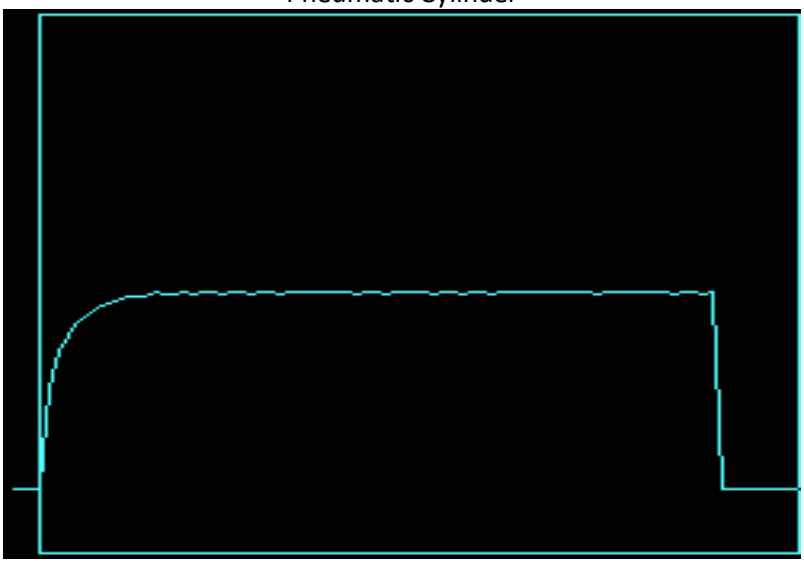
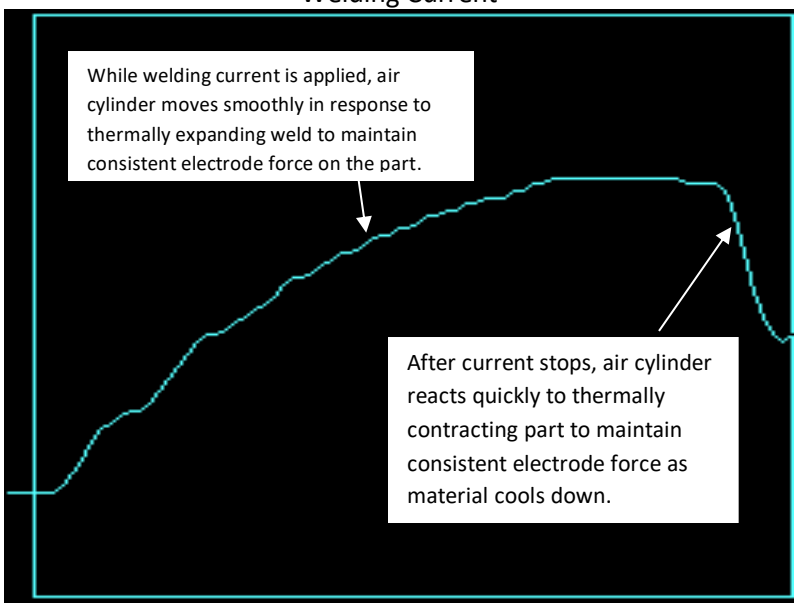
Comparison of Air Cylinder to Servo Motor on Resistance Welding Machines

Which is better for performing precision welding, a low friction pneumatic cylinder or a servo motor? High performance monitoring of the welding process makes the answer obvious. Under the dynamic conditions that occur during weld formation, a good quality welder with a low friction pneumatic cylinder reacts faster, with greater stability and repeatability than most of the servo motors presently in widespread use on resistance welders. The result is more consistent applied electrode force and higher quality welds than achievable with the servo motor driven system.

