Efficiency Vermont Residential New Construction Services

VERMONT ENERGY STAR® HOMES

ENERGY CODE PLUS

REQUIREMENTS

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To Enroll:
Call 800-893-1997

Efficiency Vermont

INTRODUCTION

Congratulations on taking the first step towards building a more energy-efficient home. Efficiency Vermont is here to help you the rest of the way. This document explains the requirements that must be achieved to earn certification and incentives through Efficiency Vermont's Residential New Construction Service.

SUMMARY OF SERVICES

Efficiency Vermont offers two Residential New Construction Services. These services are available for new homes and for homes undergoing a full gut rehabilitation in Vermont.

Vermont ENERGY STAR® Homes service

Vermont ENERGY STAR Homes is a service offered by Efficiency Vermont and Vermont Gas Systems. Since 2000, this service has been supporting and encouraging home builders to build ENERGY STAR qualified homes in Vermont. Each Vermont ENERGY STAR Home incorporates building details that ensure superior energy efficiency, durability, and promote a healthier indoor environment. Homes achieving ENERGY STAR requirements receive the U.S. Environmental Protection Agency's ENERGY STAR for Homes label. Efficiency Vermont, in partnership with Vermont Gas Systems, Washington Electric Cooperative, and Burlington Electric Department offers customers financial incentives that increase as higher levels of energy efficiency are achieved.

BENEFITS OF BUILDING AN ENERGY STAR HOME

Added Confidence
Home buying is complex enough without having to know all the details of energy-efficient construction. Instead, look for the EPA-supported ENERGY STAR label to easily identify homes that are truly energy efficient. Enjoy peace of mind knowing that they also meet strict energy efficiency guidelines.

Lower Ownership Cost
Compared to standard homes, ENERGY STAR qualified homes are designed to use substantially less energy for heating, cooling, and hot water. Over the years that you live in your home, this may add up to thousands of dollars saved on utility bills. Additional savings on maintenance can also be substantial.

Better Performance
Properly installed energy-efficient improvements deliver better protection against cold, heat, drafts, moisture, pollution, and noise. An energy-efficient home helps to ensure consistent temperatures between and across rooms, improved indoor air quality, and greater durability.

Smart Investment
To date, more than 8,500 home builders throughout the nation have partnered with EPA to construct more than 1 million ENERGY STAR labeled homes. By choosing a home with the ENERGY STAR label, you can be confident that it will have an increasingly valued feature when the time comes to sell.

Environmental Protection
Your home can be a greater source of pollution than your car. In fact, 16 percent of U.S. greenhouse gas emissions are generated from the energy used in houses nationwide. Energy used in our homes often comes from the burning of fossil fuels at power plants, which contributes to smog, acid rain, and global warming. The less energy we use in our homes, the less air pollution we generate.
Source: www.energystar.gov

Energy Code Plus service

This service is designed for homes that go beyond the minimum energy code in Vermont but are not built to the ENERGY STAR level of efficiency. Efficiency Vermont's Energy Code Plus service assists builders of new and fully gut rehabbed homes to achieve and verify energy code requirements while supporting their effort to exceed the minimum requirements of the VT-RBES.

BENEFITS OF PARTNERING WITH EFFICIENCY VERMONT

At no charge to you, an Efficiency Vermont Energy Consultant will be assigned to your project and will work with you throughout the planning and construction process to ensure successful completion of your home when you enroll in Efficiency Vermont's Residential New Construction service.

Your Efficiency Vermont Energy Consultant will:

- Provide energy efficiency design assistance through a building plan review prior to construction start. The Energy Consultant will look for potential thermal bypasses which compromise the thermal effectiveness of insulation and sheathing materials. Your Energy Consultant can also guide you in the purchase and installation of energy-efficient equipment, lights, and appliances;
- Provide you with expert guidance to complete the program checklists;
- Inspect and test your home for thermal bypass elimination, adequate ventilation, combustion safety, and air-tightness. This will ensure that your home will be energy efficient, durable and healthy;
- Perform and issue a Home Energy Rating for your completed home once the home meets all program requirements;
- Direct you to energy-saving choices that will maximize efficiency as well as qualify for Efficiency Vermont incentives.

OVERVIEW OF THE VERMONT RESIDENTIAL BUILDING ENERGY STANDARDS

The Vermont Residential Building Energy Standards (VT-RBES), also known as the Vermont energy code, is the Vermont state law that requires residential builders (or the person acting as the general contractor) to certify that the construction or repair work they perform complies with Vermont energy efficiency standards.

Participants in Efficiency Vermont's Residential New Construction Services must meet requirements of the VT-RBES.

VT-RBES applies to:

- New single family homes (including modular & log homes)
- New multifamily homes (buildings up to 3 stories)
- Additions, alterations, renovations, & repairs (only applies to portion of the home being worked on)

VT-RBES does not apply to:

- Residential buildings started before July 1, 1998;
- Act 250 projects permitted before July 1, 1997;
- Commercial and high-rise residential buildings (except for the residential portion of a mixed-use building);
- Mobile homes on a permanent chassis with detachable wheels (except for site-built components such as conditioned basements or crawlspaces);
- Buildings or additions with very low energy use (those designed for a peak energy use of less than 3.4 Btu/h [1 Watt] per square foot of floor area);
- Unconditioned buildings (buildings that are not heated or cooled);
- Hunting camps

For more information about this state law, visit the Vermont Department of Public Service website at http://publicservice.vermont.gov or call the Vermont Energy Code Assistance Center at 855-887-0673.

STARTING YOUR NEW HOME OR GUT REHABILITATION PROJECT WITH EFFICIENCY VERMONT

STEP 1

Choose the Efficiency Vermont Residential New Construction Service that fits your project and enroll. To enroll, call 800-893-1997. The following page is an overview of requirements for Efficiency Vermont's Residential New Construction Services and VT-RBES.

STEP 2

Complete the Efficiency Vermont Energy Features Form and provide us with your house plans.

STEP 3

For homes enrolled in Vermont ENERGY STAR® Homes; ensure that the builder and HVAC contractor have taken the required ENERGY STAR training. Visit: Training Opportunities at www.efficiencyvermont.com/VESH for more information.

STEP 4

Build your home to the requirements outlined in this document. **Contact Efficiency Vermont to schedule:**
1) A pre-drywall inspection with at least one week's notice
2) Final inspection when the home is complete.

STEP 5

Receive incentive payment(s), and corresponding certificates.

OVERVIEW OF REQUIREMENTS

Description of Requirement	Vermont ENERGY STAR® Homes	Energy Code Plus	VT-RBES (Energy Code)
Builders and HVAC complete EPA required ENERGY STAR training	✓		
Checklist Requirements (see page 4)			
Meet criteria of the ENERGY STAR Thermal Enclosure System Rater Checklist	✓	✓[1]	✓[2]
Meet all the criteria of the ENERGY STAR HVAC System Quality Installation Contractor Checklist	✓		
Meet all the criteria of the ENERGY STAR HVAC System Quality Installation Rater Checklist	✓		
Meet all the criteria in the Water Management System Builder Checklist	✓		
Thermal Performance (see page 4)			
VT-RBES 2011 prescriptive insulation levels installed	✓[3]	✓	✓
Maximum air leakage (as measured by blower door)	≤3 ACH50	≤4 ACH50	<5ACH50
ENERGY STAR or equivalent heating and cooling	✓	✓	
All forced air ducts (heating and air conditioning) must be within thermal boundary	✓	✓	
Indoor Air Quality & Combustion Safety (see page 5-9)			
Automated, whole house mechanical ventilation system installed	✓	✓	✓
Spot (local) ventilation installed	✓	✓	✓
Kitchen ventilation installed	✓		
Clothes dryer vented to the outdoors	✓	✓	✓
Heating systems and water heaters must be either sealed combustion (direct vent), power-vented, or must be located in an air-sealed utility room equipped with outside combustion air and fully isolated from the indoor air	✓	✓	✓
Wood, pellet, gas stoves and fireplaces must have ducted outside combustion air supply and tight-fitting gasketed doors with compression closure	✓	✓	✓
Wood, pellet and gas stoves must have ducted outside combustion air supply	✓	✓	✓
Home Energy Rating (see page 10)			
Home Energy Rating Index Score	≤HERS Target Index	≤75	≤75
Electrical Efficiency (see page 9)			
Percent of energy-efficient ENERGY STAR lighting	80%	50%	50%
ENERGY STAR appliances	✓	✓	

[1] Energy Code Plus requires a 3rd party inspection of specific sections of the Thermal Enclosure System Rater Checklist **and** a final inspection that includes a blower door test.
[2] VT-RBES requires either an inspection similar to the air sealing and air barrier sections of the Thermal Enclosure System Rater Checklist **or** a blower door test.
[3] Vermont ENERGY STAR Homes must have insulation installed to a minimum Grade I, or Grade II for walls with minimum R-5 insulated sheathing.

