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MOUNTING THERMOCOUPLES ON SPERT TEST ASSEMBLIES

by

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ABSTRACT

A method of fastening thermocouples to 0.030-inch-thick aluminum cladding on test fuel elements was developed. The installation does not lead to hot spots by the addition of extra metal or the distortion of the cooling water channels. Fuel element temperatures were faithfully followed in SPERT tests up to the melting point. The method has been useful for fastening thermocouples to aluminum sections in general.

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INTRODUCTION

The measurement of temperatures within the fuel and housing tubes of an operating reactor presents a difficult problem. The thermocouple wires must be attached in such a way that they do not appreciably change the temperature at the point of attachment. Weld beads or clamps add extraneous metal and may also produce eddies in the coolant, possibly resulting in hot spots.

The burnout testing of experimental fuel assemblies in a SPERT reactor would be seriously affected by such hot spots, since they might promote premature burnout.

This report describes a new method that was used to attach thermocouple wires to thin aluminum sections of various SPERT test fuel assemblies.

SUMMARY

A method was developed for attaching 30-gage thermocouple wires to 0.030-inch-thick aluminum sections. The thermocouple wires were embedded in the aluminum surface at a depth of about 0.015 inch. Two 0.020-inch grooves, 1 inch long, were cut with a tubing cutter wheel mounted in a milling machine. Bare thermocouple wires were laid in the grooves and a double-edged roller wheel was used to roll the displaced aluminum back into place.

The change in the thermal behavior of the aluminum in the vicinity of the thermocouple is minimized. The temperature of the aluminum pieces was faithfully followed up to the point of melting.

DISCUSSION

Several methods were tried to attach thermocouple wires to the 0.030-inch-thick aluminum cladding of a SPERT test fuel element assembly(1). Welding the thermocouple bead to the aluminum cladding left a bump that caused hot spots due to the addition of metal and the restriction of the cooling water flow. Clamping the wires in a groove by "pinging" the edge metal over the wires with a small hammer was more successful than welding, but the hammer blows distorted the fuel assemblies out of tolerance.

Successful installation was made with the special tool shown in Figure 1, which was made to fit the head of a Bridgeport milling machine. Two small cutter wheels were mounted in this tool. The sharp-edged wheel was taken from a tubing cutter while the double-edged wheel was specially made.

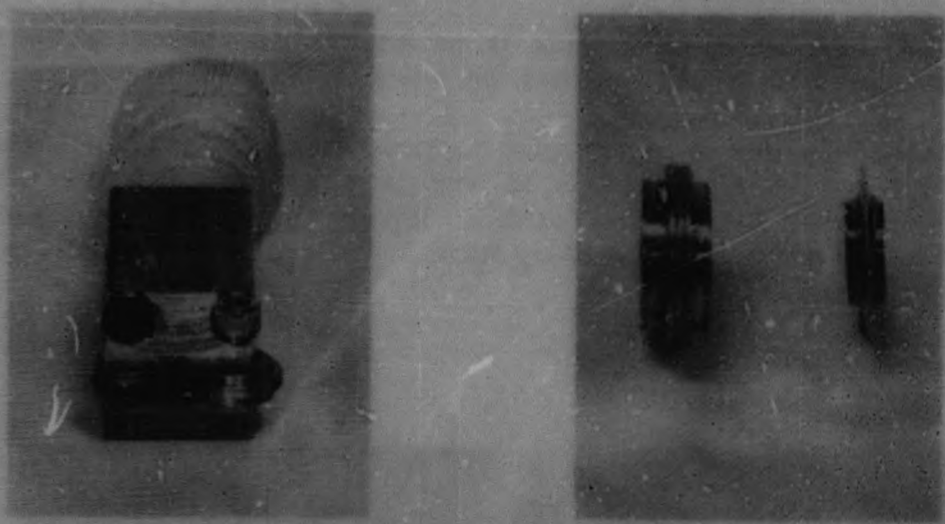

FIGURE 1 - TOOL, CUTTER WHEEL, AND DOUBLE-EDGED ROLLER FOR THERMOCOUPLE INSTALLATION

The aluminum tubing is mounted on the milling machine and two 1-inch-long grooves 0.020 inch deep are cut about 1/2 inch apart with the sharp roller as seen in Figure 2. Bare 30-gage thermocouple wires are laid in the grooves, and the aluminum is rolled back into place with the double-edged roller. Back support may be required within the tubing if its cross section is too thin.

