U.S. DEPARTMENT OF ENERGY

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Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

ANSI/ASHRAE/IES Standard 90.1-2010 Final Qualitative Determination

M Halverson
J Williamson
B Liu
M Rosenberg
E Richman

October 2011

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

A final qualitative analysis of all addenda to American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2007 (Standard 90.1-2007 or 2007 edition) that were included in ANSI/ASHRAE/Illuminating Engineering Society[1] (IES) Standard 90.1-2010 (Standard 90.1-2010 or 2010 edition) was conducted. All 109 addenda processed by ASHRAE in the creation of Standard 90.1-2010 from Standard 90.1-2007 were evaluated by DOE for their impact on energy efficiency. DOE determined whether each addendum would have a positive, neutral, or negative impact on overall building efficiency.

The results of the textual analysis indicate that less than half of the changes (47 of the total of 109 listed) were neutral. These include editorial changes, changes to reference standards, changes to alternative compliance paths, and other changes to the text of the standard that may improve the usability of the standard, but do not generally improve or degrade the energy efficiency of a building. Nineteen changes were evaluated as having a major positive impact on energy efficiency and 37 changes that were evaluated as having a minor positive impact on energy efficiency. Six changes were identified as having a minor negative impact on energy efficiency.

The 6 negative impacts on energy efficiency include the following:

1. Addendum b – allows larger than minimum ventilation rates if required by other codes.
2. Addendum c – allows an exception to dehumidification for controls for vivariums.
3. Addendum p – increases allowable pressure drop in laboratory exhaust systems.
4. Addendum aw – adds an additional lighting allowance for nightlights in hotel/motel bathrooms.
5. Addendum cc – allows higher flow rates in 8 in. piping.
6. Addendum dc – eliminates tandem wiring requirement.

None of these negative impacts is judged to be significant.

The 19 major positive impacts on energy efficiency include the following:

1. Addendum d – requires daylighting controls under skylights and commissioning of daylighting controls.
2. Addendum e – requires increased use of heat recovery.
3. Addendum f – requires cool roofs in hot climates.
4. Addendum i – lowers illuminance requirements in certain exterior zones.
5. Addendum m – updates chiller efficiency requirements.
6. Addendum n – extends variable air volume fan control requirements.

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[1] IESNA and IES refer to the same organization. The title "IESNA" is associated with Standard 90.1-2007. The title "IES" is associated with Standard 90.1-2010.

7. Addendum x – adds occupancy sensor requirements for many specific applications.
8. Addendum ab – adds daylighting control requirements for side-lighted spaces.
9. Addendum al – requires skylights and daylighting in some building types.
10. Addendum ap – reduces ventilation energy.
11. Addendum av – expands new lighting power densities to more retrofits.
12. Addendum bh – requires supply-air temperature reset for non-peak conditions.
13. Addendum bu – adds efficiency requirements for data centers.
14. Addendum by – requires lower lighting power densities.
15. Addendum cb – expands automatic damper requirements.
16. Addendum cd – requires control of exterior lighting.
17. Addendum cs – minimizes exceptions to switched receptacle requirement.
18. Addendum cy – expands use of economizers.
19. Addendum dd – requires daylighting controls in more spaces.

The 37 addenda that are rated as minor positives are too numerous to list in the summary. However, a comparison of the number of major positives and minor positives (56) to the number of minor negatives (6) indicates that the overall impact on the standard is definitely positive.

Acronyms and Abbreviations

°F	degree(s) Fahrenheit
ACCA	Air Conditioning Contractors of America
AHRI	Air Conditioning, Heating, and Refrigeration Institute
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ATC	Acceptance Test Code
BECP	Building Energy Codes Program
Btu	British thermal unit(s)
Btu/h	British thermal unit(s) per hour
cfm	cubic feet per minute
COP	coefficient of performance
DCV	demand-control(led) ventilation
DDC	direct digital control(s)
DOE	U.S. Department of Energy
ECB	energy cost budget
EISA	Energy Independence and Security Act
EER	Energy Efficient Ratio
ft^2	square feet
gpm	gallon(s) per minute
hp	horsepower
h or hr	hour(s)
in.	inch(es)
$in.^2$	square inch(es)
HVAC	heating, ventilation, and air-conditioning
IEER	Integrated Energy Efficiency Ratio
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IPLV	integrated partial load value
ISO	International Standards Organization
LPD	lighting power density
NFRC	National Fenestration Rating Council
PNNL	Pacific Northwest National Laboratory
SHGC	solar heat gain coefficient
SSPC	Standing Standards Project Committee
U.S.C.	U.S. Code

VAV	variable air volume
VRF	Variable Refrigerant Flow
VT	visible transmittance
W	watt(s)
yr	year(s)

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1.0 Introduction

In support of the U.S. Department of Energy's (DOE's) final determination of energy savings of American National Standards Institute (ANSI)/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2010 (ASHRAE 90.1-2010), staff from Pacific Northwest National Laboratory's (PNNL's) Building Energy Codes Program (BECP) prepared this final analysis of changes made to Standard 90.1 between ANSI/ASHRAE/IESNA Standard 90.1-2007 (ASHRAE 90.1-2007) and ASHRAE Standard 90.1-2010 editions. ASHRAE processes changes to Standard 90.1 in the form of individual addenda, with each addendum representing a single change or set of changes related topically or chronologically. Addenda may range from a few words changed for clarification to complete replacement of a series of requirements tables.

The ensuing sections of this document describe

- the determination process
- the addenda to Standard 90.1-2007 that are included in Standard 90.1-2010
- the impacts of the specific addenda impacts on various sections of Standard 90.1-2010.

2.0 Determination Process

DOE typically requests two types of analysis from BECP in a determination of energy savings for a revised Standard 90.1. The first analysis is a qualitative analysis that attempts to identify all the changes made to the older edition of Standard 90.1 to create the revised standard and categorize the changes as having a positive, negative, or neutral impact on energy efficiency in Standard 90.1. No attempt is made to estimate the actual impact using whole building simulation in the qualitative analysis. Three steps are typically undertaken in the qualitative analysis. The first step is to identify all changes made to Standard 90.1. The second step is to qualitatively estimate the impact of each change on the energy efficiency of Standard 90.1. The third step is to look at the changes and categorize the changes into those that have a clear impact on stringency of requirements in the standard and of these, those that can be incorporated in DOE's quantitative analysis, and those that cannot be readily incorporated into DOE's quantitative analysis.

The second type of analysis that BECP performs for DOE is the quantitative analysis of energy savings of the latest edition of Standard 90.1. This analysis uses the results of the qualitative analysis to identify which changes should be incorporated into the building models used for whole building simulation.

3.0 Addenda Included in Standard 90.1-2010

Table 1 contains the complete list of addenda processed by ASHRAE for inclusion in ANSI/ASHRAE/IES Standard 90.1-2010. A total of 109 addenda to 90.1-2007 exist. All addenda were applied to ASHRAE Standard 90.1-2007 to create ASHRAE Standard 90.1-2010. The following list is taken from Appendix F to ASHRAE Standard 90.1-2010. ASHRAE/IES Standard 90.1-2010 incorporates ASHRAE Standard 90.1-2007 and Addenda a, b, c, d, e, f, g, h, I, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, aa, ab, ac, ad, ae, af, ag, ai, aj, ak, al, am, an, ao, ap, aq, ar, as, at, au, av, aw, ax, ay, az, ba, bc, bd, bf, bg, bh, bi, bj, bk, bl, bm, bn, bo, bp, bq, br, bs, bt, bu, bv, bw, bx, by, ca, cb, cc, cd, ce, cf, ch, ck, cl, cn, co, cp, cq, cr, cs, ct, cv, cw, cy, cz, da, db, dc, dd, de, df, dg, di, dj, dk, dl, dn, do, dp, dq, and dr to ASHRAE Standard 90.1-2007. Table 1 lists each addendum and describes the way in which the text is affected by the change, as well as ASHRAE, IES, and ANSI approval dates. Table 1 is a copy of Appendix F to Standard 90.1-2010 with minor edits to define some of the acronyms used in Appendix F and to make the format of the descriptions the same.

Table 1. Complete List of Addenda Processed by ASHRAE for ANSI/ASHRAE/IESNA Standard 90.1-2010

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
a	6.8.1G	This addendum seeks to clarify that the current cooling tower requirements in the Standard apply to open-circuit cooling towers only.	6/23/2007	6/27/2007	6/12/2007	7/25/2007
b	6.5.2.3	This addendum updates the references for outdoor ventilation rates.	6/23/2007	6/27/2007	6/12/2007	7/25/2007
c	6.5.2.3	This addendum adds vivariums to the list of spaces that require specific humidity levels to satisfy process needs.	6/23/2007	6/27/2007	6/12/2007	7/25/2007
d	5.5.4.4, 9.7	This addendum modifies the daylighting requirements to allow the use of photocontrols combined with skylighting to reduce the electricity used for lighting.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
e	6.5.6	This addendum modifies the requirements for Energy Recovery by expanding them to cover the use of energy recovery by weather zone	1/23/2010	1/27/2010	1/20/2010	1/28/2010
f	5.5.3.1	This addendum sets requirements for high-albedo roofs	6/26/2010	6/30/2010	6/23/2010	7/1/2010
g	Section 5, Normative Appendix A2.3	This addendum updates the building envelope criteria for metal buildings.	6/21/2008	6/25/2008	6/30/2008	7/26/2008
h	6.5.2.1	This addendum adds a new exception that is geared toward zones with direct digital controls (DDC).	6/21/2008	6/25/2008	6/30/2008	7/26/2008
i	9.4.5	This addendum applies a four-zone lighting power density (LPD) approach to exterior lighting requirements.	6/21/2008	6/25/2008	6/30/2008	7/26/2008
j	Section 12, Informative Appendix E	This addendum updates references in the Standard.	1/19/2008	1/23/2008	1/28/2008	1/26/2008
k	Table 6.8.1E, Table 7.8	This addendum specifies specific sections of reference standards in Tables 6.8.1E and 7.8.	1/19/2008	1/23/2008	1/28/2008	7/24/2008
l	Table 6.8.1G, Section 12	This addendum adds minimum efficiency and certification requirements for both axial and centrifugal fan closed-circuit cooling towers (also known as fluid coolers) to Table 6.8.1G. In addition, a reference to ATC-105S, the Cooling Technology Institute test standard for closed-circuit cooling towers, has been added to Section 12, Normative References.	1/19/2008	1/23/2008	1/28/2008	7/24/2008

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
m	Section 6.4.1.2, Table 6.8.1C	This addendum establishes effective January 1, 2010, an additional path of compliance for water-cooled chillers and also combines all water-cooled positive displacement chillers into one category and adds a new size category for centrifugal chillers at or above 600 tons.	10/12/2008	10/24/2008	10/10/2008	10/27/2008
n	6.4.3.10	This addendum extends variable air volume fan control requirements to large single-zone units.	6/21/2008	6/25/2008	6/30/2008	7/26/2008
o	8.1	This addendum provides the necessary pressure credits for laboratory exhaust systems that allow prescriptive compliance of systems serving fume hoods.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
p	6.5.3.1.1	This addendum addresses fan power limitations to all fan systems with exception to those serving fume hoods.	6/21/2008	6/25/2008	6/30/2008	7/26/2008
q	5.4.3.4	This addendum modifies the vestibule requirements for climate zone 4.	1/19/2008	1/23/2008	1/28/2008	7/24/2008
r	Appendix G	This changes Appendix G from an informative appendix to a normative appendix.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
s	Table 6.8.1A, Table 6.8.1B	This addendum updates the Coefficient of Performance (COP) at 17°F efficiency levels for commercial heat pumps and introduces a new part load energy efficiency descriptor for all commercial unitary products above 65,000 Btu/h of cooling capacity.	10/12/2008	10/24/2008	10/10/2008	10/27/2008
t	6.4.1.5.2, Table 6.8.1D	This addendum removes the terms “replacement” and “new construction” from the product classes listed in Table 6.8.1D and replaces them with the terms “non-standard size” and “standard size,” respectively, to clarify that one product class is intended for applications with non-standard size exterior wall openings while the other is intended for applications with standard size exterior wall openings. The addendum also amends Section 6.4.1.5.2 and footnote b to Table 6.8.1D to clarify that non-standard size packaged terminal equipment have sleeves with an external wall opening less than 16 in. high or less than 42 in. wide to reflect existing applications where the wall opening is not necessarily less than 16 in. high and less than 42 in. wide.	10/12/2008	10/24/2008	10/10/2008	10/27/2008
u	6.5.5.3	This addendum adds requirements for axial fan open-circuit cooling towers.	10/12/2008	10/24/2008	10/10/2008	10/27/2008
v	6.4.2	This addendum modifies the requirements for axial fan open-circuit cooling towers.	1/24/2009	1/28/2009	1/26/2009	1/29/2009

