# *How 90.1-2010 will Affect Healthcare Facilities*

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## Learning Objectives:

- Describe the status of the new Standard 189.2 including the expected public review cycle(s) and publication schedule.
- List key elements in Standard 189.2 impacting HVAC design and energy use.
- Describe the basis and intent behind the air change requirements in Standard 170 Table 7-1.
- Define recirculated air and clarify when it is required to pass through a final filter.
- Understand the new LEED for Health Care rating system and the specific health care elements.
- List key elements in LEED for Heath

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## *Learning Objectives*

- ~~What is ASHRAE 90.1?~~
- ~~How is ASHRAE 90.1 enforced?~~
- What changed in 90.1-2010?
  - What challenges will the requirements pose?
  - Suggestions for compliance
  - Resources for more information

## *What Changed in ASHRAE 90.1 - 2010?*

## *Scope Addition*

- New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes
  - Computer rooms are the first application

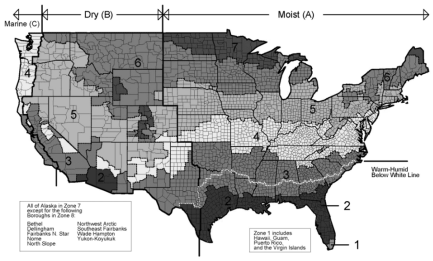
## *ASHRAE 90.1-2010*

- New version was released in October 2010
  - Goal was 30% less energy than 90.1-2004
  - 2007 version saved only a few %
- Predictions
  - IECC will incorporate most of the changes
    - 2009
    - 2011 interim update
    - 2012 major edition
  - LEED will move to ASHRAE 90.1-2010

## *ASHRAE 90.1-2010*

- Committee took final votes June 28
- BOD upheld appeals on 2 addenda
- Blue items are rejected or postponed to 2013
- Many Changes
  - Elevators was addendum DF!!
  - 118 addenda proposed

## *9 Climate 'zones' + ABC ≈ 15*




## *Building Envelope*

- Roof Insul ~~R20~~/16 cz1 >> ~~R35~~/20 cz8
- SHGF ~~0.40~~/0.25 cz1 >> ~~0.34~~/0.45 cz8
- U-values ~~0.65~~/1.2 cz1 >> ~~0.34~~/0.45 cz8
- ~~VT/SHGC ratio 1.1 includes frame~~

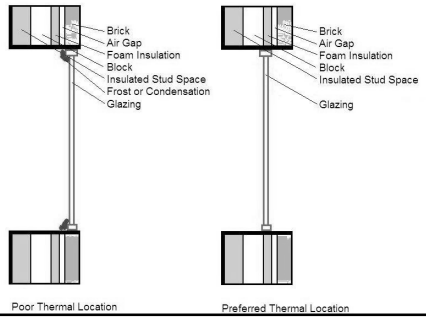
## *Building Envelope – Addendum (bb)*

- Insulation (appeal upheld : not in 2010)
  - Example – Zone 6 (Madison) Steel Framed
    - 2007 – R-13 + R-7.5 c.i.
      - 2" of expanded polystyrene (bead board)
    - 2010 – R-13 + R-15 c.i.
      - 4.0" of expanded polystyrene (at 3.8/inch)
      - Potential conflict between 90.1 and IBC
      - R-18.8 in Zone 7 = 5" EPS, 4" XPS, or 3.5" ISO
      - R-10 in Zone 4 = 3" EPS, 2.5" XPS or 2" ISO

## *Building Envelope*

- ~~Maximum 30% glass (bb)~~
  - ~~Exception: 40% if~~
    - ~~Distribute glass to daylight > 50% of floor area~~
    - ~~Install daylight dimming~~

## *Envelope – Continuity – Too Late*



## *Building Envelope – Air Barrier (bf)*

- Air barrier & joints must be detailed
- OR - Pressure test must be performed

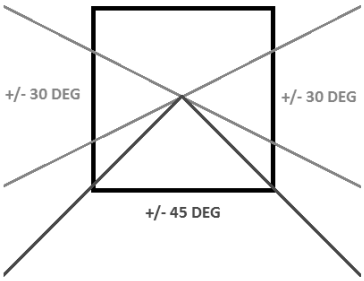
## *Air Barriers*

- Materials < 0.004 cfm/SF
- Assembly < 0.040 cfm/SF
- Testing < 0.400 cfm/SF

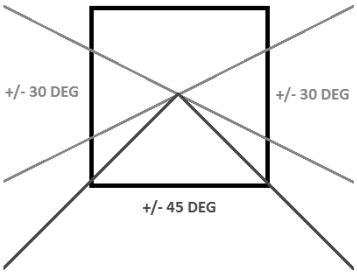
## *Building Envelope*

- More S glazing than either E or W (bn)
  - Building orientation
  - Land purchases and campus planning
  - No public review comments
- Exceptions
  - Storefront, Shaded building, Infill with nearby building on south, Alterations with no increase in glazing

