.
This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

R103.3.3 Phased approval.
The code official or other authority having jurisdiction, where one exists, shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or approved, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

R103.4 Amended construction documents.
Work shall be installed in accordance with the approved construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.
R103.5 Retention of construction documents.
One set of approved construction documents shall be retained by the code official or other authority having jurisdiction, where one exists, for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

SECTION R104 INSPECTIONS

R104.1 General.
Where required, construction or work for which a permit is required shall be subject to inspection by the code official or other authority having jurisdiction, where one exists, or his or her designated agent, and such construction or work shall remain accessible and exposed for inspection purposes until approved. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material, product, system or building component required to allow inspection to validate compliance with this code.

R104.2 Required inspections.
The code official or other authority having jurisdiction, where one exists, or his or her designated agent, upon notification, may make the inspections set forth in Sections R104.2.1 through R104.2.4.

R104.2.1 Footing and foundation inspection.
Inspections associated with footings and foundations shall verify compliance with the code as to R-value, location, thickness, depth of burial and protection of insulation as required by the code and approved plans and specifications.

R104.2.2 Framing and rough-in inspection.
Inspections at framing and rough-in shall be made before application of interior finish and shall verify compliance with the code as to: types of insulation and corresponding R-values and their correct location and proper installation (both interior and exterior); fenestration properties such as U-factor and SHGC and proper installation; and air leakage controls as required by the code; and approved plans and specifications.

R104.2.3 Plumbing rough-in inspection.
Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection, and required controls.

R104.2.4 Mechanical rough-in inspection.
Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding R-value, system air leakage control, programmable thermostats, dampers, whole house ventilation, and minimum fan efficiency.
R104.3 **Required** approvals.
Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the code official or other authority having jurisdiction, where one exists. The code official or other authority having jurisdiction, where one exists, upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the code official or other authority having jurisdiction, where one exists.

R104.23.1 Final inspection.
The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the required number of high-efficacy lamps and fixtures.

R104.34 Reinspection.
A building shall be reinspected when determined necessary by the code official or other authority having jurisdiction, where one exists.

R104.45 Approved inspection agencies.
The code official or other authority having jurisdiction, where one exists, is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided such agencies are approved as to qualifications and reliability relevant to the building components and systems they are inspecting.

R104.56 Inspection requests.
It shall be the duty of the holder of the permit or their duly authorized agent to notify the code official or other authority having jurisdiction, where one exists, when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.

R104.67 Reinspection and testing.
Where any work or installation does not pass an initial test or inspection, the necessary corrections shall be made to achieve compliance with this code. The work or installation shall then be resubmitted to the code official or other authority having jurisdiction, where one exists, for inspection and testing.

R104.78 Approval.
After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the code official or other authority having jurisdiction, where one exists.

R104.78.1 Revocation.
The code official or other authority having jurisdiction, where one exists, is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the certificate is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise, or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.
SECTION R105
VALIDITY

R105.1 General.
If a portion of this code is held to be illegal or void, such a decision shall not affect the validity of the remainder of this code.

SECTION R106
REFERENCED STANDARDS

R106.1 Referenced codes and standards.
The codes and standards referenced in this code shall be those listed in Chapter 6, and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections R106.1.1 and R106.1.2.

R106.1.1 Conflicts.
Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

R106.1.2 Provisions in referenced codes and standards.
Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

R106.2 Application of references.
References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

R106.3 Other laws.
The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.
CHAPTER 2 [RE] DEFINITIONS

SECTION R201
GENERAL

R201.1 Scope.
Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

R201.2 Interchangeability.
Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

R201.3 Terms defined in other codes.
Terms that are not defined in this code but are defined in the International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code or the International Residential Code shall have the meanings ascribed to them in those codes.

R201.4 Terms not defined.
Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

SECTION R202
GENERAL DEFINITIONS

ABOVE-GRADE WALL. A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see “Readily accessible”).

ADDITION. An extension or increase in the conditioned space floor area, number of stories or height of a building or structure.

ADVANCED WOOD HEATING SYSTEM. A wood pellet fueled central heating system that meets the standards established by the Vermont Clean Energy Development Fund and Efficiency Vermont and is listed on the Eligible Equipment Inventory posted at http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei.

AIR BARRIER. An air barrier is a durable assembly that blocks air flow between conditioned space and unconditioned space through the building thermal envelope and its assemblies. Air barriers must be continuous, sealed at all joints, penetrations, and interruptions using durable sealants intended for such use and compatible with all adjacent materials, and able to resist pressures without displacement or damage.
**AIR-IMPERMEABLE INSULATION.** An insulation that also functions as an air barrier material, having an air permeance equal to or less than 0.02 L / s-m² at 75 Pa pressure differential as tested in accordance with ASTM E 2178 or E 283.

**ALTERATION.** Any construction, retrofit or renovation to an existing structure other than *repair* or *addition*. Also, a change in a building, electrical, gas, mechanical or plumbing system that involves an extension, addition or change to the arrangement, type or purpose of the original installation.

**ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE).** The ratio of annual output energy to annual input energy which includes any non-heating season pilot input loss, and for gas or oil-fired furnaces or boilers, does not include electrical energy.

**APPROVED.** Approval by the code official or other authority having jurisdiction, where one exists, as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

**APPROVED AGENCY.** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the code official or other authority having jurisdiction, where one exists.

**AUTOMATIC.** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see “Manual”).

**BALANCED VENTILATION SYSTEM.** See “Whole House Ventilation System, Balanced”.

**BASE CODE.** The standard RBES Energy Code, as distinct from the higher stringency Stretch Code.

**BASEMENT WALL.** A wall 50 percent or more below grade and enclosing conditioned space.

**BATHROOM.** A room containing a bathtub, shower, spa or similar bathing fixture.

**BEDROOM.** A room or space 70 square feet or greater, with egress window and closet, used or intended to be used for sleeping. A “den,” “library,” or “home office” with a closet, egress window, and 70 square feet or greater or other similar rooms shall count as a bedroom, but living rooms and foyers shall not. (Source: RESNET)

**BIODIESEL.** Mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751.

**BIOMASS.** The vegetation removed from the forest, usually logging slash, small-diameter trees, tops, limbs, or trees. This includes wood logs, wood pellets and wood chips.

**BTU.** Abbreviation for British thermal unit, which is the quantity of heat required to raise the temperature of 1 pound (0.454 kg) of water 1°F (0.56°C), (1 Btu = 1,055 J), or about the amount of energy in one wooden kitchen match burned end to end.
**BUILDER.** The general contractor or other person in charge of construction, who has the power to direct others with respect to the details to be observed in construction. (Source: VT 30 V.S.A. § 51)

**BUILDING.** Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

**BUILDING SITE.** A contiguous area of land that is under the ownership or control of one entity.

**BUILDING THERMAL ENVELOPE.** The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space. This boundary also includes the boundary between conditioned space and exempt or unconditioned space.

**CATEGORY I COMBUSTION APPLIANCE.** An appliance which operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY II COMBUSTION APPLIANCE.** An appliance which operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY III COMBUSTION APPLIANCE.** An appliance which operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent. (Source: NFPA 54)

**CATEGORY IV COMBUSTION APPLIANCE.** An appliance which operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent. (Source: NFPA 54)

**C-FACTOR (THERMAL CONDUCTANCE).** The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h · ft² · °F) [W/(m² · K)].

**CIRCULATING HOT WATER SYSTEM.** A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

**CLIMATE ZONE.** A geographical region based on climatic criteria as specified in this code.

**CODE OFFICIAL, VERMONT.** The officer or other designated authority charged with the administration and enforcement of this energy code, or a duly authorized representative. The Department of Public Service Department is not the code official and shall not be required to conduct inspections of construction or construction documents.

**COEFFICIENT OF PERFORMANCE (COP)—COOLING.** The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory-assembled equipment, as tested under a nationally recognized standard or designated operating conditions.
COEFFICIENT OF PERFORMANCE (COP)—HEAT PUMP—HEATING. The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions. Supplemental heat shall not be considered when checking compliance with the heat pump equipment.

COLD-CLIMATE HEAT PUMP. An air-source heat pump with an inverter-driven, variable capacity compressor that is designed to provide full heating heat pump capacity and having a minimum COP of 1.75 or greater at an outside air temperature of 5°F.

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of “Residential building,” excluding mobile homes.

COMMERCIAL BUILDING ENERGY STANDARDS (CBES). The Vermont non-residential Energy Code, based on the IECC 2015.

CONDENSER. A heat exchanger designed to liquefy refrigerant vapor by removal of heat.

CONDENSING UNIT. A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the conditioned space. See also Finished Conditioned Floor Area.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling. See also Finished Conditioned Floor Area.

CONSTRUCTION DOCUMENTS. The physical drawings and specifications that outline the building.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

CRAWL SPACE WALL. The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

CUBIC FEET PER MINUTE (CFM). The quantity of air moved in 1 minute. A measurement typically applied to ventilation equipment.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DAYLIGHT ZONE.
1. **Under skylights.** The area under skylights whose horizontal dimension, in each direction, is equal to the sky-light dimension in that direction plus either the floor-to-ceiling height or the dimension to a ceiling height opaque partition, or one-half the distance to adjacent skylights or vertical fenestration, whichever is least.

2. **Adjacent to vertical fenestration.** The area adjacent to vertical fenestration which receives daylight through the fenestration. For purposes of this definition and unless more detailed analysis is provided, the daylight zone depth is assumed to extend into the space a distance of 15 feet (4572 mm) or to the nearest ceiling height opaque partition, whichever is less. The daylight zone width is assumed to be the width of the window plus 2 feet (610 mm) on each side, or the window width plus the distance to an opaque partition, or the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

**DEADBAND.** The temperature range in which no heating or cooling is used.

**DEGREE DAY, COOLING.** A unit, based on temperature difference and time, used in estimating cooling energy consumption and specifying nominal cooling load of a building in summer. For any one day, when the mean temperature is more than 65°F, there are as many degree days as there are degrees Fahrenheit difference in temperature between the mean temperature for the day and 65°F. Annual cooling degree days (CDD) are the sum of the degree days over a calendar year.

**DEGREE DAY, HEATING.** A unit, based upon temperature difference and time, used in estimating heating energy consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F, there are as many degree days as there are degrees Fahrenheit difference in temperature between the mean temperature for the day and 65°F. Annual heating degree days are the sum of the degree days over a calendar year.

**DEMAND CONTROL VENTILATION (DCV).** A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

**DEMAND RECIRCULATION WATER SYSTEM.** A water distribution system where having one or more recirculation pumps that pump(s) prime the service hot water piping with from a heated water supply pipe back to the heated water fixture upon user demand for hot water via push-button at the fixture.

**DIRECT-VENT APPLIANCES.** Appliances that are constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere. See also Sealed Combustion Venting System.

**DUCT.** A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

**DUCT SYSTEM.** A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.
**Dwelling Unit.** A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

**Dynamic Glazing.** Any fenestration product that has the fully reversible ability to change its performance properties, including U-factor, solar heat gain coefficient (SHGC), or visible transmittance (VT).

**Economizer, Air.** A duct and damper arrangement and automatic control system that allows a cooling system to supply outside air to reduce or eliminate the need for mechanical cooling during mild or cold weather.

**Economizer, Water.** A system where the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling.

**Electric Vehicle Supply Equipment (EVSE).** Electrical infrastructure for charging electric vehicles. EVSE can be either Level 1 (120 V) or Level 2 (240 V).

**Energy Analysis.** A method for estimating the annual energy use of the proposed design and standard reference design based on estimates of energy use.

**Energy Cost.** The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

**Energy Efficiency Ratio (EER).** The ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When consistent units are used, this ratio becomes equal to COP (see also “Coefficient of performance”).

**Energy Recovery Ventilation System (ERV).** Systems that employ air-to-air heat exchangers to recover sensible and latent energy from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

**Energy Simulation Tool.** An approved software program or calculation-based methodology that projects the annual energy use of a building.

**Entrance Door.** Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware and automatic closers and contain over 50-percent glass specifically designed to withstand heavy use and possibly abuse.

**ERI Reference Design.** A version of the rated design that meets the minimum requirements of the 2006 International Energy Conservation Code.

**Evaporator.** That part of the system in which liquid refrigerant is vaporized to produce refrigeration.

**Exterior Envelope.** See “Building Thermal Envelope.”

**Exterior Wall.** Walls that are part of the Building Thermal Envelope, including both above-grade walls and basement walls.
FAN BRAKE HORSEPOWER (BHP). The horsepower delivered to the fan’s shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

FAN SYSTEM BHP. The sum of the fan brake horsepower 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 space(s) and return it to the source or exhaust it to the outdoors.

FAN SYSTEM DESIGN CONDITIONS. Operating conditions that can be expected to occur during normal system operation that result in the highest supply fan airflow rate to conditioned spaces served by the system.

FAN SYSTEM MOTOR NAMEPLATE HP. The sum of the motor nameplate horsepower of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

FENESTRATION. Products classified as either vertical fenestration or skylights.

FENESTRATION PRODUCT, SITE-BUILT. A fenestration designed to be made up of field-glazed or field-assembled units using specific factory cut or otherwise factory-formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls and atrium roof systems.

F-FACTOR. The perimeter heat loss factor for slab-on-grade floors (Btu/h · ft · °F) [W/(m · K)].

FINISHED AREA. An enclosed area in a house that is suitable for year-round use, embodying walls, floors, and ceilings that are similar to the rest of the house.

FINISHED CONDITIONED FLOOR AREA (FCFA). The floor area in square feet of a home that is within the conditioned space of the building, and also is finished area, as measured in accordance with ANSI Standard Z765-2003 (with the exception that floor areas with ceiling heights of less than 5 feet will be included in finished square footage).

FURNACE DUCT. A furnace normally installed in distribution ducts of air-conditioning systems to supply warm air for heating and which depends on a blower not furnished as part of the duct furnace for air circulation.

FURNACE, WARM AIR. A self-contained, indirect-fired or electrically heated furnace that supplies heated air through ducts to spaces that require it.

GROSS AREA OF EXTERIOR WALLS. The normal projection of all exterior walls, including the area of all windows and doors installed therein (see “Exterior wall”).

GROUND SOURCE HEAT PUMP. A heat pump that extracts heat from the ground or water within the ground.

HEAT. The form of energy that is transferred by virtue of a temperature difference or a change in state of a material.
HEAT CAPACITY (HC). The amount of heat necessary to raise the temperature of a given mass by 1°F (0.6°C). The heat capacity of a building element is the sum of the heat capacities of each of its components.

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.

HEAT RECOVERY VENTILATION SYSTEM (HRV). A factory-assembled device or combination of devices, including fans or blowers, designed to provide outdoor air for ventilation in which heat or heat and moisture is transferred between two isolated intake and exhaust air streams.

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosyphoning of hot water during standby periods.

HEATED SLAB. Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

HEATING SEASONAL PERFORMANCE FACTOR (HSPF). The total heating output of a heat pump during its normal annual usage period for heating, in Btus, divided by the total electric energy input during the same period, in watt hours, as determined by DOE 10 CFR Part 430, Subpart B, Test Procedures, and based on Region 4.

HEAT PUMP WATER HEATER. A water heater that uses electricity and a refrigeration cycle to move heat from the ambient air to heat water instead of directly heating water.

HIGH-EFFICACY LAMPS/ LIGHTING. Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 not less than 65 lumens per watt for lamps over 40 watts;
2. 50; or light fixtures of not less than 55 lumens per watt for. In determining the number or percent of lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less, each replaceable lamp (or light string) connected to a permanently installed lighting fixture shall count as one lamp.

HISTORIC BUILDING. Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.
HOME ENERGY RATING SYSTEM (HERS). A home energy rating system accreditedapproved by the Vermont Department of Public Service Department that provides a numerical rating in compliance with 30 V.S.A. § 52. The purpose of this procedure is to ensure that accurate and consistent home energy ratings are performed by accredited HERS providers in Vermont and to promote an objective, cost-effective, sustainable home energy rating process as a compliance method for residential building energy codes; as qualification for energy programs designed to reach specific energy-saving goals; and as a way to provide Vermont’s housing market the ability to differentiate residences based on their energy efficiency.

HUMIDISTAT. A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

HVAC. Heating, ventilating and air conditioning.

HVAC SYSTEM. The equipment, distribution network and terminals that provide either collectively or individually the processes of heating, ventilating or air conditioning to a building.

HVAC SYSTEM COMPONENTS. HVAC system components provide, in one or more factory-assembled packages, means for chilling or heating water, or both, with controlled temperature for delivery to terminal units serving the conditioned spaces of the building. Types of HVAC system components include, but are not limited to, water chiller packages, reciprocating condensing units and water source (hydronic) heat pumps (see “HVAC system equipment”).

HVAC SYSTEM EQUIPMENT. HVAC system equipment provides, in one (single package) or more (split system) factory-assembled packages, means for air circulation, air cleaning, air cooling with controlled temperature and dehumidification and, optionally, either alone or in combination with a heating plant, the functions of heating and humidifying. The cooling function is either electrically or heat operated and the refrigerant condenser is air, water or evaporatively cooled. Where the equipment is provided in more than one package, the separate packages shall be designed by the manufacturer to be used together. The equipment shall be permitted to provide the heating function as a heat pump or by the use of electric or fossil-fuel-fired elements. (The word “equipment” used without a modifying adjective, in accordance with common industry usage, applies either to HVAC system equipment or HVAC system components.)

HUNTING CAMP. A seasonal building used as a temporary residence only during hunting season.

INFILTRATION. The uncontrolled inward air leakage into a building through the building thermal envelope caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

INSULATED SIDING. A type of continuous insulation with manufacturer-installed insulating material as an integral part of the cladding product having a minimum R-value of R-2.

INSULATING SHEATHING. An insulating board with a core material having a minimum R-value of R-2.

LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the
production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

**LEVEL 1 ELECTRIC VEHICLE CHARGING.** Level 1 charging uses a standard alternating current 120V outlet.

**LEVEL 2 ELECTRIC VEHICLE CHARGING.** Level 2 uses a 240V AC charging alternating current outlet.

**LIGHTING.** See “High-Efficacy Lamps/Lighting.”

**LISTED.** Equipment, materials, products or services included in a list published by an organization acceptable to the code official or other authority having jurisdiction, where one exists, and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and where the listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

**LOCAL VENTILATION.** A mechanical ventilation system including fans, controls and ducts, dedicated to exhausting moisture-laden and/or contaminated air to the outside of the building from a room or space in which the moisture or contamination is generated or supplying outdoor air to that space.

**LOW-VOLTAGE LIGHTING.** Lighting equipment powered through a transformer such as a cable conductor, a rail conductor and track lighting.

**MANUAL.** Capable of being operated by personal intervention (see “Automatic”).

**MECHANICAL VENTILATION.** The mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space by powered fans. For purposes of this standard, mechanical ventilation does not include processes driven by wind, such as turbine ventilators.

**MIXED-USE.** With respect to a structure that is three stories or less in height and is a mixed-use building that shares residential and commercial users, the term “residential building” shall include the living spaces in the structure and the nonliving spaces in the structure that serve only the residential users such as common hallways, laundry facilities, residential management offices, community rooms, storage rooms, and foyers. (From Vermont 30 V.S.A. § 51.)

**MULTIFAMILY DWELLING.** A building containing three or more dwelling units/Building. For the purpose of determining the building type that must comply with RBES under Vermont statute, a multifamily building is a residential building or mixed use building with three or more dwelling units, three stories or less in height. Multifamily buildings of four stories or more in height must comply with CBES.

(From Vermont 30 V.S.A. § 51.) See R101.2 for scope. For the purpose of determining points in R402.1.2, a multifamily dwelling is a residential building containing units built one on top of another and those built side-by-side which do not have a ground-to-roof wall and/or have common facilities (i.e., attic, basement, heating plant, plumbing, etc.) (From www.census.gov).
NAMEPLATE HORSEPOWER. The nominal motor horsepower rating stamped on the motor nameplate.

OCCUPANCY. The purpose for which a building, or portion thereof, is utilized or occupied.

OCCUPANCY CLASSIFICATIONS. Residential Group R is the occupancy group used for buildings that include sleeping rooms and are not institutional and are not generally regulated by the International Residential Code. The IRC typically regulates single family homes and duplexes, any structure with more than two units is in the International Building Code (IBC). There are four different occupancy groups within R.

The first occupancy group is R-1. This group is for transient uses like hotels, motels and boarding houses.

The next group is R-2. R-2 is the group we see most often and it is common residences where occupants are primarily permanent. This includes apartments, dormitories, fraternities and sororities. It also includes vacation timeshares and convents and monasteries. Congregate living facilities with 16 or fewer occupants go into Group R-3.

Occupancy group R-3 is for permanent occupancies that aren’t R-1, R-2, R-4 or I. These include buildings that are in the IBC but have no more than two units. Adult facilities and child care facilities that provide accommodation for five or less people less than 24 hours a day are R-3. Where these facilities are in a single family home they must comply with the IRC.

Occupancy group R-4 is for residential care/assisted living facilities including more than five and not more than 16 occupants.

OPAQUE AREAS. All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems. Doors are considered opaque when they are 50-percent or greater opaque in surface area.

OUTDOOR AIR. Air taken from the outdoors and, therefore, not previously circulated through the building.

OWNER BUILDER. If all of the following apply:

(A) The owner of the residential construction is the builder, as defined under this chapter.

(B) The residential construction is used as a dwelling by the owner.

(C) The owner in fact directs the details of construction with regard to the installation of materials not in compliance with RBES.

(D) The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with RBES. Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES, and shall itemize which measures do not meet the RBES standards in effect at the time construction.
commenced. Any certificate shall be recorded in the land records where the property is located, and sent to the Department of Public Service, within 30 days following sale of the property by the owner.

PACKAGED TERMINAL AIR CONDITIONER (PTAC). A factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies or sections (intended for mounting through the wall to serve a single room or zone). It includes heating capability by hot water, steam or electricity. (For the complete technical definition, see ARI 310/380.)

PACKAGED TERMINAL HEAT PUMP. A PTAC capable of using the refrigeration system in a reverse cycle or heat pump mode to provide heat. (For the complete technical definition, see ARI 310/380.)

POSITIVE COOLING SUPPLY. Mechanical cooling deliberately supplied to a space, such as through a supply register.

Additionally, mechanical cooling indirectly supplied to a space through uninsulated surfaces of space-cooling components, such as evaporator coil cases and cooling distribution systems which continually maintain air temperatures within the space of 85°F (29°C) or lower during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of this code.

POSITIVE HEAT SUPPLY. Heat deliberately supplied to a space by design, such as a supply register, radiator or heating element. Additionally, heat indirectly supplied to a space through uninsulated surfaces of service water heaters and space-heating components, such as furnaces, boilers and heating and cooling distribution systems which continually maintain air temperature within the space of 50°F (10°C) or higher during normal operation. To be considered exempt from inclusion in this definition, such surfaces shall comply with the insulation requirements of this code.

POWER-VENTED APPLIANCE. Appliances that operate with a positive vent static pressure (Category III) and utilize a mechanical fan to exhaust combustion gases from the appliance to the outside atmosphere.

PRIMARY SHOWERS. The one or two showers in the dwelling that will be used the most.

PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

RATED CAPACITY. In terms of ventilation, the volume of air (in cfm) that the fan can move against a given static pressure (in inches or water gage). Prescriptive compliance with the Vermont Residential Building Energy Standards requires that all fan capacities be rated at 0.1 inch (25 Pa) of water gage.

RATED DESIGN. A description of the proposed building used to determine the energy rating index.

RBES. Vermont Residential Building Energy Standards.
READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see “Accessible”).

REFRIGERANT. A substance utilized to produce refrigeration by its expansion or vaporization or absorption.

RENEWABLE ENERGY SOURCES. Means energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to solar hot water, solar hot air, solar photovoltaics, wind, and hydro.

(A) Methane gas and other flammable gases produced by the decay of sewage treatment plant wastes or landfill wastes and anaerobic digestion of agricultural products, byproducts, or wastes shall be considered renewable energy resources, but no form of solid waste, other than agricultural or silvicultural waste, shall be considered renewable.

(B) The only portion of electricity produced by a system of generating resources that shall be considered renewable is that portion generated by a technology that qualifies as renewable.

(C) Technologies using the following fuels shall not be considered renewable energy sources: coal, oil, propane, and natural gas.

(D) Biomass is considered renewable.

(E) Biodiesel is considered renewable.

REPAIR. The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

REROOFING. The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings, multifamily housing and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane. (See “Occupancy Classifications”).

ROOF ASSEMBLY. A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering, an air barrier, insulation, and structural components. A roof assembly includes the roof covering, underlayment, roof deck, insulation, air barrier, vapor retarder and interior finish. The gross area of a roof assembly consists of the total interior surface of all roof/ceiling components, including opaque surfaces, dormer and bay window roofs, trayed ceilings, overhead portions of an interior stairway to an unconditioned attic, doors and hatches, glazing and skylights exposed to conditioned space, that are horizontal or sloped at an angle less than 60 degrees (1.1 rad) from the horizontal (see “Exterior wall”). A roof assembly that is part of the thermal envelope, or portions thereof, having a slope of 60 degrees (1.1 rad) or greater from horizontal shall be considered in the gross area of exterior walls.
and thereby excluded from consideration in the roof assembly. Skylight shaft walls 12 inches (305 mm) in depth or greater (as measured from the ceiling plane to the roof deck) shall be considered in the gross area of exterior walls and are thereby excluded from consideration in the roof assembly.

**ROOF RECOVER.** The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

**ROOF REPAIR.** Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

**ROOF REPLACEMENT.** The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

**ROOM AIR CONDITIONER.** An encased assembly designed as a unit for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and shall be permitted to also include means for ventilating and heating.

**R-VALUE (THERMAL RESISTANCE).** The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \cdot ft^2 \cdot °F/Btu$) [(m$^2 \cdot K)/W].

**SASH CRACK.** The sum of all perimeters of all window sashes, based on overall dimensions of such parts, expressed in feet. If a portion of one sash perimeter overlaps a portion of another sash perimeter, only count the length of the overlapping portions once.

**SCREW LAMP HOLDERS.** A lamp base that requires a screw-in-type lamp, such as a compact-fluorescent, incandescent, or tungsten-halogen bulb.

**SEALED COMBUSTION VENTING SYSTEM.** A venting system designed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere. (See also “Direct-vent Appliances.”)

**SEASONAL ENERGY EFFICIENCY RATIO (SEER).** The total cooling output of an air conditioner during its normal annual usage period for cooling, in Btu/h, divided by the total electric energy input during the same period, in watt-hours, as determined by DOE 10 CFR Part 430, Subpart B, Test Procedures.

**SENSIBLE RECOVERY EFFICIENCY (SRE):** The net sensible energy recovered by the supply airstream as adjusted by electric consumption, case heat loss or heat gain, air leakage, airflow mass imbalance between the two airstreams and the energy used for defrost (when running the Very Low Temperature Test), as a percent of the potential sensible energy that could be recovered plus the exhaust fan energy.

**SERVICE SYSTEMS.** All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering and similar functions.

**SERVICE WATER HEATING.** Supply of hot water for purposes other than comfort heating.
SKYLIGHT. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal.

SINGLE-FAMILY DWELLING. Fully detached, semidetached (semiattached, side-by-side), row houses, and townhouses. In the case of attached units, each must be separated from the adjacent unit by a ground-to-roof wall in order to be classified as a single-family structure. Also, these units must not share heating/air-conditioning systems or utilities. (From www.census.gov).

SIMULATION TOOL. An approved software program or calculation-based methodology that projects the hour-by-hour loads and annual energy use of a building.

