Hydraulics at the core of largest-ever welder

Record-breaking linear-friction welding is made possible by high-powered hydraulics and sophisticated controls.

A welding supplier found that the key to taking its joining technology to the next level lay not in the welding heads, but in a hydraulic servo support system. Thompson Friction Welding, Halesowen, West Midlands, U.K., developed the E100, a linear-friction-welding (LFW) machine capable of welding a surface area of 15 in.$^2$, twice the area previous machines could weld. The 22,050-lb, 2.5-m-tall machine also applies a record 22,050 lb of force to the joint being welded.

To handle larger, heavier parts and cut cycle times, Thompson teamed with Moog Inc., E. Aurora, N.Y., to develop a hydraulic servocontrol system.

Normal servo and proportional valves aren’t suited for this application because spool speed and acceleration prevent them from simultaneously delivering high amplitude and high-frequency motion. A closed-loop, digital control system, in contrast, delivers fast response at high

Moog servovalves
Hydraulic power unit with accumulators and radial piston pumps
Forge head

The Thompson Friction Welding E100 can weld up to 15 in.$^2$ while applying 22,050 lb of force. Servovalves permit fast, high-amplitude motion for automatic material handling of large workpieces.
Force Stationary workpiece Oscillating workpiece joining piece. The relative velocity between the two surfaces is fairly high, so the two components being welded need to be kept under high pressure at all times.

In contrast, rotary-friction welding, also known as inertial welding, spins one of the joining pieces, so the two parts must be radially symmetric. LFW requires more complex machine architecture and control systems than rotary techniques.

MD amplitude, which permits precise control over the weld process.

For the E100, Moog valve spools perform three to four times faster than normal. Valve frequencies range from 75 to 100 Hz for large-scale welding. Special precautions ensure valve integrity over a large number of welds.

Multiple digitally controlled servovalves operate together for peak flow rates of up to 1,200 gpm. Having multiple valves also improves accuracy on smaller, lower-force welds.

To drive the system, a hydraulic powerplant with radial piston pumps delivers over 2 MW of instantaneous power. Seven 105-gallon gas-volume accumulators supplement pump flow to hit the 1,200-gpm flow rates required for the weld. The accumulators recharge in about 30 sec, even for the largest welds.

An automatic handling system positions large workpieces in place of manual fixturing. The automation saves time on these larger parts. Rapid machine opening and closing also cut production time.

LFW, sometimes known as solid-base additive manufacturing, works by rubbing a rapidly oscillating part against a fixed workpiece under forces up to 22,050 lb. Oscillations are usually under ±3 mm in amplitude and 75 to 100 Hz.