



# ENERGY STAR® Program Requirements Product Specification for Geothermal Heat Pumps

## Eligibility Criteria Version 3.2

1 Following is the **Version 3.2** product specification for ENERGY STAR qualified geothermal heat pumps. A  
2 product shall meet all of the identified criteria if it is to earn the ENERGY STAR.  
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4 **1) Definitions:** Below are the definitions of the relevant terms in this document.  
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- 6 A. Geothermal Heat Pump: A geothermal heat pump uses the thermal energy of the ground or  
7 groundwater to provide residential space conditioning and/or domestic water heating. A  
8 geothermal heat pump model normally consists of one or more factory-made assemblies that  
9 include indoor conditioning and/or domestic water heat exchanger(s), compressors, and a  
10 ground-side heat exchanger. A geothermal heat pump model may provide space heating, space  
11 cooling, domestic water heating, or a combination of these functions and may also include the  
12 functions of liquid circulation, thermal storage, air circulation, air cleaning, dehumidifying or  
13 humidifying. A geothermal heat pump system generally consists of one or more geothermal heat  
14 pump models, the ground heat exchanger(s), the air and/or hydronic space conditioning  
15 distribution system(s), temperature controls, and thermal storage tanks.  
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- 17 B. Single-Stage: Geothermal heat pumps that are designed to operate at one stage and one  
18 capacity.  
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- 20 C. Multi-Stage: Geothermal heat pumps that are designed to operate at more than one stage or  
21 capacity through the use of technologies such as multiple stage compressors, dual compressors,  
22 variable speed compressors, etc. Multi-stage models are more efficient while running at lower  
23 capacities, but have the capability to supply more heating or cooling using higher capacities when  
24 required.  
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- 26 D. Ground Heat Exchanger: The method by which heat is exchanged with the ground, groundwater,  
27 or surface water. Geothermal heat pumps may use any form of ground heat exchange, which  
28 includes horizontal, vertical, or submerged surface water closed loops; open loops using ground  
29 water, reclaimed water, or surface water; or direct refrigerant-to-ground or refrigerant-to-water  
30 heat exchange.  
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- 32 E. Closed Loop: A ground heat exchange method in which the heat transfer fluid is permanently  
33 contained in a closed piping system. Also called a *ground-loop* system.  
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- 35 F. Open Loop: A ground heat exchange method in which the heat transfer fluid is part of a larger  
36 environment. The most common open loop systems use ground water, reclaimed water, or  
37 surface water as the heat transfer medium. Also called a *ground-water* system.  
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- 39 G. Water-to-Air: A geothermal heat pump model that provides space conditioning primarily by the  
40 use of an indoor air heat exchange coil. Water-to-air models may also provide domestic water  
41 heating and hydronic space heating by using desuperheater and/or demand water heating  
42 functions.  
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- 44 H. Water-to-Water: A geothermal heat pump model that provides space conditioning and/or  
45 domestic water heating by the use of indoor refrigerant-to-water heat exchanger(s). Water-to-

46 water models may provide domestic water heating by using desuperheater and/or demand water  
47 heating functions.

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- 49 I. Direct Geexchange (DGX): A geothermal heat pump model in which the refrigerant is  
50 circulated in pipes buried in the ground or submerged in water that exchanges heat with the  
51 ground, rather than using a secondary heat transfer fluid, such as water or antifreeze solution in  
52 a separate closed loop.
- 53
- 54 a. DGX-to-Air: A DGX heat pump which provides space conditioning primarily by the use of  
55 an indoor air heat exchange coil. DGX-to-air models may also provide domestic water  
56 heating and hydronic space heating by using desuperheater and/or demand water heating  
57 functions.
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- 59 b. DGX-to-Water: A DGX heat pump which provides space conditioning and/or domestic  
60 water heating by the use of indoor refrigerant-to-water heat exchanger(s). DGX-to-water  
61 models may provide domestic water heating by using desuperheater and/or demand water  
62 heating functions.
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- 64 J. Desuperheater: A partial heat recovery system that captures heat from the hot refrigerant gas as  
65 it leaves the heat pump compressor and transfers it to the domestic hot water. Desuperheaters  
66 provide hot water only while the heat pump is providing space conditioning.
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- 68 K. Demand Water Heating: Demand geothermal heat pump water heating models provides for all,  
69 or nearly all, of the domestic hot water needs even when space conditioning is not required. This  
70 may be accomplished by either stand-alone domestic water heating models or integrated models  
71 that use the same compressor for both space conditioning and domestic water heating. This  
72 product type is sometimes referred to as a *dedicated* or *full-time* water heater.
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- 74 L. Coefficient of Performance (COP): A measure of efficiency in the heating mode that represents  
75 the ratio of total heating capacity to electrical energy input.
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- 77 M. Energy Efficiency Ratio (EER): A measure of efficiency in the cooling mode that represents  
78 the ratio of total cooling capacity to electrical energy input.
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- 80 N. Product Family: A group of models, where the same remote unit is used with several blower coil  
81 combinations (horizontal, vertical, A-coil, etc.). The “same remote unit” is defined as the unit with  
82 the same compressor and same direct geexchange heat exchanger.<sup>1</sup>

