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FEASIBILITY STUDY OF ACOUSTIC EMISSION MONITORING OF PINCH WELDING TRITIUM RESERVOIR FILL STEMS AT THE SAVANNAH RIVER SITE (U)

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FEASIBILITY STUDY OF ACOUSTIC EMISSION MONITORING OF PINCH WELDING TRITIUM RESERVOIR FILL STEMS AT THE SAVANNAH RIVER SITE (U)

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A study was conducted to determine whether acoustic emission monitoring would be feasible in monitoring the solid-state resistance pinch weld used to seal tritium reservoirs at the Savannah River Site. Experiments were performed using a commercially available acoustic emission detection system, with a transducer mounted on a flat milled onto one of the pinch weld electrodes. Welds were made using a wide range of weld power, from very cold, with no metallurgical bond, to hot, with local fusion and excessive material injection into the tube bore. The tubes were drawn type 316L stainless steel. The welds were confined (anvils prevented material flow outward from the sides of the tube not being forced inward by the electrodes) and all were made using the same electrode force.

The total number of ringdown counts for each weld was more correlated with weld power and bond length than total energy counts or total number of hits. When the ringdown counts for each weld are plotted against weld input power (Fig. 1), two distinct regions are noted: lower power welds (made at up to 75% relative power) exhibit little or no acoustic activity, and those made at higher power (>75%) gave off much more acoustic emission. No significant variation of acoustic emission with weld power or bond length was found for the lower power welds, and the acoustic emission at higher weld power varies considerably for otherwise identical welds. The bond length (determined by section metallography) varies smoothly with weld input power (Fig. 2). Production welds are made at the higher end of the lower power region in Fig. 1.

The onset of large acoustic emission at higher weld power coincides with the injection of material into the tube bore, termed extrusion if arising from a solid state weld or spitting if arising from a weld with local fusion. Since large extrusions and spits, identified by radiography, cause rejection of production welds, a useful function of acoustic emission monitoring of pinch welding might be to detect the onset of extrusion or spitting. However, low acoustic emission does not guarantee lack of excessive extrusions or spits (Fig.1). The cause of the variation of acoustic emission at high power is unknown. Since some welds exhibited no acoustic emission for weld currents up to 73% relative power (Fig.1), the weld current itself is probably not inducing electrical noise pickup by the acoustic emission detection system.

In a previous study of acoustic emission monitoring of pinch welding at the Savannah River Laboratory, it was concluded that varying degrees of oxide on the stem surface caused predictable variations in acoustic emission [1]. Replotting the data of that study (Fig. 3) shows that the acoustic emission for a given input power is independent of surface oxide thickness (as well as atmosphere and degree of axial restraint) for all three power levels used in that study. The independence of acoustic emission on surface condition was also observed in another study [2]. Oxide films are known to adversely affect the pinch weld bond [3].

The low level of acoustic emission at production weld power levels (and below), the variability of acoustic emission at power levels causing extrusion and spitting, and the inability of acoustic emission to distinguish welds made with oxidized stems indicates that acoustic emission monitoring would not be a useful nondestructive evaluation of reservoir pinch welding at the Savannah River Site.