## *Building Envelope*




## *Building Envelope*





## *Miscellaneous*

- Cool roofs (f)
  - Cz1-3, with exceptions
- Skylights with daylighting

## *Skylights in Large Interior Spaces*

- **5.5.4.2.3 Minimum *Skylight Fenestration Area.*** In enclosed spaces that are:
  - i. greater than 10,000ft², and [5,000 ft²*]
  - ii. directly under a roof with ceiling heights greater than 15 ft, and
  - iii. one of the following space types: office, lobby, atrium, concourse, corridor, storage, gymnasium/exercise center, convention center, automotive service, manufacturing, non-refrigerated warehouse, retail, distribution/sorting area, transportation, or workshop.

  The total *skylight area shall be either;*
  - a. a minimum of 3% of the roof area of that enclosed space with a skylight VLT at least 0.40, or
  - b. such that the *daylight area under skylights will be a minimum of half the* floor area and provide a minimum *skylight effective aperture of at least* 1%.

  These skylights shall have a glazing material or diffuser with a measured haze value greater than 90% when tested according to ASTM D1003. *General lighting in the* daylight area shall be controlled as described in Section 9.4.1.4.

## *HVAC*

- Scope
  - Equipment efficiency ratings
  - Fan Power
  - Energy recovery
  - Reheat limitations
  - Economizers
  - Duct sealing and leakage
  - Other

## *Fan Power*

- Current requirements
  - CAV = 0.94 BHP/1000 cfm + Allowances
  - VAV = 1.30 BHP/1000 cfm + Allowances
  - Allowances for:
    - Ducted return
    - Return control devices
    - Filters
    - Heat recovery
    - Silencers

## *Fan Power*

- 2010 requirements (VAV)
  - Offices <1.5 BHP/1000 cfm
  - Labs & Hospitals <2.3 BHP/1000 cfm
    - Based on brake HP
    - Includes all fans running at peak cooling load
    - Also in IECC 2009
    - Post 2010 maybe drive efficiency requirements

## *Fan Power*

- 2007 ERU allowance
  - Whatever the pressure drop is
- 2010 ERU allowance (dj)
  - 2.2*effectiveness – 0.5, except
  - Runaround coils = 0.6”
  - Provides incentive for higher efficiency

## *Fan Power*

- Suggestions for compliance
  - Efficient fans
  - Low static systems
    - Larger air handling units (but smaller motors)
    - Fewer duct turns
    - Shorter duct runs
    - Requires early coordination of architectural design with HVAC design
    - Sell the advantages!

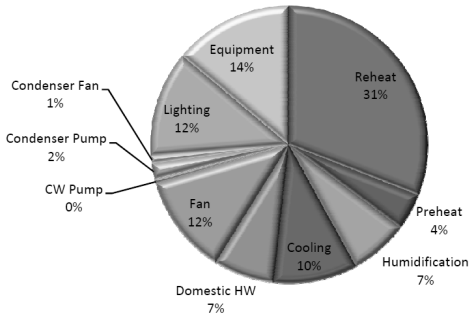
## *Energy Recovery*

- Current – if >70% OA and >5,000 cfm

**Table 6.5.6.1 A Energy Recovery Requirement (IP)**

| Zone | % Outside Air at full design cfm | | | | | |
|---|---|---|---|---|---|---|
| | ≥30% and < 40% | ≥40% and < 50% | ≥50% and < 60% | ≥60% and < 70% | ≥70% and < 80% | ≥80% |
| | Design Supply Fan CFM | | | | | |
| 3B, 3C, 4B, 4C, 5B | NR | NR | NR | NR | ≥5000 | ≥5000 |
| 1B, 2B,5C | NR | NR | ≥26000 | ≥12000 | ≥5000 | ≥4000 |
| 6B | ≥11000 | ≥5500 | ≥4500 | ≥3500 | ≥2500 | ≥1500 |
| 1A, 2A, 3A, 4A, 5A, 6A | ≥5500 | ≥4500 | ≥3500 | ≥2000 | ≥1000 | >0 |
| 7,8 | ≥2500 | ≥1000 | >0 | >0 | >0 | >0 |

