WeldComputer
The Technology Leader in Resistance Welding

MADE IN THE U.S.A.

Why It's **Critical** to Monitor **Differential Cylinder Pressure**

When performing resistance welding, electrode force impacts the size and strength of the welds produced. This force is controlled by differential cylinder pressure, meaning that monitoring this variable is another way to indirectly monitor the electrode force.

Monitoring cylinder pressure has multiple use cases. It is often used to ensure:

- Down and up pressures are set properly both during welding and during the forging operation,
- Consistent pressure delivery from weld to weld (and notify the operator if a variation occurs beyond specified limits), and
- Proper timing of forging to prevent cracks and porosity.

When one of these settings is not applied correctly, or a problem develops with the machine, forging malfunctions – such as cracks and porosity in a weld – are bound to occur.

This was the case for a MIL-SPEC aluminum resistance welding manufacturer who discovered a crack in one of their welds. The welding manufacturer struggled with this problem for multiple months and was unable to figure out how to solve the issue. They called WeldComputer to help them solve the problem.

SOLVING FOR CRACKING AND POROSITY

First, we added Differential Cylinder Pressure monitoring to the installation to assess the behavior of the manufacturer's Sciaky spot welder making an aluminum weld with more granular data. Once installed it only took making one weld to immediately notice that the forging function on the machine was malfunctioning.

For background context, the transition from welding pressure to forging pressure during a proper weld should occur within 40ms to comply with MIL-SPEC resistance welding requirements. It was only after the WeldComputer Differential Cylinder Pressure monitoring capability was added to the installation that we were able to document that the transition during the forging process occurred at a rate ten times slower than what's required for aluminum spot welds. (Fig. 1)

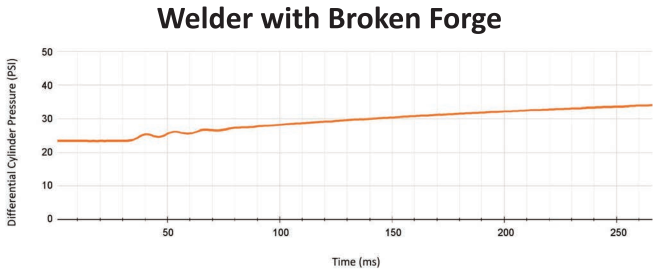

Figure 1. Data trace documents that the forging operation was out of compliance with MIL-SPEC spot welding requirements

Eliminating cracks and porosity when welding aluminum depends on two factors: 1) welding with a machine that can produce proper forging, and 2) equating that machine with a resistance welding control that can accurately coordinate the forging operation with weld cooling. By monitoring Differential Cylinder Pressure, the manufacturer could properly determine the settings needed to coordinate these actions and detect when a problem with the machine develops that requires servicing.

The Differential Cylinder Pressure monitoring capability provides detailed, real-time monitoring and recording of cylinder pressure during every weld, along with a time and date stamp. This information can assist a welding engineer in properly identifying and diagnosing problems such as leaks or other anomalies that can affect the applied electrode force.

Before adding this monitoring capability, the manufacturer was unable to determine the cause of the welding problems or to identify when such issues were occurring. Identifying the failure and pinpointing the source of the problem would have remained a "guess-and-check" process to remediate the issue.

After making a single weld that documented the forging issue, it only took 20 minutes to identify the problem was caused by a clogged muffler. Once the muffler was removed it was easy to verify that the forging function was properly operating. (Fig. 2)

Welder Broken Forge & Fixed Forge

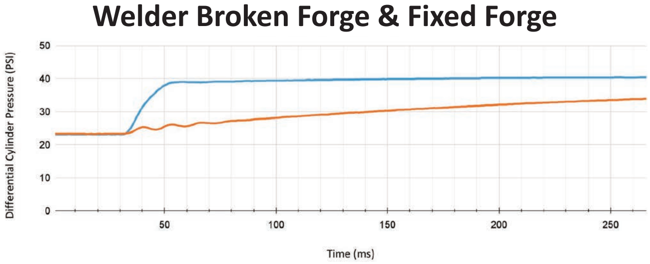

Figure 2. Comparison of forging operation before the machine was fixed (red), and after the machine was fixed (blue)

THE RESULTS

Within a matter of minutes, the manufacturer was able to use the WeldComputer Control to set the rising pressure to begin at the time as the heat was being reduced to cool the weld. All of this was accomplished without destructive testing.

