

ANSI/ASHRAE/IESNA Standard 90.1-2004

Overview of

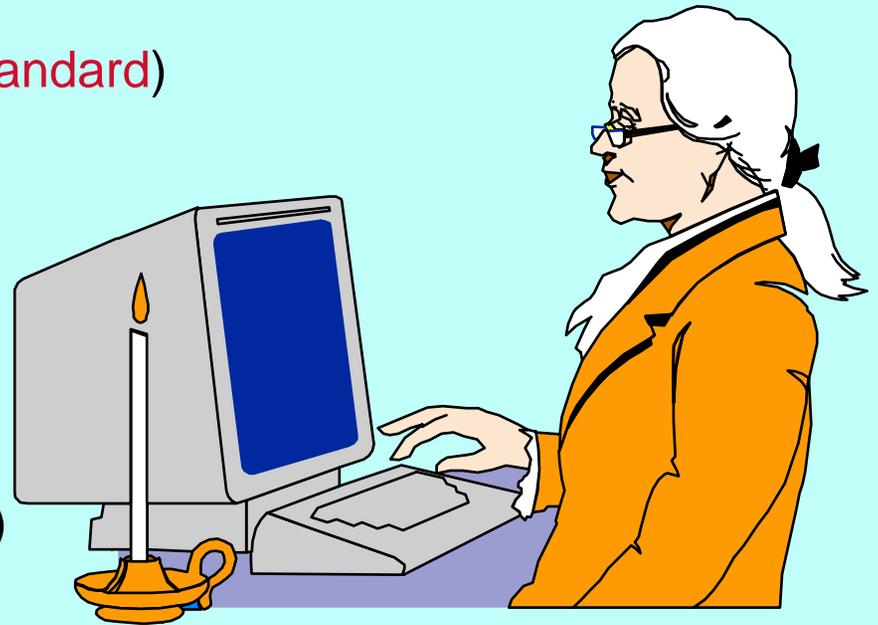
- 1. - 2004 vs. 2001 edition*
- 2. - Compliance*
- 3. - Requirements*
- 4. - Code Acceptance*



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Chairman, ASHRAE SSPC 90.1*

Background

- ◆ ASHRAE / IESNA Standard 90.1
- ◆ Historical Perspective
 - ◆ 90 –1975 (**way back-first standard**)
 - ◆ 90A-1980 (**past**)
 - ◆ 90.1–1989 (**past**)
 - ◆ 90.1–1999 (**past**)
 - ◆ 90.1 – 2001 (**present**)
 - ◆ 90.1 – 2004 (**later this year**)
 - ◆ 90.1 – 2007 (**future**)



U.S. Energy Policy Act -1992

- ◆ **Established HVAC equipment efficiencies in 90.1 as the minimum levels for new manufacturing standards**
- ◆ **Required state codes to meet or exceed requirements of 90.1–1999**
- ◆ **Required government to evaluate revisions to Standard 90.1, and may obligate states to update their codes to that level**



1. FROM 1989 TO 2004



1989 – Not code language. Contains both requirements and design guidance.

1999 – Complete rewrite. Code language, ready for adoption as energy code by AHJ.

2001 – Revision of 1999 edition. Incorporates 34 addenda published since 1999 edition issued.

2004 – Revision of 2001 edition. Incorporates 32 addenda published since 2001 edition issued

What is Code Language?

Standards language (permissive, non-enforceable):

“Designers should consider the use of renewable energy.”

Code language (mandatory, enforceable):

“Designs shall incorporate the use of renewable energy sources.”

Highlights of Standard 90.1-2004 compared to 90.1-2001

2004 edition = 2001 + 32 addenda

- ♦ Complete reformatting
- ♦ Revisions/additions noted by “revision bar”; deletions by an arrow.
- ♦ Envelope section contains new climate zone map and tables
- ♦ LPD tables for lighting updated with reduced watts/sq. ft.
- ♦ Loopholes closed
- ♦ New standards and test procedures referenced.

Re-Formatting 90.1-2004 - Conventions

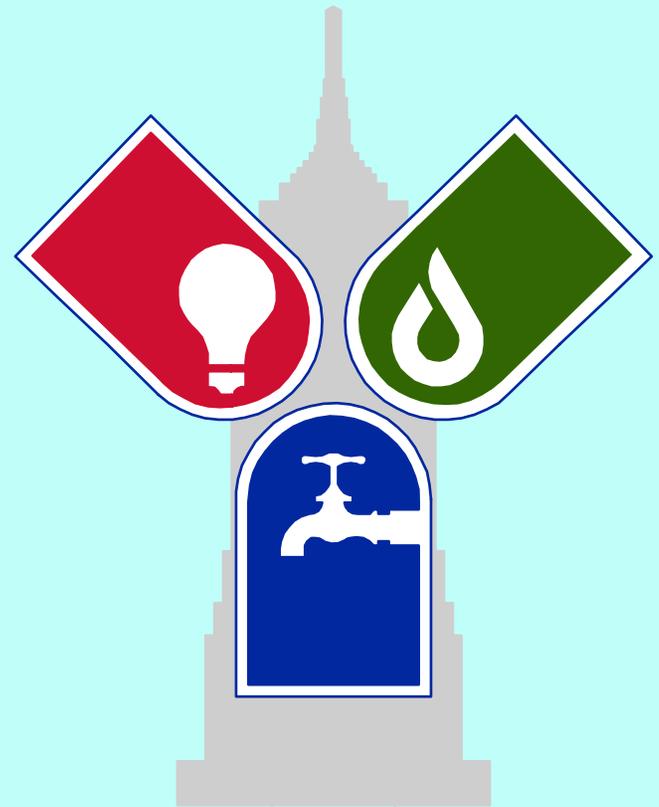
- ◆ Text should not be repeated within the document
- ◆ Each Chapter should be as “self contained” as possible
- ◆ Where there is no text for a particular section, the numbered heading will be retained followed by:
(Reserved)

The following Chapter structure is utilized:

