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4pp.

Project No. 55
M.D.F.R.L.

18 March 1947

AN IMPROVED MOUNTING FOR THERMOCOUPLES FOR THE MEASUREMENT OF THE SURFACE TEMPERATURE OF THE BODY*

OBJECT

The development of thermocouples to measure accurately the surface temperature of the body.

SCOPE

Thermocouples mounted in a special holder which allows for the measurement of the surface temperature of the body.

AN IMPROVED MOUNTING FOR THERMOCOUPLES FOR THE MEASUREMENT OF THE SURFACE TEMPERATURE OF THE BODY*

COMPOSING

The surface temperature of the body can be measured easily and with accuracy with these thermocouples.

COMPOSING

by
Edward D. Palmes, 1st Lt., SnC and
Charles R. Park, Capt., MC

These thermocouples were developed and tested where the greatest precision is required.

from

Medical Department Field Research Laboratory
Fort Knox, Kentucky, 18 March 1947

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*Sub-Project under Studies of Body Reaction and Requirements under Varied Environmental and Climatic Conditions. (M.D.F.R.L.-55). Approved by CG, ASF, 31 May 1946.

Project No. 55
MEDEA

18 March 1947

ABSTRACT

AN IMPROVED MOUNTING FOR THERMOCOUPLES FOR THE MEASUREMENT OF THE
SURFACE TEMPERATURE OF THE BODY

OBJECT

The development of thermocouples to measure accurately the surface temperature of the body.

RESULTS

Thermocouples mounted on copper window screen gave skin temperature readings comparable to those obtained by a radiometer.

CONCLUSIONS

The surface temperature of the body can be measured easily and with accuracy with these thermocouple assemblies.

RECOMMENDATIONS

These thermocouple assemblies are recommended except where the greatest precision is necessary.

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AN IMPROVED MOUNTING FOR THERMOCOUPLES FOR THE MEASUREMENT OF THE SURFACE TEMPERATURE OF THE BODY

I. INTRODUCTION

The intensity of radiation from the skin, measured by a radiometer, provides the best index of the temperature of the outermost surface of the body. The radiometer is an accurate instrument but is technically difficult to employ; it requires daily calibration, the conversion of electrical potentials to temperature is laborious, and an observer or trained subject must hold the instrument in position for each reading. Thermocouples, on the other hand, are technically easy to use, but are often inaccurate for the measurement of surface temperature because of the mountings usually employed. If a naked thermal junction is used, readings are affected by the temperature of the ambient air, and firm contact between the junction and the skin is difficult to maintain. When the thermocouple is protected from the air by a covering, heat loss from the skin is impeded and the readings are too high. The deviation in surface temperature measurements by thermocouple and radiometer is generally 1 degree C. to 3 degrees C. (1).

II. EXPERIMENTAL

A. Apparatus

It proved possible to develop a thermocouple mounting which allowed surface temperature to be determined with much greater accuracy than by those previously employed. This mounting (Figure 1) was made on a 1 x 3 in. rectangle of copper window screen (16 mesh, wire diameter 0.01 in.). Copper-constantan thermocouple leads were used, and kinking was prevented by plastic spaghetti. Double cloth insulation was retained to the point where the wires passed under the screen and single cloth and lacquer insulation were continued up to the junction itself. The insulated portion of the wire was lashed to the screen with thread. The naked leads were twisted together and the junction, one-half inch in length, was soldered to the under side of the screen as indicated. The screen remained quite flexible except for the ends, which were dipped in soft solder to provide firm connections for metal buttons. Adjustable bands of elastic cloth were snapped to these buttons and held the mounting firmly against the skin.

B. Results

Surface temperature measurements using these assemblies were compared with readings obtained by radiometer in four different environments. Thermocouples were fastened to the belly, chest, and thighs of nude subjects and temperatures on adjacent skin areas were determined simultaneously by both methods. The results are shown in Figure 2. The broken lines on each side of the central diagonal show the limits