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
w	Table G3.1.1A, Section G3.1.2.10	This addendum modifies requirements on exhaust air energy recovery for multifamily buildings in Appendix G.	10/12/2008	10/24/2008	10/10/2008	10/27/2008
x	9.4.1.1	Updates the requirements for automatic lighting shutoffs, adds specific occupancy sensor applications, and provides additional clarification.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
y	Table 7.8, Section 12	This addendum establishes ARI 1160 as the test procedure for heat pump pool heaters and that the minimum COP be met at the low outdoor temperature of 50°F.	6/21/2008	6/25/2008	6/30/2008	7/26/2008
aa	9.4.1	This change mandates that lighting controls have a “manual on” capability	6/20/2009	6/24/2009	6/15/2009	7/22/2009
ab	9.4.1	This change modifies skylighting and daylighting requirements from addendum “d” to 90.1-2007.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
ac	9.1.4, 9.6.2	This addendum modifies requirements for controls in the following applications: personal and manual dimming, multi-scene, manual and automatic bi-level switching, daylighting.	6/21/2008	6/25/2008	6/30/2008	7/24/2008
ad	Table 6.8.1K, Section 6.4.1.4, Section 12	This addendum adds requirements for liquid to liquid heat exchangers and adds a reference to AHRI 400-2008.	6/21/2008	6/25/2008	6/30/2008	7/24/2008
ae	6.4.4.1.4	Adds requirements for radiant heating panels.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
af	6.5.4.5	Modifies the pipe sizing requirements.	1/24/2009	1/28/2009	1/26/2009	1/29/2009
ag	5.8.1.10	This adds a requirement for rigid board insulation overlap.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
ai	G3.1.1.3	This clarifies how distribution pump energy is to be addressed when using purchased heat or purchased chilled water.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
aj	10.4.1	Updates the test and table of Chapter 10 to comply with the new Federal law. Since the new law and the new version of ASHRAE 90.1 will both occur in 2010, this change will ensure that there is no confusion about the new energy efficiency standards for motors that are manufactured in 2010 and beyond.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
ak	6.5.4	Modifies requirements for Heat Pump and Water-Cooled Unitary Air-Conditioners, Differential Pressure Reset, fan power limitations, chilled water cooling, and deletion of 10 hpfrom Section 6.5.4	6/6/2009	6/24/2009	6/15/2009	6/25/2009

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
al	5.5.4.2.3,	Adds skylight requirements in certain space types to promote daylighting energy savings.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
am	5.4.3.2	The intent of this addendum is to revise air-leakage criteria so they more closely reflect current practice.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
an	Appendix A2.4	This addendum expands the table of default U-factors for single-digit rafter roofs.	1/24/2009	1/28/2009	1/26/2009	1/29/2009
ao	Table 6.8.1E	Corrects errors in Table 6.8.1E, re-orders footnotes, and changes one efficiency.	1/24/2009	1/28/2009	1/26/2009	1/29/2009
ap	6.3.2	Modifies the requirements for Demand Control Ventilation (DCV).	1/24/2009	1/28/2009	1/26/2009	1/29/2009
aq	1. Purpose, 2. Scope	This addendum modifies the Title Purpose and expands the Scope of ASHRAE Standard 90.1 so the standard may regulate process loads.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
ar	9.1.3, 9.4.5	This addendum adds exterior lighting power requirements.	1/23/2010	1/27/2010	1/20/2010	1/24/2010
as	6.5.2.1	This addendum adds lab exhaust requirements.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
at	6.4.3.4	This change modifies the exhaust air damper requirements in 90.1	6/20/2009	6/24/2009	6/15/2009	7/22/2009
au	6.3.2	This change modifies the economizer requirements in Standard 90.1.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
av	9.1.2.1	This modifies the requirements of Section 9.1.2, Lighting Alterations, and replaces the previous public review draft of addendum “av” in its entirety.	1/23/2010	1/27/2010	1/20/2010	1/24/2010
aw	9.4.1.4	This change recognizes the practical design application of excluding bathroom lighting from “master” switch control in hotel/motel guest rooms and adds a requirement to eliminate wasted light in guest room bathrooms.	1/19/2008	1/23/2008	1/28/2008	7/26/2008
ax	6.5.7.1	This modifies requirements for kitchen exhaust.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
ay	9.6.1	This change requires users to identify spaces by function and is consistent with a previous interpretation. It is expected that the net energy result will be positive.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
az	9.4.6	Lighting controls must be functionally tested to ensure their proper use and appropriate energy savings. This addendum provides requirements for those tests.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
ba	6.8.3	This addendum adds system performance option that allows compensating for the insulating value of the piping while maintaining the same net thermal requirements.	6/20/2009	6/24/2009	6/15/2009	7/22/2009
bc	5.1.2.2	This clarifies that the requirements in Section 5.5.4.2.3 are also specified for unconditioned spaces.	6/6/2009	6/24/2009	6/15/2009	6/25/2009

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
bd	8.4.1	This addendum removes emergency circuits not used for normal building operation from the requirements, which will lead to increased compliance.	6/6/2009	6/24/2009	6/15/2009	6/25/2009
bf	5.4.3.1	This provides performance requirements for air leakage of the opaque envelope.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
bg	Table 6.8.1B	This provides requirements for water-to-water heat pumps.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bh	6.5.3.3	This addendum provides requirements for multiple-zone HVAC) systems (that include simultaneous heating and cooling) to include controls that automatically raise the supply-air temperature when the spaces served are not at peak load conditions.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bi	6.4.4.1.3	This addendum provides updated requirements for pipe insulation.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
bj	G3.1.2.5	This addendum adds an exception in Appendix G that allows users to claim energy cost savings credit for the increased ventilation effectiveness of certain HVAC system designs.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bk	10.4.1	This addendum distinguishes Subtype I and Subtype II motors. Addendum "aj" to ASHRAE Standard 90.1-2007 first incorporated these changes into Standard 90.1. This proposed language has different minimum efficiency requirements as called out in EISA 2007, Section 313 and clarified in the Federal Register.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bl	6.4.1.2.1	This addendum adds requirements for chillers with secondary coolants (glycol or brine). In additions, there are changes to footnote a to Table 6.8.1C in recognition of lower practical scope limits for positive displacement (both air- and water-cooled) and corrects for the lower limit introduced in Addendum M for centrifugal chillers.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bm	3.3	The intent of this addendum is to coordinate terminology for visible transmittance with NFRC 200.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bn	5.5.4.5	This addendum limits poorly oriented fenestration. Compliance can be shown by having more south-facing fenestration than west facing fenestration. For those buildings affected by this requirement, this reduces envelope loads, energy usage, and thereby costs.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
bo	11.3.2, G3.1.2.1	This addendum is part of an ongoing effort to keep the requirements of Section 11 and Appendix G consistent with other addenda to the Standard. This addendum makes changes to Section 11 and G related to Addenda e, s, and u.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bp	9.4.1	This addendum allows the use of control that provides automatic 50% auto on with the capability to manually activate the remaining 50% and has full auto-off.	1/23/2010	1/27/2010	1/20/2010	1/24/2010

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
bq	9.6.2	This addendum changes the requirements for retail space lighting, which will make use of more recent lamp technology that is readily available.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
br	9.4.5	This addendum adds an exterior zone 0 to cover very low light requirement areas	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bs	8.4.2	This new requirement will provide the means for non-critical receptacle loads to be automatically controlled (turned off) based on occupancy or scheduling without additional individual desk top or similar controllers.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
bt	6.4.1.2	This addendum modifies centrifugal chiller adjustment factor for nonstandard conditions.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
bu	6.4.1.1, 6.5.1, table 6.8.1H	This addendum adds efficiency requirements to HVAC systems dedicated to computer rooms and data centers.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
bv	G3.1.2.9	This addendum makes Appendix G of Standard 90.1 consistent with addenda aj, bk, and ax.	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bw	Table 6.8.1D	This addendum modifies efficiency requirements for packaged terminal air conditioner (PTAC).	1/23/2010	1/27/2010	1/20/2010	1/28/2010
bx	6.5.2.1	This addendum modifies variable air volume (VAV) reheat requirements.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
by	9.6.2, Table 9.5.1	Proposes new Lighting Power Densities for both the whole building and space-by-space compliance methods. In addition, the Lighting Power Density may be re-calculated based on room geometry.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
ca	6.5.3.1.1	Closes a loophole in the fan power allowances for VAV systems. Standard VAV systems are multi-zone systems with terminal units containing control dampers to vary airflow to individual zone.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cb	6.3.2, 6.4.3.4.2	This addendum includes a number of changes to require simple systems to meet prescriptive outdoor air damper requirements, allow backdraft dampers only for exhaust and relief dampers in buildings less than three stories in height, require backdraft dampers on outdoor air intakes to be protected from wind limiting windblown infiltration through the damper.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cc	Table 6.5.4.5	This addendum corrects the way 8” pipe was analyzed. RS Means data for threaded pipe was used for 8” when welded pipe data should have been used. It also includes a minor editorial change since it is not possible to operate more than 8760 hr/yr.	6/26/2010	6/30/2010	6/23/2010	7/1/2010

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
cd	9.4	Additions to 1) strengthen the language to actually require exterior control rather than just require the control capability; 2) add bi-level control for general all-night applications such as parking lots to reduce lighting when not needed; 3) add control for façade and landscaping lighting not needed after midnight.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
ce	9.4.1.2	Additional control requires that all spaces (unless exempted) have multilevel control capability (also commonly known as bi-level switching).	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cf	9.4.1.4	Adds requirements for automatic reduction of stairway lighting within thirty minutes of occupants exiting the zone.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
ch	11.3.2, G3.1.1	This addendum makes Appendix G and Section 11 consistent with requirements approved in Addenda h (dual minimum controls) and as (lab exhaust).	6/26/2010	6/30/2010	6/23/2010	7/1/2010
ck	6.5.3	This addendum expands zone level demand controlled ventilation to include various forms of system level strategies.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cl	5.5.4.4.2, Appendix C	The proposed text would clarify how to interpret the use of dynamic glazing products that are designed to be able to vary a performance property such as Solar Heat Gain Coefficient (SHGC), rather than having just a single value.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cn	Table 9.6.2	Adds two versions of a combined advanced control to the control incentives table. These control system combinations involve personal workstation control and workstation-specific occupancy sensors for open office applications. The control incentive will apply only to the particular controls when they are applied in open office areas.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
co	Table 6.8.1A	This proposal makes three major amendments to Table 6.8.1A. First, it updates Energy Efficient Ration (EER) and Integrated Energy Efficiency Ratio (IEER) values for all condensing units and water and evaporatively cooled air conditioners with cooling capacities greater than 65,000 Btu/h. Second, the proposal establishes a separate product class for evaporatively cooled air conditioners with different energy efficiency standards. Third, the proposal replaces the integrated partial load value (IPLV) descriptor for condensing units with the new IEER metric and amends the EERs with more stringent values.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cp	6.4.1.1, Table 6.8.1L	This proposal establishes, for the first time in ASHRAE 90.1, efficiency requirements for Variable Refrigerant Flow (VRF) air conditioners and heat pumps, including heat pumps that use a water source for heat rejection.	6/26/2010	6/30/2010	6/23/2010	7/1/2010

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
cq	6.4.4.2	This addendum modifies the duct-sealing requirements in ANSI/ASHRAE/IESNA Standard 90.1-2007.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cr	Table 11.3.1, Appendix G	Modifies definition of unmet load hour. It is currently lacking a throttling range or limit to the setpoint. It was decided that the baseline and proposed shall have the same thermostat throttling range. This required additional language in the unmet load hour definition as to how throttling range effects determination of an unmet hour along with additional language in Table 11.3.1 and Table G3.1, Design Model sections.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cs	8.4.2	Modifies automatic receptacle control requirements and exemptions to eliminate potential practical application issues.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
ct	9.4.1.3	This addendum sets controls for the "night lights" that are part of the emergency system when there are no occupants in the space. This has definite energy savings and is not prohibited by the electrical codes.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cv	10.4.2	This addendum adds energy efficiency requirements for service-water pressure booster systems.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cw	11.3.1	Addresses corrections and clarifications necessary to Section 11, Table 11.3.1 and Section 11, Service Hot Water Systems.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
cy	6.5.1	This addendum makes several revisions to the economizer requirements in Section 6.5.1 and in Section 6.3.2. With increased envelope insulation levels and higher internal plug loads we are seeing commercial buildings operating in cooling at lower ambient temperatures. This allows for greater air and water economizers to be used instead of mechanical cooling.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
cz	9.4.1.3	Incorporates bi-level control for parking garages to reduce the wasted energy associated with unoccupied periods for many garages AND allows an exception for lighting in the transition (entrance/exit) areas to accommodate IES recommendations.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
da	G3.1.2.5	Establishes that an Appendix G baseline shall be based on the minimum ventilation requirements required by local codes or a rating authority and not the proposed design ventilation rates.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
db	G3.1.2	This addendum modifies the fan power requirements in the energy cost budget section.	7/20/2010	7/23/2010	7/24/2010	7/26/2010

