STANDARD

ANSI/ASHRAE Standard 40-2014
(Supersedes ANSI/ASHRAE 40-2002 [RA 2006])

Methods of Testing for Rating Heat Operated Unitary Air-Conditioning and Heat-Pump Equipment

Approved by the ASHRAE Standards Committee on January 18, 2014; by the ASHRAE Board of Directors on January 22, 2014; and by the American National Standards Institute on January 23, 2014.

 ISSN 1041-2336

Approved American National Standard
ANSI
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 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.

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.

CONTENTS

ANSI/ASHRAE Standard 40-2014,
Methods of Testing for Rating
Heat-Operated Unitary Air-Conditioning and Heat-Pump Equipment

NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

(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

This is a revision of ASHRAE Standard 40-2002 (RA 2006). 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 interests of obtaining uniform standards throughout the industry.

The changes made for the 2014 version include:

- *The Scope in Section 2.3 was revised to remove specific mention of references and to clarify the intended scope*
- *The definition of "batch process" was revised to eliminate use of the term "cycle"*
- *Definitions were added for "electrically driven unitary air conditioners or heat pumps" and "heat-operated absorption chillers." Definitions for "heat-operated" and "heat-operated unitary equipment" were revised*
- *Definitions for "section" and "sorbent" were removed*
- *The unit conversions for temperature in the definitions for "standard air" and "standard temperature" were corrected*
- *Sections 4.c and 4.d were revised to improve clarity*
- *The title of ASHRAE Standard 37 was corrected in 5.1.d*
- *The capacity range of Sections 5.2.1, 5.2.2, and 14.1.2 was revised to more closely align with current industry classifications*
- *Section 5.2.2.1 was revised for clarity*
- *Section 5.2.3 was eliminated as it did not have enforceable requirements*
- *Section 5.3.1.1 was revised to increase the allowable heating value range for natural gas*
- *In Table 5.3.1 (previously Table 1), the SI units for heating value were corrected. The default heat value for natural gas was revised. The source reference was removed*
- *The wording of Sections 6.1.2, 6.6.2.4, 8.2, 9.2.3, 9.2.4, 10.3.2, 11.1.3, 11.2.4, and 12.1.4.1 were revised to use enforceable language*
- *Section 6.1.3 was eliminated as it did not have enforceable requirements*
- *The references in Section 6.5 were updated*
- *The footnotes from Section 6.6 were revised to direct the user to the correct portion of the standard*
- *Tables 10.3.2 (previously Table 4a and 4b) were relocated*
- *In Section 9.5.1, the definition of q_{thi} was revised*
- *The alternative requirements for airflow measurement in Section 10 were clarified. Additional alternative requirements are contained in the new 12.3.4*
- *Sections 10.4.1, 10.4.2, and 10.4.3 were revised for clarity*
- *The option to use mercury-in-glass-thermometers in Section 12.1.1 was removed*
- *The section that was previously numbered 12.1.4.1 was eliminated*
- *The suggested list of pressure measurement types was removed from Section 12.2.1*
- *Section 14.1.1.h was revised to stipulate that it applied to electrical power*
- *Section 16 references were updated and reorganized. References that are not required for compliance with the standard were removed*
- *Informative Annex A was revised to eliminate unnecessary material.*

1. PURPOSE

1.1 This standard provides test methods for determining the heating and cooling output capacities and energy inputs of unitary air-conditioning and heat pump equipment that is heat-operated (see Section 3, "Definitions").

1.2 These test methods may be used as a basis for rating such equipment, but it is not the purpose of this standard to specify methods of establishing ratings.

2. SCOPE

2.1 This standard applies to heat-operated unitary air conditioners and heat pumps consisting of one or more assemblies, including engine-driven systems. Where such equipment is provided in more than one assembly, the separate assemblies are designed to be used together.

2.2 Equipment within the scope of this standard may be classified as follows:

a. Component arrangements:
   1. factory-assembled equipment employing heat-operated or mechanical refrigeration cycle or cycles (e.g., a packaged unit)
   2. equipment employing a heat-operated or mechanical refrigeration cycle with indoor and outdoor sections in separate assemblies (e.g., a split system)
   3. equipment employing a heat-operated or mechanical refrigeration cycle as a liquid chiller with cooling coil in separate assembly (e.g., chiller)
   4. equipment employing refrigeration cycles and heating functions (e.g., chiller/heater).

b. Method of providing air circulation through indoor section:
   1. with circulating fan incorporated with indoor assembly
   2. without circulating fan, for use with separate fan or air handler, or with heating equipment incorporating a fan.

c. Medium for heat transfer to or from the outdoors:
   1. air
   2. water (or brine)
   3. evaporatively cooled condenser (cooling only)

2.3 This standard does not include methods of testing the following types of equipment:

a. heat-operated absorption and engine-driven liquid chillers not part of a unitary air conditioner
b. electrically driven unitary air conditioners or heat pumps
c. refrigerating systems employing the Peltier effect
d. desiccant-based cooling systems.