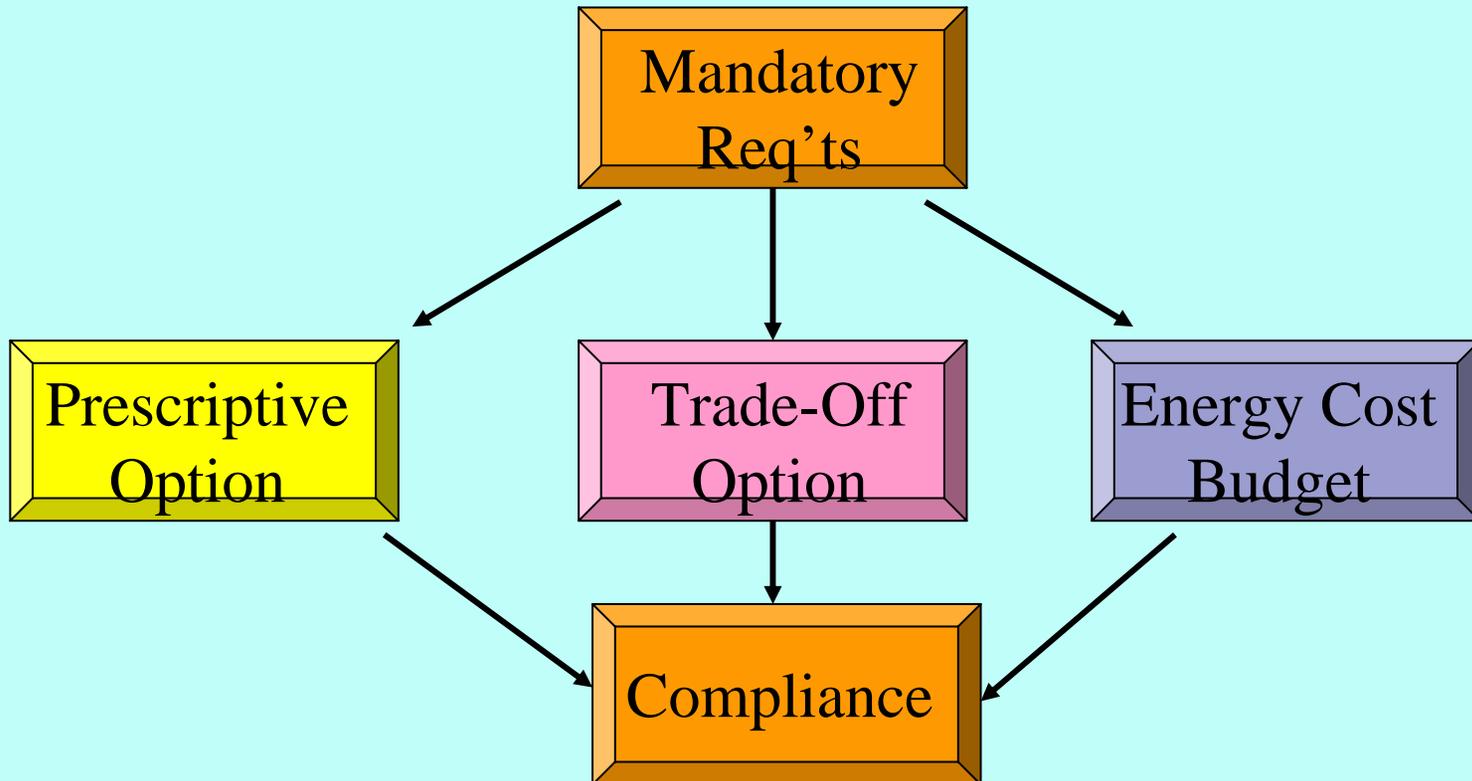
- ◆ #.1 General
- ◆ #.2 Compliance Paths
- ◆ #.3 Simplified Building Option
- ◆ #.4 Mandatory Provisions
- ◆ #.5 Prescriptive Option
- ◆ #.6 Alternate Option
- ◆ #.7 Submittals
- ◆ #.8 Product Information.

Standard 90.1 2004 Covers ...

- ◆ Envelope
- ◆ HVAC
- ◆ Service water heating
- ◆ Power
- ◆ Lighting
- ◆ Other Equipment



2. COMPLIANCE



3. OVERVIEW OF REQUIREMENTS

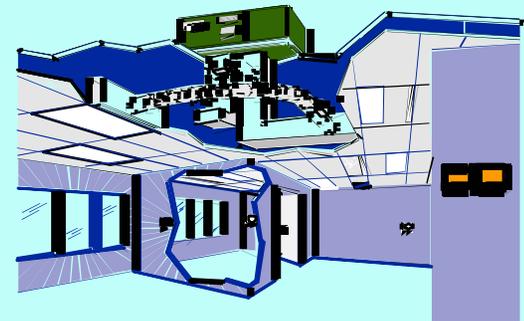
Purpose - Section 1

- ◆ ...provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings



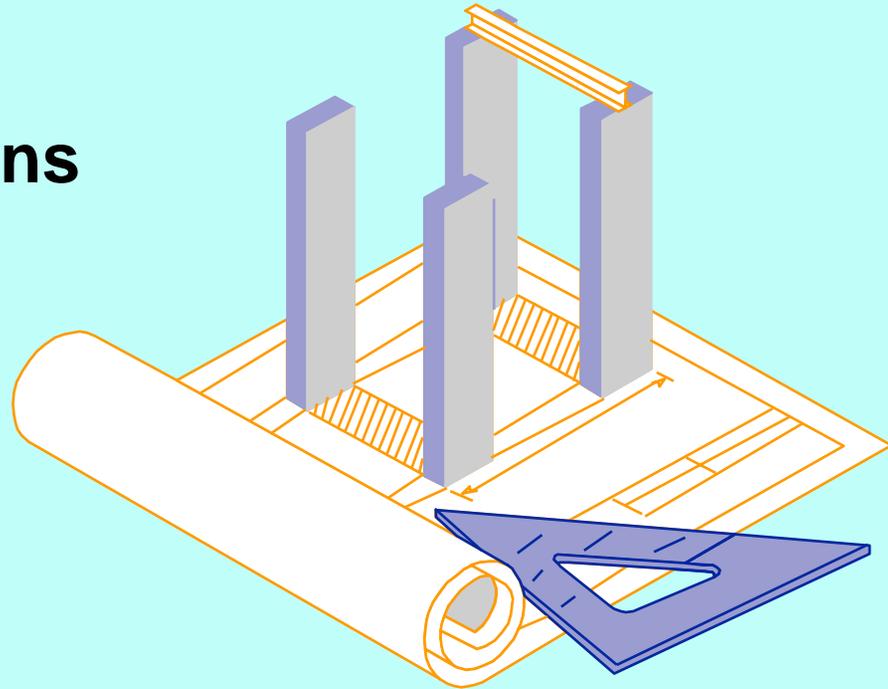
Scope - Section 2

- ◆ New buildings and systems
- ◆ New portions of buildings and systems (additions)
- ◆ New systems and equipment in existing buildings (alterations)
- ◆ ***Excludes*** low-rise residential - (Standard 90.2)