REQUIREMENTS

COMPLETION OF ENERGY STAR® CHECKLISTS

As a prerequisite for qualification in the Vermont ENERGY STAR Homes service, a home must meet the requirements of the following four checklists:

- *Thermal Enclosure System Rater Checklist*
- *HVAC System Quality Installation Contractor Checklist*
- *HVAC System Quality Installation Rater Checklist*
- *Water Management System Builder Checklist*

See **Figure 1** for a summary of the checklists.

Homes enrolled in the Energy Code Plus service only need to meet sections 1, 2, 3, and 5 of the *Thermal Enclosure Checklist* relating to quality installed insulation, fully aligned air barriers, and air sealing.

THERMAL PERFORMANCE REQUIREMENTS

Pre-Drywall Inspection

A pre-drywall inspection must be completed for Efficiency Vermont's Vermont ENERGY STAR Homes service and Energy Code Plus service. Your Efficiency Vermont Energy Consultant will use the ENERGY STAR qualified Homes *Thermal Enclosure System Rater Checklist* to ensure compliance with all requirements. The Checklist requires a visual inspection by your Energy Consultant, who will inspect insulation installation to ensure alignment with air barriers. All air and thermal barriers need to be continuous and complete. He or she will complete the checklist.

- Vermont ENERGY STAR Homes service participants must achieve compliance with the ENERGY STAR Qualified Homes Thermal Enclosure System Rater Checklist in all areas.
- Energy Code Plus participants must achieve compliance with the ENERGY STAR Qualified Homes Thermal Enclosure System Rater Checklist in all areas except for thermal bridging requirements in Section 4.

For a visual guide to explain common thermal bypass issues see Appendix 1.

Provide at least one week's notice when scheduling pre-drywall inspection

See Appendix 2 if you are interested in building a certified Vermont ENERGY STAR Homes modular or log home.

Air sealing

Enrollees in the Vermont ENERGY STAR Homes and the Energy Code Plus services will receive a visual insulation inspection and a blower door test performed by an Efficiency Vermont Energy Consultant.

Insulation levels

For both Energy Code Plus and Vermont ENERGY STAR Homes, prescriptive insulation levels of VT RBES must be met. Refer to the Insulation Requirements table (pictured below) on page A-3 of the Appendix.

Single-Family and Multi-Family Homes ~ *Fast-Track Method*

Component	*Package 1*	*Package 2*	*Package 3*	*Package 4*
1. Ceiling R-Value	R-49	R-38	R-38 or R-30+10	R-28 cont.
2. Above-Grade Wall R-value	R-20 or R-13+5	R-20+5 or R-13+7.5	R-20 or R-13+5	R-21 cont.
3. Floor R-value	R-30	R-30	R-30	R-30
4. Basement/Crawl Space Wall R-value	R-15/20	R-15/20	R-20 cont.	R-15/20
5. Slab Edge R-value	R-15, 4ft.	R-15, 4ft.	R-15, 4ft	R-15, 4 ft
6. Heated Slab R-value (Edge and Under)	R-15	R-15	R-15	R-15
7. Window and Door U-value	0.32	0.32	0.30	0.32
8. Skylight U-value	0.55	0.55	0.55	0.55

Note: R-values must be equal to or greater than the values shown. U-values must be equal to or less than the values shown.

Table Qualifiers

A Thermal Values: Use the nominal thermal values listed by the manufacturer. If the home's design specifies a component that has two different thermal values (i.e., R-38 ceiling and R-49 ceiling), an average R-value must be calculated for comparison. (See Section 3.5a.)

B Wall R-Values: "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

C Window U-Values: Window U-value is the average U-value for all glazing, including windows, skylights, and sliding and patio doors. Maximum glazing area is 20% except for sunrooms. Replacement windows must have an average U-value of 0.32. (See Section 3.5b to calculate average U-values.)

D Window and Door Exemptions: You can exclude up to 15 square feet of glazed fenestration area from the calculation of average U-value for windows, and one door (up to 24 square feet) from the calculation of average U-value for doors.

E Default Thermal Values: See Appendix B. Flat and sloped ceiling R-values assume standard truss. However, if a raised truss is used, as shown in Figure B-1 (Appendix B), R-value may be reduced to R-38.

F Ceilings Without Attics: For ceilings without attic spaces (vaulted ceilings), R-30 is allowed for up to 500 square feet or 20% of the total insulated ceiling area, whichever is less.

G Ceilings With Attics: For ceilings with attic spaces, R-38 is allowed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

H Slab Edge Insulation: Thermal values in this table require the following configurations: slab edge insulation must extend 4 feet or a combination of depth and width that equals 4 feet.

I Basement/Crawl Space R-Values: "15/20" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-20 cavity insulation at the interior of the basement wall. "15/20" is allowed to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. Crawl space wall insulation must cover the full height of the wall and extend to a depth 12 feet below grade and basement wall insulation must cover the full height of the basement wall.

J Hatches: Access hatches and doors must be insulated to the same level as the surrounding surface.

K Unconditioned Spaces: Components that enclose unconditioned spaces do not need to be considered.

L Heated Slabs: In addition to R 15 slab edge insulation, R 15 insulation is required beneath the entire slab for radiant or directly heated slabs.

M Thermal Values That Do Not Apply: Ignore the values in the table if the building component is not part of the home.

N Sunrooms: All sunrooms must meet the basic requirements and the performance requirements outlined above, except the maximum glazing requirement. For sunrooms with *thermal* isolation, the minimum ceiling insulation R-values must be R-30; the minimum wall R-value must be R-13; and the maximum fenestration U-factor must be 0.45.

ACH50 describes the air changes per hour at a 50 pascals pressure difference between the inside of the home and the outdoors. A blower door is used to create the pressure difference and this test determines the rate at which air leaks out of or enters the home. Close attention to air sealing details will result in a tighter, more energy-efficient home and is one of the most cost-effective ways of improving home efficiency.

Figure 1:

SUMMARY OF ENERGY STAR CHECKLIST REQUIREMENTS

THERMAL ENCLOSURE RATER CHECKLIST
- Insulation installation quality
- Air barrier integrity
- Thermal bridging avoided

Verified by Rater (Efficiency Vermont Technical Advisor)

HVAC CONTRACTOR CHECKLIST
- Ventilation meets ASHRAE 62.2
- System design
- System selection
- Refrigerant tests
- Airflow tests

Verified by HVAC Designer/Contractor

HVAC RATER CHECKLIST
- Duct installation
- Duct leakage
- Ventilation design
- System Flow
- MERV 6 filters

Verified by Rater (Efficiency Vermont Technical Advisor)

WATER MANAGEMENT BUILDER CHECKLIST
- Site and foundation
- Wall assembly
- Roof assembly
- Dry building materials
- Water tolerant finishes

Verified by Builder

To meet the specification for Vermont ENERGY STAR® Homes, air leakage must be ≤3 ACH50 as determined by your Energy Consultant.

Energy Code Plus homes must achieve an air leakage rate of ≤4 ACH50.

HEATING, VENTILATION & AIR CONDITIONING (HVAC)

Heating system energy efficiency

The specifications for Vermont ENERGY STAR Homes and Energy Code Plus are the same for heating system efficiency.

Space heating system requirements:

ENERGY STAR System Types	Minimum Efficiency Requirement
Boilers – oil, natural gas & propane (LP gas) fuel fired systems using water based distribution (baseboard, radiators, or radiant tubing)	85 AFUE
Furnaces – natural gas & propane (LP gas) fuel fired systems using forced air distribution (ductwork)	90 AFUE
Heat Pumps	Must be ENERGY STAR qualified

Non-ENERGY STAR System Types	Minimum Efficiency Requirement
Oil-fired Furnaces	85 AFUE or higher
Space Heaters	Fossil fuel: 80 AFUE or higher Solid fuel (wood or wood chip): must be labeled as meeting current EPA or Canadian Standards Association (CSA) emissions standards
Combination wood/ fossil fuel systems, wood boilers & wood furnaces	Must be labeled as meeting current EPA or Canadian Standards Association (CSA) emissions standards

Heating and cooling duct location

The duct location specifications for Vermont ENERGY STAR Homes and Energy Code Plus are the same:

Homes using forced hot air heating or air conditioning using ductwork to distribute conditioned air must be designed so that all the ductwork is located inside the thermal barrier and air barrier of the building.

System design and installation

To meet Vermont ENERGY STAR Homes requirements:

The requirement for completion of the *HVAC System Quality Installation Contractor Checklist* applies to:

- Ventilation Systems
- Air Conditioners (split air and unitary)
- Air or Water-Source Heat Pumps rated up to 65,000 Btu/hour (Water-Source Heat Pumps are commonly described as ground-source heat pumps or geothermal heat pumps)
- Furnaces rated up to 225,000 Btu/hour

All other equipment is exempt (e.g., boilers, space heaters, window air conditioners).

- Efficiency Vermont must receive the *HVAC System Quality Installation Contractor Checklist* completed by an ENERGY STAR certified HVAC contractor (**ENERGY STAR training is required for HVAC contractors wishing to work on ENERGY STAR projects**). Note: An AHRI certificate must show that all HVAC system components are properly matched.
- Your Efficiency Vermont Energy Consultant will complete an *HVAC System Quality Installation Rater Checklist* providing further verification of quality HVAC design and installation. This field verification looks at HVAC duct installation, insulation, and air sealing/leakage, as well as installation of ventilation and combustion safety measures.