## *Reheat – Typical VAV Hospital*




## *Reheat*

- 2007 requirements
  - Unlimited reheat if there are any pressure controlled spaces – many constant volume hospitals and labs
  - Many exceptions
  - IECC is less restrictive

## *Reheat*

- 2010 requirements
  - No reheat allowed unless:
    - ≤30% of peak flow or
    - Flow no more than required air changes
  - Bans CAV systems in most hospitals & labs
  - ORs only pressurized when unoccupied

## *Reheat*

- "BX" restricts overhead air heat to 20F above room temperature – Supplemental heat may be needed

## *Reheat*

- Suggestions for compliance
  - VAV systems
  - Perimeter heating
  - Condenser reheat
  - Heat pumps, fan coils, or chilled beams with dedicated outside air systems (DOAS) and enthalpy recovery

## *Economizers*

- 2007 requirements
  - Exempt if over 25% of area served is humidified above 35F dew-point (~22% RH)
  - Exempt if <5 or 11 tons
  - Exempt in 1a&b, 2a, 3a & 4a

## *Economizers*

- 2007

**TABLE 6.5.1 Minimum System Size for Which an Economizer is Required**

| Climate Zones | Cooling Capacity for Which an Economizer is Required |
|---|---|
| 1a, 1b, 2a, 3a, 4a | No economizer requirement |
| 2b, 5a, 6a, 7, 8 | ≥135,000 Btu/h |
| 3b, 3c, 4b, 4c, 5b, 5c, 6b | ≥65,000 Btu/h |

- 2010 (CY)

**TABLE 6.5.1a Minimum Fan-cooling Unit Size for Which an Economizer is Required for Comfort Cooling**

| Climate Zones | Cooling Capacity for Which an Economizer is Required |
|---|---|
| 1a, 1b | No economizer requirement |
| 2a, 2b, 3a, 4a, 5a, 6a<br>3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8 | ≥54,000 Btu/h |

## *Economizers (cy)*

- Requires water economizer for some zones required to be humidified
  - Run cooling towers in the winter
  - Some hospitals & labs

- Exception
  - In hospitals and ambulatory surgery centers, where more than 75% of the air designed to be supplied by the system is to spaces that are required to be humidified above 35 F dew-point temperature to comply with applicable codes or accreditation standards. In all other buildings, where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35 F dew-point temperature to satisfy process needs.

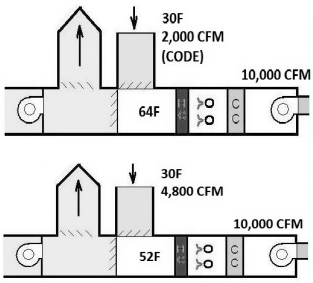
## *Humidification (since at least 1999)*

- **6.5.2.4 Humidification.** Systems with hydronic cooling and humidification systems designed to maintain inside humidity at a dew-point temperature greater than 35 F shall use a water economizer if an economizer is required by Section 6.5.1.

## *Water Economizer Capacity*

- 6.5.1.2.1…must satisfy 100% of the expected system cooling load at 45 F dry bulb/40 F wet bulb
- May determine tower sizing for some facilities

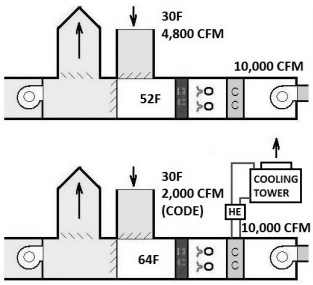
## *Economizers – None vs. Air*




No Economizer
Cooling = 126,440 Btuh
Humidifier = 22,388 Btuh
Pump = 0 Btuh
Cooling Tower = 0 Btuh
Reheat (Baseline) 0 Btuh
Total = 148,828 Btuh

Air Economizer
Cooling = 0 Btuh
Humidifier = 53,305 Btuh
Pump = 0 Btuh
Cooling Tower = 0 Btuh
Reheat (Baseline) 0 Btuh
Total = 53,305 Btuh

