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(NASA-TM-X-71868) STANDARD PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A SELECTIVELY COATED, FLAT-PLATE COPPER COLLECTOR WITH ONE TRANSPARENT COVER AND A TUBE-TO-TUBE SPACING OF 3-7/8 INCHES (NASA) G3/44

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16. Abstract

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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Power Systems Division
Lewis Research Center

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 Rocky Mountain Products of Denver, Colorado. It consists of a copper absorber panel (absorbing area = 21.97 ft^2) and ten parallel copper flow channels. The flow channels are spaced as follows: the center fin spacing is 4-3/8 inches, the two outboard fins are 2-3/8 inches and the fin spacing for all remaining is 3-7/8 inches apart. The absorber panel is coated with a selective surface. The collector has one cover plate consisting of 3/15-inch tempered glass with an area of 22.55 ft^2. The inlet and outlet manifolds are nominal 3/4-inch copper. A total of 3 inches of insulation is used, 1 inch being fiberglass and the remaining 2 inches consisted of urethane. A photograph of the collector on the test stand is shown in Figure 1.

COLLECTOR TEST RESULTS

Basic test results are given in Table I. 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 of two flow rates in Table I were used for a determination of the performance correlation given in Figure 2.

REFERENCES

1. Simon, F. F.: Flat-Plate Collector Performance Evaluation with a Solar Simulator as a Basis for Collector Selection and Performance Prediction, paper presented at the 1975 International Solar Energy Society Meeting, Los Angeles, California, July 28-August 1, 1975, NASA TMX-71793.

TABLE I - BASIC EXPERIMENTAL DATA

50/50 Water and Ethylene Glycol
Incident Angel = 0°
Tilt Angle = 57° Above Horizontal

Flow Per Radiated Surface Area lb/hr ft^2	Flow Gal/Min	Incident Radiation Flux Btu/hr ft^2	Fluid Outlet Temp.,°F	Fluid Inlet Temp.,°F	Ambient Temp.	Efficiency
14.594	0.39990	264.57	97.812	83.145	79.642	0.66443
14.630	0.40087	177.37	127.46	122.01	78.444	0.37730
14.642	0.40119	177.07	127.35	121.98	78.240	0.37240
14.598	0.39989	265.72	131.80	121.21	77.856	0.48807
14.393	0.40072	270.46	167.99	160.91	82.508	0.32364
30.354	0.82691	270.15	94.063	86.436	80.264	0.70366
30.181	0.82740	180.59	127.39	124.52	79.424	0.40211
30.142	0.82619	267.94	129.64	124.17	80.298	0.51711
29.981	0.83416	268.32	165.94	162.39	82.520	0.34108