Energy Code Plus uses Vermont energy code requirements as a baseline for HVAC system design and installation.

INDOOR AIR QUALITY

VT-RBES (Energy Code) requires that all homes built in Vermont provide a healthy indoor environment through the proper installation of mechanical ventilation and combustion safety measures.

All homes participating in Efficiency Vermont's Residential New Construction Services must meet all VT-RBES requirements.

COMPONENTS OF A QUALITY HVAC INSTALLATION

Proper Sizing of Equipment

Installing the right size equipment for your home is essential to getting the best performance for your heating and cooling equipment and maintaining the comfort you deserve. Some believe that bigger is better when buying new equipment, but a system actually operates best when each component is properly sized. Oversized equipment may cycle on and off more frequently, which can make the home less comfortable and shorten the equipment life.

Components of a quality HVAC installation cont'd

Sealing Ducts
Ducts circulate air from the furnace, central air conditioner or heat pump throughout the house. Often ducts have damage or poor connections that leak the hot or cold air and waste a lot of energy. Sealing ducts can greatly improve the efficiency of your heating and cooling system.

Optimizing Air Flow
To operate well, a heating or cooling system needs to have the proper volume of air flow. If air flow is too high or too low, it may make the home less comfortable and increase utility bills.

Proper Refrigerant Charge (Central Air Conditioners and Heat Pumps Only)
It is important for an air conditioner or heat pump to have the correct amount of refrigerant, or correct refrigerant charge. An improperly charged system may consume more energy and provide less dehumidification.

Source: www.energystar.gov

IMPORTANT NOTES

- If an applicable requirement on the checklist cannot be inspected by your Energy Consultant or HVAC contractor the home cannot be qualified as an ENERGY STAR® Home. Contact Efficiency Vermont early in the process to ensure that no critical steps are missed.
- An Efficiency Vermont Energy Consultant reviews *HVAC Quality Installation Contractor Checklist*; however, Efficiency Vermont is only responsible for ensuring that the HVAC Contractor has completed the Contractor checklist, not for assessing the accuracy of the load calculations or field verifications included. It is the Contractor's sole responsibility to ensure the system design and installation comply with the *HVAC Quality Installation Contractor Checklist.*
- Beginning in 2012, only contractors who have the requisite training and industry recognition will be eligible to install HVAC systems in ENERGY STAR homes. Contact Vermont ENERGY STAR Homes for details regarding this training at 800-893-1997.

MECHANICAL VENTILATION

Vermont ENERGY STAR Homes participants must meet ventilation and combustion criteria described in Section 1 of the HVAC System Quality Installation Contractor Checklist and Sections 5-9 of the HVAC System Quality Installation Rater Checklist. ASHRAE 62.2 ventilation requirements as required in the HVAC checklists are acknowledged as an alternate compliance path to VT-RBES. Refer to ASHRAE 62.2 worksheet or ask your Energy Consultant for more information.

Energy Code Plus participants must meet VT-RBES ventilations requirements presented in the following pages.

BENEFITS OF MECHANICAL VENTILATION

Better Indoor Air Quality
Indoor air can be many times more polluted than outdoor air, and the average American spends 90 percent of the day inside. Ventilation systems can significantly improve a home's air quality by removing allergens, pollutants, and excess moisture.

More Control
When homes rely on air flow through walls, roofs, and windows for ventilation, there is no control over the source or amount of air that comes into the house. In fact, air leaking into the house may come from undesirable areas such as the garage, attic, or crawl space. Mechanical ventilation systems, however, provide proper fresh air flow along with appropriate locations for intake and exhaust.

Improved Comfort
Mechanical ventilation systems allow a constant flow of outside air into the home and can also provide filtration, dehumidification, and conditioning of the incoming outside air.

Source: www.energystar.gov

Whole-House Mechanical Ventilation Systems

A system to provide automatic operation of mechanical ventilation for the whole house must be installed. This system can be any one, or a combination, of the following. These systems are ranked in order of effectiveness:

1. Heat or enthalpy recovery ventilator (HRV or ERV sometimes called air-to-air heat exchanger)
2. Balanced non-heat recovery ventilator (Supply and Exhaust ventilation)
3. Central multi-port exhaust fan (Exhaust Only Ventilation - EOV)
4. Energy-efficient bath fan(s) - (EOV)

Table 1: VT-RBES Whole-House Ventilation Air-Flow Requirements (all system types) for Energy Code Plus			
Prescriptive Requirement			**Performance Requirement**
Number of Bedrooms*	Minimum Nominal Rated Air-Flow (CFM)**	Minimum Number of Fans Needed to Meet Whole-House Ventilation Air-Flow Requirements	Minimum Actual Air-Flow (CFM)
1	50 CFM	1 fan	30 CFM
2	75 CFM	1 fan	45 CFM
3	100 CFM	1 fan	60 CFM
4	125 CFM	1 multi-port ducted system	75 CFM
5	150 CFM	or 2 bath fans	90 CFM
Regardless of number of bedrooms, VT-RBES air flow requirements for homes greater than 3,000 square feet are calculated using the formula below:			
Prescriptive Requirement CFM = 0.05 cfm x square feet of conditioned space			
* Bedroom – the number of bedrooms will be as listed on any building or septic permit on site or shall be determined as a room or space 70 square feet or greater, with an entry door, egress window and closet, used or intended to be used for sleeping. A "den", "library", "home office" with a an entry door, egress window, closet, and 70 square feet or greater or other similar rooms shall count as a bedroom, but living rooms and foyers shall not. ** Represents the total rated capacity (at .1 inch wg) of all fans installed for whole-house ventilation.			

Whole House Ventilation - Automatic Operation

See **Table 1,** VT-RBES Whole-House Ventilation Air-Flow Requirements (all system types).

The whole-house ventilation system must have controls capable of providing for automated operation during periods of occupancy. Options include:

- 24-hour programmable timer
- Other automatic controls capable of operating the system without the need for occupant intervention.
- Continuously operated - Systems must have a remotely mounted (i.e. not in the living space) on/off switch that is appropriately labeled.

Operation controlled solely by a humidity sensor (humidistat, or dehumidistat) does not qualify.

All ventilation equipment (both whole-house and local) must be installed according to the manufacturer's instructions and in accordance with the following requirements:

- Fan housings for ceiling- or wall-mounted fans must be sealed to the ceiling or wall to ensure exhaust air is pulled from the interior living space.
- Inlet grilles for ducted systems must be sealed to the ceiling or wall.
- Ducts that run more than 8 feet must be a smooth wall (not corrugated or flexible material). PVC, aluminum or steel ducting will meet these criteria.
- All ducts in unheated locations must be insulated.
- Mechanical fasteners — not tape — must be used to connect the ducts to the fan.
- Joints and connections must be securely fastened and air-sealed with durable and appropriate materials. Standard duct tape is not allowed for sealing ducts.
- Noise reduction of remote whole-house fans must be provided by isolating the fan from the hard ducting using at least 1 foot, but no more than 2 feet, of insulated, flexible ducting. (This requirement does not apply to fans mounted in ceilings or walls.) The fan also must be acoustically isolated from the framing of the building.
- Intake openings, if used, must be located a minimum of 10 feet from any hazardous or noxious contaminant, such as vents, chimneys, fuel fills, streets, alleys, parking lots and loading docks. The bottom of the intake opening(s) must be at least 1 foot above the expected snow accumulation level (4 feet above grade is required for Vermont ENERGY STAR® Homes).
- Outside openings for both supply and exhaust must be protected with screens, louvers or grilles having a minimum opening size of 1/4 inch and a maximum opening size of 1/2 inch.

Whole House Ventilation – Air Circulation

All ventilation systems must have a provision for circulating air to all finished living spaces, such as distribution ducts, grilles, transoms, or door undercuts. If door undercuts are used, they must be at least one-half inch above the finished floor surface.

Spot Ventilation (Local Ventilation)

- Bathrooms: All bathrooms with bathtubs, showers, and/or spas must have an exhaust flow vented to the outdoors of at least 50 CFM intermittent or 20 CFM continuous.
- Kitchens: For ENERGY STAR® Homes only, it is required that kitchens have an exhaust flow vented to the outdoors of at least 100 CFM intermittent or greater than 5 ACH based on kitchen volume. Range hoods typically meet this requirement.
- Clothes Dryers: All clothes dryers must be exhausted to outdoors, according to the manufacturer's instructions. Dryer exhaust systems must be independent of all other systems and must transport the dryer exhaust all the way to the outside of the home. An exception is made for ventless dryers equipped with condensate drain.

More ways to improve indoor air quality

Self-closing, gasketed doors are recommended between living areas and attached garages.

Vermont Fire & Building Safety Code – 2005 requires that new owner occupied single-family dwellings, and dwellings that are sold or transferred, must have CO detectors installed in the immediate vicinity of any bedrooms. New construction must have CO detectors that are wired in with battery back-up.

Install a simple, inexpensive radon and soil gas ventilation system or at least install and cap the portion of the system under the slab and just into the basement for potential future use if radon testing indicates a need for mitigation.