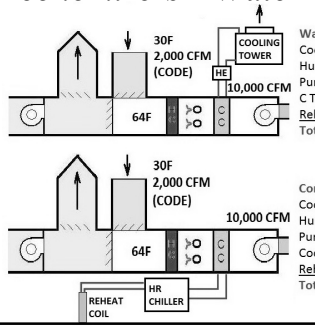
## *Economizers – Air vs. Water*




Air Economizer
Cooling = 0 Btuh
Humidifier = 53,305 Btuh
Pump = 0 Btuh
Cooling Tower = 0 Btuh
Reheat (Baseline) 0 Btuh
Total = 53,305 Btuh

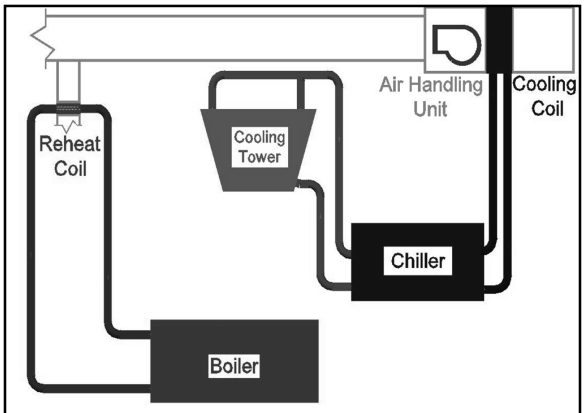
Water Economizer
Cooling = 0 Btuh
Humidifier = 22,388 Btuh
Pump = 2,545 Btuh
C Tower = 2,545 Btuh
Reheat (Baseline) 0 Btuh
Total = 27,478 Btuh

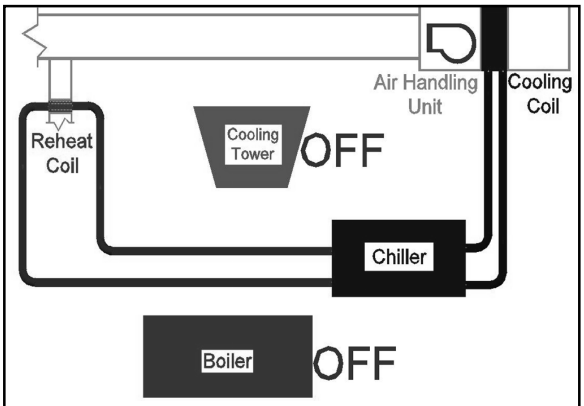
## *Economizers – Water vs. Condenser*




Water Economizer
Cooling = 0 Btuh
Humidifier = 22,388 Btuh
Pump = 2,545 Btuh
C Tower = 2,545 Btuh
Reheat (Baseline) 0 Btuh
Total = 27,478 Btuh

Condenser Reheat
Cooling = 50,576 Btuh
Humidifier = 22,388 Btuh
Pump = 1,273 Btuh
Cooling Tower = 0 Btuh
Reheat = -177,016 Btuh
Total = -102,779 Btuh




## *Duct Sealing (cq)*

- Ductwork and plenums with pressure ratings shall be seal class A
- Shaft openings require bushings
- 25% of duct systems over 3" w.g. and ALL outdoor ducts shall be leak tested
  - Tested sections chosen by owner
- Leakage class = 4 for all ducts

## *Other HVAC Changes*

- Pump head calculation
- Chilled water pipe sizing
- Chilled water pump VSDs & pressure reset
- Radiant panel insulation
- Single-zone VAV requirements
- Supply air temperature reset
  - One of the larger savings

## *Other Mechanical Changes*

- BU= data centers = 2% of USA energy
  - Critical data centers definition continues to be revised
- Cp = VRF efficiencies per AHRI
  - Easy limits until 2012

## *Lighting*

- ~ 30 lighting addenda
- 2 wattage reduction addenda
- 28 lighting control addenda
- LPD dropped a little ~10% on average

## *Lighting*

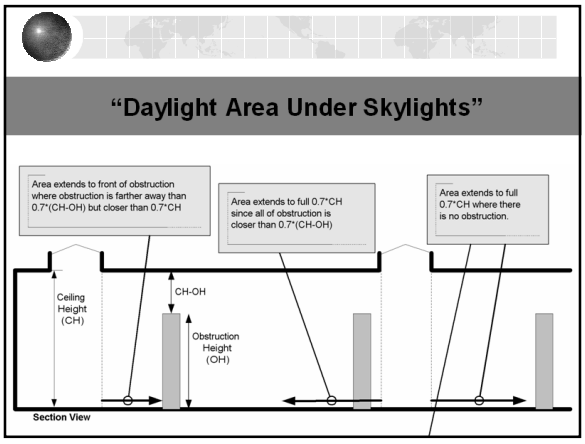
- Lighting power density changes for 2010

| LPD W/SF) | 1989 | 1999 | 2001 | 2004* | 2010 |
|---|---|---|---|---|---|
| Clinic | 1.44 | 1.60 | 1.60 | 1.00 | 0.87 |
| Hospital | 1.44 | 1.60 | 1.60 | 1.20 | 1.21 |

