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STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A FLAT-PLATE COLLECTOR WITH A SINGLE-TUBE SERPENTINE FLOW DISTRIBUTION

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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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INTRODUCTION

An area presently being investigated by the NASA Lewis Research Center in its efforts to aid in 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 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 B. Bar-on collector was manufactured in Israel. The particular collector tested was obtained through Mechanical Technology Incorporated, Latham, New York. It is contained in an aluminum box (overall box dimension 48" x 48" x 4-1/4"). The collector has a single-tube serpentine flow distribution and a single glazing of glass (area of glass 14.45 ft^2). Styrofoam blocks are placed around the edges of the collector to minimize heat loss. 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. The results are given for one flow rate in Table 1, and these results were used for a determination of the performance correlation given in Figure 2.

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
10.71	0.224	289.9	111.6	80.4	80.6	0.764
10.69	0.223	290.8	111.7	80.4	80.6	0.763
10.81	0.226	182.7	134.4	122.6	77.3	0.473
10.70	0.223	281.9	145.7	122.4	78.4	0.601
10.91	0.228	180.1	170.8	164.8	78.2	0.250
10.79	0.225	276.2	181.8	166.0	79.1	0.432
10.81	0.226	277.0	181.9	166.3	79.1	0.425

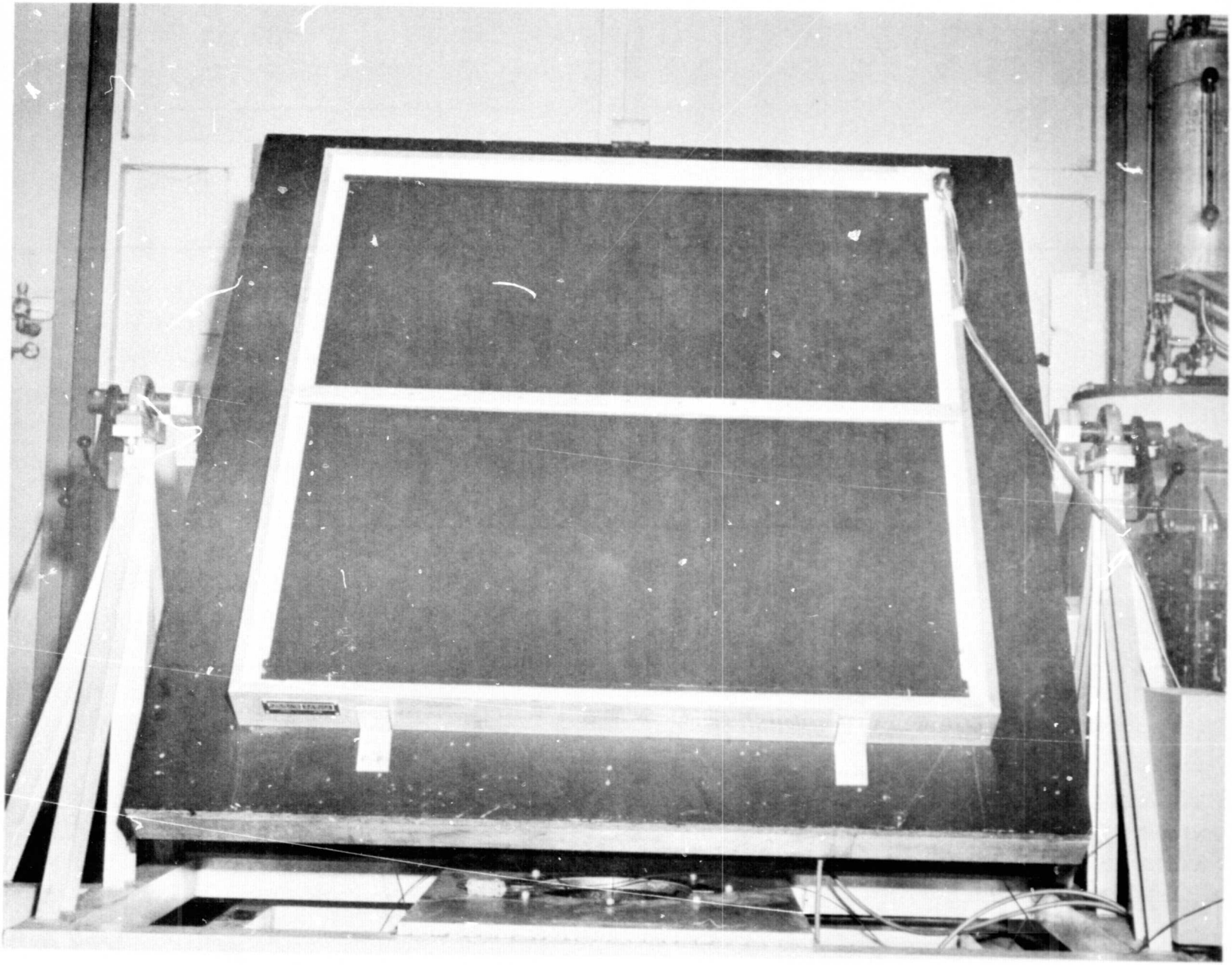

Figure 1. Collector on the Test Stand.

