

Hot Water Heat Pump Co2 Mitsubishi Electric

Research and Development of a Heat Pump Water Heater. Volume 1. Final Summary Report Energy and Economic Effects of Residential Heat Pump Water Heaters A Proposed Methodology for Rating Air-source Heat Pumps that Heat, Cool, and Provide Domestic Water Heating Strategic Nordic Products – Heat pumps Nordsyn study on air-to-water heat pumps in humid Nordic climate Research and Development of a Heat-pump Water Heater. Volume 2. R and D Task Reports Geothermal Heat Pumps Heat Pumps for Sustainable Heating and Cooling Development of a Low Cost Heat Pump Water Heater - Second Prototype Water Purification Using Heat Pumps Heat Pump Planning Handbook Heat Pump Systems A Compact and Fast Temperature-response Heat Pump Water Heater Solar and Heat Pump Water Heaters Heat Pumps Solar and Heat Pump Water Heaters Ground Water Heat Pump Anthology, Volume II. Heat Pumps Demonstration of a Heat-pump Water Heater Performance of a Heat Pump Water Heater Brian P. Dougherty Nordic Council of Ministers Stignor, Caroline Haglund Karl Ochsner Y. H. Venus Lun F A Holland *Decd* Jürgen Bonin International Energy Agency B. J. Huang Standards Australia (Organization) Staff Dermot McGuigan Standards Australia (Organization) Union Carbide Corporation Estel B. Penrod

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an electric heat pump water heater with an operating efficiency $\epsilon_{sub r}$ of 2.5 in average conditions of 70 to 75 °F ambient air

and 55 to 60 f supply water has been designed with losses taken into account the coefficient of performance cop is 2.8 or within 10% of the design objective separate heat pump designs are available for new water heaters and for retrofitting of existing ones for both models the compressor evaporator fan and controls are mounted in a round cabinet set on top of the water heater the condenser is a dual tube direct immersion type which enters the tank through a special 4 in hole in the top of new tanks for retrofit units the condenser is in the form of a helix and is screwed into the tank through the hole normally used by the lower resistance element early estimates for the cost of the device are between 200 to 250 more than for an electric resistance water heater using this estimate the payback for many applications will be between one and two years with some being less than one year the payback period is dependent on the amount of hot water consumption and the price of electricity in warm climates the benefit cost ratio will be improved by higher efficiency from warmer ambient air and by the value of free air conditioning and dehumidification provided while the unit is operating in colder climates the improved efficiency from colder supply water and the higher operating savings from higher kilowatt hour use because of the colder water tend to offset the effect of the less favorable climate a field demonstration of one hundred water heater heat pumps is planned in which each of 20 utilities will purchase install and service five units and install service and monitor instrumentation packages supplied by DOE this project will determine the annual cop of each unit and its impact on the heating and cooling load of the house

consumers are currently offered two choices in the electric water heating market conventional and solar systems a third alternative that should enter the market within three to five years is the heat pump water heater two heat pump water heater systems are being developed with funding from the department of energy one system operates on a standard rankine cycle and the other on a brayton cycle the design of each system is described and their national and regional energy conservation and economic potential is evaluated the two heat pump systems are compared to both conventional electric and solar water heating systems in the ten federal regions using the ORNL engineering economic model of residential energy use results indicate that heat pump water heaters are much more cost effective and energy conserving than either conventional or solar water heaters in each of the ten regions compared to a conventional electric water heater the payback periods for rankine and brayton cycle heat pump water heaters are 2.1 and 2.7 years respectively for a solar system designed to provide 65% of the load the payback period is 11.4 years assuming heat pumps are introduced in 1981 the projected cumulative energy saving to the year 2000 is 1.4 quads even with federal tax incentives to accelerate its use and assuming introduction of the systems in 1977 solar water heating offers less than two thirds the energy saving of heat pump water heaters

at the national institute of standards and technology nist work is on going to develop a proposed procedure for testing and rating air source heat pumps that heat cool and provide domestic water heating the family of appliances providing these three

functions are referred to here as integrated or combined heat pump water heating appliances for these appliances the heat pump contributes to heating the water in a storage type water heater through the use of a refrigerant to potable water heat exchanger the work at nist has centered upon developing a proposed rating methodology for integrated appliances that heat water in a water heating only mode or while simultaneously air conditioning or space heating despite the emphasis the proposed methodology provides a framework for rating other types of integrated heat pump water heating appliances the laboratory testing the calculation procedure and the method for reporting performance are described the testing is an adaption of the laboratory tests conducted when rating conventional heat pumps and water heaters seasonal estimates of energy consumption rates are calculated using a bin type approach combined performance factors and operating costs are used for reporting performance

the project strategic nordic products heat pumps includes an overview of legislation national schemes and actions taken to promote energy efficient heat pumps and makes recommendations on further actions and possible cooperation to be carried out by nordic authorities the project is part of nordsyn under the nordic prime ministers overall green growth initiative the nordic region leading in green growth read more at norden.org/greengrowth

the study presented in this report has been performed for nordsyn sponsored by the nordic council of ministers the aim of this study was to analyse if the information given on the energy labels of air to water heat pumps give consumers in nordic countries sufficient information on energy performance when comparing results from field measurements to declared values it shows the declared values are usually better than the field data especially in countries with humid climate there could be several reasons for this deviation as non optimal installations bypass of control systems old field data etc the suspicion that the deviation is due to that the standard tests do not take humidity sufficiently into account could not be proved nor fully dismissed recommendations are given on how this could be further investigated including field measurements in nordic countries

