Weld Monitors Deliver means to Benchmark and Verify the Weld Process and Equipment

As the pressure mounts on manufacturers to minimize downtime, reduce scrap and provide tracking data for customers the monitoring tools required to do so are now available in the latest range of weld monitors.

By providing time based waveform data on current, voltage, resistance, power, force and displacement as well as peak and RMS values these external weld monitors are able to provide the necessary data that can be used to understand, optimize, benchmark the weld and verify equipment. The electrical data can be used to confirm that the weld resistance change is consistent, and the mechanical data (weld displacement) verifies the expected deformation has occurred. This data can be used to indicate process drift, troubleshoot and ultimately provide data that a process is in control.
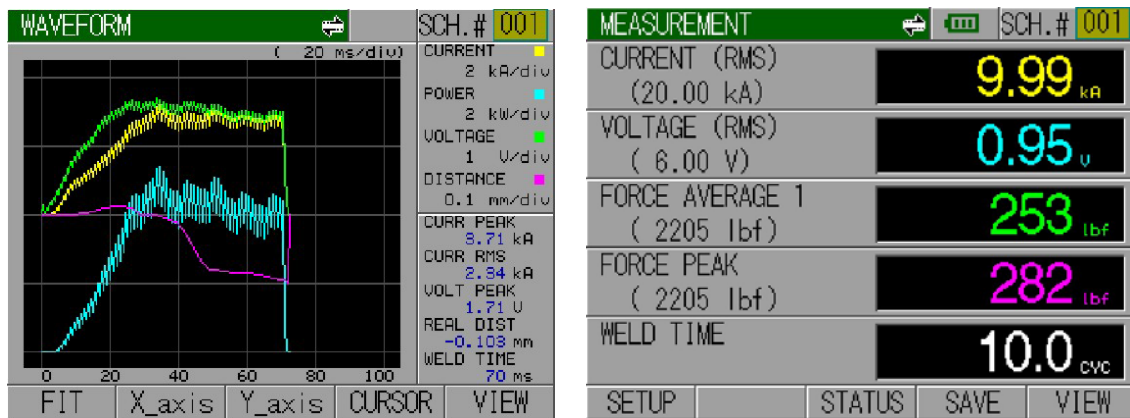

Figure 1: Waveforms of current, voltage, power and weld displacement can be displayed together on a single screen. In addition peak or RMS values of selectable parameters are shown.

There are a number of steps in towards a controlled and documented welding process –

Machine Set-Up - equipment benchmarking
Process optimization
Establishing process limits

Machine Set-Up
The welding system that includes the output characteristics of the weld control, integrity of the secondary circuit and the performance of the weld head needs to be characterized, standardized and benchmarked. For instance, hard copies of power supply waveform and peak or RMS values can be posted by the machine to enable quick reference. As an example, if the process begins to require more current, the secondary circuit can be checked at each connection and checked with the original specification. Any deviation form the specs will immediately find the loose connection or degrading cable.

A key part of any machine setup up is the timing of the force and current. Figure 2 shows two traces of force and current. The first trace shows the current firing before constant force has been reached. Using this information the squeeze time was extended to enable force to be reached as shown in the second trace. If a welding process is run with insufficient squeeze time, the force at firing is variable, and may increase during the weld with the result of inconsistent welds. Also any correlation with varying other weld parameters to improve the weld will prove difficult.
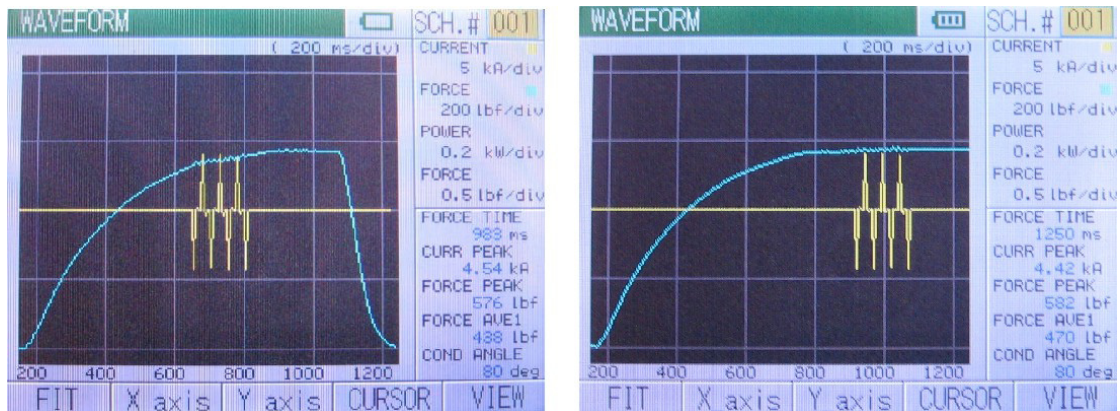

Figure 2 A time history of force and current can be used to optimize in squeeze time, and ensure force is reached before firing. The left hand trace indicates firing before force is reached, the right hand shows the with optimized timing

Other critical information such as time to force and force profile can indicate whether the pneumatic delivery system and cylinder are functioning correctly.

Weld Optimization
With graphical information of current, voltage, resistance, power, force and displacement the monitor can be used as a tool to optimize the weld. Used in conjunction with visual observations during welding and of the finished weld these waveforms can be linked to the quality of the weld process.