SLAB-ON-GRADE EDGE INSULATION. Insulation around, or underneath, the perimeter of the floor slab when the top edge of the floor perimeter slab is above the finished grade or 12 inches (305 mm) or less below the finished grade.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

SOLAR ENERGY SOURCE. Source of natural daylighting and of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation that is then reradiated, conducted or convected into the space.

SONE. A subjective unit of loudness for an average listener equal to the loudness of a 1,000-hertz (cycles per second) sound that has an intensity 40 decibels above the listener’s own threshold of hearing.

STANDARD REFERENCE DESIGN. A version of the proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

STANDARD TRUSS. Any construction that does not permit the roof/ceiling insulation to achieve the required R-value over the exterior walls.

STOREFRONT. A nonresidential system of doors and windows mulled as a composite fenestration structure that has been designed to resist withstand heavy use. Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.

STRETCH CODE. A building energy code that achieves greater energy savings than the base RBES. The Stretch Code is required for Act 250 projects and may be adopted by municipalities.

SUMMER CAMPS. Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.
SUNROOM. A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure’s exterior walls and roof.

SYSTEM. A combination of central or terminal equipment or components or controls, accessories, interconnecting means and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, service water heating or illumination.

THERMAL CONDUCTANCE, OVERALL ($U_o$). The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/h · ft$^2$ · °F) [W/(m$^2$ · K)].

The $U_o$-factor applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.

THERMAL ISOLATION. Physical and space conditioning separation from between conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

THERMAL RESISTANCE (R). The reciprocal of thermal conductance (h · ft$^2$ · °F/Btu) [(m$^2$ · K)/W].

THERMAL RESISTANCE, OVERALL ($R_o$). The reciprocal of overall thermal conductance (h · ft$^2$ · °F/Btu) [(m$^2$ · K)/W]. The overall thermal resistance of the gross area or individual component of the exterior building envelope (such as roof/ceiling, exterior wall, floor, crawl space wall, foundation, window, skylight, door, opaque wall, etc.), which includes the area-weighted R-values of the specific component assemblies (such as air film, insulation, drywall, framing, glazing, etc.).

THERMAL TRANSMITTANCE (U). The coefficient of heat transmission (air to air). It is the time rate of heat flow per unit area and unit temperature difference between the warm-side and cold-side air films (Btu/hr · ft$^2$ · °F) [W/(m$^2$ · K)]. (See thermal conductance).

The $U$-factor applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity airspaces and surface air films on both sides of a building element.

THERMAL TRANSMITTANCE, OVERALL ($U_o$). The overall (average) heat transmission of a gross area of the exterior building envelope (Btu/h · ft$^2$ · °F) [W/(m$^2$ · K)].

The $U_o$-factor applies to the combined effect of the time rate of heat flow through the various parallel paths, such as windows, doors and opaque construction areas, comprising the gross area of one or more exterior building components, such as walls, floors or roof/ceilings.
THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

TOILET ROOM. A room containing a water closet and, frequently, a lavatory, but not a bathtub, shower, spa or similar bathing fixture.

U-FACTOR (THERMAL TRANSMITTANCECONDUCTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h • ft² • °F) [W/(m² • K)].

UNITARY COOLING AND HEATING EQUIPMENT. One or more factory-made assemblies which include an evaporator or cooling coil, a compressor and condenser combination, and which shall be permitted to include a heating function as well. When heating and cooling equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

UNITARY HEAT PUMP. One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. When heat pump equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

UNUSUALLY TIGHT CONSTRUCTION. Construction meeting the following requirements:

1. Storm windows or weatherstripping on openable windows and doors; and

2. Caulking or sealants applied to areas, such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, at penetrations for plumbing, electrical and gas lines, and at other openings.

3. Buildings constructed in compliance with the RBES shall be considered built of unusually tight construction.

VAPOR PERMEABLE MEMBRANE. A material or covering having a permeance rating of 5-perms (2.9 · 1040 kg/Pa · s · m²) or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E96. A vapor permeable material permits the passage of moisture vapor.

RETARDER. A vapor-resistant material, membrane or covering such as foil, plastic sheeting or insulation facing with a permeance rating of less than 10. Vapor retarders limit the amount of moisture vapor that passes through a material or wall assembly.
**VAPOR RETARDER CLASS.** A measure of the ability of a material or assembly to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be based on the manufacturer’s certified testing of a tested assembly and defined using the desiccant method with Procedure A of ASTM E96 as follows:

**VAPOR Class 1:** 0.1 perm or less, such as sheet polyethylene, unperforated aluminum foil.

**Class 2:** 0.1 < perm < 1.0 perm, such as kraft-faced fiberglass batts.

**Class 3:** 1.0 < perm < 10 perm, such as latex or enamel paint.

### RETARDER CLASSES AND EXAMPLES

<table>
<thead>
<tr>
<th>Vapor Retarder Class¹</th>
<th>Perm Rating (Dry Cup)</th>
<th>Description</th>
<th>Examples of Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class I</strong></td>
<td>0.1 perm or less</td>
<td>Vapor impermeable or &quot;Vapor Barrier&quot;</td>
<td>Rubber membrane, sheet polyethylene, glass, foils</td>
</tr>
<tr>
<td><strong>Class II</strong></td>
<td>0.1 – 1.0 perm</td>
<td>Vapor semi-impermeable</td>
<td>Oil-based paint, Kraft-faced batt, vinyl wall coverings, stucco</td>
</tr>
<tr>
<td><strong>Class III</strong></td>
<td>1.0 – 10 perm</td>
<td>Vapor semi-permeable</td>
<td>Plywood, OSB, EPS, XPS, most latex paints, heavy asphalt-impregnated building paper, wood board sheathing</td>
</tr>
<tr>
<td><strong>Vapor open</strong></td>
<td>&gt; 10 perm</td>
<td>Vapor permeable</td>
<td>Unpainted gypsum board, unfaced fiberglass, cellulose, many &quot;housewraps&quot;</td>
</tr>
</tbody>
</table>

¹ Test Procedure for vapor retarders: ASTM E-96 Test Method A (the desiccant method or dry cup method)
VENTING SYSTEM. A continuous open passageway from the flue collar or draft hood of a solid fuel, gas-burning, kerosene or oil-burning appliance to the outside atmosphere for the purpose of removing flue or vent gases. A venting system is usually composed of a vent or a chimney and vent connector, if used, assembled to form the open passageway.

Mechanical draft venting system. A venting system designed to remove flue or vent gases by mechanical means, that consists of an induced draft portion under nonpositive static pressure or a forced draft portion under positive static pressure.

1. Forced-draft or power venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under positive static vent pressure.

2. Induced draft venting system. A portion of a venting system using a fan or other mechanical means to cause the removal of flue or vent gases under nonpositive static vent pressure.

Natural draft venting system. A venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.

Sealed combustion venting system. A venting system designed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged directly to the outside atmosphere.

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

VERTICAL FENESTRATION. Windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of a least 60 degrees (1.05 rad) from horizontal.

VISIBLE TRANSMITTANCE [VT]. The ratio of visible light entering the space through the fenestration product assembly to the incident visible light, Visible Transmittance, includes the effects of glazing material and frame and is expressed as a number between 0 and 1.

WHOLE HOUSE MECHANICAL VENTILATION SYSTEM. An exhaust system, supply system, or combination thereof that is designed to mechanically exchange indoor air with outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rates requirements.

WHOLE HOUSE VENTILATION SYSTEM, BALANCED. Balanced systems provide outdoor air for ventilation such that supply and exhaust air quantities are of equal capacity to achieve pressure equalization, such as heat recovery ventilator, an air-to-air heat exchanger or any other system that is designed to provide mechanical supply as well as mechanical exhaust.
WHOLE HOUSE VENTILATION SYSTEM, EXHAUST ONLY. Exhaust only systems exhaust stale indoor air via a single fan, multiple fans or the installation of dual-purpose fans (i.e., serving both localized and whole house ventilation functions). Fresh incoming air may be provided by installed inlet ports or from typical leaks in the building envelope. Exhaust only systems may depressurize the indoor environment.

WHOLE HOUSE VENTILATION SYSTEM, MULTI-PORT. A whole house ventilation system that has more than one exhaust or supply port inside the house.

WHOLE HOUSE VENTILATION SYSTEM, SINGLE-PORT. A whole house ventilation system that has only one connection to the conditioned space and one connection to outdoor air.

WINDOW PROJECTION FACTOR. A measure of the portion of glazing that is shaded by an eave or overhang.

YURT. A circular tent on a wooden framework used as a residential building.

ZONE. A space or group of spaces within a building’s thermal envelope with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.
CHAPTER 3 [RE]
GENERAL REQUIREMENTS

SECTION R301
[RESERVED]

SECTION R302
DESIGN CONDITIONS

R302.1 Interior design conditions.
The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

R302.2 Exterior design conditions.
R302.2 Climatic data.
The following design parameters in Table 302.2 shall be used for calculations required under this code.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter, Design Dry-Bulb</td>
<td>-11°F</td>
</tr>
<tr>
<td>Summer, Design Dry-Bulb</td>
<td>84°F</td>
</tr>
<tr>
<td>Summer, Design Wet Bulb</td>
<td>69°F</td>
</tr>
<tr>
<td>Degree Days Heating</td>
<td>7,771665</td>
</tr>
<tr>
<td>Degree Days Cooling</td>
<td>2,228489</td>
</tr>
</tbody>
</table>

For SI: °C = [(°F) - 32]/1.8.

a. The outdoor design temperature is selected from the columns of \( \frac{97}{2} \) percent values for winter and \( \frac{1}{2} \) percent values for summer from tables in the ASHRAE Handbook of Fundamentals. Adjustments shall be permitted to reflect local climates which differ from the tabulated temperatures, or local weather experience determined by the code official or other authority having jurisdiction, where one exists.

b. The degree days heating (base 65°F) and cooling (base 65°F) shall be selected from the NOAA “Annual Degree Days to Selected Bases Derived from the 1971-2000 Normals,” the ASHRAE Handbook of Fundamentals, data available from adjacent military installations or other sources of local weather data, acceptable to the code official or other authority having jurisdiction, where one exists for Burlington International Airport.
Adjustments may be made only in the following cases:

1. Winter heating design temperatures for projects either:
   i. Located at an elevation of 1,500 feet or higher, or
   ii. Located in Caledonia, Essex or Orleans counties.
   iii. Adjustments shall be made as listed in the National Climate Data Center for the specific weather station: http://www.ncdc.noaa.gov/cdo-web/.

2. As approved by the code official or other authority having jurisdiction.

SECTION R303
MATERIALS, SYSTEMS AND EQUIPMENT

R303.1 Identification.
Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

R303.1.1 Building thermal envelope insulation.
An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and R-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and R-value of installed thickness shall be listed on the certification. For insulated siding, the R-value shall be labeled on the product’s package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

R303.1.1.1 Blown or sprayed roof/and ceiling insulation.
The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam minimum thickness and installed R-value shall be listed on certification provided by the insulation installer.

R303.1.2 Insulation mark installation.
Insulating materials shall be installed such that the manufacturer’s R-value mark is readily observable upon inspection.
R303.1.3 Fenestration product rating.
U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

Exception: Where required, garage door U-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

-U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

-Products lacking such a labeled U-factor shall be assigned a default U-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

### TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION WINDOW, GLASS DOOR AND SKYLIGHT U-FACTORS

<table>
<thead>
<tr>
<th>FRAME TYPE</th>
<th>SINGLEpane WINDOW AND GLASS DOOR</th>
<th>SKYLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single pane</td>
<td>Double pane</td>
</tr>
<tr>
<td>Metal-</td>
<td>1.20-</td>
<td>0.80-</td>
</tr>
<tr>
<td>Metal with Thermal Break-</td>
<td>1.10-</td>
<td>0.65-</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad-</td>
<td>0.95-</td>
<td>0.55-</td>
</tr>
<tr>
<td>Glazed Block-</td>
<td></td>
<td>0.60-</td>
</tr>
</tbody>
</table>

### TABLE R303.1.3(2)
DEFAULT OPAQUE DOOR U-FACTORS

<table>
<thead>
<tr>
<th>DOOR TYPE</th>
<th>OPAQUE U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninsulated Metal-</td>
<td>1.20-</td>
</tr>
<tr>
<td>Insulated Metal-</td>
<td>0.60-</td>
</tr>
<tr>
<td>Wood-</td>
<td>0.50-</td>
</tr>
<tr>
<td>Insulated, nonmetal edge, max 45%. glazing, any glazing double pane-</td>
<td>0.35-</td>
</tr>
</tbody>
</table>

### TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

<table>
<thead>
<tr>
<th>SINGLE GLAZED.</th>
<th>DOUBLE GLAZED.</th>
<th>GLAZED BLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinted.</td>
<td>Tinted.</td>
<td></td>
</tr>
</tbody>
</table>
R303.1.4 Insulation product rating.
The thermal resistance (R-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission R-value rule (Part 460 of US-FTC CFR Title 16, Part 460) in units of h • ft² • °F/Btu at a mean temperature of 75°F (24°C).

R303.1.4.1 Insulated siding.
The thermal resistance (R-value) of insulated siding shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer’s instructions.

R303.2 Installation.
Materials, systems and equipment shall be installed in accordance with the manufacturer’s instructions and the International Building Code or the International Residential Code, as applicable.

R303.2.1 Protection of exposed foundation insulation.
Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation’s thermal performance. The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below grade.

R303.3 Maintenance information.
Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

SECTION R304
DESIGN CRITERIA FOR RESIDENTIAL VENTILATION SYSTEMS

304R304.1 Scope.
This section shall govern ventilation of the dwelling unit(s) within Type R-1 residential buildings, Type R-2 residential buildings and multiple single-family attached dwellings (townhouses) not more than three stories in height.

304R304.1.1 Compliance.
Compliance with Section 304 shall be achieved by meeting Section R304.2 and through R304.311 or demonstrating compliance with one of the following alternatives:
1. ASHRAE Standard 62.2-2013 (Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings)
2. BSC Standard 01-2015 (Ventilation for New Low-Rise Residential Buildings)
3. Passive house ventilation requirements (PHI or PHIUS)

Exception
Whole house balanced ventilation systems that are controlled using user-settable closed-loop feedback based on pollutant levels (e.g. carbon dioxide or volatile organic compounds) are not subject to run-time ventilation rate minimums in standards referenced above, or Section R304.6.1.1.

R304.2 Local ventilation.
BathroomsVentilation fans in bathrooms containing a bathtub, shower, spa or similar bathing fixture and not included in the whole house ventilation system shall be sized to meet the net capacity rates as required in Table 304.2. Whole house ventilation fans serving both localized and whole house ventilation functions shall be sized to meet the net capacity rates as required by Section 304.6 and must meet all other requirements listed in Section 304.3, as applicable.

### TABLE 304.2
MINIMUM REQUIRED LOCAL EXHAUST

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>MECHANICAL EXHAUST CAPACITY (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathrooms</td>
<td>50 cfm intermittent or 20 cfm continuous</td>
</tr>
</tbody>
</table>

304R304.3 Whole house ventilation (MANDATORY).
Every home and dwelling unit built to RBES shall be mechanically ventilated by a whole house ventilation system as defined in Chapter 2. The whole house ventilation system shall be one of two types: “exhaust only” or “balanced.”

304R304.4 Whole house air circulation.
Provisions shall be made to allow air flow to all finished living spaces by installation of distribution ducts, undercutting doors, installation of grilles, transoms or equivalent means. Door undercuts shall be at least ½ inch (12.7 mm) above the surface of the finished floor covering.

304R304.5 Fan motor requirements.
Fans installed for the purpose of providing whole house ventilation must meet the minimum requirements as specified in this section.

**Exception:** Fans installed exclusively for local ventilation purposes are exempt from meeting the fan motor requirements listed in Section R304.5.

304R304.5.1 Fan durability. Whole house ventilation fan motors shall be rated for “continuous duty” and have manufacturer flow ratings as listed in HVI 911.

304R304.5.2 Fan power consumption.
Single-port whole house ventilation equipment shall not exceed 50 watts as listed by the manufacturer on the fan motor or as listed in accordance with HVI 911. Power used for lights, sensors, heaters, timers or night lights shall not be included in the determination of power consumption.

304R304.5.3 Fan noise.
Whole house ventilation equipment located less than 4 feet (1219 mm) from louvers, grilles or openings shall have a sound rating no greater than 1.5 sones as determined in accordance with HVI 911.
**304R304.5.4 Performance verification.**

In-field measurements of exhaust fan flows shall be conducted using a manufactured flow-measuring device in accordance with the manufacturer’s instructions. Acceptable devices include a calibrated orifice combined with a digital manometer or a flow hood. All measuring devices shall be accurate to within 10 percent of measured flow.

**304R304.6 Net capacity requirements.**

Whole house ventilation system fans shall be installed according to the manufacturer’s installation instructions and shall have the manufacturer's fan flow ratings as listed in accordance with HVI 911. Unless the whole house system is tested according to procedures in Section 304.6.1, the minimum continuous flow rate that the ventilation system must be capable of supplying during its operation shall be based on the rate per bedroom as specified in Table 304.6.

**TABLE 304R304.6**

<table>
<thead>
<tr>
<th>NUMBER OF BEDROOMS</th>
<th>MINIMUM NOMINAL RATED TOTAL FAN CAPACITY (at 0.1 inches w.g.)</th>
<th>MINIMUM NUMBER OF FANS TO MEET WHOLE HOUSE AIRFLOW RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 cfm</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>75 cfm</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>100 cfm</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>125 cfm</td>
<td>All other systems—2 or more, or Centrally ducted systems—1</td>
</tr>
<tr>
<td>5</td>
<td>150 cfm</td>
<td>All other systems—2 or more, or Centrally ducted systems—1</td>
</tr>
</tbody>
</table>

Homes > 3,000 ft²  

|                        | cfm = 0.05 • ft²                                             | All other systems—2 or more, or Centrally ducted systems—1 |

For SI: 1 cubic foot per minute = 0.0004719 m³/s, 1 cubic foot per minute per square foot = 0.00508 m³/(s • m²).

a. Represents the total installed rated capacity of all fans designed for whole house ventilation.

**304R304.6.1 Testing option.**

Testing may be done to verify that the whole house ventilation system satisfies the ventilation requirements of this section in accordance with Sections 304.6.1, 304.6.1.1 and R304.6.1.2.

**304R304.6.1.1 Minimum outdoor air.**

Automatic operation of the ventilation system shall not reduce the minimum continuous ventilation rate below 15 cfm of outdoor air per bedroom plus 15 cfm during occupancy.

**Exception:** Whole house approach in accordance using one of the compliance alternatives in Section R304.1.1.

**R304.6.1.2 Performance verification.**

In-field measurements of exhaust fan flows shall be conducted using a manufactured flow-measuring device in accordance with the manufacturer’s instructions. Acceptable devices include a calibrated orifice combined with a digital manometer or a flow hood. All measuring devices shall be accurate to within 10 percent of measured flow.
304R304.7 Ventilation required during periods of occupancy.
Ventilation shall be provided continuously or intermittently during the period that the building is occupied.

304R304.8 Controls.
Whole house ventilation systems (balanced or exhaust-only ventilation) shall be capable of being set remotely for continuous operation or shall be provided with an automatic control for intermittent operation. All whole house ventilation controls shall be readily accessible.

Exception: Fans installed expressly for local ventilation purposes.

304R304.8.1 Intermittent operation.
Intermittently operated whole house ventilation systems shall be capable of being set remotely for continuous operation; or shall be provided with an automatic control capable of operating without the need for occupant intervention, such as a time switch or some other control device. Twist or crank-style timers are prohibited as control devices for whole house ventilation systems. Operation controlled solely by a humidity sensor (humidistat or dehumidistat) does not qualify.

304R304.8.2 Continuous operation.
Continuously operated whole house ventilation systems shall not be provided with local controls unless that control only operates the whole house ventilation system both intermittently at high speed and continuously at low speed.

304R304.8.2.1 On/off switch for continuous operation.
An on/off switch for continuously operated whole house ventilation systems shall be remotely installed and appropriately labeled.

304R304.9 Installation requirements.
Ventilation equipment shall be installed according to the manufacturer’s instructions and in accordance with Sections R304.9.1 through R304.9.8.

304R304.9.1 Fan housings.
Fan housings for single-port exhaust only systems must be sealed to the ceiling or wall.

304R304.9.2 Inlet grills.
Inlet grills for multiport exhaust ventilation systems or balanced whole house ventilation systems must be sealed to the ceiling or wall.

304R304.9.3 Ducts.
Smooth wall ducts (PVC or metal or composite) must be used for all duct runs longer than 8 feet (2438 mm). Ducts shall be insulated when installed in an unheated location or outside the building thermal envelope.

304R304.9.4 Fasteners.
Mechanical fasteners must be used to connect all ducts to the fan(s) without impeding the operation of the fan or any internal backdraft damper.

304R304.9.5 Joints and connections.
All joints, seams and connections shall be securely fastened and sealed with welds, gaskets, o-rings, mastics (adhesives), mastic embedded fabric systems or approved tapes.
304R304.9.6 Noise abatement.
Remote whole house ventilation fans shall be acoustically isolated from the structural elements of the building and from attached ducts using at least 1 foot (305 mm), but not more than 2 feet (610 mm) of insulated flexible duct.

304R304.9.7 Intake openings.
Mechanical and gravity outside air intake openings for balanced whole house systems, integrated supply systems or heat recovery ventilating systems that are installed in accordance with Section 304 shall be located a minimum of 10 feet (3048 mm) from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, fuel fills and vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code.

The bottom of the intake termination shall be located at least 12 inches (305 mm) above the normally expected snow accumulation level.

304R304.9.8 Outside opening protection.
Air exhaust and intake openings located in exterior walls shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of ¼ inch (6.4 mm) and a maximum opening size of ½ inch (12.7 mm), in any dimension. Openings shall be protected against local weather conditions.

304R304.10 Clothes dryer exhaust.
Clothes dryers shall be exhausted in accordance with the manufacturer’s instructions. Dryer exhaust systems shall be independent of all other systems and shall convey the moisture and any products of combustion to the outside of the building.

Exception: This section shall not apply to listed and labeled condensing (ductless) clothes dryers

304R304.11 Makeup air required.
Exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute (0.19 m³/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.

SECTION 305R305
COMBUSTION SAFETY (MANDATORY)

305R305.1 General.
The provisions of this section shall govern the requirements for combustion and dilution air for fuel-burning appliances in every new home built to RBES, whenever a new heating system is installed, or whenever alteration, renovation or repair work creates unusually tight construction as defined in NFPA 54 and NFPA 31.

305R305.2 Unusually tight construction.
For the purpose of applying the provisions of Section 305 to fuel gas, kerosene and oil-burning equipment, buildings constructed in compliance with the RBES shall be considered so tight that...
normal infiltration does not meet combustion air requirements, and therefore, of unusually tight construction as defined in NFPA 54 and NFPA 31.

305R305.3 Fuel gas, kerosene and oil-burning equipment.
Every new home built to the RBES that contains Category I or II natural draft venting fuel-burning appliances shall be provided with combustion and dilution air as required by NFPA 54 for fuel-gas utilization equipment or NFPA 31 for oil-burning equipment. Direct vent appliances that do not draw combustion air from inside of the building are not required to be considered in the determination of the combustion and dilution air requirements.

Exception: Where all combustion devices in the home have a sealed combustion venting system, a mechanical draft venting system or are direct-vent appliances, then the combustion and dilution air requirements of this section do not apply.

305R305.3.1 Crawl space and attic space.
For the purposes of applying the provisions of Section 305, an opening to a naturally ventilated crawl space or attic space is not considered equivalent to an opening outdoors and is therefore prohibited for the purposes of supplying combustion and dilution air.

305R305.3.2 Unvented room heaters.
Unvented fuel-fired heaters, including room heaters and unvented fireplaces are prohibited.

305R305.4 Solid fuel-burning appliances and fireplaces.
All solid fuel-burning appliances and fireplaces shall meet the provisions of this section.

305R305.4.1 Gasketed doors.
All solid fuel-burning appliances and fireplaces shall have tight-fitting (defined as gasketed doors with compression closure or compression latch system) metal glass or ceramic doors.

Exception: Any home certified to have passed the Canadian General Standards Board 51.71 “Spillage Test Appendix RA – Recommended Procedure for Worst-Case Testing of Atmospheric Venting Systems” is not required to have tight-fitting doors. The CGSB Spillage Test creates a “worst-case” condition to determine whether the appliances can vent properly even with the house closed tight and all the exhaust equipment running.

305R305.4.2 Spillage testing.
All chimney-vented equipment shall establish complete draft without spillage under “worst-case” conditions within two minutes. If any chimney-vented equipment fails this requirement, mechanically induced pressure relief shall be provided such that the requirement is met.

305R305.4.23 Exterior air supply requirements.
Solid fuel-burning appliances and fireplaces shall be equipped with an exterior air supply according to the provisions of Sections R305.4.23.1 through R305.4.23.7.

Exception: Factory-built fireplaces, masonry fireplaces and solid fuel-burning appliances that list exterior air supply ducts as optional or required for proper installation are permitted to be installed with those exterior air supply ducts according to the manufacturer’s installation instructions, in place of sections R305.4.3.1 through R305.4.3.7. This is not an exemption from the exterior air supply requirements.
Combustion air shall not be taken from within the garage, attic, or basement.

The exterior air inlet shall not terminate to the exterior higher than the firebox and the combustion air duct shall not rise vertically within 18 inches of the firebox.

Exception: Where woodstove or fireplace is installed below grade (in a basement), air intake is permitted to terminate above the firebox if the combustion air supply point is below the firebox and the combustion air intake point is greater than 15 inches (381 mm) below the top of the wood stove or fireplace chimney.

The exterior air intake must deliver combustion air to the firebox.

Exception: For older woodstoves and cookstoves where direct connection of combustion air is not possible, combustion air may be delivered within 24 inches (610 mm) of the stove’s air intake opening.

The air inlet shall be screened with ¼ inch (6 mm) mesh.

The air inlet shall be closable and designed to prevent debris from dropping into the air intake.

The exterior air inlet shall be installed so as to remain free of obstruction from snow.

The combustion air passageway for unlisted exterior air supply ducts shall be a minimum of 6 square inches (3870 mm²) and not more than 55 square inches (0.035 m²). The passageway shall be non-combustible, masonry or 30 gauge (or thicker) metal, have 1 inch clearance to combustibles for the length of the combustion air intake. Combustion air systems for listed fireplaces shall be constructed according to the fireplace manufacturer’s instructions.

CHAPTER 4 [RE]
RESIDENTIAL ENERGY EFFICIENCY

SECTION R401
GENERAL
R401.1 Scope.
This chapter applies to residential buildings.

R401.2 Compliance.
Projects shall comply with one of the following:


2. “REScheck™ software”: Section R405 and the provisions of Sections R401 through R404 labeled indicated as “Mandatory.”


R401.3 Certificate of Compliance. (Mandatory).
A certification may be issued and signed by a builder, a licensed professional engineer, a licensed architect or an accredited home energy rating organization. If certification is not issued by a licensed professional engineer, a licensed architect or an accredited home energy rating organization, it shall be issued by the builder. Any certification shall certify that residential construction meets the RBES. The Department of Public Service will develop and make available to the public a certificate that lists key features of the RBES. Any person certifying shall use this certificate or one substantially like it to certify compliance with the RBES. Certification shall be issued by completing and signing a certificate and permanently affixing it to the electrical service panel, without covering or obstructing the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall certify that the residential building has been constructed in compliance with the requirements of the RBES. The person certifying under this subsection shall provide a copy of the certificate to the Department of Public Service and shall assure that a certificate is recorded and indexed in the town land records. A builder may contract with a licensed professional engineer, a licensed architect or an accredited home energy rating organization to issue certification and to indemnify the builder from any liability to the owner of the residential construction caused by noncompliance with the RBES.

