ASHRAE 90.1-2010 and LEED v4

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Southland Industries

Steve Ours
HGA
How This Impacts You?

• Designers – Updated Rulebook
• Contractors – Varying Cost Impacts
• Owners – Building Architecture, Infrastructure, and Cost Impacts
Agenda:
• What is ASHRAE 90.1
• ASHRAE 90.1 and LEED Interconnection
• ASHRAE 90.1-2010 MEP Updates
• LEED v4 Updates
• Questions
What is 90.1
ASHRAE 90.1

• Benchmark for building energy codes in the United States
• Provides minimum requirements for energy-efficient design of most commercial buildings
• Applies to:
  • design and construction of new buildings and their systems
  • new portions of buildings and their systems
  • new systems and equipment in existing buildings
• Offers criteria for determining compliance
ASHRAE 90.1 - Appendix G: Performance Rating Method

- A guideline for modeling the energy performance of a building
- Required for LEED energy performance credits
- Comparison of a proposed design to a minimally compliant baseline building
- Gives requirements for modeling baseline and proposed building designs

<table>
<thead>
<tr>
<th>PRM Energy Comparison</th>
<th>ASHRAE Baseline</th>
<th>Proposed Design</th>
<th>Proposed vs Baseline</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Energy Use 10^6 Btu/yr</td>
<td>Energy Use 10^6 Btu/yr</td>
<td>% Savings</td>
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<tr>
<td>Lighting - Conditioned</td>
<td>Electricity</td>
<td>350.1</td>
<td>247.9</td>
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<td>20.1</td>
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<td></td>
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<td>54.7</td>
<td>78.5</td>
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<tr>
<td>Fans - Conditioned</td>
<td>Electricity</td>
<td>489.2</td>
<td>431.0</td>
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<td>Receptacles - Conditioned</td>
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<td>1,113.8</td>
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<td>Stand-alone Base Utilities</td>
<td>Electricity</td>
<td>1,216.1</td>
<td>1,009.7</td>
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<td>Total Building Consumption</td>
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<table>
<thead>
<tr>
<th>PRM Cost Comparison</th>
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<th>Proposed Design</th>
<th>Proposed vs Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/year</td>
<td>Cost/year</td>
<td>% Savings</td>
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<tr>
<td>Electricity</td>
<td>$84,336</td>
<td>$68,264</td>
<td>19%</td>
</tr>
<tr>
<td>Gas</td>
<td>$5,463</td>
<td>$2,561</td>
<td>53%</td>
</tr>
<tr>
<td>Total</td>
<td>$89,799</td>
<td>$70,825</td>
<td>21%</td>
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</table>
ASHRAE 90.1 – Current State Adoption

As of March 2014

Energycodes.gov
ASHRAE 90.1 – Future State Adoption
ASHRAE 90.1 – Federal Adoption

The Navy and Air Force, in accordance with 10 CFR Part 433, require meeting the requirements of ASHRAE 90.1-2007. The Army requires meeting the requirements of ASHRAE 90.1-2010.

UFC 1-200-02 – High Performance and Sustainable Building Requirements, March 1, 2013

“Therefore, in today’s final rule, DOE updates the energy efficiency standards for new Federal buildings to ASHRAE Standard 90.1–2010 for buildings for which design for construction began on or after one year after today’s rule is published in the Federal Register.”

Federal Register / Vol. 78, No. 131 / Tuesday, July 9, 2013 / Rules and Regulations

92 Days Away
Timeline ASHRAE 90.1 and LEED

- 1970
- 1980
- 1990
- 2000
- 2010
- 2020

- 90.1-2007 Update
- 90.1-2010 Update
- June 1, 2015

- LEED 2009
- LEED Version 4
Comparison of ASHRAE 90.1 Revisions

ASHRAE Standard 90.1 Energy Use Index Comparison
(1975 EUI = 100)

42%
Notable Changes in ASHRAE 90.1-2010
5.4.3 Air Leakage:
- Continuous Air Barriers now required
- Fenestration and door air leakage expanded upon and testing methods have been updated and have stricter requirements
Chapter 5: Building Envelope

5.5.4 Fenestration
- Skylights are required for buildings:
  - ≤ 4 stories
  - ceilings ≥ 15 ft
  - floor area ≥ 5Ksqft

- Fenestration orientation:
  - Area South ≥ Area West
  - Area South ≥ Area East
Chapter 6: HVAC Overview of Changes

ASHRAE 90.1 2007 vs 2010 Full Load Equipment Efficiencies

- AC Chillers (< 150 Tons)
- AC Chillers (> 150 Tons)
- WC Pos. Disp. Chiller (< 75 Tons)
- WC Pos. Disp. Chiller (75 - 150 Tons)
- WC Pos. Disp. Chiller (150 - 300 Tons)
- WC Cent. Chillers (> 600 Tons)
- Air Cooled DX AHU (20 - 63.3 Tons)
- Air Cooled DX AHU (> 63.3 Tons)
Chapter 6: HVAC Overview of Changes

ASHRAE 90.1 2007 vs 2010 Part Load Equipment Efficiencies
Chapter 6: HVAC Overview of Changes

Liquid Temps - 105°F-250°F
• All Piping Sizes
• 0.5” – 1.0” Additional Insulation

Liquid Temps - 251°F-350°F
• All Piping Sizes
• 1.0” – 1.5” Additional Insulation
**Case Study Building**

- **Location** - Washington DC
- **Size** - 40,000 sf
- **Condensing Natural Gas Boilers**
- **Air Cooled DX CHW Plant**
- **RTU with 100% Airside Economizer**
- **VAV w/ Reheat**
- **Minimum ventilation is 30% greater than code**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Percentage Cost Increase (Material Only)</th>
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<tbody>
<tr>
<td>3/4”</td>
<td>52%</td>
</tr>
<tr>
<td>1”</td>
<td>52%</td>
</tr>
<tr>
<td>1-1/2”</td>
<td>50%</td>
</tr>
<tr>
<td>2”</td>
<td>42%</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>50%</strong></td>
</tr>
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Fiberglass Insulation (141°F-200°F Liquid Temp)
### 6.5.1 Economizers

#### 2007 Economizer Prescriptive Requirements

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>A (moist)</th>
<th>B (dry)</th>
<th>A (moist)</th>
<th>B (dry)</th>
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<tbody>
<tr>
<td></td>
<td>Econ Req. for Cooling Capacity</td>
<td>Econ Req. for Cooling Capacity</td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>2</td>
<td>NR</td>
<td>NR</td>
<td>Req</td>
<td>≥135,000 Btu/h</td>
</tr>
<tr>
<td>3</td>
<td>NR</td>
<td>NR</td>
<td>Req</td>
<td>≥65,000 Btu/h</td>
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<td>4</td>
<td>NR</td>
<td>NR</td>
<td>Req</td>
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<td>Req</td>
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<tr>
<td>6</td>
<td>Req</td>
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<td>7</td>
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<td>Req</td>
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<tr>
<td>8</td>
<td>Req</td>
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<td>Req</td>
<td>≥65,000 Btu/h</td>
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<td>2</td>
<td>Req</td>
<td>≥135,000 Btu/h</td>
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<td>Req</td>
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<tr>
<td>8</td>
<td>Req</td>
<td>Req</td>
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</table>
### 6.5.1 Economizers

#### 2010 Economizer Prescriptive Requirements

<table>
<thead>
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<th>2010 Economizer Prescriptive Requirements</th>
<th>2010 Baseline Economizer Requirements</th>
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<td>B (dry)</td>
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<td></td>
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<tr>
<td>1</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>2</td>
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<td>≥54000 Btu/h</td>
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<td>3</td>
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<tr>
<td>7</td>
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### 6.5.6.1 Exhaust Air Energy Recovery

#### 2007 Exhaust Air Energy Recovery Requirements

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<th>40% ≤ OA &lt; 50%</th>
<th>50% ≤ OA &lt; 60%</th>
<th>60% ≤ OA &lt; 70%</th>
<th>70% ≤ OA &lt; 80%</th>
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<td>NR</td>
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<td>NR</td>
<td>≥ 5000</td>
<td>≥ 5000</td>
</tr>
<tr>
<td>1B, 2B, 5C</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>≥ 5000</td>
<td>≥ 5000</td>
</tr>
<tr>
<td>6B</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>≥ 5000</td>
<td>≥ 5000</td>
</tr>
<tr>
<td>1A, 2A, 3A, 4A, 5A, 6A</td>
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<td>NR</td>
<td>NR</td>
<td>NR</td>
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<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>≥ 5000</td>
<td>≥ 5000</td>
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### 2010 Exhaust Air Energy Recovery Requirements

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<th>Climate Zone</th>
<th>30% ≤ OA &lt; 40%</th>
<th>40% ≤ OA &lt;50%</th>
<th>50% ≤ OA &lt; 60%</th>
<th>60% ≤ OA &lt; 70%</th>
<th>70% ≤ OA &lt; 80%</th>
<th>80% ≤ OA</th>
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</thead>
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<td>3B, 3C, 4B, 4C, 5B</td>
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<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>≥ 5000</td>
<td>≥ 5000</td>
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<td>1B, 2B, 5C</td>
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<td>NR</td>
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<td>≥ 12000</td>
<td>≥ 5000</td>
<td>≥ 4000</td>
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<td>6B</td>
<td>≥ 11000</td>
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<td>≥ 1500</td>
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<td>≥ 4500</td>
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<td>&gt; 0</td>
<td>&gt; 0</td>
<td>&gt; 0</td>
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</table>
Chapter 8: Power