Testing for radon is strongly recommended after construction is complete and effective mitigation techniques employed, if necessary.

Heat Recovery Ventilation (HRV) & Enthalpy Recovery Ventilation (ERV) Air Flow & Performance Code

HRV and ERV system airflow testing is not provided by Efficiency Vermont. HRV and ERV systems are assumed to perform in the home as rated by the Home Ventilating Institute (HVI) at 0.4 inches in water column (0.4 in wg) Net Supply airflow. HRV and ERV systems are assumed to achieve code Performance Requirements when HVI shows the installed equipment provides sufficient Net Supply Airflow CFM at 0.4 in wg.

Whole-House Ventilation Specifications for Single-Port Fans (Exhaust or Supply)

- Durability: Fans must be rated for "continuous duty". Fans meeting the efficiency requirement are assumed comply with this requirement.
- Efficiency: Single-port Fans (those with only one connection to the conditioned space) must not exceed 50 watts as listed by the manufacturer. This refers to the fan power only; it does not include power used for lights, heaters, nightlights, timers, etc. This power limit does not apply to multi-port fans that have more than one connection to the living space.
- Sound: Whole house ventilation equipment located less than 4 feet from louvers, grilles or openings must have a sound rating no greater than 1.5 sones.
- All exhaust fans will be tested for performance to verify adequate ventilation is being provided.

COMBUSTION SAFETY

VT-RBES has the following combustion safety requirements that apply to homes enrolled in Vermont ENERGY STAR Homes and Energy Code Plus services:

- Heating systems and water heaters must be either sealed combustion (direct vent) or must be located in an air-sealed utility room equipped with outside combustion air and fully isolated from the indoor air.
- Solid fuel burning appliances and fireplaces must have ducted outside combustion air supply and tight-fitting gasketed doors with compression closure.
- Wood, pellet and gas stoves must have ducted outside combustion air supply.
- Attached garages must be air-sealed from living areas,
- Unvented ("vent-free") gas fireplaces and space heaters do not meet Vermont ENERGY STAR Home ventilation requirements.

Exterior Combustion Air Intake

- Must not take air from within the garage, attic, or basement.
- Must not terminate to the exterior higher than firebox and shall not rise vertically within 18" of firebox.
  - An exception to this requirement can be made when the woodstove or fireplace is installed below grade. Air intake may terminate above the firebox if the combustion air supply point is below the firebox and the combustion air exhaust point is > 15' below the top of the chimney.
- Must deliver combustion air to the firebox.
  - An exception to this requirement can be made for older woodstoves and cook stoves where direct

connection of combustion air is not possible or is being avoided to meet the below grade exception. Combustion air may be delivered within 24" of the stoves air intake opening.

- Must be screened with ¼" mesh.
- Must be closable and designed to prevent debris from dropping into the air intake.
- Must be non-combustible, masonry or 30 gauge (or thicker) metal, with minimum 1" clearance to combustibles for the length of the combustion air intake.
- Must be a minimum of 6 square inches and not more than 55 square inches.
- Must be installed so as to remain free of obstruction from snow.

An exception to the exterior air intake requirement is made for factory-built fireplaces, masonry fireplaces and heaters, 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.

BUILDING DURABILITY

To meet Vermont ENERGY STAR® Homes requirements, Efficiency Vermont must receive a completed ENERGY STAR Qualified Homes *Water Management System Builder Checklist.*

The specifications in this checklist are designed to protect the home from damage or decay caused by water and water vapor.

Energy Code Plus does not have a specific requirement for building durability, though following the specifications of the ENERGY STAR Qualified Homes *Water Management System Builder Checklist* is encouraged.

Important note for Vermont ENERGY STAR Homes participants:

- Efficiency Vermont is responsible for ensuring that the ENERGY STAR *Water Management System Builder Checklist* has been completed. Efficiency Vermont is not responsible for assessing the accuracy of the builder verifications in this checklist. It is the builder's sole responsibility to ensure home complies with the ENERGY STAR *Water Management System Builder Checklist.*
- Beginning in 2012, builders are required to complete an online ENERGY STAR training offered by EPA in order to receive ENERGY STAR certification. Contact your Efficiency Vermont Energy Consultant for more information.

ENERGY-EFFICIENT LIGHTING

Participants in Efficiency Vermont's Residential New Construction services must install ENERGY STAR qualified CFLs, LEDs or pin-based lighting so that the percentage of permanently installed lighting fixtures with high efficacy lamps in qualifying locations is as follows:

Vermont ENERGY STAR Homes - 80% or more
Energy Code Plus requirement - 50% or more

Qualifying locations include:

- Kitchens
- Garages
- Living rooms
- Bathrooms
- Hallways
- Bedrooms
- All outdoor fixtures that are mounted on a building or pole
- Dining rooms
- Family rooms or dens
- Utility rooms
- Home offices
- Entrances

Other lighting recommendations:
ENERGY STAR fluorescent exterior fixtures or CFLs used in unheated locations should have a rated starting temperature of 0° Fahrenheit or lower.

Dimmers should not be installed on fluorescent light fixtures unless both dimmer and fixture are specifically designed for compatible dimmable operation. Dimmable CFLs are widely available in Vermont and can be used with fixtures equipped with threaded lamp sockets.

Visit www.efficiencyvermont.com for more tips on lighting your home.

ENERGY-EFFICIENT APPLIANCES

All major appliances must be ENERGY STAR labeled, including:

- Refrigerator
- Dishwasher
- Clothes Washer

Note:
If two of the above appliances meet Consortium for Energy Efficiency (CEE) Tier 2 or Tier 3 efficiency standards, enrollee is eligible to receive an incentive from Efficiency Vermont upon successful completion of Energy Code Plus or Vermont ENERGY STAR Homes requirements. Visit www.cee1.org for a list of qualifying products.

HOME ENERGY RATING REQUIREMENT

A Home Energy Rating System (HERS) is a nationally recognized energy performance indicator, measuring the overall energy efficiency of a home. Homes are rated using the National Home Energy Rating Council's "Index" Rating scale, with 0 points being the most efficient net-zero energy home.

How a Home Energy Rating Works

The Home Energy Rating takes into account features such as home size, types of walls and foundation, insulation levels, air leakage, mechanical equipment, windows, orientation, and lights and appliances. Computer modeling software calculates the efficiency of the constructed home (or planned home) compared to a reference home with a HERS index of 100. Each point below 100 equals a 1% increase in energy efficiency. Since energy ratings are based on the total energy consumption of the home, all design choices and energy efficiency options are accounted for in the HERS index.

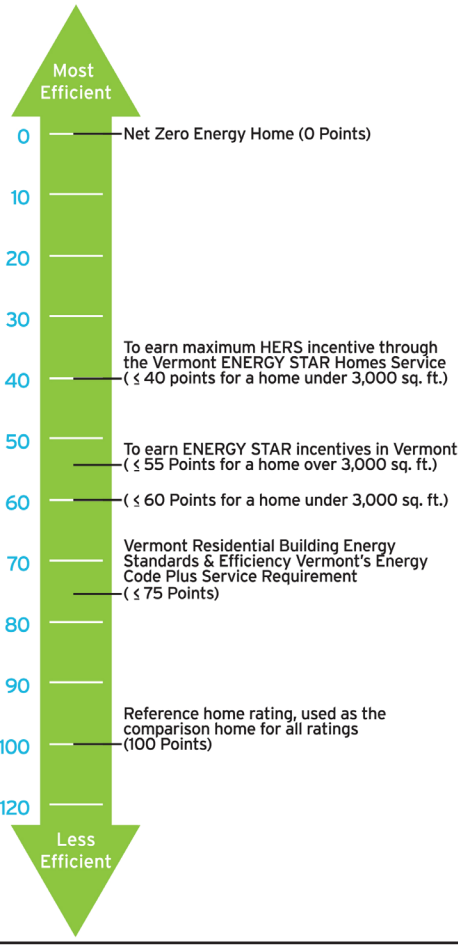
A final Home Energy Rating is produced after information is collected during the final site visit. Efficiency Vermont performs the Home Energy Rating free of charge to participants – an estimated $750 value.