SECTION R402
BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive).
The building thermal envelope shall meet the requirements of Sections R402.1.1 through R402.1.65.

Exceptions: From Section 101.5.2 the

The following buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this section shall be exempt from the building thermal envelope provisions of this code: Section R402.
1. **Low Energy Use Buildings.** Those with a peak design rate of energy usage less than 3.4 Btu/h \( \cdot \text{ft}^2 \) or 1.0 watt/ft\(^2\) per square foot of floor area space for space conditioning purposes. (10.7 W/m\(^2\) or 1.0 watt/ft\(^2\)).

2. **Unconditioned Buildings.** Those that do not contain *conditioned space.*


4. **Hunting camps.** Residential buildings shall not include hunting camps.

5. **Summer camps.** Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating system.

6. **Yurts** with only a biomass (wood) or other on-site renewable heating and hot water system.

7. **Owner-built homes.** Residential construction by an owner, if all of the following apply:
   - The owner of the residential construction is the *builder,* as defined in 30 V.S.A. § 51, and;
   - The residential construction is used as a dwelling by the owner, and;
   - The owner in fact directs the details of construction with regard to the installation of materials not in compliance with the RBES, and;
   - The owner discloses in writing to a prospective buyer, before entering into a binding purchase and sales agreement, with respect to the nature and extent of any noncompliance with the RBES. Any statement or certificate given to a prospective buyer shall itemize how the home does not comply with RBES, and shall itemize which measures do not meet the RBES in effect at the time construction commenced.

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**R402.1.1 Vapor retarder.**
Wall assemblies in and roof or ceiling assemblies which are part of the *building thermal envelope* shall comply with the vapor retarder requirements of Section R702.7 of the *International Residential Code* or Section 1405.3 of the *International Building Code,* as applicable, or with R402.2.15 in this document.

**R402.1.2 Insulation and fenestration criteria.**
The *building thermal envelope* shall comply with one of the following only:
1. **Package Plus Points Approach:** tables R402.1.2.1, R402.1.2.2 and R402.1.2.3; or
2. **U-Factor Alternative Approach:** R402.1.4; or
3. **Total UA Approach:** R402.1.5; or
4. **Log Home Approach:** R402.1.6.
Building science principles should be applied in all circumstances. Consult with a building science professional and refer to the Vermont Residential Energy Code Handbook for additional guidance and details.

R402.1.2.1 Package Plus Points Approach – Base.
Projects shall comply with items 1 to 3:
1. Select one of the five base packages listed in Table R402.1.2.1; and
2. Determine the number of points needed to comply with Table R402.1.2.2 based on building size; and
3. Incorporate a sufficient number of points from Table R402.1.2.3 to meet the points requirements from Table R402.1.2, R402.1.4 or 402.1.5.2.

TABLE R402.1.2-1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT FOR BASE PACKAGES

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT &amp; CRAWL SPACE WALL R-VALUE</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
<th>HEATED SLAB R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.32</td>
<td>0.55</td>
<td>49</td>
<td>13-10</td>
<td>15/20</td>
<td>30</td>
<td>15-continuous or 20-cavity</td>
<td>15-4 ft</td>
<td>15-4 ft</td>
</tr>
<tr>
<td>2</td>
<td>0.28</td>
<td>0.55</td>
<td>49</td>
<td>25</td>
<td>15/20</td>
<td>30</td>
<td>15-continuous or 20-cavity</td>
<td>15-4 ft</td>
<td>15-4 ft</td>
</tr>
</tbody>
</table>
a. **R-values** are minimums. **U-factors** are maximums. **When Where** insulation is installed in a cavity which that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall **not** be less than the R-value specified in the table. **Insulation R-value layers can be added to meet the required R-value.** See R402.1.4 for alternative compliance methods.

b. The fenestration U-factor column row excludes skylights.

c. **Basement** The continuous portion of basement and crawlspace insulation can be met through either R-15 continuous insulation or R-20 cavity insulation, either interior or, exterior or combination.

d. **“4 ft”** can be horizontal or vertical coverage including slab edge. “Edge and under” requires complete coverage. Up to 8 lineal feet of exposed slab edge may be insulated to R-10. **“Heated slab” are those with embedded radiation.**

e. Or insulation sufficient to fill the framing cavity.

f. **“13+10”** means R-13 cavity insulation plus R-10 continuous insulation. **R-25 can be met through any combination of insulation R-values, cavity, or cavity and continuous insulation.** When used, **continuous insulation values shall be at least R-5.**

g. The second R-value applies when more than half the insulation is on the interior of the mass wall.

h. Installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. **(See Section R402.2.1.)** **Multifamily buildings using continuous insulation with a maximum U-factor of 0.023 for the ceiling assembly satisfies this requirement.**

---

<table>
<thead>
<tr>
<th>Component*</th>
<th>Package 1</th>
<th>Package 2</th>
<th>Package 3</th>
<th>Package 4</th>
<th>Package 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling R-Value</td>
<td>R-49º</td>
<td>R-28 cont.</td>
<td>R-49º</td>
<td>R-60 attic</td>
<td>R-49º slope</td>
</tr>
<tr>
<td>Wood Frame Wall R-Value</td>
<td>R-20+5º OR R-13+10º</td>
<td>R-21 cont.</td>
<td>R-20+12º</td>
<td>R-20 cavity</td>
<td></td>
</tr>
<tr>
<td>Common Wall Insulation R-Value</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
</tr>
<tr>
<td>Basement/Crawl Space Wall R-Value</td>
<td>R-15 (continuous) OR R-20 (cavity) OR R-13+5</td>
<td>R-15 (continuous) OR R-20 (cavity) OR R-13+10º</td>
<td>R-20 (continuous) OR R-13+10º</td>
<td>R-20 (continuous) OR R-13+10º</td>
<td>R-20 (continuous) OR R-13+10º</td>
</tr>
<tr>
<td>Slab Edge R-Value</td>
<td>R-15, 4 ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4 ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-10, 4 ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4 ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4 ft OR R-10 perimeter + R-7.5 under entire rest of slab</td>
</tr>
<tr>
<td>Heated Slab R-Value</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
</tr>
<tr>
<td>Exterior (Window and Door) max U-Value</td>
<td>U-0.28</td>
<td>U-0.28</td>
<td>U-0.28</td>
<td>U-0.28</td>
<td>U-0.28</td>
</tr>
<tr>
<td>Skylight max U-Value</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>≤3.0 ACH50º tested</td>
<td>≤3.0 ACH50º tested</td>
<td>≤3.0 ACH50º tested</td>
<td>≤3.0 ACH50º tested</td>
<td>≤3.0 ACH50º tested</td>
</tr>
<tr>
<td>Duct Leakage</td>
<td>Inside thermal boundary</td>
<td>Inside thermal boundary</td>
<td>4 CFM per 100 sq. ft. of CEA</td>
<td>Inside thermal boundary</td>
<td>Inside thermal boundary</td>
</tr>
<tr>
<td>Lighting</td>
<td>Percent High Efficacy Lamps</td>
<td>90%</td>
<td>90%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
The Public Service Department has developed alternative prescriptive packages deemed to be equivalent, provided in the accompanying 2015 RBES Handbook.

g. Installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. (See Section R402.2.1.)

h. “ACH50” = air changes per hour at 50 Pascals building pressure as measured with a blower door

i. “CFA” = conditioned floor area

j. See Table R402.4.1.1 for further details.

Insulation systems complying with Table R402.1.4 shall be deemed to comply with the R-value requirements of Table 402.1.2.1.

**R402.1.2.2 Required Points by Building Size.**

Determine the number of points required by building size from Table R402.1.2.2. Building size for this table is determined by the finished conditioned floor area per dwelling unit within the building thermal envelope, including unfinished basements and storage/utility spaces. The Multifamily < 2000 square feet point requirement cannot be used for semidetached (semiattached, side-by-side), row houses, and townhouses, as defined as single-family dwellings in Definitions R202. Multifamily dwelling unit size is based on the average dwelling size for the building.

<table>
<thead>
<tr>
<th>Building/Dwelling Size</th>
<th>Required Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily &lt; 2000 square feet</td>
<td>4 points</td>
</tr>
<tr>
<td>&lt;2000 square feet</td>
<td>5 points</td>
</tr>
<tr>
<td>2000 to 4000 square feet</td>
<td>7 points</td>
</tr>
<tr>
<td>&gt;4000 square feet</td>
<td>10 points</td>
</tr>
</tbody>
</table>

**R402.1.2.3 Points by Component.**

After determining the number of points required using Table R402.1.2.2, select the components from Table 402.1.2.3 to accumulate the required number of points. The total number of points selected from Table R402.1.2.3 must meet or exceed the required points from Table R402.1.2.2.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab</td>
<td>R-10 below entire slab</td>
<td>1</td>
</tr>
<tr>
<td>Walls - Upgraded</td>
<td>Above grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Not available for base package 3) OR</td>
<td>2</td>
</tr>
<tr>
<td>Walls – High-R</td>
<td>Above grade walls ≥ R-40 (cavity and continuous) (or U-factor maximum 0.025 wall assembly)</td>
<td>3</td>
</tr>
<tr>
<td>Ceiling</td>
<td>R-80 attic flat / R-60 sloped, vaulted and cathedral</td>
<td>1</td>
</tr>
<tr>
<td>Windows</td>
<td>Average U-factor ≤ 0.27 OR</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Average U-factor ≤ 0.22</td>
<td>2</td>
</tr>
<tr>
<td><strong>Air Leaks and Ventilation</strong></td>
<td><strong>Pre-Drywall</strong></td>
<td>ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered OR</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Tight</strong></td>
<td>ACH50 ≤ 2.0 and balanced ventilation with ECM fans and ≥ 70% SRE for HRV, ≥ 65% SRE for ERV</td>
<td>OR</td>
</tr>
<tr>
<td><strong>Very Tight</strong></td>
<td>ACH50 ≤ 1.0 and balanced ventilation with ECM fans and ≥ 80% SRE for HRV, ≥ 75% SRE for ERV</td>
<td>4</td>
</tr>
<tr>
<td><strong>Heating and Cooling</strong></td>
<td><strong>Basic</strong></td>
<td>ENERGY STAR basic: (1) Gas/propane furnace ≥ 95 AFUE, Oil furnace ≥ 85 AFUE, (2) Gas/Propane Boiler ≥ 90 AFUE, Oil Boiler ≥ 87 AFUE, (3) Heat pump HSPF ≥ 9.0; PLUS any AC is SEER ≥ 14.5 OR</td>
</tr>
<tr>
<td></td>
<td><strong>Advanced</strong></td>
<td>Whole building heat/cool is (1) NEEP-listed air source heat pump combination, (2) GSHP, closed loop and COP ≥ 3.3, (3) ATWHP COP ≥ 2.5 and 120°F design temp, (4) Advanced wood heating system</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td><strong>Basic</strong></td>
<td>ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for &gt; 55 gal] OR</td>
</tr>
<tr>
<td></td>
<td><strong>Advanced</strong></td>
<td>ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥ 2.20 for &gt; 55 gal]</td>
</tr>
<tr>
<td></td>
<td><strong>Low Flow</strong></td>
<td>All showerheads ≤ 1.75 gpm, all lav. faucets ≤ 1.0 gpm, and all toilets ≤ 1.28 gpf OR</td>
</tr>
<tr>
<td></td>
<td><strong>Certified</strong></td>
<td>Certified water efficient design per WERS, WaterSense, or RESNETH2O</td>
</tr>
<tr>
<td></td>
<td><strong>Drain Heat Recovery</strong></td>
<td>Drain water heat recovery system on primary showers and tubs</td>
</tr>
<tr>
<td></td>
<td><strong>User-Demand</strong></td>
<td>Controlled hot water recirculation system with user-demand via push-button for furthest fixtures</td>
</tr>
<tr>
<td><strong>Renewables</strong></td>
<td><strong>Solar Ready</strong></td>
<td>Home is Solar Ready per R407.5, OR</td>
</tr>
<tr>
<td></td>
<td><strong>On-Site Generation</strong></td>
<td>Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site</td>
</tr>
<tr>
<td></td>
<td><strong>Solar Hot Water</strong></td>
<td>Solar hot water system designed to meet at least 50% of annual hot water load</td>
</tr>
<tr>
<td><strong>Other Measures</strong></td>
<td><strong>Monitoring</strong></td>
<td>Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data</td>
</tr>
<tr>
<td></td>
<td><strong>EV Ready</strong></td>
<td>Level 2 electric vehicle charger-ready per R407.4 OR</td>
</tr>
<tr>
<td></td>
<td><strong>Battery</strong></td>
<td>Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. Heating and cooling system points are only available if all components of primary systems comply
b. “OR” indicates that points are not additive; one component OR the following one can be selected, but not both.
c. “H/ERV” = Heat or Energy Recovery Ventilation
d. “SRE” = System Recovery Efficiency
e. “ECM” = Electronically Commutated Motor
g. “gpm” = gallons per minute
h. “gpf” = gallons per flush. Applies to new construction only.

i. “GSHP” = ground-source heat pump


k. Certification standard as of 1/1/2019 or later. “WERS” = Water Efficiency Rating Score http://www.wers.us/.


l. Points are limited to one per dwelling. Additional Level 2 charging equipment receives no more points.

R402.1.3 R-value computation.
Insulation material used in layers, such as framing cavity insulation or continuous insulation, shall be summed to compute the corresponding component R-value. The manufacturer’s settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer’s labeled R-value for insulated siding shall be reduced by R-0.6.

R402.1.4 U-factor alternative.
An assembly with a U-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative to the R-values in Table R402.1.2.1. The building must still comply with Table R402.1.2.2 and Table R402.1.2.3.

An assembly with a U-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative compliance method with no Table R402.1.2.3 points required, provided that (a) airtightness is ≤ 2.0 ACH50 tested, and (b) ventilation system is: Balanced; with ECM fan(s) plus ≥ 70% SRE for HRV, or ≥ 65% SRE for ERV.

### TABLE R402.1.4
EQUIVALENT U-FACTORS*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3227</td>
<td>0.55</td>
<td>0.0260</td>
<td>0.045044</td>
<td>0.060</td>
<td>0.0330</td>
<td>0.050035</td>
<td>0.05003</td>
<td>0.066, 4 ft</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.057.

c. Airtightness of ≤ 2.0 ACH50 tested and balanced ventilation system with ECM fan(s) plus ≥ 70% SRE for HRV, or ≥ 65% SRE for ERV are required, OR the building must comply with Table R402.1.2.2 and Table R402.1.2.3.

R402.1.5 Total UA alternative.
If the total building thermal envelope UA (the sum of U-factor times assembly area) is less than or equal to the total UA resulting from multiplying the U-factors in Table R402.1.4 (multiplied by the same assembly area as in the proposed building), the building shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met in addition to UA compliance.
R402.1.6 Log homes.  
Projects shall comply by doing all 3 steps below.

1. Design log home in accordance with ICC 400-2017 or to the requirements of Table R402.1.6.
2. Determine the number of points needed to comply, using Table R402.1.2.2 based on building size; AND
3. Incorporate a sufficient number of points from Table R402.1.2.3 to meet the points requirement from Table R402.1.2.2.

### TABLE R402.1.56
LOG HOME INSULATION, FENESTRATION AND HEATING REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>FENESTRATION U-FACTORb</th>
<th>SKYLIGHT U-FACTOR</th>
<th>MAXIMUM GLAZING AREAc</th>
<th>CEILING R-VALUE</th>
<th>LOG WALLd</th>
<th>FLOOR R-VALUEe</th>
<th>BASEMENT/ CRAWL SPACE WALL U-VALUEf</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
<th>HEATED SLAB R-VALUEg</th>
<th>HEATING SYSTEM AFUE h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>0.55</td>
<td>20%</td>
<td>49</td>
<td>≥ 5” Log</td>
<td>38</td>
<td>15/20</td>
<td>15, 4 ft.</td>
<td>15 edge and under</td>
<td>90% gas/LP, 85% oil</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

a. U-factors are maximums, R-values are minimums.
b. The fenestration U-factor column excludes skylights.
c. Glazing area includes window and skylight opening area, plus actual glazed area of glass in doors, as a percentage of wall area. Sunrooms are exempt from this requirement.
d. Log walls must comply with ICC 400 with an average minimum average wall thickness of 5” or greater. Non-log exterior walls shall be insulated in accordance with Table 402.2.1.
e. Or insulation sufficient to fill the framing cavity, with R-38 as the absolute maximum.
f. Basement walls shall be R-15 continuous insulation or R-20 cavity full basement height.
g. Heated slabs shall be completely insulated around the perimeter and under the entire slab.
h. Boilers must have an outdoor temperature reset or thermal purge control.

R402.2 Specific insulation requirements (Prescriptive).
In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections 402.2.1 through 402.2.1315.

Table R402.1.4 defines the reference conditions for a code compliant home in Vermont. The specific U-factors are not necessarily required as long as the home can demonstrate equivalent or lower energy use as compared to the same home built with these components installed. This equivalency can be demonstrated by selecting one of the packages in Table 402.1.2, selecting an alternative package in the 2015 RBES Handbook, using REScheck™ software to demonstrate equivalency, or obtaining a Home Energy Rating System (HERS) rating that meets Section 406.

R402.2.1 Ceilings with attic spaces.
Where Section R402.1.2 would require R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 would require R-60 insulation in the
ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall be
deemed to satisfy the requirement for R-60 insulation wherever the full height of
uncompressed R-49 insulation extends over the wall top plate at the eaves. This reduction
shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA
alternative in Section R402.1.5.

R402.2.2 Ceilings without attic spaces.
Where Section R402.1.2 would require insulation levels above R-30 and the design of the
roof/ceiling assembly does not allow sufficient space for the required insulation, the
minimum required insulation for such roof/ceiling assemblies shall be R-30. Insulation shall
extend over the top of the wall plate to the outer edge of such plate and shall not be
compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be
limited to 500 square feet (46 m²) or 20 percent of the total insulated ceiling area, whichever
is less. This reduction shall not apply to the U-factor alternative approach in Section
R402.1.4 and the Total UA alternative in Section R402.1.5.

402.2.2.1 Unvented attic assemblies.
Unvented attic assemblies (spaces between the ceiling joists of the top story and the
roof rafters) shall be permitted in one- and two-family dwellings and multiple single-
family dwellings (townhouses) if all the following conditions are met:

1. The unvented attic space is completely contained within the building thermal
evelope.

2. No interior vapor retarders (Class I or II) are installed on the ceiling side (attic
cellar) of the unvented attic assembly.

3. Where wood shingles or shakes are used, a minimum 1/4 inch (6 mm) vented air
space separates the shingles or shakes and the roofing underlayment above the
structural sheathing.

4. Any air-impermeable (e.g., spray foam) insulation shall be a Class III vapor
retarder, or shall have a vapor retarder coating, or covering in direct contact with
the underside of the insulation.

5. Either Item 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the
insulation directly under the structural roof sheathing.

5.1. Air-impermeable (e.g., spray foam) insulation only. Insulation shall be
applied in direct contact with the underside of the structural roof
sheathing.

5.2. Air-permeable (e.g., fiberglass or cellulose) insulation only. In addition to
the air-permeable insulation installed directly below the structural
sheathing, rigid board sheet insulation shall be installed directly above the
structural roof sheathing as specified in Table R402.4.1.1 for
condensation control.

5.3. Air-impermeable and air-permeable insulation. The air-impermeable (e.g.,
spray foam) insulation shall be applied in direct contact with the underside
of the structural roof sheathing as specified in Table R402.4.1.1 for condensation control. The air-permeable (e.g., fiberglass or cellulose) insulation shall be installed directly under the air-impermeable (e.g., spray foam) insulation.

**R402.2.3 Eave baffle.**
For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the *size net free area* of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

**R402.2.4 Access hatches and doors.**
Access doors from *conditioned spaces* to *unconditioned spaces* such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood-framed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed $R$-value of the loose-fill insulation.

**Exception:** Vertical doors that provide access from *conditioned spaces* to *unconditioned spaces* shall be permitted to meet the fenestration requirements of Table R402.1.2.

**R402.2.5 Mass walls.**
Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and, solid timber/log/timberlogs, or any other walls having a heat capacity greater than or equal to 6 Btu/ft$^2$ • °F (123 kJ/m$^2$ • K).

**R402.2.6 Steel-frame ceilings, walls and floors.**
Steel-frame ceilings, walls, and floors shall meet the insulation requirements of Table R402.2.6 or shall meet the $U$-factor requirements of Table R402.1.4. The calculation of the $U$-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.
### TABLE R402.2.6
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUE

<table>
<thead>
<tr>
<th>WOOD FRAME R-VALUE REQUIREMENT</th>
<th>COLD-FORMED STEEL EQUIVALENT R-VALUE&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel Truss Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 or R-30 + 3 or R-26 + 5</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 or R-38 + 3</td>
</tr>
<tr>
<td>R-49</td>
<td>R-38 + 5</td>
</tr>
<tr>
<td><strong>Steel Joist Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td><strong>Steel-Framed Wall, 16” on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5</td>
</tr>
<tr>
<td>R-20 + 5 or R-25</td>
<td>R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7</td>
</tr>
<tr>
<td><strong>Steel Framed Wall, 24” on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9</td>
</tr>
<tr>
<td><strong>Steel Joist Floor</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td>R-19</td>
<td>R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> Cavity insulation R-<sub>-</sub>. The first value is listed first, followed by cavity insulation R-value, and the second value is continuous insulation R-value. For example, “R-30+3” means R-30 cavity insulation plus R-3 continuous insulation.

<sup>b</sup> Insulation exceeding the height of the framing shall cover the framing.

### R402.2.7 Walls with partial structural sheathing.
Where Section R402.1.2 would require continuous insulation on exterior walls and structural sheathing covers 40 percent or less of the gross area of all exterior walls, the continuous insulation R-value shall be permitted to be reduced by an amount necessary to result in a consistent total sheathing thickness, but not more than R-3, on areas of the walls covered by structural sheathing. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.
R402.2.8 Floors.
Floor framing-cavity insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

Exception: The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall R-value in Table 402R402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.

R402.2.9 Basement walls.
Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

R402.2.10 Slab-on-grade floors.
Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the code official or other authority having jurisdiction, where one exists, as having a very heavy termite infestation.

R402.2.11 Crawl space walls.
As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

R402.2.12 Masonry veneer.
Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

R402.2.13 Sunroom insulation.
Sunrooms enclosing conditioned space shall meet the insulation requirements of this code.

Exception: For sunrooms with thermal isolation, and enclosing conditioned space, the following exceptions to the insulation requirements of this code shall apply:
1. The minimum ceiling insulation $R$-value shall be R-30.

2. The minimum wall insulation $R$-value shall be R-13. Walls separating a sunroom with a thermal isolation from conditioned space shall meet the building thermal envelope requirements of this code.

R402.2.14 Common, party, and fire walls.
Whenever continuity of the building thermal envelope is broken at walls separating dwelling units in Group R-2 building, including common, party, and fire walls, such walls shall be insulated to a minimum of R-10 on each side of the break in insulation continuity, and the walls shall be air sealed in accordance with Section R402.4.

R402.2.15 Wood-framed Frame walls.
Efforts must be made to protect insulated cavities from airborne water vapor and condensation. Air sealing the interior face of the assembly, controlled mechanical ventilation (targeting 30% relative humidity during the winter season), exterior continuous insulation and proper consideration of the vapor permeance of materials are all design elements that can contribute to this protection. Adequate protection from condensation within a standard 6" assembly is likely with R 11.25-

R402.2.15.1 Vapor retarders. Class I or II vapor retarders shall be provided on the interior side of frame walls. Exceptions:
2. Below grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

A higher exterior R402.2.15.2 Low permeability insulating sheathing: R-5 exterior.
Where a Class II vapor retarder is used on the interior side of frame walls, in combination with a low permeability insulating sheathing likely does not prevent condensation within a standard 6" assembly and may increase its likelihood.

Consultation installed as continuous insulation on the exterior side of frame walls, the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B). Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an engineered approved design professionals on these details.

R402.2.15.3 Class III vapor retarders. Class III vapor retarders on the interior side of frame walls shall be permitted where any one of the following conditions is strongly encouraged:
1. Vented cladding over the following sheathing types:
   a. fiberboard;
   b. gypsum;
   c. plywood (CDX or comparable); or
   d. solid wood
2. Insulated sheathing with $R$-value 7.5 minimum over $2 \times 4$ wall.
3. Insulated sheathing with $R$-value 11.25 minimum over $2 \times 6$ wall.
R402.2.15.4 Material vapor retarder class. The vapor retarder class shall be based on the manufacturer’s certified testing of a tested assembly. See R202 General Definitions for vapor retarder classes and examples.

R402.3 Fenestration (Prescriptive).
In addition to the requirements of Section R402.1, fenestration shall comply with Sections R402.3.1 through R402.3.65.

R402.3.1 U-factor.
An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

R402.3.2 Glazed fenestration SHGC.
An area-weighted average of fenestration products more than 50-percent glazed shall be permitted to satisfy the SHGC requirements.

Dynamic glazing shall be permitted to satisfy the SHGC requirements of Table R402.1.2 provided that the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.

Exception: Dynamic glazing is not required to comply with this section when both the lower and higher labeled SHGC already comply with the requirements of Table R402.1.1.

R402.3.3 Glazed fenestration exemption.
Up to 15 square feet (1.4 m²) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

R402.3.4 Opaque door exemption.
One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the U-factor requirement in Section R402.1.4. This exemption shall not apply to the U-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

R402.3.5 Sunroom fenestration.
Sunrooms enclosing conditioned space shall meet the fenestration requirements of this code.
Exception: For sunrooms with thermal isolation and enclosing conditioned space, the maximum fenestration U-factor shall be 0.45 and the maximum skylight U-factor shall not exceed 0.55.

New fenestration separating the sunroom with thermal isolation from conditioned space shall meet comply with the building thermal envelope requirements of this code.

R402.4 Air leakage (Mandatory).
The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4. Installing these air leakage measures results in an air leakage rate, if tested with a blower door, to not exceed three air changes per hour, if tested in accordance with ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Alternatively, the building may be tested with a blower door to not exceed three air changes per hour at 50 Pascals.

