

MaineHousing's Green Building Standards

**First Edition: August 2005
Revised August 2011**

**Developed by MaineHousing with Integral Contributions from
our Architects, Developers, Contractors and Consultants**

MaineHousing's Green Building Standards For Architects, Developers and Contractors

In keeping with its mission to assist Maine people to obtain and maintain decent, safe, affordable housing services, MaineHousing has developed a set of Green Building Standards for designers, developers and contractors who apply for MaineHousing funding. Designing and building in this fashion assures long-term affordability by providing dwellings with low energy use that will insulate owners and occupants from rising fuel prices. The intention is to create healthy, economical and durable buildings that are efficient to operate and maintain.

Green building is the design, construction and operation of buildings that save money and energy, reduce their impact on natural resources and create healthy, comfortable living environments.

The standards are a requirement for all projects that submit applications for funding after May 1, 2005. They are organized into eleven sections, from site to post occupancy. Rehab and renovation projects must conform to the guidelines to the extent that their scope of work includes any specific measure. The emphasis is on energy efficiency, good indoor air quality and, additional site and building features such as native vegetation, that reduce the negative environmental impact of development without adding to the bottom line. MaineHousing's Green Building Standards promote regional products, and support local economies and economic development.

Dale McCormick
Director

MaineHousing History/Process

PREFACE

MaineHousing's *Green Building Standards* were first published and released in August of 2005 thanks to considerable input and dedication of many of our Architect, Developer, Contractor and Consultant partners, including Fore Solutions of Portland, Maine who put the initial *Standards* into their final form. The intent of these standards is to provide a living document – one that may require interpretation from time to time based on specific applications, can and will be amended from time to time, and will continue to grow and be supplemented with new ideas and trends as the world of green building evolves over time.

Since its initial publication, the standard has been revised four times; once integral with the 2007 QAP process, once integral with the 2008 QAP process, once integral with the 2010 QAP process, and this edition, integral with the 2012 QAP process. This revised document incorporates all amendments and new standards issued since the original publication.

Requests for clarification and/or modification of MaineHousing's *Green Building Standards* shall be submitted to MaineHousing in writing to the attention of the Construction Services Manager. In making a request, the concerned party shall provide specific standard references, restate the standard in question, and provide a detailed explanation of the proposed request as related to the standard. Any necessary backup information such as hard copy literature, web sites, engineering data, etc. shall also be provided and referenced as an integral part of any requests. MaineHousing's Construction Services Manager will, in a timely manner, investigate and respond to all requests and, to the extent necessary, shall issue an amendment which documents and implements any proposed clarifications and/or modifications to the standards.

"*Commentary*" within some of the standard sections is provided to help explain a standard's intent. *Commentary* is generally based on historical and technical background. The *Commentary* is to be used in conjunction with the standard and is not a substitute for the standard; it is advisory only.

Donald R. McGilvery, LEED AP
Construction Services Manager

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| Standard | | Cost Implications | |
|---|------------|---|---|
| 1 Site | | | |
| | R 1 | Landscape with at least 75% northern hardy native species that do not require irrigation. This is measured by number of plantings. | No additional cost |
| | R 2 | Preserve existing trees and vegetation, except within 30' of buildings, driveways, solar access, areas cleared for food production and as required for grading for drainage requirements. | No to low additional cost |
| | R 3 | Minimize light pollution to the night sky. | No to low additional cost |
| 2 Building Design | | | |
| | R 1 | An overall water management plan for the building envelope for prevention of indoor air quality (IAQ) problems from mold. | Costs are dependent on which and how many of these measures differ from standard practice. |
| 3 Energy Efficiency: Building Envelope | | | |
| | R 1 | The building envelope must be sealed to prevent air leaks. | Additional labor costs and very low additional material costs. Effective training programs for project teams can reduce and contain labor costs. |
| | R 2 | The thermal envelope shall be insulated in a manner that complies with either the requirements of Chapter 5 of the 2009 IECC, this standard, or the requirements of state law, whichever is more stringent. | Additional cost for labor and materials to meet code requirements. (Note that by using Optimum Value Engineering (OVE) efficiency techniques & sheathing with rigid insulation it should be possible to meet code requirements with no or low additional cost.) |

| | | | |
|--|------------|---|--|
| | R 3 | Energy efficient windows optimized for solar gain OR advanced framing techniques such as OVE, SIPS, ICF, stress skin panel and others. | Possible additional costs (range low to high) for all recommended thermal improvement strategies except for OVE - OVE should realize both cost savings and thermal efficiency improvement. |
| | R 4 | Spaces between trusses or rafters shall have blocking at the soffit to prevent “wind-washing” of the attic insulation. | Low additional cost |
| | R 5 | No pipes or ducts in outside walls. | No additional cost |
| 4 Energy Efficiency: Systems & Appliances | | | |
| | R 1 | Energy Star labeled systems & appliances | Low cost - Energy Star appliances are currently often specified |
| | R 2 | Bathroom exhaust fans shall be low noise with energy efficient fan motor rated for continuous duty with a minimum rating of 50 cfm. | Low additional cost |
| | R 3 | Water Efficiency: Low flow faucets and showerheads | No additional cost |
| | R 4 | Water Efficiency: Low flow toilets | Additional cost for dual flush, 1.6 GPF toilets are standard. |
| | R 5 | Seal ductwork with duct mastic to prevent air leakage | Very low additional labor and material costs |
| | R6 | Solar Assist (Preheat) Domestic Hot Water Systems | Added costs offset by energy savings |
| 5 Energy Efficiency: Interior Lighting Fixtures | | | |
| | R 1 | Lighting fixtures shall be Energy Star rated. | No additional cost |
| | R 2 | No recessed light fixtures shall be installed in roof/ceiling assemblies. | No additional cost |
| | R 3 | All emergency exit signs shall be LED. | Low or no additional cost |
| | R 4 | Automatic lighting controls to minimize energy use | Minor added cost costs offset by energy savings |
| 6 Inspection/Commissioning | | | |
| | R 1 | Commissioning required for projects of five units or more with central mechanical systems. | Additional costs contingent upon size and complexity of central mechanical systems. |
| | R 2 | For each project, a representative number of units, as determined by MaineHousing, must be “Blower Door” tested to verify effectiveness of air sealing. | Blower Door tests cost \$150 - \$200 / unit tested |
| | R 3 | A representative sampling of ducted air distribution systems, as determined by MaineHousing, must be tested to verify effectiveness of duct sealing. | Low additional cost |

| 7 Indoor Environmental Quality | | | |
|---------------------------------------|------------|--|---|
| | R 1 | Position and size operable windows and glazing systems to take advantage of natural ventilation, cooling and day-lighting. | No to low additional cost |
| | R 2 | Use low VOC paint | No additional cost |
| | R 3 | Use low VOC adhesives & sealants | No additional cost |
| | R 4 | If carpet is installed it must meet CRI low emission test standard. | No additional cost |
| | R 5 | No carpet in kitchens, bathrooms or within 3' of entry doors. | No additional cost |
| 8 Materials | | | |
| | R 1 | Use framing and finish lumber harvested from sustainably managed forests OR local / regional materials OR durable materials. | Additional costs, if any, for verification should be very low. FSC certified wood and most durable products will have higher first costs. |
| 9 Resource Efficiency | | | |
| | R 1 | Provide space for recycling containers at convenient location(s) for storage of recyclables. | Cost for additional Square Footage required for recycling area |
| | R 2 | Non-mercury thermostats | No additional cost |
| 10 Post Occupancy | | | |
| | R 1 | Provide tenants with educational materials about green design, building operations, recycling & building maintenance. | Additional cost to purchase or produce, print and distribute educational materials |
| 11 Construction Practices | | | |
| | R 1 | Construction waste and/or debris recycling to the extent possible | No additional cost |

MaineHousing's Green Building Standards

SECTION 1 R1 SITE

Standard

**Landscape with at least 75% northern hardy native species that do not require irrigation.
This is measured by the number of plantings.**

Intent

Create natural areas that provide wildlife habitat and promote biodiversity appropriate to the ecosystem.