The results: Stronger, more consistent welds within MIL-SPEC compliance.

After 15 test welds, the secondary current and coordinated control of the differential cylinder pressure showed the electrical and pneumatic repeatability of the machine. (Figs. 3,4)

Secondary Current (15 Coupons)

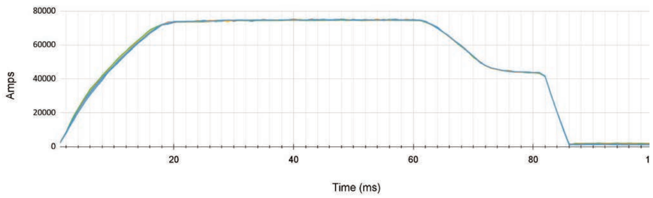

Figure 3. Overlay of 15 welds documents repeatable weld control current delivery that is virtually immune to power line fluctuations

Differential Cylinder Pressure (15 Coupons)

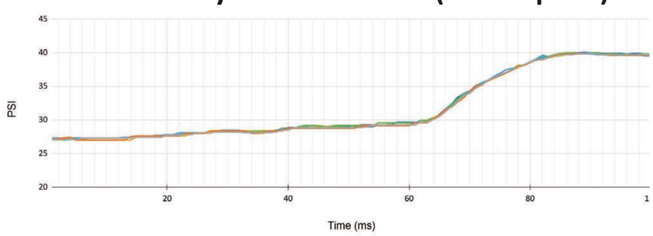

Figure 4. Overlay of 15 welds demonstrates repeatable forge performance accurately coordinated with the cooling nugget

To confirm the weld integrity and analyze the impact of the WeldComputer Control on the welding process, the welding engineer performed destructive tests on all 15 welds (Fig. 5). In his astonishment, he reported that these were the highest pull force test results he has witnessed on this machine.

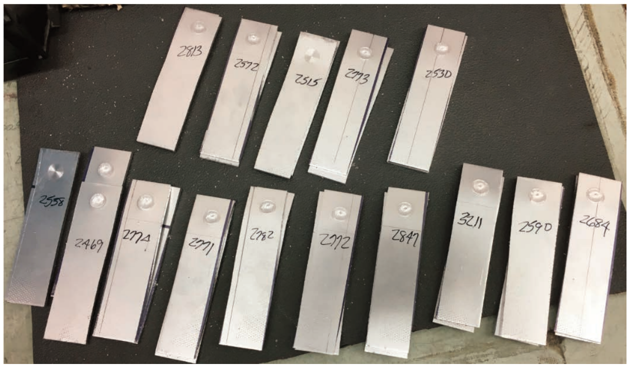

Figure 5. Image of the 15 test welds

When analyzing the impact of the Sciaky welder with the WeldComputer Control, a Process Capability (Cpk) of 2.968 was calculated, making it an 8.9 sigma process. (Fig. 6)

avg	2710.73
stdev	186.49
3*stdev	559.48
min eval	1050.00
avg-min	1660.73
cpk	2.968356911
numsig	8.905070732

Figure 6. Results from 15 test 0.125 aluminum shear tests

CONCLUSION

Without historical data from monitoring all welds produced, it is impossible to know how long this aluminum resistance welding manufacturer was delivering MIL-SPEC welded parts produced on an out-of-compliance machine.

By constantly monitoring all welds produced and having the ability to identify any problems that develop, this aluminum resistance welding manufacturer is now equipped to ensure repeatable performance for all welds.

This has been a major game changer for the company, which can now reduce or eliminate its reliance on destructive testing and reliably weld within MIL-SPEC standards.