ASHRAE STANDARD 90.1-2013
An overview of changes to Standard 90.1 for 2013

Presenter: Sean Beilman, P.E., HBDP, LEED AP+
Event: SWEEP Conference - November 5, 2014
OVERVIEW

- Over 100 addenda to 2010 incorporated into 2013
- General focus of changes:
  - Scope expansion
  - Language clarification
  - Part load equipment operation
  - Automation and controls
  - Monitoring and trending
## Building Envelope Requirements (Tables 5.5-1 thru 5.5-8)

**Table 5.5-5 Building Envelope Requirements for Climate Zone 5 (A,B,C)**  
Commercial Assembly Thermal Conductivity Comparison

<table>
<thead>
<tr>
<th>Requirement</th>
<th>2010</th>
<th>2013</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ins. entirely above deck</td>
<td>0.048</td>
<td>0.032</td>
<td>33%</td>
</tr>
<tr>
<td>Metal building</td>
<td>0.055</td>
<td>0.037</td>
<td>33%</td>
</tr>
<tr>
<td>Attic and other</td>
<td>0.027</td>
<td>0.021</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Walls above grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>0.090</td>
<td>0.090</td>
<td>0%</td>
</tr>
<tr>
<td>Metal building</td>
<td>0.069</td>
<td>0.050</td>
<td>28%</td>
</tr>
<tr>
<td>Steel-framed</td>
<td>0.064</td>
<td>0.055</td>
<td>14%</td>
</tr>
<tr>
<td>Wood-framed and other</td>
<td>0.064</td>
<td>0.051</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Walls below grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below-grade wall</td>
<td>0.119</td>
<td>0.119</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Floors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>0.074</td>
<td>0.057</td>
<td>23%</td>
</tr>
<tr>
<td>Steel-joist</td>
<td>0.038</td>
<td>0.038</td>
<td>0%</td>
</tr>
<tr>
<td>Wood-framed and other</td>
<td>0.033</td>
<td>0.033</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Slab-on-grade floors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated</td>
<td>0.730</td>
<td>0.520</td>
<td>29%</td>
</tr>
<tr>
<td>Heated</td>
<td>0.860</td>
<td>0.688</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Opaque doors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swinging</td>
<td>0.700</td>
<td>0.500</td>
<td>29%</td>
</tr>
<tr>
<td>Nonswinging</td>
<td>0.500</td>
<td>0.500</td>
<td>0%</td>
</tr>
</tbody>
</table>
Specific insulation methods required for metal building roofs have changed.

- Filled Cavity (FC) vs. Liner System (Ls)
  - FC for warmer climates
  - Ls for colder climates (including Colorado)

FENESTRATION AND DOORS
(SECTION 5.4.3.2)

- Maximum sectional garage door leakage rates added
- Glazed and opaque garage doors (non-swinging)
  - Max. 0.4 cfm/ft² @ 1.57 psf
- High speed garage doors
  - Max. 1.3 cfm/ft² @ 1.57 psf
Minimum VT/SHGC values added to benefit daylighting effectiveness

For Climate Zone 5:

\[
\frac{VT}{SHGC} = 1.10
\]

Resulting Min Visible Transmittance:

\[
VT_{min} = 0.44
\]
MINIMUM DAYLIGHTED AREAS
(SECTION 5.5.4.2.3 AND 5.5.4.5)

- Toplighting requirements now apply to
  - smaller buildings, 2,500ft² vs. 5,000ft²
  - more space types
- Except where sufficient sidelighting is present.
SECTION 5.5.4.5

- Vertical fenestration area requirements have been modified to improve performance and add flexibility.
- East and west glazing area must each be less than 25% of the total glazing area.
  - Unless an improved SHGC is used on these exposures.

**5.5.4.5 Fenestration Orientation.** The vertical fenestration shall comply with either (a) or (b):

- **a.** \( A_W \leq (A_T)/4 \) and \( A_E \leq (A_T)/4 \)
- **b.** \( A_W \times \text{SHGC}_W \leq (A_T \times \text{SHGC}_C)/4 \) and \( A_E \times \text{SHGC}_E \leq (A_T \times \text{SHGC}_C)/4 \)
EQUIPMENT PERFORMANCE TABLES (6.8.1)

- 2010 added tables for
  - Heat transfer equipment
  - VRF systems
  - CRAC units

- 2013 added tables for
  - Commercial refrigerators and freezers
  - Commercial refrigeration

- Overall focus on part load efficiency improvements
MANDATORY DIRECT DIGITAL CONTROLS (6.4.3.10)

- Mandatory dependent on equipment and project scope for:
  - New buildings
  - Major renovations
- Must have monitoring and trending capabilities
**Fan Control (6.5.3.2)**

- Section was VAV Fan Control in 2010
- Applies to single zone and multi zone
- Specifies variable speed fan operation
- Includes allowable fan power at intermediate flow rates
FAN EFFICIENCY (6.5.3.1.3)

- In addition to fan power requirements
- Fan must have a Fan Efficiency Grade (FEG) of not less than 67 (per AMCA 205)
- The fan efficiency at design conditions must be within 15 efficiency percent of the max total fan efficiency

- Many exceptions, notably
  - Small fans
  - Fans part of equipment rated as a package
Fan Efficiency Grade (6.5.3.1.3)

- Fans must have an FEG of 67 (AMCA 205)

Figure courtesy AMCA 205
**FRACTION HP FAN MOTORS (6.5.3.5)**

- Motors $\geq 1/12$ HP and $< 1$ HP must be:
  - Electronically Commutated Motors (DC Brushless)
  - $\geq 70\%$ Efficient (rated in accordance with DOE 10 CFR 431)

