

# The New Standard 90.1

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In a fitting tribute to the new millennium, ASHRAE issued ASHRAE/IESNA Standard 90.1-1999, *Energy Standard for Buildings Except Low-Rise Residential Buildings* at the Winter Meeting in Dallas in February. This new version of Standard 90.1 represents ten years of effort on the part of the project committee that completely revised the previous 1989 version of the standard.

The new standard is designed for ease of use, is written in code language to simplify enforcement, has separate publications in IP and SI units to serve the international communities, has expanded, improved and simplified criteria, has multiple compliance options, was expanded to include existing buildings, has a User's Manual available, and includes many other advancements.

## Criteria Development

The process of revising the 1989 version of Standard 90.1 began not long after the standard was published. A group of project committee members met together to try to address the major concerns raised by reviewers of the 1989 version. These concerns revolved around the stringency of the standard and the use of professional judgment by the project committee. To address these concerns, the project committee decided to ensure that the basis of the new standard would be well founded and documented, and that economics would be used in

helping to establish the criteria. In order to address the economic issues, the project committee developed a simplified National Energy Model (NEM) that was used to assess the energy savings potential of a new standard as a function of the economic stringency.

Several versions of the NEM were produced, each a refinement of the previous version. By using the NEM at the beginning of the development cycle, the project committee could be informed about the impact of the decisions regarding the economic levels. Initially, the project committee set targets for energy savings of 25% for the base standard, and 50% and 75% for enhanced levels of the standard.

Ultimately, the NEM was used for selecting the economic levels for the development of the criteria. This resulted in the 75% target savings level being dropped because the highest level of potential savings using current technology yielded by the NEM was 47% at a 30-year lifetime. The 50% target was also dropped when the decision was made to write the standard in code language since a code represents the legal minimum criteria.

## Code Language

In addition to enhanced stringency, the project committee had a mandate to produce a standard that was written in enforceable language suitable for adoption into codes. This mandate was established by the ASHRAE Board of Directors and reflected the need to speed the time to market of ASHRAE standards by producing them in a language suitable for use by the code bodies. The project committee also substantially revised the organization and structure of Standard 90.1 to make it simpler and easier to use.

## Existing Buildings

One of the more significant changes in the 1999 version was the change in scope of Standard 90.1 to include modifications made to existing buildings. This change was made to ensure that the requirements for modifications to existing buildings were the same as for new buildings. The project committee recognized that in many code jurisdictions Standard 90.1 was already being applied to existing buildings. The committee considered the impact of this change, and worked with consulting engineers and user groups to craft appropriate language for all alterations and additions.

## Envelope

The envelope section was completely revised, and now contains all of the mini-

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imum requirements for both opaque surfaces and fenestration in one table for each of the 26 specific climate zones. This represents a major simplification for the envelope criteria. The criteria have been expanded to include additional assemblies. For the first time, Standard 90.1 contains a true prescriptive option that does not require calculation on the part of the designer. Pre-calculated assemblies are included in Appendix A, and the designer can select the appropriate R-value for the insulation to show compliance. Of course, calculations may still be done to establish the U-factor for a specific assembly if the designer so desires.

One of the more popular features of the 1989 standard, the ENVSTD Envelope Tradeoff software, has been carried over to the 1999 version. The new ENVSTD 3.0 has been significantly updated, and is available as a Windows program. Implementing the tradeoff methodology contained in Appendix C, ENVSTD allows tradeoffs of all of the building envelope components. The program makes extensive use of pull-down menus, and provides an extensive library of envelope assemblies for compliance. The output from the program provides complete information for compliance checking by code officials.

### Mechanical

The mechanical sections of the standard also received some significant updates, both in stringency and ease of use. The mechanical section was substantially reorganized and presents HVAC-related requirements in order of complexity, beginning with the simplest, most common building design options. In addition, a new "simplified approach" was added to the mechanical section to address the needs of smaller commercial buildings. The revised mechanical section offers three compliance paths:

- Mandatory provisions and prescriptive requirements.
- Mandatory provisions and the energy cost budget method. This computerized method allows tradeoffs between prescriptive requirements.
- A simplified approach that includes all mandatory provisions and prescriptive requirements, for buildings two stories and less in height and less than 25,000 ft<sup>2</sup> (2320 m<sup>2</sup>) of gross floor area. To be used, the systems must also satisfy 15 specific criteria such as serving only one zone. The purpose of this approach is to reduce a designer's time to locate the requirements for these buildings.

The mandatory provisions of the standard include the equipment efficiency requirements, similar to those in the 1989 version of the standard. The present (1989) efficiencies are carried forward for the next two years. After this time, new requirements will be in effect. Two examples are shown in *Table 1*.

The new standard adds efficiency requirements for ground-source heat pumps, absorption cooling equipment and heat rejection equipment. In addition to equipment efficiencies, there are extensive control requirements including deadbands, setpoint overlap restrictions and off-hour controls. Mandatory requirements also cover system construction (including duct

Equipment Type	Minimum Efficiency	Efficiency as of 10/29/2001	Test Procedure
15-ton [53 kW] rooftop	8.5 EER	9.7 EER	ARI 340/360
300-ton [1055 kW] water-cooled centrifugal chiller	5.20 COP 5.30 IPLV	6.10 COP 6.10 IPLV	ARI 550

**Table 1: Sample new mechanical requirements for equipment efficiency.**

sealing and leakage tests) and insulation requirements for both ducts and piping. Drawings, manuals and a narrative of system operation must be supplied to the building owner. The standard also addresses system balancing on larger systems and commissioning on larger buildings.

