Not all **"adaptive" control systems** are created equal

Resistance Welding technology has slowly evolved over the years. I think everyone would agree that this arena isn't the most fast-paced or innovative, but I would be remiss to omit some significant technological advancements over the years that have shaped the industry.

Take for instance adaptive control systems. The promise was to reduce variability by "adapting" current based on the requirements of each weld rather than applying the same amount of heat to each weld and hoping for the best. But as adaptive technologies came to market, it seemed like each Control manufacturer claimed the same feature set leaving buyers struggling to understand the differences between these confusingly similar — even apparently identical — resistance welding control systems.

It's easy to understand why, but there are real and important differences that separate one from another. And as a resistance welding engineer, it's crucial for you to know what those differences mean in order to make the best system choice for your specific needs and requirements. Here we'll take a deep dive into these adaptive control systems so that you can sort through all of them with an educated eye.

WHAT IS AN "ADAPTIVE" CONTROL SYSTEM AND WHY SHOULD YOU CARE?

An adaptive control system can be used to significantly improve the performance of the resistance welding process and make it more efficient. Adaptive control systems are adept at automatically adjusting settings in response to changing welding conditions, allowing for millisecond-by-millisecond welding process adjustments to account for variabilities such as inconsistent heat, inconsistent machine force, flattening electrodes, power-line fluctuations, and other issues that can arise while welding.

For manufacturers, using adaptive control systems can result in cost savings in time and scrap, increased operator safety, improved weld quality, and a greater production yield by ensuring bad welds are not created in the first place. In short, adaptive control systems promise an evolutionary step forward that can make a positive difference in everyday resistance welding operations.

UNFORTUNATELY, NOT ALL ADAPTIVE CONTROLS CAN DELIVER ON THEIR PROMISE

Make no mistake — Adaptive Control systems are better than traditional welding controls. But it should be noted that despite the marketing materials you might read, not all adaptive controls are created equal.

We recently encountered a situation with another vendor's "adaptive" system that uses resistance to control and monitor the consistency of the welds produced. What we noticed is that resistance measurements did not always detect undersized welds that fall outside of welding specifications. It was only when using adaptive controls that rely on thermal expansion response monitoring were we able to truly differentiate normal welds from undersized welds.

We've gathered the data below to illustrate our point. We measured Current, Conductance (Resistance), and Expansion data response plots for

three welds made by a manufacturer we worked with in January 2023. All of these welds were produced with the same current on 34.5 mil combination thickness material.

Figure 1. Weld #1

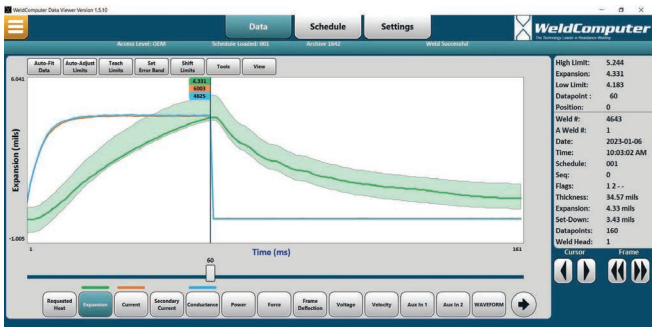

Figure 2. Weld #2

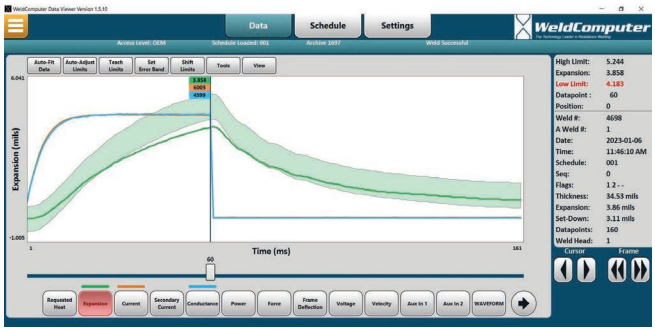

Figure 3. Weld #3

Weld measurements using resistance data:

- Weld 1 - 4492 Mhos (222 uOhms)
- Weld 2 - 4625 Mhos (216 uOhms)
- Weld 3 - 4599 Mhos (217 uOhms)

All look about the same quality welds, right?
What's interesting is the data tells a different story:

Weld measurements using thermal expansion:

- Weld 1 - 4.606 mils
- Weld 2 - 4.331 mils
- Weld 3 - 3.853 mils

You'll notice the thermal response (green curve) indicated that the first weld was nominal in size, the second was smaller but within acceptable limits, and the third was undersized and outside of specifications.

What was interesting here is that the control did not identify enough of a difference in the measured conductance (blue curve) to differentiate these conditions, but the undersized third weld was easily detected with thermal expansion. Ironically, the resistance information would incorrectly lead you to believe it is bigger than the second weld that is within specifications!

CHOOSING AN ADAPTIVE SYSTEM ISN'T A SILVER BULLET

The moral of the story: Don't trust that just because your system says it's "adaptive" means that your welds will always be up to par. It's critical you're relying on the right adaptive system for your needs to have the confidence you're not passing random, undersized welds through production undetected. One bad production batch can make for an expensive product recall. Or put your future contracts in jeopardy. Or worse, tarnish your reputation.

The data from the welding process above underscores the fact that resistance monitoring for most MIL-SPEC aerospace welding applications does not have the sensitivity to reliably differentiate between undersized welds that are just outside of specifications from welds that pass.

To pick up these problems it is necessary to monitor parameters responsive to the actual weld thermal response. Without measuring parameters that correlate with the size of the forming weld, it would be impossible for any "adaptive" system to make the decisions needed to control weld consistency.

Reach out to us to learn how WeldComputer's Adaptive Control can alleviate these issues with the gold-standard in resistance welding controls.

900120-03.30.23.02