Requirement

1. Plant with trees, shrubs, perennials, annuals and groundcovers that have one or more of the following attributes:
 - a. Northern, hardy and native to this area
 - b. Edible and/or wildlife enhancing
2. In addition to one of the above - drought tolerant
3. Permanent irrigation system to be permitted by MaineHousing on a case by case basis

Verification

1. Provide MaineHousing with a site plan demonstrating areas of paving, landscaping (with species) and building footprint.
2. Provide a list of all species to be planted
3. Construction Analyst to verify on site

Resources

University of Maine Cooperative Extension Service:
www.umext.maine.edu/onlinepubs/htmpubs/2500.htm

Rehab/Renovation

The requirements of this standard must be followed where landscaping is included within the scope of the renovation project.

Cost Implication

No additional cost

MaineHousing's Green Building Standards

SECTION 1 R2 SITE

Standard

Preserve existing trees and vegetation, except within 30' of buildings, driveways, solar access, areas cleared for food production and as required for grading for drainage requirements.

Intent

Preserve mature trees and vegetation

Requirement

- Use best practices to preserve existing trees and vegetation
1. Inventory existing healthy trees and vegetation on the site
 2. Identify trees and vegetation to be saved
 3. Identify strategies to be used:
 - a. Protective barriers (Must extend to the drip-line)
 - b. Relocation
 - c. Other as approved by MaineHousing

Verification

Provide predevelopment and post development site plans highlighting trees and vegetation that were preserved and/or relocated on site.

Resources

None

Rehab/Renovation

The requirements of this standard must be followed in all rehab projects

Cost Implication

No to low additional cost

MaineHousing's Green Building Standards

SECTION 1 R3 SITE

Standard

Minimize light pollution to the night sky

Intent

Eliminate light trespass from the building site to reduce the impact on nocturnal environments and the night sky.

Requirement

Design outdoor lighting to provide security without creating light pollution.

1. Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments (IESNA RP-33-99).
2. Design interior and exterior lighting so that zero direct beam illumination leaves the project site.
3. Do not use unshielded fixtures (floodlights)

Verification

Manufacturers cut
sheets Site lighting plan

Resources

The IESNA standard is RP-33-99, IESNA Recommended Practice Manual: Lighting for Exterior Environments

IESNA

www.iesna.org

Dark Sky

Association

www.darksky.org

Rehab/Renovation

The requirements of this standard must be followed where exterior lighting is included within the scope of the renovation project.

Cost Implication

No to low additional cost

SECTION 2 R1 BUILDING DESIGN

Standard

Implement an overall water management plan for the building envelope for prevention of indoor air quality (IAQ) problems from mold

Intent

Create durable and healthy buildings

Requirements

Exterior

Above Grade Walls

1. Provide and properly seal air barriers over sheathing
2. Provide a continuous drainage plane beneath all exterior finishes
3. Daylight all drainage planes at the base of walls
4. Flash all wall penetrations over drainage plains

Footings at Frost Walls & Slabs-on-grade

1. Foundation drains at edges of footings
2. Gravel bed or stone beneath slab minimum 4" depth
3. Minimum six mil polyethylene vapor diffusion retarder between slab and gravel with joints lapped at least one foot

Basement Footings & Slabs

1. Capillary break over footing with damp-proofing, low perm or elastomeric paint
2. Foundation drains at edges of footings
3. Sub-grade (footing) drainage system
4. Gravel bed or stone beneath slab minimum 4" depth
5. Minimum six mil polyethylene vapor diffusion retarder between slab, rigid insulation and gravel, with joints lapped at least one foot and sealed.

Surface Drainage

1. Slope final grade away from foundation wall (recommend slope of 5/8" per foot for 10 feet and patios & driveways at 1/4" per foot) not to conflict with Americans with Disabilities Act (ADA) requirements.
2. Downspouts deposit roof water at least 5' from the foundation
3. Provide a 3' by 4" thick graded perimeter of impermeable backfill around all the basement foundations

Basement Walls

1. Damp proofing or moisture barrier assembly system applied from footing to grade
2. Use porous backfill material against foundation walls
3. Provide exterior wall insulation and/or capillary break finish system that drains water to footing drain
4. Capillary break between the foundation and framing

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SECTION 2 R1 BUILDING DESIGN

Windows & Doors

1. All sides of doors and windows are to be wrapped and flashed with proper materials for moisture protection

Roof

1. Overhangs at eaves - Minimum of 1'-6" for buildings with pitched roofs

Interior

Appliances

Drainage pans under water heaters and clothes washers when installed on or over finished floors to catch minor equipment leaks (not required when located within unfinished basements)

Verification

1. Construction plans highlighting envelope details for water management
2. Construction Analyst to verify on site

Resources

Building America:

www.eere.energy.gov/buildings/building_america/

Building Science Corporation:

www.buildingscience.com/

Housing and Urban Development (HUD) 'Durability by Design' available at:

www.huduser.org/intercept.asp?loc=/Publications/PDF/durability_by_design_part1.pdf

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where rehab of the building envelope and site work that would permit water management improvements are included within the scope of the renovation project.

Cost Implications

Cost implications are dependent on which and how many of these measures differ from standard practice.

SECTION 3 R1 ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

The building envelope must be sealed to prevent air leaks

Intent

To prevent energy loss through infiltration and cold surfaces on which water vapor can condense.

Requirements

Building can be air sealed using the polyethylene vapor barrier or the airtight drywall approach (ADA).

In addition to sealing poly or drywall:

1. Gaskets or sill seals under mud sills along foundation walls.
2. Seal first floor band joists to the adjoining mud sills and plywood decking using adhesive or caulk. Use construction adhesive or caulking between multiple sill plates.
3. Seal any band joists between upper floors to the adjoining top plates and plywood decking. Use construction adhesive or caulking between multiple top plates.
4. Seal bottom plates of exterior frame walls to the sub-floor with construction adhesive or caulking.
5. Avoid locating bathtubs and shower enclosures on exterior walls. If installed on exterior walls insulate and air seal this area BEFORE shower/tub is installed.
6. Recessed lights must be airsealed and airtight. (Recessed lights may not penetrate the building envelope - see Section 5 R2).
7. Window frames and door jambs must be sealed to their rough openings using low expansion foam, backer rod or caulk but NOT fiberglass.
8. All penetrations through the building envelope must be carefully sealed. Typical penetrations include chimney, duct & plumbing chases and penetrations of pipes and wires through the top plates of top story walls. It is particularly important to seal all possible air paths to the attic.
9. Building areas such as knee wall-floor transitions, dropped soffits, split-level transitions, tuck-under garages and cantilevers must be identified and sealed with a continuous air barrier. Where joist spans or stud bays run between a heated and unheated area all bays must be blocked and sealed at the transition.
10. Attic and crawl space access doors and hatches must be weather-stripped and insulated.
11. Electrical boxes on exterior walls and ceilings should either be airsealed or placed in airtight enclosures (Lessco box or equivalent).

Requirement for Stress Skin Panel, Structural Insulated Panel (SIP), Insulating Concrete Form (ICF)

1. Air seal ceiling systems, wall-ceiling and wall-floor junctions.

SECTION 3 R1 ENERGY EFFICIENCY – BUILDING ENVELOPE

Verification

1. Construction plans highlighting envelope airsealing details.
2. Construction Analyst to verify on site.

Resources

For airsealing approaches and details:

Building Science Corporation:

www.buildingscience.com

Building America:

www.eere.energy.gov/buildings/building_america/

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where building envelope improvements are included within the scope of the renovation project.

Cost Implications

Additional labor costs and very low additional material costs. Effective training programs for project teams can reduce and contain labor costs.