• 8.4.2 Automatic receptacle controls must be installed on at least 50% of the 120V, 15 and 20 Amp receptacles in offices and computer classrooms added for 90.1-2010.
9.2 Most of the interior and exterior lighting power allowances have changed with most being reduced

<table>
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<tr>
<th></th>
<th>2007</th>
<th>2010</th>
<th>07 vs 10</th>
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<tr>
<td>Classroom</td>
<td>1.4</td>
<td>1.24</td>
<td>-11%</td>
</tr>
<tr>
<td>Conference</td>
<td>1.3</td>
<td>1.23</td>
<td>-5%</td>
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<tr>
<td>Corridor</td>
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<td>0.66</td>
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<tr>
<td>Lobby</td>
<td>1.3</td>
<td>0.9</td>
<td>-31%</td>
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<tr>
<td>Lounge</td>
<td>1.2</td>
<td>0.73</td>
<td>-39%</td>
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<tr>
<td>Office - Open</td>
<td>1.1</td>
<td>1.11</td>
<td>1%</td>
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<tr>
<td>Office - Enclosed</td>
<td>1.1</td>
<td>0.98</td>
<td>-11%</td>
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<tr>
<td>Sales Area</td>
<td>1.7</td>
<td>1.68</td>
<td>-1%</td>
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<tr>
<td>Stairway</td>
<td>0.6</td>
<td>0.69</td>
<td>15%</td>
</tr>
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</table>
Chapter 9: Lighting
Revised Mandatory Requirements

• 9.4.1.4

Daylighting Controls Required If
• Side-lighting >250 sq ft and/or
• Top-lighting >900 sq ft
Chapter 9: Lighting
Mandatory Requirement Changes

- 9.1.2 Alterations require automatic shutoff for interior and exterior lights if more than 10% are included in the project. (formerly 50%)

- 9.4.1.2 Space Control - space enclosed by ceiling height partitions shall have at least one control device with at least one control step in addition to on/off and an occupant sensor/timer
The Next Version of LEED is Here!

What’s New?
LEED v4 Development Process

Planning the next version of LEED

• Began in March 2010
• Six rounds of public comments
  - 22,000 comments received
• 100+ LEED v4 Beta projects helped fine-tune:
  - Rating System
    • More User-friendly
  - Documentation Requirements
  - Reference Guide
Key Dates Moving Forward

LEED v4 Introduction
• GreenBuild 2013 – November 15, 2013

LEED v2009 Project Registration Sunset
• June 1, 2015

Application for Certification Sunset
• LEED NC v2.2: June 27, 2015
• LEED NC v2009: June 1, 2021
Key Dates Moving Forward

Updated v4 Credential Exams
• Q2 or Q3 2014
Foundations of LEED v4

Builds on the Success of LEED v2009

• Many LEED v2009 concepts have become mainstream

During 2011:

• 220,000,000 SF certified Gold
• 149,000,000 SF certified Silver
Foundations of LEED v4

Focus of LEED v2009: “Do Less Bad”
Foundations of LEED v4

Focus of LEED v4:

“Do More Good”

LEED v4 raises the bar and strives for zero to positive environmental impact
A Long Road Ahead…

[Diagram showing a timeline with different building code certifications from Certified to Platinum, indicating a transition from traditional to green building practices over time.]
Energy Codes and LEED Requirements

Visual from USGBC
Introduction to LEEDv4 Webinar Series
LEED v4 System Goals

- Reduce contribution to **global climate change**
- Enhance individual **human health**
- Protect and restore **water resources**
- Protect and enhance **biodiversity and ecosystem services**
- Promote **sustainable and regenerative** material cycles
- Build a **green economy**
- Enhance **community quality of life**
Biggest Point Value = Best Outcome

Visual from USGBC
Introduction to LEEDv4
Webinar Series
What hasn’t changed

1. 100 point based system
2. Regional Priority credits
3. Pilot credits
4. LEED AP credential
What’s changed?

- Added new credit category
- Addresses 21 market sectors
- Includes international in requirements
- Focused on performance
Data Centers

- high energy use
- massive cooling power
- few occupants
- water use
Warehouses & Distribution Centers

transportation energy

interior spaces
Multifamily Midrise

- Major indoor air quality & human health
- Combustion safety
- Radon
- Mechanical exhaust
Hospitality

- Guest rooms
- Occupancy type
- Large water-consuming appliances
Units in LEED v4

SI: International System of Units

IP: Imperial System
INTEGRATIVE PROCESS

noun.

1. an iterative, collaborative approach that involves a project’s stakeholders in the process from visioning through completion of construction and throughout building operation.
The Benefits

- Hear from all voices
- Map the process with milestones
- Add value in process
- Benefit all phases with life cycle approach
- Use resources efficiently (energy/water)
- Achieve higher value building
- Reduce costs
- Reduce change orders
Integrative Process - IP

Healthcare Prerequisite: Integrative Project Planning and Design

• Use integrative, cross-discipline design and decision making beginning in Programming and Pre-Design to:
  - Develop Owners Program Requirements (OPR)
  - Establish Certification Level and target credits to pursue
  - Assign responsible party to each prerequisite and credit

• Minimum 4 hour design charrette
Integrative Process - IP

Credit 1: Integrative Process

• 1-5 points in Hospitality and Healthcare, 1 point all others

• Requires integrative assessment of energy and water use reduction strategies before completion of Schematic Design
Credit 1: Integrative Process

• Create a “Simple Box” energy model and use it to explore energy load reduction by assessing alternative design solutions in at least 2 of the following areas:
  - Site conditions
  - Massing and orientation
  - Basic envelope attributes
  - Lighting levels
  - Thermal comfort
  - Plug and Process loads
  - Programmatic and operational parameters
Integrative Process - IP

Credit 1: Integrative Process

• Develop a preliminary water budget analysis that addresses:
  - Indoor water demand
  - Outdoor water demand
  - Process water demand
  - Water supply sources

• Document how process informed design decisions in the Owners Program Requirements (OPR) and the Basis Of Design (BOD)
Location & Transportation
Location & Transportation Credits

LTc1 LEED for Neighborhood Development Location

- **New Credit:** 8 to 16 points
- But, precludes achieving any other LT credits!
- Locating a project within the boundary of a LEED ND Certified location earns points
  - 8 points for a “certified” location
  - 10 points for a “gold” certified location
  - 12 points for a “silver” certified location
  - 16 points for a “platinum certified location
Location & Transportation Credits

LTc2 Sensitive Land Protection
  • **Renamed** – previously “Site Selection”

LTc3 High Priority Site
  • Incorporates elements from previous “Brownfield Remediation”

LTc4 Surrounding Density and Diverse Uses
  • **Renamed** – previously “Development Density and Community Connectivity”
Location & Transportation Credits

LTc5 Access to Quality Transportation

- **Renamed** – previously “Alternative Transportation – Public Transportation Access”
- Looks at surrounding density (2-3 points) and diversity of uses (1-2 points)
  - Radius for density reduced to ¼ mile
  - Distance for diverse uses reduced to ¼ mile walking distance
Location & Transportation Credits

LTc6 Bicycle Facilities

- **Renamed** – previously “Alternative Transportation – Bicycle Storage and Changing Rooms”
- To earn credit, project must be located on a bicycle-accessible site or on a bicycle network.
  - Demarcated bike lanes
  - Bike trails
  - Streets with max 25 mph
Location & Transportation Credits

LTc7 Reduced Parking Footprint
• **Renamed** – previously “Alternative Transportation – Parking Capacity”

LTc8 Green Vehicles
• **Renamed** – previously “Alternative Transportation – Low-Emitting and Fuel-Efficient Vehicles”
  - Requires 5% of all parking reserved for green vehicles
  - Additional 2% must have refueling stations
  - Warehouse and Distribution Centers – anti-idling measures.
Sustainable Sites
Sustainable Sites Prerequisite

SSp1 Construction Activity Pollution Prevention Prerequisite

• Updated the standard, EPA Construction General Permit from 2003 to 2010.
Sustainable Sites Credits

SSc1 Site Assessment

• **New Credit**: 1 point
• Site Assessment to include:
  - Topography
  - Hydrology
  - Climate
  - Vegetation
  - Soils
  - Human use
  - Human health effects
Sustainable Sites Credits

SSc2 Site Development – Protect or Restore Habitat

• Replaced setback requirements with preservation standards

• Added an option for financial support ($0.40 per SF of site) of off-site preservation (land trust/conservation organization within 100 miles of site).
Sustainable Sites Credits

SSc3 Open Space

• **Renamed** – previously “Site Development – Maximize Open Space”

• Added qualification that open space must be of beneficial use to the occupants or the community.
Sustainable Sites Credits

SSc4 Rainwater Management

• **Combined** – previously “Stormwater Design – Quality Control” and “Stormwater Design – Quantity Control”.

