STANDARD

ANSI/ASHRAE/IES Addendum d to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on June 30, 2023, and by the Illuminating Engineering Society on June 7, 2023.

This addendum was approved 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. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336

Approved American National Standard
www.ansi.org

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus Standard developed under the auspices of 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 Senior Manager of Standards of ASHRAE should be contacted for

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

(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

Further review of Energy Credit H05: Ground-Source Heat-Pump System determined that, for ground-source fields with supplemental dry cooler or evaporative heat rejection for Climate Zones 0A, 0B, and 1A, the ground field could be further reduced with a larger heat rejection device. The smaller ground-source field results in increased fan and pump use required for heat rejection. The analysis showed that the reduced net savings of the more economical ground-source field could be accounted for in the table by multiplying the original dry cooler adjustment values by 70% and the evaporative heat rejection adjustment values by 85% for these three climate zones. The table has been revised to reflect these adjusted values and reformatted for clarity. Note that only new values are underlined in the table, even though the other values have been rearranged. This is because only the HR_{adj} values for ground source fields with supplemental dry cooler or evaporative heat rejection in Climate Zones 0A, 0B, and 1A are updated by this addendum.

The reduced values of HR_{adj} result in a more optimized ground-loop system justified in these three climate zones. However, the field reduction was inappropriate for colder climate zones where the heating load determined the minimum bore size. There are also adjustments in the text for Section 11.5.2.2.5, noting the other options for ground-source systems, and some minor editorial changes for clarity, including correcting the SI conversion for 12,000 Btu/h (3.5 kW).

Informative Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum d to Standard 90.1-2022

Revise Section 11.5.2.2.5 as shown (I-P and SI).

11.5.2.2.5 H05: Ground Source Heat Pump System. To achieve this credit, a ground source heat pump *system* shall provide cooling and heating for at least 25% of the *gross conditioned building area*. The ground source heat pump systems shall include *building* ground loop *HVAC system*s coupled with a closed-bore ground-heat exchanger, submerged heat exchanger using water-based fluid as a heat transfer medium, groundwater (well), or fluid infrastructure (such as effluent and wastewater), and shall comply with the following:

a. Loop *pump(s)* shall have controls and/or devices that will result in *pump* motor demand of no more than 30% of design wattage at 50% of design water flow and allow turn down to 15% flow. Alternatively, a separate field loop *pump* shall be provided, with either a variable-speed *building pump* or individual pumps for each ground source heat pump.

b. The geothermal-source exchanger shall be sized based on the heating and cooling loads served by the ground-source heat pump *system* and shall comply with one of the following, as allowed by climate zone, as shown in Table 11.5.2.2.5:

   1. **100% Hours Source Size.** The *system* shall meet one of the following:

      i. A closed bore field shall have at least 400 lineal feet (120 lin m) of bore *piping* per 12,000 Btu/h (3.~~500~~ *kW*) of *system* cooling or heating capacity, whichever is greater. The system shall not include additional heat rejection or addition devices.

      ii. The ground source shall be sized to provide 100% of both the cooling and heating *system* annual operating hours without requiring any supplemental heating or heat rejection from non-ground sources, as demonstrated by an analysis or testing approved by the *authority having jurisdiction.*

   2. **90% Hours Source Size.** The ground source shall be sized such that the loop heat pumps provide 100% of the heating and cooling loads for at least 90%, but less than 100%, of both the cooling and heating *system* annual operating hours without requiring any supplemental heating or heat rejection from non-ground sources, as demonstrated by an analysis approved by the *authority having jurisdiction*. Heat rejection shall include a ~~two-speed or~~ variable-speed fan *system*.

   3. **70% Hours Source Size.** The ground source shall be sized such that the loop heat pumps provide 100% of the heating and cooling loads for at least 70%, but less than 90%, of both the cooling and heating *system* annual operating hours without requiring any supplemental heating or heat rejection

from non-ground sources, as demonstrated by an analysis approved by the *authority having jurisdiction*. Heat rejection shall include a variable-speed fan system.

The ~~allowed~~ base credits are ~~based on~~ for a ground-source heat pump *system* serving 25% of the *gross conditioned building area* and includes dry cooler partial heat rejection. Adjust the base credits as follows:

$$EC_{H05\_adj} = EC_{H05\_base} \times \frac{Floor_{GSHP}}{0.25} \times HR_{adj}$$

where

EC_{H05_adj} = *energy* credits achieved for ground-source heat-pump *system*

EC_{H05_base} = H05 base ~~*energy*~~energy credit from Section 11.5.3

$Floor_{GSHP}$ = fraction of whole-project *gross conditioned floor area* with heating and cooling provided by the ground-source heat pump *system*

HR_{adj} = heat-rejection adjustment factor by climate zone from Table 11.5.2.2.5 based on ground-source hours capacity sizing

Note: Relocated or duplicated values in the table below are not underlined, as the values have not changed, and the new placement in the table is editorial. Instead, they are indicated in light gray highlight.

Table 11.5.2.2.5 GSHP Heat Rejection Adjustments

Climate Zones	HR_{adj} by ~~Field~~ Ground Source Capacity				
	~~Full-Sized Bore Field with no Heat Rejection~~		~~90% Hours Source Size; Dry-Cooler Heat Rejection~~		~~90% Hours Source Size; Evaporative Heat Rejection~~
	Dry Cooler Heat Rejection		Evaporative Heat Rejection		No Heat Rejection
	90% Hours Source Size	70% Hours Source Size	90% Hours Source Size	70% Hours Source Size	100% Hours Source Size
All climate zones	1.0				
0A		0.70	2.6	2.2	3.3
0B, 1A		0.70	5.3	4.5	7.6
~~0A,~~ 1B, 2B, 3A, 3B, 4A, 4B			2.6		3.3
~~0B, 1A,~~ 2A, 3C			5.3		7.6
4C, 5A, 5B, 5C			1.5		2.3
6A, 6B, 7, 8			1.1		1.4

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards, and connect on LinkedIn, Facebook, Twitter, and YouTube.

Visit the ASHRAE Bookstore

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous edition. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.

6/23