The prescriptive requirements of the mechanical section include the following criteria:

- Economizer (either air or water) based on climate and equipment size. An economizer may be eliminated if equipment efficiency is increased to specified levels.
- Limitations on simultaneous heating and cooling to reduce system energy consumption. A number of exceptions provide the building designer with flexibility.
- Fan power limitations expressed in terms of nameplate power, but allowing additional power for specific filtration or heat-recovery pressure additions. In addition, fans of 30 hp (22 kW) and greater must use no more than 30 percent of design power at 50 percent of design air volume at one-third of the total design static pressure. Fan pressure optimization is required for systems with direct digital control (DDC).
- Hydronic system design and control for variable-flow systems, pump isolation and appropriate temperature reset.
- Size-specific control requirements for heat rejection equipment.
- Energy recovery on specific systems.
- Exhaust hood control.
- A limitation on the use of hot gas bypass.

### Lighting

The revised lighting section seeks energy conservation primarily through lighting control and total building wattage limitations. It contains requirements for both the interior and the exterior lighting applications of buildings.

The interior lighting control requirements are designed to assure that lighting is turned off when facilities are unoccupied. This is primarily accomplished through the use of programmable building lighting control or occupancy sensors. The exterior lighting control requirements are designed to assure the exterior lights are off during daylight hours. This is primarily accomplished through the use of photosensor control.

Additionally, there are individual manual control requirements including accent lighting, task lighting, and demonstration lighting. Also, hotel and motel rooms are required to have one master control switch at the main room entry that is capable of turning off all of the lighting in the room.

The standard specifies limits on the amount of total wattage

## Features of ASHRAE/IESNA Standard 90.1-1999

- Written in mandatory language suitable for code adoption.
- Simplification and ease-of-use considerations addressed throughout.
- Available in IP and SI versions.
- Multiple compliance options available.
- Coverage for additions and alterations to existing buildings added.
- All envelope criteria contained on a single page for any climate zone.
- Expanded envelope assemblies.
- New, Windows version of ENVSTD 3.0 will be included with the revised User's Manual.
- Expanded climate data for U.S. and international locations.
- Simplified approach for mechanical criteria for smaller buildings.
- New equipment added to mechanical section (ground source heat pumps, absorption cooling, cooling towers).
- Lighting criteria based on extensive IESNA application models.
- New "use it or lose it" lighting power allowances.
- Expanded energy cost budget section with compliance supplement requirement.

### Energy Savings

The many changes made to Standard 90.1-1999 have resulted in a significant new commercial building energy standard that will lead the way into the new millennium. Based on an evaluation using the NEM, the new standard could be expected to save approximately 17% in office and retail buildings. The savings is expected to vary for other building types.

### User's Manual

A User's Manual was developed to accompany the standard and should be available simultaneously with the publication of the standard. The User's Manual contains many examples of how to use the standard as well as a complete set of compliance forms for use in demonstrating compliance with the requirements of the standard.

### Summary

Not only has ASHRAE produced a new standard that saves energy, but it has also produced a document that is greatly simplified, ready for the code market, addresses the needs of the international community, and will be supported by a timely User's Manual and software. ■

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used for lighting throughout a building by establishing a total lighting power allowance. This power allowance can be determined in two ways.

The first option, described as the building area method, allows the designer to use a simple approach of multiplying the building square footage times the total lighting watts per square foot specified for that building type. This multiplication produces a total lighting wattage budget that can be used at the lighting designer's discretion.

The second option, described as the space-by-space method, allows the designer to build a total lighting wattage budget by considering each space within the building individually. The wattage budget for each individual space is then totaled to build a total lighting wattage budget for the total area being designed within the building or the total building being designed. This lighting wattage budget can be used as the lighting designer chooses.

Additional lighting power is allowed for decorative lighting, fixtures designed to minimize glare on VDT screens, and retail accent lighting. If this lighting equipment is not installed, no additional power is allowed.

The standard specifies limits on the amount of total wattage used for exterior building entrance and exit lighting by establishing a total exterior lighting power budget. This power budget is determined by totaling the lighting power allowed for all exits, entrances and canopied areas of entrances. This exterior lighting power budget is then used at the lighting designer's discretion.

In addition, lighting power is allowed for façade lighting. A façade power budget is determined based on the total area of the exterior building surface being illuminated. This power is not part of the total exterior lighting budget and is only allowed if façade lighting is installed.

Finally, building grounds luminaires operating at greater than 100 watts, must have a minimum efficacy of 60 lumens per watt unless controlled by a motion sensor. To meet this requirement, all dusk-to-dawn building grounds lighting, greater than 100 watts, would have to contain a high pressure sodium, metal halide or fluorescent light source.

### Energy Cost Budget

The energy cost budget, used for whole building tradeoffs, was also substantially revised. The energy cost budget is generally used for more complex buildings where tradeoffs beyond the performance paths available in the major sections are desired. A significant change in the energy cost budget is the requirement for a compliance supplement that describes the rules by which the tradeoff methodology will be conducted. This change was implemented to reduce the amount of "gaming" that was possible, and to ease the enforcement burden by code officials.

### Climate Data

The number of locations with climate data were expanded for the U.S. and Canada. In addition, for the first time, 64 international countries are included in the standard. These changes will make the standard more applicable for a wider audience in both the U.S. and other countries.