ASHRAE 90.1-2010 sets the energy standard (Consulting-Specifying Engineer; January 2013)

The widely used energy standard reaches an inflection point that demands both efficient design and accountability from building inhabitants.

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As ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, has evolved and expanded over time, so has its impact on the industry. In 1992, the Energy Policy Act required the Dept. of Energy to review each new version of Standard 90.1, while requiring all states to adopt energy codes that are substantially equal to the standard as well. Additionally, the International Energy Conservation Code registers compliance with 90.1 as an alternative way of meeting that code, while the U.S. Green Building Council's LEED also references 90.1, making it one of the most successful and widely adapted energy codes to date.

Today, however, ASHRAE 90.1, with its newest 2010 version, and scheduled for a new release in 2013, stands at a key inflection point. Calling for a 30% energy improvement over the 2004 standard, the law of diminishing returns will begin to come into play as the code authoring committees and designers continue to increase the performance requirements for each new building, squeezing every last kilowatt hour out of the sponge.

This inflection point begs the question: What makes a building truly energy efficient, and how does one quantify it? In light of the 2008 report by the New Building Institute, which suggests the first generation of LEED buildings hasn't lived up to its expectations, ASHRAE 90.1-2010 must demand a new definition of high performance that moves beyond initial design to consider and account for the life of the building.

And that's just what it does. ASHRAE 90.1-2010 demands much more from a building than ever before, architecturally, aesthetically, and through modified human consumption. From the building envelope to its HVAC systems, commissioning, lighting, and power, ASHRAE 90.1-2010 ushers in a new area of accountability not only for those who design buildings, but also for those who inhabit them.

Here's a quick look at what's new and how, where, and when it all applies.

Building envelope

More insulation and better glass will be required of tomorrow's building envelope. Cool roofs are now required in climate zones 1 through 3, while building orientation will play a larger role as well. Additionally, the early integration of architecture and mechanical, electrical, plumbing (MEP), and fire protection engineering will be inevitable to achieve compliance and optimal envelope performance.

· 40% maximum glazing. Per the prescriptive path, no more than 40% of any surface façade can be fenestration unless the façade can perform as well as a wall that is 40% window or less. And, while the energy cost budget method allows for more flexibility and trade-offs between building systems, it's likely that the floor-to-ceiling glass tower built just five years ago won't be able to be replicated, as it's very difficult to get enough performance out of a floor-to-ceiling glazed curtainwall.

· Orientation requirements. While ASHRAE 90.1 previously had no orientation requirements, the 2010 version now requires that buildings be oriented so that more of the glass is distributed across the south façade, minimizing glazing on the east and west walls. This will further reduce cooling loads and take advantage of southern solar gains when the sun is low in the sky during the winter months, while being able to more effectively shade the high summer sun.

· Continuous air barrier. Assemblies, such as curtainwalls, must be rated to limit air leakage to 0.04 cfm/sq ft. The air barrier and all the joints on the façade need to be detailed.

· Daylight controls. Automatic daylight controls are required in any space adjacent to a window 250 sq ft or larger. While most new buildings employ this technology as a "sustainable element," 90.1-2010 made it standard.

· Minimum insulation. Though more significant changes are expected in the 2013 edition, the minimum insulation values for opaque assembles have also increased, depending on the climate.

HVAC systems

HVAC systems saw the greatest change in ASHRAE 90.1-2010, including alterations to the minimum equipment efficiency ratings, fan power limitations, energy recovery, reheat limitation, economizers, and duct sealing and leakage.

· Fan power. Calling for more efficient fans, ASHRAE 90.1-2010 will reduce the amount of fan power allowed to be used in a building. This can be achieved through lower static pressure duct systems, which translates to fewer bends, wider ducts, and shorter runs—all of which impact architectural space planning.

Additionally, individual variable air volume (VAV) fans with motors greater than or equal to 10 hp need a variable speed drive (VSD), or another means of reducing fan power consumption.

· Energy recovery. In some climate zones (see ASHRAE Table 6.5.6.1), energy recovery may be required for air-handling systems with as little as 30% outside air, reducing the size of a unit that triggers the requirement.