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
dc	9.4.2	The conditions and common practice that existed to create the need for this requirement on tandem wiring are no longer practiced primarily with the new Federal efficacy requirements and products available on the market. Therefore, removes information related to tandem wiring of lighting.	6/26/2010	6/30/2010	6/23/2010	7/1/2010
dd	5.5.4.2.3	This addendum modifies the VAV fan power limitation requirements.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
de	Table 9.6.1	This addendum lowers the LPDs in Standard 90.1 to reflect advances in lighting technology.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
df	10.4.3	This addendum sets requirements for elevator ventilation and lighting, which have been unregulated, regardless of occupancy.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dg	Table G3.1	This addendum adds a definition for the term "field-fabricated fenestration" used in Section 5.4.3.2, which is similar to the definition in California's Title 24.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
di	6.4.3.4.6	This addendum allows for a reduction in ventilation in uncontaminated garages.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dj	Table 6.5.3.1.1B	This addendum provides limits on the pressure drop of energy-recovery devices.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dk	Appendix C	This addendum makes Standard 90.1-2010 consistent with changes made in addenda al, bc, and bn.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dl	Appendix C	This addendum gives instruction to the users of Appendix C on how to model the base envelope design and the proposed envelope design in complying with the cool-roof provisions in Section 5.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dn	G3.1.1	This addendum modifies the efficiencies for variable refrigerant flow equipment.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
do	9.7	This addendum establishes the goals and requirements of the lighting system including controls and to ensure that the owner is provided all information necessary to best use and maintain the lighting systems	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dp	Section 12	This addendum updates the references in Standard 90.1. While these changes reflect the current edition of the cited standard it should be noted that substantive changes in the referenced documents did not affect the requirements in Standard 90.1 or change the stringency of the requirements of Standard 90.1.	7/20/2010	7/23/2010	7/24/2010	7/26/2010
dq	Appendix C	This addendum modifies the calculations found in Appendix C in order to reflect modifications to the modeling assumptions in the equations.	7/20/2010	7/23/2010	7/24/2010	7/26/2010

Table 1. (contd)

Addendum	Section(s) Affected	Description of Changes	ASHRAE Standards Committee Approval	ASHRAE Board of Directors Approval	IESNA Board of Directors Approval	ANSI Approval
dr	9.4.4	The original purpose for this provision was to limit the use of inefficient lighting sources for high wattage applications when there was not a comprehensive table of exterior LPD limits. With the table of requirements now in the 2007 edition and beyond versions of Standard 90.1, the need for this limit is superseded.	7/20/2010	7/23/2010	7/24/2010	7/26/2010

4.0 Impacts of Addenda in Standard 90.1-2010

After obtaining the complete list of ASHRAE addenda in Table 1, each addendum was examined to provide a subjective evaluation of the impact of the addenda on overall building energy efficiency. Many of the addenda are simply clarification of the text of Standard 90.1 and have been determined to have no impact on energy efficiency. Other addenda have been determined to have significant positive or negative impacts on energy efficiency. The most common type of positive impact on energy efficiency occurs when a requirement is changed from one level of performance to a higher level of performance. The reverse change, from a higher level of performance to a lower level of performance, is less common. However, there are a number of addenda where exceptions are provided for various requirements and addition of an exception or expansion of an exception would be considered a negative impact on energy efficiency.

No attempt is made to quantify the impact on energy efficiency except to rank changes as major and minor. Quantification of the impact on energy efficiency is the focus of the second part of DOE's determination process. A later section in this document will address the possibility of quantifying the impact of each individual addendum.

Table 2 assesses the energy efficiency impact of each addendum. Addenda are ranked as "major +" (having significant positive impact), "minor +" (minor positive impact), "0" (no impact), "major –" (negative impact), or "minor –" (minor negative impact) on energy efficiency. A reason for the ranking is provided for each addendum as well. Two addenda are also listed as having "small but unquantifiable impact" because the assumed impact depends on how DOE interprets the existing language of Standard 90.1-2007. The rating provided for each addendum includes consideration of its impact on all compliance paths where the addendum has an impact.

Table 2. Summary of Differences between Standards 90.1-2007 and 90.1-2010, by Addenda