R402.4.1 Building thermal envelope.
The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation.
The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction.
### TABLE R402.4.1.1
**AIR BARRIER AND INSULATION INSTALLATION**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>AIR BARRIER CRITERIA</th>
<th>INSULATION INSTALLATION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>General conditions and appropriate materials for air barriers</td>
<td>A continuous, durable air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous, durable air barrier. Breaks or joints in the air barrier shall be sealed. An air barrier is defined as any durable solid (non-porous) material that completely blocks air flow between conditioned space and unconditioned space, including necessary accessories to provide adequate support to resist positive and negative pressures without displacement or damage. The air barrier should be continuous and be durably connected to all penetrations, windows and other (structural) interruptions. Open-cell or closed-cell foam shall have a finished thickness ≥ 5.5 in. or 1.5 in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise. If flexible air barriers are used, they shall be fully sealed at all seams and edges and supported per manufacturer's installation instructions. Flexible air barriers shall not be made of kraft paper, or other materials that are easily torn. If polyethylene is used, its thickness shall be ≥ 6 mil. Materials meeting ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies are acceptable.</td>
<td>Air-permeable insulation shall not be used as a sealing material. and shall be when installed in all vertical walls, sloped ceilings, and floors within the thermal envelope, it shall be enclosed on all six sides and in contact with a durable, air barrier.</td>
</tr>
<tr>
<td>Dropped ceilings/soffits</td>
<td>The air barrier in any dropped ceiling/soffit shall be aligned with (in contact with) the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed, insulated and gasketed.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with (in contact with) the air barrier and shall be enclosed on five sides and in contact with a durable, interior air barrier. A top-side air barrier is not required in a flat attic.</td>
</tr>
<tr>
<td>Framing junctions and cavities</td>
<td>The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior wall sheathing shall be sealed. Knee walls shall be air sealed. When part of the thermal-envelope, knee wall insulation shall be enclosed on all six sides and in contact with a durable, interior air barrier.</td>
<td>Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Exterior thermal envelope insulation for framed walls shall be enclosed on all six sides and in contact with a durable, air barrier.</td>
</tr>
<tr>
<td>Windows, skylights and doors</td>
<td>The space between window/door jambs and framing, and skylights and framing shall be sealed with minimally-expanding foam.</td>
<td>—</td>
</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall include the air barrier. Junctions of the foundation and sill plate, sill plate and rim band, and rim band and subfloor shall be sealed. When air permeable insulation is installed, a durable, interior air barrier shall be installed at the rim joist.</td>
<td>Rim joists shall be insulated and air sealed.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Floors (including above garage and cantilevered floors)</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or with continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.</td>
</tr>
<tr>
<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
<td>Where provided instead of floor insulation, insulation vapor barrier shall be permanently attached to the crawlspace walls.</td>
</tr>
<tr>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed. Doors or hatches in knee walls opening to exterior or unconditioned space shall be insulated and gasketed.</td>
<td>—</td>
</tr>
<tr>
<td>Narrow cavities</td>
<td>Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.</td>
<td></td>
</tr>
<tr>
<td>Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
<td></td>
</tr>
<tr>
<td>Recessed lighting and appliances</td>
<td>Recessed light fixtures and other appliances (speakers, exhaust fans, light shafts, etc.) installed in the building thermal envelope shall be ICICAT (Insulation Contact and Air Tight) rated, airtight labeled (or &quot;Washington State Approved&quot;) and sealed with a gasket or caulking between the housing and the interior wall or ceiling cover. Fixtures and appliances shall maintain required clearances of not less than ½” from combustible material and not less than 3” from insulation material, or as required by manufacturer’s installation requirements.</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and ICICAT rated. (ICAT rated indicates Insulation Contact and Air Tight and meets IC and air tightness requirement).</td>
</tr>
<tr>
<td>Plumbing and wiring</td>
<td>All plumbing and wiring penetrations shall be sealed to the air barrier.</td>
<td>Insulation shall be placed between the exterior of the wall assembly and pipes. Insulation should not be installed on the interior of the piping. Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring and shall</td>
</tr>
<tr>
<td>Location</td>
<td>Requirement</td>
<td>Testing</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shower/tub on exterior wall</td>
<td>Exterior walls adjacent to showers and tubs shall have insulation filling any gaps or voids between tub or shower walls and unconditioned space.</td>
<td>Exterior walls adjacent to showers and tubs shall have a rigid, durable, air barrier separating the exterior wall from the shower and tubs and be insulated.</td>
</tr>
<tr>
<td>Electrical/phone box on exterior walls</td>
<td>The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.</td>
<td>Insulation completely fills voids between the box and exterior sheathing.</td>
</tr>
<tr>
<td>Common wall</td>
<td>Whenever continuity of the building thermal envelope is broken at walls separating dwelling units in Group R-2 building, including common, party, and fire walls, such walls shall be insulated to a minimum of R-10 on each side of the break in insulation continuity.</td>
<td>Air barrier shall be installed in common wall between dwelling units. Common walls shall be sealed at junctions with outside walls and at the top pressure plane of the house.</td>
</tr>
<tr>
<td>HVAC register boots</td>
<td>HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.</td>
<td></td>
</tr>
<tr>
<td>Concealed sprinklers</td>
<td>When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
<td></td>
</tr>
<tr>
<td>Fireplace</td>
<td>A durable air barrier shall be installed in contact with insulation. Fireplace shall have compression closure doors and combustion air supplied from the outdoors.</td>
<td></td>
</tr>
</tbody>
</table>

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400-2017.

**R402.4.1.2 Air Leakage Testing.**

The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding three (3) air changes per hour. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Testing and verification shall be conducted by an applicable Building Performance Institutes (BPI) Professional, a Home Energy Rating System (HERS) Energy Rater, HERS Field Inspector, or a Vermont Department of Public Service approved air leakage tester. A written report of the results of the test shall be signed by the party conducting the test. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

**During testing:**

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.

6. Supply and return registers, where installed at the time of the test, shall be fully open.

7. Plumbing and drainage traps shall be filled with water as normally found, but not otherwise sealed.

R402.4.1.3 Reporting. Air leakage testing shall be reported on the RBES Certificate in units of air changes per hour at 50 Pascals (ACH50).

Exception: Report cubic feet per minute at 50 Pascals (CFM50) per square foot of building thermal shell area. Building thermal shell area shall include all six (6) sides of the building.

R402.4.2 Fireplaces.
New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

R402.4.3 Fenestration air leakage.
Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 Rooms containing fuel-burning appliances.
Where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall R-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.

2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the International Residential Code.
R402.4.5 Recessed lighting.
Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be ICAT-rated (Insulation Contact and Air Tight) or IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

R402.5 Maximum fenestration U-factor and SHGC (Mandatory).
The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.3230 for vertical fenestration, and 0.55 for skylights.

402.6 Vapor retarders.
Class I or II vapor retarders are required on the interior side of frame walls.

R402.6 Vestibules.
Multifamily buildings 3-stories or less built above a parking garage require a vestibule in accordance with C402.4.7 from the Vermont Commercial Building Energy Standards (CBES).

Exceptions:
1. Basement walls.
2. Below grade portion of any wall.
3. Construction where moisture or its freezing will not damage the materials.

402.7 Class III vapor retarders.
Class III vapor retarders shall be permitted where any one of the following conditions is met:
1. Vented cladding over fiberboard.
2. Vented cladding over gypsum.
3. Insulated sheathing with R-value 7.5 over 2 × 4 wall.
4. Insulated sheathing with R-value 11.25 over 2 × 6 wall.

402.8 Material vapor retarder class.
The vapor retarder class shall be based on the manufacturer’s certified testing or a tested assembly. The following shall be deemed to meet the class specified:

Class I: Sheet polyethylene, unperforated aluminum foil.

Class II: Kraft-faced fiberglass batts.

Class III: Latex or enamel paint.

SECTION R403
SYSTEMS

R403.1 Controls (Mandatory).
At least one thermostat shall be provided for each separate heating and cooling system.

R403.1.1 Programmable thermostat.
The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed by the manufacturer with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C). Adjustments to these settings for elderly, disabled or those with special needs is permissible.

The following exceptions are allowed as long as 5-wire connection to thermostat location is provided:
1. Radiant floor, wall, ceiling and/or beam system on dedicated zone
2. Cold-climate heat pump not designed for setbacks
3. Wifi or ‘smart’ Internet-connected thermostats

R403.1.2 Heat pump supplementary heat (Mandatory).
Ductless air-source heat

Heat pumps shall not have integrated supplementary electric-resistance heat integral to the unit—other than that provided for frost control. See R404.2 for guidance on electric resistance heating equipment other than heat pumps.

R403.2 Hot water boiler outdoor temperature setback.
Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

R403.3 Ducts.
Ducts and air handlers for space conditioning shall be in accordance with Sections R403.3.1 through R403.3.5.

R403.3.1 Insulation (Prescriptive).
All supply and return ducts shall be insulated to meet the same R-value requirement that applies to immediately proximal surfaces.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

R403.3.2 Sealing (Mandatory).
Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.
1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.

2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

R403.3.2.1 Sealed air handler.
Air handlers shall have a manufacturer’s designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

R403.3.3 Duct testing (Mandatory).
Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:
1. A duct air leakage test shall not be required structure where the ducts and air handlers are located entirely within the building thermal envelope.

2. Ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by an individual certified as either a Building Performance Institute (BPI) Heating Professional or Air Conditioning/Heat Pump Professional, a Home Energy Rating System (HERS) Energy Rater or HERS Field Inspector or a Vermont Department of Public Service approved duct leakage tester, and provided to the code official or other authority having jurisdiction, where one exists, and to the Department of Public Service along with the RBES certificate upon completion of the construction project.

R403.3.4 Duct leakage (Prescriptive).
The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 3 cubic feet per minute (85.0 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the
1. **Rough-in test**: The total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

**R403.3.5 Building cavities (Mandatory).**

*Building* framing cavities shall not be used as ducts or plenums.

**R403.3.6 Ducts buried within ceiling insulation.**

Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation $R$-value not less than R-8.

2. At all points along each duct, the sum of the ceiling insulation $R$-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-40, excluding the $R$-value of the duct insulation.

**R403.3.7 Ducts located in conditioned space.**

For ducts to be considered as inside a *conditioned space*, such ducts shall comply with either of the following:

1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.

2. The ducts shall be buried within ceiling insulation in accordance with Section R403.3.6 and all of the following conditions shall exist:

   2.1. The air handler is located completely within the *continuous air barrier* and within the building thermal envelope.

   2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m²) of conditioned floor area served by the duct system.

   2.3. The ceiling insulation $R$-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation $R$-value, less the $R$-value of the insulation on the duct.

**R403.4 Mechanical system piping insulation (Mandatory).**

Mechanical system piping capable of carrying designed to carry fluids above 105°F (41°C) or below 55°F (13°C) shall be located within the building thermal envelope and insulated to a minimum of R-3.
R403.4.1 Protection of piping insulation.
Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

R403.5 Service hot water systems.
Energy conservation measures for service hot water systems shall be in accordance with Sections R403.5.1 and R403.5.4.

R403.5.1 Heated water circulation and temperature maintenance systems (Mandatory).
Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

R403.5.1.1 Circulation systems.
Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

R403.5.1.2 Heat trace systems.
Electric heat trace systems shall comply with IEEE 515.1 or UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

R403.5.2 Demand recirculation systems.
A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:

1. The controls shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.

2. The controls shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

R403.5.3 Hot water pipe insulation (Prescriptive).
Insulation for hot water pipe with a minimum thermal resistance, R-value, of R-3 shall be applied to the following:

1. Piping ¾ inch (19.1 mm) and larger in nominal diameter.
2. Piping serving more than one dwelling unit.

3. Piping located outside the conditioned space.

4. Piping from the water heater to a distribution manifold.

5. Piping located under a floor slab.


7. Supply and return piping in recirculation systems other than demand recirculation systems.

R403.5.4 Drain water heat recovery units.
Where installed, drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

R403.6 Mechanical ventilation (Mandatory).
The building shall be provided with ventilation that meets the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.6.1 Whole-house mechanical ventilation system fan efficacy.
Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1. Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

**TABLE R403.6.1**

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE MINIMUM (CFM)</th>
<th>MINIMUM EFFICACY (CFM/WATT)</th>
<th>AIR FLOW RATE MAXIMUM (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV or ERV</td>
<td>Any</td>
<td>1.2 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

a. When tested in accordance with IBC-18
b. Standard 916.

For SI: 1 cfm = 28.3 L/min.

**Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.
R403.7 Equipment sizing and efficiency rating (Mandatory). Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed for Climate Zone 6.

R403.8 Systems serving multiple dwelling units (Mandatory). Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the 2015 Vermont Commercial Building Energy Standards (CBES) in lieu of Section R403.

R403.9 Snow melt and ice system controls (Mandatory). Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (4.8°C).

R403.10 Pools and permanent spa energy consumption (Mandatory). The energy consumption of pools and permanent spas shall be in accordance with Sections R403.10.1 through R403.10.4.

R403.10.1 Residential pools and permanent residential spas. Residential swimming pools and residential permanent spas that are accessory to detached one- and two-family dwellings and townhouses three stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP-145.

R403.10.2 Heaters. The heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

R403.10.3 Time switches. Time switches or other control methods that can automatically turn off and on according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

R403.10.4 Covers. Outdoor heated pools and outdoor permanent spas shall be provided with an insulated vapor-retardant cover of at least R-12 or other approved vapor-retardant means.
Exception: Where more than 7075 percent of the energy for heating, computed over an operation season, is from site-recovered energy, such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

R403.11 Portable spas (Mandatory).
The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

R403.12 Residential pools and permanent residential spas.
Residential swimming pools and permanent residential spas that are accessory to detached one- and two-family dwellings and townhouses three stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP-15.

SECTION R404
ELECTRICAL POWER AND LIGHTING SYSTEMS

R404.1 Lighting equipment (Mandatory).
Not less than 7590 percent of the lamps (or “bulbs”) in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75 percent of the. Where multiple replaceable lamps are connected to a permanently installed lighting fixtures shall contain only high-efficacy lamps. The number of lamps is to be used in calculating the percentage.

R404.1.1 Lighting equipment (Mandatory).
Fuel gas lighting systems shall not have continuously burning pilot lights.

404R404.1.2 Lighting equipment for multifamily spaces (Mandatory).
Multifamily buildings three-stories or less with parking garages and exterior parking areas and drives, must meet the lighting power density (LPD) specifications of the Vermont Commercial Building Energy Standards (CBES). For parking garages, see C405.3.2; for uncovered parking areas and drives, see C405.4.2.

R404.2 Electric resistance heating equipment. In the City of Burlington, the use of Heat pumps having supplementary electric resistance heat shall be certified cold-climate heat pumps only and shall have controls that, except during defrost, prevent supplementary electric heat operation where the heat pump compressor can meet the heating load.

Building heating with electric resistance heating equipment is prohibited, except where:

Exceptions*:
1. Replacement of existing electrical resistance units.
2. Limited areas where other heating sources are cost prohibitive or impractical (e.g., a small interior space such as a bathroom or stairwell, which is distant from the distribution system).
3. Buildings with Cold-Climate Heat Pump(s) as the primary heating system, provided:
   a. The supplemental electric resistance heat is controlled to prevent it from operating at an outside air temperature of 5°F or higher; and
   b. The building has a tested air tightness of ≤ 2.0 ACH50.
4. Multifamily buildings with heating loads ≤ 6.0 Btu/hour/square foot at design temperature.
*Buildings served by the City of Burlington Electric Department (BED) must also receive approval from BED before installing electric resistance heating equipment.

**R404.3 Electric vehicle charging.**

New parking lots serving *multifamily* developments of 10 or more dwelling units shall provide either level 1 or level 2 electrical service within 5 feet of the centerline of the parking space (“EV Charging Parking Space”) with the capacity to serve the number of Electric Vehicle Charging Parking Spaces in Table R404.3. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service.

Exception: Parking spaces are not counted in Table R404.3 if one of the following conditions apply:
1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
2. Parking spaces are separated from the meter by a public right-of-way.
3. Parking spaces which are limited to parking durations of less than an hour.

Parking spaces with *Electric Vehicle Supply Equipment* (“EVSE”) shall be marked for EV use only.

Exception: The number of parking spaces with EVSE that are marked for “EV use only” need not exceed the number of EV cars driven by occupants of the building. This exception does not reduce the number of EVSE spaces required, just the number that are marked for EV use only.

Level 1 Electric Vehicle Charging Parking requires one 120V 20 amp grounded AC receptacle, NEMA 5-20R or equivalent, within 5 feet of the centerline of each EV Charging Parking Space.

Level 2 Electric Vehicle Charging Parking requires one 208/240V 40 amp grounded connection for electric vehicle charging through dedicated EVSE with J1772 connector or AC receptacle, NEMA 14-50, or equivalent, within 5 feet of the centerline for each EV Charging Parking Space.

**TABLE R404.3**

REQUIRED ELECTRIC VEHICLE CHARGING PARKING SPACES FOR MULTIFAMILY BUILDINGS (BASE and STRETCH CODE)

<table>
<thead>
<tr>
<th>NUMBER OF PARKING SPOTS</th>
<th>REQUIRED NUMBER OF EV CHARGING PARKING SPACES</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–25</td>
<td>1</td>
</tr>
<tr>
<td>26–50</td>
<td>2</td>
</tr>
<tr>
<td>51–75</td>
<td>3</td>
</tr>
<tr>
<td>76–100</td>
<td>4</td>
</tr>
</tbody>
</table>
SECTION R405
SIMULATED PERFORMANCE ALTERNATIVE USING
RESCHECK™ SOFTWARE (PERFORMANCE)

R405.1 Scope.
This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling and service water heating energy only.

R405.2 Mandatory requirements.
Compliance with this section requires that the provisions in Sections R402.1.1, R403.3.1, R403.5.3 and the mandatory provisions identified in Sections R401.3.2, R402, R403 and R404 be met. All supply and return ducts not completely inside the building thermal envelope shall be insulated to meet the same R-value requirement that applies to immediately proximal surfaces.

R405.3 Performance-based compliance.
Compliance is based on documentation from REScheck™ modeling software that indicates the home meets or exceeds the target UA for that building.

SECTION R406
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R406.1 Scope.
This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis. This approach uses a Home Energy Rating System (HERS) Energy Rating provided by a Vermont Department of Public Service Department-approved accredited HERS provider. The “ERI” referenced herein is the same as the RESNET HERS Index.

R406.2 Mandatory requirements.
Compliance with this section requires that the provisions in Sections R402.1.1, R403.3.1, R403.5.3 and the mandatory provisions identified in Sections R401.3.2, R402, R403 and R404 and R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.2 of the 2009 International Energy Conservation Code for Climate Zone 6.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to a minimum of R-6.

R406.3 Energy Rating Index.
The Energy Rating Index (ERI) shall be a numerical integer value that is based on a linear scale constructed such that the ERI reference design has an Index value of 100 and a residential building that uses no net purchased energy has an Index value of 0. Each integer value on the scale shall represent a 1-percent change in the total energy use of the rated design relative to
the total energy use of the *ERI reference design*. The ERI shall consider all energy used in the residential building.

**R406.3.1 ERI reference design.**
The *ERI reference design* shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirements.

The proposed residential building shall be shown to have an annual total normalized modified load less than or equal to the annual total loads of the *ERI reference design*.

**R406.4 ERI-based compliance.**
Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.4 when compared to the ERI reference design when compared to the *ERI reference design*. Up to 5 ERI points can be earned with renewables. This includes all residential structures, including log homes. The ERI to be used to verify compliance is “HERS Index with IAF” using REM/Rate version 15.7. Up to 5 ERI points can be earned with renewables. If the HERS Index scale is revised, the Department of Public Service may update these Index points.

**TABLE R406.4**

<table>
<thead>
<tr>
<th>Base Code Target</th>
<th>Maximum HERS Index to demonstrate code compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub-Target</th>
<th>Maximum HERS Index without any renewables incorporated</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewables</th>
<th>Maximum HERS Index points that can be counted towards Code Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Includes all residential structures, including log homes. Based on REM/Rate version 14. If the HERS Index scale is revised, the Public Service Department may update these Index points.

**R406.5 Verification by approved agency.**
Verification of compliance with Section R406 shall be completed by a certified HERS Rater working under the authority of a Vermont PSD-approved accredited HERS Provider.

**R406.6 Documentation.**
Documentation of the software used to determine the ERI and the parameters for the residential building shall be in accordance with Sections R406.6.1 through R406.6.3.

**R406.6.1 Compliance software tools.**
Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code official or other authority having jurisdiction, where one exists and be an approved Software Rating Tools in accordance with RESNET/ICC 301.

**R406.6.2 Compliance report.**
Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:
1. Address or other identification of the residential building.

2. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.

3. Name of individual completing the compliance report.

4. Name and version of the compliance software tool.

**Exception:** Multiple orientations. Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

R406.6.3 Additional documentation.

The *code official or other authority having jurisdiction, where one exists*, shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design*.

2. A certification signed by the builder providing the building component characteristics of the *rated design*.

3. Documentation of the actual values used in the software calculations for the *rated design*.

R406.7 Calculation software tools.

Calculation software, where used, shall be in accordance with Sections R406.7.1 through R406.7.3.

**R406.7.1 Minimum capabilities.**

Calculation procedures used to comply with this section shall be software tools capable of calculating the ERI as described in Section R406.3, and shall include the following capabilities:

1. Computer generation of the *ERI reference design* using only the input for the *rated design*.

The calculation procedure shall not allow the user to directly modify the building component characteristics of the *ERI reference design*.

2. Calculation of whole building, as a single zone, sizing for the heating and cooling equipment in the *ERI reference design* residence in accordance with Section R403.7.

3. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
4. Printed code official or other authority having jurisdiction, where one exists, inspection checklist listing each of the rated design component characteristics determined by the analysis to provide compliance, along with their respective performance ratings.

R406.7.2 Specific approval.
Performance analysis tools meeting the applicable sections of Section R406 shall be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction. The code official or other authority having jurisdiction, where one exists, shall approve tools for a specified application or limited scope.

R406.7.3 Input values.
When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source such as RESNET/ ICC 301.

SECTION R407
VERMONT STRETCH CODE

R407.1 Scope.
This section establishes criteria for compliance with Vermont’s “Stretch Code,” as defined in 30 V.S.A. § 51. Act 250 residential projects and residential buildings in municipalities that adopt the Stretch Code shall demonstrate compliance with one of the packages in Table R407.1, alternative packages in the 2015 RBES Handbook or the maximum ERI values in Table R407.2. All other requirements in the RBES shall apply.

All Base Code requirements shall be met in addition to the requirements in this Stretch Code section R407 in order to be in compliance with the Stretch Code.

R407.2 Compliance.
Compliance for Stretch Code shall be documented through R407.2.1 Package Plus Points Approach or R407.2.2 ERI-based compliance for Stretch Code.

R407.2.1 Package Plus Points Approach.

R407.2.1.1 Projects shall comply by completing all three steps below:

1. Select one of the three base packages listed in Table R407.2.1.1; and
2. Determine the number of points needed to comply with Table R407.2.1.2 based on building size; and
3. Incorporate a sufficient number of points from Table R407.2.1.3 to meet the points requirements from Table R407.2.1.2.
### TABLE R407.1
**STRETCH CODE 2.1.1**

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT FOR STRETCH PACKAGES**

<table>
<thead>
<tr>
<th>Component&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Package 1</th>
<th>Package 2</th>
<th>Package 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Standard”</td>
<td>“SIPS”</td>
<td>“Thick Wall”</td>
</tr>
<tr>
<td>Envelope</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling R-Value</td>
<td>R-60&lt;sup&gt;b&lt;/sup&gt; attic / R-49&lt;sup&gt;c&lt;/sup&gt; slope</td>
<td>R-36 cont.</td>
<td>R-49&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Wood Frame Wall R-Value</td>
<td>R-20+5&lt;sup&gt;e&lt;/sup&gt; OR 13+10&lt;sup&gt;e&lt;/sup&gt;</td>
<td>R-21 cont.</td>
<td>R-20+12&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Common Wall Insulation</td>
<td>R-10</td>
<td>R-10</td>
<td>R-10</td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
</tr>
<tr>
<td>Basement/Crawl Space Wall R-Value</td>
<td>R-20 (continuous) OR R-13+10&lt;sup&gt;e&lt;/sup&gt;</td>
<td>R-20 (continuous) OR R-13+10&lt;sup&gt;e&lt;/sup&gt;</td>
<td>R-20 (continuous) OR R-13+10&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Slab Edge&lt;sup&gt;d&lt;/sup&gt; R-Value</td>
<td>R-15, 4ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
<td>R-15, 4ft OR R10 perimeter + R-7.5 under entire rest of slab</td>
</tr>
<tr>
<td>Heated Slab&lt;sup&gt;d&lt;/sup&gt; R-Value</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
<td>R-15 (edge and under)</td>
</tr>
<tr>
<td>Fenestration&lt;sup&gt;b&lt;/sup&gt; (Window and Door) max. U-Value</td>
<td>U-0.28</td>
<td>U-0.28</td>
<td>U-0.30</td>
</tr>
<tr>
<td>Skylight&lt;sup&gt;e&lt;/sup&gt; max. U-Value</td>
<td>U-0.55</td>
<td>U-0.55</td>
<td>U-0.55</td>
</tr>
</tbody>
</table>

<sup>a</sup> COMPONENT:

<sup>b</sup> WINDOW:

<sup>c</sup> SLOPE:

<sup>d</sup> EDGE:

<sup>e</sup> WALL:

<sup>f</sup> SLAB:

<sup>g</sup> U-VALUE:
a. **R-values, ACH50 and mechanical system efficiencies** are minimums. **U-factors** are maximums.

b. The fenestration **U-factor column** excludes skylights.

c. **Basement** insulation can be met through either continuous insulation (interior, exterior) or a combination of cavity and continuous insulation (interior or exterior).

d. "4 ft" can be horizontal or vertical coverage including slab edge. "Edge and under" requires complete coverage. Up to 8 lineal feet of exposed slab edge may be insulated to R-10. "Heated slab" are those with embedded radiation.

e. Or insulation sufficient to fill the framing cavity. Up to 8 lineal feet of exposed slab edge may be insulated to R-10.

f. The first value is cavity insulation, the second value is continuous insulation, so "13 + 10" means R-13 cavity insulation plus R-10 continuous insulation. R-25 **These insulation requirements** can be met through any combination of insulation R-values, cavity, or cavity and continuous insulation, or a combination of cavity and continuous insulation, either interior or exterior.

g. The second R-value applies when more than half of the insulation is on the interior of the mass wall.

h. Installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. (See Section R402.2.1.) **Multifamily buildings** using continuous insulation with a maximum U-factor of 0.023 for the ceiling assembly satisfies this requirement.

i. Installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. (See Section R402.2.1.)

j. "ACH50" = air changes per hour at 50 Pascals building pressure as measured with a blower door.

k. See Table R402.4.1.1 for further details.

l. "H/ERV" = Heat or Energy Recovery Ventilation

m. "SRE" = System Recovery Efficiency

n. "ECM" = Electronically Commutated Motor.

---

### R407.2.1.2 Required Points by Building Size

Determine the number of points required by building size from Table R402.1.2.2. Building size for this table is determined by the **finished conditioned floor area per dwelling unit** within the **building thermal envelope**, including unfinished basements and storage/utility spaces. The Multifamily < 2000 square feet point requirement cannot be used for semidetached (semiattached, side-by-side), row houses, and townhouses, as
defined as single-family dwellings in Definitions R202. Multifamily dwelling unit size is based on the average dwelling size for the building.

<table>
<thead>
<tr>
<th>TABLE R407.2.1.2</th>
<th>REQUIRED POINTS BY BUILDING SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building/Dwelling Size</td>
<td>Required Points</td>
</tr>
<tr>
<td>Multifamily &lt; 2000 square feet average unit size</td>
<td>6 points</td>
</tr>
<tr>
<td>&lt;2000 square feet</td>
<td>7 points</td>
</tr>
<tr>
<td>2000 to 4000 square feet</td>
<td>9 points</td>
</tr>
<tr>
<td>&gt;4000 square feet</td>
<td>12 points</td>
</tr>
</tbody>
</table>

R407.2.1.3 Points by Component. After determining the number of points required using Table R407.2.1.2, select the components from Table 407.2.1.3 to accumulate the required number of points. The total number of points selected from Table 407.2.1.3 must meet or exceed the required points from Table 407.2.1.2.