3. DEFINITIONS

apparatus: the test facility conditioning device and other test and measurement devices called for in this standard (see *equipment*).

batch process: a cycle that delivers cooling and/or heating in a nonsteady or noncontinuous manner. For this process, the nominal capacity is the integral of instantaneous capacity over a complete cycle (sorption) divided by the cycle time. The process includes, but is not limited to, desorption, adsorption, or absorption (whichever is applicable), and all pressure and temperature transient periods. Steady state of a batch process is when the integral over each cycle, from cycle to cycle, changes by no more than that allowed by the standard.

capacity, cooling (heating): the rate of heat removal (heat gain) from (to) a heat-transfer medium. See *sensible*, *latent*, and *total*.

coil, indoor: the heat exchanger that removes heat from (cooling) or adds heat to (heating) the airstream being conditioned. For direct expansion refrigerant systems: in the cooling mode, the coil operates as an evaporator; in the heating mode, the coil operates as a condenser.

coil, outdoor: the heat exchanger that rejects heat to (cooling) or absorbs heat from (heating) a source external to the conditioned space. In the cooling mode, the coil operates as a condenser. In the heating mode, the coil operates as an evaporator.

coolant**:** a single-phase fluid (usually a liquid) used for transferring heat from one place to another. Sometimes referred to as "heat-transfer fluid," "brine," and/or "secondary refrigerant" (see *refrigerant*).

electrically driven unitary air conditioners or heat pumps: mechanical-compression equipment consisting of one or more assemblies that include an indoor aircoil(s), a compressor(s), and an outdoor coil(s). Where such equipment is provided in more than one assembly, the separated assemblies are designed to be used together.

equipment: refers exclusively to the device to which this method of test is applied (see *apparatus*).

external resistance: the differential pressure imposed by an air-distribution duct system on a forced-air system.

heat engine: a device that is operated by the heat of combustion of a fuel or other appropriate heat source. Its principal output is mechanical work. The heat may be applied externally or internally to the drive elements of the engine. An external combustion engine uses steam or a gas (helium, hydrogen) to transfer the heat from the source to the drive elements. The drive elements of an internal combustion engine may be reciprocating pistons or a rotating cylinder.

heat-operated: describes any equipment whose energy source is thermal energy. Heat may be provided by combustion, steam, or other means. The heat may manifest itself as thermal energy (elevated temperatures) or other available energy (such as elevated pressure) and may activate a heat cycle (e.g., absorption process) or a work cycle (e.g., vapor compression cycle) by means of heat-transfer surfaces and/or heat engines.

heat-operated absorption chillers: water-cooled, single-effect steam and hot-water-operated water-chilling units; water-cooled, double-effect steam and hot water operated water chilling units; and double-effect, direct-fired water-chilling/heating units.

heat-operated unitary equipment: consists of one or more factory-made assemblies that include an evaporator and condenser as part of a heat- or fuel-energized refrigerating system consisting of a continuous or batch type process that may also include a heating function. The equipment may comprise, either alone or in combination with separate heating equipment, the functions of circulating, cleaning, heating, cooling, and/or dehumidifying the air. Where such equipment is provided in more than one assembly, the separated assemblies are designed to be used together.

latent cooling capacity: the rate, expressed in W (Btu/h), at which the equipment removes latent heat (reduces the moisture content) of the air passing through it under specified conditions of operation.

refrigerant: substance that changes phase or condition (e.g., from liquid to vapor [evaporation] or from bonded-to-solid to vapor [desorption]) in the process of absorbing heat within the air-conditioning equipment.

sensible cooling capacity: the rate, expressed in W (Btu/h), at which the equipment lowers the dry-bulb temperature (removes sensible heat) of the air passing through it under specified conditions of operation.

shall: where "shall" or "shall not" is used for a provision, that provision is mandatory if compliance with this standard is claimed.

should, recommended, or "it is recommended": terms used to indicate provisions that are not mandatory but are desirable as good practice.

standard air: air having a density of 1.204 kg/m^3 (0.075 lb/ft^3), equivalent to dry air at a temperature of 20°C (68°F), and a barometric pressure of 101.325 kPa (14.696 psi, 29.92 in. Hg).

standard barometric pressure: barometric pressure of 101.325 kPa (14.696 psi, 29.92 in. Hg).

standard temperature: temperature of 20°C (68°F).

total cooling capacity: the rate, expressed in W (Btu/h), at which the equipment removes heat from the air passing through it under specified conditions of operation, including both sensible and latent heats.