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
1	A	6. Heating, Ventilating, and Air Conditioning	Table 6.8.1G	Same	Removes closed-circuit cooling tower requirements from 6.8.1G	0 (clarifies that requirements do not apply to closed-circuit cooling towers)
2	B	6. Heating, Ventilating, and Air Conditioning	6.5.2.3	Same	Revises exception a to Section 6.5.2.3 to allow for codes other than ASHRAE 62.1 to dictate minimum ventilation rates.	Minor – (allows larger minimum ventilation rates if required by other codes)
3	C	6. Heating, Ventilating, and Air Conditioning	6.5.2.3	Same	Adds vivarium to list of spaces that require specific humidity levels to satisfy process needs.	Minor – (allows exception to dehumidification controls for vivariums)
4	d	3. Definitions, Abbreviations, and Acronyms; 5. Building Envelope; 9. Lighting	3.2, 5.5.4.4.2, 5.7.3, 5.8.2.1, 5.8.2.2, 5.8.2.6, 9.4.1.4, Figures 9.1 and 9.2, 9.4.1.5, 9.4.1.6, and 9.7	Same	Adds exceptions for solar heat gain coefficient (SHGC) and visible transmittance (VT) requirements for skylights; adds requirement for including visible light transmittance test results with construction documents; adds information on determining daylit area under skylights, automatic daylighting controls (with exceptions), and submittal requirements.	Major + (requires daylighting controls under skylights and commissioning of daylighting controls)
5	e	6. Heating, Ventilating, and Air Conditioning	6.3.2, 6.5.6, and Table 6.5.6.1	Same	Changes exhaust air energy-recovery requirements and harmonizes requirements in simplified Section 6.3.2 with requirements in the Section 6.5 prescriptive path.	Major + (increased use of heat recovery)
6	f	5. Building Envelope	5.5.3.1	Same	Requires high-albedo roofs in hot climates.	Major + (requires cool roofs in hot climates)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
7	g	3. Definitions, Abbreviations, and Acronyms; 5. Building Envelope Normative Appendix A. Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations	3.2, Table 5.5-1 through Table 5.5-8, A2.3, and Tables A2.3 and A3.2	Same	Updates building envelope criteria for metal buildings.	Minor + (increases envelope requirements for metal buildings)
8	h	6. Heating, Ventilating, and Air Conditioning	6.5.2.1	Same	Adds another exception to Section 6.5.2.1 Limitation of Simultaneous Heating and Cooling. The exception addresses the apparent conflict between standards and allows users to achieve comfort, meet the code, and save energy.	Minor + (allows another exception that saves energy in some applications)
9	i	9. Lighting	9.4.5, Table 9.4.6	Same	Applies a four-zone LPD approach to exterior lighting requirements. Deletes the 5% additional power allowance in Section 9.4.5 and replaces it with a base wattage allowance per site. Defines the four zones and applies the appropriate requirements.	Major + (lowers illuminance requirements in certain zones)
10	j	6. Heating, Ventilating, and Air Conditioning; 12. Normative References; Appendix E. Informative References	Table 6.8.1E, Chapter 12, and Appendix E	Same	Updates the mechanical test procedures references in the standard. The changes also modify a reference in Table 6.8.1E, the normative references in Chapter 12, and the informative references in Informative Appendix E.	0 (updates references)
11	k	6. Heating, Ventilating, and Air Conditioning; 7. Service Water Heating	Table 6.8.1E and Table 7.8	Same	Updates Tables 6.8.1E and 7.8 to identify specific sections of referenced standards. Table 7.8 also reflects the current Federal efficiency levels for residential water heaters and adds a requirement for electric table-top water heaters.	0 (updates tables to reflect current Federal standards)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
12	l	6. Heating, Ventilating, and Air Conditioning; 12. Normative References	Table 6.8.1G, Section 12	Same	Adds minimum efficiency and certification requirements for axial and centrifugal fan closed-circuit cooling towers. Also adds a reference to ATC-105S, the Cooling Technology Institute test standard for closed-circuit cooling towers to Section 12.	0 (Requirement codifies industry standard practice)
13	m	6. Heating, Ventilating, and Air Conditioning	6.4.1.2 and Table 6.8.1C	Same	Updates chiller efficiency requirements. Establishes additional path of compliance for water-cooled chillers. Combines all water-cooled chillers into one category and adds a new size category for centrifugal chillers at or above 600 tons.	Major + (updates chiller efficiency requirements)
14	n	6. Heating, Ventilating, and Air Conditioning	6.3.2 and 6.4.3.10	Same	Extends VAV fan control requirements to large single-zone units.	Major + (extends control requirements to another equipment class)
15	o	8. Power	8.1, 8.4.2, and Table 8.1	Same	Modifies the scope of Section 8 and adds requirements specific to low voltage dry-type distribution transformers.	0 (implements Federal efficiency standards for transformers)
16	p	6. Heating, Ventilating, and Air Conditioning	6.5.3.1.1 and Table 6.5.3.1.1B	Same	Provides pressure credits for laboratory exhaust systems that allow prescriptive compliance with the standard.	Minor – (increases allowable pressure drop in laboratory exhaust systems)
17	q	5. Building Envelope	5.4.3.4	Same	Vestibules, remove climate zone 4 exception	Minor + (applies vestibule requirement in more locations)
18	r	Informative Appendix G. Performance Rating Method	Informative Appendix G. Performance Rating Method	Normative Appendix G. Performanc e Rating Method	Changes Informative Appendix G Performance Rating Method into a Normative Appendix. Additionally, some language has been modified to make the appendix enforceable.	0 (performance rating method only)
19	s	6. Heating, Ventilating, and Air Conditioning	Tables 6.8.1A and B	Same	Updates the COP at 17°F efficiency levels for commercial heat pumps and introduces a new part-load energy efficiency descriptor (IEER) for all commercial unitary products above 65,000 Btu/h of cooling capacity.	0 (replaces IPLV with IEER to capture part load performance)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
20	t	6. Heating, Ventilating, and Air Conditioning	6.4.1.5.2 and Table 6.8.1D	Same	Removes the term "replacement" and "new construction" from the product classes listed in Table 6.8.1D and replaces them with the terms "nonstandard size" and "standard size" to clarify that one product class is intended for applications with nonstandard size exterior wall openings while the other is intended for applications with standard size exterior wall openings. Also amends Section 6.4.1.5.2 and footnote b to Table 6.8.1D to clarify that nonstandard size packaged terminal equipment have sleeves with an external wall opening less than 16 in. high or less than 42 in. wide to reflect existing applications where the wall opening is not necessarily less than 16 in. high and less than 42 in. wide. However, to avoid a potential abuse of the definition, nonstandard size packaged terminal equipment is required to have a cross-sectional area of the sleeves less than 670 $in.^2$.	0 (clarification of definitions)
21	u	6. Heating, Ventilating, and Air Conditioning	6.5.5.3	Same	Adds a new section requiring centrifugal fan open-circuit cooling towers over 1100 gpm at the rating conditions to meet efficiency requirements for axial fan units found in 6.8.1G.	Minor + (applies cooling tower requirements more broadly)
22	v	6. Heating, Ventilating, and Air Conditioning; 12. Normative References	6.4.2 and Section 12	Same	Revises Section 6.4.2.1 to reference ANSI/ASHRAE/Air Conditioning Contractors of America (ACCA Standard 183-2007 for sizing heating and cooling system design loads. Adds requirements for calculating pump head.	0 (updates references)
23	w	Normative Appendix G. Performance Rating Method	Table G3.1.1A and Section G3.1.2.10	Same	Changes footnote to Table G3.1.1A to make it clear that Exception a to Section G3.1.1 also applies here. Changes the exception to G3.1.2.10 on Exhaust Air Energy Recovery for multifamily buildings because they are unlikely to have a centralized exhaust air system needed to effectively recover heat.	0 (performance rating method)
24	x	9. Lighting	9.1.2, 9.4.1.1, and 9.4.1.2,	Same	Updates requirements for automatic lighting shutoff, adds specific occupancy sensor applications, and provides additional clarification.	Major + (adds occupancy sensor requirements for many specific applications)
25	y	7. Service Water Heating	Table 7.8	Same	Establishes ARI 1160 as the test procedure for heat pump pool heaters and requires that the minimum COP of 4 be met at the low outdoor temperature of 50 °F.	Minor + (requires COP be met at lower temperature)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
26	aa	9. Lighting	9.4	Same	Adds space exceptions for automatic lighting controls.	Minor + (limits automatic-on controls to specific space types)
27	ab	3. Definitions, Abbreviations, and Acronyms ; and 9. Lighting	3.2, Figure 3.1, Figure 3.2, Figure 3.4, 5.5.4.4.4.2, 9.4.1.3, and 9.4.1.4	Same	Adds definitions and provides daylighting control requirements for side-lighted spaces.	Major + (adds daylighting control requirements for side-lighted spaces)
28	ac	3. Definitions, Abbreviations, and Acronyms; 9. Lighting	3.2, 9.1.4, 9.6.2 and Table 9.6.2	Same	Adds incentives to use advanced lighting controls.	0 (alternate compliance path)
29	ad	6. Heating, Ventilating, and Air Conditioning; 12. Normative References	Table 6.8.1K, 6.4.1.4 and Section 12	Same	Includes certification requirements for liquid-to-liquid heat exchangers to benefit both manufacturers and consumers, allow product comparisons, and provide incentives to manufacturers to improve efficiency in order to gain market share.	0 (documentation only)
30	ae	3. Definitions, Abbreviations, and Acronyms; 6. Heating, Ventilating, and Air Conditioning	3.2 and 6.4.4	Same	Adds a requirement for insulating the surfaces of radiant panels that do not face conditioned spaces.	Minor + (reduced heat loss in radiant panels)
31	af	3. Definitions, Abbreviations, and Acronyms; 6. Heating, Ventilating, and Air Conditioning	3.2, 6.5.4.5, and Table 6.5.4.5	Same	Provides requirement for designers, contractors, and owners to properly size system piping (hydronic systems) to balance ongoing energy costs and first costs.	Minor + (requires proper hydronic system sizing)
32	ag	5. Building Envelope	5.8.1.10	Same	Adds requirement for rigid board insulation overlap.	Minor + (reduces potential for thermal bridging)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
33	ai	Normative Appendix G. Performance Rating Method	Informative Appendix G. Performance Rating Method	Same	Removes requirement for comparing proposed buildings using chilled water with a baseline building with onsite chillers, and instead requires a baseline that also uses purchased chilled water. Details modifications to be made to the baseline HVAC systems when purchased chilled water or heat are included.	0 (alternative compliance path)
34	aj	10. Other Equipment	10.4 and 10.8	Same	Updates the text and table of Chapter 10 to comply with new Federal law for motors rated at 1.0 hp and greater. Adding this information will help designers, end-use customers, and code officials with motor specifications and verifications.	0 (implements Federal motor requirements)
35	ak	6. Heating, Ventilating, and Air Conditioning	6.5.4, 6.5.4.1, and 6.5.4.2	Same	Adds a pump isolation requirement for systems with multiple chillers and boilers and temperature reset requirement for equipment with a minimum Btu/h. Revises wording to have requirements of Section 6.5.4.1 apply only to cooling systems. Changes threshold of variable speed systems to 7.5 hp. Adds requirement for differential pressure reset. Does not preclude also implementing chilled water supply temperature setpoint reset. Includes requirements for hydronic heat pump and water-cooled unitary air conditioners.	Minor + (reduces pumping energy)
36	al	5. Building Envelope	5.5.4.2.2 and 5.5.4.2.3	Same	Adds skylight requirements in certain space types (enclosed spaces) to promote daylighting energy savings.	Major + (requires skylights and daylighting in some building types
37	am	3. Definitions, Abbreviations, and Acronyms; 5. Building Envelope; 12. Normative References	3.2, 5.4.3.2, and 12. Normative References	Same	Revise air-leakage criteria for fenestration and doors.	Minor + (decreased air leakage)
38	an	Normative Appendix A. Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations	A2.4	Same	Expands table of default U-factors for single-digit rafter roofs.	0 (updates default tables)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
39	ao	6. Heating, Ventilating, and Air Conditioning	Table 6.8.1E	Same	Repairs know errata to Table 6.8.1E and re-orders the notes to properly organize them. Corrects the error of identifying E_C, which should be listed as Et under "Warm Air Furnaces, Gas-Fired," and also eliminates incorrect and redundant footnotes.	0 (editorial only)
40	ap	6. Heating, Ventilating, and Air Conditioning	6.3.2	Same	Includes demand-controlled ventilation in the simplified approach.	Major + (reduces ventilation energy)
41	aq	Title, 1. Purpose, and 2. Scope	Sections 1 and 2	Same	Modify Title Purpose & Scope of ASHRAE Standard 90.1.	0 (no impact now, but does allow future positive additions to Standard 90.1)
42	ar	9. Lighting	3.2, 9.1.3, 9.1.4, and 9.4.5	Same	Corrects an oversight in previous editions where expanded exterior lighting power limits were put in place but the details of how to calculate the installed power and compare it to the limits was not included. This language revision puts the needed details in the standard.	0 (editorial only)
43	as	3. Definitions, Abbreviations and Acronyms; 6. Heating, Ventilating, and Air Conditioning	3.2, 6.5.2.1, and 6.5.7	Same	Removes exception for VAV turndown requirements for zones with special pressurization requirements. Reduces laboratory threshold where VAV or heat recovery is required.	Minor + (saves large amount of fan and reheat energy in hospitals)
44	at	6. Heating, Ventilating, and Air Conditioning	6.4.3.4.2, 6.4.3.4.3, 6.4.3.4.4, and 6.5.1.1.4	Same	Clears up inconsistencies and conflicts regarding damper requirements in Chapter 6.	0 (editorial only)
45	au	6. Heating, Ventilating, and Air Conditioning	Table 6.3.2	Same	Updates efficiency tradeoff table for eliminating economizers.	0 (alternate compliance path)
46	av	9. Lighting	9.1.2	Same	Changes Section 9.1.2 to require that in all spaces where alterations take place, all requirements of Section 9 are met. Changes exception so that the LPD requirements of the standard are met in the altered space if less than 10% of luminaries are replaced.	Major + (expansion of new LPDs to more retrofits)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
47	aw	9. Lighting	9.4.1.4	Same	Recognizes practical design application of excluding bathroom lighting from "master" switch control in hotel/motel guest rooms and adds a requirement to eliminate wasted light in guest room bathrooms. Adds a 5-W allowance for night-lights that recognizes the practical current design application of guest room bathroom night-light use but at a reasonable low level.	Minor – (adds additional lighting allowance)
48	ax	3. Definitions, Abbreviations, and Acronyms ; 6. Heating, Ventilating, and Air Conditioning	Section 3 and 6.5.7.1	Same	Expands requirements for Kitchen Exhaust Systems (formerly Section 8.4.1 Kitchen Hoods). Includes addition of definitions for transfer air, replacement air, and makeup air. Adds Table 6.5.7.1.3 defining the maximum exhaust flow rate through various hood types (cfm/linear foot of hood length). Include provisions for hoods with flows greater than 5,000 cfm. Require performance testing to evaluate design airflow rates and demonstrate capture and containment performance.	Minor + (more stringent kitchen exhaust requirements)
49	ay	9. Lighting	9.6.1	Same	Change that requires users to identify spaces by function.	Minor + (requires users to use proper LPDs)
50	az	9. Lighting	9.4.6	Now in Section 9.4.due to deletions of sections in other addenda	Adds requirements for lighting controls to be functionally tested to ensure proper use and appropriate energy savings.	Minor + (requires testing of lighting systems)
51	ba	6. Heating, Ventilating, and Air Conditioning	Table 6.8.3 footnote e	Same	Allows a system performance option that allows for compensating for the insulating value of the piping while maintaining the same net thermal requirements.	0 (alternative compliance path)
52	bc	5. Building Envelope	5.1	Same	Clarifies that the requirements in Section 5.5.4.2.3 are also specified for unconditioned spaces.	0 (clarification only)
53	bd	8. Power	8.4.1	Same	Removes emergency circuits not used for normal building operation from the requirements, which will lead to increased compliance. Allows for an increased conformance/use of Standard 90.1 by eliminating issues of impracticality of feeder drop requirements for emergency circuits and provides significant initial cost savings.	0 (removes emergency circuits from requirements, but only impact is when emergency circuits are activated)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
54	bf	3. Definitions, Abbreviations, and Acronyms ; 4. Administration and Enforcement; 5. Building Envelope	3.2, 4.2.4, and 5.4.3.1	Same	Modifies language to include performance requirements for air leakage of the opaque envelope.	Minor + (reduces air leakage allowances in opaque envelope)
55	bg	6. Heating, Ventilating, and Air Conditioning; 12. Normative References	Table 6.8.1B and Chapter 12	Same	Establishes a product class for water-to-water heat pumps. Intent is to recognize the technology in Standard 90.1 by requiring minimum energy efficiency standards. Cooling EERs and heating COPs are proposed for products with cooling capacities below 135,000 Btu/h at standard rating conditions listed in ISO standard 13256-2.	Minor + (adds requirement where no requirement previously existed)
56	bh	6. Heating, Ventilating, and Air Conditioning	6.5.3.3 and Table 6.8.1B	Same	Provides requirements for multiple-zone HVAC systems (that include simultaneous heating and cooling) to include controls that automatically raise the supply-air temperature when the spaces served are not at peak load conditions. Allows an override of the temperature reset if a maximum space humidity setpoint is exceeded. There is an exception from this requirement for warm and humid climate zones 1a, 2a, and 3a.	Major + (requires supply-air temperature reset for non-peak conditions)
57	bi	6. Heating, Ventilating, and Air Conditioning	6.4.4.1.3 and Table 6.8.3 (A and B – new designations)	Same	Updates requirements for piping insulation, including incorporation of new Standard 90.1 economic criteria used in developing standard requirements. Adds footnotes to address constrained locations and clarify requirements for direct buried piping.	Minor + (reduced piping heat loss/gain)
58	bj	Normative Appendix G. Performance Rating Method	G3.1.2.5	Same	Adds an exception in Appendix G that allows users to claim energy cost savings credit for the increased ventilation effectiveness of certain HVAC system designs.	0 (alternative compliance path)
59	bk	3. Definitions, Abbreviations and Acronyms; and 10. Other Equipment	3.2 and 10.4	Same	Includes the minimum efficiency requirements for both Subtype I and Subtype II motors and clarifies to what specific motor types these requirements apply.	0 (clarification only)
60	bl	6. Heating, Ventilating, and Air Conditioning	6.4.1.2	Same	Corrects the intent of the standard to not exempt all chillers with secondary coolants for freeze protection from coverage by Table 6.8.1C and removes ambiguity. Changes footnote a to Table 6.8.1C in recognition of lower practical scope limits for the lower limit introduced in Addendum M for centrifugal chillers.	Minor + (removes exemption for some chillers)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
61	bm	3. Definitions, Abbreviations, and Acronyms	3.2	Same	Coordinates terminology for visible transmittance with NFRC 200.	0 (terminology only)
62	bn	5. Building Envelope; 11. Energy Cost Budget Method	5.5.4.5 and Table 11.3.1	Same	Limits use of poorly oriented fenestration – compliance shown by having more south-facing than west-facing fenestration. Provides exceptions for retail glass and buildings potentially shaded from the south or west. Exception also provided for certain additions and alterations.	Minor + (limits poor fenestration orientation)
63	bo	11. Energy Cost Budget Method; Normative Appendix G. Performance Rating Method	11.3.2.1, G3.1.2.1, G3.1.2.10, and G.3.1.3.11	Same	Effort to keep requirements of Section 11 and Appendix G consistent with other addenda. Makes changes related to Addenda E, S, and U.	0 (alternative compliance path)
64	bp	9. Lighting	9.4.1	Same	Allows the use of control that provides automatic 50% auto-on with the capability to manually activate the remaining 50% and has full auto-off.	Minor + (allows use of additional energy-saving control strategy)
65	bq	9. Lighting		Same	Retail lighting additional allowance levels reduced.	Minor + (lower retail lighting energy)
66	br	9. Lighting	Table 9.4.5 and Table 9.4.6	Same	Adds an exterior zone 0 to cover very low light requirement areas.	Minor + (reduces exterior lighting energy)
67	bs	8. Power	8.4.2	Same	Adds requirements to provide a means for non-critical receptacle loads to be automatically controlled based on occupancy or scheduling without additional individual desktop or similar controllers.	Minor + (reduces energy use during unoccupied periods)
68	bt	6. Heating, Ventilating, and Air Conditioning	6.4.1.2 and footnote to Table 6.8.1C	Same	Modifies equation for determining the performance adjustment factor for chillers under nonstandard conditions. Adds labeling requirements for chillers to make compliance determinations simpler.	Minor + (chillers that were previously exempt are no longer exempt)
69	bu	3. Definitions, Abbreviations, and Acronyms; and 6. Heating, Ventilating, and Air Conditioning	3.2, 6.4.1.1, 6.5.1, 6.5.1.2, 6.5.2.3 and Table 6.8.1h	Same	Modifies and adds to requirements for computer rooms.	Major + (adds efficiency requirements for data centers)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
70	bv	11. Energy Cost Budget Method; Normative Appendix G. Performance Rating Method	11.3.2, Table G3.1, G3.1.2.9, 11.3.2, and G3.1.1	Same	Effort to keep requirements of Section 11 and Appendix G consistent with other addenda to 90.1. This addendum includes changes to Section 11 and Appendix G due to Addenda y, aj, bk, and ax	0 (alternative compliance paths)
71	bw	6. Heating, Ventilating, and Air Conditioning	Table 6.8.1D	Same	Amends minimum energy efficiency requirements for standard-size package terminal equipment to be consistent with the new Federal standards.	0 (implements existing Federal standards)
72	bx	6. Heating, Ventilating, and Air Conditioning	6.5.2.1	Same	Supplements changes made in Addenda h and as. Attempts to bring into alignment requirements of ASHRAE 90.1 and ASHRAE 62.1. Limits the reheat supply-air temperature from ceiling supply-air devices to achieve better room air distribution and reduce short-circuiting of air into ceiling return air inlets. Promotes alternative methods of heating perimeter spaces with high heat losses other than use of a VAV box with terminal reheat.	Minor + (limits reheat supply-air temperatures)
73	by	3. Definitions, Abbreviations, and Acronyms; 9. Lighting	3.2, Table 9.5.1, Table 9.6.1, and Section 9.6.3	Same	Revision represents a complete review, update, correction, and restructuring of the modeling and calculation basis for the space type and resulting whole building type LPDs.	Major + (lowers LPDs)
74	ca	6. Heating, Ventilating, and Air Conditioning	6.5.3.1.1	Same	Closes a loophole in the fan power allowances for single-zone VAV systems.	Minor + (removes fan power allowance for VAV systems without terminal units)
75	cb	6. Heating, Ventilating, and Air Conditioning	6.3.2, 6.4.3.4.2, and 6.4.3.4.3	Same	Adds requirement for simple systems to meet prescriptive outdoor air damper requirements. Allows backdraft dampers only for exhaust and relief dampers in buildings less than three stories in height. Requires backdraft dampers on outdoor air intakes to be protected from wind limiting windblown infiltration through the damper. Moves climate zone 5a to the category of climates that require low-leak dampers. Corrects a mistake in Table 6.4.3.4.4. Reformats Table 6.4.3.4.4 for clarity.	Major + (expansion of automatic damper requirements)
76	cc	6. Heating, Ventilating, and Air Conditioning	Table 6.5.4.5	Same	Corrects the way 8-in. pipe was analyzed.	Minor - (increases allowable flow rate in 8-in. pipe)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
77	cd	9. Lighting	9.4.1.3 and 9.4.5	Same	Additions to 1) strengthen language to actually require exterior control rather than just require the control capability, 2) add bi-level control for general all-night applications such as parking lots to reduce lighting when not needed, and 3) add control for façade and landscape lighting not needed after midnight.	Major + (requires control of exterior lighting – savings during night when lights not needed)
78	ce	9. Lighting	9.4.1.2	Same	Adds requirements for multilevel control capability (bi-level switching) in all spaces except those specifically exempted.	0 (manual control requirement)
79	cf	9. Lighting	9.4.1.4	Same	Adds requirements for automatic reduction of stairway lighting within 30 minutes of occupants exiting the zone.	Minor + (energy savings through use of controls in stairways)
80	ch	11. Energy Cost Budget Method; Normative Appendix G. Performance Rating Method	Footnotes to Table 11.3.2A, G3.1.1, footnote to Table G3.1.1A, and G3.1.13	Same	Clarifies baseline minimum setpoints for fan-powered boxes and VAV reheat boxes. Modifies exceptions to remove exception originally intended for hospitals and laboratory type spaces, clarify that lab systems with greater than 5,000 cfm of exhaust air use a single VAV baseline system; and add exception to the 50% lab VAV minimum airflow to address minimum ventilation requirements lab designers follow to meet codes and accreditation standards.	0 (alternative compliance path)
81	ck	6. Heating, Ventilating, and Air Conditioning	6.5.3	Same	Expands zone-level demand-controlled ventilation to include various forms of system level strategies. It is being added to the prescriptive section, so that it could be traded off using the Energy Cost Budget (ECB) method.	Minor + (expands automatic zone reset in multi-zone systems)
82	cl	3. Definitions, Abbreviations, and Acronyms; 5. Building Envelope; Normative Appendix C. Methodology for Building Envelope Trade-Off Option in Subsection 5.6	3.2, 5.5.4.4.1, 5.5.4.4.2, and C1.3	Same	Clarifies how to interpret the use of dynamic glazing, which is designed to be able to vary a performance property such as SHGC, rather than having just a single value.	0 (alternative compliance path)
83	cn	9. Lighting	Table 9.6.2	Same	Adds two editions of a combined advanced control to the control incentives table (9.6.2). These control system combinations involve personal workstation control and work-station-specific occupancy sensors for open office applications.	0 (alternative compliance path)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
84	co	6. Heating, Ventilating, and Air Conditioning	Table 6.8.1	Same	This proposal makes three amendments to Table 6.8.1A. First, it updates EER and IEER values for all condensing units and water and evaporatively cooled air conditioners with cooling capacities greater than 65,000 Btu/h. Second, the proposal establishes a separate product class for evaporatively cooled air conditioners with different energy efficiency standards. Third, the proposal replaces the IPLV descriptor for condensing units with the new IEER metric and amends the EERs with more stringent values.	Minor + (improves efficiency of minor market products)
85	cp	3. Definitions, Abbreviations, and Acronyms; 6. Heating, Ventilating, and Air Conditioning	Section 3, 6.4.1.1, 6.8.1L, and 6.8.1M	Same	Establishes efficiency requirements for VRF air conditioners and heat pumps including heat pumps that use a water source for heat rejection.	0 (not more stringent than common practice)
86	cq	6. Heating, Ventilating, and Air Conditioning; Informative Appendix E. Informative References	6.3.2k, 6.4.4.2, Table 6.4.4.2A, Table 6.4.4.2B, and Appendix E	Same	Addendum is based on economic analysis using the current scalar value. Nearly all classes are economically justified at seal class A, allowing for the removal of two tables.	Minor + (reduced duct leakage)
87	cr	3. Definitions, Abbreviations, and Acronyms; 11. Energy Cost Budget Method and Normative Appendix G. Performance Rating Method	3.2, 11, Table 11.3.1, and Appendix G	Same	Modifies definition of unmet load hour and adds definition for temperature control throttling range. Requires that both baseline and proposed unmet hours not exceed 300. Removes language allowing modification of system coil capacities to reduce unmet hours as needed.	0 (alternative compliance paths)
88	cs	8. Power	8.4.2	Same	Modifies automatic receptacle control requirements and exemptions to eliminate potential practical application issues.	Major+ (minimizes exceptions to switched receptacle requirement
89	ct	9. Lighting	9.4.1.3	Same	Reduces the area threshold where side daylighting requires daylight sensor control down to 250 ft^2.	Minor + (reduces area requirement for occupancy sensors)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
90	cv	10. Other Equipment	10.4.2	Same	Adds requirements for service-water pressure booster systems.	Minor + (adds requirements for service-water pressure booster systems)
91	cw	11. Energy Cost Budget Method	Table 11.3.1	Same	Revises the ECB for service hot water heaters. Corrects contradiction with Section 11.32(b). Provides user instruction for situations where a certain type of service hot water system is not listed in Table 7.8.	0 (alternative compliance path)
92	cy	6. Heating, Ventilating, and Air Conditioning	6.5.1, Table 6.5.1A, 6.5.1.1, 6.5.1.2, Table 6.5.1.1.3A and Table 6.5.1.1.3B	Same	Makes several revisions to the economizer requirements in Sections 6.5.1 and 6.3.2. Updates Table 6.3.2, which allows for the elimination of economizers through the use of higher-efficiency HVAC equipment.	Major + (expands use of economizers)
93	cz	9. Lighting	9.2.2.3, 9.4.1.3,	Same	Incorporates bi-level control for parking garages to reduce energy waste during unoccupied periods.	Minor + (reduced parking garage lighting)
94	da	Normative Appendix G. Performance Rating Method	G3.1.2.5	Same	Establishes that an Appendix G baseline shall be based on the minimum ventilation requirements required by local codes or a rating authority and not the proposed design ventilation rates.	0 (performance rating method)
95	db	Normative Appendix G. Performance Rating Method	G3.1.2.5	Same	This addendum modifies the design air flow rates for laboratory systems in the baseline building in Appendix G.	0 (performance rating method)
96	dc	9. Lighting	9.4.2	No longer in Standard 90.1	Removes information related to tandem wiring of lighting.	Minor – (tandem wiring no longer used in practice – possible small increase in energy usage)
97	dd	5. Building Envelope; and 9. Lighting	5.5.4.2, 5.5.4.2.3, and 9.4.1.4	Same	Reduces the area threshold where skylights are required to be designed into building spaces down to 5,000 ft^2 and similarly reduces the threshold where daylighting controls must be applied to 900 ft^2.	Major + (requires daylighting controls in more spaces)
98	de	9. Lighting	Table 9.6.1	Same	Splits the "generic lobby" from common elevator lobbies and LPDs were adjusted to reflect specific space needs. Also removes the fitness center audience seating because it is considered a space type that was considered not used and potentially confusing.	0 (allows more lighting power in lobbies but less in elevator lobbies)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
99	df	10. Other Equipment	10.4.3	Same	Adds requirements that address excess energy use in elevators due to ventilation fans and cab lighting.	Minor + (small lighting and ventilation savings)
100	dg	3. Definitions, Acronyms, and Abbreviations; and Normative Appendix G. Performance Rating Method	3.2 and Table G3.1	Same	Adds a definition for the term "field-fabricated fenestration" used in Section 5.4.3.2 consistent with Interpretation IC 90.1-2007-01 and similar language in California's Title 24.	0 (clarification of definition)
101	di	3. Definitions, Abbreviations, and Acronyms; 6. Heating, Ventilating, and Air Conditioning	3.2, 6.4.3.4.6, and 6.7.2.2	Same	Adds requirements for enclosed parking garage ventilation.	Minor + (reduced parking garage ventilation energy)
102	dj	6. Heating, Ventilating, and Air Conditioning	Table 6.5.3.1.1B	Same	Limits the fan energy allowance for energy-recovery devices to values that approximate the results of the economic analysis, with some allowance to permit adequate pressure drop for products near the minimum recovery effectiveness of 50%. A separate allowance is also created for coil runaround loop systems.	Minor + (limits fan energy allowance of energy-recovery devices)
103	dk	Normative Appendix C. Methodology for Building Envelope Trade-Off Option in Subsection 5.6	C3.4, C3.5, C3.7 and C6.2	Same	Adds clarity and instruction to the users of Appendix C, the envelope tradeoff option, for new requirements that were added in Addenda al, bc, and bn. Addendum al required skylights and lighting controls in certain occupancies. Addendum bc required skylights and lighting controls in unconditioned semi-heated spaces. Addendum bn dealt with orientation specific SHGC requirements.	0 (alternative compliance path)
104	dl	Normative Appendix C. Methodology for Building Envelope Trade-Off Option in Subsection 5.6	C3.6	Same	Gives instruction to the users of Appendix C on how to model the base envelope design and the proposed envelope design on how to comply with the cool-roof provisions of Section 5.	0 (alternative compliance path)
105	dn	Normative Appendix G. Performance Rating Method	Appendix G	Same	This addendum adds system types 9 and 10 for heated only storage spaces and associated changes.	0 (performance rating method)

