

Development of Testing and Rating Procedures for Integrated Heat Pumps

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Test Standards

The most relevant standards for testing an integrated space conditioning heat pump capable of also water heating are ARI Standard 290-96 and ASHRAE Standard 137-1995, in conjunction with the more traditional ARI Standards 210/240 and ASHRAE Standards 37 and 116 for heat pumps.

ARI Standard 290-96 provides standard operating and simulated use conditions for single, two-step, and continuously modulated space conditioning equipment. It also provides one approved rating procedure for a single-capacity integrated unit that was developed by Nordyne for the Powermiser (no longer being manufactured). These existing procedures provide sufficient guidance for initial testing of developmental equipment for comparison with previous designs at full capacity operation. For capacity modulation operation in space cooling and heating modes with water heating, tests can be run according to Standard 290, however there is no approved procedure for determining performance rating calculations. There is, however, an extensive draft procedure developed by the National Institute of Standards and Technology (NIST) in the early 1990s for this purpose (Dougherty), and this could be the initial basis for performance rating estimates.

DOE/ORNL is developing an integrated heat pump (full space conditioning and water heating) for tight buildings. Due to the tightness, the IHP needs to have an active ventilation/dehumidification mode.. With regard to equipment testing in the cooling/dehumidification ventilation mode with or w/o water heating (of interest to the U.S. due to the need for space heating and cooling), recommended conditions from Standard 290 could be adapted for initial tests. Results from TRNSYS seasonal analyses may be used to determine the ambient conditions near the peak of the operating time x ventilation load (delivered load hours) for the ventilation cases in cooling and heating mode. This information would be used to make refinements to the ventilation mode test conditions and to investigate initial simplified means to calculate the seasonal performance contribution from active ventilation air treatment.

Existing or Draft Standards Related to an Integrated Heat Pump and a Ground-coupled Heat Pump

***Standard 290-96, *Air-Conditioning and Heat Pump Equipment Incorporating Potable Water Heating Devices*, Air-Conditioning and Refrigeration Institute (ARI) 4301, North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.

This is the closest relevant standard and includes as an appendix the procedure developed by Nordyne to rate the Powermiser. It is considered to be supplemental to ARI

Standard 210/240 for evaluating the water heating and/or the combined space conditioning and water heating capability of dual function equipment.

****Draft Test Procedure, B. Dougherty, NIST, early 1990s, Appendix M-1 to Subpart B – Uniform Method for Measuring the Energy Consumption of Combined Heat Pump -- Water Heating Appliances, 430 Pages*

This is a detailed draft test procedure prepared by NIST in the early 90's on testing of single and multiple-speed ACs or heat pumps with combined water heating capabilities.

***ASHRAE Standard 137-1995, Method of Testing for Efficiency of Space-Conditioning/Water Heating Appliances that include a Desuperheater Water Heater, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.*

This standard relates specifically to electric, air-to-air space conditioning equipment that includes a refrigerant-to-water desuperheater, but is the only relevant ASHRAE standard referenced in ARI standard 290.

ASHRAE Standard 124-1991 - Method of Testing for Rating Combination Space Heating and Water Heating Appliances . American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

This standard establishes a method of test to rate the performance of a combination space-heating/water-heating appliance. Scope: This standard covers electric, gas-fired, and oil-fired combination space-heating/water-heating appliances; This standard covers appliances up to 300,000 Btu/h rated input (87.9 kW)

This standard does not appear to cover electric ACs or HPs, only gas-or oil fired or resistance heated units. There is a related report NISTIR 5626, Performance Testing of a Family of Type I Combination Appliances, 1995 by Liu, Kelly, and Terlizzi that deals primarily with gas-fired boilers.

Ongoing ASHRAE and IEA Work relevant to an IHP

SPC 124 MOT / Rating Combination Space Heating and Water Heating Appliances

SPC 116 MOT / Rating Seasonal Efficiency of Unitary AC & HP

SPC 118.2-1993R MOT / for Rating Residential Water Heaters

SSPC 62.2P Ventilation and Acceptable IAQ in Low-Rise Residential Buildings

SSPC 90.2 Energy Efficient Design of New Low-Rise Residential Buildings

ASHRAE Standard 62.2-2004, *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

ASHRAE Standard 90.2-2004. *Energy-Efficient Design of Low-Rise Residential Buildings*, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

Ongoing work/reports in the current IEA Annex 28 on Rating Procedures for Combination Equipment.

Existing Relevant Electric Space Conditioning Standards:

ASHRAE Standard 37-1988, *Methods of Testing for Rating Unitary Air Conditioners and Heat Pumps*, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE., Atlanta, GA 30329, U.S.A.

ARI Standard 210/240-94, *Unitary Air-Conditioning and Air-Source Heat Pump Equipment*, Air-Conditioning and Refrigeration Institute (ARI) 4301, North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.

ASHRAE Standard 116-1995, *Method of Testing for Rating Seasonal Efficiency of Unitary Air Conditioners and Heat Pumps*, American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE., Atlanta, GA 30329, U.S.A.

ISO 13256-1, *Water-Source Heat Pumps – Testing and Rating for Performance – Part 1: Water-to-Air and Brine-to-Air Heat Pumps*, 1998, International Organization for Standardization, Case Postale 56, CH-1211, Geneva 21 Switzerland.

ARI Standard 330-98, 1998. *Ground-Source Closed-Loop Heat Pumps*, Air-Conditioning and Refrigeration Institute (ARI) 4301, North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A

ANSI/ARI 870, 2001. *Direct Geoexchange Heat Pumps*, , Air-Conditioning and Refrigeration Institute (ARI) 4301, North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A