Commentary:

The Building-as-a-System concept has been demonstrated as the most cost effective way to analyze, design, and construct thermally efficient structures. Without question, this concept has had a dramatic impact on the way buildings are currently being built when compared with those of years past. The attention to the establishment of definable, buildable, continuous air-barriers cannot be overshadowed. Taking every opportunity to study, detail, build, inspect, and test air-barriers assures that the resultant air leakage will be minimized, which is paramount for the success of this approach.

Over the past six years, MaineHousing has been successfully achieving a much higher level of air-sealing in its projects due to the attention given to the areas outlined in this standard. While a properly installed polyethylene vapor barrier is suggested as an effective means to achieve air-sealing, the use of alternative insulation materials and continuous interior sheetrock have proven to be the best methods to assure compliance with the standard. Certain products such as dense-packed cellulose insulation and spray foam insulations have proven superior to the once popular fiberglass insulation in reducing air flows within thermal components. In most instances, the use of these products has eliminated the need for Lessco boxes at electrical outlet and switches and vapor barriers in walls. It is the attention to the details such as sealing ALL penetrations in the air-barriers, assuring that the air-barriers are continuous between floors, and properly installing the various insulating materials, that assures that this standard continues to be met.

Renovation projects present unique challenges, however experience gained from oversight of ongoing programs in other divisions of MaineHousing continually reinforces the need for attention to controlling the energy demands of our projects. Therefore the new construction standards are always a primary goal during renovation for all projects receiving MaineHousing funding.

MaineHousing's Green Building Standards

SECTION 3 R2 ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

The thermal envelope shall be insulated in a manner that complies with either the requirements of Chapter 5 of the 2009 International Energy Conservation Code (IECC), the requirements of state law, or the requirements stated herein, whichever is more stringent.

Intent

To prevent conductive energy loss and eliminate cold surfaces that can condense water vapor and create rot, mold or mildew.

Requirements

1. Maine Climate Zones 6 & 7 requirements - see following page
2. Maximum amount of window area shall not exceed 15% of the gross area of exterior walls (insulated envelope wall areas only) for detached one and two family dwellings or 25% for all other building types without further consideration of additional energy conservation measures. Such additional measures may include lower Ti values for the windows, upgrades to the wall area R values, or a combination of both to assure that the overall effectiveness of the building envelope is maintained. Each such condition shall be evaluated on a case-by-case basis.

Verification

1. Construction plans and specifications highlighting envelope insulation materials and installation details.
2. Construction Analyst to verify on site.

Resources

Energy Star:
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WI

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where building envelope improvements are included within the scope of the renovation project.

Cost Implications

Additional cost for labor and materials to meet code requirements. (Note that by using Optimum Value Engineering (OVE) efficiency techniques & sheathing with rigid insulation it should be possible to meet code requirements with no or low additional cost.)

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SECTION 3 R2 ENERGY EFFICIENCY – BUILDING ENVELOPE

Minimum Requirements of the International Energy Conservation Code, Chapter 4, 2009 Edition or as stated herein

Climate Zone 6: Maine except for Aroostook County
Climate Zone 7: Aroostook County

| Climate Zone | Fenestration U-Value | Skylight U Factor | Glazed Fenestration SHGC | Ceiling R Value | Wood Frame Wall R Value (2) (4) | Mass Wall R Value (6) | Floor R Value | Basement Wall R Value | Slab R Value & Depth (1) | Crawl Space Wall R Value |
|--------------|-------------------------------|-------------------------------|-------------------------------|-----------------|---------------------------------|--------------------------------|---------------|-----------------------|--------------------------|--------------------------|
| 6 or 7 | 2010 Energy Star Requirements | 2010 Energy Star Requirements | 2010 Energy Star Requirements | 49 | 21 OR 15+5 OR 15+10 OR 19+5 | Zone 6: 15/19 Zone 7: 19/21 | 30 | 15/19(3)(5) | 10, 4ft | 10/13 ⁽³⁾ |

The R Values in the above table are the minimum values for the insulation materials; they are not composite, average, aged, or any other form of factored value.

Long-Term Thermal Resistance (LTTR) values are recognized in the industry as a way of evaluating insulation values over time. LTTR, when tested in accordance with recognized standards (i.e. ASTM C 1303-95) shall be used in evaluating and selecting products for MaineHousing projects.

In summary, the R values listed in the table should be considered as minimums – what could be reasonably expected in a conventionally framed simple structure with standard framing materials and standard spacing, with a reasonable glazed area included in the building envelope. Alternative designs that require additional framing or that include large amounts of glazing erode the thermal envelope performance and must include provisions to meet the minimum R values when compared to a more conventionally framed building.

2010 Energy Star Qualification Criteria for Residential Windows, Doors & Skylights

Windows

| Climate Zone | Ti Factor | SHGC |
|--------------|-----------|--------|
| Northern* | < 0.30 | Any |
| | = 0.31 | > 0.35 |
| | = 0.32 | > 0.40 |

*Northern zone windows can meet prescriptive (1st row) or alternative energy performance (2nd & 3rd row) criteria to qualify for Energy Star.

Swinging and Sliding Doors

| Glazing | Ti Factor | SHGC |
|------------|-----------|-----------|
| Opaque | < 0.21 | No Rating |
| < 1/2 Lite | < 0.27 | < 0.30 |
| > 1/2 Lite | < 0.32 | < 0.30 |

Skylights < 0.55 No Rating

MaineHousing's Green Building Standards

SECTION 3 R2 ENERGY EFFICIENCY – BUILDING ENVELOPE

¹ “Slab R Value & Depth,” the 4ft requirement is clarified as follows:

Traditionally, slabs-on-grade and frost wall foundations have been insulated either with horizontal insulation under the slab edge or vertical insulation on the inside face of the frost walls at a minimum. The “4ft” “Depth” requirement in the Table applies to either of these methods - horizontal or vertical.

Please note also that in addition to the minimum requirements contained in these *Green Building Standards*, MaineHousing has a Construction Standard for Thermal and Moisture Protection (see Construction Services’ *Design and Construction Manual*) that requires a minimum of R5 insulation beneath the entire floor slab area.

² When expressed with a “+” the first R value applies to framing cavity insulation and the second applies to continuous insulation.

³ The first R value applies to continuous insulation, the second to cavity insulation; either meets the requirements.

⁴ MaineHousing’s minimum insulation standards for exterior walls are as follows:

21 OR 15+5: can only be proposed if cavity insulation products that considerably restrict air flow within the insulated framing bays are used. Note: Fiberglass insulation of any density does not meet this requirement.

15+10: can use any cavity wall insulation, including fiberglass, that provides the designated R value supplemented by continuous exterior insulation with a minimum LTTR meeting this option

19+5: can use any cavity wall insulation, including fiberglass, that provides the designated R value supplemented by continuous exterior insulation with a minimum LTTR meeting this option

⁵ Portions of basement walls that are above outside finished grades shall be insulated to the same R value as the exterior walls they support.

⁶ The second R value applies when more than half the insulation is on the interior of the mass wall.

NOTE: Understanding that steel framing is a viable alternative to wood framing, please be advised that Table 402.2.5 of the *International Energy Conservation Code*, provides for insulation equivalents to the minimum wood framing requirements for steel stud framing. Please note that due to the thermal “short circuiting” of steel studs continuous insulation over such framing is generally required as an integral part of the equivalency to the wood framing requirements.

NOTE: Mechanical equipment access panels, roof hatches or scuttles that penetrate thermal envelope components shall provide equivalent thermal and air sealing barriers as the components in which they are installed.

Commentary:

Similar to the air-sealing concepts discussed earlier, once again the Building-as-a-System approach concept has been demonstrated as the most cost effective way to analyze, design, and construct thermally efficient structures. Without question, today’s attention to energy use has a dramatic impact on the way buildings are currently being built when compared with those of years past. First costs can be overshadowed by long term energy use operating costs. The attention to the establishment of definable, buildable, continuous thermal barriers can not be overshadowed. Every opportunity to study, detail, build, inspect, and test thermal envelopes helps to assure that the resultant resistance to conductive heat loss will be maximized. Every decision related to insulation materials, thicknesses, density, workmanship, etc. impacts the performance of the building. The values provided within this standard are minimums and designers, contractors, and owners are all encouraged to improve upon these whenever feasible.