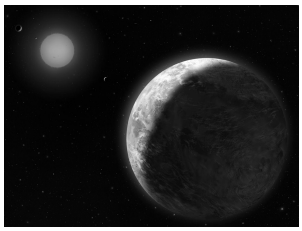
* Few changes between 2004 and 2007

## *Lighting Controls*

- No daylighting rules until 2010
- Addenda d, ab, al, ct



## *Exterior Lighting*



- 4 zones (i)
  - National parks
  - Residential
  - Other
  - Metro
- 500 – 1300W + .04-.80 W/SF

## *Lighting Automatic Shutoff*

- **MANY** more lighting controls
- Vacancy sensors
- Bi-level control

## *Exterior (cd)*

- MUST turn off exterior lighting when plenty of sun
- Off midnight or closing to 6am

## *Functional Testing (az)*

- Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

## *Lighting Automatic Shutoff*

- Whole-building shutoff
  - Exceptions for:
    - Patient care areas
    - Lighting required for 24-hour use
    - Where automatic-off would be unsafe
- Individual space controls
- Exterior – astronomical timer or daylight sensor

## *Exit Signs Limited to 5 Watts*

## *Power – Controversial! (overturned)*

- "BZ" may add separate monitoring of:
  - Total electrical energy
  - HVAC systems electricity
  - Exterior lighting
  - Interior lighting
  - Receptacle circuits
- 15-minute reporting


## *Power - Receptacles (bs)*

- 50% of 120V need automatic control
  - Includes modular partitions
- Options
  - Time of day
  - Occupancy sensor
  - Another control or alarm system

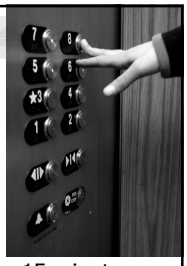
## *Power - Receptacles (bs)*

- **Exceptions:**
  - Receptacles specifically designated for equipment requiring 24 hour operation
  - Spaces where patient care is rendered
  - Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

## *Other Equipment*

- Booster Pumps
  - Sensor to start and/or control speed
  - Remote sensor or simulation logic
  - No PRV at pumps
  - Pumps off when no flow

## *Other Equipment*



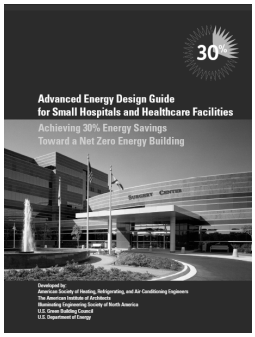
- Elevators
  - Lighting efficacy ≥35 LPW
  - Ventilation ≤ 0.33 W/cfm
  - Lights & fans off if unused for >15 minutes
  - Future – Movement efficiency
  - Future – Escalators & fast-walks

## *What if I Want More?*

- IGCC 2010 (includes 189.1)
- ASHRAE-USGBC-IESNA Standard 189.1
- VAV complies, but won't save big
  - Good savings with condenser reheat
- Advanced Energy Design Guide series
  - Office, school, small healthcare, warehouse

## *AEDG*

- Small Healthcare
  - Hospitals
  - Clinics
  - Cookbook method to achieve ~40% savings over 90.1-1999




## *AEDG – **Large** Healthcare*

## *Modeling*

- 16 buildings, 17 climate zones
- Weighting factors
- Hospital 2.8% of USA SF, Clinic 3.5%
- Warehouse 13%, Stand-alone retail 12%
- 44 addenda for 2007
- 64 more for 2010

## *90.1-2010 Savings over 90.1-2004*

**62.1 – 2001**

- 21.7% including plug loads
- 27.4% excluding plug loads

**62.1 - 2007**

- 24.8% including plug loads
- 30.9% excluding plug loads

## *90.1 Progress Indicator 2010-06-28*

- Additional addenda to be included
  - F – Cool Roofs
  - S – DX efficiency
  - CK – ventilation reset
  - CT, DD – Daylighting
  - BF – Continuous air barrier
  - others

## *Which Facility Do You Want to Own?*