- Exceptions:
  - Heating only applications (fan in airstream)
  - Motors in space conditioning equipment rated as a package
  - Motors already covered in Chapter 10 of 90.1
**Exhaust Air Energy Recovery (6.5.6.1)**

- Exhaust air energy recovery based on run time

<table>
<thead>
<tr>
<th>Zone</th>
<th>% Outdoor Air at Full Design Airflow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥10% and &lt;20%</td>
</tr>
<tr>
<td></td>
<td>≥80%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Supply Fan Airflow Rate, cfm</th>
</tr>
</thead>
<tbody>
<tr>
<td>3B, 3C, 4B, 4C, 5B</td>
</tr>
<tr>
<td>NR</td>
</tr>
</tbody>
</table>

Less strict for Denver

<table>
<thead>
<tr>
<th>Zone</th>
<th>% Outdoor Air at Full Design Airflow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥10% and &lt;20%</td>
</tr>
<tr>
<td></td>
<td>≥2500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Supply Fan Airflow Rate, cfm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A, 2A, 3A, 4B, 5B</td>
</tr>
</tbody>
</table>

More strict for Denver

Table courtesy ASHRAE Standard 90.1-2013
CRAC UNITS

90.1 Scope Changed in 2010
- Included equipment for process cooling
- CRAC Unit requirements are scattered throughout the standard
  - Variable air flow
  - Humidification
  - Dehumidification
  - Efficiencies
  - Economizer
**SECTION 6.6**

Computer Rooms (and Data Centers) may use Section 6.6 as an alternative compliance path using PUE

PUE: Power Usage Effectiveness

*Reference: Recommendations for Measuring and Reporting Overall Data Center Efficiency v2 17 May 2011, The Green Grid*
COMMERCIAL REFRIGERATION (6.4.5 AND 6.5.11)

The 2010 scope change opened the standard up to other equipment including:
- Walk-in Coolers
- Walk-in Freezers
- Commercial Refrigeration

*These new requirements cover all aspects of this equipment category*
SERVICE WATER HEATING

Chapter 7
HIGH-CAPACITY SERVICE WATER HEATERS (SECTION 7.5.3)

- Service Water Heating systems greater than 1,000,000 btu/h must be 90% efficient
  - May be prorated based on input capacity

![Diagram of water heaters](image_url)

\[
\begin{align*}
80\% & \quad 200\text{MBH} \\
95\% & \quad 500\text{MBH} \\
95\% & \quad 500\text{MBH} \\
\end{align*}
\]

= 92.5%
Automatic Receptacle Control (Section 8.4.2)

- Automatic receptacle control remains from 2010
- Added automatic control of circuits intended for modular furniture
ELECTRICAL ENERGY MONITORING (SECTION 8.4.3)

- Buildings ≥25,000sf, monitor and store for 36 months:
  - Whole building
  - HVACR
  - Interior lighting
  - Exterior lighting
  - Receptacle circuits
LIGHTING

Chapter 9
LIGHTING ALTERATIONS (SECTION 9.1.2)

- Clarified alteration
  - Replacement of lamp/ballast with like components is not an alteration
  - Replacement of lamp/ballast with dissimilar components is an alteration
- Alterations that affect more than 10% of the installed lighting power must comply with Chapter 9
GUESTROOM CONTROL (SECTION 9.4.1)

- Control of guestroom lighting and receptacles
  - 2010 Manual control
  - 2013 Automatic control – off within 20 min of occupants leaving the space
**Lighting Power Density and Lighting Controls (Section 9.4.1 and Table 9.6.1)**

- Section 9.4.1, Mandatory Lighting Controls has been replaced with new text
  - Requirements are similar
  - Uses Table 9.6.1 for lighting controls
- Table 9.6.1 – Space-by-Space LPD is lower for some space types

Table courtesy ASHRAE Standard 90.1-2013
OTHER EQUIPMENT

Chapter 10
Moving Walkways and Escalators (Section 10.4.4)

- Maximum unoccupied speed has been specified
- Maximum acceleration speed specified
  - Both speeding up and slowing down
WHOLE-BUILDING ENERGY MONITORING (10.4.5)

- Complements energy monitoring in Chapter 8
- Monitor and store hourly energy data for the following utility energy types for 36 months:
  - Natural gas
  - Fuel oil
  - Propane
  - Steam
  - Chilled water
  - Heating water
- Buildings $\geq$ 25,000sf
90.1-2013 Final Energy Saving Analysis

ASHRAE 90.1 Progress Indicator analysis and results by:
Bing Liu and Mike Rosenberg
Pacific Northwest National Laboratory

<table>
<thead>
<tr>
<th>National Weighted Average</th>
<th>Site Energy EUI (kBtu / ft²-yr)</th>
<th>Energy Cost Index ($ / ft²-yr)</th>
<th>% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90.1-2004</td>
<td>90.1-2013</td>
<td>90.1-2010 vs. 90.1-2004</td>
</tr>
<tr>
<td>Whole Building</td>
<td>76.7</td>
<td>54.1</td>
<td>23.4%</td>
</tr>
<tr>
<td></td>
<td>$1.87</td>
<td>$1.33</td>
<td>22.1%</td>
</tr>
<tr>
<td>Regulated Loads</td>
<td>58.1</td>
<td>36.2</td>
<td>30.4%</td>
</tr>
<tr>
<td></td>
<td>$1.38</td>
<td>$0.86</td>
<td>29.3%</td>
</tr>
</tbody>
</table>
THANK YOU

Questions?