NASA TECH BRIEF

NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.



Calibration Technique for Electromagnetic Flowmeters

The problem:

To calibrate electromagnetic flowmeters for liquid alkali metals such as liquid potassium and liquid sodium.

The solution:

A thermal calorimetric method in which the electromagnetic flowmeter is placed in the liquid metal flow system in series with a thermal calorimeter.

How it's done:

An immersion heater is used for heat input to the calorimeter to assure that all of the heat input goes into the liquid metals' sensible heat. To determine the liquid metal flow rate, three parameters have to be known to solve the heat balance equation

 $W = \frac{q}{Cp\Delta T}$

where

$$w = flow rate$$

$$q =$$
 heat input to calorimeter

- Cp = specific heat of liquid metal
- ΔT = liquid metal temperature increase across calorimeter due to heat input

The heat input to the calorimeter through the immersion heater is measured very accurately by a standard wattmeter. The calorimeter heat loss and the systematic temperature measurement error between the inlet and outlet thermocouples are determined by a special technique developed in the process of calibrating the thermocouples.

Simultaneously as the heat input to the calorimeter and temperature rise of the liquid metal at the inlet and outlet of the calorimeter are recorded, the electromagnetic flowmeter reading is recorded. Since the calorimeter and electromagnetic flowmeter are in series, the calculated flow rate through the calorimeter can be compared directly with the respective electromagnetic flowmeter reading.

Notes:

1. Flow rates calculated from the heat balance equation were used as the basis for calibration of an electromagnetic flowmeter for the liquid metal potassium over the following range of calorimeter conditions:

Potassium flow rate	0.14 to 0.31 lb/sec
Potassium temperature	11.5° to 43.4°F
difference	
Average potassium	600° to 700° F
temperature	
Calorimeter heat input	0.76 to 1.6 BTU/sec
	(approximated area)

(continued overleaf)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States

Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.

- 2. Four sets of calibrations resulted in an average ratio of the calorimeter to electromagnetic flowmeter flow rates of 1.145 with a standard error of $\pm 1.3\%$.
- 3. Additional details are contained in NASA CR-851, Thermal and Hydraulic Performance of Potassium during Condensation inside Single Tubes, by S. G. Sawochka, August, 1967. Copies of this report are available from:

Technology Utilization Officer Lewis Research Center 21000 Brookpark Road Cleveland, Ohio 44135 Reference: B67-10554

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D. C. 20546.

Source: S. G. Sawochka of General Electric under contract to Lewis Research Center (LEW-10328)

Category.01