FIGURE 2
COMPARISON OF SIMULTANEOUS THERMOCOUPLE AND BALANCE
MEASUREMENTS OF SURFACE TEMPERATURE

FIGURE 1
THE THERMOCOUPLE ASSEMBLY

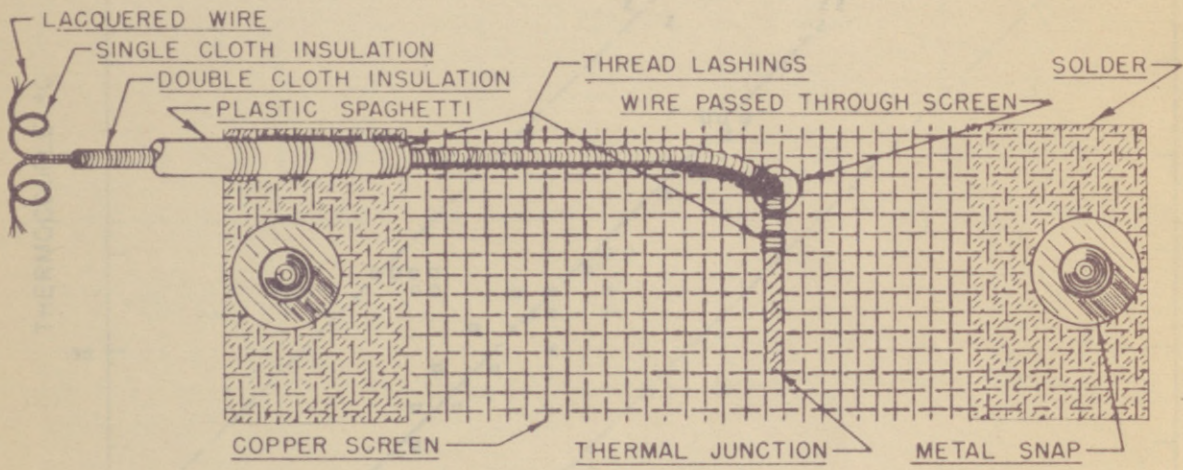
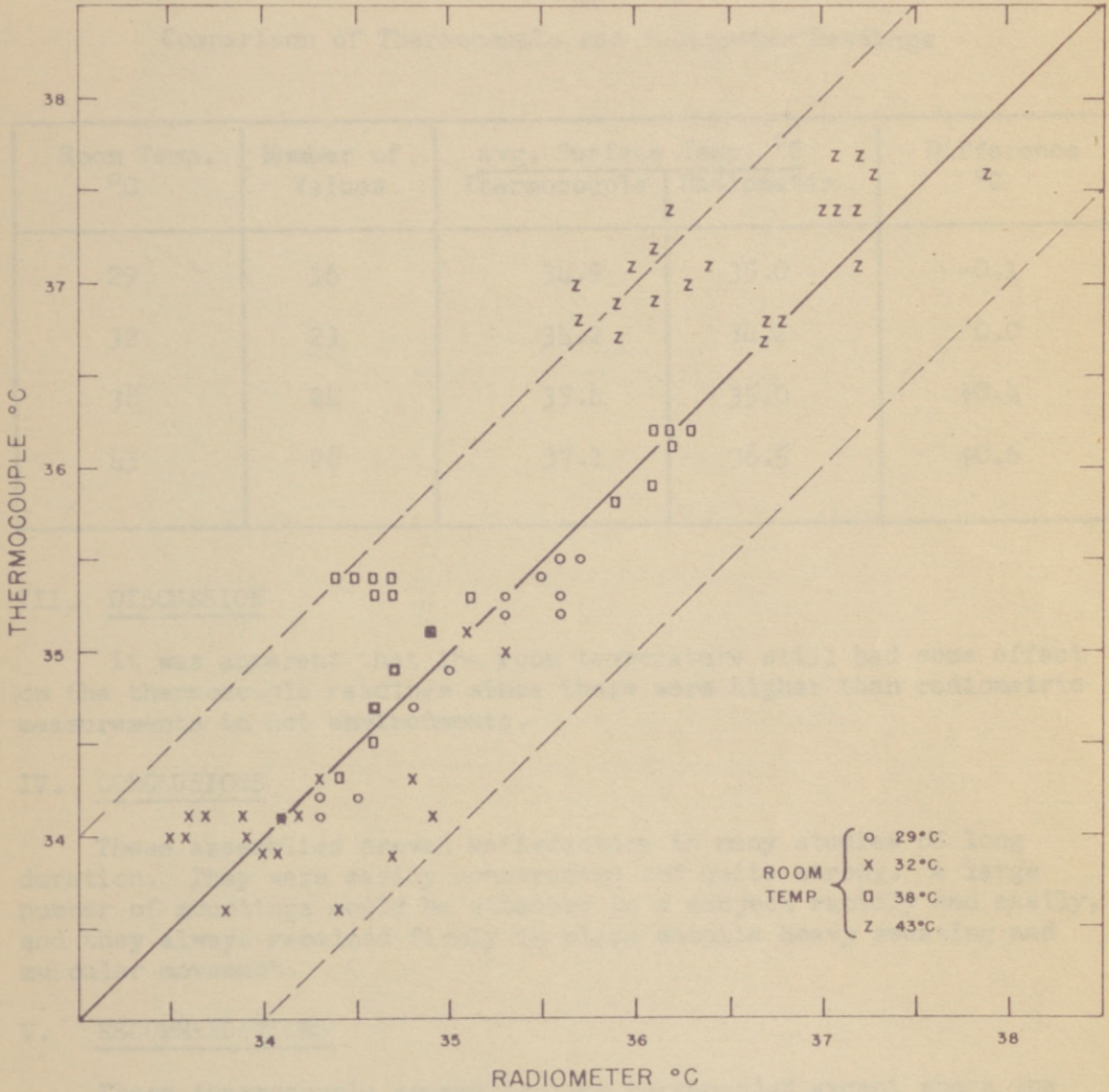


FIGURE 2

COMPARISON OF SIMULTANEOUS THERMOCOUPLE AND RADIOMETER MEASUREMENTS OF SURFACE TEMPERATURES



of variations of ± 1 degree C between the readings and enclose 95% of all measurements. Thermocouple and radiometric determinations in each environment were then averaged separately and the values compared (Table 1).

TABLE 1

Comparison of Thermocouple and Radiometer Readings

Room Temp. °C	Number of Values	Avg. Surface Temp. °C		Difference °C
		Thermocouple	Radiometer	
29	16	34.9	35.0	-0.1
32	23	34.2	34.2	0.0
38	24	35.4	35.0	+0.4
43	28	37.1	36.5	+0.6

III. DISCUSSION

It was apparent that the room temperature still had some effect on the thermocouple readings since these were higher than radiometric measurements in hot environments.

IV. CONCLUSIONS

These assemblies proved satisfactory in many studies of long duration. They were easily constructed and quite strong. A large number of mountings could be attached to a subject rapidly and easily, and they always remained firmly in place despite heavy sweating and muscular movement.

V. RECOMMENDATIONS

These thermocouple assemblies are recommended except where the greatest precision is necessary.

VI. BIBLIOGRAPHY

1. Hardy, J. D.: J. Clin. Investigation 13:605, 1934