Definitions - Section 3

- ◆ **Definitions**
- ◆ **Abbreviations**
- ◆ **Acronyms**



Admin. & Enforcement - Section 4

- ◆ **Compliance requirements**
 - ◆ new buildings and systems
 - ◆ existing buildings and systems
 - *additions*
 - *alterations (comply if you change it)*
- ◆ **Compliance documentation**
 - ◆ drawings, manuals
 - ◆ labeling - envelope, mechanical



Section 4 – New for 2004

- ♦ Addenda “a”:
 - ◆ **Removes Section 4.4.7 Titled *Transformers***
- ♦ Addenda “af”:
 - ◆ **Revisions to requirements for alterations.**
 - ◆ **Increases stringency.**
 - ◆ **Eliminates possible loopholes**

General Layout

Sections 5, 6, 7, 8, 9 & 10

- ◆ **Mandatory requirements**
- ◆ **Prescriptive requirements**
- ◆ **Performance methodology**

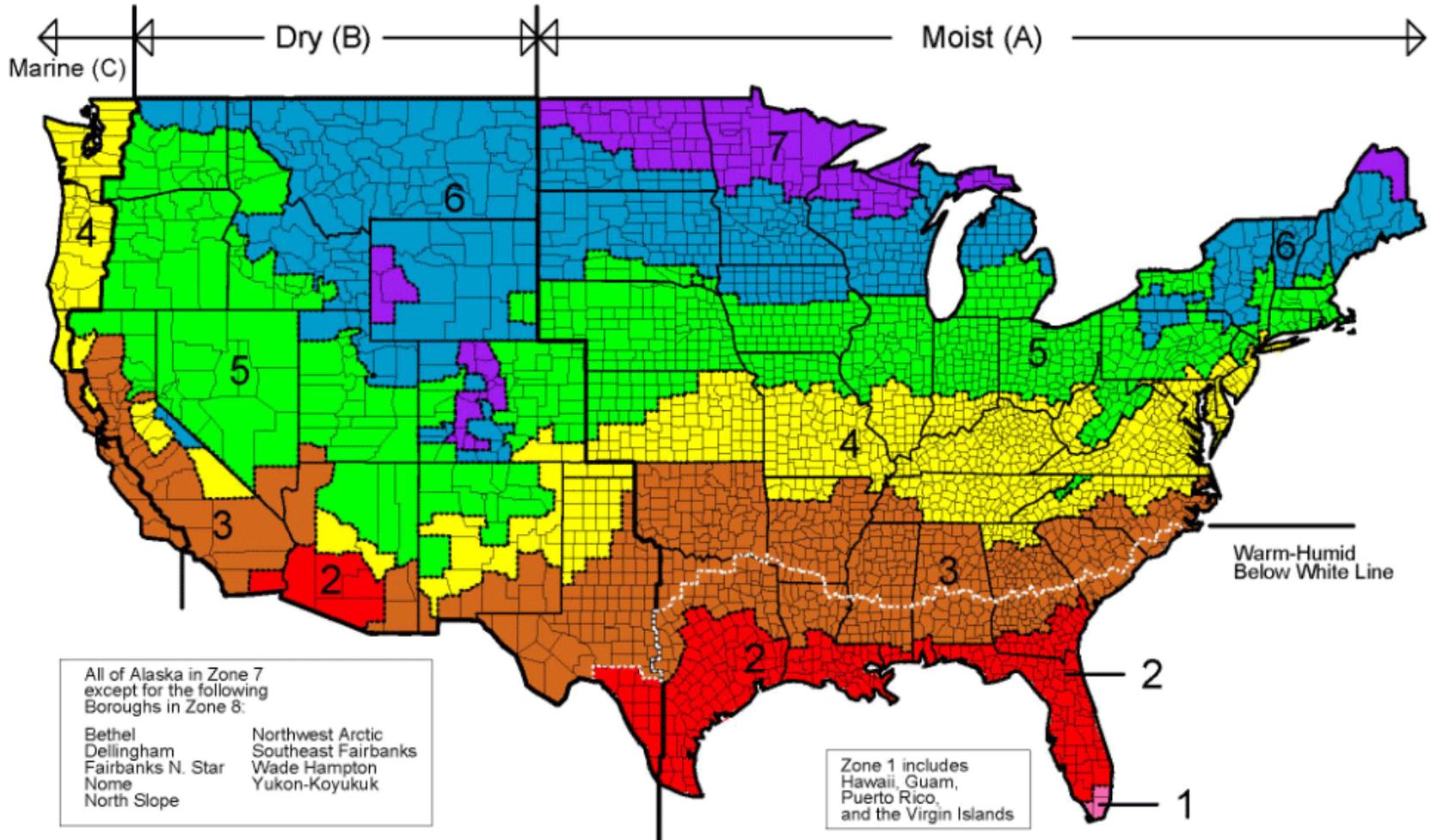


Building Envelope – Section 5

New for 2004:

- ◆ **New Climate zone map - Old 26 zones vs. new 8 zones**
- ◆ **Information easier to read and use.**

Building Envelope – Section 5



BUILDING ENVELOPE CHANGES

Table 3-2 Heated Space Criteria

Heating Output	Climate zone
Btu/h·ft ²	
5	1 and 2
10	3
15	4 and 5
20	6 and 7
25	8

