

# **Maine State Housing Authority Green Building Standards**

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

**Prepared by Fore Solutions  
Portland, Maine**

# Maine State Housing Authority Green Building Standards

In keeping with its mission to assist Maine people to obtain and maintain decent, safe, affordable housing services, Maine State Housing Authority (MSHA) has developed a set of Green Building Standards for designers, developers and contractors who apply for MSHA 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 ten 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. MSHA's Green Building Standards promote regional products, and support local economies and economic development.

**Dale McCormick**  
Director



# Maine State Housing Authority

## Green Building Standards

Standard		Cost Implications
<b>1 Site</b>		
<b>R 1</b>	Landscape with at least 75% northern hardy native species that do not require irrigation. This is measured by number of plantings.	No additional cost
<b>R 2</b>	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
<b>R 3</b>	Minimize light pollution to the night sky.	No to low additional
<b>2 Building Design</b>		
<b>R 1</b>	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
<b>3 Energy Efficiency: Building Envelope</b>		
<b>R 1</b>	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.
<b>R 2</b>	The thermal envelope shall be insulated in a manner that complies with either the requirements of Chapter 4 of the 2004 IECC 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.)
<b>R 3</b>	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
<b>R 4</b>	Spaces between trusses or rafters shall have blocking at the soffit to prevent 'windwashing' of the attic insulation	Low additional cost
<b>R 5</b>	No pipes or ducts in outside walls	No additional cost

<b>4 Energy Efficiency: Systems &amp; Appliances</b>			
	<b>R 1</b>	Energy Star labeled systems & appliances	Low cost - Energy Star appliances are currently often
	<b>R 2</b>	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
	<b>R 3</b>	Water Efficiency: Low flow faucets and showerheads	No additional cost
	<b>R 4</b>	Water Efficiency: Low flow toilets	Additional cost for dual flush, 1.6 GPF toilets are standard.
	<b>R 5</b>	Seal ductwork with duct mastic to prevent air leakage	Very low additional labor and material costs
<b>5 Energy Efficiency: Interior Lighting Fixtures</b>			
	<b>R 1</b>	Lighting lamps and fixtures shall be Energy Star rated	No additional cost
	<b>R 2</b>	No recessed light fixtures shall be installed in roof/ceiling assemblies	No additional cost
	<b>R 3</b>	All emergency exit signs shall be LED	Low or no additional cost
<b>6 Inspection/Commissioning</b>			
	<b>R 1</b>	Commissioning required for projects of five units or more with central mechanical systems	Additional costs contingent upon size and complexity of central mechanical
	<b>R 2</b>	For each project, a representative number of units, as determined by MSHA, must be "Blower Door" tested to verify effectiveness of air	Blower Door tests cost \$150 - \$200 / unit tested
	<b>R 3</b>	A representative sampling of ducted air distribution systems, as determined by MSHA, must be tested to verify effectiveness of duct	Low additional cost
<b>7 Indoor Environmental Quality</b>			
	<b>R 1</b>	Position and size operable windows and glazing systems to take advantage of natural ventilation, cooling and daylighting	No to low additional cost
	<b>R 2</b>	Use low VOC paint	No additional cost
	<b>R 3</b>	Use low VOC adhesives & sealants	No additional cost
	<b>R 4</b>	If carpet is installed it must meet CRI low emission test standard	No additional cost
	<b>R 5</b>	No carpet in kitchens, bathrooms or within 3' of entry doors	No additional cost
<b>8 Materials</b>			
	<b>R 1</b>	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
<b>9 Resource Efficiency</b>			
	<b>R 1</b>	Provide space for recycling containers at convenient location(s) for storage of recyclables	Cost for additional Square Footage required for recycling
	<b>R 2</b>	Non-mercury thermostats	No additional cost
<b>10 Post Occupancy</b>			
	<b>R 1</b>	Provide tenants with educational materials about green design, building operations, recycling & building maintenance.	Additional cost to purchase or produce, print and distribute educational materials

# MSHA 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 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 MSHA on a case by case basis