<table>
<thead>
<tr>
<th>Table R407.2.1.3</th>
<th>POINTS BY COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>Description</td>
</tr>
<tr>
<td>Slab</td>
<td>R-10 below entire slab</td>
</tr>
<tr>
<td>Walls-</td>
<td>Above Grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Exception: not available for stretch package 3) OR</td>
</tr>
<tr>
<td>Upgraded</td>
<td></td>
</tr>
<tr>
<td>Walls –</td>
<td>Above Grade walls ≥ R-40 (cavity + continuous) (or U-factor maximum 0.025 wall assembly)</td>
</tr>
<tr>
<td>High-R</td>
<td></td>
</tr>
<tr>
<td>Ceiling</td>
<td>R-80 attic / R-60 sloped, vaulted and cathedral</td>
</tr>
<tr>
<td>Windows</td>
<td>Average U-factor ≤ 0.22</td>
</tr>
<tr>
<td>Pre-Drywall</td>
<td>ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered OR</td>
</tr>
<tr>
<td>Tight</td>
<td>ACH50 ≤ 2.0 and balanced ventilation with ECM fans and ≥ 70% SRE for HRV, ≥65% SRE for ERV OR</td>
</tr>
<tr>
<td>Very Tight</td>
<td>ACH50 ≤ 1.0 and balanced ventilation with ECM fans and ≥ 80% SRE for HRV, ≥75% SRE for ERV</td>
</tr>
<tr>
<td>Basic</td>
<td>ENERGY STAR basic: (1) Gas/propane furnace ≥95 AFUE, Oil furnace ≥85 AFUE, (2) Gas/Propane Boiler ≥90 AFUE, Oil Boiler ≥87 AFUE, (3) Heat pump HSPF ≥9.0; PLUS any AC is SEER ≥14.5 OR</td>
</tr>
<tr>
<td>Advanced</td>
<td>Advanced: Whole building heat/cool is (1) NEEP-listed heat pump combination, (2) GSHP, closed loop and COP ≥ 3.3, (3) ATWHP COP ≥2.5 and</td>
</tr>
<tr>
<td>Water</td>
<td>120F design temp, (4) Advanced wood heating system</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Basic</td>
<td>ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for &gt; 55 gal] <strong>OR</strong>[^b]</td>
</tr>
<tr>
<td>Advanced</td>
<td>ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥2.20 for ≥ 55 gal]</td>
</tr>
<tr>
<td>Low Flow</td>
<td>All showerheads ≤ 1.75 gpm[^i], all lav. faucets ≤ 1.0 gpm[^i], and all toilets ≤ 1.28 gpf[^h] <strong>OR</strong>[^b]</td>
</tr>
<tr>
<td>Certified</td>
<td>Certified water efficient design per WERS, WaterSense, or RESNETH2O (for new construction only)</td>
</tr>
<tr>
<td>Drain Heat Recovery</td>
<td>Drain water heat recovery system on primary showers and tubs</td>
</tr>
<tr>
<td>User-Demand</td>
<td>Controlled hot water recirculation system with user-demand via push-button for furthest fixtures</td>
</tr>
<tr>
<td>On-Site Generation</td>
<td>Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site <strong>1 per 1.5 kW, max. 4</strong></td>
</tr>
<tr>
<td>Solar Hot Water</td>
<td>Solar hot water system designed to meet at least 50% of annual hot water load</td>
</tr>
<tr>
<td>Solar PV</td>
<td>Solar Photovoltaic (PV), 1 point per 1.5 kW per housing unit of renewable generation on site <strong>1 per 1.5 kW, max. 4</strong></td>
</tr>
<tr>
<td>Solar Ready for Multifamily</td>
<td>Multifamily building complies with Solar Ready Zone R.407.5.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>1.5 kW, max. 4</td>
</tr>
<tr>
<td>Advanced</td>
<td>1.5 kW, max. 4</td>
</tr>
<tr>
<td>Low Flow</td>
<td>All showerheads ≤ 1.75 gpm[^i], all lav. faucets ≤ 1.0 gpm[^i], and all toilets ≤ 1.28 gpf[^h] <strong>OR</strong>[^b]</td>
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<tr>
<td>On-Site Generation</td>
<td>Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site <strong>1 per 1.5 kW, max. 4</strong></td>
</tr>
<tr>
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<td>Multifamily building complies with Solar Ready Zone R.407.5.</td>
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<td>Monitoring</td>
<td>Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Measures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EV Ready Battery</td>
<td>Level 2 electric vehicle charger-ready per 407.4[^k]</td>
</tr>
<tr>
<td>Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

- **a.** Heating and cooling system points are only available if all components of primary systems include heating, air conditioning and domestic hot water compliance.
- **b.** "OR" indicates that points are not additive; one component OR the following one can be selected, but not both.
- **c.** "H/ERV" = Heat or Energy Recovery Ventilation
- **d.** "SRE" = System Recovery Efficiency
- **e.** "ECM" = Electronically Commutated Motor
- **f.** "ATWHP" = Air-to-Water Heat Pump
- **g.** "gpm" = gallons per minute
- **h.** "gpf" = gallons per flush. Applies to new construction only.
- **i.** "GSHP" = ground-source heat pump
- **j.** https://neep.org/initiatives/high-efficiency-products/emergingtechnologies/ashp/cold-climate-air-source-heat-pump
- **k.** Points are limited to one per dwelling. Additional Level 2 charging equipment receives no more points.
- **l.** See Section R403.3.3 and R403.3.4 for duct leakage requirements.
R407.2 Testing.
For the Stretch Code, the building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding three air changes per hour. Testing shall be conducted in accordance with ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Testing and verification shall be conducted by an applicable Building Performance Institutes (BPI) Professional, a Home Energy Rating System (HERS) Energy Rater, HERS Field Inspector, or a Vermont Public Service Department approved air leakage tester. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official or other authority having jurisdiction, where one exists, and to the Public Service Department along with the RBES certificate upon completion of the construction project. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:
1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, if installed at the time of the test, shall be open.
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.

R407.2.2 ERI-based compliance for Stretch Code. Compliance based on an ERI analysis requires that the rated design be shown to have an ERI less than or equal to 54 when compared to the ERI reference design. This includes all residential structures, including log homes. The ERI to be used to verify compliance is “HERS Index with IAF” using REM/Rate version 15.7. Up to 5 ERI points can be earned with renewables.

6. Supply and return registers, if installed at the time of the test, shall be fully open.

<table>
<thead>
<tr>
<th>Stretch Code Target</th>
<th>Maximum HERS Index to demonstrate code compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub-Target</th>
<th>Maximum HERS Index without any renewables incorporated</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Renewables</th>
<th>Maximum HERS Index points that can be counted towards Code Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

TABLE R407.2
MAXIMUM STRETCH CODE ENERGY RATING INDEX
Note: Based on REM/Rate version 14. If the HERS Index scale is revised, the Department of Public Service Department may update these Index points.

**R407.3 Electric vehicle charging**

*R407.3 Air Leakage Testing for Stretch Code.* In addition to the requirements in R402.1.2 for testing air leakage, air leakage testing shall be reported on the RBES Certificate in units of air changes per hour at 50 Pascals (ACH50) in addition to cubic feet per minute (cfm) at 50 Pascals (CFM50) per square foot of building thermal shell area. Building thermal shell area shall include all six (6) sides of the building.

**R407.4 Electric vehicle charging for Stretch Code.**

For single family housing, one Level 1 parking space is required with accessible socket.

Parking lots serving multifamily developments of 10 or more dwelling units, 4% of parking spaces (rounded up to the nearest whole number) shall have a socket capable of providing either a shall provide level 1 or level 2 charge (see below) electrical service to the required number of Electric Vehicle Charging Parking Spaces in Table R404.3. If level 1 service is provided, the required EV Charging Parking Spaces shall also be "Level 2 ready" as defined below in this Section R407.4. Electrical service capacity includes use of a listed cabinet, box or enclosure connected to a conduit linking the parking spaces with the electrical service.

**Exception:** Parking spaces are not counted in Table R404.3 if one of the following conditions apply:

1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
2. Parking spaces are separated from the meter by a public right-of-way.
3. Parking spaces which are limited to parking durations of less than an hour.

Parking spaces with Electric Vehicle Supply Equipment ("EVSE") shall be marked for EV use only.

**Exception:** The number of parking spaces with EVSE that are marked for “EV use only” need not exceed the number of EV cars driven by occupants of the building. This exception does not reduce the number of EVSE spaces required, just the number that are marked for EV use only.

Level 1 Electric Vehicle Charging Parking requires one 120V 20 amp grounded AC receptacle, NEMA 5-20R or equivalent, within 5 feet of the centerline of the parking space (“each EV Charging Parking Space”).

Level 2 Electric Vehicle Charging Parking requires one 208/240V 40 amp grounded AC outlet, or equivalent, for each EV Charging Parking Space.

Level 2 requires one 208/240V 40 amp grounded AC outlet, or equivalent, for each EV Charging Parking Space.
TABLE 407.3

Level 2 “ready” includes space in the panel for at least one minimum 40-ampere branch circuit to be provided to garages and/or the exterior of the building to accommodate a future dedicated Society of Automotive Engineers (SAE) standard J1772-approved Level 2 EVSE. The circuits shall have no other outlets. The service panel shall provide sufficient capacity and space to accommodate the circuit and over-current protective device. A permanent and visible label stating “EV READY” shall be posted in a conspicuous place at both the service panel and the circuit termination point.

R407.5 Solar Ready Zone for Stretch Code.

R407.5.1 General.
New detached one- and two-family dwellings, and multiple single-family dwellings (townhouses) with not less than 600 ft² (55.74 m²) of roof area oriented between 110° and 270° of true north shall comply with sections 407.5.

EXCEPTIONS:
1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded for more than 70% of daylight hours annually.
3. Buildings and structures as designed and shown in construction documents that do not meet the conditions for a solar-ready zone area.
4. Buildings with possible location(s) for ground mounted systems identified in the submitted construction documents. Buildings claiming this exception must either install appropriate electrical conduit to the site of the proposed ground mounted solar array or include a solar site evaluation that supports the siting of the proposed ground mounting location.

R407.5.2 Construction Document Requirements for Solar Ready Zone
Construction documents shall indicate the solar ready zone where applicable.

R407.5.3 Solar-Ready Zone Area.
The total solar-ready zone area shall consist of an area not less than 300 ft² (27.87 m²) exclusive of mandatory access or set back areas. New multiple single-family dwellings (townhouses) three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 ft² (185.8 m²) per dwelling shall have a solar-ready zone area of not less than 150 ft² (13.94 m²). Multifamily buildings should maximize the solar-ready zone by consolidating mechanicals, access, set back areas and other roof obstructions with a goal of 40% of the roof area available for the solar-ready zone. The solar-ready zone shall be composed of areas not less than five feet (1,524 mm) in width and not less than 80 ft² (7.44 m²) exclusive of access or required set back areas.

For ground-mounted systems, possible locations of the panels must be identified in the submitted construction documents and be supported by a solar site evaluation. At least one
potential location must be identified in the construction documents for the future installation of the panels.

R407.5.4 Obstructions.
Solar-ready zones shall consist of an area free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R407.5.5 Roof Load Documentation.
The structural design loads for roof dead load and roof live load to support the solar system shall be clearly indicated on the construction documents.

R407.5.6 Interconnection Pathway.
Construction documents shall indicate pathways for routing of conduit (or plumbing for solar thermal systems) from the solar-ready zone to the electrical service panel or service hot water system. Alternatively, install two 1” minimum diameter EMT conduits from the main electrical panel location to the attic or other area easily accessible to the solar array’s proposed location. Conduits for future solar installations are to be capped, airtight and labeled at both ends.

R407.5.7 Electrical Service Reserved Space.
The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.” The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location. Note: this requirement is in addition to the electrical service reserved space for electric vehicle charging.
CHAPTER 5 (RE)
EXISTING BUILDINGS

SECTION R501
GENERAL

R501.1 Scope.
The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

R501.1.1 Additions, alterations, or repairs: General.
Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503 or R504. Unaltered portions of the existing building or building supply system shall not be required to comply with this code. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

R501.1.2 Compliance approaches.
Thermal efficiency can be achieved through any of the compliance paths, including any one of the following approaches: prescriptive packages, REScheck™ software, or a Home Energy Rating System (HERS) rating.

R501.2 Existing buildings.
Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

R501.3 Maintenance.
Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this code shall be maintained in conformance to the code edition under which installed. The owner or the owner’s authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection and safety systems and devices in existing structures.

R501.4 Compliance.
R501.5 New and replacement materials.
Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided that hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

R501.6 Historic buildings.
No provision of this code relating to the construction, repair, alteration, restoration and movement of structures, and change of occupancy shall be mandatory for historic buildings provided a “Historic Building Exemption Report” obtained from the State Historic Preservation Office has been submitted to the State Historic Preservation Office and signed by either the owner, an owner's agent, a registered design professional, or a representative of the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic fabric or function of the building. The State Historic Preservation Office, upon receipt of the report, will review and validate the exemption request. Upon request, a copy of the report shall be provided to the local authority having jurisdiction.

SECTION R502
ADDITIONS

R502.1 General.
Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition uses no more energy than the existing building. Additions shall be in accordance with Section R502.1.1 or R502.1.2.

R502.1.1 Prescriptive compliance.
Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

R502.1.1.1 Building envelope.
New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: Where unconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the UA, as determined in Section 402.1.4, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to UA generated for the existing building.

R502.1.2 Heating and cooling systems.
New heating, cooling and duct systems that are part of the addition shall comply with Sections R403.1, R403.2, R403.3, R403.5 and, R403.6 and R404. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.
**Exception:** Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

**R502.1.1.3 Service hot water systems.**
New service hot water systems that are part of the addition shall comply with Section R403.4. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

**R502.1.1.4 Lighting.**
New lighting systems that are part of the addition shall comply with Section R404.1.

**R502.1.2 Existing plus addition compliance (Simulated Performance Alternative).**
Where unconditioned space is changed to conditioned space, the addition shall comply where the annual energy cost or energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with any of the Chapter 4 compliance options in its entirety.

**SECTION R503 ALTERATIONS**

**R503.1 General.**
Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alteration.

Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

**R503.1.1 Building envelope.**
Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.1213, R402.3.1, R402.3.2, R402.4.3 and R402.4.4. Uninsulated or under-insulated wall, floor and roof building cavities that are filled with insulation only need to fill that cavity with insulation, and are not required to meet the R-value requirements in Table R402.1.2 or R407.4.

**Exception:** The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.

3. Construction where the existing roof, wall or floor cavity is not exposed.

4. Roof recover.

5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.

6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing or fenestration assembly to be replaced.

R503.1.1.1 Replacement fenestration.
Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC as provided in Table R402.1.4. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the U-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance.

R503.1.2 Heating and cooling systems.
New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3 and R403.6 and R404. Connections or repairs to, or maintenance of existing mechanical systems do not constitute an alteration to that system.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R503.1.3 Service hot water systems.
New service hot water systems that are part of the alteration shall comply with Section R403.45.

R503.1.4 Lighting.
New lighting systems that are part of the alteration shall comply with Section 404.1.

Exception: Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

R503.2 Change in space conditioning.
Any unconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance (REScheck) option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.
SECTION R504
REPAIRS

R504.1 General.
Buildings, structures and parts thereof shall be repaired in compliance with Section R501.3 and this section. Work on nondamaged components necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section R501.3, ordinary repairs exempt from permit, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section and are exempt from meeting RBES requirements.

R504.2 Application.
For the purposes of this code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.
2. Roof repairs.
3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior lighting power.

SECTION R505
CHANGE OF OCCUPANCY OR USE

R505.1 General.
Spaces undergoing a change in use that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

R505.1.1 Hunting Camps and Summer Camps. Once a hunting camp or a summer camp changes occupancy and becomes a residence, or is converted from an "non-conditioned space" to a "conditioned space", it must then be upgraded to comply with the code.

R505.2 General.
Any space that is converted to a dwelling unit or portion thereof from another use shall comply with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.
# CHAPTER 6
## REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 106.

### AAMA
American Architectural Manufacturers Association  
1827 Walden Office Square  
Suite 550  
Schaumburg, IL 60173-4268

<table>
<thead>
<tr>
<th>Standard reference number</th>
<th>Title</th>
<th>Referenced in code section number</th>
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</table>

### ACCA
Air Conditioning Contractors of America  
2800 Shirlington Road, Suite 300  
Arlington, VA 22206

<table>
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<th>Standard reference number</th>
<th>Title</th>
<th>Referenced in code section number</th>
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<tr>
<td>Manual S—1314</td>
<td>Residential Equipment Selection</td>
<td>R403.7</td>
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</tbody>
</table>

### APSP
The Association of Pool and Spa Professionals  
2111 Eisenhower Avenue  
Alexandria, VA 22314

<table>
<thead>
<tr>
<th>Standard reference number</th>
<th>Title</th>
<th>Referenced in code section number</th>
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<tbody>
<tr>
<td>ANSI/APSP/ICC 14—112014</td>
<td>American National Standard for Portable Electric Spa Energy Efficiency</td>
<td>R403.10.1, 403.11</td>
</tr>
</tbody>
</table>

### ASHRAE
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.  
1791 Tullie Circle, NE  
Atlanta, GA 30329-2305

<table>
<thead>
<tr>
<th>Standard reference number</th>
<th>Title</th>
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<tbody>
<tr>
<td>ASHRAE—20132017</td>
<td>ASHRAE Handbook of Fundamentals</td>
<td>Table R402.1.5, Table R405.5.2(1)</td>
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20152019 Vermont Residential Building Energy Standards  
102
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<tbody>
<tr>
<td>C 1363—11</td>
<td>Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus-</td>
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<tr>
<td>E 283—04(2012)</td>
<td>Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen</td>
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<tr>
<td>E 779—10</td>
<td>Standard Test Method for Determining Air Leakage Rate by Fan Pressurization</td>
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<tr>
<td>E 1827—11</td>
<td>Standard Test Methods for Determining Airtightness of Building Using an Orifice Blower Door</td>
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<tr>
<td>E 2357</td>
<td>Standard Test Method for Determining Air Leakage of Air Barrier Assemblies</td>
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<tr>
<td>51.71—95</td>
<td>The Spillage Test Method to Determine the Potential for Pressure-Induced Spillage from Ventilated Fuel-Fired Space Heating Appliances, Water Heaters and Fireplaces</td>
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<tr>
<td>CSA 55.1—2012</td>
<td>Test Method for measuring efficiency and pressure loss of drain water heat recovery units</td>
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<tr>
<td>CSA 55.2—2012</td>
<td>Drain water heat recovery units</td>
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### DASMA

**Door and Access Systems Manufacturers Association**  
1300 Sumner Avenue  
Cleveland, OH 44115-2851

<table>
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<th>Title</th>
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<td>105—92(R2004)—132016</td>
<td>Test Method for Thermal Transmittance and Air Infiltration of Garage Doors</td>
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### HVI

**Home Ventilating Institute**  
1000 North Rand Road, Suite 214  
Wauconda, IL 60084

<table>
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<th>Title</th>
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<td>916—09</td>
<td>Airflow Test Procedure</td>
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### ICC

**International Code Council, Inc.**  
500 New Jersey Avenue, NW  
6th Floor  
Washington, DC 20001

<table>
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<tr>
<td>ICC 400—12 IBC—18</td>
<td>Standard on the Design and Construction of Log Structures International Building Code®</td>
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<td>IECC—09</td>
<td>2009 International Energy Conservation Code®</td>
<td>R406.2</td>
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<td>IECC—06</td>
<td>2006 International Energy Conservation Code®</td>
<td>R406.3.1</td>
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<td>IFC—15</td>
<td>International Fire Code®</td>
<td>R201.3, R501.4</td>
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<td>IFGC—18</td>
<td>International Fuel Gas Code®</td>
<td>R201.3, R501.4</td>
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<tr>
<td>IEGC—15</td>
<td>International Fuel Gas Mechanical Code®</td>
<td>R201.3, R403.3.2, R403.6.1, R501.4</td>
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<td>IMC—15</td>
<td>International Mechanical Plumbing Code®</td>
<td>R201.3, R403.3.2, R403.6.1, R501.4</td>
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<td>IPC—18</td>
<td>International Plumbing Private Sewage Disposal Code®</td>
<td>R201.3, R501.4</td>
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<tr>
<td>IPSDC—18</td>
<td>International Private Sewage Disposal Property Maintenance Code®</td>
<td>R201.3, R501.4</td>
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<tr>
<td>IPMC—15</td>
<td>International Property Maintenance Residential Code®</td>
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<tr>
<td>515.1—2012</td>
<td>IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications</td>
<td>R403.5.1.2</td>
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<td>31—06</td>
<td>Installation of Oil-Burning Equipment</td>
<td>R305.1, R305.2, R305.3</td>
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<td>54—09</td>
<td>National Fuel Gas Code</td>
<td>R305.1, R305.2, R305.3</td>
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<td>70—1417</td>
<td>National Electrical Code</td>
<td>R501.4</td>
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<td>100—20092017</td>
<td>Procedure for Determining Fenestration Products U-factors—Second Edition</td>
<td>R303.1.3</td>
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<td>Procedure for Determining Fenestration Product Air Leakage—Second Edition</td>
<td>R402.4.3</td>
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<td>RESNET</td>
<td>Residential Energy Services Network, Inc.</td>
<td></td>
</tr>
<tr>
<td>P.O. Box 4561</td>
<td>Oceanside, CA 92052-4561</td>
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<td>20152019 Vermont Residential Building Energy Standards</td>
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<tr>
<td>UL LLC</td>
<td>UL LLC 333 Pfingsten Road Northbrook, IL 60062</td>
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<td>127—11</td>
<td>Standard for Factory Built Fireplaces – with Revisions through May 2015</td>
<td>R402.4.2</td>
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<td>515—11</td>
<td>Electrical Resistance Heat Tracing for Commercial and Industrial Applications including revisions through November 30, 2011 July 2015</td>
<td>R403.5.1.2</td>
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<td>US-FTC</td>
<td>United States-Federal Trade Commission 600 Pennsylvania Avenue NW Washington, DC 20580</td>
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<td>Standard reference number</td>
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<td>WDMA</td>
<td>Window and Door Manufacturers Association 2025 M Street, NW Suite 800 Washington, DC 20036-3309</td>
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<td>Standard reference number</td>
<td>Title</td>
<td>Referenced in code section number</td>
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APPENDIX RA
RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS UNDER R402.4 OR R405 CONDITIONS ≤ 5ACH₅₀

(This appendix is informative and is not part of the code.)

SECTION RA101
SCOPE

RA101.1 General.
This appendix is intended to provide guidelines for worst-case testing of atmospheric venting systems. Worst-case testing is recommended to identify problems that weaken draft and restrict combustion air.

SECTION RA201
GENERAL DEFINITIONS

COMBUSTION APPLIANCE ZONE (CAZ). A contiguous air volume within a building that contains a Category I or II atmospherically vented appliance or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside the building or dwelling unit. The CAZ includes, but is not limited to, a mechanical closet, a mechanical room, or the main body of a house or dwelling unit.

DRAFT. The pressure difference existing between the appliance or any component part and the atmosphere that causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

Mechanical or induced draft. The pressure difference created by the action of a fan, blower or ejector that is located between the appliance and the chimney or vent termination.

Natural draft. The pressure difference caused by a vent or chimney because of its height and the temperature difference between the flue gases and the atmosphere.

SPILLAGE. Combustion gases emerging from an appliance or venting system into the combustion appliance zone during burner operation.

SECTION RA301
TESTING PROCEDURE

RA301.1 Worst-case testing of atmospheric venting systems.
Buildings or dwelling units containing a Category I or II atmospherically vented appliance; or a Category III or IV direct-vent or integral vent appliance drawing combustion air from inside of the building or dwelling unit, shall have the Combustion Appliance Zone (CAZ) tested for spillage,
acceptable draft and carbon monoxide (CO) in accordance with this section. Where required by the code official or other authority having jurisdiction, where one exists, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official or other authority having jurisdiction, where one exists. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope and prior to final inspection.

**Exception:** Buildings or dwelling units containing only Category III or IV direct-vent or integral vent appliances that do not draw combustion air from inside of the building or dwelling unit.

The enumerated test procedure as follows shall be complied with during testing:

1. Set combustion appliances to the pilot setting or turn off the service disconnects for combustion appliances. Close exterior doors and windows and the fireplace damper. With the building or dwelling unit in this configuration, measure and record the baseline ambient pressure inside the building or dwelling unit CAZ. Compare the baseline ambient pressure of the CAZ to that of the outside ambient pressure and record the difference (Pa).

2. Establish worst case by turning on the clothes dryer and all exhaust fans. Close all interior doors that make the CAZ pressure more negative. Turn on the air handler, where present, and leave on if, as a result, the pressure in the CAZ becomes more negative. Check interior door positions again, closing only the interior doors that make the CAZ pressure more negative. Measure net change in pressure from the CAZ to outdoor ambient pressure, correcting for the base ambient pressure inside the home. Record “worst case depressurization” pressure and compare to Table RA301.1(1).

   Where CAZ depressurization limits are exceeded under worst-case conditions in accordance with Table A301.1(1), additional combustion air shall be provided or other modifications to building air-leakage performance or exhaust appliances such that depressurization is brought within the limits prescribed in Table RA301.1(1).

3. Measure worst-case spillage, acceptable draft and carbon monoxide (CO) by firing the fuel-fired appliance with the smallest Btu capacity first.

   a. Test for spillage at the draft diverter with a mirror or smoke puffer. An appliance that continues to spill flue gases for more than 60 seconds fails the spillage test.

   b. Test for CO measuring undiluted flue gases in the throat or flue of the appliance using a digital gauge in parts per million (ppm) at the 10-minute mark. Record CO ppm readings to be compared with Table RA301.1(3) upon completion of Step 4. Where the spillage test fails under worst case, go to Step 4.

   c. Where spillage ends within 60 seconds, test for acceptable draft in the connector not less than 1 foot (305 mm), but not more than 2 feet (610 mm) downstream of the draft diverter. Record draft pressure and compare to Table RA301.1(2).
d. Fire all other connected appliances simultaneously and test again at the draft diverter of each appliance for spillage, CO and acceptable draft using procedures 3a through 3c.

4. Measure spillage, acceptable draft, and carbon monoxide (CO) under natural conditions—without clothes dryer and exhaust fans on—in accordance with the procedure outlined in Step 3, measuring the net change in pressure from worst case condition in Step 3 to natural in the CAZ to confirm the worst-case depressurization taken in Step 2. Repeat the process for each appliance, allowing each vent system to cool between tests.

5. Monitor indoor ambient CO in the breathing zone continuously during testing and abort the test where indoor ambient CO exceeds 35 ppm by turning off the appliance, ventilating the space, and evacuating the building. The CO problem shall be corrected prior to completing combustion safety diagnostics.

6. Make recommendations based on test results and the retrofit action prescribed in Table RA301.1(3).

**TABLE RA301.1(1)**
CAZ DEPRESSURIZATION LIMITS

<table>
<thead>
<tr>
<th>VENTING CONDITION</th>
<th>LIMIT (Pa)</th>
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<tbody>
<tr>
<td>Category I, atmospherically vented water heater</td>
<td>−2.0</td>
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<tr>
<td>Category I or II atmospherically vented boiler or furnace common-vented with a Category I atmospherically vented water heater</td>
<td>−3.0</td>
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<tr>
<td>Category I or II atmospherically vented boiler or furnace, equipped with a flue damper, and common vented with a Category I atmospherically vented water heater</td>
<td>−5.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented boiler or furnace alone</td>
<td>−5.0</td>
</tr>
<tr>
<td>Category I or II atmospherically vented, fan-assisted boiler or furnace common vented with a Category I atmospherically vented water heater</td>
<td>−5.0</td>
</tr>
<tr>
<td>Decorative vented, gas appliance</td>
<td>−5.0</td>
</tr>
<tr>
<td>Power-vented or induced-draft boiler or furnace alone, or fan-assisted water heater alone</td>
<td>−15.0</td>
</tr>
<tr>
<td>Category IV direct-vented appliances and sealed combustion appliances</td>
<td>−50.0</td>
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</table>

For SI: 6894.76 Pa = 1.0 psi.

