ANSI/AHRI Standard 1111 (SI)

2013 Standard for

Performance Rating of Mechanical Transport Refrigeration Units

Approved American National Standard
ANSI

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Note:

For I-P ratings, see ANSI/AHRI Standard 1110 (I-P)-2013.

The AHRI Mechanical Transport Refrigeration (TR) Certification Program will certify only to ANSI/AHRI Standard 1110 (I-P)-2013. AHRI Standard 1111 (SI)-2013 will not be used for the TR Certification Program.

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PERFORMANCE RATING OF MECHANICAL TRANSPORT REFRIGERATION UNITS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for Mechanical Transport Refrigeration Units: 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.

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 encased direct expansion vapor compression type Mechanical Transport Refrigeration Units with the following components:

2.1.1 Compressor
2.1.2 Air-cooled condenser
2.1.3 Refrigerant flow control(s)
2.1.4 Forced-Circulation Air-Cooler
2.1.5 Base or frame
2.1.6 Prime Mover as described in the unit manufacturer's literature
2.1.7 Power Train (coupling, power take-off, transmission, V-belt drive, etc.) connecting the unit to the Prime Mover

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the ASHRAE Wikipedia website (http://wiki.ashrae.org/index.php/ASHRAEwiki) unless otherwise defined in this section.

3.1 *Ambient Air*.

3.1.1 The air surrounding the vehicle served by the Mechanical Transport Refrigeration Unit.
3.1.2 The air in the test enclosure surrounding the Calibrated-Box, per the calibrated-box method of testing.
3.1.3 The air surrounding the engine-condenser side of a Mechanical Transport Refrigeration Unit, per the isothermal-box method of testing.

3.2 *Calorimeter.* A test facility consisting of one or two rooms, which may have an annular space(s); each equipped with instrumented reconditioning equipment. The output of this equipment is measured and controlled to counterbalance the Net Refrigerating Capacity of the Mechanical Transport Refrigeration Unit under test.

3.2.1 *Calibrated-Box.* A well-insulated enclosure, with a known heat transfer rate determined through calibration, which is used for measuring the heat loss or gain between the enclosure's interior temperature and ambient temperature. The area surrounding the entire exterior of the Calibrated-Box is maintained at the rated ambient air temperature.

3.2.2 *Isothermal-Box.* A well-insulated enclosure, with a known heat transfer rate determined through calibration, which is used for measuring the heat loss or gain between the enclosure's interior temperature and ambient temperature. The area surrounding the Isothermal-Box is divided into a Surround Area and an ambient space. The Surround Area is maintained at the rated return air temperature to the Forced-Circulation Air-Cooler, while the ambient space is maintained at the rated ambient air temperature.

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3.3 *Forced-Circulation Air-Cooler*. A factory-made assembly including means for forcing air circulation and components where heat is transferred from air to refrigerant. The purpose of this unit is to transfer heat from a refrigerated space, through the medium of air, to the refrigerant.

3.4 *High-Temperature Service*. Service requiring the maintenance of air temperature at a value of -4.0°C or above in the refrigerated compartment of the vehicle typically transporting non-frozen product.

3.5 *Low-Temperature Service*. Service requiring the maintenance of air temperature at a value below -4.0°C in the refrigerated compartment of the vehicle typically transporting frozen product.

3.6 *Mechanical Transport Refrigeration Unit*. A combination of one or more of the following factory-made assemblies:

3.6.1 A compressor, drive, and condenser combination
3.6.2 A Forced-Circulation Air-Cooler
3.6.3 All necessary refrigerant lines and electrical wiring
3.6.4 Means whereby the unit can be suitably mounted and installed on a vehicle which it is intended to serve

Where such equipment is used in more than one assembly, the individual assemblies are designed to be used together, and the requirements of rating outlined in this standard are based on the use of matched assemblies.

3.7 *Net Refrigerating Capacity*. The rate of heat transferred from the air in the refrigerated space to the refrigerant circulated through the Forced-Circulation Air-Cooler, less heat added by the fan and drive, and other sources, in operation under specified conditions. It is the net refrigerating effect available for useful cooling.

3.8 *Observation*. A specific instance in time where measurements are recorded.

3.9 *Power Train*. A mechanical device whereby power received from a primary source of power at a given rotating speed is transferred to a driven device at the same or a different rotating speed.

3.9.1 *Power Train Ratio*. The ratio of the rotating speed at which power is delivered to the driven device, to the rotating speed at which power is received from the primary source.

3.10 *Prime Mover*. An engine, motor or similar device that drives a refrigeration system at a known speed.

3.11 *Published Rating*. A statement of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. The term Published Rating 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.

3.11.1 *Application Rating*. A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.11.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

3.11.3 *Standby Rating*. A Published Rating based on using a standby power source and tests performed under Standard Rating Conditions or application Rating Conditions.

3.12 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.12.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

3.13 "*Shall*" *or* "*Should.*" "Shall" or "should" shall be interpreted as follows:

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

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

3.14 *Standby Drive*. A device included in a Mechanical Transport Refrigeration Unit, which receives power from a source external to the vehicle served. The unit may operate to refrigerate the vehicle while it is at rest.

3.15 *Surround Area*. The enclosure about the Isothermal-Box.

3.16 *Test Nominal Condition.* The reading that is taken at the initial Observation of the test and is used as a basis of reference for all subsequent observations.