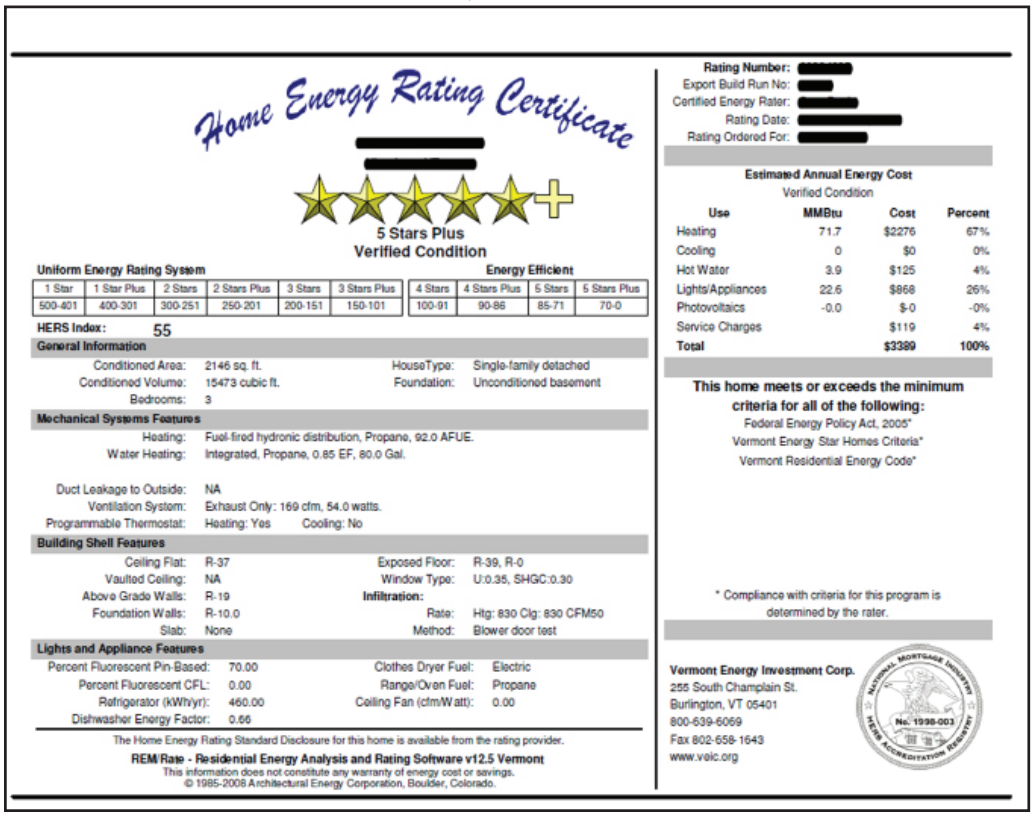
An Efficiency Vermont Energy Consultant will review your building plans and Energy Features Form to determine whether a formal Home Energy Rating plan review is warranted or whether an informal plan review is more appropriate.

Where enrolled homes do not meet Vermont ENERGY STAR® Homes or Energy Code Plus minimum requirements, a Home Energy Rating certificate and a VT-RBES compliance certificate (when home complies) may be purchased.

See the next page for ways to lower your home's HERS score.

Home Energy Rating Index





Home Energy Rating Certificate

[redacted]

5 Stars Plus
Verified Condition

Uniform Energy Rating System / Energy Efficient

1 Star	1 Star Plus	2 Stars	2 Stars Plus	3 Stars	3 Stars Plus	4 Stars	4 Stars Plus	5 Stars	5 Stars Plus
500-401	400-301	300-251	250-201	200-151	150-101	100-91	90-86	85-71	70-0

HERS Index: 55

General Information
Conditioned Area: 2146 sq. ft. — HouseType: Single-family detached
Conditioned Volume: 15473 cubic ft. — Foundation: Unconditioned basement
Bedrooms: 3

Mechanical Systems Features
Heating: Fuel-fired hydronic distribution, Propane, 92.0 AFUE.
Water Heating: Integrated, Propane, 0.85 EF, 80.0 Gal.
Duct Leakage to Outside: NA
Ventilation System: Exhaust Only: 169 cfm, 54.0 watts.
Programmable Thermostat: Heating: Yes Cooling: No

Building Shell Features
Ceiling Flat: R-37 — Exposed Floor: R-39, R-0
Vaulted Ceiling: NA — Window Type: U:0.35, SHGC:0.30
Above Grade Walls: R-19 — Infiltration:
Foundation Walls: R-10.0 — Rate: Htg: 830 Clg: 830 CFM50
Slab: None — Method: Blower door test

Lights and Appliance Features
Percent Fluorescent Pin-Based: 70.00 — Clothes Dryer Fuel: Electric
Percent Fluorescent CFL: 0.00 — Range/Oven Fuel: Propane
Refrigerator (kWh/yr): 460.00 — Ceiling Fan (cfm/Watt): 0.00
Dishwasher Energy Factor: 0.66

The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

REM/Rate - Residential Energy Analysis and Rating Software v12.5 Vermont
This information does not constitute any warranty of energy cost or savings.
© 1985-2008 Architectural Energy Corporation, Boulder, Colorado.

Rating Number: [redacted]
Export Build Run No: [redacted]
Certified Energy Rater: [redacted]
Rating Date: [redacted]
Rating Ordered For: [redacted]

Estimated Annual Energy Cost
Verified Condition

Use	MMBtu	Cost	Percent
Heating	71.7	$2276	67%
Cooling	0	$0	0%
Hot Water	3.9	$125	4%
Lights/Appliances	22.6	$868	26%
Photovoltaics	-0.0	$-0	-0%
Service Charges		$119	4%
Total		$3389	100%

This home meets or exceeds the minimum criteria for all of the following:
Federal Energy Policy Act, 2005*
Vermont Energy Star Homes Criteria*
Vermont Residential Energy Code*

* Compliance with criteria for this program is determined by the rater.

Vermont Energy Investment Corp.
255 South Champlain St.
Burlington, VT 05401
800-639-6069
Fax 802-658-1643
www.veic.org

Questions? Efficiency Vermont is here to help. Contact your Energy Consultant at 888-921-5990, with any questions you have about these requirements.

LOWERING YOUR HOME'S ENERGY USE AND YOUR HERS INDEX:

PRIMARY:

- **Build smaller:**
  All things being equal, a larger home will consume more energy and will cost more to operate than a smaller home.
- **Implement efficient air sealing:**
  Caulk/foam any and all openings & gaps, including wood to wood connections
  Glue drywall to top plates
  Pay special attention to corners, changes in angles/materials/sizes
- **Reduce thermal bridging** (particularly of above grade walls) some options are:
  Add a layer (or more) of foamboard across studs
  Use staggered double wall framing
  Use advanced framing techniques: 24 oc framing, ladder blocking, right sized headers (where needed), two stud corners
  Use Insulated Concrete Forms (ICF's) or Structurally Insulated Panels (SIPS)
- **Increase insulation R-Values and decrease window U-values**
- **Install high efficiency heating/cooling equipment**
- **Lower electric loads** by installing an ECM motor on the furnace (as applicable), increasing amount of high efficiency lighting, and choosing high efficiency and low-water consumption appliances

SECONDARY:

- **Reduce window to wall ratio/glazing percentage:**
  Fewer or smaller windows to optimize whole-wall performance
- **Optimize orientation of windows:**
  Install least number of windows on the North and East sides, optimize orientation of house and bulk of windows for Southern solar gain

HERS Target Index and Benchmark Home (ENERGY STAR® only)

A HERS Target Index specific to your home must be met in order to meet ENERGY STAR home requirements. Your Technical Advisor calculates the HERS Target Index through energy modeling using ENERGY STAR's "Reference Design Home" as a baseline. The HERS index of your home must meet or exceed the HERS Target Index of the ENERGY STAR Reference Design Home which uses your home's dimensions and orientation and has a set of fixed ENERGY STAR features such as lighting, appliances, HVAC equipment, and energy code-level insulation values.

An average-size home for a specific number of bedrooms is termed the "Benchmark Home."
Homes of all sizes can be qualified as ENERGY STAR; however homes that are larger than their Benchmark Home Size will have a Size Adjustment Factor applied to the baseline HERS Target Index to account for the increased energy use associated with larger homes.

Benchmark Home Size								
Bedrooms	1	2	3	4	5	6	7	8
Conditioned Floor Area	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

GREEN BUILDING RESOURCES IN VERMONT

Leadership in Energy and Environmental Design (LEED) for Homes, National Green Building Standard and Vermont Builds Greener require participation in Efficiency Vermont Residential New Construction Services.

For information about green building certification programs in Vermont visit the website of the Vermont Green Home Alliance: www.VermontGreenHomeAlliance.org.

U.S. Green Building Council - LEED™ for Homes

LEED for Homes is a for fee "green" building rating system and service that picks up where ENERGY STAR stops and helps participants build not only energy-efficient but truly sustainable homes. This U.S. Green Building Council certification is provided for homes that meet the LEED for Homes criteria. Visit www.usgbc.org for more information.

National Association of Home Builders-National Green Building Standard™

The National Green Building Standard (NGBS) is a for fee "green" building rating system and service that builds upon the ENERGY STAR Home certification and helps builders design and construct sustainable homes. The National Association of Home Builders maintains a web based Green Scoring Tool that builders use to design homes to achieve this certification Visit www.nahbgreen.org for more information.

Building for Social Responsibility- Vermont Builds Greener program

The Vermont Builds Greener (VBG) program, an initiative of Building for Social Responsibility (BSR), certifies residential buildings that are constructed to sustainable criteria developed for Vermont homes. This for fee green building rating system and service promotes the construction of homes in Vermont that are healthy, durable and have reduced impact on the immediate and global environment. Visit www.bsr-vt.org for more information.

VT Housing Finance Agency-Green Building and Design Standards

Vermont Housing Finance Agency's "Green Building and Design Standards" encourage developers who apply for VHFA financing and Housing Credits to embrace green practices, materials and design in the planning and construction of their buildings. Visit www.vhfa.org for more information.