**TABLE RA301.1(2)**
ACCEPTABLE DRAFT TEST CORRECTION

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<tr>
<th>OUTSIDE TEMPERATURE (°F)</th>
<th>MINIMUM DRAFT PRESSURE REQUIRED (Pa)</th>
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<td>&lt; 10</td>
<td>−2.5</td>
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<tr>
<td>10 – 90</td>
<td>(Outside Temperature ÷ 40) – 2.75</td>
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<tr>
<td>&gt; 90</td>
<td>−0.5</td>
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</table>

For SI: 6894.76 Pa = 1.0 psi.

20452019 Vermont Residential Building Energy Standards 109
## TABLE RA301.1(3)
### ACCEPTABLE DRAFT TEST CORRECTION

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<thead>
<tr>
<th>CARBON DIOXIDE LEVEL (ppm)</th>
<th>AND OR</th>
<th>SPILLAGE AND ACCEPTABLE DRAFT TEST RESULTS</th>
<th>RETROFIT ACTION</th>
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<tr>
<td>0 – 25</td>
<td>and</td>
<td>Passes</td>
<td>Proceed with work</td>
</tr>
<tr>
<td>25 &lt; x ≤ 100</td>
<td>and</td>
<td>Passes</td>
<td>Recommend that CO problem be resolved</td>
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<tr>
<td>25 &lt; x ≤ 100</td>
<td>and</td>
<td>Fails in worst case only</td>
<td>Recommend an appliance service call and repairs to resolve the problem</td>
</tr>
<tr>
<td>100 &lt; x ≤ 400</td>
<td>or</td>
<td>Fails under natural conditions</td>
<td>Stop! Work shall not proceed until appliance is serviced and problem resolved</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>and</td>
<td>Passes</td>
<td>Stop! Work shall not proceed until appliance is serviced and problem resolved</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>and</td>
<td>Fails under any condition</td>
<td>Emergency! Shut off fuel to appliance and call for service immediately</td>
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</tbody>
</table>
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RE: Vermont Residential Building Energy Standards Rule Responsiveness Summary

Attached please find the responses of the Public Service Department (“Department”) to comments and suggested changes received during the public comment period for the Residential Building Energy Standards (“RBES”) rule. All comments received by the Department are included in its filing. In most cases the Department did not draft responses to comments that did not include specific suggestions for changes to the language. These comments tended to be general or of a policy nature.

The Department made a few changes to the rule language based on informal conversations with stakeholders (as opposed to in direct response to specific public comments). Those changes are detailed below:

- Removed the words “and hot water” from exemption #5 in Section R101.5.2, which now reads: “Summer camps. Residential buildings constructed for non-winter occupation with only a biomass (wood) or other on-site renewable heating and hot water system.
- Changed the word “nonconditioned” to “unconditioned” (italicized because it is defined in Section R202) throughout the document.
- Added a new Section R505.1.1 to clarify that a Hunting Camp or Summer Camp is not exempt from RBES if it becomes a permanent residence or is converted from an unconditioned space to a conditioned space.

The issue of code compliance and enforcement was a strong and reoccurring topic during the lengthy stakeholder engagement process that the Department undertook to update this rule. It is not within the Department’s purview to make the changes proposed by stakeholders, as compliance and enforcement requirements are embedded in statute. It should be noted though that industry groups collectively petitioned the legislature to look at measures that could address the compliance and enforcement of the energy codes. The core reason stated for wanting some level of enforcement and compliance was to ‘level the playing field’ by ensuring that all those involved in construction follow the law as described in this rule. Another related recommendation was to have code officials who can review technical plans and drawings prior to construction to ensure that the proposed structure meets the rule’s requirements.

Please contact me if you need any additional information or clarification on this item.

Regards,

Keith Levenson
Energy Program Specialist,
Energy and Efficiency Resources Division
Public Service Department
<table>
<thead>
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<th>Commenter</th>
<th>Chapter Ref.</th>
<th>Comment Summary</th>
<th>PSD Response</th>
<th>Decision &amp; Changes Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/24/2019</td>
<td>Brian Just,</td>
<td>Table R402.1.2.1</td>
<td>Footnote f states that R-25 can be met by any combination of insulation R-values, suggesting that R-20+5 is equal to R-25. This is not correct. We recommend clarifying the footnote. The code and proper accounting of heat flow through framing does not allow straight addition of cavity and continuous insulation components.</td>
<td>Agreed.</td>
<td>Edited footnote to Table R402.1.2.1:  f. The first value is cavity insulation, the second value is continuous insulation, so &quot;13+10&quot; means R-13 cavity insulation plus R-10 continuous insulation. Just these insulation requirements can be met through any combination of insulation R-values, cavity or cavity and continuous insulation that yields an equivalent effective R-value using a series-parallel path calculation method. Also changed footnotes: a. Added &quot;See R402.1.4 for alternative compliance methods.&quot; e. Added: &quot;When used, continuous insulation values shall be at least R-5.&quot;</td>
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<td>5/24/2019</td>
<td>Brian Just,</td>
<td>Sections R101.8 and R202</td>
<td>During my review of the latest RBES while working on the Code Handbook recommendations, I noticed some typos: - P21 R101.8 Option 1: needs the word &quot;list&quot; between Table R407.2.1.1 and the word three - P31 Demand Recirc Water System: final phrase should read &quot;from a heated water supply pipe to the heated water fixture upon user demand...&quot; - P35: extra period at the end of Level 2 EV charging def'n</td>
<td>Agreed.</td>
<td>Made all suggested corrections: - P.21, R101.8 Option 1: inserted the word &quot;list&quot; between Table R407.2.1.1 and the word 'three' - P.31, Demand Recirculation Water System: final phrase now reads &quot;from a heated water supply pipe to the heated water fixture upon user demand...&quot; - P.35, deleted extra period at the end of Level 2 EV charging definition</td>
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<td>5/24/2019</td>
<td>Brian Just,</td>
<td>Table R402.4.1.1, page 72</td>
<td>P.72: missing Component type in first left row of Table R402.4.1.1</td>
<td>Agreed.</td>
<td>Turned combined section in TABLE R402.4.1.1 into three separate rows and added &quot;Component&quot; types for these first three rows: &quot;General conditions and appropriate materials for air barriers&quot;, &quot;Dropped ceilings/soffits&quot; and &quot;Framing junctions and cavities&quot;</td>
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<td>5/24/2019</td>
<td>Brian Just,</td>
<td>P65: R402.2.2.1</td>
<td>P.65: R402.2.2.1 Item 4: IRC 2015 states: &quot;In Climate Zones 5, 6, 7 and 8, any air-impermeable insulation shall be a Class II vapor retarder, or shall have a Class III vapor retarder coating or covering in direct contact with the underside of the insulation.&quot; – it might be worth having someone review why we vary the wording and have Class III listed (appears to be a carryover from 2015 RBES)</td>
<td>Agreed to align this language with the IRC, which prescribes a Class II vapor retarder</td>
<td>&quot;Class III&quot; changed to &quot;Class II&quot; in Section R402.2.2.1 Item 4.</td>
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<td>5/24/2019</td>
<td>Brian Just,</td>
<td>Section R406.2</td>
<td>P.85: R406.2: incorrect sections referenced that could weaken intent of code. Someone should have a glance by what was meant by &quot;R402.1 and R403.5.3.&quot; I don’t think they are valid anymore</td>
<td>Add internal references in Section R406.2 to the minimum compliance requirements elsewhere in the code.</td>
<td>Added internal references to all minimum requirements in Section R406.2</td>
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<td>5/24/2019</td>
<td>Brian Just,</td>
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<td>There is a discrepancy between the solar ready points options in Base and Stretch code.</td>
<td>This is intentional. For stretch code, multifamily buildings are not required to be solar ready, so the code offers a point if they choose to construct a solar ready building per Section R.407.5.</td>
<td>No change.</td>
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<td>6/4/2019</td>
<td>Sam Scofield <a href="mailto:sam@samarch.com">sam@samarch.com</a></td>
<td>Table R402.1.2.1</td>
<td>Regarding the proposed 2020 RBES Table R402.1.2.1 as a registered architect in Vermont I believe that it is irresponsible of the State to publish and therefore promote R values for Envelope and especially Wood Framed Wall construction using exterior insulation values that have been discredited in a number of studies as having inadequate amounts of exterior continuous insulation for our climate zone. Please revise these numbers accordingly to follow guidelines for our Climate Zone. In addition, please give some guidance as to achieving your desired overall energy savings without using exterior insulation, which presents a number of problems with detailing and correct execution of construction.</td>
<td>The Department is aware of the potential moisture problems in exterior walls when improperly applying inadequate exterior insulation. We have added language at the end of Section R402.1.2 and other relevant locations in the code to emphasize the potential for moisture problems. There are continuous exterior insulation products (e.g. rock wool) that, if applied correctly, can provide R-5 insulation without moisture condensation in our climate. RBES code language is intended to specify insulation levels and not how to apply materials correctly using proper building science; that is the designer’s and builder’s prerogative and responsibility. However, the Code Handbook will provide details and guidance on proper insulation installation and applications that meet the R-values in RBES while ensuring durability and moisture protection of building components.</td>
<td>Added the following language at the end of Section R402.1.2, “Building science principles should be applied in all circumstances. Consult with a building science professional and refer to the Vermont Residential Energy Code Handbook for additional guidance and details.” The Code Handbook will emphasize the potential for moisture problems using R-5 continuous exterior insulation and provide guidance on proper insulation systems for building durability and moisture protection.</td>
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<td>6/19/2019</td>
<td>Regan Ratliff <a href="mailto:Rratliff@phta.org">Rratliff@phta.org</a> Pool and Hot Tub Alliance</td>
<td>R403.10.1, R403.12</td>
<td>We are supportive of the inclusion of the pool &amp; spa IECC sections, but want to bring to your attention the following: After looking through section R403.10 ‘Pools and permanent spa energy consumption (Mandatory)’ of the proposed rule it seems there may be a duplicate section. Section R403.10.1 is a duplicate of section R403.12 and there is also a typo in section R403.10.1 which references APSP-145 when it is actually APSP-15. We would like to see the deletion of section R403.10.1 as the appropriate language is already referenced in section R403.12. This also would follow what is in the IECC, as the duplication was fixed in an ICC errata.</td>
<td>Agreed.</td>
<td>Section R403.12 deleted</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
<td>Slab Edge – For concrete slab floors above a basement parking garage, it is difficult to achieve the requirements for slab edge insulation.</td>
<td>In the context of the code, these concrete slabs are treated as exposed floors. The RBES definition refers to &quot;slab-on-grade&quot; and all other references in the code are now to &quot;slab-on-grade&quot; to avoid confusion.</td>
<td>All references to &quot;slab edge&quot; have been changed to &quot;slab-on-grade edge&quot; which is defined in Section R202.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
<td>Larger Homes – consider higher efficiency standards for larger homes.</td>
<td>There has been a good deal of discussion among stakeholders, the Advisory Committee and affordable housing advocates to settle on the points required based on home size in Table R402.1.2.2. We are disinclined to change this table at this late date without proper vetting. The PSD will continue to discuss this issue with stakeholders in the interim between code updates.</td>
<td>No change.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
<td>Section R404.2 Electric Heat – Confirm reference to &quot;Burlington Electric Department&quot; rather than any other Burlington city department.</td>
<td>The asterisk in Section R404.2 refers to &quot;The City of Burlington Electric Department.&quot; This should simply read &quot;Burlington Electric Department&quot;</td>
<td>Corrected references to BED in R404.2.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
<td>Section R407.5</td>
<td>Solar Ready - Suggestion that deeded community solar should count for sites that don’t have a solar resource.</td>
<td>The Department needs to more fully understand how this would work, what the legal implications are, and whether the deed provision would be permanently linked to the house before including this option in the code.</td>
<td>The PSD will continue to discuss this and other issues with stakeholders in the interim between code updates.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
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<td>Request for an energy usage intensity (EUI) approach for compliance.</td>
<td>For builders or designers who wish to use an EUI approach, REScheck will be able to provide this compliance path. Compliance using a HERS index is very similar to an EUI except it must be done by a 3rd party certified energy rater.</td>
<td>No change.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
<td>Section R202</td>
<td>There is no definition for Advanced Wood Heating in the code.</td>
<td>This definition has been added to the RBES redline document: ADVANCED WOOD HEATING SYSTEM. A wood pellet fueled central heating system that meets the standards established by the Vermont Clean Energy Development Fund and Efficiency Vermont and is listed on the Eligible Equipment Inventory posted at <a href="http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei">http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei</a>.</td>
<td>Definition for ADVANCED WOOD HEATING SYSTEM added to Section R202: &quot;A wood pellet fueled central heating system that meets the standards established by the Vermont Clean Energy Development Fund and Efficiency Vermont and is listed on the Eligible Equipment Inventory posted at <a href="http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei">http://www.rerc-vt.org/advanced-wood-heating-system/eligible-equipment-inventory-eei</a>.&quot;</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
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<td>“Cold Climate” Heat Pump – Ensure that our definitions, notes and references are aligned and up to date. Consider delineating “air to air” ductless systems from ducted systems from “ground-source” from “air-to-water systems”. Consider “heat pumps that perform in cold climates”</td>
<td>Striking the words “air source” from the definition of &quot;cold climate heat pump&quot; keeps the standard but broadens it beyond just air-source to also include ground source. The rest of the 44 references to heat pumps throughout the RBES redline have been left as-is.</td>
<td>Deleted the words &quot;air source&quot; from the definition of &quot;cold climate heat pump.&quot; The other 44 references to heat pumps throughout the RBES redline have been left as-is.</td>
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<td>6/10/2019</td>
<td>Comments from June 10 RBES training</td>
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<td>Ground source heat pumps (GSHP): need to add a definition.</td>
<td>Added a GROUND SOURCE HEAT PUMP definition to RBES redline.</td>
<td>Added a new definition to RBES redline: &quot;GROUND SOURCE HEAT PUMP. A heat pump that extracts heat from the ground or water within the ground.&quot;</td>
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<td>6/11/2019</td>
<td>Jeff Forward</td>
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<td>See response three lines above.</td>
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<td>6/11/2019</td>
<td>Jeff Forward</td>
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<td>I continue to be troubled by the allowing electric resistance space heat in stairwells. I understand that the overall efficiency of the building needs to meet ambitious standards, but still I see no need for this exclusion and fear it may lead to increased use of electric resistance heat when and where it is unnecessary. If electric resistance heat were placed in any residential stairwell, it would likely be in multi-family housing. If the stairwell is in the thermal envelope, then I fail to see why it would need to be heated. The envelope requirements would keep most any space within the thermal boundary from freezing. ...</td>
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<td>The Renewable Energy Standard Tier III encourages strategically electrifying buildings to reduce fossil fuel use. Acknowledging that, our goal in RBES has been to allow for heating with cold-climate heat pumps without requiring any backup heating system, which could be prohibitively costly. To provide a level of assurance to builders to minimize potential customer concerns/complaints, we had a good deal of discussion with stakeholders and the Advisory Committee about these allowances, and they suggested the few electric resistance exemptions. ...</td>
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<td>If the stairwell is not within the thermal envelope, it absolutely should not be heated by any source. Some have said that there may be a sprinkler head in a stairwell and therefore should be heated to reduce the risk of freezing that sprinkler head... I can see that might be a reasonable exception to the rule. But even then, the stairwell thermostat should be kept at maybe 45-50 degrees to reduce the risk of freezing. Another way to do this perhaps is to ... control electric resistance space heaters in stairwells to prevent operation above some temperature to prevent freezing, but not heating necessarily. An alternative to electric resistance space heat for back-up to a home heated with air source heat pumps would be ... the use of EPA certified wood pellet stoves. Pellet stoves compliment air source heat pumps very effectively. ... A properly sized pellet stove will work most efficiently at exactly the time when an air source heat pump is its least efficient.</td>
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<td>(continued) ... Stairwells with sprinkler systems in multifamily buildings that don't make economic sense to install a heat pump or have sprinklers that can't freeze are an important provision for affordable housing stakeholders. We expect very little electric energy use from these exemptions and think that the benefit of encouraging an all-electric heat pump solution for buildings outweighs the little additional electric use these bathrooms and stairwell exemptions will require. We will attempt to assess the installation of electric heat in order to better understand its installation and use for future iterations of RBES. In terms of pellet stoves, there is no reason they can't be used to meet whole-home energy demands. However, they would not be a likely substitute for supplemental heating in locations that are hard for heat pumps to heat (i.e., bathrooms and stairwells) where electric resistance represents a low first-cost solution.</td>
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<tr>
<td>6/11/2019</td>
<td>Jeff Forward</td>
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<td>I am uncertain about allowing for electric resistance heat in bathrooms. I can see how a homeowner might want some heat in a remote bathroom when they step out of the shower. I don't think freezing pipes should be a concern in any home built to the envelope standards. I also understand how it might be expensive to extend a central heating system to a remote bathroom and if the home is heated with space heaters like an air source heat pump it might be difficult to get enough circulation to that remote bathroom. However, I suggest tracking how frequently electric resistance heat is being used in code compliant homes. Since electric resistance heat is the cheapest heating technology, I fear an unanticipated consequence could be a significant uptick of inefficient electric resistance heat.</td>
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<td>Tracking residential use of electric resistance heat should be included as part of future market assessment studies in Vermont to enable us to answer the question of how often electric heat is being installed.</td>
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<td>6/11/2019</td>
<td>Jeff Forward</td>
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<td>I appreciate that the updated code recognizes several solar technologies when calculating performance points. However, some sites are not and will not likely be appropriate for siting on-site solar. However, they may meet the intent of these performance goals by purchasing into off-site community solar systems. I think RBS and CBES should recognize off-site community solar for added performance points. I suggest looking toward the USGBC LEED Standard that acknowledges different points for on-site vs. off-site renewable energy utilization.</td>
<td>Points for solar systems that are not permanently installed on the home or on the property should be scrutinized. While we acknowledge that there are many sites in Vermont not suitable for on-property solar installations and that community solar may be a better solution, we want to ensure that RBS only recognizes permanent energy solutions on homes. In the interim between code cycles, we will commit to looking into whether a deeded (or other) legal arrangement to off-site solar should be considered a permanent solution and should receive recognition in future versions of RBS.</td>
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<td>6/12/2019</td>
<td>Richard Faesy</td>
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<td>By simply changing a few words in statute, we could ensure that we would enlist an army of energy code enforcement officers and require an RBES Certificate at every closing. Lenders, Realtors, appraisers and closing attorneys would all insist on seeing an RBES Certificate at every closing if the “marketable title” of a property was affected by the lack of an RBES Certificate. All we would need to do would be to have the Legislature make the very simple language changes suggested below.</td>
<td>This approach would require a legislative change and is beyond the scope of this code update.</td>
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<td>6/12/2019</td>
<td>Richard Faesy (continued)</td>
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<td>Change the law (providing for a sufficient grace period for builder education and grandfathering of all previously constructed homes) to read:</td>
<td>This approach would require a legislative change and is beyond the scope of this code update.</td>
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<td>h) Title validity not affected for all homes under jurisdiction where construction is initiated after January 1, 2021. A defect in marketable title shall not be created by a failure to issue certification or a certificate, as required under subsection (e) or subdivision (g)(4) of this section, or by a failure under that subsection to: affix a certificate; to provide a copy of a certificate to the department of public service; or to record and index a certificate in the town records affected for all homes under jurisdiction where construction is initiated after January 1, 2020. (Added 1997, No. 20, § 1; amended 2005, No. 208 (Adj. Sess.), § 7; 2007, No. 92 (Adj. Sess.), § 8; 2009, No. 45, § 11, eff. May 27, 2009.)</td>
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<td>6/21/2019</td>
<td>Enrique Bueno, Passive House Alliance</td>
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<td>An Urgent Call for Vermont’s Legislature and Administration from the VT Passive House Organization VTPH <a href="http://www.vermontpassivehouse.org">www.vermontpassivehouse.org</a>. The VTPH organization is convinced that the Passive House Standard should be adopted as the base for the RBES building code, in order to make achievable the goals in the Comprehensive Energy Plan 2016 as well as make sustainable the goals of the EAN 2017 Report “90% Renewable by 2050”. If a cycle base implementation is required, then to achieve in the future the Passive House Standard, VTPH suggest that the first step required in that direction is an amendment to the RBES upgrade 2019 draft (Base and Stretch Code) as follows:</td>
<td>After the stakeholder and Advisory Committee discussions that included members of the Passive House Alliance, the Department concluded that the building industry is not prepared to make the large leap to the Passive House standard for this version of RBES, even if it could be adopted without extensive rewriting of the code. There is also concern that because the Passive House standards are out of the State of Vermont’s control and dictated by others, that it may be challenging to reference as an alternative standard at this time. However, the Department and stakeholders will discuss both referencing Passive House as an alternative compliance standard and increased stringency towards Passive House levels for the next iteration of RBES during the interim between code updates. There was a good deal of discussion with stakeholders and the Advisory Committee about all of these three specific recommendations, including with representatives from the Passive House Alliance, and we arrived at the values in the current version of RBES as a compromise incremental step forward.</td>
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| 6/21/2019  | Enrique Bueno, Passive House Alliance (Continued) |               | 1) Make balanced ventilation with heat recovery mandatory for all new construction in Base Code as it is in the Stretch Code. The code upgrade draft allows for extract only ventilation for the first 3 years. At this point it is well understood in building science that “EXTRACT ONLY VENTILATION” is insufficient for adequate ventilation  
2) Require an airtightness ≤ 1 ACH50 for all new construction  
3) Require a u-values of ≤ 0.2 for all windows in new construction  
These amendments will still leave the Code upgrade far from PH standard, but will be the first step in the right direction, and closer to VEIC’s high performance standard buildings. It is the opinion of VTPH that the consequences of not reaching at least this numbers are: | Regarding the specific recommendations:  
1. Balanced ventilation is recognized in the points section of RBES (Table R402.1.2.3) and will likely be a path many builders choose in selecting their required points. It may be considered as a requirement in the next version of the code.  
2. Tighter homes are also recognized in the points section of RBES. Based on the results of the current market assessment study, there may be an opportunity to move the required tightness level from ≤3.0 ACH50 in subsequent versions of RBES.  

