

# STANDARD

**ANSI/ASHRAE/IES Addendum cv 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 February 28, 2023, and by the Illuminating Engineering Society on February 15, 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](http://www.ashrae.org)) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: [orders@ashrae.org](mailto: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](http://www.ashrae.org/permissions).

© 2023 ASHRAE

ISSN 1041-2336



# ASHRAE Standard Project Committee 90.1

## Cognizant TC: 7.6 Systems Energy Utilization

**SPLS Liaison: Jennifer Isenbeck • ASHRAE Staff Liaisons: Emily Toto • IES Liaison: Mark Lien**

Donald Brundage*, <i>Chair</i>	Jason Glazer*	Andrew Klein	Loren Ross
Thomas Culp*, <i>Co-Vice Chair</i>	Melissa Goren*	Vladimir Kochkin*	Robert Ross*
Richard Lord*, <i>Co-Vice Chair</i>	Mark Graham	Michael Lane*	Marty Salzberg*
Rahul Athalye	Aaron Gunzner	Toby Lau	Christopher Schaffner
William Babbington	David Handwork*	Chonghui Liu	Greg Schluterman
John Bade*	Rick Heiden	Emily Lorenz	Amy Schmidt
Sean Beilman*	David Herron*	Christopher Mathis*	Leonard Sciarra*
Kyle Bergeron	Armin Hauer	Merle McBride*	Kelly Seeger*
Jeffrey Boldt	Gary Heikkinen	James McClendon*	Wayne Stoppelmoor*
Scott Campbell	Mark Heizer	Benjamin Meyer*	Matthew Swenka
Paula Cino*	Scott Hintz*	Frank Morrison*	Christian Taber*
Glen Clapper	Emily Hoffman	Michael Myer	Steven Taylor*
Ernest Conrad*	Mike Houston*	Frank Myers*	Douglas Tucker
Shannon Corcoran*	Jonathan Humble*	James C. Moore	Jason Vandever
Jay Crandell*	Michael Ivanovich	Michael Patterson*	Martha VanGeem*
Brandon Damas*	Harold Jepsen	Timothy Peglow*	Michael Waite*
Julie Donovan*	Chad Johnson	Tien Peng	McHenry Wallace*
Craig Drumheller*	Greg Johnson*	Christopher Perry	Jerry White*
James Earley	Duane Jonlin*	Laura Petrillo-Groh*	Jeremiah Williams*
D. Andrew Fouss	Michael Jouaneh	Michael Rosenberg*	Amber Wood
Phillip Gentry	Maria Karpman*	Steven Rosenstock*	

\* Denotes members of voting status when the document was approved for publication

## ASHRAE STANDARDS COMMITTEE 2022–2023

Susanna S. Hanson, <i>Chair</i>	Phillip A. Johnson	Lawrence C. Markel	Christopher J. Seeton
Jonathan Humble, <i>Vice-Chair</i>	Srinivas Katipamula	Patrick C. Marks	Christian R. Taber
William P. Bahnfleth	Gerald J. Kettler	Margaret M. Mathison	Paolo M. Tronville
Thomas E. Cappellin	Jay A. Kohler	Kathleen Owen	William F. Walter
Douglas D. Fick	Cesar L. Lim	Gwelen Paliaga	Steven C. Sill, <i>BOD ExO</i>
Patricia Graef	Paul A. Lindahl, Jr.	Karl L. Peterman	Sarah E. Maston, <i>CO</i>
Jaap Hogeling	James D. Lutz	Justin M. Prosser	
Jennifer A. Isenbeck	Julie Majurin	David Robin	

Connor Barbaree, *Senior Manager of Standards*

## 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

- interpretation of the contents of this Standard,
- participation in the next review of the Standard,
- offering constructive criticism for improving the Standard, or
- 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.

**(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

*Tables 6.8.1-13 and 6.8.1-14 of Standard 90.1 address the minimum efficiency requirements for electrically operated DX-DOAS units, single-package and remote condenser, without and with energy recovery, respectively. Presently, these minimum efficiency requirements are based on ISMRE for dehumidification and ISCOP for heating, referencing AHRI 920-2015, Performance Rating of Direct Expansion-Dedicated Outdoor Air System Units.*

*In 2020, AHRI published a significant revision to the test procedure AHRI 920-2020 with Addendum 1, Performance Rating of Direct Expansion-Dedicated Outdoor Air System Units<sup>1</sup>.*