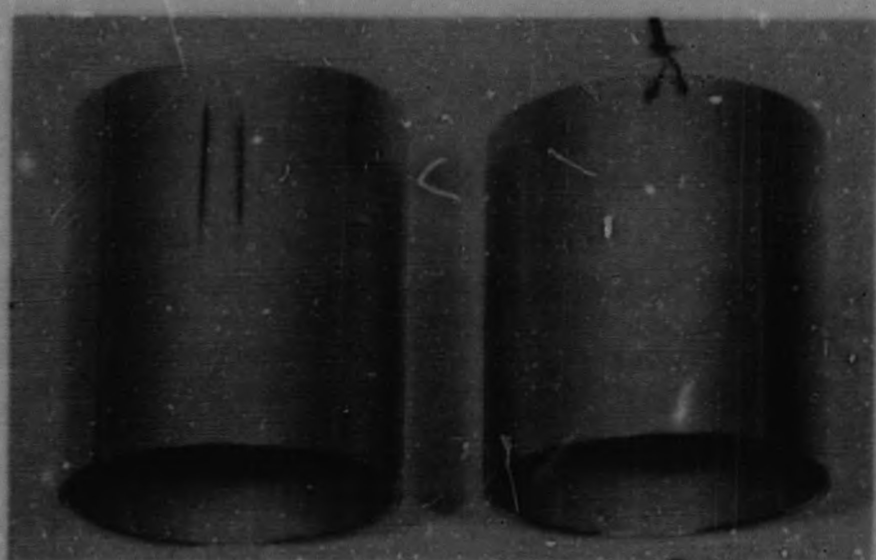

FIGURE 2 - ALUMINUM TUBING SHOWING GROOVES AND INSTALLED THERMOCOUPLE

The assembled couple makes little or no change in the cross section of the aluminum tubing wall as may be seen in Figure 3.

The thermocouple wires were 30-gage chromel-alumel insulated with spun glass rated for 1100°F service. Ninety couples gave satisfactory service under water up to the point at which the aluminum elements melted. Cooling water flows of up to 6.2 feet per second did not dislodge the wires.

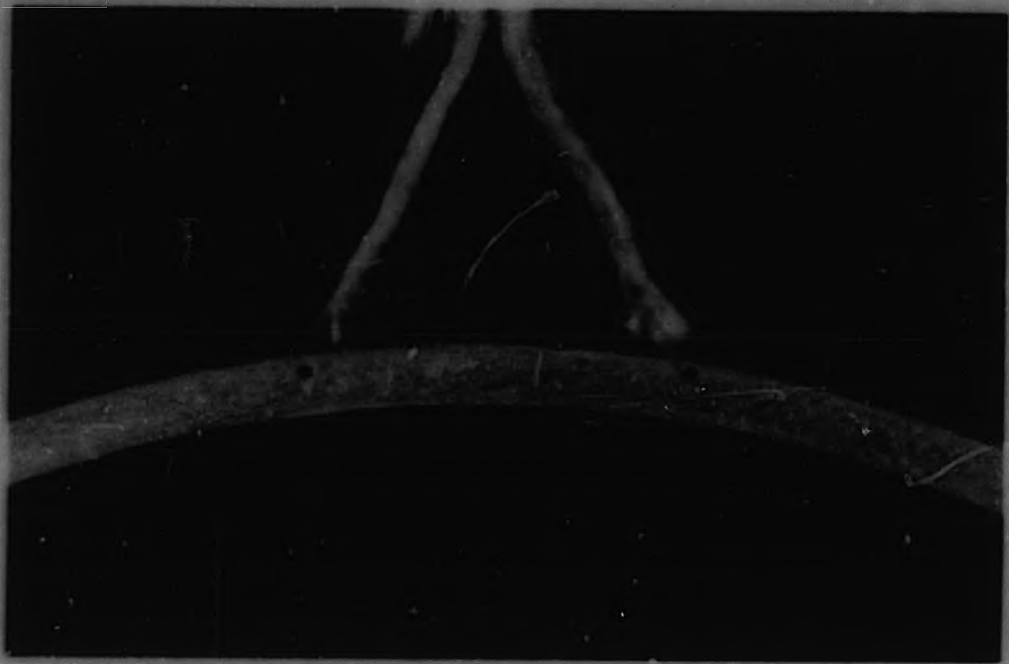

FIGURE 3 - CROSS SECTION OF THERMOCOUPLE INSTALLATION

Since the dissimilar thermocouple wires were attached separately, the indicated temperature was the average of the two points at which the wires emerged. Since aluminum is a good thermal conductor this caused no problem. The length of the embedded portion of the wires was not critical, since the effective thermocouple junctions were very close to the point at which the wires emerged.

Many thermocouple applications of the new method have been made since the SPERT experiments were conducted. The cutter tool can be adapted for hand use by the addition of a handle to the milling machine adapter. Satisfactory thermocouple installations have been made both by hand and in the milling machine.

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BIBLIOGRAPHY

1. Seaboch, J. R. and Wade, J. W., Fuel Meltdown Experiments. E. I. du Pont de Nemours and Co., DP-314, October 1958 (Secret).