Table 2. (contd)

No.	Addendum to Standard 90.1-2007	Section Affected	Location in Standard 90.1-2007 Edition	Location in 90.1-2010 Edition	Description of Changes	Impact on Energy Efficiency and Reason
106	do	4. Administration and Enforcement; 9. Lighting	4.2.2.3 and 9.7	Same	Establishes the goals and requirements of the lighting system including controls and ensures that owners are provided all the information necessary to best use and maintain lighting systems.	0 (documentation only)
107	dp	12. Normative References	12. Normative References	Same	Updates the references in Standard 90.1 to reflect the current edition of the cited standard. Substantive changes in the referenced documents did not affect the requirements in 90.1 or change the stringency of the requirements of 90.1.	0 (updates references)
108	dq	Normative Appendix C. Methodology for Building Envelope Trade-Off Option in Subsection 5.6	C5.6, C6.2, Table C6.1, C6.3, C6.4, C6.8.2, C6.8.3, C6.9, and C6.10.3	Same	Modifies the calculations found in Appendix C in order to reflect modifications to the modeling assumptions.	0 (alternative compliance path)
109	dr	9. Lighting	9.4.4	No longer in Standard 90.1	Original purpose of Section 9.4.4 was to limit the use of inefficient lighting sources for high-wattage applications when there was not a comprehensive table of LPD limits. With such a table now in place, Section 9.4.4 is no longer necessary.	0 (editorial only)

Table 3 shows the overall summary of the impacts of addenda.