• Redirected emphasis: “Stormwater” = bad or problematic; “Rainwater” = good or beneficial
Sustainable Sites Credits

SSc4 Rainwater Management

• Terminology/Jargon:
  - “GI” (Green Infrastructure): Soil and vegetation-based approach to wet-weather management that mimics natural hydrology
  - “LID” (Low Impact Development): Approach that emphasizes engineered on-site natural features to protect water quality by replicating natural land cover hydrology (rain gardens, vegetated swales and buffers, permeable pavements, rainwater harvesting, soil amendments, etc.)
Sustainable Sites Credits

SSc5 Heat Island Reduction

- **Combined** – previously “Heat Island Effect – Nonroof” and “Heat Island Effect – Roof”
- Increased initial Roof Solar Reflectance Index (SRI) requirements and takes into account the 3-year aged SRI values.
- Changed Paving materials criteria to Solar Reflectance (SR)
- Tree canopy shade area now based on 10 years of growth (previously 5-years)
Sustainable Sites Credits

SSc6 Light Pollution Reduction

• Removed interior lighting requirements to Energy and Atmosphere Category
• Added Lighting Zone 0 where protection of dark environment is critical.
• Terminology/Jargon:
  - BUG Rating System: Added Option to use “BUG” rating system for determining compliance – much easier to use – supersedes previous “cutoff” ratings - other option is calculations. BUG rating classifies luminaires in terms of backlight (B), uplight (U) and glare (G), Standard: IES TM-15-11, Addendum A.
Water Efficiency
Water Efficiency Prerequisite

WEp1 Outdoor Water Use Reduction

- **New Prerequisite**
- Requires reduction in landscape water use by 30% using EPA WaterSense Water Budget Tool – or – no irrigation.
WEp2 Indoor Water Use Reduction

- Prerequisite All Categories

Cooling Tower and Evaporative Condenser
Makeup Water Meter and Conductivity Controller

Duration based savings for auto control faucets is now removed
WEp3 Building Level Water Metering

- Prerequisite All Categories
- Commit to reporting water usage data to USGBC for 5 years or until building ownership changes
Water Efficiency Credits

WEc1 Outdoor Water Use Reduction

- **Renamed** – previously “Water Efficient Landscaping”
- Requires reduction in landscape water use by not less than 50% using EPA WaterSense Water Budget Tool – or – no irrigation.
## WEc2 Indoor Water Use Reduction

- 1-7 Points Schools, Retail, Healthcare
- 1-6 Points All Other Categories

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<th>Water Savings Percentage</th>
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**Schools, Retail, Hospitality, Healthcare**
1-2 additional points for meeting minimum requirements for commercial laundry facilities, kitchens, labs, or district steam
WEc3 Cooling Tower Water Use

- **New Credit:** 1-2 points

- Perform chemical analysis of make-up water for concentration of:
  - Ca (as CaCO$_3$)
  - Total Alkalinity
  - SiO$_2$
  - Cl
  - Conductivity

- Minimize water use by maximizing number of cooling tower cycles possible before concentrations of contaminants exceed acceptable levels
WEc4 Water Metering

• 1 Point All Categories
• Install a Water Meter in Two or More of the Following

- Healthcare Facilities Must Meter Five Additional Sources

- Irrigation
- Indoor Plumbing Fixtures

- Hot Water Heaters, Boilers, and Instantaneous Water Heaters
- Reclaimed Water
Energy & Atmosphere
Energy & Atmosphere Prerequisite

EAp1 Fundamental Commissioning and Verification

- **Renamed** – previously “Fundamental Commissioning of Building Energy Systems”
- Must engage CxA before completion of the Design Development phase.
- Elements of envelope commissioning (BECx) are now incorporated into the OPR and BOD.
- Design Review is required.
EAp2 Minimum Energy Performance

**Minimum Energy Performance**

- NC
- Reno
- C&S
- Data Center (NEW)

**Savings**

- 2009 (90.1-2007)
- V4 (90.1-2010)

**Data Center Energy Savings**

- 95%
- 5%
- 3%
- 2%

- Energy Usage
- Power and Cooling Infrastructure Savings
- All Other Infrastructure Savings
EAp3 Building Level Energy Metering

- Prerequisite All Categories
- Monthly utility consumption must be shared with USGBC for a minimum of 5 years or until building ownership changes

![Electricity Meter](image1)

Electricity

![Natural Gas Meter](image2)

Natural Gas

![District CHW Meter](image3)

District CHW

![District Steam Meter](image4)

District Steam
Energy & Atmosphere Credits

EAc1 Enhanced Commissioning

• Option 1 – Path 1: 3 points - Enhanced Commissioning (Cx) – as before.
• Option 1 – Path 2: 4 points – Enhanced (Cx) and Monitoring-Based Commissioning (MBCx):
  - Combines permanent energy monitoring systems, real-time energy analysis and ongoing commissioning.
  - Update systems manual to reflect modifications and new settings that result from monitoring data.
• Option 2: 2 points – Building Envelope Commissioning (BECx):
    • Air infiltration
    • Water infiltration
    • Exhaust reentrainment
    • Thermal performance
    • Building envelope pressure
    • Building envelope air leakage
    • Daylighting glare control
EAc2 Optimize Energy Performance

- 1-20 Points Healthcare
- 1-16 Points Schools
- 1-18 Points All Others

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**LEED 2009 – BD&C**

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**Case Study Building – 22%**

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**LEED v4 – BD&C**

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**Case Study Building – 7%**
LEED 2009

ASHRAE 90.1-2007
G3.1.2.5 Ventilation. Minimum outdoor air ventilation rates shall be the same for the proposed and baseline building designs

LEED v4

ASHRAE 90.1-2010
G3.1.2.6 Minimum ventilation system outdoor intake flow shall be the same for the proposed and baseline building designs

Exception C. If the minimum outdoor air intake flow in the proposed design is provided in excess of the amount required by the rating authority or building official then the baseline building design shall be modeled to reflect the greater of that required by the rating authority or building official and will be less than the proposed design.
- 1-20 Points Healthcare
- 1-16 Points Schools
- 1-18 Points All Others

### LEED 2009 – BD&C

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With Matching Ventilation Rates

- Case Study Building – 22%
- Case Study Building – 7%
EAc3 Advanced Energy Metering

- 1 Point All Categories
- Any individual energy end uses that represent greater than 10% of the total annual consumption.

- Receptacle Equipment ✓
- Interior Lighting ✓
- Space heating
- Space cooling ✓
- Fans ✓
- Pumps
- Heat Rejection
- Exterior lighting
- Service water heating

✓ Meters Required on Case Study Building
EAc4 Demand Response

- 1-2 Points All Categories
Manual

1. DR Event notice sent via text email or phone call
2. Decision to participate is made by a person
3. DR measures are initiated by people on-site and limited to manually adjustable components such as light switches, thermostats, etc.

Semi-Automated

1. DR Event notice sent via text email or phone call
2. Decision to participate is made by a person
3. Pre-programmed DR measures are initiated by a person at a workstation

Fully-Automated

1. DR Event notice sent over the Internet or private network
2. Pre-programmed DR measures are initiated automatically
3. In some cases, meter feedback is provided
EAc5 Renewable Energy Production

- **Renamed** – previously “On-Site Renewable Energy”

- Allows solar gardens and community renewable energy systems if:
  - Project owns the system -or- has minimum 10 year lease.
  - System is located with the same utility service area as the Project

- Significant change to points achieved
  - v2009 (NC & Schools): 1 point for 1% renewable, plus 1 additional point for each 2% step up to 7 points for 13% renewable.
  - v4 (All, except Core and Shell): 1 point for 1%, 2 points for 5% and maximum 3 points for 10%.
EAc7 Green Power and Carbon Offsets

- **Renamed** – previously “Green Power”
- Now based on total building energy usage associated with Scope 1 and Scope 2 greenhouse gas emissions:
  - Scope 1 = greenhouse gases emitted directly (on-site generator, etc).
  - Scope 2 = greenhouse gases emitted elsewhere by the utility and the related transmission and distribution losses.
  - Includes electricity + nonelectrical energy use (high-temp water, chilled water or steam from a utility provider).
- Required contract extended from 2 years to 5 years and must be from a source that came online after January 1, 2005.
- Points thresholds changed
  - v2009: 2 points for 35% offset
  - v4: 1 point for 50% offset, 2 points for 100%
Materials & Resources

Most controversial
- Will require market change (product transparency)

Most heavily revised category
- Shift to rewarding multiple sustainable attributes with “reuse” receiving the highest points.
Materials & Resources Prerequisites

MRp1 Storage and Collection of Recyclables

• Existing Prerequisite
• Added requirement for dedicated storage of at least 2 of the following:
  - Batteries
  - Mercury-containing lamps
  - Other electronic waste
MRp2 Construction and Demolition Waste Management Planning

- New Prerequisite
- Requires developing waste diversion goals for the Project for at least 5 materials – structural and non-structural
- Requires detailed reporting of waste diversion activities – waste sorting, recycling and diversion rate (total waste diverted/total waste produced by project) x 100
Materials & Resources Credits

MRc1 Building Life Cycle Impact Reduction

• Combination of “Building Reuse-Maintain Existing Walls, Floors, and Roof” and “Building Reuse-Maintain Interior Nonstructural Elements”: 2 - 5 points (CS 2 - 6 points)

• Option 1: Historic building reuse: 5 points (CS 6 points)

• Option 2: Renovation of abandoned or blighted building: 5 points (CS 6 points)

• Option 3: Building and material reuse: 2-4 points (CS 2 – 5 points)
Option 4: “Cradle-to-Grave” Whole Building Life Cycle Assessment (LCA): 3 points

- New construction Projects conduct a life-cycle assessment of the structure and enclosure that demonstrates a minimum 10% reduction (compared with a “baseline” building, in at least 3 of the following impact categories, one of which must be global warming potential:
  - Global warming potential
  - Depletion of the stratospheric ozone layer
  - Acidification of land and water sources
  - Eutrophication (overabundance of nutrients nitrogen and/or phosphates in water)
  - Formation of tropospheric ozone (photochemical reactions – smog)
  - Depletion of nonrenewable energy resources
- No impact category assessed may increase by more than 5%
- Assessment must be at least 60 years to account for maintenance and replacement.
- Similar to energy modeling except with materials.
- Software
  - ATHENA® Impact Estimator V4.2 (can import bill of materials from CAD system)
  - EPAs Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) V2.1 or newer
MRc2 Building Product Disclosure and Optimization – Environmental Product Declarations

• New Credit: 1 – 2 points

• Option 1: Environmental Product Declaration (EPD): 1 point

• Use 20 different permanently installed products sourced from at least 5 different manufacturers that meet the disclosure requirements

  - An EPD is a standardized way of communicating the environmental impacts such as global warming potential and energy resource depletion associated with a product or systems raw material extraction, energy use, chemical makeup, waste generation and emissions to air, soil and water. It is based on a Product Life-Cycle Assessment with same impact categories as the Whole Building LCA.
- All EPDs must be consistent with ISO standards that address how to set up and perform LCA, how LCA feeds into an EPD and the level of detail and content included in an EPD.