*AHRI 920-2020 is technically superior to AHRI 920-2015. AHRI 920-2020 transitioned the primary metric from ISMRE to ISMRE2. DX-DOAS units are no longer required to reheat to “neutral air” (70°F to 75°F) on the supply airstream. With changed standard rating conditions, a name change was important to avoid confusion with ISMRE calculated using the 2015 standard. ISMRE2 calculation weights used with MRE values at conditions A, B, C, and D are different than ISMRE. Conditions C and D vary between the 2015 and 2020 versions, and the return-air condition changes at Point D are unfavorable with ERV. Supply air fan (SAF) external static pressure (ESP) increased about 0.6 in. of water, or 150%, between the 2015 and 2020 versions, depending on unit size. Return airflow (RAF) ESP, required with ERV, increased static pressure similarly to SAF ESP. It should also be noted that part-load unloading requirements are much more demanding. A  $C_d$  penalty of 35% is applied whenever compressor capacity cannot be reduced to match load. Excess moisture removal capacity beyond the design leaving dew point is no longer credited at part-load conditions.*

*Likewise, ISCOP has transitioned to ISCOP2. ISCOP2 includes a new  $COP_{DOAS}$  metric, which essentially includes the same changes as the transition from ISMRE to ISMRE2.*

*Developing a crosswalk between ISMRE and ISCOP to ISMRE2 and ISCOP2 has been difficult because of the testing difficulties with AHRI 920-2015 and the many changes between the editions. AHRI has held approximately 23 meetings since June 2020 to discuss the crosswalk with relevant stakeholders, including DOE contractors and California utility consultants (CA IOUs). During the process, AHRI collected 21 data points that were <324 lb/h MRC and had both ISMRE and ISMRE2 ratings. DOE gathered four data points, and the CA IOUs collected one data point. All AHRI data collected was provided to DOE consultant, Guidehouse, under a nondisclosure agreement to protect sensitive technical information. While work was ongoing to map the relationship between ISCOP to ISCOP2 through the AHRI group, the U.S. Department of Energy (DOE) and DOE consultants continued a separate analysis culminating in the February 1, 2022, publication of a proposed rule to adopt energy conservation standards<sup>2</sup>.*

*To ensure marketplace consistency with DOE’s proposed adoption of ISMRE2 and ISCOP2 levels based on AHRI 920-2020, Addendum cv makes the following changes:*

- a. Updates existing ASHRAE Standard 90.1-2019 ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards using the crosswalk analysis proposed by DOE in the February 1, 2022, notice of proposed rule for eight equipment classes.*
- b. For the four equipment classes covered by Standard 90.1, but not considered by DOE, this addendum updates existing Standard 90.1-2019 ISMRE and ISCOP standards to ISMRE2 and ISCOP2 standards based on an industry analysis. Four of these equipment classes will be combined into two.*
- c. Adds AHRI Standard 920-2020 to Section 12, “Normative References.”*

## Economic Analysis

This is an update to the test procedure referenced and will have no economic impact.

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

---

1. [www.ahrinet.org/search-standards/ahri-920-i-p2020-performance-rating-direct-expansion-dedicated-outdoor-air-system](http://www.ahrinet.org/search-standards/ahri-920-i-p2020-performance-rating-direct-expansion-dedicated-outdoor-air-system)  
2. 87 FR 5560 (February 1, 2022) [www.regulations.gov/document/EERE-2017-BT-STD-0017-0008](http://www.regulations.gov/document/EERE-2017-BT-STD-0017-0008)

# **Addendum cv to Standard 90.1-2022**

**Modify Tables 6.8.1-13 and 6.8.1-14 as shown (I-P).**

**Table 6.8.1-13 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements**

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air cooled (dehumidification mode)		<del>4.03.8</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
Air source heat pumps (dehumidification mode)		<del>4.03.8</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	<del>4.94.7</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
	Chilled water	<del>6.03.8</del> <i>ISMRE<sub>2</sub></i>	
Air source heat pump (heating mode)		<del>2.72.05</del> <i>ISCOP<sub>2</sub></i>	AHRI 920
Water source heat pump (dehumidification mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>4.84.6</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
	<del>Ground water source</del>	<del>5.0</del> <i>ISMRE</i>	
	Water source	<del>4.03.8</del> <i>ISMRE<sub>2</sub></i>	
Water source heat pump (heating mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>2.02.13</del> <i>ISCOP<sub>2</sub></i>	AHRI 920
	<del>Ground water source</del>	<del>3.2</del> <i>ISCOP</i>	
	Water source	<del>3.52.13</del> <i>ISCOP<sub>2</sub></i>	

a. For minimum efficiency compliance purposes, open-loop systems shall be rated using closed-loop test conditions.