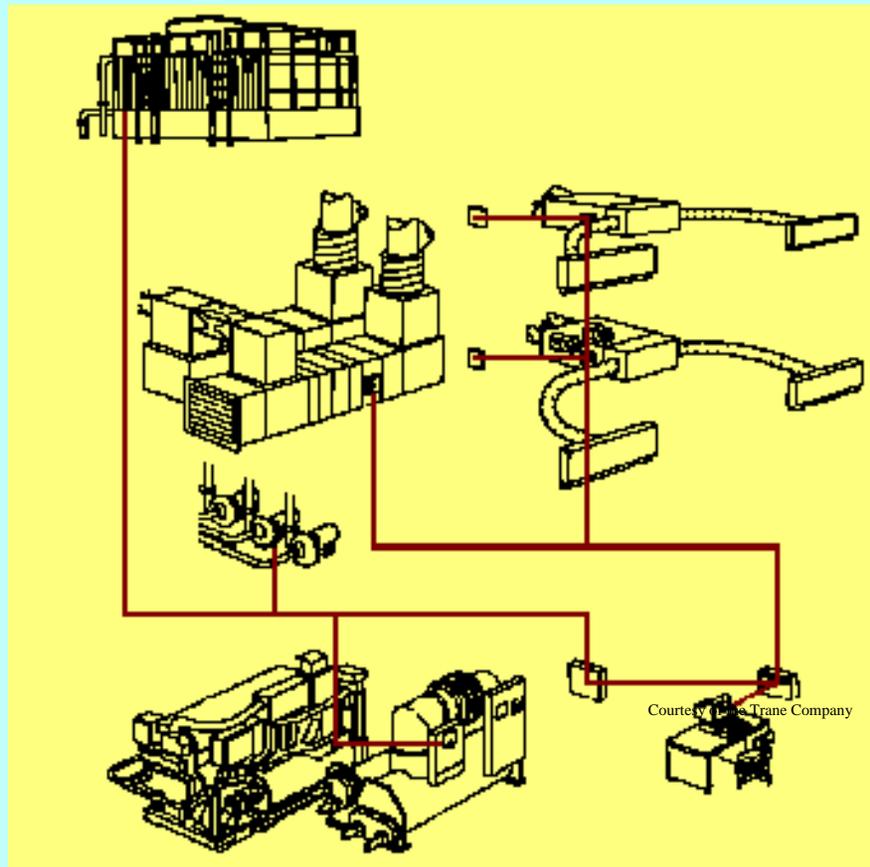
BUILDING ENVELOPE CHANGES (cont)

- ♦ Tables 5.3.1.1A and 5.3.1.1B
 - ◆ **Changed to indicate Climate Zone vs. HDD**
- ♦ Tables B-2, B-5, B-10, B-9, B-13, B-17, B-19, B-22, B-24 Building Envelope requirements
 - ◆ **Renumbered to match climate zones**
 - ◆ **All other tables eliminated**
- ♦ Table 6.1.3 Eliminate Required Economizer
 - ◆ **Changed to indicate Climate Zone vs. CDD**
- ♦ Tables 6.2.3.3.4 Maximum Damper Leakage
 - ◆ **Revised table and changed from HDD/CDD to climate zones**

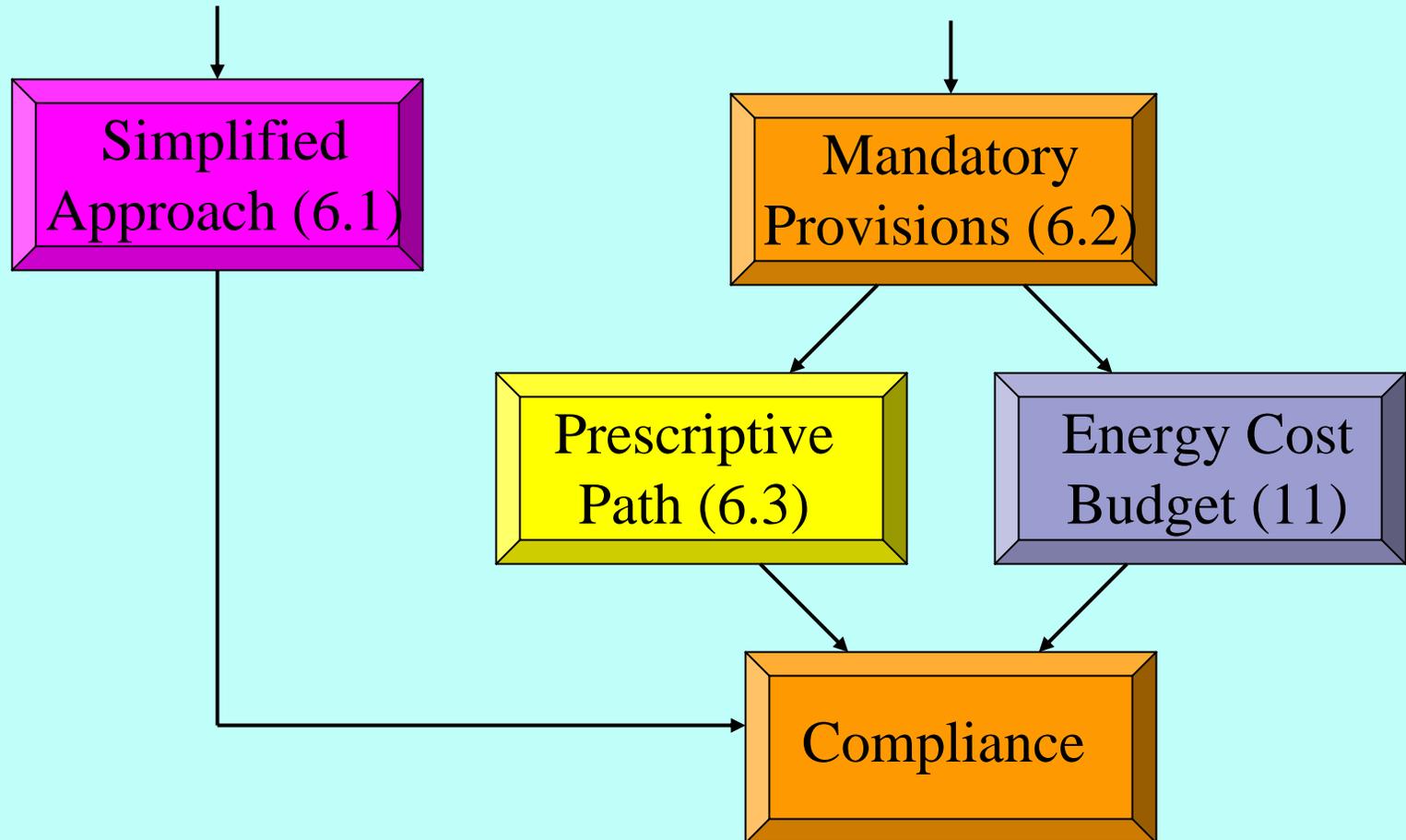
BUILDING ENVELOPE CHANGES (cont)