Passive House

The Passive House standard is one of the most aggressive energy-efficiency standard in the U.S. A home designed to the Passive House standard uses 90% less energy for heating and cooling compared to a home built to VT-RBES. Through extensive energy modeling, a certified Passive House consultant evaluates appropriate methods for achieving this high level of efficiency.
Visit www.passivehouse.us for more information.

Renewable Energy Resource Center

Assistance and incentives are available through the Vermont Small Scale Renewable Energy Incentive Program which is administered by the Renewable Energy Resource Center. Visit www.rerc-vt.org or call 877-888-7372 for more information.

Renewable Energy Vermont

Renewable Energy Vermont is Vermont's renewable energy trade organization. To find a renewables installer near you, visit www.revermont.org or call 802-229-0099.

APPENDICES- TABLE OF CONTENTS

Appendix 1
Enrollee Guide to Thermal Enclosure Guidelines

The pre-drywall inspection is a critical requirement of Efficiency Vermont's Residential New Construction services addressing thermal defects in a home known as thermal bypasses. A thermal bypass involves the movement of heat around or through insulation or air barriers. In order to reduce unnecessary heat loss and make homes more energy-efficient, comfortable, and durable, a visual inspection is required.

To help you plan for the pre-drywall inspection, we've included photographs of key inspection criteria. The sooner you contact Efficiency Vermont with questions about the pre-drywall inspection, the easier it will be to meet the requirements.

PLANNING

Required for pre-drywall inspection:

- Decide on slab edge insulation detail- minimum R-15 required (full coverage to top of slab required where exposed to 1 ft. or less below grade).
- Insulation that is not an air barrier in and of itself (e.g., fiberglass, cellulose, etc.) must have a continuous thermal boundary in which insulation is enclosed on all six sides with a durable, rigid air barrier that is in contact with the insulation (exception: attic flat insulation does not have to have an attic-side air barrier).
- Cape or room truss: when knee wall is the thermal boundary a durable, rigid air barrier must be installed on cold side of knee wall, and blocking at top and bottom of knee wall (i.e. top and bottom plates) must enclose air permeable cavity insulation (see Attic Knee Wall diagram page A-5).
- Install a durable, rigid air barrier behind wood paneling, tongue and groove, or other non-continuous finish materials.

Best Practices and Issues to Consider:

- Keep bathrooms out of insulated floor areas.
- If plumbing cannot be kept out of insulated floors, plan to box plumbing with full air barrier and insulation.
- Strapping between drywall and ceiling framing in insulated ceilings is only allowed when a loose fill or spray applied insulation is used (no airspace may exist between insulation and drywall or other durable, rigid air barrier).
- Locate plumbing vent pipes in interior partition walls.

FOUNDATION AND SLAB

Required for pre-drywall inspection:

- Insulate the foundation wall to minimum R-15 with rigid foam.
- Continuous R-15 slab insulation to 4 feet (down, down and out, or down and in) is required to avoid thermal bypasses at exposed concrete; R-15 is required under slab if slab is heated.
- Slab insulation must align with garage door or walkout basement (if applicable).

FRAMING

Required for pre-drywall inspection:

- Double walls must have continuous top plates and be fully filled with insulation, or the primary wall must be fully insulated and drywalled before the interior wall is framed.
- Balloon-framed walls must have blocking at the plane of the insulated ceiling.
- Insulated floors must have blocking at the uninsulated transition.

- Townhouse party wall must have continuous top plate, sheet metal or spray foam to seal area between top of walls
- Install durable, rigid air barrier on insulated wall before framing soffit.

Best Practices and Issues to Consider:

- Create insulation cavities that can be sealed.
- Seal rough opening around windows and doors with minimum expanding foam.

ROUGH-IN

Required for pre-drywall inspection:

- Exterior walls behind tub/shower enclosures must be insulated and have a durable, rigid air barrier installed before installation of tub/shower enclosure.
- Exterior walls with fireplaces, dropped soffits, etc. must be insulated and have a durable, rigid air barrier installed in direct contact with insulation when insulation material used is air permeable (example: fiberglass and cellulose).
- Wiring and plumbing holes in insulated top plates must be sealed.

INSULATION

Required for pre-drywall inspection:

- Home must have a continuous thermal boundary in which insulation is enclosed on all six sides with a durable, rigid air barrier that is in contact with the insulation (exception: attic flat insulation does not have to have an attic-side air barrier).
- Fill thickened wall with insulation to contact air barrier on both warm and cold sides.
- Vermont ENERGY STAR Homes require Grade I insulation installation or Grade II with exterior rigid foam of at least R-5. Insulation must be at least Grade II for Energy Code Plus.

Best Practices and Issues to Consider:

- Seal cutouts in drywall before installing attic insulation.
- Cut batt insulation to fit around electrical, blocking, other irregularities (required to meet Grade I insulation installation).

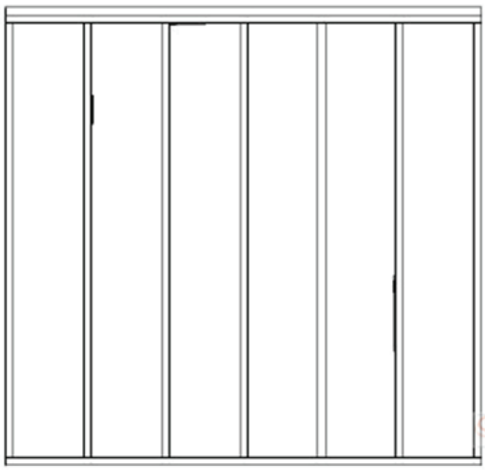
FINISH

Required for pre-drywall inspection:

- Sheetrock sealed to the top plate
- Insulate and seal attic hatch.

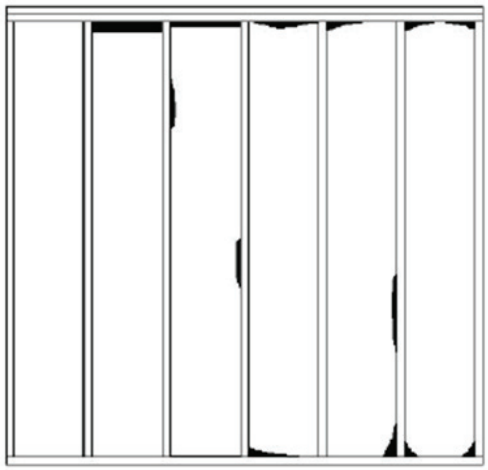
GRADE I INSULATION

- Enclosed on 6 sides
- In full contact with enclosure
- No gaps
- < 2% compression



GRADE II INSULATION

- Enclosed on 6 sides
- In full contact with enclosure
- < 2% gaps
- < 10% compression



Single-Family and Multi-Family Homes ~ *Fast-Track Method*

Component	*Package 1*	*Package 2*	*Package 3*	*Package 4*
1. Ceiling R-Value	R-49	R-38	R-38 or R-30+10	R-28 cont.
2. Above-Grade Wall R-value	R-20 or R-13+5	R-20+5 or R-13+7.5	R-20 or R-13+5	R-21 cont.
3. Floor R-value	R-30	R-30	R-30	R-30
4. Basement/Crawl Space Wall R-value	R-15/20	R-15/20	R-20 cont.	R-15/20
5. Slab Edge R-value	R-15, 4ft.	R-15, 4ft.	R-15, 4ft	R-15, 4 ft
6. Heated Slab R-value (Edge and Under)	R-15	R-15	R-15	R-15
7. Window and Door U-value	0.32	0.32	0.30	0.32
8. Skylight U-value	0.55	0.55	0.55	0.55

Note: R-values must be *equal to or greater* than the values shown. U-values must be *equal to or less* than the values shown.

Table Qualifiers

A Thermal Values: Use the nominal thermal values listed by the manufacturer. If the home's design specifies a component that has two different thermal values (i.e., R-38 ceiling and R-49 ceiling), an average R-value must be calculated for comparison. (See Section 3.5a.)

B Wall R-Values: "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

C Window U-Values: Window U-value is the average U-value for all glazing, including windows, skylights, and sliding and patio doors. Maximum glazing area is 20% except for sunrooms. Replacement windows must have an average U-value of 0.32. (See Section 3.5b to calculate average U-values.)

D Window and Door Exemptions: You can exclude up to 15 square feet of glazed fenestration area from the calculation of average U-value for windows, and one door (up to 24 square feet) from the calculation of average U-value for doors.

E Default Thermal Values: See Appendix B. Flat and sloped ceiling R-values assume standard truss. However, if a raised truss is used, as shown in Figure B-1 (Appendix B), R-value may be reduced to R-38.

F Ceilings Without Attics: For ceilings without attic spaces (vaulted ceilings), R-30 is allowed for up to 500 square feet or 20% of the total insulated ceiling area, whichever is less.

G Ceilings With Attics: For ceilings with attic spaces, R-38 is allowed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

H Slab Edge Insulation: Thermal values in this table require the following configurations: slab edge insulation must extend 4 feet or a combination of depth and width that equals 4 feet.