Pneumatic Cylinder

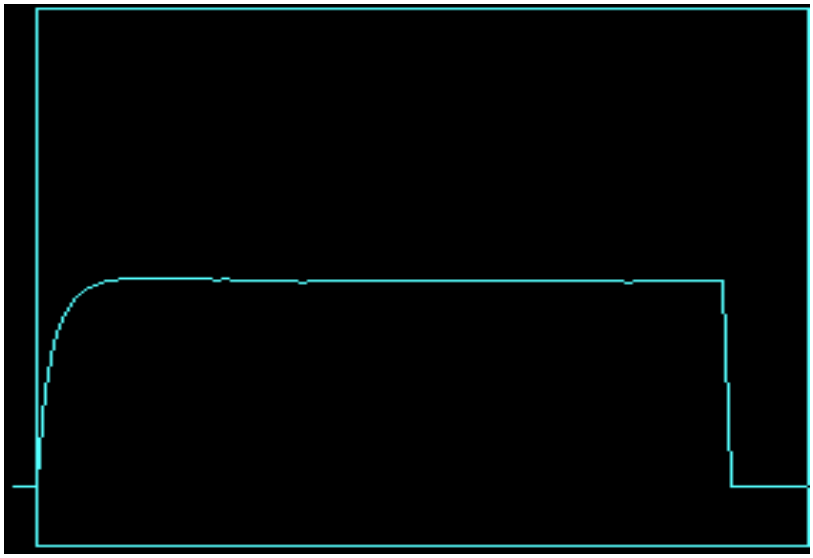


Welding Current

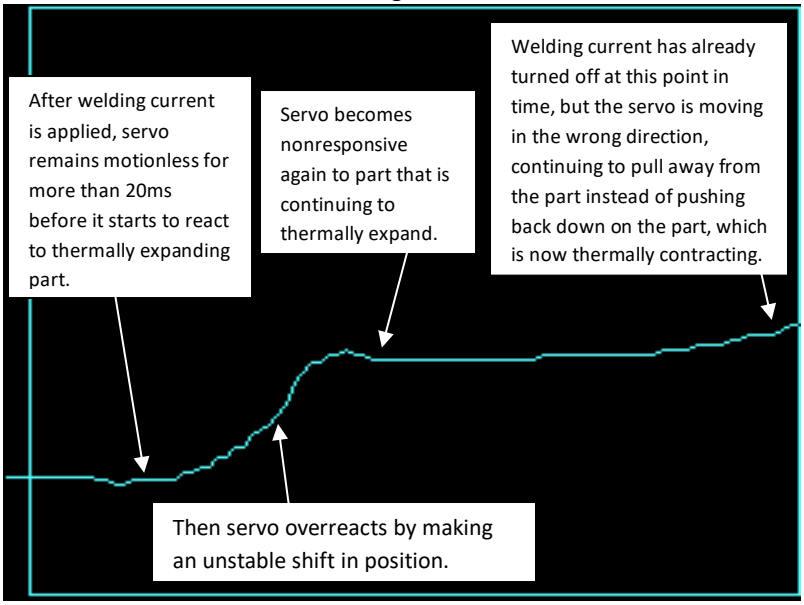


Electrode Motion On Part Using Air Cylinder

Servo Motor



Welding Current



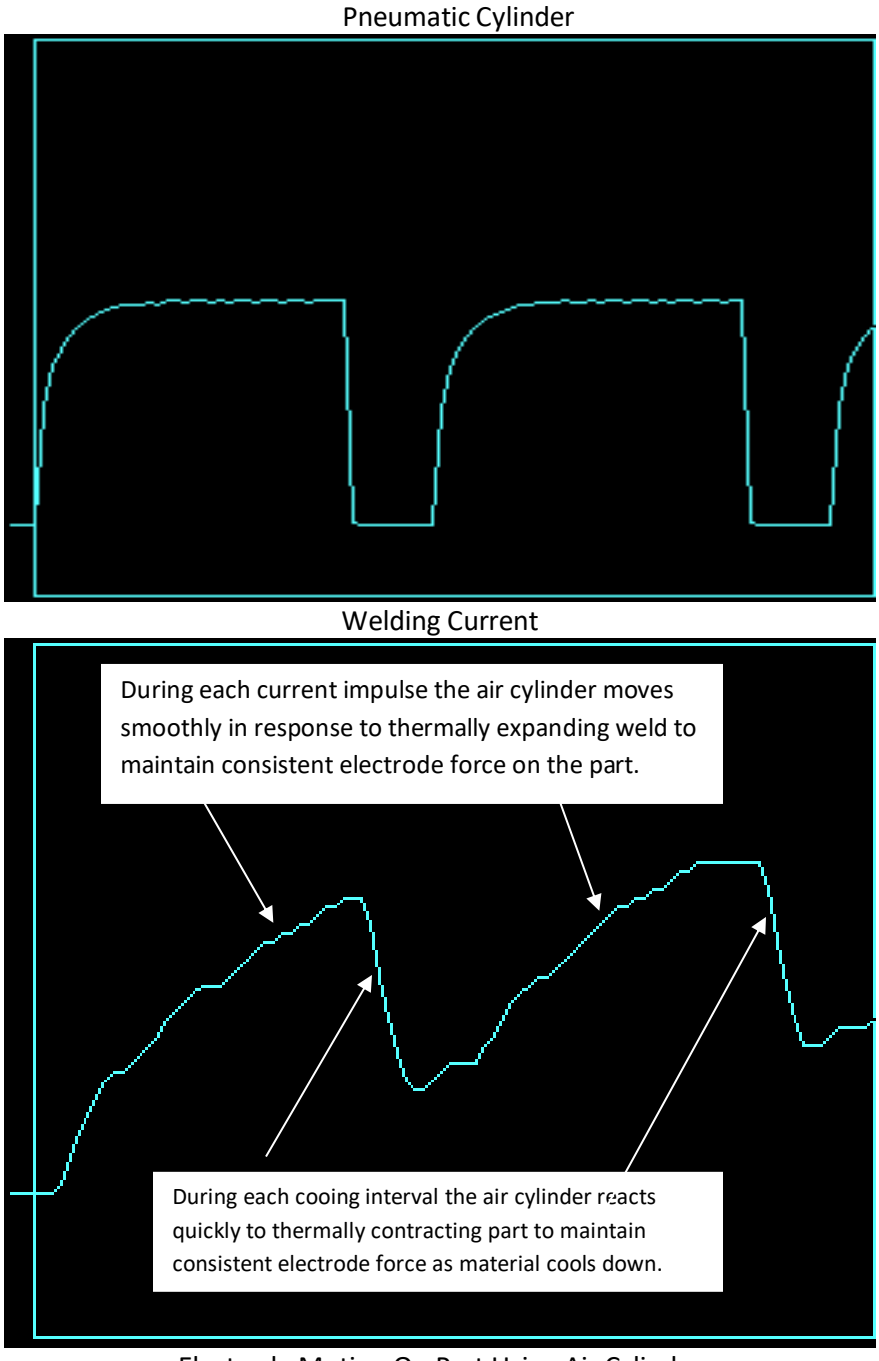
Electrode Motion On Part using Servo Motor

During weld formation the welder with the pneumatic cylinder (left) maintains consistent applied electrode force by allowing the electrode to move in relation to the part that thermally expands while current is applied and thermally contracts upon termination of welding current.