Table 3. Overall Summary of Addenda Impact

Major Negative	Minor Negative	Neutral	Minor Positive	Major Positive	Total
None	6 (b, c, p, aw, cc, and dc)	47	37	19	109

Based on the final analysis, the sum of the major positive and minor positive addenda (56) greatly overwhelms the number of minor negative addenda (6), leading to the conclusion that the overall impact of the addenda on the standard is positive.

The 6 negative impacts on energy efficiency include the following :

1. Addendum b – allows larger than minimum ventilation rates if required by other codes.
2. Addendum c – allows an exception to dehumidification for controls for vivariums.
3. Addendum p – increases allowable pressure drop in laboratory exhaust systems.
4. Addendum aw – adds an additional lighting allowance for nightlights in hotel/motel bathrooms.
5. Addendum cc – allows higher flow rates in 8–in. piping.
6. Addendum dc – eliminates tandem wiring requirement.

None of these negative impacts is judged to be significant. Addendum b acknowledges that Standard 90.1 does not address ventilation rates that are required in other codes. Addendum c adds vivariums (spaces used for plant or animal growth) to the list of spaces that may have more stringent humidity requirements than normal spaces. Addendum p increases allowable pressure drop in laboratory exhaust systems and addresses some noted shortcomings in the previous edition of Standard 90.1 with regard to fume hoods. Addendum aw acknowledges the common practice of the use of bathroom lights as "night-lights" in hotel/motel guest rooms. Addendum cc corrects a calculation error in the previous edition of Standard 90.1. Addendum dc eliminates a tandem wiring requirement for ballasts that is no longer used with the widespread use of electronic ballasts.

The 19 major positive impacts on energy efficiency include the following:

1. Addendum d – requires daylighting controls under skylights and commissioning of daylighting controls.
2. Addendum e – requires increased use of heat recovery.
3. Addendum f – requires cool roofs in hot climates.
4. Addendum i – lowers illuminance requirements in certain exterior zones
5. Addendum m – updates chiller efficiency requirements.
6. Addendum n – extends variable air volume (VAV) fan control requirements.
7. Addendum x – adds occupancy sensor requirements for many specific applications.
8. Addendum ab – adds daylighting control requirements for side-lighted spaces.
9. Addendum al – requires skylights and daylighting in some building types.

10. Addendum ap – reduces ventilation energy.
11. Addendum av – expands new LPDs to more retrofits.
12. Addendum bh – requires supply-air temperature reset for non-peak conditions
13. Addendum bu – adds efficiency requirements for data centers.
14. Addendum by – requires lower LPDs.
15. Addendum cb – expands automatic damper requirements.
16. Addendum cd – requires control of exterior lighting.
17. Addendum cs – minimizes exceptions to switched receptacle requirement.
18. Addendum cy – expands use of economizers.
19. Addendum dd – requires daylighting controls in more spaces.

Many of these "major positive" addenda are self-descriptive. The high-level themes of the major positive addenda tend to be as follows:

- better lighting, daylighting, and controls (d, i, x, ab, al, av, by, cd, cs, and dd)
- better mechanical systems and application to more systems (e, m, n, ap, bh, bu, cb, and cy)
- better building envelope (f).

Table 4 shows the results of the textual analysis on a section-by-section basis. Some addenda affect multiple sections. Addenda are listed by the primary technical section addressed in the addenda. Thus, an addendum that modifies the lighting requirements and a definition related to lighting is listed only in the lighting section. Any addendum that modifies only definitions would be listed in the definitions section. Any addendum that modifies multiple technical sections (say Building Envelope and Lighting) would be credited to each section. Thus, the totals noted at the bottom of Table 4 will add up to more than the 109 addenda processed for Standard 90.1-2010, as reported in Table 1, Table 2, and Table 3, and in the text of this document.

Table 4. Results of Textual Analysis by Section of Standard 90.1

Section of Standard	Total Number of Changes Attributed to Section	Number of Positive (Energy Saving) Changes	Number of Neutral (No Energy Saving) Changes	Number of Negative (Energy Increasing) Changes
Title, Purpose, and Scope	1	0	1	0
Definitions, Abbreviations and Acronyms	0	0	0	0
Administration and Enforcement	0	0	0	0
Envelope and Normative Appendices	17	10	7	0
HVAC Equipment and Systems	44	26	14	4
Service Water Heating	1	1	0	0
Power	4	2	2	0
Lighting	26	17	7	2
Other Equipment	4	2	2	0
Energy Cost Budget and Appendix G Performance Rating Method	14	0	14	0
Normative and Informative References	1	0	1	0
Overall	112	57	49	6

Overall, the impacts of the positive changes outweigh the negative changes on a simple count basis.

5.0 Detailed Discussion of Impacts of Addenda on Various Sections of Standard 90.1-2010

Standard 90.1-2010 contains 12 normative sections and 5 normative appendices that are considered part of the standard. Standard 90.1-2010 also contains two informative appendices that provide additional information relevant to use of the Standard, but that are not considered part of Standard 90.1-2010. One appendix that was previously informative (Appendix G) is now normative. DOE's evaluation of Standard 90.1-2010 focuses on the normative sections and appendices of the standard. This section of the qualitative analysis looks at each normative section and its associated appendices to identify the changes associated with each section and to assess the impact of those changes on various compliance paths allowed for that section.

Sections 5 through 9 are the heart of the technical requirements of Standard 90.1-2010. For Sections 5 through 9, Standard 90.1-2010 offers multiple compliance paths. Each section has mandatory requirements that must be met for all buildings. Each section may also have one or more sets of prescriptive requirements that must be met for all buildings unless a tradeoff option is used. Sections 5 and 6 have specific tradeoff options for use within these sections. Section 6 also has a simple system approach that combines mandatory and prescriptive requirements for certain buildings. Section 11 also provides an overall whole building tradeoff for Standard 90.1-2010 based on equal energy cost between a baseline building and the proposed design.

Some addenda affect more than one section. Addenda are listed with the section that is most significantly affected.

5.1 Changes to Title, Section 1 Purpose, and Section 2 Scope

One change was made to Title, Section 1 Purpose, and Section 2 Scope during the creation of Standard 90.1-2010.

- Addendum aq: This addendum changes the Purpose of Standard 90.1 to establish minimum energy efficiency requirements of commercial buildings for design, construction, and a plan for operation and maintenance and use of onsite renewable energy resources. In addition, the Scope of Standard 90.1 is expanded to include operation and maintenance as well as inclusion of new equipment. These changes have no direct impact on energy efficiency, but they do allow for future positive additions to the Standard.

5.2 Changes to Section 3, Definitions, Abbreviations, and Acronyms

A number of updates to definitions in addenda to Standard 90.1-2007 were included in Standard 90.1-2010. These definitions, and their impact on the stringency of the standard, are discussed in conjunction with the appropriate technical section (5 through 11) of Standard 90.1-2010 below.

- Addendum dg: This text adds a definition for the term "field-fabricated fenestration" used in Section 5.4.3.2, consistent with Interpretation IC 90.1-2007-01 and similar language in California's Title 24.

5.3 Changes to Section 4, Administration and Enforcement

No changes were made solely to Section 4 Administration and Enforcement during the creation of Standard 90.1-2010.

5.4 Changes to Section 5, Building Envelope and Normative Appendices A–D

The building envelope section has mandatory requirements applicable to all compliance paths and contains two compliance paths: prescriptive and envelope tradeoff. In addition, the prescriptive requirements of the building envelope section form the baseline envelope requirements for the whole building tradeoff method in Section 11, Energy Cost Budget Method.

- Addendum f: This addendum adds roof solar reflectance and thermal emittance requirements for roofs in climate zones 1–3. This change represents significant energy savings in hot climates.
- Addendum g: This addendum updates the building envelope criteria for metal buildings. This change contributes to minor energy savings in metal buildings.
- Addendum q: This addendum modifies the vestibule requirements for climate zone 4, requiring a vestibule for a building entrance of more than 1,000 ft^2. This change contributes minor energy savings by expanding the requirement for vestibules into climate zone 4.
- Addendum ag: This addendum adds a requirement for rigid board insulation overlap. This change contributes to minor energy savings by reducing the potential for thermal bridging.
- Addendum al: This addendum adds skylight requirements in certain space types (enclosed spaces) to promote daylighting energy savings. The energy savings from this change are significant.
- Addendum am: This addendum revises air-leakage criteria for fenestration and doors. This revision results in minor energy savings from reduced air leakage.
- Addendum an: This addendum expands the table of default U-values for single-digit rafter roofs. This update to default tables does not result in any energy savings.
- Addendum bc: This addendum clarifies that the requirements in Section 5.5.4.2.3 are also specified for unconditioned spaces. No energy savings result from this clarification.
- Addendum bf: This addendum modifies language to include performance requirements for leakage of the opaque envelope. This change results in minor energy savings due to reduced air leakage.
- Addendum bn: This addendum limits poorly oriented fenestration. Compliance can be shown by having more south-facing fenestration than west-facing fenestration. Exceptions for retail glass buildings potentially shaded from the south or west are provided. Also, an exception is provided for certain additions and alterations. These changes result in small energy savings.
- Addendum dd: This addendum reduces the area threshold where skylights are required to be designed into buildings spaces down to 5,000 ft^2 and also reduces the threshold where daylighting controls must be applied to 900 ft^2. The addition of daylighting controls in more spaces saves a significant amount of energy.

5.5 Changes to Section 6, Heating, Ventilating, and Air-Conditioning

The heating, ventilating, and air-conditioning (HVAC) section contains two intertwined compliance paths: simple buildings (a combination of mandatory and prescriptive requirements for a specific set of systems) and complex systems (mandatory and prescriptive requirements for all other systems). In addition, this section contains a tradeoff between economizer usage and equipment efficiency. The prescriptive requirements of this section also form the baseline HVAC requirements for the whole building tradeoff method in Section 11 Energy Cost Budget Method.

- Addendum a: This addendum removes closed-circuit cooling tower requirements from Section 6.8.1G. This is a clarification that does not result in energy savings.
- Addendum b: This addendum revises exception a to Section 6.5.2.3 to allow for codes other than ASHRAE 62.1 to dictate minimum ventilation requirements. This change results in a small loss of energy savings because some other codes allow for larger minimum ventilation rates.
- Addendum c: This addendum adds vivariums to the list of spaces that require specific humidity levels to satisfy process needs. The change results in a small energy loss because it allows an exception to dehumidification requirements for vivariums.
- Addendum e: The addendum changes exhaust air energy-recovery requirements and also harmonizes the requirements in the simplified Section 6.3.2 with the requirements in the Section 6.5 prescriptive path. These changes will result in significant energy savings for buildings with outdoor airflow rates of 30% and greater.
- Addendum h: This addendum adds a new exception to Section 6.5.2.1 that addresses the apparent conflict between standards and allows users to achieve comfort, meet the code, and save energy. This addendum results in small energy savings in some applications.
- Addendum j: This addendum updates the mechanical test procedure referenced in the standard. The changes also modify a reference in Table 6.8.1E, the normative references in Chapter 12, and the informative references in Appendix E. This updating of references does not produce any energy savings.
- Addendum k: This addendum updates Tables 6.8.1E and 7.8 to identify specific sections of the referenced standards. Table 7.8 is also updated to reflect the current Federal efficiency levels for residential water heaters and adds a requirement for electric table-top water heaters. These updates to reflect Federal standards do not produce any energy savings.
- Addendum l: This addendum adds minimum efficiency and certification requirements for both axial and centrifugal fan closed-circuit cooling towers into Table 6.8.1G. In addition, a reference to Acceptance Test Code ATC-105S, the Cooling Technology Institute test standard for closed-circuit cooling towers, has been added to Section 12, Normative References. There are no energy savings associated with this codification of industry standard practice.
- Addendum m: This addendum updates chiller efficiency requirements, establishes an additional compliance path for water-cooled chillers, and combines all water-cooled chillers into one category. The addendum also adds a new size category for centrifugal chillers at or above 600 tons. The updates to chiller efficiency requirements are expected to provide significant energy savings.