#### Verification

- 1 Provide MSHA 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:**  
<http://www.umext.maine.edu/onlinepubs/htmpubs/2500.htm>  
**Maine Natural Areas Program Department of Conservation:**  
<http://www.mainenaturalareas.org/index.php>

#### 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

# MSHA 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 dripline)
  - b. Relocation
  - c. Other as approved by MSHA

### Verification

Provide predevelopment and postdevelopment site plans highlighting trees and vegetation that were preserved and/or relocated on site

### Resources

### Rehab/Renovation

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

### Cost Implication

No to low additional cost

# MSHA 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](http://www.iesna.org)  
**Dark Sky Association**  
[www.darksky.org](http://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

# MSHA Green Building Standards

## 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

##### Footings & Slab

- 1 Capillary break over footing with dampproofing, low perm or elastomeric paint
- 2 Foundation drain at outside perimeter edge of footing
- 3 Sub-grade (footing) drainage system
- 4 Gravel bed beneath slab minimum 4" depth, 1/2 " gravel, no fines)
- 5 Minimum six mil polyethylene vapor diffusion retarder between slab and gravel with joints lapped at least one foot.

##### 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' graded perimeter of impermeable backfill around the foundation

##### Basement

- 1 Damp proofing or moisture barrier assembly system applied 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

##### Windows & Doors

- 1 Sill wrapped with membrane for moisture protection

##### Roof

- 1 Overhangs - Minimum of 1 foot

#### Interior

##### Appliances

Drainage pans under water heaters and clothes washers when installed on or over finished floors - 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:** [http://www.eere.energy.gov/buildings/building\\_america/](http://www.eere.energy.gov/buildings/building_america/)  
**Building Science Corporation:** <http://www.buildingscience.com/>  
**Housing and Urban Development (HUD)** 'Durability by Design' available at [http://www.huduser.org/intercept.asp?loc=/Publications/PDF/durability\\_by\\_design\\_part1.pdf](http://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.



# MSHA Green Building Standards

## 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 kneewall -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 (SIPs), Insulating Concrete Form

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

#### 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](http://www.buildingscience.com)

**Building America:** [http://www.eere.energy.gov/buildings/building\\_america/](http://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.

# MSHA 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 4 of the 2004 International Energy Conservation Code (IECC) or the requirements of state law 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 (except Aroostook County) Climate Zone 6 requirements - see following page
- 2 Aroostook County Climate Zone 7 requirements - see following page

#### Verification

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

#### Resources

International Energy Conservation Code, 2004 Supplement Edition (ISBN 1-58001-230-2)

#### 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

#### 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.)

## MSHA Green Building Standards - Referenced Code

### SECTION 3 R2 ENERGY EFFICIENCY - BUILDING ENVELOPE

#### Minimum Requirements of the International Energy Conservation Code, Chapter 4, 2004 Supplement

**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	Mass Wall R Value	Floor R Value	Basement Wall R Value	Slab R Value & Depth	Crawl Space Wall R Value
6	0.35	0.6	NR	49	21 or 15+5	15	30*	10/13**	10, 4ft	10/13**
7	0.35	0.6	NR	49	21	19	30*	10/13**	10, 4ft	10/13**

\*Or insulation sufficient to fill the framing cavity with R19 a minimum

\*\* The first R value applies to continuous insulation, the second to framing cavity insulation; either meets the requirements

# MSHA 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:
  - a. U value of less than .35
  - b. Solar Heat Gain Coefficient (SHGC) of .45 or higher
  - c. 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 MSHA

#### Verification

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

#### Resources

[www.efficientwindows.org](http://www.efficientwindows.org)

[www.efficientwindows.org/factsheets/maine.pdf](http://www.efficientwindows.org/factsheets/maine.pdf)

[www.energystar.gov/index.cfm?c=bop.pt\\_bop\\_maine](http://www.energystar.gov/index.cfm?c=bop.pt_bop_maine)

