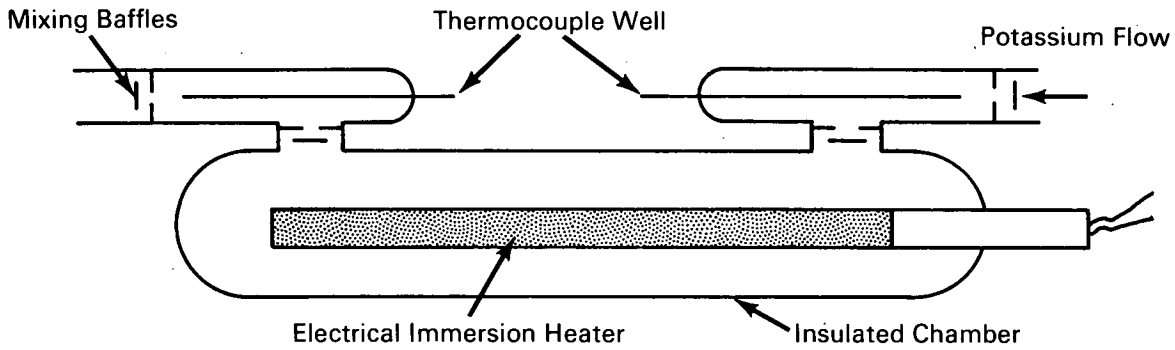
NASA TECH BRIEF

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 difference	11.5° to 43.4°F
Average potassium temperature	600° to 700°F
Calorimeter heat input	0.76 to 1.6 BTU/sec

(continued overleaf)

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
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