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STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - REVERE FLAT-PLATE COLLECTOR WITH TWO TRANSPARENT COVERS

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STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A NONSELECTIVE, COPPER COLLECTOR WITH TWO TRANSPARENT COVERS

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 Revere Copper and Brass, Incorporated of Rome, New York. It consists of a laminated copper absorber panel (absorbing area = 16.3 $ft.^2$) and seven parallel copper flow channels of rectangular cross-section. The flow channels are spaced $3\frac{1}{2}$ inches apart and are clamped and bonded with a thermally conductive cement to the absorber panel. The absorber panel is coated with a nonselective flat black paint. The collector double-glazing material is glass with an area of 17.2 square feet. An insulation of $3\frac{1}{2}$ inches of fiber glass 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 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 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 TM X-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
15.112	0.30747	195.98	106.31	96.287	90.137	0.67304
15.096	0.30716	186.93	106.41	96.364	90.388	0.67085
15.128	0.30780	196.69	106.35	96.300	90.417	0.67315
15.242	0.30995	275.66	111.20	96.007	90.818	0.69896
15.219	0.30949	275.66	111.26	95.911	90.794	0.70147
15.250	0.31012	275.00	111.36	95.979	90.995	0.70362
14.560	0.30575	195.44	129.26	122.27	89.283	0.43657
14.429	0.30296	196.78	129.37	122.30	89.469	0.43496
14.963	0.31412	195.67	129.55	122.11	89.569	0.47725
13.484	0.28278	293.07	135.15	122.17	90.768	0.51944
14.344	0.30080	293.54	135.42	121.74	90.231	0.58056
15.001	0.31458	294.86	135.34	121.94	90.095	0.50303
14.705	0.30815	197.72	163.13	160.25	90.402	0.18311
14.784	0.30979	197.25	163.15	160.31	90.105	0.18276
14.755	0.30913	196.46	163.35	160.25	90.050	0.19012
14.773	0.30964	276.45	169.82	161.49	90.186	0.33434
14.719	0.30833	278.34	169.93	161.48	90.203	0.33397
14.730	0.30881	276.76	169.08	161.51	90.381	0.34747
14.548	0.30525	277.05	201.02	197.45	91.551	0.16401
14.570	0.30574	277.71	200.93	197.65	91.654	0.15225
14.538	0.30509	275.66	200.93	197.84	91.743	0.14288

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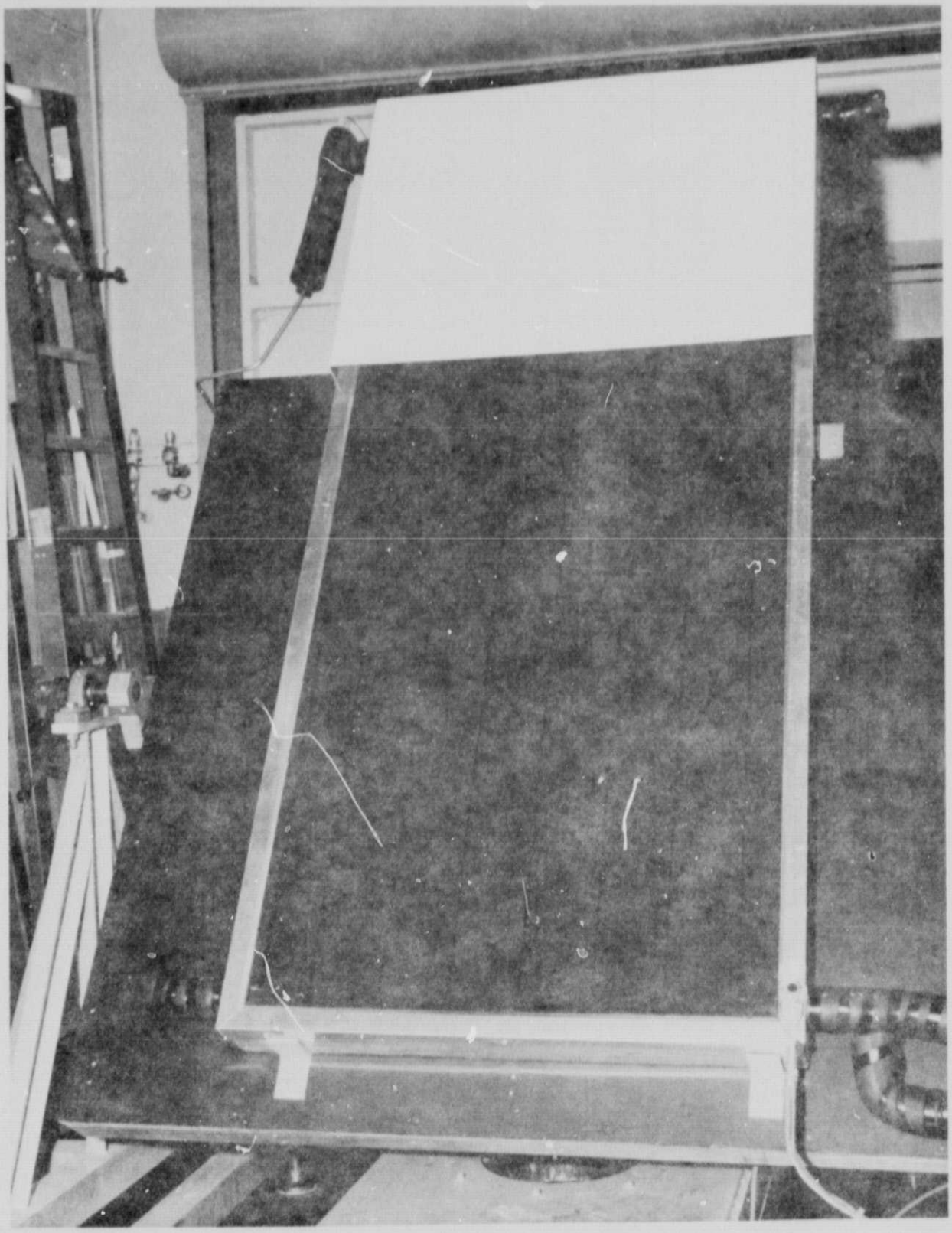