- ◆ Table 6.2.4.2A Minimum Duct Insulation
 - ◆ **Changed to indicate Climate Zone and omitted Criteria Table column and the HDD & CDD column**
- ◆ Table 6.3.1 Minimum System size for Economizer
 - ◆ **Totally new table and simplified**
- ◆ Tables 6.3.1.1.3A & 6.3.1.1.3B High Limit shutoff controls for economizers
 - ◆ **Changed to indicate Climate Zone**
- ◆ Tables 6.2.3.3.4 Maximum Damper Leakage
 - ◆ **Revised table and changed from HDD/CDD to climate zones**

Section 6 – HVAC



Section 6 – Compliance Paths



Section 6.1 Simplified – New for 2004

- ◆ Addenda “n”
 - ◆ Addition of a detailed explanation of control means to clarify the intent of the supplemental heater control requirements
 - ◆ Exempt NAECA- regulated equipment

Section 6.2 Mandatory – New for 2004

- ◆ Addenda “b”:
 - ◆ **Revisions to Mechanical equipment efficiency requirements for cooling towers**
- ◆ Addenda “c”:
 - ◆ **Allows pressure-sensitive tape for duct sealing if it meets UL-181A or 181B by independent certified testing lab.**

Section 6.2 – New for 2004 (cont.)

- ◆ Addendum “d”:
 - ◆ **Adds minimum efficiency standards for single-package vertical units**

- ◆ Addenda “i”:
 - ◆ **Revises the Standard for three-phase AC units and heat pumps less the 65,000Btu/h. SEER of 12 and an additional 7.4 HSPF for the heat pumps. This addendum does not take effect until January 23, 2006 when the DOE Final Rule is effective.**

- ◆ Addenda “k”:
 - ◆ **Removes the use of standard pneumatic controllers for either zone thermostatic or supply loop control**

Section 6.2 – New for 2004 (cont.)

Addenda “r”:

- ◆ **Revision to duct insulation tables to clarify that insulation requirements for return ducts apply to all return ducts whether for cooling only or heating only or a combined heat/cool system**

◆ Addenda “x”:

- ◆ **Broadens the Requirement for off-hour controls Sec. 6.2.3.2 for HVAC systems (65 Mch to 15 Mch) and adds Sec. 6.2.3.3.5 motors larger than $\frac{3}{4}$ hp to have automatic shutoff controls**

◆ Addenda “z”:

- ◆ **Clarifies the exception to Section 6.2.1 – changes to show that applications requiring secondary coolants are excluded from the standard**

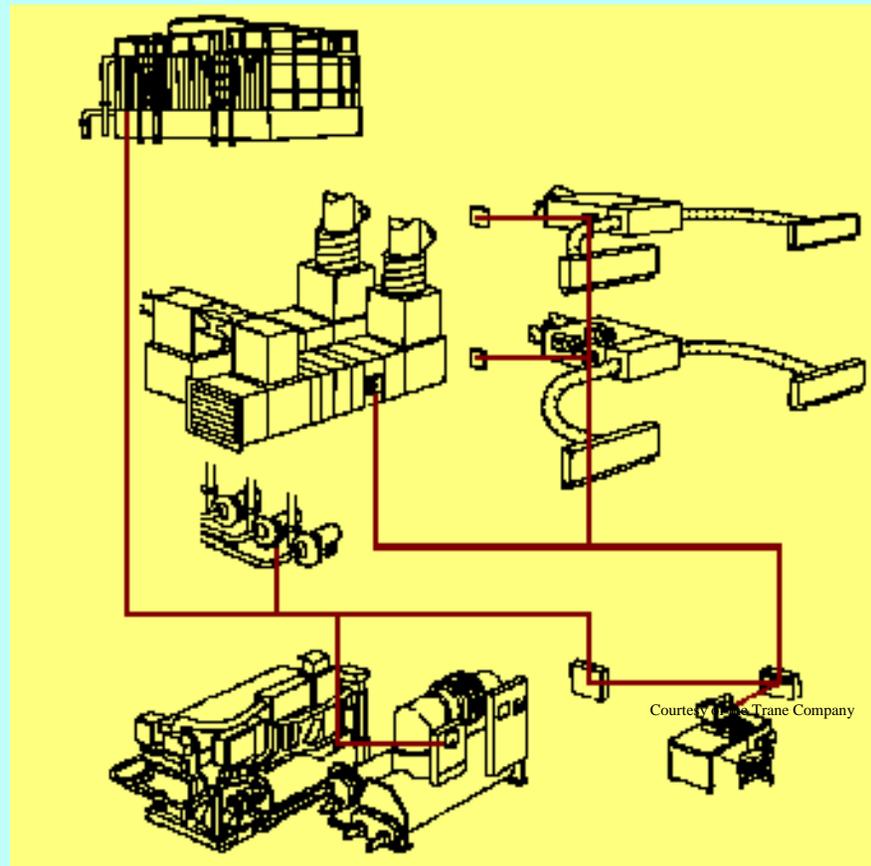
Section 6.3 Prescriptive – New for 2004

- ◆ Addenda “o”:
 - ◆ **Revision to clearly indicated that the exception only applies to heat recovery systems.**
- ◆ Addenda “s”:
 - ◆ **Exception “i” to 6.3.6.1 is modified to apply to any systems requiring dehumidification that employ series energy recovery technology.**
- ◆ Addenda “u”:
 - ◆ **Adds dew-point and dry-bulb temperature as a shutoff control type for Air Economizers to Table 6.3.1.1.3A and 6.3.1.1.3B**

Section 6.3 – New for 2004

- ♦ Addenda “y”:
 - ◆ **Changes the limitation on VAV fan motor requirements (30 hp to 15 hp)**
- ♦ Addenda “ab”:
 - ◆ **Changed wording to be inline with NFPA 96 and the International Mechanical Code on kitchen hoods**

