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STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A STEEL FLAT-PLATE COLLECTOR WITH TWO TRANSPARENT COVERS AND A PROPRIETARY COATING

by Power Systems Division
Lewis Research Center
Cleveland, Ohio 44135
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This preliminary data report gives basic test results of a flat-plate solar collector whose performance was determined in the NASA-Lewis solar simulator. The collector was tested over ranges of inlet temperatures, fluxes, and coolant flow rates. Collector efficiency is correlated in terms of inlet temperature and flux level.
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INTRODUCTION

An area presently being investigated by the NASA Lewis Research Center in its efforts to aid in the utilization of alternate energy sources is the use of solar energy for the heating and cooling of buildings. An important part of this effort is the evaluation of solar collectors which have the potential to be efficient, economical, and reliable.

This preliminary data report gives basic test results of a collector whose performance was determined in the NASA-Lewis solar simulator. In the interest of providing performance data on this collector to the technical community as quickly as possible, the basic test results reported herein are presented without evaluation. Detailed analyses and interpretation of these results may be presented in subsequent papers or reports by this Center. Some of the results contained in this report may be changed as warranted by reviews and evaluations, or by obtaining additional data on this collector.

Reference 1 describes the solar-simulator test facility, as well as the basic test procedure.

COLLECTOR DESCRIPTION

The collector was made by Southwestern Sheet Metal Works, Incorporated, El Paso, Texas. It consists of a 20-gage electrogalvanized steel absorber panel (absorbing area = 17.06 ft²) and seven parallel galvanized steel flow channels. The flow channels are spaced 3-5/8 inches apart. The absorber panel is coated with a proprietary coating. The collector has two glass covers of 3/16-inch water-white crystal, with the outer cover being tempered glass (glass area = 17.32 ft²). Insulation consisting of 4 inches of fiberglass is used to reduce conduction heat losses. A photograph of the collector on the test stand is shown in Figure 1.
COLLECTOR TEST RESULTS

Basic test results are given in Table 1. Since this collector was larger than the area of radiation provided by the solar simulator, it was necessary to use a "shield" approach as explained in Reference 1. This technique allows one to determine the efficiency of the entire collector even though only a portion of it is actually exposed to radiation. By using the analytical method outlined in Reference 1 for a collector tested with a "shield", the results given in Table I were used for a determination of the performance correlation given in Figure 2.

REFERENCES

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<th>Flow Per Radiated Surface Area lb/hr ft²</th>
<th>Flow Gal/Min</th>
<th>Incident Radiation Flux Btu/hr ft²</th>
<th>Fluid Outlet Temp., °F</th>
<th>Fluid Inlet Temp., °F</th>
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Figure 1. - Collector on test stand.
COLLECTOR EFFICIENCY ($\eta$) AS A FUNCTION OF FLUID INLET TEMPERATURE ($T_1$) AND INCIDENT FLUX ($q_i$)

$$\frac{T_1 - T_{ambient}}{q_i} \times 10^2 \left( \frac{BTU}{HR FT^2 \circ F} \right)^{-1}$$

Figure 2. - Collector Performance Correlation