- Product Category Rule (PCR) defines how to standardize the information for a specific product type. PCRs are developed by program operators (i.e. standards organizations, industry associations or private/government organizations).

- Process - requires a significant market response:
  - Manufacturer searches for existing PCR for its product category. If it does not exist, manufacturer will work with a program operator to create the PCR (convene group of experts, issue proposal, issue draft, open consultation, panel review, approval and publication of the PCR)
  - Manufacturer conducts Life-Cycle Assessment (see previous impact categories)
• Manufacturer creates the EPD and initiates 3\textsuperscript{rd} party verification that ISO procedures were used and that the EPD meets the requirements of the PCR.

• Manufacturer registers the EPD with the Program Operator (UL Environmental, ICC-ES, ASTM, NSF, etc.)

• **Option 2: Multi-Attribute Optimization: 1 point**
  
  - Use products that constitute 50\% (by cost) of the total value of permanently installed products in the Project that are 3\textsuperscript{rd} party certified to demonstrate a reduction below the industry average in at least 3 of the LCA impact categories.

  - Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200\% of their cost.
MRc3 Building Product Disclosure and Optimization – Sourcing of Raw Materials

• New Credit: 1 – 2 points

• Option 1: Raw Material Source and Extraction Reporting: 1 point
  - Use at least 20 different in-place products from at least 5 manufacturers that have publicly released a report which includes environmental impacts of extraction operations and activities associated with the manufacturers’ product and the products supply chain.
  - Products with self-declared reports = ½ product for credit purposes.
  - Products with a 3rd party verified Corporate Sustainability Report (CRS) = 1 product for credit purposes.
• Option 2: Leadership Extraction Practices: 1 point

- Use products that meet at least 1 of the following for at least 25% (by cost) of the total value of permanently installed building products in the project:
  - Extended Producer Responsibility (collection and recycling after use).
  - Bio-based materials: Must be Sustainable Agriculture Standard compliant
  - Wood Products: Must be FSC certified.
  - Materials Reuse: Salvage, refurbished or reused.
  - Recycled Content: Postconsumer recycled content plus ½ the preconsumer recycled content based on cost.

- Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their cost.
MRc4 Building Product Disclosure and Optimization – Material Ingredients

- New Credit: 1 – 2 points

- Option 1: Material Ingredient Reporting: 1 point
  - Use at least 20 different in-place products from at least 5 manufacturers that use any of the following programs to demonstrate chemical inventory of the product to at least 0.1%:
    - Manufacturer’s published inventory of all ingredients by name and Chemical Abstract Service Registration Number (CASRN)
    - Health Product Declaration (HPD)
    - Cradle-to-Cradle: certified v2 basic or v3 bronze.
    - Other USGBC approved program
• Option 2: Material Ingredient Optimization: 1 point
  - Use products the document optimization for at least 25% (by cost) of the total value of permanently installed products in the project
  • Materials are valued at 100% of cost or 150% of cost depending on their compliance levels with GreenScreen v1.2 benchmark, Cradle-to-Cradle certification level, International Alternative Compliance Path (REACH Optimization) or other USGBC approved program.
  • Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their cost.
• Option 3: Product Manufacturer Supply Chain Optimization: 1 point
  - Use products for at least 25% (by cost) of the total value of permanently installed products in the project that are sourced from manufacturers with 3rd party certified supply chain with verified robust safety, health, environmental hazard and risk programs.
  - Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their cost.
MRc5 Construction and Demolition Waste Management

- Revised Credit: 1-2 points
- Option 1: Diversion 1-2 points
  - Path 1: Divert 50% and 3 Material Streams: 1 point
  - Path 2: Divert 75% and 4 Material Streams: 2 points
- Option 2: Reduction of Total Waste Material: 2 points.
  - Generate a maximum of 2.5 pounds of construction waste per SF of the building’s floor area
Indoor Environmental Quality
Indoor Environmental Quality Prerequisites

EQp1 Minimum Indoor Air Quality Performance

- Prerequisite All Categories

Outside Air Monitoring installed with accuracy of +/- 10%
EQp2 Environmental Tobacco Smoke (ETS) Control

• Prerequisite
• Designated smoking rooms are no longer permitted (except residential)
• No-smoking policy expanded to include outdoor areas used for business that are within 25 feet of building openings.
• Signs must be within 10’ of entrances.
• Additional leakage testing standards – other than blower door testing.
Indoor Environmental Quality Credits

EQc1 Enhanced Indoor Air Quality Strategies

- 1-2 Points All Categories
- No changes for BD&C
- 1 additional point from any 1 of the following for mechanically ventilated areas:
  - Exterior contamination prevention (CFD modeling, etc.)
  - CO2 Controls or Additional source control and monitoring

30% Increase in Ventilation
EQc2 Low-Emitting Materials

- Consolidation of previous Low-Emitting Materials credits into one credit: 1 – 3 points
- Based on VOC emissions rather than VOC content
- Systems approach to emissions within space
- Emissions from furniture, ceiling and insulation are now required to be considered.

- Option 1 – Product Category Calculations
  - Simpler but less flexible
  - Points scaled to the number of the following categories that achieve compliance:
    - Interior paints and coatings
    - Interior adhesives and sealants
    - Flooring
    - Composite wood
    - Ceilings, walls, thermal and acoustic insulation
    - Furniture
    - Exterior applied products (schools and healthcare only)
• Option 2 – Budget Calculation Method
  - Categorize building interior products into 6 assemblies.
  - Partial credit if at least 50% of assembly is compliant. Partial credits can be combined. May lead to higher points than Option 1
  - Points scaled to match increasing percentage of total compliance.
EQc4 Indoor Air Quality Assessment

• 1-2 Points All Categories
EQc6 Interior Lighting

• New Credit

• Option 1: Lighting Control: 1 point
  - 90% of individual occupant spaces must achieve 3 levels of lighting control On / Off / Midlevel (30% to 70% of maximum illumination level)

• Option 2: Lighting Quality: 1 point
  - Achieve at least 4 of the following:
    • Light fixture luminance less than 2,500 cd/m² between 45 and 90 degrees from nadir
    • Light sources with CRI of 80 or higher
    • 75% of total connected lighting load have a life of at least 24,000 hours.
    • Direct only overhead lighting for 25% or less of total connected load
• Meet or exceed average surface reflectance of 85% for ceilings, 60% for walls and 25% for floors.
• Furniture surface reflectance exceeds 45% for worksurfaces and 50% for movable partitions.
• 75% of occupied floor area ratio of wall surface illuminance to average work plan illuminance does not exceed 1:10.
• 75% of occupied floor area ratio of ceiling surface illuminance to average work plan illuminance does not exceed 1:10.
EQc7 Daylight

- **Renamed** – previously “Daylight and Views - Daylight”: 1-2 points (previously 1 point)
- Prescriptive option deleted (calculation visible light transmittance x window-to-floor area ratio)
- Option 1: Simulation: Spatial Daylight Autonomy (SDA) and Annual Sunlight Exposure (ASE)
  - 2 points for 55% of space SDA compliant and less than 10% ASE; 3 points for 75% of space SDA compliant and less than 10% ASE
    - Computer modeling and simulations based on IES Lighting Measurements (LM) 83-12 methodology
    - Must include local climate weather files (typical meteorological year)
• Option 2: Simulation: Illuminance Calculations
  • 1 point if 75% of floor area is 300 – 3,000 lux
  • 2 points if 90% of floor area is 300 -3,000 lux
    - Calculated at 9AM and 3PM on equinox
    - Must include local climate weather files (typical meteorological year)

• Option 3: Measurement
  • 1 point if 75% of floor area is 300 – 3,000 lux
  • 2 points if 90% of floor area is 300 - 3,000 lux
    - Measurements at two points during a year
EQc8 Quality Views

- **Renamed** – previously “Daylight and Views - Views”: 1 point

- Exemplary performance requirements from LEED v2009 are now the basis for the credit requirements

- Direct line of sight to outdoors from 75% of all regularly occupied floor area
  - Not obstructed by frits, fibers, patterned glazing or tints that distort color balance.