Section 7 – Service Water Heating



Section 7.2 – New for 2004

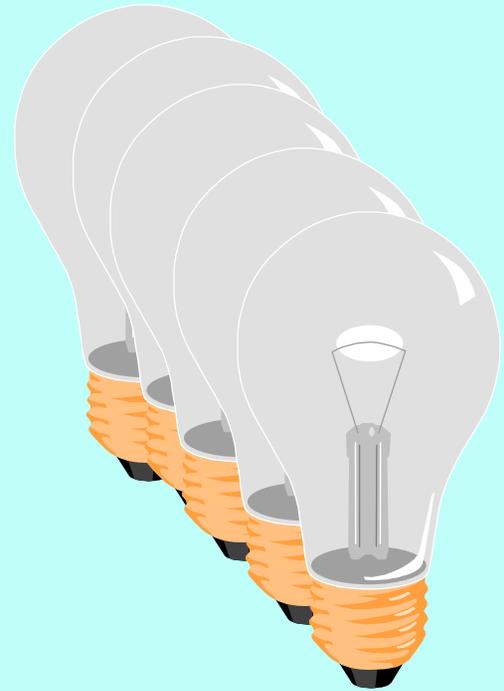
- ◆ Addenda “m”

- ◆ **Adds Performance Requirements for Heat Pump Pool Heaters**

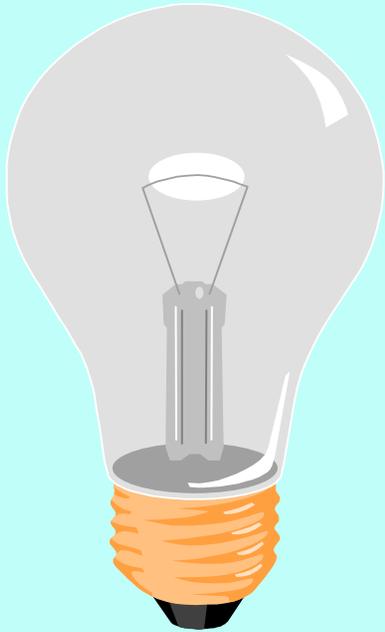
Performance Requirements for Water Heating Equipment

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Performance Required ^a	Test Procedure ^b
Heat Pump Pool Heaters	All		4.0 COP	ASHRAE 146

Section 9 - Lighting



Section 9 - Lighting



- ◆ **9.1 General Application**
- ◆ **9.2 Mandatory Provisions**
- ◆ **9.3 Prescriptive Path**
 - ◆ Interior Lighting Power Allowance
 - *Building Area Method*
 - *Space by Space Method*
 - ◆ Exterior Lighting Power Allowance

9.2 – Mandatory Requirements

New for 2004:

- ◆ Addenda “j”:
 - ◆ **Eliminates possible confusion in understanding the application of control provisions**

- ◆ Addenda “t”:
 - ◆ **Adds exceptions for automatic lighting shutoff devices.**
9.2.1.1c. Spaces where shutoff would endanger safety or security of the room occupants.

- ◆ Addenda “ae”:
 - ◆ **Adds required locations of automatic lighting control devices**

9.2 – New for 2004 (cont)

- ◆ Addenda “ai”:
 - ◆ **Modifies the wattage of exits lights to “shall not exceed 5 watts per face”**
- ◆ Addenda “q”:
 - ◆ **The exterior lighting portion is extensively revised**

9.2 Mandatory Provisions

- ◆ **Automatic Lighting control devices**
 - *Control device shall turn the lighting off within 30 minutes of all occupants leaving the space*
 - Classrooms (not including shop classrooms, laboratories and preschool through 12th grade
 - Conference/meeting rooms
 - Employee lunch and break rooms
 - *All other spaces control device shall be manually by occupant or sensing an occupant*

Section 9.3 – Prescriptive Requirements

SUMMARY:

- ♦ Interior lighting power allowance – two compliance options:
 - ◆ **Building area method**
 - ◆ **Space-by-space method**
- ♦ Exterior lighting power allowance

Section 9.3 – New for 2004

- ◆ Addenda “g” & “ag”:
 - ◆ **Revises the LPDs for both the Building Area Method and Space-by-Space Method**

Lighting Power Densities - 9.3.1.1

- ◆ Building space models were developed to calculate power densities limits using:
 - ◆ **Current product performance data**
 - ◆ **Updated efficacy and loss factors**
 - ◆ **New building construction data**
 - ◆ **IES-recommended light levels**
 - ◆ **Professional lighting design consensus**

9.3.1.1 Building Area Method Lighting Power Densities

Building Area Type ^a	Lighting Power Density (W/ft ²)	
Automotive Facility	1.5	0.9
Convention Center	1.4	1.2
Court House	1.4	1.2
Dining: Bar Lounge/Leisure	1.5	1.3
Dining: Cafeteria/Fast Food	1.8	1.4
Dining: Family	1.9	1.6
Dormitory	1.5	1.0
Exercise Center	1.4	1.0
Gymnasium	1.7	1.1
Healthcare-Clinic	1.0	
Hospital	1.6	1.2
Hotel	1.7	1.0
Library	1.5	1.3
Manufacturing Facility	2.2	1.3
Motel	2.0	1.0
Motion Picture Theatre	1.6	1.2
Multi-Family	1.0	0.7
Museum	1.6	1.1

Office	1.3	1.0
Parking Garage	0.3	0.3
Penitentiary	1.2	1.0
Performing Arts Theatre	1.5	1.6
Police/Fire Station	1.3	1.0
Post Office	1.6	1.1
Religious Building	2.2	1.3
Retail	1.9	1.5
School/University	1.5	1.2
Sports Arena	1.5	1.1
Town Hall	1.4	1.1
Transportation	1.2	1.0
Warehouse	1.2	0.8
Workshop	1.7	1.4

Prescriptive

Space-by-Space Method – 9.3.1.2

- ◆ Identify different building types in your project
- ◆ Divide gross lighted area of the building into each of the space types
- ◆ Calculate lighting power allowance for each space type
- ◆ Sum all the allowances
- ◆ Advantages
 - ◆ **More flexible**
 - ◆ **Applicable to all building types**