I Basement/Crawl Space R-Values: "15/20" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-20 cavity insulation at the interior of the basement wall. "15/20" is allowed to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. Crawl space wall insulation must cover the full height of the wall and extend to a depth 12 feet below grade and basement wall insulation must cover the full height of the basement wall.

J Hatches: Access hatches and doors must be insulated to the same level as the surrounding surface.*

K Unconditioned Spaces: Components that enclose unconditioned spaces do not need to be considered.

L Heated Slabs: In addition to R-15 slab edge insulation, R-15 insulation is required beneath the entire slab for radiant or directly heated slabs.

M Thermal Values That Do Not Apply: Ignore the values in the table if the building component is not part of the home.

N Sunrooms: All sunrooms must meet the basic requirements and the performance requirements outlined above, except the maximum glazing requirement. For sunrooms with *thermal isolation*, the minimum ceiling insulation R-values must be R-30; the minimum wall R-value must be R-13; and the maximum fenestration U-factor must be 0.45.

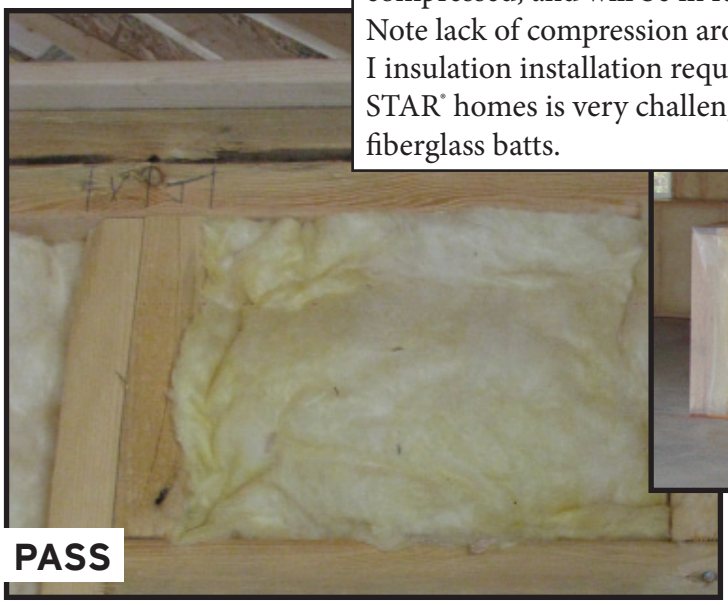
* Energy Code Plus and Vermont ENERGY STAR Homes require minimum R-40 attic hatch and R-20 in rim/band joists.

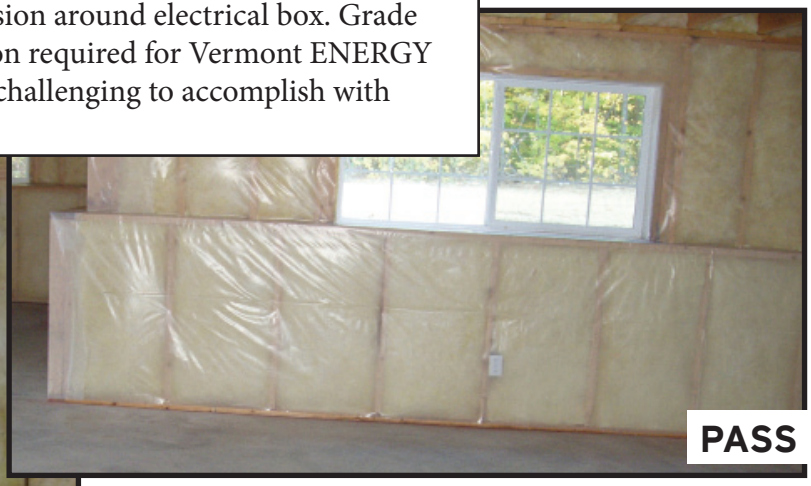
COMMON CHALLENGES WITH THE PRE-DRYWALL INSPECTION

- Overall alignment throughout home.
- Insulation shall be installed in full contact with sealed interior and exterior air barrier. Qualified homes must have a continuous thermal boundary in which insulation is enclosed on all six sides with a durable, rigid air barrier that is in contact with the insulation (exception: attic flat insulation does not have to have an attic-side air barrier).

FIBERGLASS INSTALLATION

Energy Code Plus Pass: Insulation fills cavity, is not compressed, and will be in full contact with air barrier. Note lack of compression around electrical box. Grade I insulation installation required for Vermont ENERGY STAR® homes is very challenging to accomplish with fiberglass batts.





Fail: Side-stapling and strapping results in insulation that is not in full contact with air barrier and will not pass inspection.

SLAB EDGE

Continuous R-15 slab insulation to 4 feet (down, down and out or down and in) is required to avoid thermal by-passes at exposed concrete; R-15 is required under slab if slab is heated.

Option 1: Outside Frost

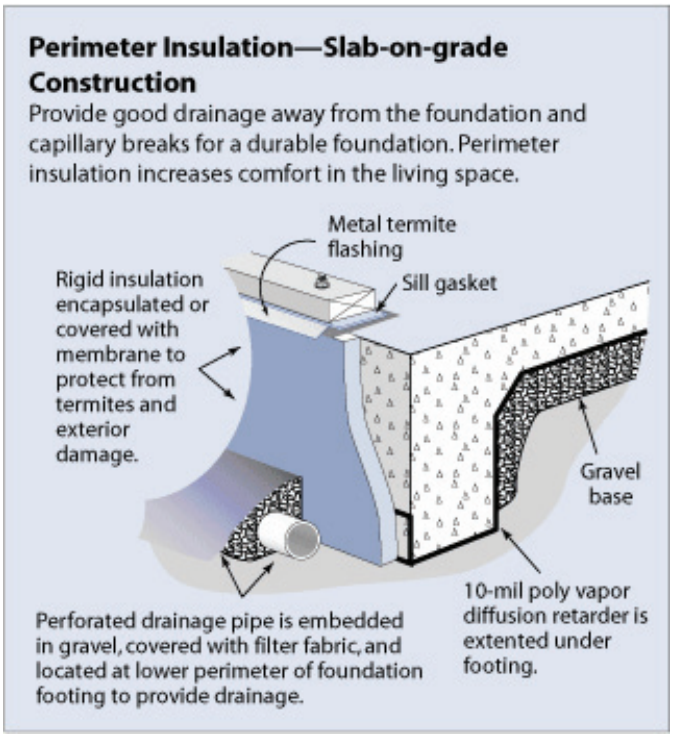
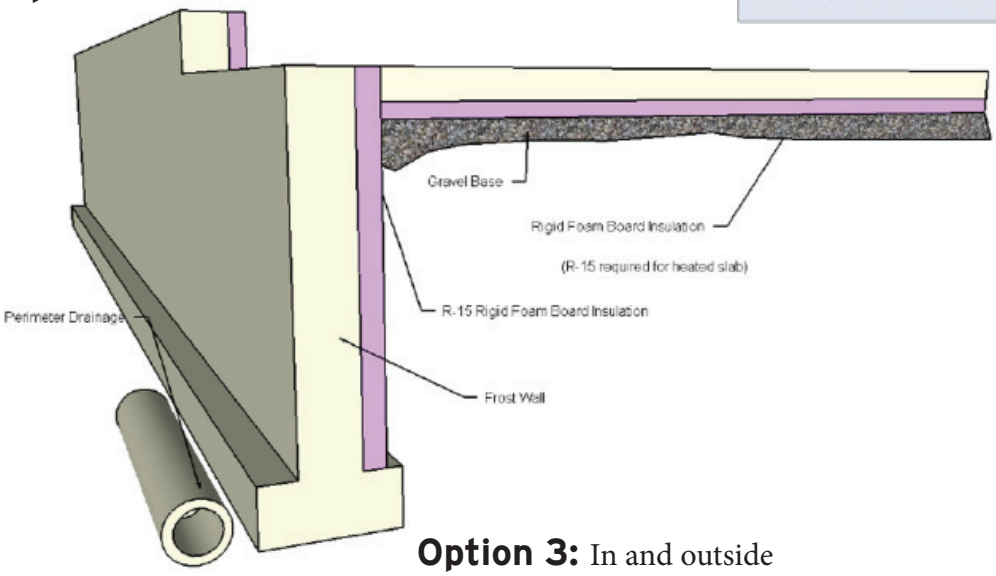
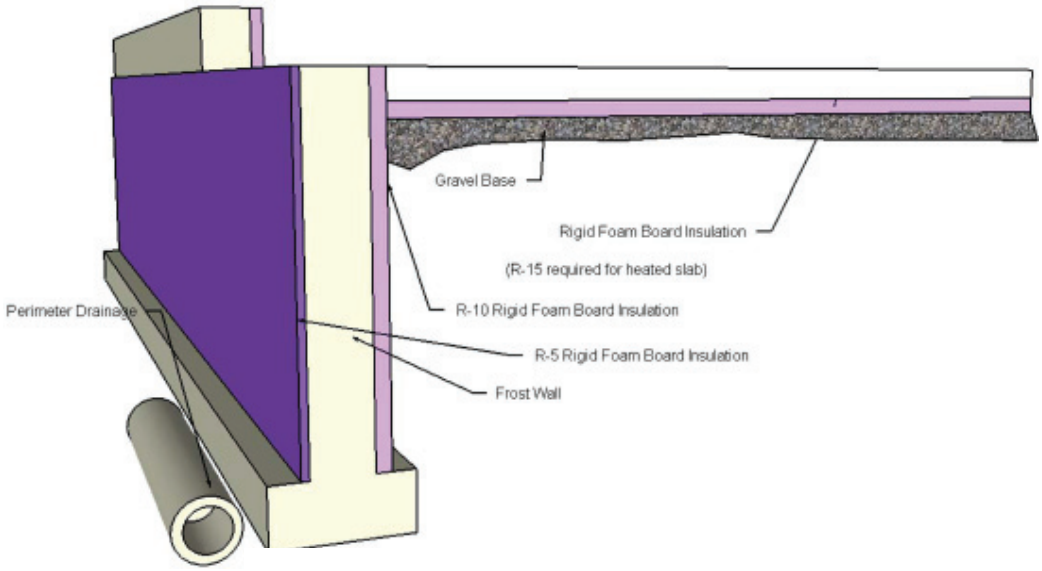