COLLECTOR EFFICIENCY (η) AS A FUNCTION

OF AVERAGE FLUID TEMPERATURE (T_i) AND INCIDENT FLUX (q_i)

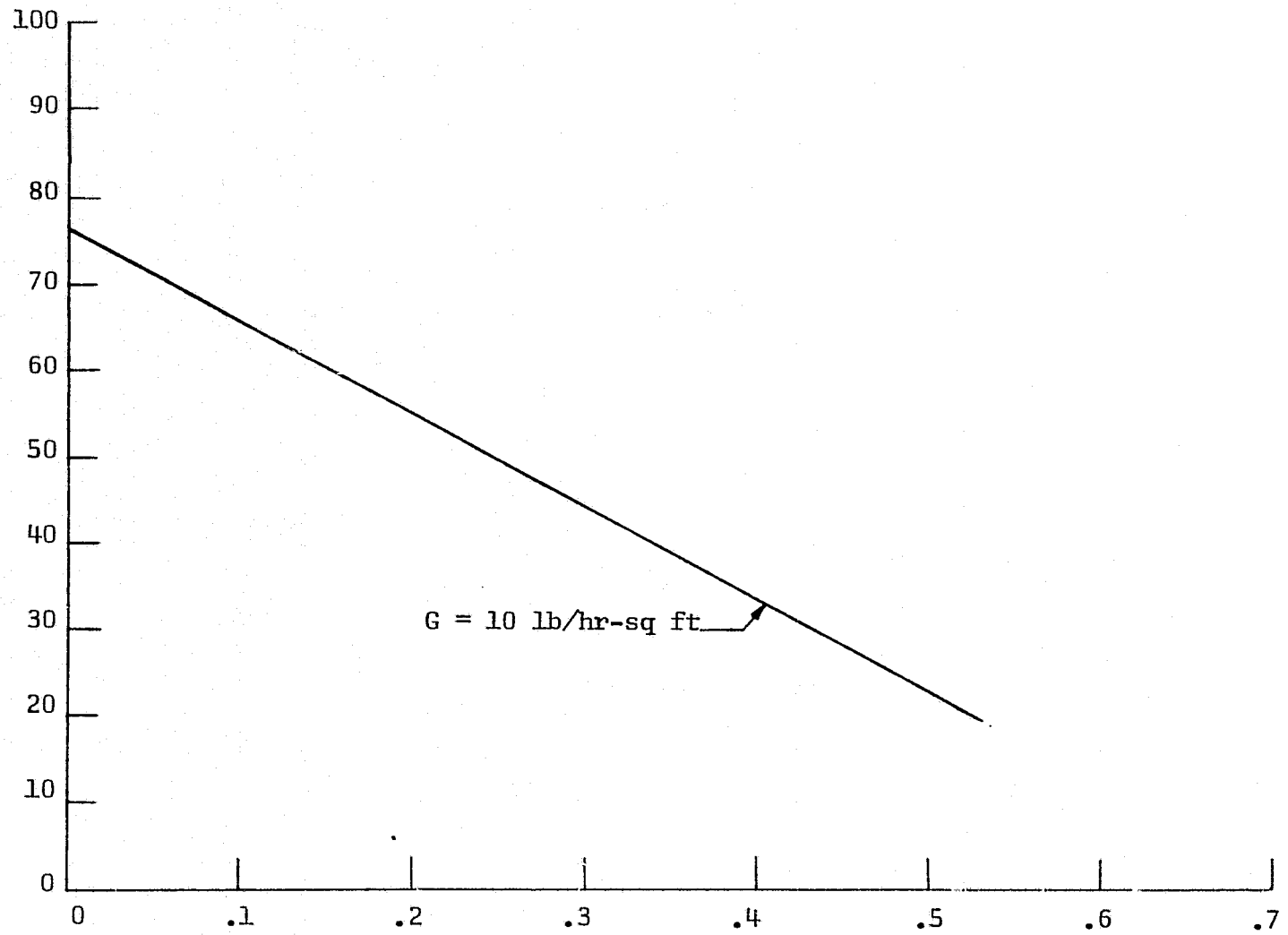

Figure 2 - Collector Performance Correlation