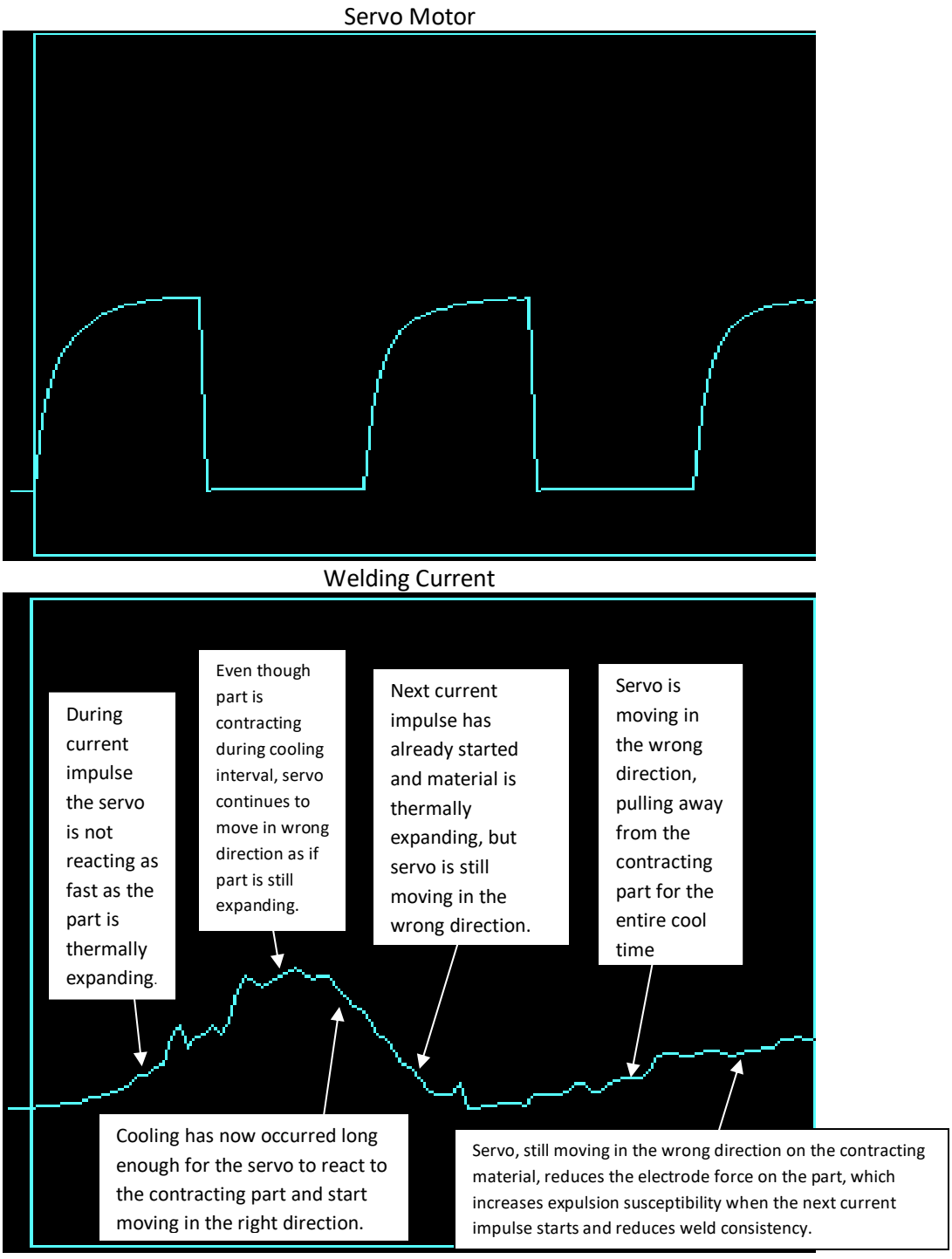
The welder with the servo motor (right) has erratic and inconsistent applied electrode force because it does not move in relation to the part, which thermally expands while current is applied, and thermally contracts when the current is stopped. The servo remains motionless for the first 20ms of applied current before it starts to react to the thermally expanding part. It then overreacts over the next 20ms to catchup to where it would have been had consistent applied force been maintained, and then becomes motionless again. The servo doesn't begin to react again until nearly at the end of applied weld current. After the current is terminated, at a point in time when the part is now thermally

contracting, the servo is moving in the wrong direction by continuing to pull away from the part instead of moving in the other direction to maintain force on the part as it cools down and contracts.

Multi-Impulse Weld



Electrode Motion On Part Using Air Cylinder



Electrode Motion On Part Using Servo Motor

During each current impulse the welder with the pneumatic cylinder (left) maintains consistent applied electrode force by allowing the electrode to move in relation to the part that thermally expands while current is applied, and thermally contract during the cool time between each current impulse.

The welder with the servo motor (right) has erratic and inconsistent applied electrode force, which is different for each successive identical current impulse. During the first current impulse the servo starts reacting slowly to the thermally

expanding part and accelerates over the duration of the pulse. Upon completion of the current impulse, during the cool time when the part is actually thermally contracting, the servo is moving in the wrong direction by continuing to pull away from the part instead of maintaining force on the part as it cools down and contracts. The problem is compounded because recovery from this unstable behavior does not occur by the time the next current impulse begins. This results in less electrode force on the start of the second impulse than what was applied on the start of the first impulse. The reduced electrode force, in addition to increasing weld variability, further reduces the stability of the welding operation and increases the susceptibility of expulsion occurring. During most of the second current impulse the servo continues to move the electrode in the wrong direction, increasing electrode force on the part, instead of pulling away in relation to the thermally expanding part, which is what would be necessary to maintain consistent electrode force and produce consistent welds.