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84 **2) Scope:**

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- 86 A. Included Products: Open loop, closed loop, and DGX products that meet the definition of a  
87 Geothermal Heat Pump as specified herein are eligible for ENERGY STAR qualification, with  
88 the exception of products listed in Section 2.B.
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- 90 B. Excluded Products: Geothermal heat pumps intended for commercial use (i.e., 3-phase units)  
91 are not eligible for ENERGY STAR.
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<sup>1</sup> “Remote unit” is used here to describe the portion of a split system that houses the compressor. Unlike air source heat pumps, geothermal units are typically located indoors as they do not exchange heat with the outdoor air, but the compressor system may still be housed separately from the air handler.

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**3) Qualification Criteria:**

A. Energy Efficiency Requirements:

<b>Table 1: Requirements</b>		
<b>Product Type</b>	<b>EER</b>	<b>COP</b>
<b>Water-to-Air</b>		
Closed Loop Water-to-Air	17.1	3.6
Open Loop Water-to-Air	21.1	4.1
<b>Water-to-Water</b>		
Closed Loop Water-to-Water	16.1	3.1
Open Loop Water-to-Water	20.1	3.5
<b>DGX</b>		
DGX-to-Air	16.0	3.6
DGX-to-Water	15.0	3.1

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B. Qualifying Multi-Stage Models: Multi-stage models shall be qualified using the following calculations:

- $EER = (\text{highest rated capacity EER} + \text{lowest rated capacity EER}) / 2$
- $COP = (\text{highest rated capacity COP} + \text{lowest rated capacity COP}) / 2$

C. Significant Digits and Rounding:

- c. All calculations shall be carried out with actual measured or observed values. Only the final result of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.
- d. Unless otherwise specified, compliance with specification limit shall be evaluated using exact values without any benefit from rounding.

D. Warranty Requirements: Partner shall provide, as standard, a manufacturer limited warranty for its ENERGY STAR qualified geothermal heat pump models for all parts and labor for a minimum of two years. The major refrigerant circuit components, including the compressor(s), heat exchanger(s), and expansion and reversing valve(s) shall be warranted for parts and labor for a minimum of five years.

**4) Test Requirements:**

A. Representative Models shall be selected for testing per the following requirements:

- a. For qualification of an individual product model, the representative model shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.
- b. For qualification of a product family, any model within that product family can be tested and serve as the representative model.

B. When testing geothermal heat pumps, the following test methods shall be used to determine ENERGY STAR qualification:

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Table 2: Test Methods for ENERGY STAR Qualification		
ENERGY STAR Requirement	System Type	Test Method Reference
EER and COP	Closed and Open Loop Systems	ISO 13256-1-1998 “ <i>Water-source heat pumps -- Testing and rating for performance -- Part 1: Water-to-air and brine-to-air heat pumps</i> ” for water-to-air models  <b>OR</b>  ISO 13256-2-1998 “ <i>Water-source heat pumps -- Testing and rating for performance -- Part 2: Water-to-water and brine-to-water heat pumps</i> ” for water-to-water models
	DGX Systems	ANSI/AHRI 870-2016 “ <i>Performance Rating of Direct Geothermal Heat Pumps</i> ”

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- 5) **Effective Date:** This ENERGY STAR Geothermal Heat Pump Specification shall take effect on **January 1, 2012**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the date of manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.
- 6) **Future Specification Revisions:** EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that the ENERGY STAR qualification is not automatically granted for the life of a product model.