3. The stakeholder and Advisory Committees talked at length about window U factors and settled on the values in Table R402.1.2.1. They determined that the market is not quite ready for moving all new construction to triple-glazed windows at this point, mainly due to the minimal availability of affordable qualifying windows. However, points are available for this option in Table R402.1.2.3.  
The Department and stakeholders will address all of these specific recommendations for the next version of RBES during the interim between code updates. |                      |
| 6/21/2019  | Enrique Bueno, Passive House Alliance (Continued) |               | 1) Insufficient ventilation has serious implications in the health and productivity of the occupants as has been extensively documented in many medical research papers, adding to the health system burden.  
2) The allowed airtightness of 3 ACH50 in the Code upgrade draft will have serious implications in energy loss as well as moisture penetration, condensation and mold formation adding to the health problems of a poorly ventilated building. Especially in multifamily buildings.  
3) The code upgrade draft allows for windows’ u-value ≤ 0.3. That is an R-3 window. In VT an R-3 window, in addition to great energy loss and discomfort, will also cause condensation and mold formation, adding to the health problems cause by poor ventilation and loose airtightness. | Responses to specific recommendations (continued)  
3. The stakeholder and Advisory Committees talked at length about window U factors and settled on the values in Table R402.1.2.1. They determined that the market is not quite ready for moving all new construction to triple-glazed windows at this point, mainly due to the minimal availability of affordable qualifying windows. However, points are available for this option in Table R402.1.2.3.  
The Department and stakeholders will address all of these specific recommendations for the next version of RBES during the interim between code updates. |                      |
| 6/21/2019  | Enrique Bueno, Passive House Alliance (Continued) |               | During the following 6 years that the proposed RBES 2019 upgrade will rule from the day of its implementation, VT will see a great number of buildings being built during those years, and if we cannot adopt at least the amendments above suggested, the industry will be doing a great disservice to the consumer and a great loss to the State and the climate. Why can the Passive House Standard be implemented right away?  
- It holds no patents nor proprietary information that may incur in royalties’ charges from anybody  
- The WUFI Passive energy modeling software is available to the public free of charge  
- Materials and components are available off the shelf | See response above. |                      |
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| 6/21/2019  | Enrique Bueno, Passive House Alliance (Continued) | - VT has qualified PASSIVE HOUSE builders and PH trainers to meet the challenge  
- Any contractor or builder can be trained in four days’ time if necessary  
- It is a simplified standard based on performance rather than prescription with well-defined goals  
- The PHIUS+ Standard is being called the ‘next level of high-performance building standards’ by the US Department of Energy (DOE) because DOE’s extensive climate-based building science research laid the groundwork for PHIUS+ 2015.  
- PHIUS+ certification requires that projects also comply with DOE-accepted performance practices including the US Environmental Protection Agency’s Indoor airPLUS and WaterSense programs.  
- PHIUS+ certified residential projects also qualify for the DOE’s Zero Energy Ready Home program.  
- By incorporating these programs that are widely accepted by ASHRAE, ICC, DOE, and other Government and professional organizations, PHIUS has cleared many of the hurdles perceived to accompany passive building. | See response above. | |
| 7/2/2019   | Matt Cota, Vermont Fuel Dealers Association | R202 General Definitions | In Section R202 (GENERAL DEFINITIONS), renewable liquid fuel that is currently and commonly used to heat Vermont homes is not defined.  
[P]lease add following language (underlined and bold) to Section R202.  
The language [below] comes from Vermont Law (10 V.S.A. § 585):  
RENEWABLE ENERGY SOURCES. Means energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to solar hot water, solar hot air, solar photovoltaics, wind, and hydro.  
Paragraph (C) has been changed to reflect the fact that technologies cannot be defined as renewable or not renewable. Renewability depends on the fuel that the technology uses which can be easily interchangeable in the case of biodiesel and fuel oil.  
In Section R202 (GENERAL DEFINITIONS), the following language (underlined and bold) was added to Section R202 and the language in red strikethrough was removed.  
RENEWABLE ENERGY SOURCES. Means energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to solar hot water, solar hot air, solar photovoltaics, wind, and hydro.  
(A) [No change]  
(B) [No change]  
(C) Technologies using the following fuels shall not be considered renewable energy supplies: coal, oil, propane, and natural gas.  
(D) Biomass is considered renewable.  
(F) Biodiesel is considered renewable. | Agreed to add "(F) Biodiesel is considered renewable". The definition of Biodiesel at the end of paragraph (F) will be removed from the Renewable Energy Sources definition and included separately in Section R202. | |
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| 7/2/2019 | Matt Cota, Vermont Fuel    | R202 General Definitions| (A) Methane gas and other flammable gases produced by the decay of sewage treatment plant wastes or landfill wastes and anaerobic digestion of agricultural products, byproducts, or wastes shall be considered renewable energy resources, but no form of solid waste, other than agricultural or silvicultural waste, shall be considered renewable.  
(B) The only portion of electricity produced by a system of generating resources that shall be considered renewable is that portion generated by a technology that qualifies as renewable.  
(C) Technologies using the following fuels shall not be considered renewable energy supplies: coal, oil, propane, and natural gas.  
(D) Biomass is considered renewable.  
(F) Biodiesel is considered renewable. Biodiesel means mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751. | see above                         | The following definition was added to Section R202 (GENERAL DEFINITIONS):  
Biodiesel means mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751. |
<p>| 7/9/2019 | William Nash, ICC          | [Excerpt] Vermont’s adoption of the I-Codes provides the greatest safety to its citizens and supports the construction industry when economic investment in building construction is essential to the state and local economy. Further, the adoption of updated model building &amp; energy codes is an economic incentive. Statewide building construction codes reduce costs associated with personal injury in the built environment, reduce property damage and associated costs while providing for the safety of the public and emergency responders, which is critical in the present economy. The economic benefits of building to updated codes include improved safety, reduced maintenance costs, energy savings, and lower insurance premiums. | No response required                 |                                     |                         |</p>
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<tr>
<td>7/10/2019</td>
<td>William Nash ICC</td>
<td>(continued)</td>
<td>(continued)... The ICC would like to commend the State of Vermont for its consistently outstanding work for reviewing and now proposing to update the Vermont RBES that is based on the 2015 IECC with the 2018 updates. The proposed amendments and update of this code, while incorporating amendments that reflect the unique character and needs of Vermont, will ensure that the Vermont RBES remain technically viable, allow for consistency in code application and enforcement, allow for economic investment in building construction, and provide for the greatest safety of the public and emergency responders, while embracing new technology, energy efficiency, and building practices.</td>
<td>No response required</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum</td>
<td>R501.6 Historic buildings.</td>
<td>HISTORIC PRESERVATION: The loss of historic fabric ... is a serious issue in the context of energy retrofits, yet the embodied energy of an existing building and its historic cultural value are not considered in the 2019 revisions. Vermont is fortunate to have a large number of historic residential and commercial buildings. ... These buildings are going to be threatened simply because they are not net-zero buildings and they will most likely continue to require fossil fuels. At the May 1 RBES training, the subject came up when someone asked how to add a net-zero addition to an historic house. The answer was: Gut and retrofit the original house. With new requirements for continuous insulation, the exterior of historic buildings is also at risk. The following language is included in the proposed code language: R501.6 Historic buildings. No provision of this code relating to the construction, repair, alteration, restoration and movement of structures, and change of occupancy shall be mandatory for historic buildings provided a &quot;Historic Building Exemption Report&quot; obtained from the State Historic Preservation Office has been submitted to the State Historic Preservation Office and signed by either the owner, an owner’s agent, a registered design professional, or a representative of the historic preservation authority having jurisdiction, demonstrating that compliance with that provision would threaten, degrade or destroy the historic fabric or function of the building.</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum</td>
<td>(continued)</td>
<td>The situation is compounded when one considers that many moderate to low income families live in historic houses, and many have been turned into apartments. My guess is that it will become exorbitantly expensive to retain stone foundations, plaster interiors, historic trim, or original windows. Solar panels and visible heat pump equipment will become increasingly evident on exteriors. MANY of these houses, particularly the &quot;bread and butter&quot; homes, are just going to be torn down. .... These issues will be added to the agenda for discussion with stakeholders, including AIA and the Division of Historic Preservation, in the interim between code updates.</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum</td>
<td>(continued)</td>
<td>At the very least, the Division of Historic Preservation should be consulted for both the CBES and RBES. I suggest in addition asking Judy Hayward, of Historic Windsor, plus a member of the Preservation Trust of VT and also AIA-VT to sit on a sub-committee to outline some approaches for 2019 that can be expanded in future editions.</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum (continued)</td>
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<td>When both residential and commercial are trying to earn points, why are you not including more passive techniques that would help lower heating/cooling loads? -- Trombe walls -- mass slabs as heat sinks -- outside shades -- mechanical shades -- rain screen walls -- more UV coating These have been proven over the years, they don’t cost much up front, and most are zero energy users. Measures need to provide a minimum level of energy savings in order to be included on the list. Some of these (like rain screening) are sound building practices, but don’t necessarily contribute to direct and measurable energy savings. There would need to demonstrated energy savings impacts along with some level of interest in those measures and availability of components in order to include them in the points list. Other measures have merit as energy efficiency improvements but have yet to be vetted for cost-effectiveness, availability, durability or interactive effects. These will be discussed with stakeholders in the interim between code updates and considered for inclusion in the next RBES update.</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum (continued)</td>
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<td>Specifically, I want a credit to be added in both the CBES and RBES for programmable skylights. They are an extremely efficient (self-solar operated) approach to ventilation. For example: <a href="https://www.veluxusa.com/active">https://www.veluxusa.com/active</a> Of note, these programmable skylights are eligible for residential tax credits.</td>
<td>This measure will be discussed with stakeholders in the interim between code updates and considered for inclusion in the next RBES update.</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum (continued)</td>
<td>RBES 402.1.2.1</td>
<td>The draft specifies in Package 1 that wood framed walls can have a 5 continuous insulation with an R-20 inside or R-10 continuous with R-13 inside. This is a very big problem. According to Martin Holladay, continuous insulation needs to be a minimum thickness or there will be condensation on the continuous layer/sheathing interface. All of Vermont is in Zone 6. The minimum outside/continuous insulation for Zone 6 is R7.5 for 2x4; R11.25 for 2x6. There are several other important concerns described by Holladay. See: <a href="https://www.greenbuildingadvisor.com/article/calculating-the-minimum-thickness-of-rigid-foam-sheathing">https://www.greenbuildingadvisor.com/article/calculating-the-minimum-thickness-of-rigid-foam-sheathing</a>. You will be misleading builders, designers and architects into thinking these numbers are adequate, putting them and their clients in danger for disruption and potential lawsuits over time as their buildings deteriorate. Please revise these numbers accordingly to follow guidelines for Zone 6. The Department is aware of the potential moisture problems in exterior walls when improperly applying inadequate exterior insulation. We have added language at the end of Section R402.1.2 and other relevant locations in the code to emphasize the potential for moisture problems. There are continuous exterior insulation products (e.g. rock wool) that, if applied correctly, can provide R-5 insulation without moisture condensation in our climate. RBES code language is intended to specify insulation levels and not how to apply materials correctly using proper building science; that is the designer’s and builder’s prerogative and responsibility. However, the Code Handbook will provide some details and guidance on proper insulation installation and applications that meet the R-values in RBES while ensuring durability and moisture protection of building components.</td>
<td>Added language at the end of Section R402.1.2 and other relevant locations in the code to emphasize the potential for moisture problems</td>
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<td>7/9/2019</td>
<td>Sandra Vitzthum (continued)</td>
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<td>Please give some guidance how to install exterior insulation, which presents a number of problems with detailing and correct execution of construction. No matter how one details the penetrations in the exterior insulation for windows and doors there is always a point where the full value of the exterior insulation meets the connection point of the window or door and the R value drops to a negligible amount, leaving a place for condensation to form and a starting point for potential rot. Spraying foam in does not solve this problem.</td>
<td>RBES is intended as a minimum standard for residential buildings and not intended as a design guide. It would be impossible to provide guidance on design and detailing for every assembly that could meet these standards. However, the RBES Handbook will provide cross sections of some examples of qualifying wall systems and guidance on the proper use of exterior continuous insulation to avoid moisture problems.</td>
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| 7/9/2019 | Chris Snyder, Snyder Homes |              | I am writing to express my concerns related to the changes as proposed in the RBES. Here are my concerns: The cost of housing in Vermont is too high. This is a fact that continues to be understood throughout the State. What are the drivers of the cost of housing:  
- Permitting costs – State and Local Municipality  
- Impact Fees - imposed by the State and Local Municipalities  
- Offsite improvements being added by the State and Local Municipalities  
- Cost of construction  
  - Materials are generally in line with other states  
  - Labor is high  
  - Due to the fact that housing is high, and labor rates reflect this high cost of housing |                                                                                       |                                                                                       |
| 7/9/2019 | Chris Snyder, Snyder Homes (continued) |              | With the proposed changes to only construction of new homes, the cost of adding housing to our undersupplied market will decrease the number of homes that will be constructed.  
- The cost of existing housing that is not impacted by these code changes will become higher priced and even more undersupplied  
  - Why are we not focusing on the predominant housing stock in the State, existing homes that do not even come close to the efficiency of our current new homes.  
- New construction of homes will be reduced and the thousands of trades that work on the homes will be reduced as there is no work available. |                                                                                       |                                                                                       |
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<td>7/9/2019</td>
<td>Chris Snyder, Snyder Homes</td>
<td>(continued)</td>
<td>Our company has reviewed the proposed changes to the RBES and determined the following:</td>
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<td>- The cost of a 1,700 [ SF ] single family home will increase by $8,568</td>
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<td>- The cost of a 1,850 [ SF ] two story single family home will increase by $7,343</td>
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<td>- I do not personally think any buyer would be willing to pay the additional cost associated with these changes.</td>
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<td>The PSD acknowledges the fact that the proposed changes in RBES will make the first cost of a new home higher. However a</td>
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<td>cost/benefit analysis that incorporated these numbers determined that, if the reduced monthly energy cost is factored in, an average</td>
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<td>homeowner using market rate mortgage financing would end up with lower monthly expenses than the buyer of a similar home built to the</td>
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<td>current 2015 RBES standard.</td>
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<td>7/9/2019</td>
<td>Chris Snyder, Snyder Homes</td>
<td>(continued)</td>
<td>I have been concerned about these changes since they were proposed. I have expressed my concerns throughout the last six months, and everyone</td>
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<td>agrees that increasing the cost of housing is a problem. How can the Public Service Department plan to proceed with these changes when it is</td>
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<td>supposed to take into account the impact that it will have on future homeowners, trades, and builders that currently are providing the</td>
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<td>service of constructing homes to meet the demand?</td>
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<td>(continued) The proposed RBES is designed to improve the long term affordability of new homes, as well as to help meet the State's energy</td>
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<td>and greenhouse gas emissions reduction goals.</td>
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<td>7/9/2019</td>
<td>Chris Snyder, Snyder Homes</td>
<td>(continued)</td>
<td>I have attached a sheet that shows the payback to homeowners, and I understand the rationale of these formulas, however, buyers will not be</td>
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<td>willing to pay the higher price of housing. The consideration of payback will become moot when they do not proceed with the purchase of a</td>
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<td>new even-more efficient home. Buyer will be pushed to purchase older homes that do not meet any energy efficiency requirements. This code</td>
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<td>increase will only increase the demand on the existing homes.</td>
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<td>7/9/2019</td>
<td>Chris Snyder, Snyder Homes</td>
<td>(continued)</td>
<td>I would also like to express my concerns that the current RBES process is not being enforced. There are many companies that are self-certifying</td>
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<td>their achievements, but this is a minority of the homes constructed in the State of Vermont. Prior to increasing the code changes, it is</td>
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<td>imperative that the enforcement of the existing level of RBES be completed.</td>
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<td>As a builder that develops homes with Act 250 review, I think it is important to note that we have to already exceed the current code</td>
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<td>to meet the stretch code requirement. I would think by increasing the base requirements, the State will be pushing more builders to consider</td>
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<td>small, more spread out development to eliminate the need for an Act 250 review and associated efficiency requirements. This clearly goes</td>
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<td>against the State's current policy to promote in-fill development versus scattered lot construction.</td>
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<td>RBES compliance mechanisms and the requirement for stretch code for Act 250 projects is defined in statute in 30 V.S.A. § 51. Changes to the</td>
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<td>statute are a legislative issue and outside of the purview of the Department.</td>
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<td>7/9/2019</td>
<td>Chris Snyder, Snyder Homes</td>
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<td>Recommendations: 1. Leave the RBES at its current level of efficiency  2. Develop and enforcement of the existing RBES for all homes constructed  3. Focus our attention on how can we improve the efficiency of the existing housing stock.</td>
<td>The Department contends that the rule as proposed strikes a balance between maintaining the existing level of stringency and moving toward net zero design and other State energy goals immediately, which has been advocated for by other stakeholders. Issues of enforcement are beyond the scope of this rulemaking. This code update does address alterations and additions to the existing building stock as well as new.</td>
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<td>7/10/2019</td>
<td>Jean Terwilliger</td>
<td></td>
<td>We can do better! The materials and knowledge are here now to make every building net-zero for very little additional cost. The small steps included in the energy are not at all adequate to the task at hand. If we are to meet the climate crisis head-on, all buildings need to be net-zero ready or better by 2030. Passive house (or very close to it) is the most direct way to meet the climate challenge and provide resiliency and comfort for residences. I recommend that the DPS increased the energy efficiency to meet passive house standards by the next code and half-way there (net-zero ready) in this code cycle.</td>
<td>Although &quot;net zero ready&quot; is a term that has not been defined in the Vermont context, the proposed RBES was calibrated to be the first step toward reaching the Comprehensive Energy Plan goal of all new construction to be &quot;net zero design&quot; (also yet to be defined) by 2030. This issue will be a major topic of discussion in the interim between code updates. At any rate, it would be difficult to adopt passive house into RBES since Passive House is a standard, and as such, is not readily translatable into enforceable code language.</td>
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<td>7/10/2019</td>
<td>Keith Dewey</td>
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<td>First, we architects are under extraordinary pressure from commercial and residential clients to eliminate anything which includes additional cost. This includes... the reality that it takes more time and money to design and build a green building than to not do so. ... I am all for moving toward more energy efficient buildings using carrots and sticks (if the carrots are LARGE enough, sticks are not necessary), but architects and builders are REALLY feeling the resistive pinch from project owners. I think there is a MAJOR public education effort needed to accompany our energy code upgrades to explain why architects, engineers and contractors deserve higher fees to do this increased level of work. Without it, the entire efficiency push will be seen more and more cynically by most everyone involved. If the public understands they are getting more for their initial added costs in the long run, they are more apt to embrace green design and building and see our efforts with a positive attitude.</td>
<td>The Energy Efficiency Utilities (EVT, BED, &amp; VGS) do provide training for professionals on the energy codes and supply educational materials through their websites and public events to members of the public.</td>
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<td>7/10/2019</td>
<td>Keith Dewey (continued)</td>
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<td>...After all these years of unfunded energy code mandates where the solution has been to pin the responsibility on design and construction entities and expose them to never ending civil action lawsuits rather than having all compliance judgments made by a recognized and staffed and funded state agency in the same way all building code requirements are handled by the Vermont Division of Fire Safety. It is time that the State of Vermont legislature FINDS THE MONEY TO FINALLY FUND SUCH AN AGENCY AND EFFORT IN THE CORRECT WAY instead of taking the easy way out and pinning a complex and gray area liability on the practicing professionals.</td>
<td>The energy code certification process and provision for civil action for noncompliance is defined in statute in 30 V.S.A. § 51 and 30 V.S.A. § 53. Changes to the statute are a legislative issue and outside of the purview of the Department.</td>
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<td>7/10/2019</td>
<td>Keith Dewey (continued)</td>
<td>R402.1.2</td>
<td>Project owners are going to run from paying for blower door tests and building commissioning. They will try to pin this cost on the design professionals. The State of Vermont needs to somehow provide this service for free to owners and the quality of these test and commissioning tasks need to be of the highest quality.</td>
<td>Since the builder is responsible for RBES compliance, the responsibility for performing blower door tests rests with the builder rather than the architect. RBES cannot prescribe who will pay for the cost of testing. RBES also allows for the builder to perform his/her own blower door test as long as they have the proper training and certification.</td>
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<td>7/10/2019</td>
<td>Keith Dewey (continued)</td>
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<td>I believe the number of required EV changing stations are far too low in light of the fact that we need to get to 97% clean energy use no later than 2025 globally.</td>
<td>Noted. The decision was made to limit the number of required EV charging stations based on the added cost and the lack of return on that investment for the building owner.</td>
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<td>7/10/2019</td>
<td>Keith Dewey (continued)</td>
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<td>...there are some proposed energy code issues which do not necessarily consider the point of view of architects or protect future building design creativity and the free expression of architecture as an art form and it’s sociological impact. I caution the energy code core development group to consider these things when developing their proposed changes. As I have said, I am all for energy conservation, but some of the proposed codes seem to be formulated with little concern for the importance of architectural freedom.</td>
<td>RBES is meant to be neutral with respect to architectural design considerations, and there is a compliance pathway (UA method/REScheck) that is available for site-built windows and unconventional designs.</td>
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<td>Keith Dewey</td>
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Good morning Kelly,

My name is Regan Ratliff, I'm the Government Relations Associate for the Pool and Hot Tub Alliance (PHTA). I'm writing in response to the proposed rule for Residential Building Energy Standards. We have actually spoke over the phone several times along with Barry Murphy.

By way of background, PHTA was formed in 2019, combining the Association of Pool & Spa Professionals (APSP) and the National Swimming Pool Foundation (NSPF). APSP, now PHTA, is the world’s oldest and largest association representing swimming pool, hot tub, and spa manufacturers, distributors, manufacturers’ agents, designers, builders, installers, suppliers, retailers, and service professionals. Dedicated to the growth and development of its members’ businesses and to promoting the enjoyment and safety of pools and spas, PHTA offers a range of services, from professional development to advancing key legislation and regulation at the federal, state and local levels, to consumer outreach and public safety.

PHTA is the only industry organization recognized by the American National Standards Institute (ANSI) to develop and promote national standards for pools, hot tubs, and spas. Since 1983, APSP (now PHTA) has been accredited by ANSI as the Standards Development Organization for the nation’s pool and spa standards. These national consensus standards establish voluntary minimum guidelines that, when adopted by governments and agencies, have the force of law. These standards are used in the design, operation, and maintenance of swimming pools.

We understand that the proposed rule for Residential Building Energy Standards combines sections from the 2015 and 2018 International Energy Conservation Code (IECC). We are supportive of the inclusion of the pool & spa IECC sections, but want to bring to your attention the following: After looking through section R403.10 'Pools and permanent spa energy consumption (Mandatory)' of the proposed rule it seems there may be a duplicate section. Section R403.10.1 is a duplicate of section R403.12 and there is also a typo in section R403.10.1 which references APSP-145 when it is actually APSP-15. We would like to see the deletion of section R403.10.1 as the appropriate language is already referenced in section R403.12. This also would follow what is in the IECC, as the duplication was fixed in an ICC errata.

I am aware there is a public hearing this Thursday, June 21st. Will this email suffice as a comment on the proposed rule or do I need to draft a formal letter on behalf of the Alliance?

Thank you,
From: Matt Cota <matt@vermontfuel.com>  
Sent: Tuesday, July 2, 2019 4:35 PM  
To: PSD - Code Update Res <PSD.CodeUpdateRes@vermont.gov>  
Subject: Public Comments regarding RBES

PUBLIC COMMENTS REGARDING RBES AND CBES

July 2, 2019

In Section R202 (GENERAL DEFINITIONS), renewable liquid fuel that is currently and commonly used to heat Vermont homes is not defined.

On behalf of biodiesel producers, blenders and retailers, as well as Vermont consumers that heat their homes with renewable liquid fuel, please add following language (underlined and bold) to Section R202 (GENERAL DEFINITIONS):

RENEWABLE ENERGY SOURCES. Means energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate including, but not limited to solar hot water, solar hot air, solar photovoltaics, wind, and hydro.  
(A) Methane gas and other flammable gases produced by the decay of sewage treatment plant wastes or landfill wastes and anaerobic digestion of agricultural products, byproducts, or wastes shall be considered renewable energy resources, but no form of solid waste, other than agricultural or silvicultural waste, shall be considered renewable.  
(B) The only portion of electricity produced by a system of generating resources that shall be considered renewable is that portion generated by a technology that qualifies as renewable.  
(C) Technologies using the following fuels shall not be considered renewable energy supplies: coal, oil, propane, and natural gas.  
(D) Biomass is considered renewable.  
(F) Biodiesel is considered renewable. Biodiesel means mono alkyl esters derived from plant or animal matter that meet the registration requirements for fuels and fuel additives established by the Environmental Protection Agency under section 211 of the Clean Air Act (42 U.S.C. § 7545), and the requirements of ASTM D6751.

The language above comes from Vermont Law (10 V.S.A. § 585).

Thank you for your time and consideration.

Sincerely,

Matt Cota  
VFDA  
802-223-7750  
matt@vermontfuel.com
Dear Ms. Launder,

My name is William Nash and I am the Governmental Relations Manager in Vermont for the International Code Council (ICC) and your liaison to the ICC. Please allow this letter to serve as public comment in support of a final approval relative to the pending update to the 2019 Vermont Residential Building Energy Standards (RBES). The update is based on the 2015 International Energy Conservation Code (IECC) with the 2018 updates.

The ICC is a member-focused association dedicated to helping the building safety community and the construction industry provide safe and sustainable construction through the development of codes and standards used in the design, build, and compliance process. Most U.S. states and communities, Federal agencies, and many global markets choose the International Codes (I-Codes) to set the standards for regulating construction, fire prevention, and energy conservation in the built environment.

The IECC is in use or adopted in 49 states, the District of Columbia, the U.S. Virgin Islands, and Puerto Rico among other jurisdictions (an adoption chart can be found at: https://www.iccsafe.org/wp-content/uploads/Code_Adoption_Maps.pdf)

The IECC along with 14 other I-Codes are updated and revised every three years through a national consensus process that strikes a balance between the latest technology, new building products, installation techniques, economics, and cost while incorporating the most recent advances in public and first responder safety. It is an open, inclusive process that encourages input from all individuals and groups and allows ICC Governmental Members to determine the final code provisions. Because of this process, many beneficial changes to the model code that Vermont is considering adopting were made. We recognize the significant efforts that leaders in Vermont have made along with their commitment to a safe built and energy efficient environment for their visitors and citizens. This involvement is critical to the success of the next version of the I-Codes and the expertise of Vermont building and fire and energy officials, design professionals, builders, contractors, labor representatives and other stakeholder organizations interested in building safety is vital to your adoption efforts as well as ours.

Why adopt up-to-date energy codes? Energy Savings: Today’s new construction is tomorrow’s existing building. States that don’t adopt new codes leave significant energy and financial
savings on the table. Consistent code adoption from 2010 through 2016 represents a national annual energy savings of 1.98 billion dollars. Life Safety, Durability and Resiliency: The energy code affects moisture management (rot, mold, and mildew), indoor air quality, fire safety, extreme weather protection, and resiliency of homes and buildings. Additionally, according to a National Association of Home Builders (NAHB) report revealing what home buyers really want, the first and foremost response was energy efficiency. Nine out of ten buyers would rather buy a home with energy-efficient features and permanently lower utility bills than one without those features that cost 2 percent to 3 percent less.

Vermont’s adoption of the I-Codes provides the greatest safety to its citizens and supports the construction industry when economic investment in building construction is essential to the state and local economy. Further, the adoption of updated model building & energy codes is an economic incentive. Statewide building construction codes reduce costs associated with personal injury in the built environment, reduce property damage and associated costs while providing for the safety of the public and emergency responders, which is critical in the present economy. The economic benefits of building to updated codes include improved safety, reduced maintenance costs, energy savings, and lower insurance premiums.

The ICC would like to commend the State of Vermont for its consistently outstanding work for reviewing and now proposing to update the Vermont RBES that is based on the 2015 IECC with the 2018 updates. The proposed amendments and update of this code, while incorporating amendments that reflect the unique character and needs of Vermont, will ensure that the Vermont RBES remain technically viable, allow for consistency in code application and enforcement, allow for economic investment in building construction, and provide for the greatest safety of the public and emergency responders, while embracing new technology, energy efficiency, and building practices.

Technical assistance and training from ICC is always available to groups including, but not limited to: Vermont Design Professionals, Vermont Plans Examiners, The Vermont Plumbers’ Examining Board, The State Department of Public Safety, Department of Public Service, and the State Fire Marshal’s Office and inspection staff. They will have access to, among other things, ICC training programs and materials, product Evaluation Reports, certification programs, and ICC technical staff, who will assist with code opinions and interpretations based on the IECC.

Thank You for the opportunity to submit these comments. The ICC is honored to partner with the State of Vermont in support of the adoption and administration of the Vermont RBES and we look forward to continuing to serve your needs for many more years. Please feel free to contact me via email or cell phone (information noted below) if you have any questions, concerns, or comments relative to the IECC/RBES adoption or anything else ICC related.

Sincerely,
William J. Nash, Jr.
Government Relations Manager
International Code Council
wnash@icc sage.org
888-422-7233; Ext. 4876
From: Keith Dewey <deweyaia@sover.net>
Sent: Wednesday, July 10, 2019

Subject: Vermont RBES and CBES Code Update Comments

Dear Public Service Department and Gabrielle Stebbins of the Energy Futures Group,

I realize time has passed me by and my comments on the energy code updates are due today, so I will at least share a few of my thoughts regarding the proposed updates. These thoughts, unfortunately, are a bit incomplete but I feel the need to raise a few important points which are important from the perspective of many Vermont-licensed architects, including myself.

First, we architects are under extraordinary pressure from commercial and residential clients to eliminate anything which includes additional cost. This includes a battle over the reality that it takes more time and money to design and build a green building than to not do so. We can play games with tradeoff costs, but it just does. I am all for moving toward more energy efficient buildings using carrots and sticks (if the carrots are LARGE enough, sticks are not necessary), but architects and builders are REALLY feeling the resistive pinch from project owners. I think there is a MAJOR public education effort needed to accompany our energy code upgrades to explain why architects, engineers and contractors deserve higher fees to do this increased level of work. Without it, the entire efficiency push will be seen more and more cynically by most everyone involved. If the public understands they are getting more for their initial added costs in the long run, they are more apt to embrace green design and building and see our efforts with a positive attitude.

It is time…. After all these years of unfunded energy code mandates where the solution has been to pin the responsibility on design and construction entities and expose them to never ending civil action lawsuits rather than having all compliance judgments made by a recognized and staffed and funded state agency in the same way all building code requirements are handled by the Vermont Division of Fire Safety. It is time that the State of Vermont legislature FINDS THE MONEY TO FINALLY FUND SUCH AN AGENCY AND EFFORT IN THE CORRECT WAY instead of taking the easy way out and pinning a complex and gray area liability on the practicing professionals. IT IS TIME to do this correctly….

Related to the above comments, many of us architects in Vermont strongly do not agree with the proposed concept of having us sign off on project commissioning requirements which are beyond our scope of training and experience and always performed by other professionals. This is open season on undue and unjust potential lawsuits and many are completely opposed to such action. Major errors and omissions liability companies which insure many of the Vermont licensed architects and engineers have weighed in on this issue with strong opposition. If architects are not going to be insured by the their insurance companies if they sign such certifications no architect in their right mind will ever sign such a commissioning verification certificate. The Public Policy Committee of AIA/Vermont is in full agreement of this opinion.

Project owners are going to run from paying for blower door tests and building commissioning. They will try to pin this cost on the design professionals. The State of Vermont needs to somehow provide this service for free to owners and the quality of these test and commissioning tasks need to be of the highest quality.
I believe the number of required EV changing stations are far too low in light of the fact that we need to get to 97% clean energy use no later than 2025 globally.

Also, there are some proposed energy code issues which do not necessarily consider the point of view of architects or protect future building design creativity and the free expression of architecture as an art form and it’s sociological impact. I caution the energy code core development group to consider these things when developing their proposed changes. As I have said, I am all for energy conservation, but some of the proposed codes seem to be formulated with little concern for the importance of architectural freedom. A small example of this is the requirement of UL-certified window and door labels from all but one exempted window or door in a project. What if an architect wanted to design their own unique doors and windows which matched or exceeded the energy objective of the new code, but the expense of gaining UL testing and certification for all the custom windows and doors was beyond any reasonable project budget? This means no architectural project could ever again practically be built which did not use out-of-the box, UL-certified, manufactured windows or doors! All energy codes need to be developed with flexibility to provide alternative methods of compliance without handcuffing the opportunity for creative quality architecture.