MaineHousing's Green Building Standards

SECTION 3 R3

ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

Energy efficient windows optimized for solar gain OR advanced framing techniques such as OVE, SIPS, ICF, stress skin panel and others.

Intent

To increase the efficiency of the thermal envelope

Requirements

1. Windows must be National Fenestration Rating Council (NFRC) rated AND have U and Solar Heat Gain Coefficients (SHGC) that meet Energy Star requirements for Northern Climate and have an Air Leakage Rate (AL) of .30 or less.
2. For advanced framing:
 - a. OVE (Optimum Value Engineering) - see below
 - b. ICF (Insulated Concrete Form)system
 - c. SIPS (Structural Insulated Panel) system
 - d. Equivalent system as approved by MaineHousing

Any one of the “advanced framing techniques” (OVE or ICF or SIPS) can be utilized to meet the standard. Further, if for example, Optimum Value Framing (OVE) is proposed, it shall be utilized throughout the entire building or project and the more energy efficient windows would then not be required. If, however, Structural Insulated Panel Systems (SIPS) were proposed for a roof system only, with the wall systems designed as conventionally framed, we would expect that energy efficient windows would also be provided in order to meet the intent of the R3 requirement. Therefore, it is important that both the alternative selected be effective and that the extent of the impact be fully understood in determining compliance with the R3 requirements. Providing energy efficient windows **and** advance framing techniques provide the best energy efficiency.

Verification

1. NFRC window labels or manufacturer documentation
OR
2. Construction drawings highlighting framing details.
3. Construction Analyst to verify on site

SECTION 3 R3 ENERGY EFFICIENCY – BUILDING ENVELOPE

Resources

www.efficientwindows.org

www.efficientwindows.org/factsheets/maine.pdf

www.energystar.gov/index.cfm?c=bop.ptb

National Fenestration Rating Council: www.nfrc.org

Residential Windows: A Guide to New Technology and Energy Performance by John Carmody, Stephen Selkowitz, Dariush Arasteh, and Lisa Hescong, WW Norton, ISBN 0-393-73053-0

SIPS:

www.sips.org/

ICF:

www.icfhomes.com/

OVE:

<http://www.buildingscience.com/documents/insights/bsi-030-advanced-framing>

Energy Star:

http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WI

Notes

Optimum Value Engineering (OVE) includes but is not limited to:

1. 2x6 @ 24" o.c.
2. Align windows and other openings with framing layout
3. Use of box headers designed for loading conditions
4. Eliminate unnecessary studs such as at corners and T-walls
5. Use drywall clips or an acceptable alternative to eliminate drywall backer studs and ceiling blocking
6. Corner bracing for racking support

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where building envelope improvements are included within the scope of the renovation project.

Cost Implications

Possible additional costs (range low to high) for all recommended thermal improvement strategies except for OVE - OVE should realize both cost savings and thermal efficiency improvement.

SECTION 3 R4 ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

Spaces between trusses or rafters shall have blocking at the soffit to prevent "wind-washing" of the attic insulation*

Intent

To help prevent ice dams and cold interior 'condensing' surfaces

Requirements

*Note that this requirement applies to vented roofs that are insulated with fiberglass, cellulose or other products that do not stop air flow and not to systems that utilize stress skin panels, rigid insulation, SIPS etc.

Block space between trusses or rafters at soffit with durable material sealed in place to prevent the flow of air through or under ceiling insulation.

Verification

1. Construction plans highlighting truss/rafter blocking details
2. Construction Analyst to verify on site

Resources

None

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where building envelope improvements are included within the scope of the renovation project.

Cost Implications

Low additional cost

MaineHousing's Green Building Standards

SECTION 3 R5 ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

No pipes or ducts in outside walls

Intent

Minimize heat loss from ducts and pipes and prevent water damage from frozen pipes

Requirements

No pipes or ducts in outside walls

Verification

1. Construction documents highlighting duct and pipe runs
2. Construction Analyst to verify on site

Resources

None

Rehab/Renovation

The requirements of this standard must be followed to the maximum extent possible where plumbing and/or mechanical and building envelope improvements are included within the scope of the renovation project.

Cost Implications

No additional cost

MaineHousing's Green Building Standards

SECTION 3 R6 ENERGY EFFICIENCY – BUILDING ENVELOPE

Standard

Provide thermally efficient doors providing access to all heated spaces.

Intent

To save energy by increasing the efficiency of the thermal envelope

Requirements

1. Insulated Core Doors must meet the following:
 - a. U Value equal to .15 or less
 - b. Air Leakage Rate (AL) of .30 cfm/SF or less
 - c. Hollow metal doors AND frames shall be thermally broken type
2. Swinging and Sliding Glass Doors
 - a) Glazing U Factor SHGC
 - b) Opaque < 0.21 No Rating
 - c) < 1/2 Lite < 0.27 < 0.30
 - d) > 1/2 Lite < 0.32 < 0.30
 - e) Metal for doors AND frames shall be thermally broken type
 - f) Full glass doors should only be used as part of a vestibule entry system

Verification

1. Provide project design specifications and/or drawings clearly indicating intent
2. All products shall be labeled by the manufacturer indicating compliance with the standards
3. Construction Analyst to verify installation and operation

Resources

Energy Star:
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WI

Notes

None

Rehab/Renovation

The requirements of this standard must be followed where building envelope improvements are included within the renovation project scope.

Cost Implications

None

MaineHousing's Green Building Standards

SECTION 4 R1 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

Energy Star labeled systems and appliances

Intent

Energy Star systems and appliances are the most fuel efficient and save resources, energy and money.

Requirements

1. Energy Star rated furnaces, boilers utilizing sealed combustion up to 300,000 BTU sizes, Then use AFUE greater than or equal to 85%
2. Energy Star rated refrigerators for all units
3. Energy Star rated clothes washers for on-site laundry facilities
4. Where installed - Energy Star rated dishwashers, freezers
5. Where installed - Energy Star rated heat pumps
6. Where installed - Energy Star rated ceiling Fans
7. Energy Star rated exhaust fans
8. Energy Star rated ducted range hoods

Verification

1. Submittals for systems and appliances highlighting Energy Star rating
2. Construction Analyst to verify installation

Resources

Consortium for Energy Efficiency:

www.cce1.org/

Energy Star:

www.energystar.gov/index.cfm?c=home.index

Rehab/Renovation

The requirements of this standard must be followed where building systems and appliance improvements are included within the scope of the renovation project.

Cost Implications

Low cost - Energy Star appliances are currently often specified.

MaineHousing's Green Building Standards

SECTION 4 R2

ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

When provided, bathroom exhaust fans shall meet the requirements of ASHRAE 62.2 - 2007 Ventilation & Acceptable Indoor Air Quality in Low-Rise Residential Buildings.

Intent

To provide systems adequate for spot ventilation that could also provide background whole house ventilation if needed.

Requirements

Fan CFM rating and some level to be sized according to ASHRAE 62.2 2007 Guidelines regarding the number of bedrooms in the unit and whether or not fans run continuously or intermittently.

Verification

1. Contractor submittals
2. Construction Analyst to verify on site

Resources

1. Standard of quality is Panasonic Whisperfit series
2. **Home Ventilating Institute:**
www.hvi.org/

Notes

Timer controls (such as Airtrak or equivalent) can be installed to cycle the air on a set schedule in order to provide supplemental ventilation and improve air quality - this is an option and is not required by MaineHousing.

Airtrak Controller, Tamarack Technologies: www.tamtech.com

Rehab/Renovation

The requirements of this standard must be followed in all rehab projects.

Cost Implications

Low cost

SECTION 4 R3 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

Water Efficiency: Low flow faucets and showerheads

Intent

Save money and protect potable water resources

Requirements

1. Faucets: Flow rate of no more than 1 gallon per minute (GPM)
2. Showerheads: Flow rate of no more than 2 gallons per minute (GPM)

Verification

1. Submittals and cut sheets for plumbing fixtures
2. Construction Analyst to verify installation

Resources

H2ouse.org:
www.h2ouse.org/

Rehab/Renovation

The requirements of this standard must be followed where plumbing fixture improvements are included within the scope of the renovation project.

