AHRI Standard 560-2023 (I-P)

2023 Standard for

Performance Rating of Water-cooled Lithium Bromide Absorption Water-chilling and Water-heating Packages

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Note:

This standard supersedes AHRI Standard 560-2000.

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Intent

This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

Review and Amendment

This standard is subject to review and amendment as technology advances.

2023 Edition

This edition of AHRI Standard 560, *Performance Rating of Water-cooled Lithium Bromide Absorption Water-chilling and Water-heating Packages*, was prepared by the Chiller Standards Technical Committee. The standard was approved by the Applied Standards Subcommittee on 28 November 2023.

Origin and Development of AHRI Standard 560

The initial publication was ARI Standard 560-1992, *Absorption Water Chilling and Water Heating Packages*. Subsequent revisions include:

AHRI Standard 560-2000 (SI/I-P), *Absorption Water Chilling and Water Heating Packages*

Summary of Changes

AHRI Standard 560 (I-P) contains the following update(s) to the previous edition:

- Reference ASHRAE 182-2020 as method of test
- Align definitions and requirements with AHRI 550/590 and 551/591 where possible
- Remove scope exclusion for air-cooled applications
- Update title to “Performance Rating of Water-cooled Lithium Bromide Absorption Water-chilling and Water-heating Packages”

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Committee Personnel

Chiller Standards Technical Committee

Participant	Interest Category Classification	Voting Member Role	State / Country
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Darrin Anderson Multistack LLC	Product Manufacturer	Primary Voter	WI, USA
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John Cummings LG Electronics, Inc.	Product Manufacturer	Primary Voter	GA, USA
Dana Fischer Mitsubishi Electric	Product Manufacturer	Primary Voter	GA, USA
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Chiller Standards Technical Committee Scope:

The Chiller Standards Technical Committee is responsible for the development and maintenance of AHRI standards and guidelines pertaining to performance rating of liquid-chilling and heat pump liquid-heating packages using the vapor compression cycle, absorption liquid chilling and liquid heating packages, fouling factor applications related to air-conditioning and refrigeration, and non-condensable gas purge equipment for use with low pressure centrifugal liquid chillers.

Out of scope for this STC are water-to-water heat pumps with a capacity less than 135,000 Btu/h as covered by ASHRAE/AHRI/ISO 13256-2, and air-to-water units designed exclusively to heat potable water as covered by AHRI 1300.

Product definitions are as defined on the AHRI website Applied Sector page.

Applied Standards Subcommittee

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Applied Standards Subcommittee Scope:

The scope of the Applied Standards Subcommittee is standards and guidelines related to the end products that are part of the AHRI Applied Industry Sector. (The definition of and list of products associated with each sector are found on the AHRI website.

These lists represent the membership at the time the Standards Technical Committee and Standards Subcommittee were balloted on the final text of this edition. Since that time, changes in the membership may have occurred. Membership on these committees shall not in and of itself constitute an endorsement by the committee members or their employers of any document developed by the committee on which the member serves.

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PERFORMANCE RATING OF WATER-COOLED LITHIUM BROMIDE ABSORPTION WATER-CHILLING AND WATER-HEATING PACKAGES

Section 1. Purpose

This standard establishes definitions, test requirements, rating requirements, minimum data requirements for *published ratings*, marking and nameplate data, and conformance conditions for *water-cooled lithium bromide absorption water-chilling and water-heating packages*.

Section 2. Scope

2.1 Scope

This standard applies to lithium bromide 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* (natural gas, oil, LP gas) water-chilling/heating units. Water is the refrigerant and LiBr (lithium bromide) the absorbent. See definitions in Section 3.

2.2 Exclusions

This standard does not apply to heat pump applications, exhaust gas fired applications, and non-standard units.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the ASHRAE Terminology website unless otherwise defined in this section.

Common conversion factors are defined in Section 7 and are referred to in equations using K1, K2, K3, and K4.

3.1 Expression of Provisions

Terms that provide clear distinctions between requirements, recommendations, permissions, options, and capabilities.

3.1.1 “Can” or “cannot”

Express an option or capability.

3.1.2 “May”

Signifies a permission expressed by the document.

3.1.3 “Must”

Indication of unavoidable situations and does not mean that an external constraint referred to is a requirement of the document.

3.1.4 “Shall” or “shall not”

Indication of mandatory requirements to strictly conform to the standard and where deviation is not permitted.

3.1.5 “Should” or “should not”

Indication of recommendations rather than requirements. In the negative form, a recommendation is the expression of potential choices or courses of action that is not preferred but not prohibited.

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3.2 Standard Specific Definitions

3.2.1 Absorber

A component included in *absorption packages* where a concentrated solution absorbs refrigerant and becomes dilute, while rejecting heat from the cycle.

