



STANDARD

**ANSI/ASHRAE Standard 194-2017**  
(Supersedes ANSI/ASHRAE Standard 194-2012)

# Method of Test for Direct-Expansion Ground-Source Heat Pumps

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#### NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at [www.ashrae.org/technology](http://www.ashrae.org/technology).

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## FOREWORD

ASHRAE Standard 194 provides a method of test for rating residential, commercial, and industrial direct-expansion (DX) ground-source heat pumps (GSHPs).

This updated 2017 edition of the standard

- a. updates the text to make Standard 194 compatible with AHRI Standards 870 and 871-2016;
- b. revises equations to be consistent with ANSI/AHRI/ASHRAE ISO Standards 13256-1:1988 (RA2012) and 13256-2:1998 (RA 2012);
- c. adds new equations for determining net heating and cooling capacities;
- d. adds new optional refrigerant charging procedures that include all current manufacturers' heat pump designs;
- e. adds and revises dimensional requirements for test equipment setups;
- f. adds refrigerant temperature and pressure to data to be recorded during test;
- g. adds new Normative Appendix A, "Commissioning, Setup, and Start-Up Procedure for Testing Samples," and Normative Appendix B, "Determination of Airflow Rate and External Static Pressure for DX-to-Air Ducted Samples";
- h. expands COP and EER equations to include all heat-pump fan and indoor pump options; and
- i. updates Section 8, "Reference Properties and Data," and Section 9, "References," and adds new Section 10, "Informative Bibliography."

This standard was prepared under the auspices of ASHRAE. It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interest of obtaining uniform standards throughout the industry.

## 1. PURPOSE

The purpose of this standard is to provide test procedures for rating factory-made residential, commercial, and industrial direct-expansion (DX) ground-source heat pumps (GSHPs), as defined in Section 3.

This standard addresses heat-pump capacity ranges of 3.5 through 52.8 kW (12,000 through 180,000 Btu/h) and all standard voltage and frequency ratings.

## 2. SCOPE

**2.1** This standard provides test procedures for determining heating capacity, cooling capacity, coefficients of performance (COPs), and energy efficiency ratios (EERs) for systems, as defined in Section 3.

**2.2** This standard applies only to electrically driven, mechanical vapor-compression refrigeration systems.

**2.3** This standard applies to the testing of heat pumps with an outdoor refrigerant to test liquid heat exchanger utilized to condition the refrigerant entering the system under test. This standard does not apply to individual assemblies for separate use.

## 3. DEFINITIONS AND SYMBOLS

**3.1 Definitions.** All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilating, Air Conditioning and Refrigeration*<sup>1</sup> unless otherwise defined in this section.

**coefficient of performance, cooling ( $COP_c$ ):** ratio of net total cooling capacity to the effective power input of the heat pump (in watts per watts) at any given set of test conditions.

**coefficient of performance, heating ( $COP_h$ ):** ratio of net heating capacity to the effective power input of the heat pump (in watts per watts) at any given set of rating conditions.

**direct-expansion (DX) ground-source heat exchanger (GSHE):** continuous sealed-tube heat exchanger with refrigerant supply and refrigerant return. DX-GSHEs may comprise several tubes, be supplied with each heat pump, and be factory or field assembled. For purposes of testing in accordance with this standard, the DX-GSHE (ground loop) is simulated by a refrigerant-to-test liquid heat exchanger (earth loop simulator).

**direct-expansion (DX) ground-source heat pump (GSHP):** heat pump consisting of (a) one or more factory-made assemblies that normally include an indoor conditioning coil with air- or water- moving means, (b) one or more compressor, and (c) a subsurface refrigerant piping loop system that functions as a heat exchanger, including the means to provide a heating function, cooling function, or both. The separate assemblies shall be designed to be used together. In this standard, the term "heat pump" may be used to refer to either DX-to-air or DX-to-water heat pumps.

For purposes of testing, an outdoor refrigerant used to test a liquid heat exchanger shall be used with other matched system assemblies. The heat exchanger energy calculations shall be determined by means of the outdoor test liquid-enthalpy method detailed in Section 6.

DX-GSHPs shall provide the function of circulating air or water cooling and/or heating with controlled temperature and may include the functions of potable water heating, air cleaning, humidifying, and dehumidifying.

Models designated as cooling-only units need not include the heating function, and models designated heating-only units need not include the cooling function.

**effective power input:** average electrical power input  $E_e$  (in watts) to the heat pump within a defined interval of time. This is the sum of the following, as applicable (see Section 6):

- Power input  $E_c$  (in watts) for operation of the compressor, excluding additional heating devices.
- Power input  $E_{cs}$  (in watts) for all control and safety devices of the heat pump.