Cost Implications

No additional cost

SECTION 4 R4 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

Water Efficiency: Low flow toilets and urinals

Intent

Save money and protect potable water resources

Requirements

1. Toilets: Rated at 1.6 gallons per flush (GPF) or less OR dual flush
2. Urinals: Rated at 1.0 GPF or waterless

Verification

1. Submittals and cut sheets for plumbing fixtures
2. Construction Analyst to verify installation

Resources

H2ouse.org:
www.h2ouse.org/

Rehab/Renovation

The requirements of this standard must be followed where toilet and urinal replacements are included within the scope of the renovation project.

Cost Implications

Additional cost for dual flush (though prices are dropping) 1.6 GPF toilets are standard.

MaineHousing's Green Building Standards

SECTION 4 R5 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

Seal ductwork with duct mastic to prevent air leakage

Intent

Optimize performance and prevent air leakage from ductwork

Requirements

Seal duct connections with water based* duct mastic.

Areas that must be sealed include:

1. Swivel elbows
2. Branch take-offs from trunk ducts
3. Finger jointed connections
4. Folded corners of boots & fittings
5. Filter racks & plenum connections

Verification

1. Provide appropriate language in project specifications
2. Construction Analyst to verify installation

Resources

None

Notes

* Water based duct mastic has low VOC content

Rehab/Renovation

The requirements of this standard must be followed in all rehab projects

Cost Implications

Very low additional labor and material costs

MaineHousing's Green Building Standards

SECTION 4 R6

ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Standard

Solar Assist (Preheat) Domestic Hot Water Systems

Intent

Where physically possible and economically feasible, capture the sun's energy to heat domestic hot water.

Standard

Solar Assist (Preheat) Domestic Hot Water Systems

Intent

Where physically possible and economically feasible, capture the sun's energy to heat domestic hot water.

Requirements

1. Analyze each site for potential exposure to the sun.
2. To the maximum extent possible, orient and construct buildings to take full advantage of available sun.
3. Calculate a cost/benefit analysis of providing solar assisted domestic hot water system(s).
 - a. System costs shall include all equipment, labor, and any necessary project upgrades (structure, electrical, etc.) to provide a complete system.
 - b. System shall be sized to provide a minimum output equal to 80% of estimated summertime need.
 - c. Baseline for comparison shall be the conventional fuel used for the heating of domestic hot water.
 - d. Expected available energy shall be based on standards in the industry for the project location.
 - e. Daily hot water demand shall be highest in the morning.
 - f. SRCC Certification and Rating Category C Mildly Cloudy Day, shall be basis of BTU/day output of collectors.

The decision to install a complete system is voluntary.

If the decision is made to install a system, the system shall be properly maintained and include energy output monitoring and reporting of the domestic hot water output in a format, frequency, and level of detail as required by MaineHousing.

If the decision is made not to install a complete system, then one of the options that follow must be included:

Option 1 - Provide minimal preparations for the likely installation of a complete system. Such minimal preparations are to include south facing building orientation(s) and roof surfaces in new construction projects, providing for rough-ins (structurally reinforced building structure, pipe chases and/or runs, adequate spare electrical circuitry, and adequate space for DHW storage) for such system(s).

OR

MaineHousing's Green Building Standards

SECTION 4 R6 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Option 2 - Utilizing the funding that would have been necessary in Option 1, provide upgrades to the thermal envelope of the building(s) that exceeds Green Building Standard Section 3 R2. Such upgrades may include thermally superior windows and/or higher R Values for wall and ceiling areas.

Verification

1. Complete analysis and design documents shall be submitted to MaineHousing for review and acceptance.
2. Submittals for systems and equipment consistent with design intent shall be provided to MaineHousing.
3. Construction Analyst to verify installation.
4. System outputs shall be monitored for a minimum of 5 years.

Resources/References

Solar Rating and Certification Corporation (SRCC)
List of Maine Certified Solar System Installers:
<http://energy.sourceguides.com/businesses/byGeo/US/byS/ME/byP/solar/solar.shtml>
Maine State Plumbing Code
ASHRAE 93
ASHRAE 90336

Notes

None

MaineHousing's Green Building Standards

SECTION 4 R6 ENERGY EFFICIENCY – SYSTEMS & APPLIANCES

Rehab/Renovation

The requirements of this standard should be followed where building site and/or orientation allow for the installation of solar assist system(s) for domestic hot water.

Cost Implications

Initial capital expenditure will be offset by reduced operating costs over a reasonable amount of time.

Commentary

Since its implementation in 2008, this standard has resulted in the inclusion of solar assist pre-heat domestic hot water in some form in virtually all tax credit projects. These projects have included new construction and substantial rehabilitation projects for both workforce and elderly populations. These systems have proven that the technology works and, dependant on the fuel source being off-set by the sun's "free" energy, have demonstrated varied and mostly favorable paybacks.

We have learned that there is no one system or size that fits every application; that actual domestic hot water demand from the pre-heat component, in most instances, is much less than codes or national trends would suggest; that this technology is constantly developing; that there are various opinions and theories as to how best to implement the standard; and that MaineHousing's requirement for system monitoring, data collection, and data transmission to MaineHousing has been a challenge in some instances. While there remains a learning curve, much has been learned to date.

Some issues that have presented challenges on several occasions have included anticipating and designing for roof loadings due to the addition of the roof top components; shading of rooftop collectors; space needs for systems' water storage; performance specifications (design-build delivery method) vs. detailed systems design; integration of solar pre-heat with the standard domestic hot water systems; systems startup and commissioning; and systems output monitoring, data collection, and data transmission.

When this standard was established it was hoped it would encourage the use of alternative energy to help offset rising fuel costs; to encourage product/systems design and installation; to provide new opportunities for employment; and to provide MaineHousing with carbon credits to be packaged with an ongoing carbon credit program. It will take some time before these systems can be fully evaluated for all of these goals.

MaineHousing has determined that the data collected from the systems provided prior to this edition of the standard is sufficient to document typical systems' outputs for our purposes. However, it has been shown that systems start-up, commissioning, and minimal short-term monitoring is invaluable in assuring that domestic hot water solar-assist systems are placed in service and operated correctly from the onset. Instead of the previous requirement of detailed and timely reporting of systems' outputs directly to MaineHousing, it is now required that the Owner, through his design and management team, will set up a monitoring system that will adequately document, in a periodic manner, the output of the system installed at the project. Such monitoring shall include documented readouts of systems outputs that can be converted to BTU's that provides evidence that the system is operating and performing to design expectations. The specific data to be collected, the form of collection, and the documentation report format shall be as directed by the design team. Copies of the documented results shall be provided to MaineHousing on a bi-weekly basis in a summary form for a minimum period of 3 months (a total of 6 reports). If after 3 months the systems are proven to be functioning properly another summary report shall be provided after 6 months and 1 year of operation. All reports are to be submitted to MaineHousing's Construction Services Manger either in hard copy by mail or as attachments to e-mail.

It is further suggested that all systems include some form of alarm that, in a timely manner, notifies project personnel should system failure occur. Such notification can be at the site if it is properly manned, or off-site as part of other building alarm systems or its own system. The Owner shall work closely with the project design team to assure that the alarm system designed and installed will provide proper and timely notification of system failure.

MaineHousing continues to believe that using renewable and/or "free" energy sources makes good sense for housing in Maine.