The operator or weld engineer can then gain a true understanding of what is happening in the process, for example, when the current is increased or the force reduced. This provides an accelerated path when to optimal settings. Once the weld has been optimized the waveforms can then be recorded as benchmarks, and used to indicate process drift.

Utilizing Weld Displacement
If current and force are the key input parameters for the weld, then weld displacement is one of the key measurable weld output parameters. A linear encoder can be mounted on the weld head to provide data on initial part thickness, final displacement and the displacement profile. Depending upon the weld control I/O features there may be an option to use a pre determined displacement value to terminate the weld.
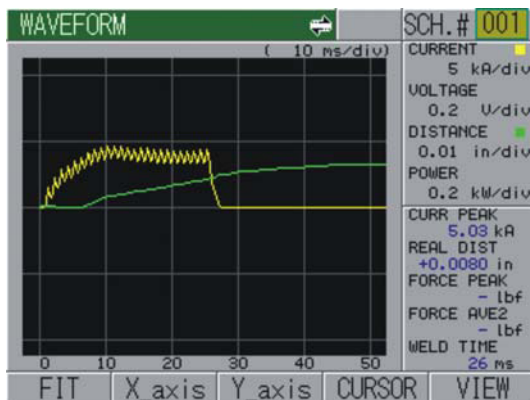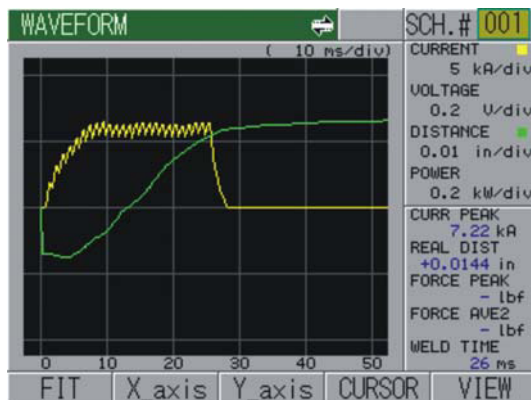
Figure 3 Mounted displacement sensor on weld head.
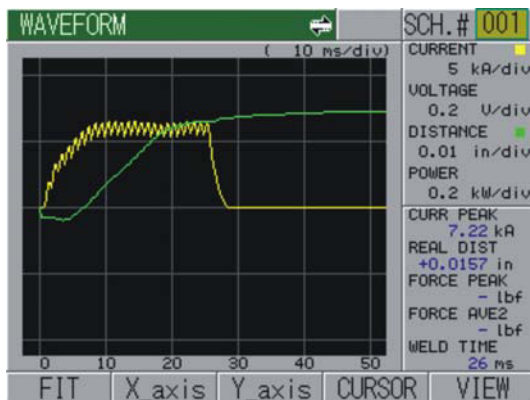
Good Weld
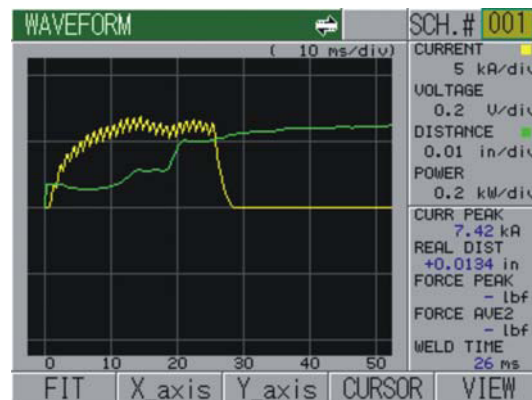
Low Force

Low Current

Misaligned electrodes

Figure 4 Welding 0.04" stainless steel with a projection. The good weld signature shows a smooth displacement trace. The defects are clearly apparent when compared to this.

Establishing Limits
When the weld has been optimized it is very useful to know when the weld moves outside of the process window. This may be an individual weld or a slow process drift. In either event the capability to provide instant recognition and alert of an out of process event prevents scrap product and timely intervention. Setting limits is an iterative

process initially determined by weld optimization. Usually moving to production requires the limits to be fine tuned as the process becomes solid and mature. The MM370 has programmable outputs according to set Hi/Lo limits, as well as waveform enveloping. The enveloping function can place limits part of or the entire signature waveform for a process, giving a much more detailed and comprehensive out of limits identifier.

Data Output
Extracting data is accomplished either using a printer or data transfer via the COM port. There is immense value in being able to produce instant hard copies of data that can be analyzed and shared. This information can be used to provide weld historical data for customers and also have process trending to establish preventative maintanence schedules. The MM370 monitor can be setup to print an error or out of limits report that can indicate instantly a process drift or a step change in the weld. Along with the raw data screen capture software allows electronic records of each of waveforms, peak and RMS values and weld history.

Types of Weld Monitors
The MM380 offers a portable hand held checker that can be used to provide instant data on weld current, force, voltage, power and resistance. The MM370 provides the additional measurement of displacement, along with limit setting and machine I/O. Both can be used to establish benchmarks for machine setup and the weld. The equipment is characterized with regard to weld control output, weld head force profile and secondary circuit resistance. The weld can be understood and optimized using the time based waveform displays, with final weld signature waveforms used for reference. In the case of the MM370 limits can be set around these signature values to enable quick alert of process drift or equipment malfunction.

MM380 Handheld checker

MM370 machine mountable monitor

Using external monitoring provides a means of understanding the weld, benchmarking the process and equipment, and accelerate fault finding. The value to the manufacturer is an in control process with minimized scrap, downtime and process data.