AHRI Standard 1520-2022 (SI/I-P)

2022 Standard for

Performance Rating of Centrifugal Refrigerant Compressors

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Price $10.00 (M) $20.00 (NM)
Printed in U.S.A.

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PERFORMANCE RATING OF CENTRIFUGAL REFRIGERANT COMPRESSORS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Centrifugal Compressors: definitions, test requirements, rating requirements, minimum data requirements for Published Ratings, operating requirements, marking and nameplate data, and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users. The standard defines the minimum amount of information, in a standard form to enable the evaluation and comparison of different Centrifugal Compressors for use in an application.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This standard applies to Centrifugal Compressors and their presentation of performance in heating, ventilation, and air-conditioning applications. The manufacturer is solely responsible for the determination of values to be used in published product information. This standard stipulates the minimum amount of information to be provided and suggests a method to be used to verify the accuracy of that information.

2.2 Exclusions.

2.2.1 This standard does not apply to compressors intended for use in:

a. Household refrigerators and freezers
b. Automotive air-conditioners
c. Household dehumidifiers
d. Industrial products other than heating and cooling
e. Compressed air applications

2.2.2 This standard does not apply to compressors when contained within a package or system.

Section 3. Definitions

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

3.1 *Flow.* Volumetric flow rate through the compressor expressed in ft^3/min, m^3/sec.

3.2 *Individual Published Rating.* A data table used to represent the nominal performance of a Compressor at a single Step.

3.3 *Interstage Port.* An inlet port for vapor or liquid between two stages of compression.

3.4 *Model Number*. The identifier for a product containing one or more Compressors and any accessories that are supplied by the manufacturer, required to sustain operation of the Compressor(s) at the rating conditions or that impact the Published Rating.

Note: Accessories may include, but are not limited to, interconnecting piping, fans, liquid receivers, desuperheaters, strainers, service valves, check valves, suction filters, lubricant separators, motors, motor starters, and unloaders, as supplied or specified by the compressor manufacturer.

3.4.1 *Centrifugal Compressor*. A dynamic compression machine in which an increase in refrigerant vapor pressure is attained by imparting velocity to the refrigerant and then increasing static pressure by a reduction in [illegible]

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velocity through work applied to the compressor's mechanism. For clarity of this standard, the term Compressor implies Centrifugal Compressor.

3.4.2 *Compressor Housing Types*

3.4.2.1 *Hermetic Refrigerant Compressor*. A Compressor and motor assembly, both of which are contained within a gas tight housing that is permanently sealed by welding or brazing with no access for servicing internal parts in the field.

3.4.2.2 *Open Type Refrigerant Compressor*. A Compressor with a shaft or other moving part extending through its casing to be driven by an outside source of power thus requiring a shaft seal or equivalent rubbing contact between fixed and moving parts.

3.4.2.3 *Semi-hermetic Refrigerant Compressor*. A Compressor and motor assembly contained within a gas-tight housing that is sealed by gasketed joints to provide access for servicing internal parts.

3.5 *Population of Compressors*. Compressors intended to perform the same function, produced in quantity, manufactured to the same technical specifications and characterized by the same Published Rating.

3.6 *Power Input.* The time rate of energy usage of the Compressor (compressor power) plus any accessories required to sustain operation of the compressor at the Rating Condition.

3.7 *Published Operating Range.* The applicable boundaries of head and flow coefficients for which ratings are published.

3.8 *Published Rating.* Composed of Individual Published Ratings used to represent the nominal performance of a Compressor.

3.8.1 *Individual Published Rating.* A data table used to represent the nominal performance of a Compressor at a single Step.

3.9 *Rating Condition*. A saturated suction temperature and saturated discharge temperature point used to determine the number of Steps required to be published per Section 5.

3.10 *Rating Uncertainty Limit (Tolerance).* The limit within which the measured performance of an individual Compressor falls relative to the Published Rating.

3.11 *Reference Rating Conditions.* A specific operating condition selected from Table 4 for quick reference or comparison.

3.12 *Refrigerant Mass Flow Rate*. The mass flow rate of the volatile refrigerant, which is potentially mixed with lubricant.

3.13 *Refrigerating Capacity*. The capacity associated with the increase in total enthalpy between the refrigerant entering the evaporator and the superheated return gas entering the Compressor. The calculation of Refrigeration Capacity does not include parasitic heat transfer effects., expressed in Btu/h, W.

Terms used to determine the number of Steps required to be published per Section 5:

3.13.1 *Maximum Capacity*. The rated Refrigerating Capacity of the modulating Compressor operating at the Maximum Step for a manufacturer defined Rating Condition, expressed in Btu/h, W.