the heat pump water heater is a device that works much like a window air conditioner except that heat from the home is pumped into a water tank rather than to the outdoors the objective established for the device is to operate with a coefficient of performance cop of 3 or an input of one unit of electric energy would create three units of heat energy in the form of hot water with such a cop the device would use only one third the energy and at one third the cost of a standard resistance water heater this volume 2 contains the final reports of the three major tasks performed in phase i in task 2 a market study identifies the future market and selects an initial target market and channel of distribution all based on an analysis of the parameters affecting feasibility of the device and the factors that will affect its market acceptance in the task 3 report the results of a

design and test program to arrive at final designs of heat pumps for both new water heaters and for retrofitting existing water heaters are presented in the task 4 report a plan for an extensive field demonstration involving use in actual homes is presented volume 1 contains a final summary report of the information in volume 2

this leading manual presents the most recent information and market developments in order to put any installer engineer or architect in the position to design select and install a domestic geothermal heat pump system

this book highlights the significance of using sustainable energy to prevent the deterioration of our planet using heat pumps energy sustainability can be achieved through improved energy efficiency in this regard heat pumps offer an energy efficient alternative for heating and cooling to drive the adoption of heat pumps as a key component of sustainable buildings the authors focus on examining sustainable practices in heat pump operations and innovative system design in view of the growing desire to use sustainable energy to meet heating and cooling demands and improve indoor air quality this book offers a valuable reference guide to the available options in hvac heating ventilation and air conditioning system design to begin with the authors define sustainable energy and discuss the trend of thinking green in building design they then discuss sustainable practices and heat pump applications in mapping out hvac systems in turn they examine the use of green operations to promote sustainable practices and in order to highlight the importance of innovative design discuss the configuration options and precision control aspects in closing the authors illustrate innovative sustainable design on the basis of several energy efficient cases the book's main goal is to drive the adoption of sustainable energy solutions heat pumps it argues represent the most efficient system for meeting commercial recreational residential heating and cooling demands the book not only examines industrial practices in heat pump application but also discusses advanced heat pump technologies and innovative heat pump designs

since the 1980s various attempts have been made to apply the efficiency of heat pumps to water heating the products generated in the 80s and 90s were not successful due in part to a lack of reliability and difficulties with installation and servicing at the turn of the century environmaster international emi produced a heat pump water heater hpwh based on a design developed by arthur d little adl with subsequent developmental assistance from oak ridge national laboratory ornl and adl this design was a drop in replacement for conventional electric water heaters in field and durability testing conducted by ornl it proved to be reliable and saved on average more than 50 of the energy used by the best conventional electric water heater however the retail price set by emi was very high and it failed in the market ornl was tasked to examine commercially available hpwh product technology and manufacturing processes for cost saving opportunities several cost saving opportunities

were found to verify the feasibility of these cost saving measures ornl completed a conceptual design for an hpwh based on an immersed condenser coil that could be directly inserted into a standard water tank through a sleeve affixed to one of the standard penetrations at the top of the tank after some experimentation a prototype unit was built with a double wall coil inserted into the tank when tested it achieved an energy factor ef of 2.12 to 2.2 using doe specified test procedures a o smith contacted ornl in may 2006 expressing their interest in the ornl design the prototype unit was shipped to a o smith to be tested in their laboratory after they completed their test ornl analyzed the raw test data provided by a o smith and calculated the ef to be approximately 1.92 the electric resistance heating elements of a conventional electric water heater are typically retained in a heat pump water heater to provide auxiliary heating capacity in periods of high demand a o smith informed us that when they applied electric resistance backup heating using the criterion that resistance heat would be applied whenever the upper thermostat saw water temperatures below the heater's nominal setpoint of 135°F they found that the ef dropped to approximately 1.5 this is an extremely conservative criterion for backup resistance heating in a field test of the previously mentioned emi heat pump water heater residential consumers found satisfactory performance when the criterion for use of electric resistance backup heating was the upper temperature dropping below the set point minus 27 degrees applying this less conservative criterion to the raw data from the original a o smith ef tests indicates that electric resistance heating would never have come on during the test and thus the ef would have remained in the vicinity of 1.9 a o smith expressed concern about having an ef below 2 as that value triggers certain tax advantages and would assist in their marketing of the product we believe that insertion of additional length of tubing plus a less conservative set point for electric resistance backup heating would remedy this concern however as of this writing a o smith has not decided to proceed with a commercial product

this book is the result of a long term co operative research and professional development programme between the instituto de investigaciones electricas iie mexico and the university of salford uk it provides the design basis for the fabrication of small and large scale commercial absorption heat pump systems and includes a comprehensive treatment of the economics of heat pump systems it charts the development of heat pump technology from theoretical principles to the operation of practical systems for the purification of water both for human consumption and a wide variety of industrial purposes in addition to the increasing demand for potable water there is a rapidly increasing demand for clean water in industries ranging from foodstuffs and pharmaceuticals to electronics this book will be essential reading for industrial engineers and others concerned with the cost effective environmentally friendly production of clean water

the heat pump planning handbook contains practical information and guidance on the design planning and selection of heat pump systems allowing engineers designers architects and construction specialists to compare a number of different systems

and options including detailed descriptions of components and their functions and reflecting the current state of technology this guide contains sample tasks and solutions as well as new model calculations and planning evaluations also economic factors and alternative energy sources are covered which are essential at a time of rising heat costs topics included ecological and economic aspects introduction to refrigeration water heat pump systems configuration of all necessary components planning examples problems and solutions

presented at the asme asia 97 congress exhibition singapore september 30 october 2 1997

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