Fig. 1 - Collector on Test Stand

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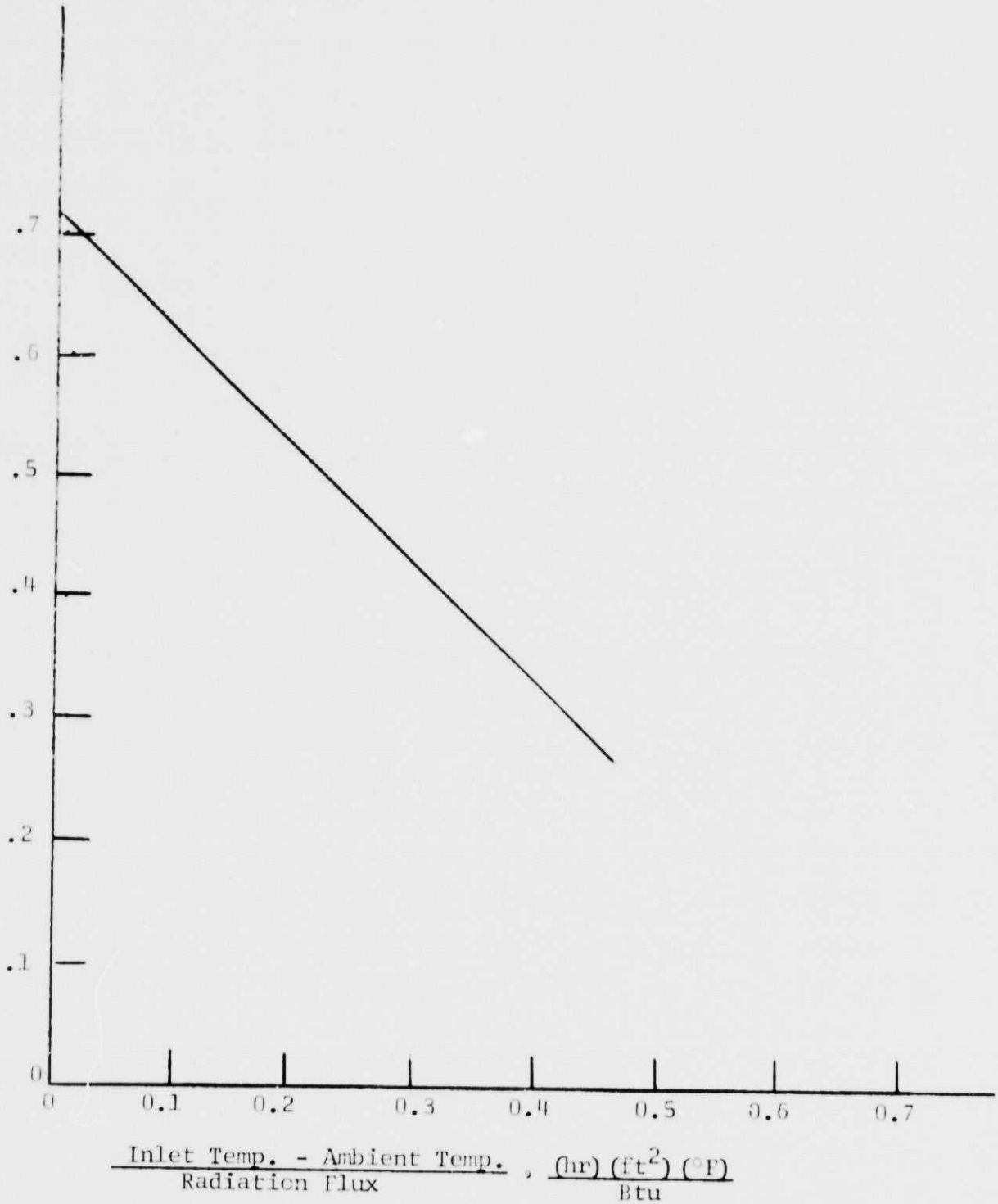

Fig. 2 - Collector Performance Correlation