- Addendum n: This addendum extends VAV requirements to large single-zone units. This expansion of control requirements is expected to provide significant energy savings.
- Addendum p: This addendum provides pressure credits for laboratory exhaust systems that allow prescriptive compliance with the standard. A small energy loss is expected due to the increase in allowable pressure drop in laboratory exhaust systems.
- Addendum s: This addendum updates the coefficient of performance (COP) at 17°F efficiency levels for commercial heat pumps and introduces a new part-load energy efficiency descriptor (Integrated Energy Efficiency Ratio [IEER]) for all commercial unitary products above 65,000 Btu/h of cooling capacity. The new descriptor, IEER, is a replacement for the integrated partial load value (IPLV), because it allows for uniform rating of all products including single- and multi-stage units. IEER is a part-load metric that is expected to more accurately rate the part-load performance of commercial unitary equipment. The replacement of IPLV with IEER to capture part-load performance is not expected to result in any energy savings.
- Addendum t: This addendum removes the terms "replacement" and "new construction" from the product classes listed in Table 6.8.1D and replaces them with the terms "nonstandard size" and "standard size," respectively, to clarify that one product class is intended for applications with nonstandard size exterior wall openings, while the other is intended for applications with standard size exterior wall openings. The addendum also amends Section 6.4.1.5.2 and footnote b in Table 6.8.1D to clarify that nonstandard size packaged terminal equipment have sleeves with an external wall opening less than 16 in. high or less than 42 in. wide to reflect existing applications where the wall opening is not necessarily less than 16 in. high and less than 42 in. wide. However, to avoid a potential abuse of the definition, nonstandard size packaged terminal equipment are required to have a cross-sectional area of the sleeves less than 670 $in.^2$ (less than 16 x 42 in.). This clarification of definitions does not result in any energy savings.
- Addendum u: This addendum adds a new section requiring centrifugal fan open-circuit cooling towers over 1100 gpm at the rating conditions to meet efficiency requirements for axial fan units found in 6.8.1G. The broader application of cooling tower requirements is expected to result in small energy savings.
- Addendum v: This addendum revises Section 6.4.2.1 to reference ANSI/ASHRAE/ACCA Standard 183-2007 for sizing heating and cooling system design loads and adds requirements for calculating pump head. This update of references does not result in any energy savings.
- Addendum ad: This addendum includes certification requirements for liquid-to-liquid heat exchangers to benefit both manufacturers and consumers, allow product comparisons, and provide incentives to manufacturers to improve efficiency. This documentation of certification requirements does not result in any energy savings.
- Addendum ae: This addendum adds a requirement for insulating the surfaces of radiant panels that do not face conditioned spaces. The reduced heat loss in radiant panels is expected to result in small energy savings.
- Addendum af: This addendum provides requirements for proper sizing of system piping in hydronic systems to balance ongoing energy costs and first costs. The proper sizing of hydronic system piping is expected to result in small energy savings.

- Addendum aj: This addendum updates the text and table of Chapter 10 to comply with the new Federal law for motors rated at 1.0 hp and greater. Adding this information will help designers, end-use customers, and code officials with motor specifications and verifications. The implementation of Federal requirements does not result in any energy savings.
- Addendum ak: Five basic changes are included in this addendum: 1) adds a pump isolation requirement for systems with multiple chillers and boilers and a temperature reset requirement for equipment with a minimum British thermal units per hour; 2) revises wording to have requirements of Section 6.5.4.1 apply only to cooling systems; 3) changes threshold of variable-speed systems to 7.5 hp; 4) adds a requirement for differential pressure reset that does not preclude also implementing chilled water supply temperature point reset; and 5) includes requirements for hydronic heat pump and water-cooled unitary air conditioners. The reduction in pumping energy from these changes is expected to result in small energy savings.
- Addendum ao: This addendum repairs known errata to Table 6.8.1E and re-orders the notes to properly organize them. It corrects the error of identifying E_c, which should be listed as E_t under "Warm Air Furnaces, Gas Fired," and also eliminates incorrect and redundant footnotes. This is an editorial change that does not affect energy savings.
- Addendum ap: This addendum includes demand-controlled ventilation in the simplified approach. This reduction in ventilation energy is expected to result in significant energy savings.
- Addendum as: This addendum removes the exception for VAV turndown requirements for zones with special pressurization requirements and reduces the laboratory threshold where VAV or heat recovery is required. This change is expected to save a large amount of fan and reheat energy in hospitals, and result in an overall small energy savings.
- Addendum at: This addendum clears up inconsistencies and conflicts regarding damper requirements found in several places in Chapter 6. This is an editorial change that has no impact on energy savings.
- Addendum au: This addendum updates efficiency tradeoff table (Table 6.3.2) for eliminating economizers. This change affects the alternate compliance path and thus has no impact on energy savings.
- Addendum ax: This addendum makes the following five changes: 1) expands requirements for kitchen exhaust systems; 2) adds definitions for transfer air, replacement air, and makeup air; 3) adds Table 6.5.7.1.3, which defines the maximum exhaust flow rate through various hood types; 4) includes provisions for hoods with flows greater than 5,000 cfm; and 5) requires performance testing to evaluate design airflow rates and demonstrate capture and containment performance. These more stringent kitchen exhaust requirements are expected to result in small energy savings.
- Addendum ba: This addendum allows a system performance option that allows for compensating for the insulating value of the piping while maintaining the same net thermal requirements. This alternative compliance path change does not result in any energy savings.
- Addendum bg: This addendum establishes a product class for water-to-water heat pumps. The intent is to recognize the technology in Standard 90.1 by requiring minimum energy efficiency standards. Cooling EERs and heating COPs are proposed for products with cooling capacities below 135,000 Btu/h at standard rating conditions listed in ISO Standard 13256-2. The addition of a requirement where none previously existed is expected to result in small energy savings.

- Addendum bh: This addendum provides requirements for multiple-zone HVAC systems (that include simultaneous heating and cooling) to include controls that automatically raise the supply-air temperature when the spaces served are not at peak load conditions. The addendum also allows an override of the temperature reset if a maximum space humidity setpoint is exceeded. There is an exception from this requirement for warm and humid climate zones 1a, 2a, and 3a. The requirement for supply-air temperature reset under non-peak conditions is expected to result in significant energy savings.
- Addendum bi: This addendum updates requirements for piping insulation, including incorporation of new 90.1 SSPC economic criteria used in developing standard requirements. It also adds footnotes to address constrained locations and clarify requirements for direct buried piping. This addendum is expected to result in small energy savings due to reduced heat loss/gain in piping.
- Addendum bl: This addendum corrects the intent of the standard to not exempt all chillers with secondary coolants for freeze protection from coverage by Table 6/8/1C and removes ambiguity. In addition, this addendum changes footnote a to Table 6.8.1C in recognition of lower practical scope limits for positive displacement (both air- and water-cooled) and corrects for the lower limit introduced in addendum m for centrifugal chillers. The removal of the exemption for certain chillers is expected to result in small energy savings.
- Addendum bm: This addendum coordinates terminology for visible transmittance with National Fenestration Rating Council (NFRC) 200. This clarification does not affect energy savings.
- Addendum bt: This addendum modifies the equation for determining the performance adjustment factor for chillers under nonstandard conditions and adds labeling requirements for chillers to simplify determination of compliance. It is expected that this addendum will result in small energy savings by making chillers that were previously exempt comply with the standard.
- Addendum bu: This addendum modifies and adds to requirements for computer rooms. The added efficiency requirements for data centers are expected to result in significant energy savings.
- Addendum bw: This addendum amends the minimum energy efficiency requirements for standard-size package terminal equipment to be consistent with the Federal standards. The implementation of existing Federal standards does not impact energy savings.
- Addendum bx: This addendum supplements changes made in Addendum h and Addendum as and attempts to bring into alignment requirements of Standards 90.1 and 62.1. By limiting the reheat supply-air temperature from ceiling supply-air devices, better room air distribution effectiveness will be achieved and short circuiting of air into ceiling return air inlets will be reduced (limiting energy loss). This addendum promotes alternative methods of heating perimeter spaces with high heat losses other than the use of a VAV box with terminal reheat. It is expected that limiting reheat supply-air temperatures will result in small energy savings.
- Addendum ca: This addendum closes a loophole in the fan power allowances for VAV systems. The removal of fan power allowances for VAV systems without terminal units is expected to result in small energy savings.
- Addendum cb: This addendum includes the following six changes: 1) adds a requirement for simple systems to meet prescriptive outdoor air damper requirements; 2) allows backdraft dampers only for exhaust and relief dampers in buildings less than three stories in height; 3) requires backdraft dampers on outdoor air intakes to be protected from wind to limit windblown infiltration through the damper;

4) moves climate zone 5a into the category of climates that require low-leak dampers; 5) corrects a mistake in Table 6.4.3.4.4; and 6) reformats Table 6.4.3.4.4 for clarity. The expansion of automatic damper requirements is expected to result in significant energy savings.

- Addendum ck: This addendum expands zone-level demand-controlled ventilation to include various forms of system-level strategies. It is being added to the prescriptive section, so that it could be traded off using the ECB method. The expansion of automatic zone reset in multi-zone systems is expected to result in small energy savings.
- Addendum co: This addendum makes three major amendments to Table 6.8.1A. First, it updates EER and IEER values for all condensing units and water- and evaporatively cooled air conditioners with cooling capacities greater than 65,000 Btu/h. Second, the proposal establishes a separate product class for evaporatively cooled air conditioners with different energy efficiency standards. Third, the proposal replaces the IPLV descriptor for condensing units with the new IEER metric and amends the EERs with more stringent values. These changes are expected to result in small energy savings.
- Addendum cp: This addendum establishes efficiency requirements for VRF air conditioners and heat pumps, including heat pumps that use a water source for heat rejection. Because the requirements are not more stringent than common practice, there are no energy savings as a result of this change.
- Addendum cq: This addendum is based on economic analysis using the current scalar value. Nearly all classes are economically justified at seal class A, allowing for the removal of two tables. Small energy savings are expected due to reduced duct leakage.
- Addendum cy: This addendum makes several revisions to the economizer requirements in section 6.5.1 and in section 6.3.2. The addendum also updates Table 6.3.2 which allows for the elimination of economizers through the use of higher efficiency HVAC equipment. The expanded use of economizers is expected to result in significant energy savings.
- Addendum di: This addendum adds requirements for enclosed parking garage ventilation. The changes are expected to reduce parking garage ventilation energy and result in small energy savings.
- Addendum dj: This addendum limits the fan energy allowance for energy-recovery devices to values that approximate the results of the economic analysis, with some allowance to permit adequate pressure drop for products near the minimum recovery effectiveness of 50%. A separate allowance is also created for coil runaround loop systems. The limited allowance of fan energy for energy-recovery devices is expected to result in small energy savings.

5.6 Changes to Section 7, Service Water Heating

One change was made to Section 7, Service Water Heating, during the creation of Standard 90.1-2010.

- Addendum y: This addendum establishes ARI 1160 as the test procedure for heat pump pool heaters and requires that the minimum COP of 4 be met at the low outdoor temperature of 50°F. This change is expected to result in small energy savings due to the requirement that COP be met at a lower temperature.

5.7 Changes to Section 8, Power

Four changes were made to Section 8, Power, during the creation of Standard 90.1-2010.

- Addendum o: This addendum modifies the scope of Section 8 and adds requirements specific to low-voltage dry-type transformers. The implementation of Federal efficiency standards into 90.1 has no impact on energy savings.
- Addendum bd: This addendum removes emergency circuits not used for normal building operation from the requirements, which will lead to increased compliance. This allows for an increased conformance/use of the Standard 90.1 by eliminating issues of impracticality of feeder drop requirements for emergency circuits and provides significant initial cost savings. Because the only impact occurs when emergency circuits are activated, there are no energy savings associated with this change.
- Addendum bs: This addendum adds requirements to provide a means for non-critical receptacle loads to be automatically controlled (turned off) based on occupancy or scheduling without additional individual desk-top or similar controllers. This change will result in small energy savings due to reduced energy use during unoccupied periods.
- Addendum cs: This addendum modifies automatic receptacle control requirements and exemptions to eliminate potential practical application issues. The reduced exceptions to the requirement for switched receptacles is expected to result in significant energy savings.

5.8 Changes to Section 9, Lighting

A total of 27 addenda were processed for the Lighting section.

- Addendum d: This addendum adds exceptions for SHGC and visible transmittance (VT) requirements for skylights; adds a requirement for including visible light transmittance test results with construction documents; and adds information about determining daylit area under skylights, automatic daylighting controls (with exceptions), and submittal requirements. The required use of daylighting controls under skylights and commissioning of daylight controls are expected to result in significant energy savings.
- Addendum i: This addendum applies a four-zone LPD approach to exterior lighting requirements. The addendum deletes the 5% additional power allowance in Section 9.4.5 and replaces it with a base wattage allowance per site. The addendum also defines the four zones and applies the appropriate requirements. The lower illuminance requirements in certain zones is expected to result in significant energy savings.
- Addendum x: This addendum updates the requirements for automatic lighting shutoff, adds specific occupancy sensor applications, and provides additional clarification. The addition of occupancy sensor requirements in a number of specific applications is expected to result in significant energy savings.
- Addendum aa: This addendum adds space exceptions for automatic lighting controls. The limitation on automatic-on controls in certain space types is expected to result in small energy savings.