3.2.2 Auxiliary Power

Power provided to devices that are not inherent elements of the refrigerating and heating cycles including, but not limited to: burners, refrigerant pumps, solution pumps, control power, fans, and heaters.

3.2.3 Capacity

The rate heat is added to or removed from a liquid stream of an *absorption package*. This is the useful product of an *absorption package* and is the product of the water mass flow rate and the change in water enthalpy entering and leaving the heat exchanger, measured at the point of the field connection. For this standard, the enthalpy change is approximated as the sensible heat transfer using specific heat and temperature difference.

3.2.3.1 Net Heating Capacity

The *capacity* calculated as the sensible heat transfer of water heated either in what is the *evaporator* in cooling mode (acting as a *condenser* in *heating mode*, two-pipe system) or in a separate hot-water heat exchanger (four-pipe system) that is available for useful heating of the thermal load external to the *absorption package*.

3.2.3.2 Net Refrigerating Capacity

The *capacity* calculated as the sensible heat transfer produced by the *evaporator* that is available for useful cooling of the thermal load external to the *absorption package*.

3.2.4 Condenser

A refrigeration system component that condenses refrigerant vapor.

3.2.4.1 Water-cooled Condenser

A component that utilizes refrigerant-to-water heat transfer means, causing the refrigerant to condense and the water to be heated for rejection to ambient.

3.2.5 Energy Efficiency

3.2.5.1 Cooling Energy Efficiency

3.2.5.1.1 Cooling Coefficient of Performance (COP_R)

A ratio of the *net refrigerating capacity* to the *thermal energy input* at any given set of *rating conditions*.

3.2.5.1.2 MBH/ton_R

Thermal energy input per unit *capacity*. The cooling efficiency expressed as a ratio of *thermal energy input* divided by the *net refrigerating capacity* using the following units of measure: MBH for *thermal energy input* and ton_R for *net refrigerating capacity*.

3.2.5.2 Heating Energy Efficiency

3.2.5.2.1 Heating Coefficient of Performance (COP_H)

A ratio of the *net heating capacity* to the *thermal energy input* at any given set of *rating conditions*.

3.2.6 Evaporator

A refrigeration system component that evaporates refrigerant liquid.

3.2.7 Fouling Factor

The thermal resistance due to fouling accumulated on the water side heat transfer surface.

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3.2.7.1 Fouling Factor Allowance

A specified value for *published ratings* as a provision for anticipated thermal resistance due to water side fouling during use, expressed in $h \cdot ft^{2} \cdot {}^{o}F/Btu$

3.2.8 Generator

A component of *absorption packages* that utilizes heat from an external source to desorb refrigerant from dilute solution to create a more concentrated solution.

3.2.9 Higher Heating Value (HHV)

The amount of heat produced per unit of fuel when complete combustion takes place at constant pressure. The products of combustion are cooled to the initial temperature of the fuel and air, and the vapor formed during combustion is condensed, Btu/lb or Btu/ft^{3} for gaseous fuel, or Btu/lb or Btu/gal for liquid fuel.

3.2.10 Part-load Value (PLV)

A single number figure of merit expressing part-load efficiency for equipment based on weighted operation at various partial load capacities for the equipment.

3.2.10.1 Integrated Part-load Value (IPLV.IP)

A single number part-load efficiency figure of merit calculated per the method described in this standard at *standard rating conditions*.

3.2.10.2 Non-standard Part-load Value (NPLV.IP)

A single number part-load efficiency figure of merit calculated per the method described in this standard referenced to conditions other than *IPLV.IP* conditions.

3.2.11 Percent Load

The ratio of the part-load net *capacity* to the *full load* rated net *capacity*, stated in decimal format. (For example, 100% = 1.0).

3.2.11.1 Full Load (100% Load)

The highest *capacity* the *absorption package* has been rated at specific conditions. Corresponds to the *100% load* point utilized in *IPLV. IP* or *NPLV.IP*.

3.2.12 Published Ratings

A statement of the assigned values of those performance characteristics, under stated *rating conditions*, where a unit can be chosen to fit the application. These values apply to all units of the same nominal size and type (identification) produced by the same manufacturer. This includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated *rating conditions*.

3.2.12.1 Application Rating

A rating based on tests performed at *application rating conditions* other than *standard rating conditions*.

3.2.12.2 Standard Rating

A rating based on tests performed at *standard rating conditions*.

3.2.13 Rating Conditions

Any set of operating conditions where a single level of performance results and that causes only that level of performance to occur.

3.2.13.1 Application Rating Conditions

A set of operating conditions within the range of Table 2 selected for a customer application (other than *standard rating conditions*).

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