Image: US Department of Energy

Option 2: Inside Frost



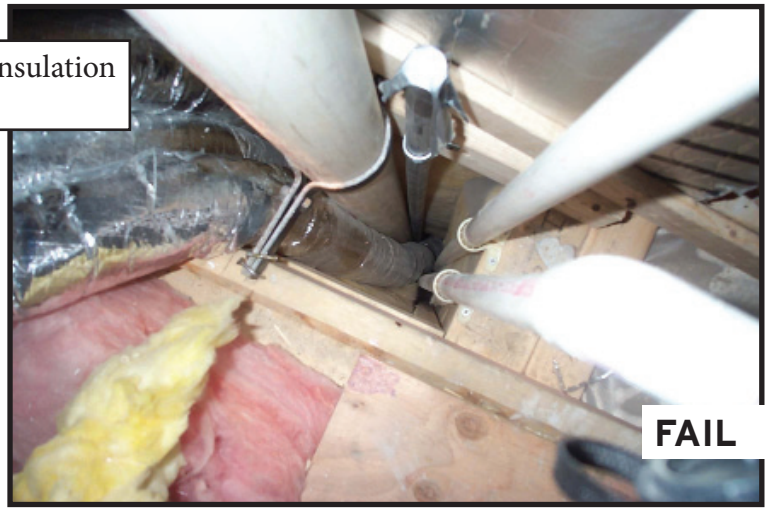
Option 3: In and outside



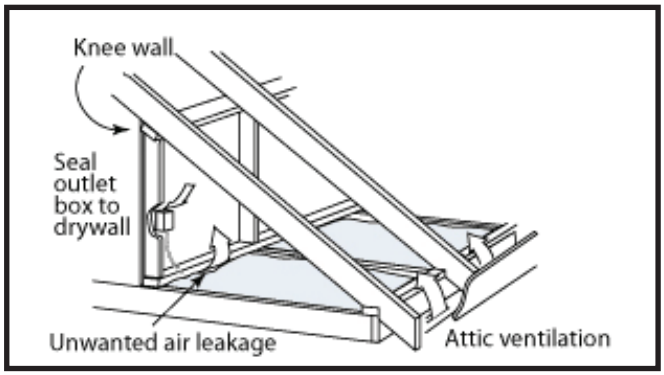
MECHANICAL SHAFTS: PIPING, FLUE, DUCT

Openings to unconditioned space must be fully sealed with solid blocking or flashing and any remaining gaps are to be sealed with caulk or foam (provide fire-rated collars and caulking where required).

NOTE: Filling the penetration with fiberglass batt insulation is not sufficient, as fiberglass is not an air barrier.



ATTIC KNEE WALLS



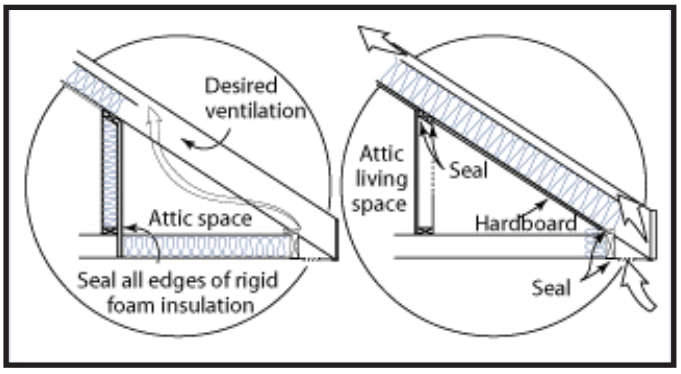


Image: US Department of Energy

- Kneewall must have a durable, rigid air barrier on both the interior and exterior
- Preferred insulation method is down the slope.
- Continuous top and bottom plates need to be installed along with an air barrier on the attic side of insulated walls, including exposed edges of insulation at joists and rafters.
- Where truss framing is used, blocking is required at the top and bottom of each framing bay.
- Use baffles to limit wind washing of insulation materials

PROPER INSTALLATION OF AIR BARRIER AND INSULATION ON EXTERIOR WALL BEHIND SHOWER/TUB & FIREPLACE

SHEETROCK SEALED TO TOP PLATE AT ALL ATTIC/ WALL INTERFACES

- Use Silicone caulk or latex foam.

view is looking down from above

Appendix 2
Specifications for Modular and Log Homes

Modular Homes & the Thermal Enclosure System Rater Checklist

Modular homes are encouraged to participate in either of Efficiency Vermont's Residential New Construction Services and must comply with the Thermal Enclosure System Rater Checklist requirements. Modular manufacturers can choose to have their home modules inspected at their plant by an accredited Home Energy Rating Systems provider/rater or they may become an EPA ENERGY STAR® certified plant, perform a self-inspection of their modules, and sell an ENERGY STAR ready product for full ENERGY STAR completion and compliance at the home site. This plant certification process is overseen and facilitated by the Systems Building Research Alliance.

Where home modules are being constructed outside of Vermont by manufacturers that have not been approved for self-inspection by the EPA or another local accredited Home Energy Rating Systems provider/rater:

- Efficiency Vermont will pay the enrollee, after successful completion of Vermont ENERGY STAR Homes or Energy Code Plus $200 as an incentive for pre-drywall inspections performed by a Home Energy Rating Systems accredited Rater in an out-of-state modular plant.
- These incentive payments apply only to those homes where Efficiency Vermont is provided with a properly completed and signed *Thermal Enclosure System Rater Checklist*, and only after achievement of all minimum criteria is verified.
- This should enable the Vermont homebuyer or builder (enrollee) to recoup some or all of the fees associated with inspections conducted by a Home Energy Rating Systems accredited Rater in an out-of-state modular plant. The $200 incentive, when applicable, will be paid regardless of the actual cost paid by the modular firm and/or passed on to the enrollee for a completed Thermal Enclosure System Rater Checklist.
- No receipt for an inspection is required. Verification will be based on receipt by Efficiency Vermont of a properly completed Thermal Enclosure System Rater Checklist signed by a HERS accredited Rater on the RESNET Certified Rater Directory (www.resnet.us/directory/raters.aspx).
- Should the U.S. EPA ENERGY STAR Homes program develop different criteria for modular homes eliminating the need for this type of arrangement, Efficiency Vermont reserves the right to phase out these offers.

Efficiency Vermont recommends purchase of modular homes from ENERGY STAR certified manufacturers. Efficiency Vermont may, on a limited basis, work with modular home contractors and manufacturers through its Energy Code Plus service even if *Thermal Enclosure System Rater Checklist* is not completed by a HERS accredited Rater at an out-of-state, non-ENERGY STAR certified modular manufacturer plant. Efficiency Vermont will perform a Thermal Enclosure System Rater Checklist inspection of all areas that can be visually inspected during the final site visit. Any thermal bypass or deficiencies that are visually identified must be rectified in order to be eligible for incentives, rating documentation and code certifications.

Log Homes

Log and other mass wall homes may participate in Efficiency Vermont Residential New Construction Services if they meet Mass Wall insulation requirements as stated in VT Residential Building Energy Standards. This is achieved by building an R-15 or R-20 insulated wall, where R-20 applies when more than half of the insulation is on the interior side of the mass wall. If constructed entirely out of logs or other continuous material, wall must achieve a minimum R-16.7 (following Mass Wall U-Factor requirement in VT-RBES); Default R-Values are R 1.4/inch for softwoods and R .71 for hardwoods.

To meet ENERGY STAR V.3 Reduced Thermal Bridging Requirement, the Environmental Protection Agency requires that, "The minimum log wall thickness must achieve the required thermal resistance or an additional wall component that meets the requirements must be integrated into the assembly (e.g., an insulated wood frame wall with reduced thermal bridging, a SIP wall, an ICF wall, or a double wall may be constructed on the interior side of the wood logs or in between wood log facades)."