Thermal Force Feedback (TFF) ... for resistance welding

Thermal Force Feedback is an innovative method for assuring quality resistance spot welds for the most demanding applications. We can “feel” the weld grow right in between the electrode tips and let you know if the weld is good. The concept is simple yet very rugged and is most applicable for requirements outside the welding lab right onto your factory floor.

The weld control is monitoring welding electrode force each half cycle while the weld nugget is being produced.

Thermal expansion caused by the growing weld nugget will be felt by the welding gun as “Thermal Forces”. This will indicate to the controller whether sufficient weld nugget growth has been achieved.

Thermal force monitoring is a method of observation that is clearly better than either micro-displacement measures of welding electrodes or complex methods and apparatus of ultrasonic detection systems.

- Performs quality welds with assurance
- Reduces weld cycle times
- Increases welding electrode life
- Eliminates destructive testing
- Good for Dual Phase metals that can not be chisel tested
- Most advanced Closed Loop system available today!

The TFF feature is protected under the following US patents:
5,789,719; 5,504,297; 5,254,828; 5,111,020 and 4,419,558.
Other patents are pending.

Easier than linear displacement or ultrasonic measurements

Listen to the Inventor:
A video interview of Mr. Ariel Stiebel is available on-line at http://www.weldtechcorp.com under the “Processes & Applications” tab.

This video dates back to the early 1990s however the principles discussed in the interview still apply today. With the advent of servo welding guns, more applications will become candidates for TFF systems.

Listen to this knowledgeable speaker concerning the reasons why TFF is by far the best method for determining if a weld is good while it is being processed.

The chart above is the observed thermal forces detected under three different conditions of which two does not produce a weld. When you close the weld gun tip-to-tip without any metal, there will be thermal expansion that creates increased forces on a braking gun system. The increase in force rises almost linearly. A similar observation is observed when one puts only one sheet thickness between the electrodes. The force gradually rises. When there are two sheets of metal and a weld is produced, we observe the classic TFF signal response as described in the inside of this document.

[Diagram showing Thermal Force Feedback Monitor, weld data for channel 1 device 1, weld cycles, C factor, status, etc.]

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Adapting to Welding Excellence

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Monitoring the signal resulting from the thermal expansion of the weld nugget, we get a clear picture of the growth of the welding nugget. As soon as the weld current begins to flow as shown in graph "Is", we begin to see a rise of "thermal force" as shown in graph "F". The rate of change in force is shown in graph "δF".

Thermal force increases at a rapid rate until an inflection point (3) where the rate of change begins to diminish. Thermal force is maximized when thermal expansion no longer occurs (4). This is where the rate of change of thermal force is nul as shown in "δF". When weld indentation period begins, the thermal forces begin to drop (5). At this point, the rate of change as shown in "δF" becomes negative.

Once it has been determined that the weld nugget has maximized and that indentation has begun, the flow of welding current is terminated (6) and the system will identify a “Good Weld”. If the signal does not behave in this classic form, the system will identify a suspected “Bad Weld”.

Patent # 6,596,958 issued for welding gun shown above.

An electric servo actuated welding gun as shown here must be robust in order to transfer the TFF signals to the control. The algorithm for controlling the servo must abide by TFF rules so that the electrodes will not be allowed to back up while weld nugget expansion occurs.

When Technology Counts!

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