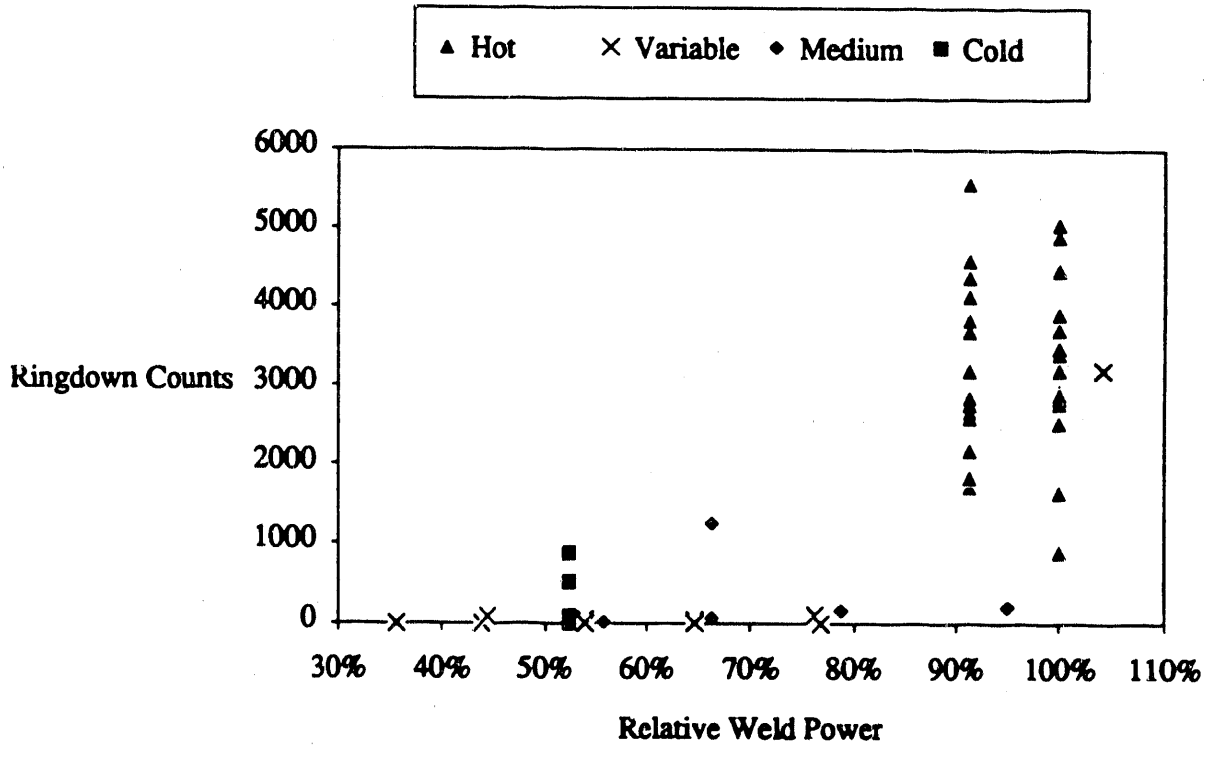

Figure 1. Acoustic emission ringdown counts versus relative weld input power. Experiments performed in four series, labled "Hot", "Variable", "Medium", and "Cold" as shown.

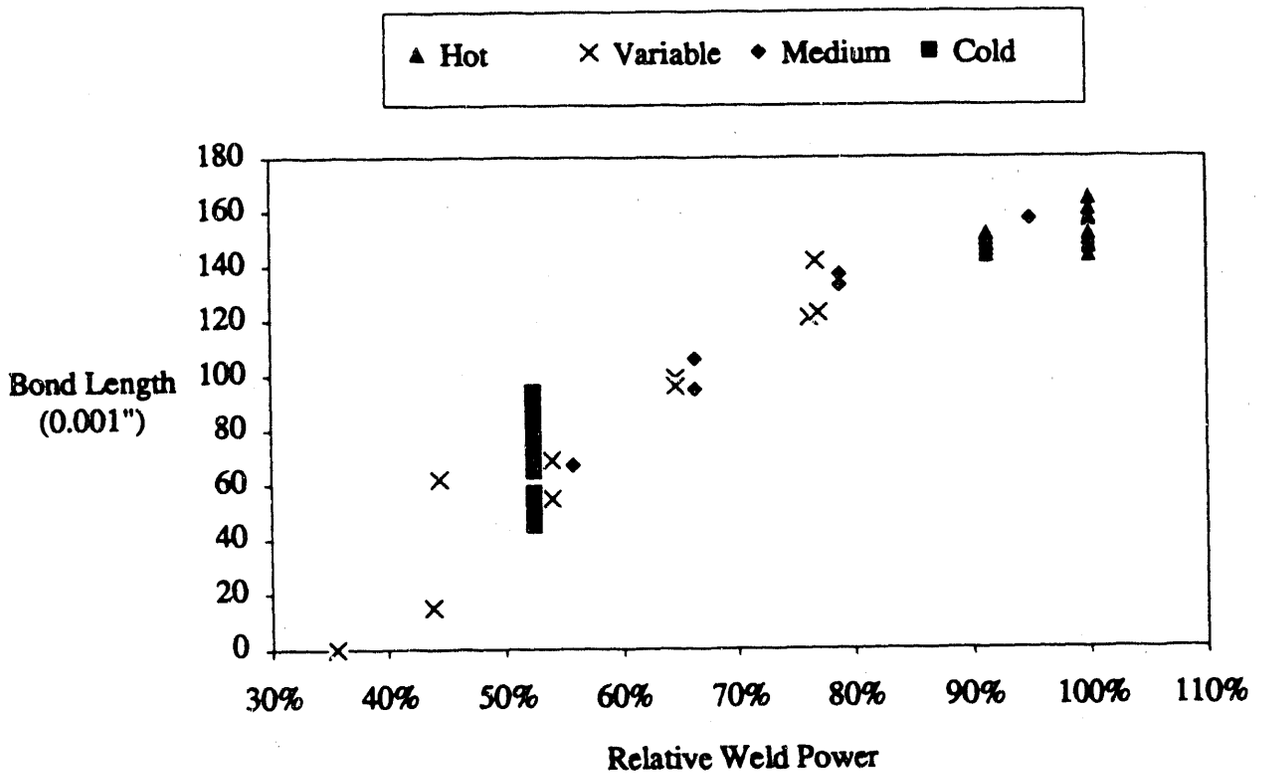

Figure 2. Pinch weld bond length versus relative weld power. Same welds as Fig. 1.