3.13.2 *Minimum Capacity*. The rated Refrigerating Capacity of the modulating Compressor operating at the Minimum Step for a manufacturer defined Rating Condition, expressed in Btu/h, W.

3.13.3 *% Capacity*. A percentage of the Maximum Capacity based on the manufacturer defined Rating Condition

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at a specific Step (Maximum Capacity is 100% Capacity).

3.14 *Step.* A level of modulation achieved by changing the Flow not limited to the examples listed below:

3.14.1 *Step Method*

a. VFD frequency, Hz
b. Compressor speed, RPM
c. Mechanical unloading setting (fixed or time weighted average) (%).

Note: This "%" is a representation or name of the Step and not necessarily an actual % Capacity.

3.14.2 *Maximum Step*. The Step producing the highest Flow of the modulating Compressor.

3.14.3 *Minimum Step*. The Step producing the lowest Flow of the modulating Compressor.

3.15 *"Shall"* or *"Should," shall be interpreted as follows:*

3.15.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.15.2 *Should.* "Should" is used to indicate provisions which are not mandatory, but which are desirable as good practice.

3.16 *Vapor Injection.* A method of increasing evaporator capacity using an economizer to sub-cool liquid refrigerant exiting the condenser and reducing discharge temperature. Refrigerant vapor or wet vapor that exits the economizer enters an intermediate port or an interstage port on the compressor.

3.17 *Variable Frequency Drive (VFD)*. A power electronic device that regulates the speed of an alternating current (AC) motor by adjusting the frequency and the voltage of the electrical power supplied to the motor.

Section 4. Test Requirements

4.1 *Test Requirements*. All Published Ratings shall be verified by tests conducted in accordance with ANSI/ASHRAE Standard 225.

4.2 *Ambient Temperature*. Published Ratings shall be established with an ambient temperature around the Compressor and its accessories of 95.0°F, 35.0°C. If Published Ratings are established at ambient temperatures other than 95.0°F, 35.0°C, the actual ambient temperature used to establish the Published Ratings shall be stated by the manufacturer.

4.3 *Airflow*. Published Ratings shall be established with no airflow across the Compressor. If Published Ratings are established with airflow across the compressor, the details of the airflow over the Compressor used to establish Published Ratings shall be stated by the manufacturer.

4.4 *Nameplate Voltages for Rating*. Published Ratings shall be established using the nameplate rated voltage and frequency. For dual nameplate voltage ratings, Published Ratings shall be established using both voltages, or using the higher of the two voltages, if only a single rating is to be published.

4.5 *Power Input*. For Hermetic or Semi-hermetic Refrigerant Compressors with a factory integrated or factory specified VFD, the Power Input is measured at the VFD input terminals. If accessories are not included, it shall be explicitly stated.

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Section 5. Rating Requirements

5.1 *Published Rating.* A Published Rating is one or more Individual Published Ratings that represents Flow coefficient, head coefficient, and isentropic efficiency parameters across the Published Operating Range of the Compressor.

5.1.1 *Reference Rating Condition.* Superheat, Subcooling, Saturation Temperatures, and/or return gas temperature conditions specified in Table 4 shall be used for reference rating conditions. The intent of the reference rating conditions is for manufacturers to publish performance for the ease of comparing to other compressors.

5.1.2 *Continuous Modulating Compressor*. The Published Rating of a continuous modulating Compressor shall be provided per the following requirements to comprise each set of Individual Published Ratings.

5.1.2.1 An Individual Published Rating of the Compressor at the Maximum Rated Step.

5.1.2.2 An Individual Published Rating of the Compressor at the Minimum Rated Step.

5.1.2.3 At least two Individual Published Ratings of the Compressor between the Maximum and Minimum Rated Step.

5.1.2.3.1 Each Step shall be evenly spaced between the Maximum and Minimum Rated Step within ± 5%.

5.1.2.4 An individual published rating of the Compressor shall contain sufficient points such that interpolation between the points produces a representation within the specified uncertainty found in Table 4 and Figure 1.

5.1.3 *Operating map***.**

5.1.3.1 *Surge definition.* The lowest flow point along an Individual Published Rating will be considered the last stable operating point prior to surge at that step.

5.1.3.2 *Choke definition.* The highest flow point along an Individual Published Rating will be considered the choke point.

5.5 *Rating Methods*. Compressors or compressor units shall be rated in one of four ways shown in Table 1. Manufacturers shall declare which rating method is used when providing Published Ratings. If no method is referenced it is assumed that AHRI Standard 1520 Method 1 is used.

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