· Reheat limitations. Reheat will not be allowed unless the air being reheated is less than or equal to 30% of the peak flow or the minimum required ventilation rates. This effectively encourages HVAC designers to look toward a dedicated outside air systems (DOAS) in commercial spaces, as well as likely eliminating constant volume systems for hospitals and labs. Employing separate perimeter heating, or finned tube radiation, is another simple way to meet this requirement.

· Economizers. Economizers are now required for all climate zones, except 1A and 1B (see ASHRAE climate table), for systems with more than 54,000 Btu/hour (previously 134,000 Btu/hour). This applies to air conditioning units 4.5 tons and larger, which includes just about every commercial setting. A waterside economizer may be able to be substituted to achieve the same result.

· Duct sealing and leakage (addendum cq). Duct work higher than 3-in. w.g. and all outdoor air ducts need to be Seal Class A and Leakage Class 4. By surface area, 25% needs to be tested to demonstrate conformance.

· Minimum equipment efficiencies. Minimum performance requirements of heating and air conditioning equipment, including chillers, boilers, and packaged equipment, continue to increase from the previous standard. Designers must pay special attention to which path of compliance will be used when testing chillers with or without VFDs.

· Supply air temperature reset. While often employed in commercial HVAC design, 90.1-2010 marks the first time supply air temperature reset control is actually required.

· Heat rejection. This now effectively limits the use of centrifugal fans in cooling towers.

· HVAC commissioning. Possibly the most significant ASHRAE 90.1-2010 update, HVAC commissioning is now required for control systems on most projects greater than 50,000 sq ft.

Lighting

From exit signs to parking garages, artificial lighting (and the lack of it) continues to gain efficiency with 90.1-2010, not only in the lighting power density (LPD) requirements, but also in the application and use of lamps and controls.

· Whole building lighting power density. Power allowances are reduced, dropping about 10% on average (see Table 9.5.1).

· Daylighting. Previously used to add efficiency, daylighting is now required in many spaces in the prescriptive path.

· Efficient lighting. More efficient lighting is now also required, including exit signs that are limited to 5 W/lighted face, which means using LED or LEC (electroluminescent) exit lights. Parking garage lighting needs to be reduced by 30% when there is no activity.

· Controls. Daylighting controls are now required in projects larger than 50,000 sq ft, while more sophisticated occupancy sensors are required for training rooms, lecture halls, and storage rooms 50 to 1,000 sq ft. Automatic shut-off is required, with the exception of patient care areas, spaces where lighting is required for 24-hour use, and where automatic shut-off would be unsafe. Functional testing of all of these controls is also now required.

Power

Beyond the power that supports the energy-consuming building systems, ASHRAE 90.1-2010 targets the local receptacle, attempting to reduce the ever-growing “vampire” plug loads, both during downtime and after hours.

120-V outlets. Fifty percent of 120-V outlets that serve private offices, open offices, and computer classrooms must be provided with automatic receptacle control. Buildings are encouraged to put parasitic loads (i.e., printers, chargers, heaters, etc.) on half of the outlets so they can be switched off with occupancy, as plug-in loads can account for 15% to 50% of a building’s electricity. To reach the next level of performance, efficiency requirements must trickle down to building inhabitants and their behaviors. How people interact with the building and how process loads are handled in the building will all be crucial to the success and compliance of ASHRAE 90.1-2010, and beyond.

While previously, energy standards focused only on construction practices, tomorrow’s standards will require that all building inhabitants become active participants in reducing the energy consumption of their buildings by being cognizant of their surroundings. ASHRAE 90.1-2010 has hit this inflection point. To do a whole lot better than 90.1-2010, aesthetics, cost, and human behavior will have to change.

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ASHRAE 90.1-2010 compliance

ASHRAE 90.1-2010 compliance will once again permit the use of the energy cost budget method to demonstrate that the proposed building's energy cost will be the same or less than that of a building designed to minimally comply with the standard. This is different than the Appendix G simulation, often used in calculating U.S. Green Building Council LEED compliance, that includes more flexibility for trade-offs. While both methods employ energy modeling, and Appendix G is often preferred for its allowance of different baseline and proposed HVAC system types, only the energy cost budget method can be used to demonstrate compliance with ASHRAE 90.1-2010 or the International Energy Conservation Code (IECC).