3.16.1 *Ambient Nominal Condition.* The reference temperature for the ambient space of the Calibrated-Box or Isothermal-Box. It is taken as the arithmetic average of the individual temperature measurement stations within the ambient space at the initial Observation of the test.

3.16.2 *Box Nominal Condition.* The reference temperature for the interior of the Calibrated-Box or Isothermal-Box. It is taken as the arithmetic average of the individual temperature measurement stations within the Calibrated-Box or Isothermal-Box at the initial Observation of the test.

3.17 *Unit-Mounting*. Types of mountings for Mechanical Transport Refrigeration Units are:

3.17.1 *Nose-Mounted.* A Mechanical Transport Refrigeration Unit in which the condensing unit is mounted on the external front wall of the refrigerated compartment.

3.17.2 *Under-Mounted.* A Mechanical Transport Refrigeration Unit in which the condensing unit is mounted externally on the bottom of the refrigerated compartment.

Section 4. Test Requirements

4.1 *Test Requirements*. Mechanical Transport Refrigeration Units shall be tested for the rated Net Refrigerating Capacity in accordance with one of the two methods set forth in Appendix C and Appendix D.

4.2 *All-Electric Unit.* When the unit being tested includes an engine-generator set in conjunction with an electric drive, the space in which the engine-generator set is located shall be maintained at the same ambient condition as the condensing section of the Mechanical Transport Refrigeration Unit.

Section 5. Rating Requirements

5.1 *Standard Ratings*. Standard Ratings shall be published for the Standard Rating Conditions specified in Table 1. All Standard Ratings shall be verified by tests conducted in accordance with one of the two test methods described in Appendix C and Appendix D.

Table 1. Standard Rating Conditions

Standard Rating	Return Air Temperature to Forced-Circulation Air-Cooler	Entering Air Temperature to Condenser
	°C	°C
High Temperature	0.0	30.0
Low Temperature	-20.0	30.0
NOTE: The unit shall be rated at a compressor driven speed in accordance with manufacturer's recommended high speed setting ± 50 rpm.		

5.1.1 *Values of Standard Ratings*. Standard Ratings at or below 2900 W shall be Net Refrigerating Capacity and shall be expressed only in terms of W in multiples of 30 W. Standard ratings above 2900 W shall be Net Refrigerating Capacity and shall be expressed only in terms of W in multiples of 150 W.

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5.2 *Application Ratings.* Application Ratings shall be expressed in the same terms as Standard Ratings and shall be accompanied by pertinent conditions.

5.3 *Standby Ratings.* When an electric Standby Drive is provided, the unit shall be rated in accordance with this standard. The nameplate voltage and frequency of the standby drive motor is measured at the unit's service connection and under Standard Rating Conditions.

5.4 *System Requirements.*

5.4.1 *Compressor.* For all tests, the compressor shall be operated at a rotating speed in accordance with the manufacturer's recommended high speed operational setting. During the test, operating speed shall not vary by more than ± 50 rpm.

5.4.1.1 For an electrically driven compressor, the frequency tolerance shall be in compliance with the rotational tolerance in 5.4.1

5.4.2 *Condensing Unit.* Any engine or motor hoods, cabinets, louvers, wind deflectors, dampers, fan guards, coil guards, and other furnished components and equipment specified by the manufacturer shall be used during the test. These components shall be installed in accordance with the manufacturer's instructions.

5.4.3 *Refrigerant.* The unit shall be charged with the refrigerant type and the charge amount as shown on the unit's nameplate. The unit shall be charged in accordance with the manufacturer's published instructions.

5.4.4 *Refrigerant Flow Control(s).* Refrigerant flow control(s) used during the test shall be the same as that furnished by the manufacturer. It shall be operated at the manufacturer's specified setting.

5.4.5 *Forced-Circulation Air-Cooler.* Any nozzles, diffusers, cowls, deflecting vanes and other furnished components and equipment shall be used during the test. These components shall be installed in accordance with the manufacturer's published installation instructions. Under zero external static pressure, tests shall be on completely assembled units with fans operating at normal speed.

5.4.6 *Split Systems.* For testing purposes, split systems shall be connected by the following minimum lengths of refrigerant tubing and fittings of a type and size furnished or recommended for installation:

5.4.6.1 Under-Mounted: 7.5 m
5.4.6.2 Nose-Mounted: 2.0 m

5.5 *Tolerance.* To comply with this standard, measured Net Refrigerating Capacity at rating conditions shall not be less than 95% of published capacity ratings.

Section 6. Minimum Data Requirements for Published Ratings

6.1 *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall include all Standard Ratings. All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with ANSI/AHRI Standard 1111 (SI)." All claims to ratings outside the scope of this standard shall include the statement "Outside the scope of ANSI/AHRI Standard 1111 (SI)." Wherever Application Ratings are published or printed, they shall include a statement of the conditions at which the ratings apply.

6.2 Each Published Rating of Mechanical Transport Refrigeration Units shall include, or be accompanied by the following information:

6.2.1 Model number
6.2.2 Net Refrigerating Capacity, W
6.2.3 Refrigerant designation(s) in accordance with ANSI/ASHRAE Standard 34 with Addenda
6.2.4 Compressor speed, rpm

Section 7. Operating Requirements

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