- Plus, 75% of all regularly occupied floor area must have at least two of the following:
  - Multiple lines of sight in different directions at least 90° apart
  - Views that include at least 2 of
    - Flora, fauna or sky
    - Movement
    - Objects at least 25 feet away
- Unobstructed views located within 3 times the head height of the vision glazing
- View with a view factor of 3 or greater (in a scale of 1 – 5) as defined in “Windows and Offices; A Study of Office Worker Performance and the Indoor Environment” (uses unobstructed view within a range of viewing angles with greater viewing angle equaling a higher view factor)
EQc9 Acoustic Performance

- New Credit for all except Schools and Healthcare: 1 point
- Response to a survey by Center for the Built Environment (CBE) of 34,000 building occupants that showed that LEED buildings outperformed standard design in all areas of indoor environmental quality except acoustics.
- HVAC background noise must be below limit established by ASHRAE Handbook or AHRI Standard
- Establishes minimum STC ratings based on adjacent space types.
- Establishes maximum reverberation times based on space type and use.
• Conference rooms and auditoriums seating more than 50 persons must be evaluated to determine if sound reinforcement and AV playback systems are needed.
  - If needed must meet speech intelligibility, minimum sound level and sound-level coverage requirements
• If masking systems are used levels must not exceed 48 dBA and must be uniform and effectively mask speech spectra
Conclusion:

The Future Is Now...
Questions?
Contact Information

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Sample Environmental Product Declaration (EPD)

Environmental Product Declaration

Cashmere®

Certainteed
Cashmere and Fine Fissured High NRC Mineral Fiber Ceiling Panels

Two families of ceiling products with a range of aesthetic, acoustical, and other performance properties to meet your needs in education, office, and healthcare buildings.

Environmental Product Declaration

Certainteed
Cashmere and Fine Fissured High NRC Mineral Fiber Ceiling Panels

UL Environment CERTIFIED

This declaration is an environmental product declaration in accordance with ISO 14025 that describes the environmental characteristics of the aforementioned product. It promotes the development of sustainable products. This is a certified declaration and all relevant environmental information is disclosed.

<table>
<thead>
<tr>
<th>PROGRAM OPERATOR</th>
<th>CertainTeed Ceilings</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION HOLDER</td>
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<tr>
<td>DECLARATION NUMBER</td>
<td>12CA18904-1021</td>
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<tr>
<td>DECLARED PRODUCT</td>
<td>Cashmere and Fine Fissured High NRC Mineral Fiber Ceiling Panels</td>
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<tr>
<td>REFERENCE PCR</td>
<td>Institut für Bauwirtschaft e.V.</td>
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<tr>
<td>DATE OF ISSUE</td>
<td>12CA18904-1021</td>
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<td>CONTENTS OF THE DECLARATION</td>
<td>Product definition and information about building physics</td>
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<td>Information about basic material and the material's origin</td>
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<td>Description of the product's manufacture</td>
</tr>
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<td></td>
<td>Indication of product processing</td>
</tr>
<tr>
<td></td>
<td>Information about the in-use conditions</td>
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<tr>
<td></td>
<td>Life cycle assessment results</td>
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<td>Testing results and verifications</td>
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</table>

The EPD was used for the product:

Certainteed Innovations and CertainTeed e.V.
Rheinufer 108
D-53119 Köln
Germany
Tel: +49 2223 39618-0
Fax: +49 2223 39618-1
Email: info@bau-uniswerk.com

This declaration was independently verified by Underwriters Laboratories in accordance with ISO 14025

Internal

External

Loretta Tam, Declaration Verifier

Eva Schrimm, LCA Verifier
Sample Environmental Product Declaration (EPD)

**Product Classification**

**Product Description**

The Cashmere and Fine Fissured High NRC product families are made up of ceiling panels which are produced in L’Anse, Michigan using mineral fibers with pre-consumer and post-consumer recycled content. These product families have a standard core panel with a variety of coating and finishing options. This Environmental Product Declaration (EPD) examines the Cashmere (34" thickness) product. There are multiple coating options for the mineral fiber ceiling panels. The coatings with the maximum environmental impacts were used on the model of each ceiling panel to demonstrate the worst case scenario for the coatings. The coatings modeled include base, prime and finish coatings.

**Product Styles**

![Image of ceiling panel](image)

**Figure 1: Example Ceiling Panel Application**

Cashmere, Cashmere Customline, Cashmere High NRC, Cashmere Style Edge, and Fine Fissured High NRC

The Cashmere, Fine Fissured and High NRC products contain a minimum of 67% recycled content (62% Pre-Consumer, 6% Post-Consumer). The products are manufactured in L’Anse, Michigan manufacturing facilities that use a model of industrial ecology and product stewardship. L’Anse receives renewable electricity from the nearby Warden Electric Biomass power plant, which generates its electricity from waste wood. Excess steam from that same plant is also channeled to the ceiling manufacturing facility, reducing its overall natural gas use. The result is a manufacturing facility that obtains a large portion of its energy from renewable sources and generates almost zero waste. This EPD is focused on this process and the product.

**Application**

Unilateral installation of suspended ceilings in commercial buildings.

**Codes of Practice**

- ASTM E1264- Classification For Acoustic Ceilings
- ASTM E84- Surface Burning Characteristics: Pursuant to test certificate
- ASTM C440 and EN ISO 11654- sound absorption coefficient data of product and surface
- ASTM E1414 and ISO 140-3- sound insulation: product and system related data of sound insulation
- ASTM C518-10- Thermal conductivity: [R²-F h/ft²]

**Quality Assurance**

- ISO 9001 Quality Management System
- GreenCircle Certified (http://www.greencirclecertified.com)
- Certificate of Compliance for VOC Emissions: Berkeley Analytical

**Delivery Condition**

Relative shipping distances for the base raw materials are shown below in Table 3. Final product is typically sold within the continental United States and transported by truck.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mineral Fiber Ceiling Panel</th>
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<tbody>
<tr>
<td><strong>Type of Manufacture</strong></td>
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<tr>
<td><strong>Product Specifications</strong></td>
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<tr>
<td><strong>Core Type</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Base Material Composition</strong></td>
<td></td>
</tr>
<tr>
<td>Mineral Wool</td>
<td>&lt; 60%</td>
</tr>
<tr>
<td>Fiber</td>
<td>&lt; 45%</td>
</tr>
<tr>
<td>Newspaper</td>
<td>&lt; 10%</td>
</tr>
<tr>
<td>Starch</td>
<td>&lt; 20%</td>
</tr>
<tr>
<td>Back Coating</td>
<td>varies</td>
</tr>
<tr>
<td>Auxiliary Substrates - Coatings and Finishes</td>
<td></td>
</tr>
<tr>
<td>Prime Coating</td>
<td>varies</td>
</tr>
<tr>
<td>Finish Coating</td>
<td>varies</td>
</tr>
</tbody>
</table>
Sample Environmental Product Declaration (EPD)

Environmental Product Declaration

Certainteed Ceilings
Cashmere and Fine Fissured High NRC Mineral Fiber Ceiling Panels

Technical Data

Fire
ASTM E265- Class A
ASTM E84: Flame spread of 25 of less, Smoke developed of 50 or less

Water Damage
This product is subject to water damage. No water or water vapor from sources including, but not limited to, condensation, leaking pipes and/ or ducts, or steam must come in contact with the ceiling panels.

Mechanical Damage
This product is intended for commercial applications. Use and Practice information can be found in "Acoustical Ceilings: Use and Practice" published by Ceilings & Interior Systems Construction Association (CISCA). The product should be installed according to CertainTeed Ceilings installation instructions.

Base Materials

Primary Products

Figure 2: Diagram of Cashmere Product Family Product Construction

Environmental Product Declaration

Certainteed Ceilings
Cashmere and Fine Fissured High NRC Mineral Fiber Ceiling Panels

According to ISO 14025

Material Definitions

- Prime and Finish Coatings—consists of Prime Coat and Finish Coating. Standard Afterspray; both products are applied to the surface of the panel.
- Mineral Fiber Core—consists of 6 raw materials including: Mineral Wool, Perlite, Newspaper, and Starch. A mixture of those raw materials with the same ratio called "Dry Broke" is recovered within the manufacturing process.

- Mineral Wool is a pre-consumer material produced from slag, a by-product of smelting iron ore. Slag is a secondary material that is produced without environmental burden. Raw materials in mineral wool include 10% rock, 12% coke, and 78% slag.
- Perlite is an abundant, naturally occurring mineral.
- Newspaper is a post-consumer raw material. Newspaper is a renewable resource, as it is plant-based.
- Starch is a rapidly renewable resource made from the corn refining process.

- Basic Coating—consists of Backside coating applied to the back of the product.
- Prime and Finish Coatings—consists of paints, primers, and dear coats. Paints and primers vary by product.

Table 2: Material Content of the Cashmere Product

<table>
<thead>
<tr>
<th>Layer</th>
<th>Composition</th>
<th>Recyclability</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Perlite, Mineral Resource, Non Renewable, Abundant</td>
<td>US</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Newspaper, Recycling Material, Abundant</td>
<td>US</td>
</tr>
<tr>
<td>Back Coating</td>
<td>Paints/Primer</td>
<td>Starch, Renewable Resource, Abundant</td>
<td>US</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Backside, Fossil Resource, Limited</td>
<td>US and Canada</td>
</tr>
</tbody>
</table>

Raw Material Extraction and Origin

Mineral Wool (pre-consumer)
Most mineral wool produced in the United States today is produced from slag, or a mixture of slag, and rock. Most of the slag used by the industry is generated by integrated iron and steel plants as a byproduct of pig iron production. Other sources of slag include the copper, lead, and phosphate industries. The slag in this analysis is assumed to come from iron production only. The mineral wool production process has 3 primary components—molten mineral generation in the cupola, fiber formation and collection, and final product formation. The mineral wool used in this product is sourced within the United States.
Sample Environmental Product Declaration (EPD)

**Environmental Product Declaration**

**Certainteed Ceilings**

**Cashmere and Fine Fletured High NRC Mineral Fiber Ceiling Panels**

According to ISO 14025

**Perlite**

A naturally occurring, abundant mineral that is mined and then expanded during the ceiling panel manufacturing process. The perlite used in this product is sourced within the United States.