**National Fenestration Rating Council:** [www.nfrc.org](http://www.nfrc.org)

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

**SIPS:** <http://www.sips.org/>

**ICF:** <http://www.icfhomes.com/>

**OVE:** <http://www.buildingscience.com/buildingamerica/targets.htm>, then  
"Advanced Framing" under Recommendations: Green Building Aspects  
**National Association of Homebuilders** 'Simplified Residential Framing  
Guide', published by NAHB Research Center [www.nahbrc.org](http://www.nahbrc.org) Report is  
Summarized at

<http://www.nahbrc.org/searchR.asp?selcategory=0&Action=Find&CategoryID>

## 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  
Use drywall clips or an acceptable alternative to eliminate drywall backer
- 5 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

# MSHA Green Building Standards

## SECTION 3 R4

### ENERGY EFFICIENCY - BUILDING ENVELOPE

#### Standard

**Spaces between trusses or rafters shall have blocking at the soffit to prevent 'windwashing' 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

#### 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

#### Cost Implications

Low additional cost

# MSHA 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

#### 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.

# MSHA 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
- 2 Energy Star refrigerators for all units
- 3 Energy Star clotheswashers for on-site laundry facilities
- 4 Where installed - Energy Star dishwashers, freezers
- 5 Where installed - Energy Star rated heat pumps

#### Verification

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

#### Resources

**Consortium for Energy Efficiency:** <http://www.cee1.org/>

**Energy Star:** <http://www.energystar.gov/index.cfm?c=home.index>

#### Notes

#### 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



# MSHA Green Building Standards

## SECTION 4 R2

### ENERGY EFFICIENCY - SYSTEMS & APPLIANCES

#### Standard

**Bathroom exhaust fans shall meet the requirements of ASHRAE 62.2 - 2003 *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 sone level to be sized according to ASHRAE 62.2 2003 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: <http://www.hvi.org/>
- 3 Maine PUC: [http://www.state.me.us/mpuc/doing\\_business/rules/part9.htm](http://www.state.me.us/mpuc/doing_business/rules/part9.htm)

#### 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 MSHA  
Airtrak Controller, Tamarack Technologies: [www.tamtech.com](http://www.tamtech.com)

#### Rehab/Renovation

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

#### Cost Implications

Low cost

# MSHA Green Building Standards

## 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:** <http://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.

# MSHA Green Building Standards

## 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: <http://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.

# MSHA 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

#### Notes

\* Water based duct mastic has low VOC content

#### Rehab/Renovation

# MSHA Green Building Standards

## SECTION 5 R1

### ENERGY EFFICIENCY - INTERIOR LIGHTING FIXTURES

#### Standard

Lighting lamps and fixtures shall be Energy Star rated

#### Intent

Optimize the energy efficiency of indoor lighting

#### Requirements

Specify and install fixtures and lamps that are Energy Star rated

#### Verification

Contractors submittals highlighting Energy Star rating

#### Resources

**Energy Star:** <http://www.energystar.gov/index.cfm?c=home.index>

**Efficiency Maine:** <http://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

# MSHA 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

#### Rehab/Renovation

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

#### Cost Implications

No additional cost

# MSHA Green Building Standards

## 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

#### Rehab/Renovation

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

#### Cost Implications

Low or no additional cost

# MSHA Green Building Standards

## SECTION 6 R1

### INSPECTION/COMMISSIONING

#### Standard

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

#### Intent

To verify that systems are operating as designed and specified

#### Requirements

Commissioning and commissioning report is required for:

- 1 Boilers & Controls
- 2 Air-conditioning Systems & Controls
- 3 Ventilation Systems & Controls

#### Verification

Commissioning report from a qualified engineer or HVAC contractor not employed by or affiliated with the installation contractor or general contractor

#### Resources

#### Rehab/Renovation

The requirements of this standard must be followed where central mechanical system replacements 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



# MSHA Green Building Standards

## SECTION 6 R2 INSPECTION/COMMISSIONING

### Standard

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

### Intent

Verify that the building meets MSHA 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)