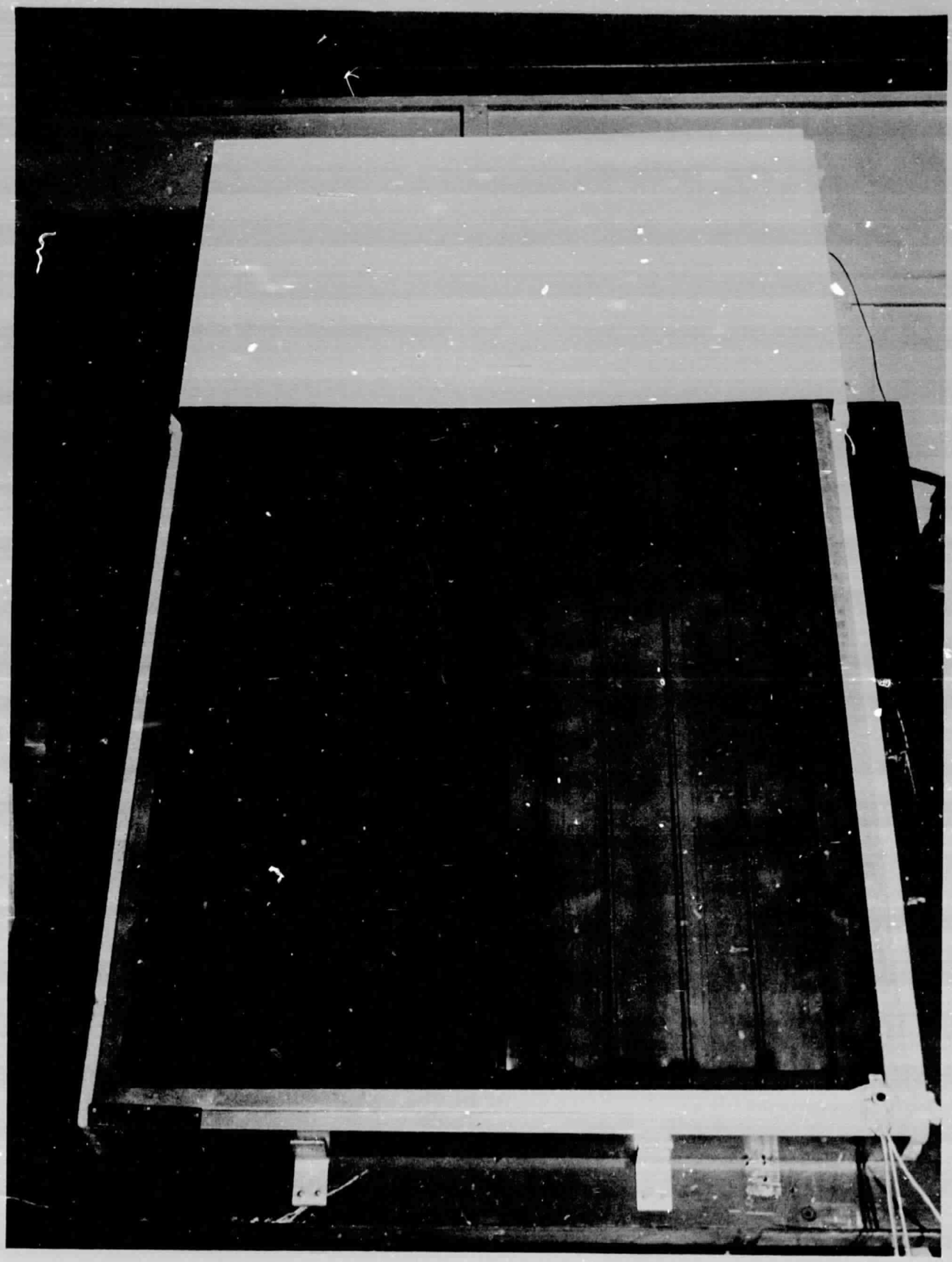

Figure 1. - Collector on Test Stand

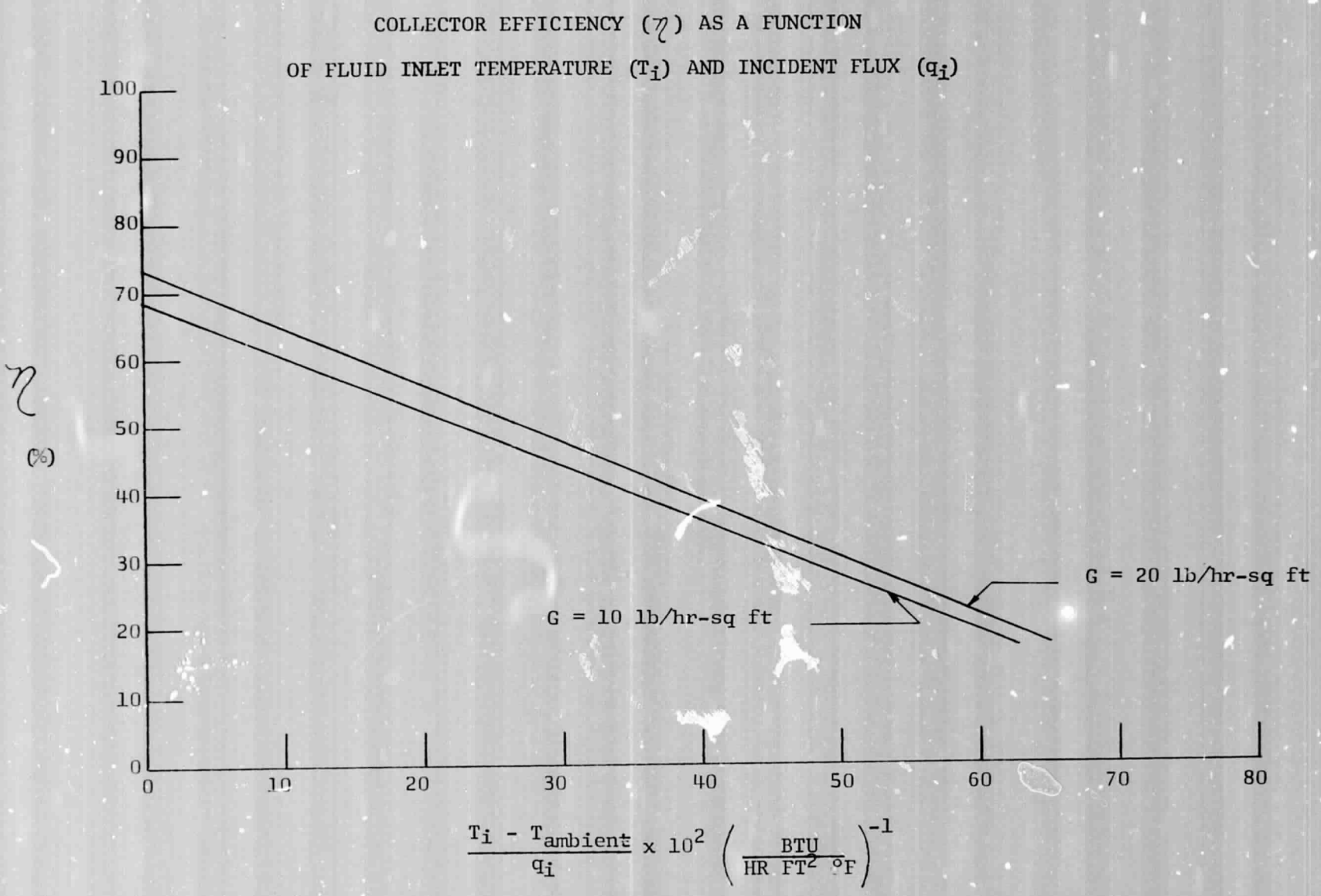

Figure 2. - Collector Performance Correlation