**Newspaper (post-consumer)**

The recovered newspaper is collected, banded, and transported directly to the L’Airea manufacturing plant for use in the production of mineral fiber ceiling panels. The recovered newspaper is mixed with water on-site to create a wet pulp mixture. The newspaper used in this product is sourced within the United States.

**Starch**

A rapidly renewable agricultural product made from corn. The starch used in this product is sourced within the United States.

**Production Process**

![Diagram of L'Airea Facility Ceiling Panel Production Process](image1)

**Figure 3. Diagram of L'Airea Facility Ceiling Panel Production Process**

**Health, Safety, and Environmental Aspects during Production**

Certainteed has well-established Environmental, Health, and Safety (EHS) and product stewardship programs, which help to ensure proper evaluation and monitoring of chemicals that are chosen to manufacture products. These programs ensure that all environmental and OSHA requirements are met or exceeded to ensure the health and safety of all employees and contractors. In addition, this plant is zero discharge to Publicly Owned Treatment Works (POTW). The water system utilizes a settling pond on-site and discharges the remaining water to a spray field rather than a sewer system.

![Production Process Photos](image2)

**Figure 4. Example Production Process Photos**
Sample Environmental Product Declaration (EPD)

**Environmental Product Declaration**

CertainTeed
Cashmere and Fine Felted High NRC
Mineral Fiber Ceiling Panels

According to ISO 14025

**Installation of Ceiling Panels**

**Installation Recommendations**

The ceiling panels must be installed in accordance with all applicable CertainTeed installation guidelines applicable at the time of installation. Approved installation procedures described in the Ceiling Systems Handbook published by the ceilings & Interior Systems Construction Association must be followed.

Installation of CertainTeed products is accomplished by manual labor and typically does not require any coating or finishing. Cutting is accompanied by hand using hand held cutting tools. This EPD covers the ceiling panels only and does not include grid.

Fig. 5. Example Ceiling Panel Installation

**Health, Safety, and Environmental Aspects during Installation**

There are no apparent risks involved with the installation of ceiling panels since no coating or finishing is required. The installer should wear safety glasses while installing the panels to avoid debris from falling into eyes as well as approved gloves.

**Residual Material**

Waste is minimized by the modular aspect of the ceiling panels. This product was modeled as being disposed of in a landfill at the end of its life. However, CertainTeed Ceilings has developed a ceiling panel take back and recycling program which allows recovery of ceiling panels from construction sites. The ceiling panels are then used to manufacture new ceiling panels. As this program expands, it has the opportunity to significantly reduce environmental impacts associated with raw materials extraction and processing by offsetting virgin raw material demand.

**Packaging**

Ceiling panels are packaged using sleeves made from recycled cardboard and plastic shrink wrap. These packaging materials are recommended to be recycled if recycling infrastructure exists. The packaging was modeled and is included in the life cycle impacts of the EPD.

**Environmental Product Declaration**

CertainTeed
Cashmere and Fine Felted High NRC
Mineral Fiber Ceiling Panels

According to ISO 14025

**Use Stage**

**Use of the Ceiling Panel**

Coating and maintenance

Once installed, ceiling panels typically require no cleaning or maintenance. Maintenance personnel should wear white, clean cotton gloves when handling panels so oils and dirt from the hands do not transfer to panels.

Prevention of Structural Damage

To ensure longevity of the product, make sure panels are not exposed to high humidity or high temperatures. Criteria can be found in the CertainTeed Ceilings Warranty information for each specific product.

Please visit [www.certainteed.com/products/ceilings](http://www.certainteed.com/products/ceilings) for more information.

**Effects on the Environment and Health**

This ceiling panel is stationary during typical use and does not emit harmful emissions.

Broken or damaged panels should be picked up and placed in a container. Dust generated from making modifications of the panel should be cleaned by wet wiping or filtered vacuuming. Do not dry sweep or use compressed air to remove dust.

**Useful Life**

The product is warranted for a service life of 10-10 years of use (and up to 15 if used in conjunction with certainTeed Ceiling Grid System). However, the useful life of ceiling panels can be as long as the building’s useful life if properly installed and maintained. The useful life of these panels is considered to be 50 years.

**End-of-Life**

**Recycling or Revise**

The preferred method for the product to be recycled through the CertainTeed’s Ceiling Recycling Program. Information on this program can be found at the link below.

Please visit [www.certainteed.com/products/ceilings](http://www.certainteed.com/products/ceilings) for more information.
Sample Environmental Product Declaration (EPD)

Environmental Product Declaration

Certainteed
Cashmere and Fire Fissured High NRC
Mineral Fiber Ceiling Panels

Disposal
Recycling of the product through Certainteed’s Ceiling Recycling Program is strongly recommended, but disposal in municipal landfill or commercial incineration facilities is permissible and should be done in accordance with local, state, and federal regulations.

Life Cycle Assessment

Product System and Modeling of the Life Cycle

Functional Unit
One square foot (3/4" x 12" x 12") ceiling panel for use of 60 years. The use stage is considered for 60 years of service life, though based on typical operational data, this product does not require any inputs during the Use Phase. The reference flow is one square foot (3/4" x 12" x 12") of modular ceiling panel.

System Boundaries
The life cycle analysis for the production of ceiling panels comprises the life cycle phases from cradle to grave. It begins with the consideration of the ceiling panel production (extraction of raw materials and product manufacturing), Final Product Shipping, Installation and Use, and End-of-Life stages, as shown in Figure 6 below.

Assumptions
There are no specific assumptions to list.

Cutoff Criteria
Processes whose total contribution to the final result, with respect to their mass and in relation to all considered impact categories, is less than 1% can be neglected. The sum of the neglected processes may not exceed 9% by mass of the considered impact categories. For that a documented assumption is admissible.

For Hazardous Substances – as defined by the U.S. Occupational Health and Safety Act the following requirements apply:
- The Life Cycle Inventory (LCI) of hazardous substances will be included, if the inventory is available.
- If the LCI for a hazardous substance is not available, the substance will appear as an input in the LCI of the product. If its mass represents more than 0.1% of the product composition.
- If the LCI of a hazardous substance is approximated by modeling another substance, documentation will be provided.

This EPD is in compliance with the cutoff criteria. No processes were neglected or excluded. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

Transportation
Relative shipping distances for the base raw materials are shown below in Table 3. Final product is typically sold within the continental United States and transported by truck.

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>Distance (Mi)</th>
<th>Mode of Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral Wool</td>
<td>&lt; 150</td>
<td>Truck</td>
</tr>
<tr>
<td>Paper</td>
<td>~ 0,000</td>
<td>Train</td>
</tr>
<tr>
<td>Newspaper</td>
<td>&lt; 500</td>
<td>Truck</td>
</tr>
<tr>
<td>Branch</td>
<td>&lt; 1,000</td>
<td>Train</td>
</tr>
<tr>
<td>Coatings</td>
<td>&lt; 1,000</td>
<td>Truck</td>
</tr>
</tbody>
</table>

Period under Consideration
The data used refer to the production processes of the calendar year 2011. The quantities of raw materials, energies, auxiliary materials, and supplies used have been ascertained as average annual values. The LCA was created for the reference area “United States.”
Sample Environmental Product Declaration (EPD)

Background Data
For life cycle modeling the SimPro v7.2 Software System for Life Cycle Engineering, a recognized LCA modeling software program, was used. All background data sets relevant for production and disposal were taken from this software except for the mineral wool model. This model was created based on discussions and data provided by industry experts and AP-42 Compilation of Air Pollutant Emission Factors.

Data Quality
For the data used in this LCA, the data quality is considered to be “good to high.” The definition of this quality range stems from the following descriptions. The data and data sets cover all relevant process steps and technologies over the supply chain of the represented ceiling products. The LCIs are from the SimPro v7.2 database and whenever secondary data is used, they adopt critically reviewed data whenever possible for consistency, precision, and reproducibility to limit uncertainty. The data source is complete and representative of North America in terms of the geographic and technological coverage and is of a recent-vintage, i.e. less than ten years old.

Allocation
The LCI data was collected from the L'Anse, Michigan plant for the production year 2011. This plant produces 100% of CertainTeed mineral wool ceiling panels. The manufacturing process for all products made at this facility have similar energy, waste, and water input requirements. Allocation was done on a mass basis. This gate-to-gate flow data was combined with resource extraction, processing, transportation, installation, use, and disposal data to construct the cradle-to-grave LCI for CertainTeed mineral wool ceiling panels.

Notes on the Use Stage
The product is warranted for a service life of 1-10 years of use (and up to 15 if used in conjunction with CertainTeed Ceiling Grid System), however, ceiling panels can last the full life of a building. The ceiling panel is mainly used for acoustics and aesthetics throughout its useful life. No direct maintenance or cleaning is required during the panel useful life. The useful life of these panels is considered to be 60 years.

End of Life Scenario
The ceiling panel was modeled as being disposed of in a landfill. This includes an analysis of the benefits of the CertainTeed Ceilings Take Back Program.

