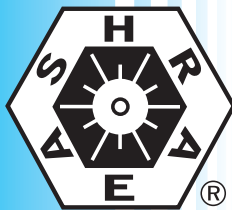


ANSI/ASHRAE/IESNA Standard 90.1-2004
(Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F)



ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

SI Edition

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IESNA Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, <http://www.ashrae.org>, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in U.S. and Canada).

© Copyright 2004 ASHRAE, Inc.

ISSN 1041-2336

Jointly sponsored by



The
LIGHTING
AUTHORITY

**Illuminating
Engineering Society
of North America**



120 Wall Street, 17th Floor, New York, NY 10005-4001

**American Society of Heating, Refrigerating
and Air-Conditioning Engineers, Inc.**

1791 Tullie Circle NE, Atlanta, GA 30329

www.ashrae.org

ASHRAE Standing Standard Project Committee 90.1
Cognizant TC: TC 7.6, Systems Energy Utilization
SPLS Liaisons: Hugh F. Crowther and Michael H. Tavares
ASHRAE Staff Liaison: Mark Weber
IESNA Liaison: Rita M. Harrold

Jerry W. White, Jr., <i>Chair</i>	Richard V. Heinisch	Edward P. O'Brien
James M. Calm, <i>Vice-Chair</i>	Randall T. Higa	James A. Ranfone
Donald F. Steiner, <i>Vice-Chair</i>	Adam W. Hinge	Eric E. Richman
Karim Amrane	Billy G. Hinton, Jr.	Jack F. Roberts
Wagdy A.Y. Anis	John F. Hogan	Michael I. Rosenberg
Anthony M. Arbore	Samantha Holloman	Steven Rosenstock
William P. Bahnfleth	William G. Holy	Robert D. Ross
Albert R. Barfield	Graham C. Hunter, II	Donald L. Sampler
Pete Baselici	J. Delaine Jones	David A. Schaaf, Jr.
Van D. Baxter	Hyman M. Kaplan	Leonard C. Sciarra
Denise M. Beach	Gersil N. Kay	Bipin Vadilal Shah
Donald L. Beaty	Steven D. Kennedy	Peter Simmonds
Albert W. Black, III	Larry Kouma	Stephen V. Skalko
Valerie L. Block	Ronald D. Kurtz	Larry G. Spielvogel
Donald M. Brundage	Samantha H. LaFleur	Frank A. Stanonik
Ernest A. Conrad	Michael D. Lane	Joseph K. Ting
Charles C. Cottrell	Dean E. Lewis	T. Ming Tran
Roy Crane	Steven J. Lit	Cedric S. Trueman
Joseph J. Deringer	Richard Lord	Martha G. VanGeem
David Duly	Kenneth Luther	Carl Wagus
Keith I. Emerson	Ronald Majette	Frederick F. Wajcs, Jr.
Drake H. Erbe	Itzhak H. Maor	McHenry Wallace, Jr.
Douglas S. Erickson	Carol E. Marriott	Richard D. Watson
Thomas A. Farkas	R. Christopher Mathis	David Weitz
Charles R. Foster, III	Merle F. McBride	Robin Wilson
Allan B. Fraser	Michael W. Mehl	Michael W. Woodford
James A. Garrigus	Harry P. Misuriello	Dale L. Woodin
Jason J. Glazer	Louis J. Molinini	Thomas R. Worlledge
Ashok Gupta	John Montgomery	Donald R. Wulfinghoff
S. Pekka Hakkarainen	Frank T. Morrison	Stanley W. Zajac
Katherine G. Hammack	Frank Myers	
Susanna S. Hanson	Ronald G. Nickson	

ASHRAE STANDARDS COMMITTEE 2003-2004

Van D. Baxter, *Chair*
Davor Novosel, *Vice-Chair*
Donald B. Bivens
Dean S. Borges
Paul W. Cabot
Charles W. Coward, Jr.
Hugh F. Crowther
Brian P. Dougherty
Hakim Elmahdy
Matt R. Hargan
Richard D. Hermans
John F. Hogan

Frank E. Jakob
Stephen D. Kennedy
David E. Knebel
Frederick H. Kohloss
Merle F. McBride
Mark P. Modera
Cyrus H. Nasser
Stephen V. Santoro
Gideon Shavit
David R. Tree
James E. Woods
Ross D. Montgomery, *BOD ExO*
Kent W. Peterson, *CO*

Claire B. Ramspeck, *Manager of Standards*

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus standard developed under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Consensus is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this standard as an ANS, as "substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution." Compliance with this standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Manager of Standards of ASHRAE should be contacted for:

- interpretation of the contents of this Standard,
- participation in the next review of the Standard,
- offering constructive criticism for improving the Standard,
- permission to reprint portions of the Standard.

DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE's Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

CONTENTS

ANSI/ASHRAE/IESNA Standard 90.1-2004 Energy Standard for Buildings Except Low-Rise Residential Buildings

SECTION	PAGE
Foreword.....	4
1 Purpose	4
2 Scope	4
3 Definitions, Abbreviations, and Acronyms	4
4 Administration and Enforcement.....	15
5 Building Envelope	17
6 Heating, Ventilating, and Air Conditioning	31
7 Service Water Heating.....	56
8 Power.....	59
9 Lighting	60
10 Other Equipment	67
11 Energy Cost Budget Method	68
12 Normative References	77
<i>Normative Appendices (these appendices are normative and part of this standard)</i>	
Appendix A: Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations.....	80
Appendix B: Building Envelope Climate Criteria	109
Appendix C: Methodology for Building Envelope Trade-Off Option in Subsection 5.6	121
Appendix D: Climatic Data.....	130
<i>Informative Appendices (these appendices are informative and not part of this standard)</i>	
Appendix E: Informative References.....	164
Appendix F: Addenda Description Information.....	166
Appendix G: Performance Rating Method	169

NOTE

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at <http://www.ashrae.org>.

© Copyright 2004 American Society of Heating,
Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE
Atlanta, GA 30329
www.ashrae.org

All rights reserved.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

The original Standard 90 was published in 1975 and revised editions were published in 1980, 1989, and 1999 using the ANSI and ASHRAE periodic maintenance procedures. Based upon these procedures, the entire standard was publicly reviewed and published in its entirety each time. As technology and energy prices began changing more rapidly, however, the ASHRAE Board of Directors voted in 1999 to place the standard on continuous maintenance, permitting the standard to be updated several times each year through the publication of approved addenda to the standard. Starting with the 2001 edition, the standard is now published in its entirety in the fall of every third year. This schedule allows the standard to be submitted and proposed by the deadline for inclusion or reference in model building and energy codes. All approved addenda and errata will be included in the new edition every three years. This procedure allows users to have some certainty about when new editions will be published.

This 2004 edition of the standard has several new features and includes changes resulting from the continuous maintenance proposals from the public. The standard has been completely reformatted for ease of use and clarity. The climate zones have been reduced from 26 to 8 and the Lighting LPDs have been reduced as well. The committee welcomes suggestions for improving the standard. Users of the standard are encouraged and invited to use the continuous maintenance procedure to suggest changes. A form, Submittal of Proposed Change, is included in the back of this standard. The committee will take formal action on every proposal received.

The project committee is continually considering changes and proposing addenda for public review. When addenda are approved, notices will be published on the ASHRAE and IESNA Web sites. Users are encouraged to sign up for the free ASHRAE and IESNA internet list server for this standard to receive notice of all public reviews and approved and published addenda and errata.

Changes from the previous 2001 edition of the standard are not marked in the margin, as was the practice with the 1999 edition, because of the extensive reformatting that has taken place in this 2004 edition.

This edition corrects all known typographical errors in the 2001 standard. It includes the content of 31 addenda that were processed by the committee and approved by the ASHRAE and IESNA Boards of Directors. For the publication dates and brief descriptions of the addenda to 90.1-2001, see Appendix F.

1. PURPOSE

The purpose of this standard is to provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings.

2. SCOPE

2.1 This standard provides:

- (a) minimum energy-efficient requirements for the design and construction of:
 - 1. new buildings and their systems,
 - 2. new portions of buildings and their systems, and
 - 3. new systems and equipment in existing buildings and
- (b) criteria for determining compliance with these requirements.

2.2 The provisions of this standard apply to:

- (a) the envelope of buildings, provided that the enclosed spaces are:
 - 1. heated by a heating system whose output capacity is greater than or equal to 10 W/m² or
 - 2. cooled by a cooling system whose sensible output capacity is greater than or equal to 15 W/m², and
- (b) the following systems and equipment used in conjunction with buildings:
 - 1. heating, ventilating, and air conditioning,
 - 2. service water heating,
 - 3. electric power distribution and metering provisions,
 - 4. electric motors and belt drives, and
 - 5. lighting.

2.3 The provisions of this standard do not apply to:

- (a) single-family houses, multi-family structures of three stories or fewer above grade, manufactured houses (mobile homes) and manufactured houses (modular),
- (b) buildings that do not use either electricity or fossil fuel, or
- (c) equipment and portions of building systems that use energy primarily to provide for industrial, manufacturing, or commercial processes.

2.4 Where specifically noted in this standard, certain other buildings or elements of buildings shall be exempt.

2.5 This standard shall not be used to circumvent any safety, health, or environmental requirements.

3. DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

3.1 General

Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard. Terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based upon American standard English language usage as documented in an unabridged dictionary accepted by the *adopting authority*.