- Addendum ab: This addendum adds definitions and provides daylighting control requirements for side-lighted spaces. The additional daylighting control requirements are expected to result in significant energy savings.
- Addendum ac: This addendum adds incentives to use advanced lighting controls. This alternate compliance path approach does not affect energy savings.
- Addendum ar: This addendum corrects an oversight in previous editions where expanded exterior lighting power limits were in place but the details of how to calculate the installed power and compare it to the limits were not included. This revision adds the needed details to the standard. This is a purely editorial change that does not affect energy savings.
- Addendum av: This addendum modifies the requirements of Section 9.1.2 to require that in all spaces where alterations take place, all requirements of Section 9 are met. The exception has been changed so that the LPD requirements of Standard 90.1are met in the altered space if less than 10% of luminaires are replaced. The expansion of new LPDs to more retrofits is expected to result in significant energy savings.
- Addendum aw: This addendum recognizes the practical design application of excluding bathroom lighting from "master" switch control in hotel/motel guest rooms and adds a requirement to eliminate wasted light in guest room bathrooms. The addendum adds a 5-W allowance for night-lights that recognizes the practical current design application of guest room bathroom night-light use but at a reasonable low level. The addition of a lighting allowance is expected to result in a small increase in energy use.
- Addendum ay: This addendum requires users to identify spaces by function. The requirement to properly use LPDs is expected to result in small energy savings.
- Addendum az: This addendum adds requirements for lighting controls to be functionally tested to ensure proper use and appropriate energy savings. The testing to ensure proper use is expected to result in small energy savings.
- Addendum bp: This addendum allows the use of control that provides automatic 50% auto-on with the capability to manually activate the remaining 50% and has full auto-off. The additional use of lighting control strategies is expected to result in small energy savings.
- Addendum bq: This addendum reduces the levels of the additional retail lighting allowances. Lower retail lighting use is expected to result in small energy savings.
- Addendum br: This addendum adds an exterior zone 0 to cover very low-light requirement areas. The reduced exterior lighting energy is expected to result in small energy savings.
- Addendum by: This addendum represents a complete review, update, correction, and restructuring of the modeling and calculation basis for the space type and resulting whole building type LPDs. The lowered LPDs are expected to result in significant energy savings.
- Addendum cd: This addendum makes additions that 1) strengthen the language to actually require exterior control rather than just require the control capability; 2) add bi-level control for general all-night applications such as parking lots to reduce lighting when not needed; and 3) add control for façade and landscaping lighting not needed after midnight. The added requirement for control of exterior lighting during times when lighting is not needed is expected to result in significant energy savings.

- Addendum ce: This addendum adds requirements for multilevel control capability (bi-level switching) in all spaces except those specifically exempted. Because this is a manual control requirement, it is not expected to affect energy savings.
- Addendum cf: This addendum adds requirements for automatic reduction of stairway lighting within 30 minutes of occupants exiting the zone. The use of controls in stairways is expected to result in small energy savings.
- Addendum cn: This addendum adds two editions of a combined advanced control to the control incentives table (Table 9.6.2). These control system combinations involve personal workstation control and workstation-specific occupancy sensors for open office applications. Because this is an alternative compliance path option, there is no impact on energy savings.
- Addendum ct: This addendum reduces the area threshold where side daylighting requires daylight sensor control down to 250 ft^2. The reduced area threshold is expected to result in small energy savings.
- Addendum cv: This addendum adds requirements for service-water pressure booster systems. These added requirements are expected to result in small energy savings.
- Addendum cz: This addendum incorporates bi-level control for parking garages to reduce the wasted energy associated with unoccupied periods. The reduction in parking garage lighting is expected to result in small energy savings.
- Addendum dc: This addendum removes information related to tandem wiring of lighting. It is expected that this change will result in a small increase in energy usage.
- Addendum dd: This addendum reduces the area threshold where skylights are required to be designed into building spaces down to 5,000 ft^2 and similarly reduces the threshold where daylighting controls must be applied to 900 ft^2. It is anticipated that the increased use of daylighting controls will result in significant energy savings.
- Addendum de: This addendum splits the "generic lobby" from common elevator lobbies and LPDs were adjusted to reflect specific space needs. In addition, this addendum removed the fitness center audience seating because it is considered a space type that was considered not used and potentially confusing. It is anticipated that this change will result in no impact on energy savings because, although less lighting is allowed in elevators, more is allowed in lobbies.
- Addendum do: This addendum establishes the goals and requirements of the lighting system including controls and ensures that the owners are provided all the information necessary to best use and maintain the lighting systems. This is a documentation requirement that has no impact on energy savings.
- Addendum dr: The original purpose for this provision (exterior building grounds lighting) was to limit the use of inefficient lighting sources for high-wattage consumptions when there was not a comprehensive table of exterior LPD limits. With the table of requirements now in the 2007 and later editions of Standard 90.1, the need for this limit is superseded. This is an editorial change that has no impact on energy savings.

5.9 Changes to Section 10, Other Equipment

Two changes were made to Section 10, Other Equipment, during the creation of Standard 90.1-2010.

- Addendum bk: This new addendum includes the minimum efficiency requirements for both Subtype I and Subtype II motors and clarifies to what specific motor types these requirements apply. This change is for clarification only and has no impact on energy savings.
- Addendum df: This addendum adds requirements that address excess energy use in elevators due to ventilation fans and cab lighting. These changes result in small energy savings resulting from small lighting and ventilation savings.

5.10 Changes to Section 11, Energy Cost Budget Method

Section 11, Energy Cost Budget Method, is the whole building tradeoff compliance method for Standard 90.1. The mandatory and prescriptive requirements of the envelope; HVAC; service-water heating; and power, lighting, and other systems all provide the baseline requirements for the whole building tradeoff. In addition, specific changes to the rules of the tradeoff associated with Section 11 may also affect the stringency of this compliance path. Five specific changes were made to Section 11 in Standard 90.1-2010.

- Addendum bo: This addendum is part of an ongoing effort to keep the requirements of Section 11 and Appendix G consistent with other addenda to Standard 90.1-2007 that are included in Standard 90.1-2010. Because these changes apply to the alternative compliance path, there is no impact on energy savings.
- Addendum bv: This addendum is part of an ongoing effort to keep the requirements of Section 11 and Appendix G consistent with other addenda to Standard 90.1-2007 that are included in Standard 90.1-2010. This addendum includes changes to Section 11 and Appendix G due to Addenda y, aj, bk, and ax. Because these changes apply to the alternative compliance path, there is no impact on energy savings.
- Addendum ch: This addendum clarifies baseline minimum setpoints for fan-powered boxes and VAV reheat boxes. The addendum also modifies exceptions to remove the exception originally intended for hospitals and laboratory type spaces, clarify that labs with greater than 5,000 cfm of exhaust air use a single VAV baseline system, and add an exception to the 50% lab VAV minimum airflow to address minimum ventilation requirements lab designers follow to meet codes and accreditation standards. Because this is an alternative compliance path requirement, there is no impact on energy savings.
- Addendum cr: This addendum modifies the definition of unmet load hour and adds a definition for temperature control throttling range, requires that both baseline and proposed unmet hours not exceed 300, and removes language allowing modification of system coil capacities to reduce unmet hours as needed. Because this is an alternative compliance path requirement, there is no impact on energy savings.
- Addendum cw: This addendum revises the ECB for service hot water heaters, corrects a contradiction with Section 11.32(b), and provides user instruction for situations where a certain type

of service hot water system is not listed in Table 7.8. Because this is an alternative compliance path requirement, there is no impact on energy savings.

5.11 Changes to Section 12, Normative References

One change was made to Section 12 in Standard 90.1-2010.

- Addendum dp: This addendum updates the references in ASHRAE Standard 90.1. While these changes reflect the current edition of the cited standard, it should be noted that substantive changes in the referenced documents did not affect the requirements in 90.1 or change the stringency of the requirements of 90.1 and have no impact on energy savings.

5.12 Changes to Normative Appendix C, Methodology for Building Envelope Trade-Off Option in Subsection 5.6

Four changes were made to Normative Appendix C for Standard 90.1-2010.

- Addendum cl: This addendum clarifies how to interpret the use of dynamic glazing products, which are designed to be able to vary a performance property such as SHGC, rather than having just a single value. Because this is an alternative compliance path requirement, there is no impact on energy savings.
- Addendum dk: This addendum adds clarity to Appendix C and instructions to the users of Appendix C, the envelope tradeoff option, for new requirements that were added in Addenda al, bc, and bn. Addendum al required skylights and lighting controls in certain occupancies, addendum bc required skylights and lighting controls in unconditioned spaces, and addendum bn dealt with orientation-specific SHGC requirements. Because this is an alternative compliance path requirement, there is no impact on energy savings.
- Addendum dl: This addendum gives instruction to the users of Appendix C, the envelope tradeoff option, on how to model the base envelope design and the proposed envelope design and how to comply with the cool-roof provisions of Section 5. Because this is an alternative compliance path requirement, there is no impact on energy savings.
- Addendum dq: This addendum modifies the calculations found in Appendix C in order to reflect modifications to the modeling assumptions in the equations. Because this is an alternative compliance path requirement, there is no impact on energy savings.

5.13 Changes to Informative Appendix E, Informative References

No changes were made solely to Informative Appendix E, Informative References, during the creation of Standard 90.1-2010.

5.14 Changes to Informative Appendix F Addenda Description Information

Informative Appendix F, Addenda Description Information, is simply a list of all addenda to Standard 90.1-2007 processed during the creation of Standard 90.1-2010. Informative Appendix F is completely replaced each time Standard 90.1 is updated.

5.15 Changes to Informative (now Normative) Appendix G, Performance Rating Method

Informative Appendix G, Performance Rating Method, is the basis of the energy points associated with the U.S. Green Building Council Leadership in Energy and Environmental Design rating system. Addenda to this appendix, while they may have an impact beyond Standard 90.1, have no impact on compliance with Standard 90.1. During the course of the creation of Standard 90.1-2010, Appendix G was changed from an informative appendix to a normative appendix. A total of 12 changes were made to Appendix G in Standard 90.1-2010.

- Addendum r: This addendum changes Informative Appendix G, Performance Rating Method, into a Normative Appendix. In addition, some language has been modified to make the appendix enforceable. Because this change is related to a performance rating method, there is no impact on energy savings.
- Addendum w: This addendum contains two changes. The first change is to the footnote of Table G3.1.1A to make it clear that Exception a to Section G3.1.1 also applies here. The second change is to the exception to G3.1.2.10 on Exhaust Air Energy Recovery for multifamily buildings, because these buildings are unlikely to have a centralized exhaust air system needed to effectively recover heat. Because this change is related to a performance rating method, there is no impact on energy savings.
- Addendum ai: This addendum removes the requirement for comparing proposed buildings using purchased chilled water with a baseline building with onsite chillers, and instead requires a baseline that also uses purchased chilled water. The addendum also details the modifications that are to be made to the baseline HVAC systems when purchased chilled water or heat are included. Because this change is related to a performance rating method, there is no impact on energy savings.
- Addendum bj: This addendum adds an exception in Appendix G that allows users to claim energy cost savings credit for the increased ventilation effectiveness of certain HVAC system designs. Because this change is an alternative compliance path, there is no impact on energy savings.
- Addendum bo: This addendum is part of an ongoing effort to keep the requirements of Section 11 and Appendix G consistent with other addenda to the standard. This addendum makes changes to Section 11 and G related to Addenda e, s, and u. Because this change is an alternative compliance path, there is no impact on energy savings.
- Addendum bv: This addendum is part of an ongoing effort to keep the requirements of Section 11 and Appendix G consistent with other addenda to the standard. This addendum includes changes to Section 11 and Appendix G due to Addenda y, aj, bk, and ax. Because this change is an alternative compliance path, there is no impact on energy savings.

- Addendum ch: This addendum clarifies baseline minimum setpoints for fan-powered boxes and VAV reheat boxes. It modifies exceptions to remove the exception originally intended for hospitals and laboratory type spaces, clarify that lab systems with greater than 5,000 cfm of exhaust air use a single VAV baseline system, and add an exception to the 50% lab VAV minimum airflow to address minimum ventilation requirements lab designers follow to meet codes and accreditation standards. Because this change is an alternative compliance path, there is no impact on energy savings.
- Addendum cr: This addendum modifies the definition of unmet load hour and adds a definition for the temperature-control throttling range. It requires that both baseline and proposed unmet hours not exceed 300. It removes language allowing modification of system coil capacities to reduce unmet hours as needed. Because this change is an alternative compliance path, there is no impact on energy savings.
- Addendum da: This addendum establishes that an Appendix G baseline shall be based on the minimum ventilation requirements required by local codes or a rating authority and not be the proposed design ventilation rates. Because this change is related to a performance rating method, there is no impact on energy savings.
- Addendum db: This addendum modifies the design air flow rates for laboratory systems in the baseline building in Appendix G. Because this change is related to a performance rating method, there is no impact on energy savings.
- Addendum dg: This addendum adds a definition for the term "field-fabricated fenestration" used in Section 5.4.3.2, consistent with Interpretation IC 90.1-2007-01 and similar language in California's Title 24. This definition clarification has no impact on energy savings.
- Addendum dn: This addendum adds system types 9 and 10 for heated only storage spaces and associated changes. Because this change is related to a performance rating method, there is no impact on energy savings.

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