MaineHousing's Green Building Standards

SECTION 5 R1 ENERGY EFFICIENCY – INTERIOR LIGHTING FIXTURES

Standard

Fixtures shall be Energy Star rated or equivalent or better as documented/recognized by Efficiency Maine or MaineHousing

Intent

Optimize the energy efficiency of indoor lighting

Requirements

Specify and install fixtures that are Energy Star rated or Efficiency Maine's listed energy efficient fixtures or submit alternative fixtures for review and acceptance

Verification

Design documents to specify which standards are being met for each fixture with sufficient backup documentation as requested by Construction Analyst
Contractors submittals highlighting Energy Star rating or Efficiency Maine compliance

Resources

Energy Star:
www.energystar.gov/index.cfm?c=home.index
Efficiency Maine:
www.energymaine.com/

Rehab/Renovation

The requirements of this standard must be followed where interior lighting fixture replacements are included within the scope of the renovation project.

Cost Implications

No additional cost

MaineHousing's Green Building Standards

SECTION 5 R2

ENERGY EFFICIENCY – INTERIOR LIGHTING FIXTURES

Standard

No recessed light fixtures shall be installed in roof/ceiling assemblies

Intent

To maintain the thermal integrity of the building envelope

Requirements

No recessed light fixtures shall be installed in roof / ceiling assemblies or in any ceiling that would interrupt the integrity of the building envelope.

Verification

Construction Analyst to verify on site

Resources

None

Rehab/Renovation

The requirements of this standard must be followed by all rehab projects.

Cost Implications

No additional cost

SECTION 5 R3

ENERGY EFFICIENCY – INTERIOR LIGHTING FIXTURES

Standard

All emergency exit signs shall be LED

Intent

To save energy and replacement costs

Requirements

All emergency exit signs shall be LED (Light Emitting Diodes)

Verification

1. Contractor submittals
2. Construction Analyst to verify on site

Resources

None

Rehab/Renovation

The requirements of this standard must be followed by all rehab projects.

Cost Implications

Low or no additional cost

SECTION 5 R4

ENERGY EFFICIENCY – INTERIOR LIGHTING FIXTURES

Standard

Research, specify, and provide as appropriate, automatic lighting controls to minimize energy use in unoccupied or infrequently occupied spaces within project buildings.

Intent

To save energy by turning off or reducing unnecessary lighting.

Requirements

Provide automatic on/off lighting controls activated by occupant load and/or natural light sensors or other “smart” control systems for lights or groups of lights in common areas such as stairways, corridors, community rooms, public toilet facilities, offices, laundries, etc. while still maintaining minimum lighting levels, particularly in egress routes, as required by applicable codes.

Verification

1. Design specifications and/or drawings that clearly indicate functional intent consistent with this standard provided by designer of record.
2. Commissioning Agent will review and verify that opportunities have been explored to the maximum extend feasible, consistent with the goals and objectives of this standard.
3. Installation and proper operation by Construction Analyst.

Resources

Green Building Products 2nd Edition, Edited by Wilson, Piep Korn, Maling, Battisto, New Society Publishers.

Rehab/Renovation

The requirements of this standard must be followed where building lighting systems improvements are included within the renovation project scope.

Cost Implications

Minor added construction costs for additional sensor/switches/controls/wiring with very likely considerable energy costs savings over the life of the project.

MaineHousing's Green Building Standards

SECTION 6 R1 INSPECTION/COMMISSIONING

Standard

Commissioning required for projects of five units or more with central mechanical and electrical systems

Intent

To verify that systems are operating as designed and specified

Requirements

The Owner shall retain a qualified third party to:

1. Review the mechanical and electrical systems design and equipment selections during the design phases with regard to their compatibility with the overall building design, energy conservation, systems function, and code compliance; and
2. Provide quality assurance and test monitoring during construction to help assure that the design intent is met.
3. Augment and advise the project team.
4. Periodic inspections of the building thermal envelope
5. Commissioning and commissioning report is required for:
 - a. Boilers & Controls
 - b. Air-conditioning Systems & Controls (only in common spaces)
 - c. Ventilation Systems & Controls
 - d. Electrical Systems (lighting and power)
 - e. Construction of the thermal envelope

Verification

Third party to provide professional services that are three-fold: to review the mechanical and electrical systems designs and equipment selections during the design phases, including review and comment of their compatibility with the overall building design as related to energy conservation, systems function, and code compliance; secondly, to provide quality assurance and monitoring during construction to help assure that the design intent is met; thirdly to periodically inspect and document the construction of the thermal envelope. It is not the intent of this requirement to diminish in any way the responsibilities and liabilities of the design team of record or to diminish the work of the contractors employed to carry out the work. The commissioning agent is an "advisor" to the Owner/Developer and the other members of the project team, and MaineHousing.

The expected work products are to include periodic reports documenting the review and recommendations relative to the systems designs as the project design evolves. These should include input from the concept stage through to the completion of the construction documents. THE OWNER/DEVELOPER AND/OR THE DESIGN TEAM SHALL ADDRESS ALL RECOMMENDATIONS AND PROVIDE WRITTEN DOCUMENTATION AS TO WHY ANY OF THE COMMISSIONING AGENT'S SUGGESTIONS ARE NOT INCLUDED INTO THE PROJECT DESIGN. During construction, periodic field reports of physical inspections of the project at various stages of completion shall be provided by the commissioning agent. Reviews and comments related to the systems shop drawings process should also be documented. A written review and comments on systems test monitoring and test results should be provided. Lastly, a concluding document shall be provided stating that, in the opinion of the Commissioning Agent, the building systems have or have not been designed and/or installed properly.

SECTION 6 R1 INSPECTION/COMMISSIONING

Resources

None

Rehab/Renovation

The requirements of this standard must be followed where central mechanical and/or electrical system replacements or thermal envelope upgrades in projects of five or more units are included within the scope of the renovation project.

Cost Implications

Additional costs contingent upon size and complexity of central mechanical systems.

MaineHousing's Green Building Standards

SECTION 6 R2 INSPECTION/COMMISSIONING

Standard

For each project, a representative number of units, as determined by MaineHousing, must be "Blower Door" tested to verify effectiveness of air sealing.

Intent

Verify that the building meets MaineHousing requirements for effective air sealing to prevent heat loss and creation of cold surfaces that can cause condensation and mold growth.

Requirement

1. Blower Door test conducted with calibrated equipment operated by a trained and qualified technician to be performed before the drywall is installed if polyethylene is the air barrier & after installation if airtight drywall approach (ADA).
2. Maximum building envelope leakage is to not exceed 0.20 cubic feet per minute per square foot at 50 pascals negative pressure (0.20 CFM/SF @ 50 PA).

The SF (Square Foot) reference in the standard is the total building envelope square footage area measured using the inside surface dimensions. The intent is to analyze the effectiveness of the air sealing.

Example: A building that is 8' tall (single story) and has dimensions that is 24' by 24' would have an envelope SF of:

$$\begin{array}{r} \text{walls: } 4 \text{ walls } 8' \times 24' = 768 \\ \text{floor: } 24 \times 24 = 576 \\ \text{roof: } 24 \times 24 = \underline{576} \\ \hline 1,920 \text{ SF of Envelope} \end{array}$$

3. Air sealing individual units may have no real bearing on building envelope heat loss if the building shell is leaky. Therefore, MaineHousing requires building shell air sealing from design through to construction completion.

Verification

1. Blower Door test report(s) completed by a trained and qualified technician
2. Verify that any unwanted leakage areas identified by the test are sealed after the test
3. Verify that test results demonstrate that the building meets the envelope leakage requirements of the International Energy Conservation Code (IEC C)

Resources

The Energy Conservatory:

www.energyconservatory.com/

Infiltec:

www.infiltec.com/inf-bd.htm

Home Energy Magazine:

www.homeenergy.org/archive/hem.dis.anl.gov/echem/94/940110.html

MaineHousing's Green Building Standards

SECTION 6 R2 INSPECTION/COMMISSIONING

Rehab/Renovation

The requirements of this standard must be followed where envelope air sealing is included within the scope of the renovation project.