**Table 6.8.1-14 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements**

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air cooled (dehumidification mode)		<del>5.25.0</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
Air source heat pumps (dehumidification mode)		<del>5.25.0</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
Water cooled (dehumidification mode)	Cooling tower condenser water	<del>5.35.1</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
	Chilled water	<del>6.64.6</del> <i>ISMRE<sub>2</sub></i>	
Air source heat pump (heating mode)		<del>3.33.20</del> <i>ISCOP<sub>2</sub></i>	AHRI 920
Water source heat pump (dehumidification mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>5.25.0</del> <i>ISMRE<sub>2</sub></i>	AHRI 920
	<del>Ground water source</del>	<del>5.8</del> <i>ISMRE</i>	
	Water source	<del>4.84.6</del> <i>ISMRE<sub>2</sub></i>	
Water source heat pump (heating mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>3.83.5</del> <i>ISCOP<sub>2</sub></i>	AHRI 920
	<del>Ground water source</del>	<del>4.0</del> <i>ISCOP</i>	
	Water source	<del>4.84.04</del> <i>ISCOP<sub>2</sub></i>	

a. For minimum efficiency compliance purposes, open-loop systems shall be rated using closed-loop test conditions.

**Modify Tables 6.8.1-13 and 6.8.1-14 as shown (SI)**

**Table 6.8.1-13 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements**

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air cooled (dehumidification mode)		<del>1.8</del> <u>1.7</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
Air source heat pumps (dehumidification mode)		<del>1.8</del> <u>1.7</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
Water cooled (dehumidification mode)	Cooling tower condenser water	<del>2.2</del> <u>2.1</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
	Chilled water	<del>2.7</del> <u>1.7</u> <i>ISMRE<sub>2</sub></i>	
Air source heat pump (heating mode)		<del>1.22</del> <u>0.5</u> <i>ISCOP<sub>2</sub></i>	AHRI 921
Water source heat pump (dehumidification mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>2.2</del> <u>2.1</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
	<del>Ground water source</del>	<del>2.3</del> <i>ISMRE</i>	
	Water source	<del>1.8</del> <u>1.7</u> <i>ISMRE<sub>2</sub></i>	
Water source heat pump (heating mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>2.02</del> <u>1.3</u> <i>ISCOP<sub>2</sub></i>	AHRI 921
	<del>Ground water source</del>	<del>3.2</del> <i>ISCOP</i>	
	Water source	<del>3.52</del> <u>1.3</u> <i>ISCOP<sub>2</sub></i>	

a. For minimum efficiency compliance purposes, open-loop systems shall be rated using closed-loop test conditions.

**Table 6.8.1-14 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements**

Equipment Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air cooled (dehumidification mode)		<del>2.42</del> <u>3</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
Air source heat pumps (dehumidification mode)		<del>2.42</del> <u>3</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
Water cooled (dehumidification mode)	Cooling tower condenser water	<del>2.42</del> <u>3</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
	Chilled water	<del>3.02</del> <u>1</u> <i>ISMRE<sub>2</sub></i>	
Air source heat pump (heating mode)		<del>3.33</del> <u>20</u> <i>ISCOP<sub>2</sub></i>	AHRI 921
Water source heat pump (dehumidification mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>2.42</del> <u>3</u> <i>ISMRE<sub>2</sub></i>	AHRI 921
	<del>Ground water source</del>	<del>2.6</del> <i>ISMRE</i>	
	Water source	<del>2.22</del> <u>1</u> <i>ISMRE<sub>2</sub></i>	
Water source heat pump (heating mode)	Ground source, closed <u>and open</u> loop <sup>a</sup>	<del>3.83</del> <u>50</u> <i>ISCOP<sub>2</sub></i>	AHRI 921
	<del>Ground water source</del>	<del>4.0</del> <i>ISCOP</i>	
	Water source	<del>4.84</del> <u>04</u> <i>ISCOP<sub>2</sub></i>	

a. For minimum efficiency compliance purposes, open-loop systems shall be rated using closed-loop test conditions.

**Modify Section 12 as shown (I-P and SI).**

## 12. NORMATIVE REFERENCES

Reference	Title
ANSI/AHRI 921-2015 <del>2020</del> with Addendum 1	Performance Rating of DX-Dedicated Outdoor Air System Units

## **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](http://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](http://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](http://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](http://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.**