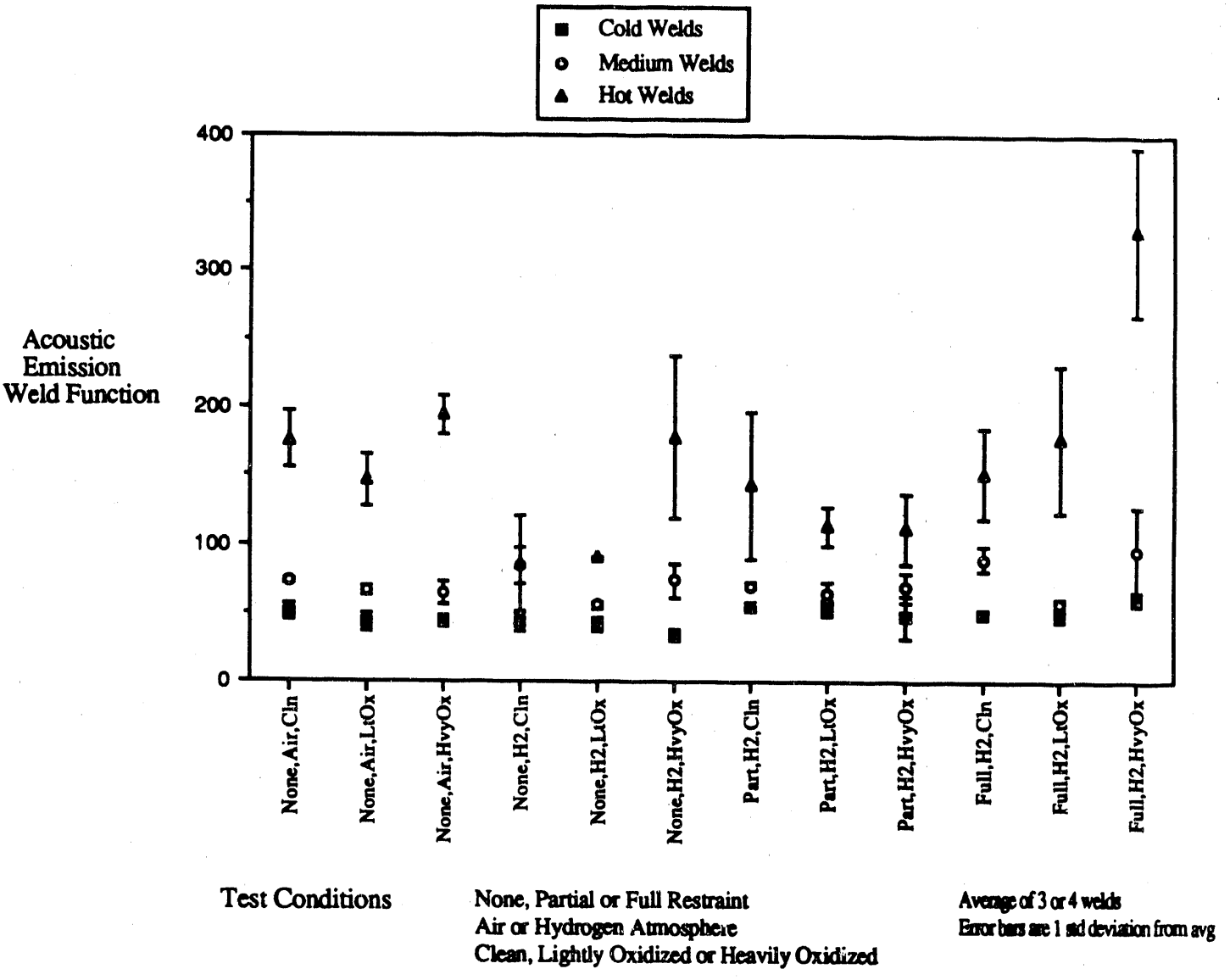

Figure 3. Acoustic emission weld function for previous study, for welds made at various conditions of restraint, atmosphere, and degree of oxidation as shown. Acoustic emission weld function is energy counts for a weld divided by weld power; this is roughly equivalent to the ringdown counts used in Fig. 1. Weld power levels Hot, Medium and Cold in this figure do not necessarily correspond to those of Figs. 1 and 2.

References

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