Cost Implications

Blower Door tests cost \$150 - \$200 / unit tested

Commentary

*A blower door measures the amount of "hole" in a single continuous surface - imagine the six sides of a large closed cardboard **box**. A blower door test then tells you how much air will move through the total surface area under any given pressure. If you place several smaller closed boxes inside the larger one and then try to test the individual boxes, you will get a number for each but it is relative/y meaningless because the blower door can't, without multiple doors &/ or a lot of complicated "sub-tests," isolate the small box surface leakage from the surrounding big box surface leakage.*

General/y speaking testing individual units in a large building will reveal the air leaks — you can feel the air coming in - but you can't see the path, it won't tell you if the air is coming from the outside, from the basement &/ or attic or from another unit. We care because exterior air has to be heated while basement/ attic or adjoining unit air may be contaminated with something.

Another issue in large buildings is shell leakage. It is quite possible for the units to have very little leakage while the shell leaks considerably. Blower door testing of individual units - without some detective work - like/y won't define shell leakage. We care because the heating system is sized by exterior wall & ceiling surface. If the shell is leaks, all the interior walls are "washed" in exterior air, making them radiate heat at the same rate as the exterior walls and this vast/y increases the building heat load.

It is high/y unlike/y that units constructed within a MaineHousing project will expect to accomplish "air sealing" utilizing on/y polyethylene. It is more like/y that through the diligent use of caulking at wall plates and door and window installations; attention to tightly sealing any and all penetrations in framing members, including top and bottom plates of walls; and assuring a continuous and tight drywall installation, including air sealing above ceilings, in party walls, in and around cabinetry; that blower door testing will most effective/y be conducted after the completion of the drywall work. As to "verification" the intent is to test and investigate how effective the air sealing measures have been executed by performing blower door testing. Such "verification" is not intended to be quantitative - it is meant to be more qualitative, i.e., by looking for and identifying "leaks" in the air seal, utilizing equipment (infrared camera), visual, and/ or other "telltale" (smoke, powder) methods. Where testing general/y occurs at a point when most finishes are in place, remediation efforts, if found to be necessary, can be difficult at best, f not impossible... therefore making it particularly critical to attend to all potential sealing challenges recognized throughout the course of construction, regardless of how minimal they may be perceived to be. It is further important to understand that once leaks are identified, they must be corrected. This may prove to be difficult or impossible based on the type of construction.

Experience has shown that multiple blower doors are necessary when testing buildings comprised of multiple townhouse and/ or flats so that each unit can be isolated and test on/y its thermal surfaces. In large buildings, multiple blower doors may be necessary to achieve test pressure to the large volume of building to be tested.

MaineHousing's Green Building Standards

SECTION 6 R3 INSPECTION/COMMISSIONING

Standard

A representative sampling of ducted air distribution systems, as determined by MaineHousing, must be tested to verify effectiveness of duct sealing.

Intent

Verify that the ductwork meets MaineHousing requirements for effective air sealing to optimize performance and prevent heat loss.

Requirement

Duct test conducted with calibrated equipment conducted by a trained and qualified technician.

Verification

Duct tightness test report(s) completed by a trained and qualified technician.
Verify that the leakage areas identified by the test are sealed after the test.

Resources

The Energy Conservatory:

www.energyconservatory.com/

Home Energy Magazine:

www.homeenergy.org/archive/hem.dis.anl.gov/eehem/99/991114.html

Rehab/Renovation

The requirements of this standard must be followed where ducted distribution systems are included in the project.

Cost Implications

Low additional cost

MaineHousing's Green Building Standards

SECTION 7 R1 INDOOR ENVIRONMENTAL QUALITY

Standard

Position and size operable windows and glazing systems to take advantage of natural ventilation, cooling and day-lighting.

Intent

Optimize day-lighting and passive ventilation opportunities

Requirement

1. Operable windows to the east and west to take advantage of summer ventilation
2. Shading to reduce overheating

Verification

Review of 50% building plans

Resources

None

Rehab/Renovation

The requirements of this standard must be followed to the extent possible where window & glazing system replacements are included within the scope of the renovation project.

Cost Implications

No to low additional cost

MaineHousing's Green Building Standards

SECTION 7 R2 INDOOR ENVIRONMENTAL QUALITY

Standard

Use low VOC paint

Intent

Protect installers and occupants from irritating and/or harmful indoor air contaminants

Requirement

Volatile Organic Compound (VOC) emissions from paints, primers, & coatings must not exceed the VOC limits of Green Seal's standard GS-1 1 requirements.

1. Non-flat: 150 g/L
2. Flat: 50 g/L

Verification

Manufacturers cut sheets and submittals

Resources

Sustainable ABC:

www.sustainableabc.com/m_p_f_a.html

Zero VOC Paint Guide:

www.aqmd.gov/prdas/brochures/paintguide.html

Green Seal:

www.greenseal.org (Charge for publication)

Sourcebook for Green & Sustainable Building:

www.greenbuilder.com/sourcebook/FinishesAdhesives.html

Rehab/Renovation

The requirements of this standard must be followed where interior painting is included within the scope of the renovation project.

Cost Implications

No additional cost

MaineHousing's Green Building Standards

SECTION 7 R3 INDOOR ENVIRONMENTAL QUALITY

Standard

Use low VOC adhesives & sealants

Intent

Protect installers and occupants from irritating and/or harmful indoor air contaminants

Requirement

Volatile Organic Compound (VOC) emissions from adhesives and sealants must not exceed VOC limits of South Coast Air Quality Management District Rule #1168 AND sealants used as fillers must meet the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51
(Attach tables)

Verification

Manufacturers cut sheets and submittals

Resources

Bay Area Air Quality Management District:
www.baaqmd.gov

MaineHousing's Green Building Standards

SECTION 7 R3 INDOOR ENVIRONMENTAL QUALITY

Limits on VOCs in grams per liter for adhesives and sealants used on interior of building are as follows:

| | VOC Limit (g/L) |
|-------------------------------------|--------------------|
| Welding and Installation | |
| Indoor Carpet Adhesives | 50 |
| Carpet Pad Adhesives | 50 |
| Outdoor Carpet Adhesive | 150 |
| Wood Flooring Adhesive | 100 |
| Rubber Floor Adhesives | 60 |
| Subfloor Adhesives | 50 |
| Ceramic Tile Adhesives | 65 |
| VCT and Asphalt Tile Adhesives | 50 |
| Dry Wall and Panel Adhesives | 50 |
| Cove Base Adhesives | 50 |
| Multipurpose Construction Adhesives | 70 |
| Structural Glazing Adhesives | 100 |
| Single Ply Roof Membrane Adhesives | 250 |
| PVC Welding | 510 |
| CPVC Welding | 490 |
| ABS Welding | 400 |
| Plastic Cement Welding | 350 |
| Adhesive Primer for Plastic | 650 |
| Contact Adhesive | 250 |
| Special Purpose Contact Adhesive | 250 |
| Substrates | |
| Metal to metal | 30 |
| Plastic foams | 50 |
| Porous material except wood | 50 |
| Wood | 30 |
| Fiberglass | 80 |

MaineHousing's Green Building Standards

SECTION 7 R3 INDOOR ENVIRONMENTAL QUALITY

Limits on VOCs in grams per liter for sealants and sealant primers per South Coast Rule #1168 by the South Coast Air Quality Management District:

| | VOC Limit (g/L) |
|---------------------------|--------------------|
| Sealants | |
| Architectural | 250 |
| Other | 420 |
| Sealant Primers | |
| Architectural – nonporous | 250 |
| Architectural – porous | 775 |
| Other | 750 |

Limits on VOCs in grams per liter for Sealants used as Fillers per Bay Area Air Quality Management District, Reg. 8 Rule 51

| | VOC Limit (g/L) |
|---------------------------|--------------------|
| Sealants | |
| Architectural | 250 |
| Other | 420 |
| Sealant Primers | |
| Architectural- Nonpourous | 250 |
| Architectural- Pourous | 775 |
| Other | 750 |

Rehab/Renovation

The requirements of this standard must be followed where adhesives and sealants are included within the scope of the renovation project.