Space-by-Space Method 2001– Max. Lighting Power Densities – 9.3.1.2

Building Type	Common Space Types and LPDs (watts/ft ²)																Building Specific Space Types and LPD's (watts/ft ²)			
	Office--enclosed	Office--open plan	Conference Meeting / Multipurpose	Classroom/ Lecture/ Training	Audience/ Seating Area	Lobby	Atrium--first three floors	Atrium-- each additional floor	Lounge/Recreation	Dining area	Food Preparation	Restrooms	Corridor/Transition	Stairs - active	Active Storage	Inactive storage			Electrical/ mechanical	
GYMNASIUM	1.5	1.3	1.5		0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Playing Area	1.9	
																		Dressing Room	0.8	
																			Exercise Area	1.1
EXERCISE CENTER	1.5	1.3	1.5		0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Exercise Area	1.1	
																			Dressing Room	0.8
COURTHOUSE	1.5	1.3	1.5	1.6	1.6	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Courtroom	2.1	
																			Confinement Cells	
																			Judges Chamber	
Police Station																	1.3	Police Station		

Space-by-Space Method 2004

Common Space Types	W/ft ²)
Office-enclosed	1.1
Office-open plan	1.1
Conference/ Meeting/ Multipurpose	1.3
Classroom/ Lecture/ Training	1.4
For Penitentiary	1.3
Lobby	1.3
For Hotel	1.1
For Performing Arts Theater	3.3
For Motion Picture Theatre	1.1
Audience/ Seating Area	0.9
For Gymnasium	0.4
For Exercise Center	0.3
For Convention Center	0.7
For Penitentiary	0.7
For Religious Buildings	1.7
For Sports Arena	0.4
For Performing Arts Theatre	2.6
For Motion Picture theatre	1.2
For Transportation	0.5
Atrium-first three floors	0.6
Atrium-each additional floor	0.2
Lounge/Recreation	1.2
For Hospital	0.8
Dining area	0.9
For Penitentiary	1.3
For Hotel	1.3
For Motel	1.2
For Bar Lounge/Leisure Dining	1.4
For Family Dining	2.1

Food Preparation	1.2
Laboratory	1.4
Restrooms	0.9
Dressing/Locker/Fitting Room	0.6
Corridor/Transition	0.5
For Hospital	1.0
For Manufacturing Facility	0.5
Stairs – active	0.6
Active Storage	0.8
For Hospital	0.9
Inactive storage	0.3
For Museum	0.8
Electrical/ mechanical	1.5
Workshop	1.9
Building Specific Space Types	
Gymnasium/ Exercise Center	
Playing Area	1.4
Exercise Area	0.9
Courthouse/ Police Station/ Penitentiary	
Courtroom	1.9
Confinement Cells	0.9
Judges Chambers	1.3

Fire Stations	
Fire Station Engine room	0.8
Sleeping Quarters	0.3
Post Office - Sorting Area	1.2
Convention Center - Exhibit Space	1.3
Library	
Card File & Cataloguing	1.1
Stacks	1.7
Reading Area	1.2
Hospital	
Emergency	2.7
Recovery	0.8
Nurse station	1.0
Exam/Treatment	1.5
Pharmacy	1.2
Patient Room	0.7
Operating Room	2.2
Nursery	0.6
Medical Supply	1.4
Physical Therapy	0.9
Radiology	0.4
Laundry-Washing	0.6
Automotive - Service/Repair	0.7
Manufacturing	
Low Bay (<25 ft Floor to Ceiling Height)	1.2
High Bay (>25 ft Floor to Ceiling Height)	1.7
Detailed Manufacturing	2.1
Equipment room	1.2
Control room	0.5

Hotel/ Motel Guest Rooms	1.1
Dormitory - Living Quarters	1.1
Museum	
General Exhibition	1.0
Restoration	1.7
Bank/Office - Banking Activity Area	1.5
Religious Buildings	
Worship-pulpit, choir	2.4
Fellowship Hall	0.9
Retail [For accent lighting see 9.3.1.2.1.(c)]	
Sales area	1.7
Mall Concourse	1.7
Sports Arena	
Ring Sports Area	2.7
Court Sports Area	2.3
Indoor Playing Field Area	1.4
Warehouse	
Fine Material Storage	1.4
Medium/Bulky Material Storage	0.9
Parking Garage - Garage Area	0.2
Transportation	
Airport - Concourse	0.6
Air/Train/Bus - Baggage Area	1.0
Terminal - Ticket counter	1.5

Exterior Lighting

THE
GREAT
OUTDOORS



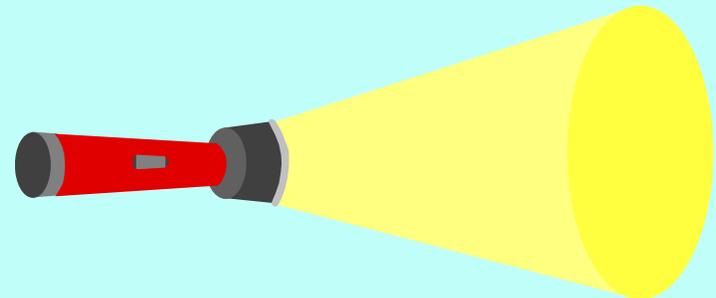
9.2 Mandatory Provisions – Exterior Controls

- ◆ Automatic Exterior Lighting Control Shutoff when sufficient daylight is available or when lighting is not required during nighttime hours
 - *Astronomical time switch for non dusk-to-dawn operation*
 - *Astronomical time switch or photo sensor for dusk-to-dawn operation*



9.3.2 Exterior Building Lighting Power

- ◆ Total exterior lighting power allowance equals the sum of the lighting power densities in Table 9.3.2 and an additional 5%.
- ◆ Trade-offs are allowed only among applications listed in Table 9.3.2 titled “Tradable Surfaces”.
- ◆ Exceptions to 9.3.2 added or modified
 - ◆ “b” is now “l” (monuments and historic landmarks)
 - ◆ Advertising or directional signage
 - ◆ Lighting integral to equipment or instrumentation install by manufacture
 - ◆ Theatrical purposes
 - ◆ Athletic playing areas
 - ◆ Theme/amusement parks