Description of the Assessment Results and Analysis
Life Cycle Stages Assessed
1. Production
2. Final Product Shipping
3. Installation and Use Stage
4. End-of-Life

Primary Energy by Life Cycle Stage
Tables and Figures below are based on functional unit – Cashmere (6’x12’x1’).

| Table 4: Primary Energy by Life Cycle Stage of product End of Life |  |
|---|---|---|---|---|---|
| | Unit | Production | Final Product Shipping | Installation and Use | End of Life | Total Energy Use |
| Total | NJ | 11.4 | 0.3 | 0.6 | 0.1 | 12.9 |

| Table 5: Environmental Impact of Life Cycle Stages of Cashmere Ceiling Panel |  |
|---|---|---|---|---|---|
| | Type | Unit | Production | Final Product Shipping | Installation and Use | End of Life | Total |
| Coal | NJ | 4.5 | <0.1 | 0.2 | <0.1 | 5.1 |
| Natural Gas | NJ | 0.9 | <0.1 | 0.3 | <0.1 | 5.0 |
| Oil | NJ | 1.6 | 0.5 | 0.1 | 0.1 | 2.0 |
| Total | NJ | 9.7 | 0.5 | 0.5 | 0.1 | 11.1 |
Sample Environmental Product Declaration (EPD)

**Environmental Product Declaration**

Certainteed
Cashmere and Fine Fissured High NRC
Mineral Fiber Ceiling Panels

According to ISO 14025

---

**Primary Energy Use, Non-renewable**

- Coal: 18%
- Natural Gas: 27%
- Oil: 41%

Figure 1: Relative Non-renewable Primary Energy by Source

---

**Primary Energy Use, Renewable**

- Waste Stream: 58%
- Non-renewable: 42%

Figure 2: Relative Renewable Primary Energy by Source

---

**Water and Waste**

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>Production</th>
<th>Product Shipping</th>
<th>Installation and Use</th>
<th>End of Life</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>MU</td>
<td>0.9</td>
<td>0.0</td>
<td>&lt;0.1</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Waste Steam</td>
<td>MU</td>
<td>0.7</td>
<td>0.0</td>
<td>&lt;0.1</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>MU</td>
<td>1.6</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Table 1: Water and Waste from the Life Cycle Stage per Square Foot Produced

<table>
<thead>
<tr>
<th>Source</th>
<th>Production</th>
<th>Product Shipping</th>
<th>Installation and Use</th>
<th>End of Life</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Water Use</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Non-hazardous Waste</td>
<td>&lt;0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*No significant amount of additional waste types were generated during the life cycle of this product.*
Sample Environmental Product Declaration (EPD)

Environmental Product Declaration

Certainteed
Cashmere and Fine Fissured High NRC
Mineral Fiber Ceiling Panels

According to ISO 14025

Life Cycle Impact Assessment

<table>
<thead>
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<th>Impact Assessment Method: TRACI 4.0</th>
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</thead>
<tbody>
<tr>
<td>PCR Impact Category</td>
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<tr>
<td>Global warming</td>
</tr>
<tr>
<td>Acidification</td>
</tr>
<tr>
<td>Eutrophication</td>
</tr>
<tr>
<td>Ozone depletion</td>
</tr>
<tr>
<td>Ozone</td>
</tr>
</tbody>
</table>

Impact Assessment Method: CML 2 baselines 2000 V2.04

| PCR Impact Category | Impact | Units |
| Global warming (GWP100) | 0.76 | kg CO₂ eq |
| Acidification | 8.1E-03 | kg SO₂ eq |
| Eutrophication | 1.0E-07 | kg P₂O₅ eq |
| Ozone layer depletion (ODDP) | 9.4E-05 | kg CFC-11 eq |
| Photochemical oxidation | 3.5E-03 | kg CH₄ eq |

Figure 8: Relative Environmental Impact by Life Cycle Stage

Figure 11: Environmental Impact Reduction from 12% Addition of Post-Consumer Recycled Ceiling Panels (through full utilization of CertainTeed’s end-of-life recycling program)
Sample Environmental Product Declaration (EPD)

Environmental Product Declaration

Certainteed
Ceilings
Cashmere and Fine Fissured High NRC
Mineral Fiber Ceiling Panels

According to ISO 14025

Life Cycle Impact Reduction
Certainteed Ceilings strives to continually improve its operations in order to reduce environmental impacts. Since 2006, several efficiencies have been implemented which reduce energy consumption of the L.A. Area facility and therefore the entire life cycle assessment. Figure 2b below illustrates the impact reductions made in six impact categories.

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>2008 Data</th>
<th>2011 Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Energy</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Global Warming</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Ozone Depletion</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Acidification</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Smog</td>
<td>60%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Figure 2b: Reduction in environmental impacts from 2008 to 2011

Interpretation

Production Process Impacts
The majority of the environmental impacts occur during the extraction and processing of raw materials which is included in the Production stage. Mineral wool represents the highest percentage of impacts from raw materials. The use of renewable energy and waste steam reduces Global Warming Potential (Scopes 1 and 2 in the manufacturing process) by approximately 36 percent, which significantly reduces impacts of the manufacturing process compared to traditional manufacturing operations.

Installation Stage
Installation has minimal impacts due to the modular nature of ceiling panels and minimal energy requirements for installation. Transport energy from the distribution center to job site is included in this stage.

Use Stage
The assumption is that the ceiling panels require no cleaning or maintenance so use phase impacts are zero.

End-of-Life Impacts
End-of-life impacts are a result of landfill disposition. The end-of-life impacts can be significantly reduced by recycling the panels through Certainteed’s Take Back Program. An analysis of truck transportation for recycling compared to use of virgin materials indicates a reduced carbon footprint when the ceiling panels are shipped less than 1,000 miles to the processing facility when compared to the use of virgin raw materials.

Additional Information, Evidence, and Test Results

Biosustainability
Sisal wool fiber has been classified as “not classifiable as to its carcinogenicity to humans” (Group 3) by the International Agency for Research on Cancer (IARC). Primary routes of exposure are inhalation, eyes, and skin. Follow installation instruction and MSDS to reduce any effects.

VOC Emissions
This product meets the testing and product requirements of the California Department of Public Health CDPH/HEALDS/Standard Method Version 8.1, 2010 (Emissions Testing Method for CA Specification 01305). Independent test reports are available.

LCA Development
LCA was prepared by Sustainable Solutions Corporation of Royersford, Pennsylvania.
Sample Environmental Product Declaration (EPD)

References

PCR
Product Category Rules for Environmental Product Declarations – ceiling panels for suspended ceiling systems. Confirmed by IBU Advisory Board October, 2010

IBU 2006
Leitfaden Umwelt-Produktdklerationen (Ausgabe 20.01.2006) für die Formulierung der produktgruppen-spezifischen Anforderungen der Umwelt-Produktdklerationen (Typ III) für Bauprodukte, (Guideline for Setting Up the Product Category Requirements of AIB Declarations (Type III for Construction Products) Institut Bauw und Umwelt e.V. www.bau
umwelt.com

US LCI

Standards and Laws

ISO 14025: 2007-10, Environmental Labelling and Declarations - Type III – Environmental Declarations - Principles and Procedures (ISO 14025:2009); German and English version


ASTM E1264
Classification for Acoustic Ceiling Products

ASTM E119
Fire Test of Building Construction and Materials


ASTM C856
"Std Practice for Installation of Metal Ceiling Suspension Systems for Acoustic Panel and Lay-in Panels"

ASTM C423
Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ISO 11954

ASTM E1414
Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum


CA Specification 01350
# Sample Health Product Declaration (HPD)

## Name
- CertainTeed Ceilings Formula 8S

## Product ID
- Multiple IDs (see Description below)

## Classification
- HPD Version 1.0

## Manufacturer
- CertainTeed Ceilings Corp

## Contact Name
- Dennis Wilson

## Title
- Director, Product Stewardship & Sustainability

## Email
- dennis.wilson@saint-gobain.com

## Description
- HPD Covers the Following CertainTeed Ceilings Products: Cashmere, Cashmere Cashmere, Cashmere High-Blc, Cashmere Stucco Edge, Fine Fissured High-NRC, Gym

## HPD URL
- [HPD URL](#)

## HPD Declaration

### Summary
- The content of this product was assessed for health hazard warnings as required using the following method:
- Measured 100 ppm (ideal)
- Measured 1000 ppm
- Predicted by process chemistry
- All ingredients are not listed by name to protect intellectual property.

### Ingredients

<table>
<thead>
<tr>
<th>Ingredient Name</th>
<th>Number</th>
<th>% Weight</th>
<th>GSI</th>
<th>IRC</th>
<th>Hand Rating</th>
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</thead>
<tbody>
<tr>
<td>Mineral Wool</td>
<td>65827-1-3</td>
<td>94%-94%</td>
<td>U</td>
<td>N</td>
<td>Core</td>
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<tr>
<td>Starch</td>
<td>9005-849</td>
<td>9%-11%</td>
<td>U</td>
<td>N</td>
<td>None</td>
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<tr>
<td>None Found</td>
<td>No warning found on the HPD Priority lists</td>
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<tr>
<td>Expanded Starch</td>
<td>95133-76-3</td>
<td>5%-10%</td>
<td>U</td>
<td>PC</td>
<td>None</td>
</tr>
<tr>
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<td>No warning found on the HPD Priority lists</td>
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<tr>
<td>Clay</td>
<td>1323-58-7</td>
<td>2%-5%</td>
<td>U</td>
<td>N</td>
<td>Paint Additive</td>
</tr>
<tr>
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<tr>
<td>Cellulose Fibre</td>
<td>9004-016</td>
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<td>U</td>
<td>PC</td>
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<td>Calcium Carbonate</td>
<td>471-34-1</td>
<td>3%-6%</td>
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<td>N</td>
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<tr>
<td>PVC</td>
<td>14461-84-3</td>
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<td>BM</td>
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<tr>
<td>Titanium Dioxide</td>
<td>13483-67-7</td>
<td>5%-9%</td>
<td>BM</td>
<td>No</td>
<td>Paint Additive</td>
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<tr>
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<td>No warning found on the HPD Priority lists</td>
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<tr>
<td>Crystalline Silica</td>
<td>14808-66-7</td>
<td>&lt;0%</td>
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### Health Hazards

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<tr>
<th>Health Hazard</th>
<th>Development</th>
<th>Neurotoxicity</th>
<th>Land Toxicity</th>
<th>Reprotoxicity</th>
<th>Reproductive</th>
<th>Physical Hazard</th>
<th>Aquatic Toxicity</th>
<th>Marine Actor</th>
<th>Stoic Expiration</th>
<th>Dioxin Depletion</th>
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<tbody>
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</table>

### Material (g/l)
- N/A

### Regulatory (g/l)
- N/A

### Certification and Compliance
- [Certifications and Compliance](#)

### VOC Emissions
- [VOC Emissions](#)

### VOC Content
- [VOC Content](#)
Sample Health Product Declaration (HPD)

CERTIFICATIONS AND COMPLIANCE
Certifying Party = Self declaration. Manufacturer's self-declaration using results from an independent lab and declaration of conformance. Second Party: Verification by trade association or other interested party. Third Party: Verification by independent verifier (listed)

Applicable Boeing = Manufacturing sites to which testing applied.

