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Weld Metal Temperature Measurement

HARPOON TECHNIQUE WITH RHODIUM-PLATINUM THERMOCOUPLES

The thermal history of weld metal gives a good indication of the behaviour of the weld thereafter. For example, the thermal behaviour of the weld bead affects the properties of transformable steel. To record the thermal history of a weld bead platinum metal thermocouples may be inserted during the welding process but until recently many of them melted in use and the instruments became open circuit.

C. Pedder of the Welding Institute's Metallurgical Department at Abington Hall, Cambridge, has now described a simple technique in which platinum: 13 per cent rhodium-platinum harpoon thermocouples of 0.5 mm wire are used. The wires are insulated in twin bore ceramic insulators supported in a close-fitting steel tube so that they protrude 3 mm beyond the insulator, which itself protrudes 5 mm beyond the steel tube end. They dip into the pool of weld metal which completes the circuit by acting as the thermocouple hot junction. Tests showed similar results to those using conventional thermocouples up to 1000°C. The e.m.f.s differed by less than 0.01 mV (10°C at 1000°C).

Manual and semi-automatic methods have been used to plunge the thermocouple accurately into the weld metal pool. In the latter case the welder can also operate the harpoon thermocouple, and when used with implant cracking test equipment the thermocouple records the thermal cycle and also actuates the implant loading mechanism at the predetermined temperature.

Weld thermal cycles and cooling times have been measured by the harpoon thermocouple for the MMA, MIG and submerged arc processes. It has also made possible the thermal analysis of weld metal austenite transformation immediately after deposition, whereas previous dilatometry studies gave transformation characteristics of reheated metal. The thermal analysis process uses a differential amplifier to convert thermocouple output to a voltage proportional to the cooling rate. F. J. S.