Sincerely,

Keith Dewey - AIA - LEED AP + BD&C
Certified Passive House Designer

DEWEY + ASSOCIATES, ARCHITECTS AND PLANNERS
P. O. BOX 612 - LONDONDERY, VERMONT 05148 - (802) 824-5612

From: Jean Terwilliger <jean@vermontintegratedarchitecture.com>
Sent: Wednesday, July 10, 2019
Subject: 2019 RBES Comment

Dear DPS,

We can do better! The materials and knowledge are here now to make every building net-zero for very little additional cost. The small steps included in the energy are not at all adequate to the task at hand. If we are to meet the climate crisis head-on, all buildings need to be net-zero ready or better by 2030. Passive house (or very close to it) is the most direct way to meet the climate challenge and provide resiliency and comfort for residences.

I recommend that the DPS increased the energy efficiency to meet passive house standards by the next code and half-way there (net-zero ready) in this code cycle.

I wish I had been able to attend the hearings last month, but was finishing drawings for a 24 unit affordable housing complex in Vergennes that goes beyond the proposed codes. Housing Vermont understands that they will save money in the long run by building better building envelopes now.
From: Sandra Vitzthum <vitzthum@sover.net>
Sent: Tuesday, July 9, 2019
Subject: 2019 RBES Comment

COMMENTS FOR THE RBES AND CBES REVISIONS

I think some of the confusion is that I and others wrote our comments to Richard Faesy who was the Dept Public Service’s consultant. I don’t know if he passed everything on to Efficiency Vermont and/or PSD.

COMMISSIONING

A couple of us followed up soon after May 1 on this issue. In a nutshell, the contractor is responsible for materials and methods used to construct a project. The owner may hire a third party to verify conformance with contract documents. The owner may hire the architect to do this as an additional service. But it is not standard for the architect to be responsible for conformance with contract documents.

HISTORIC PRESERVATION

The loss of historic fabric (parts of buildings or entire buildings) is a serious issue in the context of energy retrofits, yet the embodied energy of an existing building and its historic cultural value are not considered in the 2019 revisions.

Vermont is fortunate to have a large number of historic residential and commercial buildings. In Montpelier 80% of its houses are historic. They are an important cultural and invested energy resource. These buildings are going to be threatened simply because they are not net-zero buildings and they will most likely continue to require fossil fuels.

At the May 1 RBES training, the subject came up when someone asked how to add a net-zero addition to an historic house. The answer was: Gut and retrofit the original house. With new requirements for continuous insulation, the exterior of historic buildings is also at risk.

The situation is compounded when one considers that many moderate to low income families live in historic houses, and many have been turned into apartments. My guess is that it will become exorbitantly expensive to retain stone foundations, plaster interiors, historic trim, or original windows. Solar panels and
visible heat pump equipment will become increasingly evident on exteriors. MANY of these houses, particularly the "bread and butter" homes, are just going to be torn down. It's happened on Cedar Street, Franklin Street, and River Street in Montpelier already.

At the very least, the Division of Historic Preservation should be consulted for both the CBES and RBES. I suggest in addition asking Judy Hayward, of Historic Windsor, plus a member of the Preservation Trust of VT and also AIA-VT to sit on a sub-committee to outline some approaches for 2019 that can be expanded in future editions.

PASSIVE CREDITS
This is what I wrote to Richard Faesy, and his response is in red.

When both residential and commercial are trying to earn points, why are you not including more passive techniques that would help lower heating/cooling loads?

-- Trombe walls
-- mass slabs as heat sinks
-- outside shades
-- mechanical shades
-- rain screen walls
-- more UV coating

These have been proven over the years, they don't cost much up front, and most are zero energy users. If you like, I can put some language together with other architects.

There are a few issues here. One is that the “package plus points” approach is designed for the “standard” home builders to use approaches that are more commonplace or readily accessible. For higher performance buildings that might incorporate things like Trombe walls, mechanical shades, heat sinks, etc., the better approach might be to get a Home Energy Rating that can model these features and better capture the contributions to the specific building. Lastly, any of the points for measures need to provide a minimum level of energy savings in order to be equivalent to the other measures on the list. Some of these (like rain screening) are good building science, but don’t necessarily contribute to direct and measurable energy savings. We would need sound, modeled savings impacts along with some indication of interest in those measures to include them in the points list.

Specifically, I want a credit to be added in both the CBES and RBES for programmable skylights. They are an extremely efficient (self-solar operated) approach to ventilation. For example: https://www.veluxusa.com/active Of note, these programmable skylights are eligible for residential tax credits.

RBES 402.1.2.1 and similar for CBES: CONTINUOUS INSULATION (FROM SAM SCOFIELD)

The draft specifies in Package 1 that wood framed walls can have R-5 continuous insulation with an R-20 inside or R-10 continuous with R-13 inside. This is a very big problem. According to Martin Holladay, continuous insulation needs to be a minimum thickness or there will be condensation non the continuous layer/sheathing interface. All of Vermont is in Zone 6. The minimum outside/continuous insulation for Zone 6 is R7.5 for 2x4; R11.25 for 2x6. There are several other important concerns described by Halladay. See: https://www.greenbuildingadvisor.com/article/calculating-the-minimum-thickness-of-rigid-foam-sheathing
You will be misleading builders, designers and architects into thinking these numbers are adequate, putting them and their clients in danger for disruption and potential lawsuits over time as their buildings deteriorate. Saying they followed your guidelines will not keep this all from falling into the hands of the lawyers and I doubt the State will jump in to take responsibility when this starts happening. Please revise these numbers accordingly to follow guidelines for Zone 6.

In addition, please give some guidance how to install exterior insulation, which presents a number of problems with detailing and correct execution of construction. No matter how one details the penetrations in the exterior insulation for windows and doors there is always a point where the full value of the exterior insulation meets the connection point of the window or door and the R value drops to a negligible amount, leaving a place for condensation to form and a starting point for potential rot. Spraying foam in does not solve this problem. I am curious to see what details you may be proposing for these junctions of dissimilar R value materials or whether you are simply leaving it up to us in the construction industry to solve these intractable problems.

**INSPECTIONS, FROM C104.1 General**

Where required, construction or work for which a permit is required shall be subject to inspection by the code official or other authority having jurisdiction, his or her designated agent or an approved agency, ......

Does this mean that any town or city in which the project is built can request jurisdiction in order to require an inspection? This would not be uncommon in most other states, where local authorities have jurisdiction over code enforcement.

Since residential permits are handled at the local level, it would be relatively easy to request that a small percentage of these are inspected by an energy code inspectors selected for a list of licensed approved energy code inspectors. The builder would have to pay a set fee per sf for the inspection, as they currently do for electrical inspections. Towns and cities have local zoning permit requirements for commercial buildings. There would need to be a change, I believe, of the local zoning requirements for energy code inspections to become a requirement for a small percentage of projects. Note, a credible threat of an inspection would cause contractors to develop some respect for the energy code, and this would also create jobs to fulfill a service that is needed.

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**From:** Chris Snyder <csnyder@snyderhomesvt.com>  
**Sent:** Tuesday, July 9, 2019  
**Subject:** Residential Building Code Update

To the Public Service Department:

I am writing to express my concerns related to the changes as proposed in the RBES. Here are my concerns:

The cost of housing in Vermont is too high. This is a fact that continues to be understood throughout the State. What are the drivers of the cost of housing:

- Permitting costs – State and Local Municipality
- Impact Fees - imposed by the State and Local Municipalities
- Offsite improvements being added by the State and Local Municipalities
- Cost of construction
  - Materials are generally in line with other states
  - Labor is high
    - Due to the fact that housing is high, and labor rates reflect this high cost of housing

With the proposed changes to **only construction of new homes**, the cost of adding housing to our undersupplied market will decrease the number of homes that will be constructed.

- The cost of existing housing that is not impacted by these code changes will become higher priced and even more undersupplied
  - **Why are we not focusing on the predominant housing stock in the State, existing homes that do not even come close to the efficiency of our current new homes.**
- New construction of homes will be reduced and the thousands of trades that work on the homes will be reduced as there is no work available.

Our company has reviewed the proposed changes to the RBES and determined the following:

- The cost of a 1,700 single family home will **increase by $8,568**
- The cost of a 1,850 two story single family home will **increase by $7,343**
- I do not personally think any buyer would be willing to pay the additional cost associated with these changes.

I have been concerned about these changes since they were proposed. I have expressed my concerns throughout the last six months, and everyone agrees that increasing the cost of housing is a problem. How can the Public Service Department plan to proceed with these changes when it is supposed to take into account the impact that it will have on future homeowners, trades, and builders that currently are providing the service of constructing homes to meet the demand?

I have attached a sheet that shows the payback to homeowners, and I understand the rationale of these formulas, however, buyers will not be willing to pay the higher price of housing. The consideration of payback will become moot when they do not proceed with the purchase of a new even-more efficient home. Buyer will be pushed to purchase older homes that do not meet any energy efficiency requirements. This code increase will only increase the demand on the existing homes.

I would also like to express my concerns that the current RBES process is not being enforced. There are many companies that are self-certifying their achievements, but this is a minority of the homes constructed in the State of Vermont. Prior to increasing the code changes, it is imperative that the enforcement of the existing level of RBES be completed.

As a builder that develops homes with Act 250 review, I think it is important to note that we have to already exceed the current code to meet the stretch code requirement. I would think by increasing the base requirements, the State will be pushing more builders to consider small, more spread out development to eliminate the need for an Act 250 review and associated efficiency requirements. This clearly goes against the State’s current policy to promote in-fill development versus scattered lot construction.
Recommendations:

1. Leave the RBES at its current level of efficiency
2. Develop and enforcement of the existing RBES for all homes constructed
3. Focus our attention on how can we improve the efficiency of the existing housing stock.

I look forward to having any discussions about these comments and recommendations.

Sincerely,

Chris Snyder | PRESIDENT
SNYDER HOMES | SnyderHomesVT.com | 802.985.5722

From: Enrique Bueno <ebueno@eplusbuildings.com>
Sent: Friday, June 21, 2019
Subject: RBES Code Upgrade - hearing documentation

Good morning

Attached please find the electronic copy of the statement I made at today's hearing.

Thanks you all for the good work you are doing

Regards
Enrique Bueno
Senior Engineer - CPHC
E+ Buildings
Montpelier VT USA
Ph: 802-229-4301

An Urgent Call for Vermont’s Legislature and Administration from the VT Passive House Organization VTPH
www.vermontpassivehouse.org

The VT Passive House organization is convinced that the Passive House Standard should be adopted as the base for the RBES building code, in order to make achievable the goals in the Comprehensive Energy Plan 2016 as well as make sustainable the goals of the EAN 2017 Report "90% Renewable by 2050".

If a cycle base implementation is required, then to achieve in the future the Passive House Standard, VTPH suggest that the first step required in that direction is an amendment to the RBES upgrade 2019 draft (Base and Stretch Code) as follows:

1) Make balanced ventilation with heat recovery mandatory for all new construction in Base Code as it is in the Stretch Code. The code upgrade draft allows for extract only ventilation for the first 3 years. At this point it is well understood in building science that “EXTRACT ONLY VENTILATION” is insufficient for adequate ventilation
2) Require an airtightness ≤ 1 ACH50 for all new construction
3) Require a u-values of ≤ 0.2 for all windows in new construction
These amendments will still leave the Code upgrade far from PH standard, but will be the first step in the right direction, and closer to VEIC’s high performance standard buildings.

It is the opinion of VTPH that the consequences of not reaching at least this numbers are:

1) Insufficient ventilation has serious implications in the health and productivity of the occupants as has been extensively documented in many medical research papers, adding to the health system burden.
2) The allowed airtightness of 3 ACH50 in the Code upgrade draft will have serious implications in energy loss as well as moisture penetration, condensation and mold formation adding to the health problems of a poorly ventilated building. Especially in multifamily buildings.
3) The code upgrade draft allows for windows’ u-value ≤ 0.3. That is an R-3 window. In VT an R-3 window, in addition to great energy loss and discomfort, will also cause condensation and mold formation, adding to the health problems cause by poor ventilation and loose airtightness.

During the following 6 years that the proposed RBES 2019 upgrade will rule from the day of its implementation, VT will see a great number of buildings being built during those years, and if we cannot adopt at least the amendments above suggested, the industry will be doing a great disservice to the consumer and a great loss to the State and the climate.

Why can the Passive House Standard be implemented right away?

- It holds no patents nor proprietary information that may incur in royalties’ charges from anybody
- The WUFI Passive energy modeling software is available to the public free of charge
- Materials and components are available off the shelf
- VT has qualified PASSIVE HOUSE builders and PH trainers to meet the challenge
- Any contractor or builder can be trained in four days’ time if necessary
- It is a simplified standard based on performance rather than prescription with well-defined goals
- The PHIUS+ Standard is being called the 'next level of high-performance building standards' by the US Department of Energy (DOE) because DOE’s extensive climate-based building science research laid the groundwork for PHIUS+ 2015.
- PHIUS+ certification requires that projects also comply with DOE-accepted performance practices including the US Environmental Protection Agency’s Indoor airPLUS and WaterSense programs.
- PHIUS+ certified residential projects also qualify for the DOE’s Zero Energy Ready Home program.
- By incorporating these programs that are widely accepted by ASHRAE, ICC, DOE, and other Government and professional organizations, PHIUS has cleared many of the hurdles perceived to accompany passive building.

From: DeSantis, Erin <Erin_DeSantis@americanchemistry.com>
Sent: Thursday, June 20, 2019 10:46 AM
Subject: ACC Comments Supporting Adoption of the Commercial Building Energy Standards and Residential Building Energy Standards

Good Morning,

Attached please find a letter supporting VT’s adoption of the 2020 Building Energy Code Update.

Please feel free to contact us if you have any questions.
Ms. Kelly Launder  
Assistant Director, Planning and Energy Resource Division  
Vermont Department of Public Service  
112 State Street  
Montpelier, VT 05602  
Via e-mail to: PSD.CodeUpdateRes@vermont.gov; PSD.CodeUpdateComm@vermont.gov  
RE: ACC Comments Supporting the Adoption of the Commercial Building Energy Standards and Residential Building Energy Standards  

Dear Ms. Launder:

The American Chemistry Council (ACC) is a national trade association representing a diverse set of companies engaged in the business of chemistry. ACC represents the leading U.S. chemical and plastic manufacturers, including companies in Vermont. Our members are committed to the safety of their products and public health through Responsible Care® and other beneficial programs. Over 96% of all manufactured goods are directly touched by the business of chemistry, making this industry an essential part of our nation’s economy.

ACC supports the proposed rules for the Commercial Building Energy Standards and Residential Building Energy Standards. ACC was pleased to participate in the stakeholder process in advance of this rule and we applaud the Department of Public Service for leading a transparent, deliberative process that resulted in significant improvements in Vermont’s energy code.

The new code will be good for Vermont’s economy. Vermont has a vibrant manufacturing sector. Many businesses employ people in the production and sale of building products and systems used to increase the energy efficiency of buildings and homes. These companies have also invested substantially in R&D that leads to cutting edge products with enormous environmental and cost savings. Similarly new tools of material science are being used to test and evaluate innovation before incorporation into the code. Adopting an updated energy code takes advantage of innovation and technology in a win-win that supports consumers, home owners, workers, and the state economy.

We are happy to answer any questions that you have as you work to maximize building energy efficiency. Please contact me at (518) 432-7835 if we can be of any further assistance.

Sincerely,

Margaret Gorman  
Senior Director, Northeast Region
American Chemistry Council

From: Jeff Forward <jeffrey.w.forward@gmail.com>
Sent: Tuesday, June 11, 2019 3:07 PM
Subject: 2019 RBES Comments

Thank you for providing me an opportunity to comment on RBES

Comment 1  I appreciate the recognition of advanced wood heating as being of value in the advanced portion of code compliance. I recommend using the list of eligible equipment used by Efficiency Vermont and the Clean Energy Development Fund to define “Advanced Wood Heating”. Here is the current list:


Further eligibility requirements include:

- Rebates are for new, high-efficiency wood pellet furnaces and boilers installed as primary central heating systems in spaces up to 5,000 sq ft. For larger spaces, please contact us.
- Systems must be pellet-only and must be classified as indoor systems and installed inside.
- System must have at least 1 ton fuel-storage and automated on/off and fuel feed.
- For qualifying models, please see www.rerc-vt.org.
- Commercial new construction projects are not eligible for this rebate, but may be eligible for custom incentives.

Comment 2. I continue to be troubled by the allowing electric resistance space heat in stairwells. I understand that the overall efficiency of the building needs to meet ambitious standards, but still I see no need for this exclusion and fear it may lead to increased use of electric resistance heat when and where it is unnecessary. Let me explain:

- If electric resistance heat were placed in any residential stairwell, it would likely be in multi-family housing. If the stairwell is in the thermal envelop, then I fail to see why it would need to be heated. The envelop requirements would keep most any space within the thermal boundary from freezing. Stairwells are not really spaces that people hang out in. I see no reason to heat them. If there are other common spaces that need heat, those spaces would still need some kind of heat source and if there is a heat source for common spaces, then stairwells should be included on that system.
- If the stairwell is not within the thermal envelope, it absolutely should not be heated by any source.
- Some have said that there may be a sprinkler head in a stairwell and therefore should be heated to reduce the risk of freezing that sprinkler head. That may be the case and I can see that might be a reasonable exception to the rule. But even then, the stairwell thermostat should be kept quite low at maybe 45 -50 degrees to reduce the risk of freezing. Another way to do this perhaps is to make the requirement for stairwells to be similar as for electric resistance back-up heat for homes heated with air source heat pumps. Control electric resistance space heaters in
stairwells to prevent operation above some temperature to prevent freezing, but not heating necessarily.

- An alternative to electric resistance space heat for back-up to a home heated with air source heat pumps would be to encourage the use of EPA certified wood pellet stoves. Pellet stoves compliment air source heat pumps very effectively. They are both space heaters. A properly sized pellet stove will work most efficiently at exactly the time when an air source heat pump is its least efficient.

Comment 3. I am uncertain about allowing for electric resistance heat in bathrooms. I can see how a homeowner might want some heat in a remote bathroom when they step out of the shower. I don’t think freezing pipes should be a concern in any home built to the envelope standards. I also understand how it might be expensive to extend a central heating system to a remote bathroom and if the home is heated with space heaters like an air source heat pump it might be difficult to get enough circulation to that remote bathroom. However, I suggest tracking how frequently electric resistance heat is being used in code compliant homes. Since electric resistance heat is the cheapest heating technology, I fear an unanticipated consequence could be a significant uptick of inefficient electric resistance heat.

Comment 4. I appreciate that the updated code recognizes several solar technologies when calculating performance points. However, some sites are not and will not likely be appropriate for siting on-site solar. However, they may meet the intent of these performance goals by purchasing into off-site community solar systems. I think RBS and CBES should recognize off-site community solar for added performance points. I suggest looking toward the USGBC LEED Standard that acknowledges different points for on-site vs. off-site renewable energy utilization.

Respectfully submitted,

Jeff Forward

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From: Sam Scofield <sam@samarcht.com>
Sent: Tuesday, June 4, 2019 12:05 PM
Subject: RBES Comments

To Whom It May Concern,

   Regarding the proposed 2020 RBES Table R402.1.2.1 and the similar Table in the proposed Commercial code for 2020: as a registered architect in Vermont I believe that it is irresponsible of the State to publish and therefore promote R values for Envelope and especially Wood Framed Wall construction using exterior insulation values that have been discredited in a number of studies as having inadequate amounts of exterior continuous insulation for our climate zone. You will be misleading
builders, designers and architects into thinking these numbers are adequate, putting them and their clients in danger for disruption and potential lawsuits over time as their buildings deteriorate. Saying they followed your guidelines will not keep this all from falling into the hands of the lawyers and I doubt the State will jump in to take responsibility when this starts happening.

Please revise these numbers accordingly to follow guidelines for our Climate Zone.

In addition, please give some guidance as to achieving your desired overall energy savings without using exterior insulation, which presents a number of problems with detailing and correct execution of construction. No matter how one details the penetrations in the exterior insulation for windows and doors there is always a point where the full value of the exterior insulation meets the connection point of the window or door and the R value drops to a negligible amount, leaving a place for condensation to form and a starting point for potential rot. I am curious to see what details you may be proposing for these junctions of dissimilar R value materials or whether you are simply leaving it up to us in the construction industry to solve these intractable problems.

Thank you,
Arthur B. Scofield
Sam Scofield Architect A.I.A.
VT reg. # 1306
INTERAGENCY COMMITTEE ON ADMINISTRATIVE RULES (ICAR) MINUTES

Meeting Date/Location: May 13, 2019
Pavilion Building, Auditorium, 109 State Street, Montpelier, VT 05609

Members Present: Chair Brad Ferland, Dirk Anderson, Ashley Berliner, Diane Bothfeld, John Kessler, Matt Langham, Clare O'Shaughnessy, and Steve Knudson

Members Absent: Jennifer Mojo

Minutes By: Melissa Mazza-Paquette

• 2:01 p.m. meeting called to order.
• Review and approval of minutes from the April 8, 2019 meeting.
• No additions/deletions to agenda. Agenda approved as drafted.
  o Note: During the hearing, after proposed rule #5 was heard, it was decided to review #10 next and proposed rules #6-9 below were presented after.
• No public comments made.
• Presentation of Proposed Rules on pages 2-11 to follow.
  1. Vermont Hemp Rules, Agency of Agriculture, Food and Markets, page 2
  2. Refugee Medical Assistance, Agency of Human Services, page 3
  3. Vermont Residential Building Energy Standards (RBES), Public Service Department, page 4
  4. Vermont Commercial Building Energy Standards (CBES), Department of Public Service, page 5
  6. Prescribed Drugs, Agency of Human Services, page 8
    a. Note: Due to the change in #10, this proposed rule was moved to #7 during the hearing.
  7. Pharmaceuticals, Medical Supplies and Equipment - General Information, Agency of Human Services, page 9
    a. Note: Due to the change in #10, this proposed rule was moved to #8 during the hearing.
  8. Gender Affirmation Surgery for the Treatment of Gender Dysphoria, Agency of Human Services, page 10
    a. Note: Due to the change in #10, this proposed rule was moved to #9 during the hearing.
  9. VPharm Prescribed Drugs, Agency of Human Services, page 11
    a. Note: Due to the change in #10, this proposed rule was moved to #10 during the hearing.
  10. Vermont Wetland Rules, Agency of Natural Resources, page 7
    a. Note: Rule was moved up to #6 during the hearing.
• Next scheduled meeting is Monday, June 10, 2019 at 2:00 p.m.
• 3:50 p.m. meeting adjourned.
Proposed Rule: Vermont Hemp Rules, Agency of Agriculture, Food and Markets
Presented by Gary Giguere

Motion made to accept the rule by Dirk Anderson, seconded by John Kessler, and passed unanimously except for Diane Bothfeld who abstained, with the following recommendations:

1. Proposed Rule Coversheet, page 4, #11: Include landowners if applicable.
3. Proposed Rule Coversheet, page 4, #13 and #14: Include hearing information or TBD.
4. Economic Impact Analysis, pages 1-2, #3: Spell out the acronyms and include them after in parentheses. Consider using a different word for ‘route’ in the last sentence of the second to last paragraph. Clarify last paragraph (i.e. it states ‘These rules’ in the first sentence and ‘It’ in the second). Spell out VAAFM and include it in parentheses after.
5. Economic Impact Analysis, page 3, #7: Include the positive financial impacts.
6. Environmental Impact Analysis, page 1, #3: Change ‘These rule’ to the appropriate term.
7. Public Input, page 1, #4: Add ‘least’ between ‘The Agency will hold at’ and ‘three public meetings…’. Correct misspelled word ‘pubic’.
8. Public Input, page 2, #5: Correct misspelled word ‘lobbiests’.
9. Text: Clarify the 0.3 percent threshold.
10. Text: Correct the section reference of the Farm Bill.
11. Text, page 1, Section 2: Change ‘wants’ to something else, such as ‘intends’ or ‘plans’.
12. Text, pages 1-2, Section 3.5: Add spaces after commas.
13. Text, pages 8-9, Sections 7.6 and 9.3: Expand upon.
Motion made to accept the rule by Diane Bothfeld, seconded by Dirk Anderson, and passed unanimously except for Ashley Berliner who abstained, with the following recommendation:

1. Economic Impact Analysis, page 2, #3: Include the number of participants affected.
Proposed Rule: Vermont Residential Building Energy Standards (RBES), Public Service Department
Presented by Kelly Launder, Keith Levenson and Allison Bates Wannop

Motion made to accept the rule by John Kessler, seconded by Matt Langham, and passed unanimously with the following recommendations:

1. Proposed Rule Coversheet, page 4, #13 and #14: Include information or TBD.
2. Public Input, page 2-3 #5: Consider reaching out to the Vermont Employee State Credit Union (VESCU).
Proposed Rule: Vermont Commercial Building Energy Standards (CBES), Department of Public Service
Presented by Barry Murphy, Kelly Launder, Allison Bates Wannop

Motion made to accept the rule by Dirk Anderson, seconded by John Kessler, and passed unanimously with the following recommendations:

2. Proposed Rule Coversheet, page 4, #13 and #14: Include information or TBD.
3. Public Input, page 2-3 #5: Consider reaching out to the Vermont Employee State Credit Union (VESCU).
4. Scientific Information, page 2, #5: Include contact information such as phone number and email address.
Presented by Cathy Jamieson, Josh Kelly, Anne Bijur

Motion made to accept the rule by Diane Bothfeld, seconded by John Kessler, and passed unanimously with the following recommendations:

1. Proposed Rule Coversheet, page 4, #13 and #14: Include information or TBD.
2. Proposed Rule Coversheet, page 5, #16: Include Solid Waste Management Entities and SWME if appropriate.
4. Environmental Impact Analysis, page 2, #4: Include how the ‘.... Plan indirectly maintains…’.
5. Public Input, page 1, #3: Update.
7. Scientific Information, page 2, #5: Include phone number.
8. Incorporation By Reference, page 2, #5: Include phone number.
Proposed Rule: Vermont Wetland Rules, Agency of Natural Resources
Presented by Laura Lapierre, Hannah Smith

Motion made to accept the rule by Matt Langham, seconded by Diane Bothfeld, and passed unanimously with the following recommendations:

1. Proposed Rule Coversheet, pages 4 and 5, #13 and #14: Include information or TBD.
2. Scientific Information, page 3, #5: Include phone number and any other relevant information to obtain copies.
Proposed Rule: Prescribed Drugs, Agency of Human Services
Presented by Ashley Berliner

Motion made to accept the rule by John Kessler, seconded by Dirk Anderson, and passed unanimously except for Ashley Berliner who abstained, with the following recommendations:

1. Proposed Rule Coversheet, page 3, #7: Spell out the acronym and include it after in parentheses.
2. Public Input, page 1, #3: Update.
3. Make clear that this proposed rule doesn’t aggravate the potential of over prescribing.
Proposed Rule: Pharmaceuticals, Medical Supplies and Equipment - General Information, Agency of Human Services
Presented by Ashley Berliner

Motion made to accept the rule to repeal as presented by Diane Bothfeld, seconded by Dirk Anderson, and passed unanimously except for Ashley Berliner who abstained.
Proposed Rule: Gender Affirmation Surgery for the Treatment of Gender Dysphoria,
Agency Human Services
Presented by Ashley Berliner

Motion made to accept the rule by Dirk Anderson, seconded by John Kessler, and passed unanimously except for Ashley Berliner who abstained, with the following recommendation:

1. Text, page 1, 4.238.1 (c): Clarify the definition of “Gender Identity” as written is a clinical definition as it differs from the one in Vermont State Statue.
Proposed Rule: VPharm Prescribed Drugs, Agency of Human Services
Presented by Ashley Berliner

Motion made to accept the rule as presented by Diane Bothfeld, seconded by Matt Langham, and passed unanimously except for Ashley Berliner who abstained.