### 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 (IECC) 2004 Supplement

### Resources

**The Energy Conservatory:** <http://www.energyconservatory.com/>

**Infiltec:** <http://www.infiltec.com/inf-bd.htm>

**Home Energy Magazine:**

<http://homeenergy.org/archive/hem.dis.anl.gov/eehem/94/940110.html>

### Notes

### 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

# MSHA Green Building Standards

## SECTION 6 R3

### INSPECTION/COMMISSIONING

#### Standard

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

#### Intent

Verify that the ductwork meets MSHA 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:** <http://www.energyconservatory.com/>

**Home Energy Magazine:**

<http://homeenergy.org/archive/hem.dis.anl.gov/eehem/99/991114.html>

**Testing Methodology:** <http://epb.lbl.gov/publications/lbnl-47308.pdf>

#### Rehab/Renovation

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

#### Cost Implications

Low additional cost

# MSHA 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 daylighting

#### Intent

Optimize daylighting and passive ventilation opportunities

#### Requirement

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

#### Verification

Review of 50% building plans

#### Resources

#### 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

# MSHA 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 & coatings must not exceed the VOC limits of Green Seal's standard GS-11 requirements

1 Non-flat: 150 g/L

2 Flat: 50 g/L

#### Verification

Manufacturers cut sheets and submittals

#### Resources

**Sustainable ABC:** [http://www.sustainableabc.com/m\\_p\\_f\\_a.html](http://www.sustainableabc.com/m_p_f_a.html)

**Zero VOC Paint Guide:**

<http://www.aqmd.gov/prdas/brochures/paintguide.html>

**Green Seal:** [www.greenseal.org](http://www.greenseal.org) (Charge for publication)

**Sourcebook for Green & Sustainable Building:**

<http://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

# MSHA 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

South Coast Air Quality Management District:  
[www.aqmd.gov/rules/html/r1168.html](http://www.aqmd.gov/rules/html/r1168.html)  
 Bay Area Air Quality Management District: [www.baaqmd.gov](http://www.baaqmd.gov)

#### SUMMARY OF REFERENCED STANDARDS

#### South Coast Rule #1168 by the South Coast Air Quality Management District

[www.aqmd.gov/rules/html/r1168.html](http://www.aqmd.gov/rules/html/r1168.html)

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

	VOC Limit (g/L)
<b>Welding and Installation</b>	
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
<b>Substrates</b>	
Metal to metal	30
Plastic foams	50
Porous material except wood	50
Wood	30
Fiberglass	80

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)
<b>Sealants</b>	
Architectural	250
Other	420
<b>Sealant Primers</b>	
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)
<b>Sealants</b>	
Architectural	250
Other	420
<b>Sealant Primers</b>	
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

# MSHA 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](http://www.carpet-rug.com)

**Limits on VOCs in grams per liter for carpets, cushion, and adhesives per the Carpet and Rug Institute Green Label Testing Program:**

	<b>Emission factor limit (mg/m<sup>2</sup>/hr)</b>
<b>Carpets</b>	
Total VOCs	0.5
4 – Phenylcyclohexane	0.05
Formaldehyde	0.05
Styrene	0.4
<b>Cushion</b>	
Total VOCs	1
4 – Phenylcyclohexane	0.3
Formaldehyde	0.05
Styrene	0.05
<b>Adhesives</b>	
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

# MSHA Green Building Standards

## 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

#### Verification

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

#### Resources

#### Rehab/Renovation

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

#### Cost Implications

No additional cost



# MSHA 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
  - Composite decking with high recycled content
  - Natural linoleum flooring
  - Ceramic tile bathroom or kitchen flooring
  - Roofing with a warranty of at least 40 years
  - Insulated glass with a warranty of at least 20 years
  - Siding with a warranty of at least 40 years
  - Wood, cork or bamboo flooring

### 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 sawlogs 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:

Manufacturers product information and warranties

### Resources

**Maine Department of Conservation:** [http://mainegov-images.informe.org/doc/mfs/fpm/for\\_cert/forest\\_cert\\_brochure.pdf](http://mainegov-images.informe.org/doc/mfs/fpm/for_cert/forest_cert_brochure.pdf)

### 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

# MSHA 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

#### 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

# MSHA 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:**  
<http://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

# MSHA 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

### 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 MSHA with copies of educational materials

### Resources

### 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