Cost Implications

No additional cost

MaineHousing's Green Building Standards

SECTION 7 R4 INDOOR ENVIRONMENTAL QUALITY

Standard

If carpet is installed it must meet CRI low emission label standard

Intent

Protect installers and occupants from irritating and/or harmful indoor air contaminants

Requirement

Carpet systems must meet or exceed Carpet & Rug Institute (CRI) Green Label Indoor Air Quality Test Program.

Verification

Manufacturers cut sheets & submittals verifying that carpet systems meet CRI Air Quality test requirements.

Resources

Carpet & Rug Institute:

www.carpet-rug.com

Limits on VOCs in grams per liter for carpets, cushion, and adhesives per the Carpet and Rug Institute Green Label Testin^g Pro^gram:

| | Emission factor limit (mg/m ² /hr) |
|-------------------------|---|
| Carpets | |
| Total VOCs | 0.5 |
| 4 – Phenylcyclohexane | 0.05 |
| Formaldehyde | 0.05 |
| Styrene | 0.4 |
| Cushion | |
| Total VOCs | 1 |
| 4 – Phenylcyclohexane | 0.3 |
| Formaldehyde | 0.05 |
| Styrene | 0.05 |
| Adhesives | |
| Total VOCs | 10 |
| Formaldehyde | 0.05 |
| 2 - Ethyl - 1 – Hexanol | 3 |

Rehab/Renovation

The requirements of this standard must be followed where carpet installation is included within the scope of the renovation project.

Cost Implications

No additional cost

SECTION 7 R5 INDOOR ENVIRONMENTAL QUALITY

Standard

No carpet in kitchens, bathrooms or within 3' of entry doors

Intent

Prevent the growth of mold and mildew in carpet systems

Requirement

Do not install carpet in kitchens, bathrooms or within 3 feet of entry doors that will be subject to wet or muddy foot traffic

Verification

1. Construction drawings highlighting carpet system installation requirements
2. Construction Analyst to verify on site

Resources

None

Rehab/Renovation

The requirements of this standard must be followed in all rehab projects

Cost Implications

No additional cost

Commentary

Units with at-grade access are subject to the entry requirement. Main entrances to multi-unit buildings are subject to the entry standard. The use of products designed and maintained as "walk-off" surfaces at main building entries will be reviewed on a case-by-case basis. Providing an easily cleaned hard surface near all entry doors for the storage of footwear is encouraged.

MaineHousing's Green Building Standards

SECTION 8 R1 MATERIALS

Standard

Use framing and finish lumber harvested from sustainably managed forests OR local / regional materials OR durable materials.

Intent

Preserve resources by using certified, regional or durable products

Requirement

Choose one of the following:

1. Use framing and finish lumber milled from logs harvested from sustainably managed forests - credit requires that 25% of wood products (as measured by dollar value) used in the project come from "certified forests".
2. Local / regional materials that are manufactured / harvested / extracted within a 300 mile radius of the project - credit requires 20% of building materials (measured by dollar value)
3. For durable materials - use at least 2 of the following products:
 - Fiber cement siding covering at least 75% of all buildings
 - Composite decking with high recycled content, for all exterior deck applications
 - Natural linoleum flooring, for at least all kitchen or bathroom floors of all buildings
 - Ceramic tile bathroom or kitchen flooring, for all such flooring in all buildings
 - Roofing with a warranty of at least 40 years, for all buildings
 - Insulated glass with a warranty of at least 20 years, for all exterior windows
 - Siding with a warranty of at least 40 years, covering at least 75% of all buildings
 - Wood, cork or bamboo flooring, covering at least 15% of all floor areas within the project
 - Brick covering at least 40% of all buildings

Verification

For certified wood - verify with:

The contractor must verify sustainable forest management through a letter from the sawmill to the lumber yard that declares the percentage of saw-logs harvested from certified forestland that were used in manufacturing lumber sold to the contractor. Certification of the forestland may be by the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), American Tree Farm System (ATFS), Certified Master Logger Program (MLP), or some other established standard, as approved by the state of Maine Department of Conservation, as such standards evolve over time.

For local/regional materials:

Declaration from product vendor or manufacturer stating where product is manufactured

For durable materials:

Manufacturer's product information and warranties

MaineHousing's Green Building Standards

SECTION 8 R1 MATERIALS

Resources

None

Rehab/Renovation

The requirements of this standard must be followed to the extent possible where framing or finish material replacement is included within the scope of the renovation project.

Cost Implications

Additional costs, if any, for verification should be very low. FSC certified wood and most durable products will have higher first costs.

MaineHousing's Green Building Standards

SECTION 9 R1 RESOURCE EFFICIENCY

Standard

Provide space for recycling containers at convenient location(s) for storage of recyclables

Intent

Encourage building occupants to recycle

Requirement

Provide recycling area /containers for each unit or building

Verification

Verify recycling location on plans

Resources

None

Rehab/Renovation

The requirements of this standard must be met by all rehab projects

Cost Implications

Cost for additional Square Footage required for recycling area

MaineHousing's Green Building Standards

SECTION 9 R2 RESOURCE EFFICIENCY

Standard

Non-mercury thermostats

Intent

Prevent the release of mercury into the environment

Requirement

All thermostats must be non-mercury thermostats

Verification

1. Contractor submittals
2. Construction Analyst to verify on site

Resources

Maine Department of Environmental Protection:
www.maine.gov/dep/mercury/

Rehab/Renovation

The requirements of this standard must be followed where thermostat replacements are included within the scope of the renovation project.

Cost Implications

No additional cost

Commentary

While it is herein noted that thermostats containing mercury are generally outlawed for new construction, this standard serves as a reminder that they should be addressed in any projects undergoing renovation.

MaineHousing's Green Building Standards

SECTION 10 R1 POST OCCUPANCY

Standard

Provide tenants and facility managers with educational materials about green design, building operations, recycling and building maintenance.

Intent

To maintain the 'green' goals of the project after occupancy by educating and involving occupants in the site and building operations and maintenance procedures.

Requirement

1. Introductory presentation to prospective tenants describing design, operations, recycling, site and building maintenance goals
2. Brochure or handout materials containing background information, resources.

Verification

Provide MaineHousing with copies of educational materials

Resources

MaineHousing's *Green operations and Maintenance Manual* template – contact MaineHousing's Asset Management Division or Website

MaineHousing's *Green Healthy Homes Guide* template – contact MaineHousing's Asset Management Division or Website

Rehab/Renovation

The requirements of this standard are to educate tenants about all relevant green design and construction measures included within the scope of the renovation project.

Cost Implications

Additional cost to purchase or produce, print and distribute educational materials.

MaineHousing's Green Building Standards

SECTION 11 R1 CONSTRUCTION PRACTICES

Standard

Research, specify, and require as appropriate, construction waste and/or debris recycling.

Intent

To minimize impacts to landfills and maximize the recycling of reusable materials where reuse/recycling facilities are reasonably accessible to the project site.

Requirement

Provide a written construction materials recycling/waste management work plan, provide on-site containers specific to the items targeted in the plan, monitor and document results of the efforts taken, and report all quantifiable results.

Verification

1. Develop and document a construction materials recycling/waste management work plan.
2. Construction Analyst to verify efforts and operations and track any quantifiable results.
3. 3. To determine if recycling facilities are reasonably accessible, an analysis of costs vs. benefits shall be prepared and presented, indicating whether or not this standard can be met.

Resources

Maine Housing and Building Materials Exchange, Gray, Maine
www.mainebme.org

Maine Materials Exchange, Freeport, Maine
www.m2x.com

Commercial Paving and Recycling, Scarborough, Maine
www.cpcrs.com

KTI Biofuels, Lewiston, Maine
www.casella.com

Institutional Recycling Network, Inc., Concord, NH
www.ir-network.com
www.wastemiser.com

Rehab/Renovation

The requirements of this standard must be followed where scheduled building improvements will generate construction wastes and/or debris as part of the renovation project.

Cost Implications

No anticipated added costs – potentially cost benefits to the contractor and the overall construction budget.