



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

Public Review Draft

Proposed Addendum d to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low- Rise Residential Buildings

**First Public Review (March 2023)
(Draft Shows Proposed Changes to Current Standard)**

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ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092

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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 have been 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. This included correcting the SI conversion for 12,000 Btu/hr (3.5 kW).

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum d to 90.1-2022

Modify the standard as follows for IP (and SI) Units:

Revise Section 11.5.2.2.5 as follows:

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 systems 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 *pipng* 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 to reviewers; relocated or duplicated values in table below are not underlined as the values have not changed and the new placement in the table is editorial. *Instead, they have been indicated in red.*

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
	<u>Dry cooler heat rejection</u>		<u>Evaporative heat rejection</u>		<u>No heat rejection</u>
	<u>90% hours source size</u>	<u>70% hours source size</u>	<u>90% hours source size</u>	<u>70% hours source size</u>	<u>100% hours source size</u>
All Climate Zones	1.0				
<u>0A</u>		<u>0.70</u>	2.6	<u>2.2</u>	3.3
<u>0B, 1A</u>		<u>0.70</u>	5.3	<u>4.5</u>	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