9.3.2 Exterior Building Lighting Power - 2001

EXISTING TABLE 9.3.2
Lighting Power Limits for Building Exteriors

Applications	Power Limits
<i>Building entrance with canopy or free standing canopy</i>	3 W/ft ² of canopied area
<i>Building entrance without canopy</i>	33 W/lin ft of door width
<i>Building exit</i>	20 W/lin ft of door width

Applications	NEW for 2004	Lighting Power Densities
Tradable Surfaces		
Uncovered Parking Areas		
Parking Lots and drives		0.15 W/ft ²
Building Grounds		
Walkways less than 10 feet wide		1.0 Watts/linear foot
Walkways 10+ feet, Plaza areas and Special feature areas		0.2 W/ft ²
Stairways		1.0 W/ft ²
Building Entrances and Exits		
Main Entries		30 Watts/linear foot of door width
Other doors		20 Watts/linear foot of door width
Canopies and Overhangs		
Canopies (free standard & attached and overhangs)		1.25 W/ft ²
Outdoor Sales		
Open areas (including vehicle sales lots)		0.5 W/ft ²
Street Frontage for vehicle sales lots in add to "open area" allowance		20 Watts/linear foot
Non-Tradable Spaces		
Building Facades		0.2 W/ft ² for each illuminated wall or surface or 5.0 Watts/linear foot for each illuminated wall or surface length
Automated Teller Machines & Night Depositories		270 watts per location plus 90 watts per additional ATM per location
Entrances and Gatehouse Inspection Stations at guarded facilities		1.25 W/ft ² of uncovered area (covered areas are included in the Canopies and Overhangs section of Tradable Surfaces)
Loading Areas for Law Enforcement, Fire, Ambulance and other Emergency Service Vehicles		0.5 W/ft ² of uncovered area (covered areas are included in the Canopies and Overhangs section of Tradable Surfaces)
Drive-up Windows at Fast Food Restaurants		400 watts per drive-through
Parking near 24-hour Retail Entrances		800 watts per main entry

Section 11 – ECB Method (Energy Cost Budget)

The Ultimate 90.1 Trade-off Approach

Section 11 – New for 2004

- ◆ Addenda “e”:
 - ◆ **Added or revised 7 definitions**
 - ◆ **Developed a new Informative Appendix “G” (Performance Rating Method)**
- ◆ Addenda “p”:
 - ◆ **Adds a requirement that building energy simulation programs be tested using Standard 140 and that the test results be made available**
- ◆ Addenda “al”:
 - ◆ **Updates the references in Appendix “E”.**

Section 11 – New for 2004 (cont.)

- ◆ Addenda “ac”:
 - ◆ **Number of unrelated changes that are intended to add clarity and specificity.**
 - *Exceptions to 11.3.6 Add: exception (d) manually operated shading devices shall not be modeled. Permanent devices shall be modeled.*
 - *Section 11.3.9 “Other systems” replaced with “Miscellaneous loads”*
 - *Table 11.4.3A (Note 7) Completely rewritten to include requirements for modeling water-source heat pumps*
 - *Additional minor requirements in Section 11.4.3 k(1) and Section 11.4.5*

Section 12 – New for 2004 (cont.)

- ◆ Addenda “aa”:
 - ◆ **Deletes references that are no longer referred to in the Standard, add new references and corrects and updates existing references**

Appendix D – New for 2004

- ◆ Addenda “ah”:
 - ◆ **Adds weather data for the District of Columbia and US Territories to Table D-1**
 - ◆ **Adds weather data for the Philippines to Table D-3**

U.S. and Territories Climatic Data

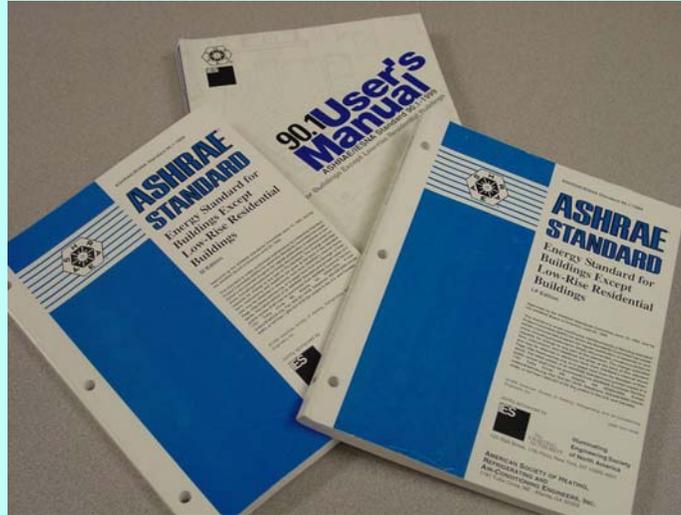
State	City	Table	Latitude	Longitude	Elev. (ft)	HDD65	CDD50	<i>IP Units (°F)</i>			
								Win. Des.	Summer DB	No. Hrs. WB	8am-4pm 55<Tdb<69
District of Columbia (DC)											
	Ronald Reagan Airport	B-13	38.85 N	77.03 W	66	4,047	4,391	15	92	76	657
Puerto Rico (PR)											
	San Juan/Isla Verde WSFO	B-1	18.43 N	66.00 W	10	0	11,406	69	90	78	N.A.
Pacific Islands (PI)											
	Guam (GU) - Andersen AFB	B-2	13.58 N	144.93 E	361	0	10,690	74	87	79	N.A.
	Marshall Island (MH) - Kwajalein Atoll	B-1	8.73 N	167.73 E	26	0	11,670	76	88	79	N.A.
	Midway Island (MH) - Midway Island NAF	B-3	28.22 N	177.37 W	13	134	8,323	59	86	75	N.A.
	Samoa (WS) - Pago Pago WSO Airport	B-1	14.33 S	170.72 W	9	0	11,018	72	88	80	N.A.
	Wake Island - Wake Island WSO Airport	B-1	19.28 N	166.65 E	12	0	11,097	71	89	79	N.A.

4. CODE COMPLIANCE

IECC Chapter 7 requires buildings to comply with **90.1-2001** Part of the ICC series of codes that replace the UBC, BOCA & SBC

NFPA 5000 requires compliance with **90.1 - 2001**

How to Get the Standard



**Standard 90.1-2004 will be available 4th Quarter
this year**

**Visit the ASHRAE Bookstore at
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