<table>
<thead>
<tr>
<th>Type</th>
<th>Certifying Party</th>
<th>Issue Date</th>
<th>Expiry Date</th>
<th>Certificate URL</th>
<th>Certificate &amp; Compliance Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC Emissions (water products only)</td>
<td>Independent Lab / 13-Sep-2011</td>
<td>CertainTeed L'Anse, MI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOC Content (not content only)</td>
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<tr>
<td>Recycled Content</td>
<td>GreenCircle</td>
<td>4-Mar-2010</td>
<td>04-Mar-2014</td>
<td>CertainTeed L'Anse, MI</td>
<td>ISO14021 and FTC Green Guides</td>
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</table>

ACCESSORY MATERIALS
This section is for additional products required by warranty or recommended by the manufacturer for installation (such as adhesives, fasteners, or factory coating) or for maintenance, cleaning, or operations. Refer to Health Product Declarations, published separately, for a complete view of these products. Note: This declaration is not intended to address hazards of the installation process.

Required or recommended product: [URL for companion Health Product Declaration]

01 Aluminum Ceiling Tile Grid
Ceramic tiles are sealed inside of ceiling grid that is hung from an overhead structure.

02
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14
Sample Health Product Declaration (HPD)

NOTES

Additional detail on VOC and Recycled Content Certifications are available from CertaTeak.

### Agency List

<table>
<thead>
<tr>
<th>Agency/List Abbreviation</th>
<th>Full List Title</th>
<th>Hazard Issuing Agency</th>
<th>URL</th>
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</thead>
<tbody>
<tr>
<td>ASBEC</td>
<td>ABEC Exposure Codes - Asthmaogen List</td>
<td>Association of Occupational and Environmental Clinics</td>
<td><a href="https://www.asbec.org">link</a></td>
</tr>
<tr>
<td>CDS</td>
<td>Canadian Environmental Protection Act (CEPA) - Environmental Toxicity Database (ETDB)</td>
<td>Environment Canada</td>
<td><a href="https://www.ec.gc.ca">link</a></td>
</tr>
<tr>
<td>CDSS</td>
<td>Chemicals of Concern Action Plans</td>
<td>US Environmental Protection Agency</td>
<td><a href="https://www.epa.gov">link</a></td>
</tr>
<tr>
<td>EPA Priority Products</td>
<td>Priority Priority Products</td>
<td>US Environmental Protection Agency</td>
<td><a href="https://www.epa.gov">link</a></td>
</tr>
<tr>
<td>EPA-C</td>
<td>Integrated Risk Information System (IRIS)</td>
<td>US Environmental Protection Agency</td>
<td><a href="https://www.epa.gov">link</a></td>
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<tr>
<td>EPA-GW</td>
<td>Global Warming Potentials of Ozone Depleting Substances</td>
<td>US Environmental Protection Agency</td>
<td><a href="https://www.epa.gov">link</a></td>
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<tr>
<td>EPA-CHS</td>
<td>Chlorine Dependent Substances (CDSS) Class 1 &amp; Class 2</td>
<td>US Environmental Protection Agency</td>
<td><a href="https://www.epa.gov">link</a></td>
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<tr>
<td>EU CMR(2)</td>
<td>Regulation on the Classification, Labelling and Packaging of Substances and Mixtures (CLP) Annex 6 Table 3-1</td>
<td>European Commission</td>
<td><a href="https://ec.europa.eu">link</a></td>
</tr>
<tr>
<td>EU ED</td>
<td>EU Community Strategy for Endocrine Disruptors - Priority List</td>
<td>European Commission</td>
<td><a href="https://ec.europa.eu">link</a></td>
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<td>EU HRI</td>
<td>Regulation on the Classification, Labelling and Packaging of Substances and Mixtures (CLP) Annex 6 Table 3-1</td>
<td>European Commission</td>
<td><a href="https://ec.europa.eu">link</a></td>
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<td>EU PIH</td>
<td>European chemical Substances Information System (ECSIS) - PIH List</td>
<td>European Commission</td>
<td><a href="https://ec.europa.eu">link</a></td>
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<td>QEL Neuro</td>
<td>Developmental neurotoxicity of industrial chemicals, List of 201 Chemicals known to be neurotoxic in man</td>
<td>Lancet</td>
<td><a href="https://www.lancet.com">link</a></td>
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<tr>
<td>NIOSH</td>
<td>NIOSH Carcinogen List</td>
<td>National Institute of Occupational Safety and Health</td>
<td><a href="https://www.cdc.gov">link</a></td>
</tr>
</tbody>
</table>

Health Product Declaration v1.3 (15 Dec 2012) - Notations - hpdbcollaborative.org - Page 5 of 7
# Sample Health Product Declaration (HPD)

<table>
<thead>
<tr>
<th>Agency/Lab Abbreviation</th>
<th>Full List Title</th>
<th>Hazard Leasing Agency</th>
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<tbody>
<tr>
<td>NTP-Ok-Use</td>
<td>Expert Panel Reports &amp; Monographs on Reproductive and Developmental Toxicity</td>
<td>US Dept of Health &amp; Human Services, National Toxicology Program (NTP), Office of Health Assessment and Translation</td>
<td>ntp.niehs.nih.gov/chemistry</td>
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<td>NTP-Roc</td>
<td>National Toxicology Program (NTP) 12th Report on Carcinogens</td>
<td>NTP, Office of Health Assessment and Translation</td>
<td>niehs.nih.gov/roc</td>
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<tr>
<td>NWMP Priority</td>
<td>Priority Chemicals List</td>
<td>US Environmental Protection Agency</td>
<td><a href="http://www.epa.gov/epawaste/hazardw/assessingpriority.htm">www.epa.gov/epawaste/hazardw/assessingpriority.htm</a></td>
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<tr>
<td>OR P3</td>
<td>Priority Persistent Pollutant (P3) List</td>
<td>State of Oregon Department of Environmental Quality</td>
<td><a href="http://www.deq.state.or.us/epi/001737371">www.deq.state.or.us/epi/001737371</a></td>
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<td>OSPAR</td>
<td>OSPAR Convention For The Protection of the Marine Environment of the North-East Atlantic Chemical List of Priority Action &amp; Possible Concern</td>
<td>Oslo-Paris Convention Commission</td>
<td><a href="http://www.ospar.org/content/content.aspx?menu_id=034034444000_00000_00000">www.ospar.org/content/content.aspx?menu_id=034034444000_00000_00000</a></td>
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<td>Proposition 65</td>
<td>Chemicals Known to the State to Cause Cancer or Reproductive Toxicity - California Proposition 65</td>
<td>State of California Environmental Protection Agency</td>
<td><a href="http://www.cep.ca.gov/p65info/p65_lsthawlist.html">www.cep.ca.gov/p65info/p65_lsthawlist.html</a></td>
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<td>San Antonio</td>
<td>San Antonio Statement on Brominated and Chlorinated Flame Retardants</td>
<td>Environmental Health Perspectives</td>
<td>ehs03.san.ahu.gov/article/infodoc/13-12961ep5-1039289</td>
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<td>SIN</td>
<td>SIN (Substitute It Now) List</td>
<td>Chemico: The International Chemical Secretariat</td>
<td><a href="http://www.chemico.org/ssi">www.chemico.org/ssi</a></td>
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<td>TESSY</td>
<td>TESSY List of Potential Endocrine Disruptors</td>
<td>The Endocrine Disruption Exchange (EDS)</td>
<td><a href="http://www.endocrinedisruption.org">www.endocrinedisruption.org</a></td>
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<td>TRI PBT</td>
<td>TRI PBT Chemical List</td>
<td>US Environmental Protection Agency</td>
<td><a href="http://www.epa.gov/tri/registry/pti/pti_chemicals/pti_chemicals_list.htm">www.epa.gov/tri/registry/pti/pti_chemicals/pti_chemicals_list.htm</a></td>
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<td>VwWfd</td>
<td>Administrative Regulation on the Classification of Substances hazardous to waters</td>
<td>German Federal Environment Agency</td>
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</tr>
</tbody>
</table>
Chapter 6: HVAC Overview of Changes

**IPLV vs. IEER**

IPLV = 0.01A + 0.42B + 0.45C + 0.12D

IEER = 0.02A + 0.617B + 0.238C + 0.125D

A = EER at 100% Capacity
B = EER at 75% Capacity
C = EER at 50% Capacity
D = EER at 25% Capacity