

Smart managers reduce arc time

Apply the five do's of welding control to reduce cycle time and welding costs. The second of five articles tells how to profit by reducing arc time per weldment.

By Jack R. Barckhoff

The first article in this series explained how to reduce weld metal volume:

- Make sure engineering calls out weld sizes no larger than needed, not "just a little thicker" due to lack of faith in ability of the shop to produce quality welds.

- Make sure that welding operators lay in beads of the size specified, not making an extra pass for insurance.

The second do

The next step is reducing arc time per weldment. This is not the same as step one. Step two aims for the fastest possible deposition rate, for reducing to a minimum the time an operator spends making each weld.

In the shop, each operator may weld at a different current level, resulting in inconsistent output from welding work stations. This is why shops monitor welding by observing current meters on power sources. Conscientious supervisors calibrate meters regularly to assure accuracy. Even so, production may still be lower than it should be, because operators seldom set current at the high end of the usable range; as a result, they don't deposit weld metal as rapidly as possible.

Increase current

Two examples demonstrate easy savings. In self-shielded flux-cored-arc welding with 3/32-inch-diameter wire, increasing current

FIVE DO'S

for management and control of welding:

Reduce weldmetal volume.

Reduce arc time per weldment.

Reduce scrap and rework.

Reduce work effort and fatigue.

Reduce motion and delay time.

from 350 to 400 A can save \$8,850 per operator per year. The savings are based on deposition rates of 14.5 lb/h at 350 A and 18.0 lb/h at 400, 40-percent operating factor and 85 percent deposition efficiency, labor costing \$25/h, and 240 working days per year.

In gas-metal-arc welding with 0.035-inch-diameter wire and short-circuiting metal transfer, increasing current from 100 to 150 A can save \$19,000 per operator annually. Deposition rate goes from 2.4 to 4.5 lb/h. Operating factor, efficiency, labor cost, and days worked per year are the same as for FCAW, but deposition efficiency is 92 percent. The quoted savings neglects cost reduction due to reduced consumption of shielding gas.

Maximize deposition rate

Many shops that weld a variety of thicknesses, from thin sheet to light plate, use short-circuiting transfer, ideal for thin sheet, when they join thicker material. Those shops should switch to alternative trans-

fer modes that use higher currents—thicker materials can tolerate the higher heat input. By switching to spray transfer or to buried-arc transfer at maximum currents, these shops can reduce arc time tremendously, cutting costs of processing.

In GMAW joining 10-gage sheet to 7-gage sheet (0.134- to 0.180-inch), operators were using 0.035-inch-diameter wire at 140 A and 20 V, depositing 3.9 lb/h in the short-circuiting mode. Going to 200 to 210 A and 25 V, operators jumped deposition rate 62 percent, to 6.3 lb/h. In another case, joining 1/4-inch angle stiffeners to 1/4-inch plate, operators were using 0.035-inch wire at 160 to 174 A and 20 to 21 V. Deposition rate was 5.3 lb/h. Raising current to 275 A and voltage to 26 V increased deposition rate to about 11 lb/h. Both shops realized other benefits: elimination of cold laps at weld starts, better weld contour, and greater penetration.

Steps for reducing arc time

Maximize deposition rate by using the largest diameter electrode possible and the highest current compatible with the job, production requirements, and quality requirements. Current level is the variable that most affects deposition rate: for a given electrode size, increasing current raises deposition rate and travel speed, thus reducing arc time. Accurate control of welding current and weld size results in consistent,

BURIED ARC, A GMAW TRANSFER MODE

Buried arc, a term not recognized by the AWS, identifies a transfer mode in GMAW by which a stiff arc forces a deep depression in a molten weld pool, putting the electrode tip level with or slightly below the pool surface. Current density is high, well up in the spray-transfer range, but voltage runs slightly below that for spray transfer. Deposition rate is just slightly less than spray transfer. The arc makes a very rapid, steady crackle.

For 0.035-inch-diameter wire, current is 220 to 270 A and arc voltage is 24 to 26 V; shielding uses 95 Ar-5 O₂. Spatter is nil. Travel speed is fast, so heat input and distortion are lower than for spray transfer. Buried arc welds well vertical-down.

controlled travel speed and arc time.

When joint thickness or position impose an upper limit on current, select an electrode of diameter to carry maximum allowable current, just higher than the maximum allowed by the joint or position. The current density in the electrode will then be as high as possible, maximizing deposition rate. When neither joint thickness nor position limits amperage, use the largest-diameter electrode and current in the high range for that electrode.

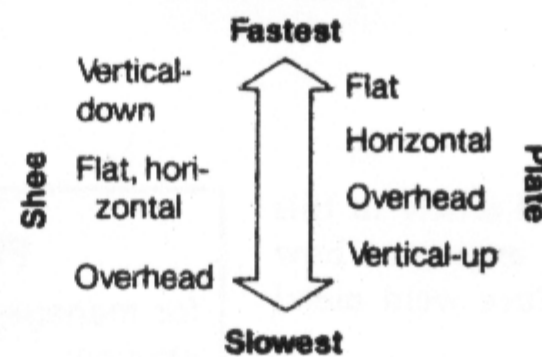
Pay attention to detail

Managers must ensure that designers consider joint accessibility. A design that limits electrode access or requires awkward gun or electrode position reduces travel speeds and deposition rates, perhaps resulting in excessive spatter, poor penetration, poor bead shape, and rework.

Maximize arc time by use of positioners, fixtures, and tooling that puts joints in the most favorable position, usually flat or horizontal. Poor fitups may require current reduction or use of a welding process of low deposition rates. Oversize gaps require a large bead or fillet or welding at a lower current to prevent burnthrough, increasing arc time.

When welding sheet metal (3/16 inch and thinner), arc time is the same in flat as in horizontal position. When using plate (material thickness greater than 3/16 inch) welds take less time in the flat than in the horizontal position, because gravity doesn't displace the molten weld metal. When welding vertical-

WELDING SPEED VARIES WITH THICKNESS AND POSITION



REDUCERS OF AVAILABLE ARC TIME

- Weld starts and stops.
- Electrode sticking.
- Changing electrode or wire.
- Slag and spatter removal.
- Clipping wire.
- Cleaning spatter from cup.
- Resetting power supply.

down, operators must take extra care to prevent lack of penetration, lack of fusion, slag inclusions, and undersize weld throats.

Reducing arc time per weldment brings dividends worthy of managers' attention. Companies can save thousands of dollars with no capital investment. ■



Jack Barckhoff, P.E., president of Barckhoff and Associates, Inc., has offices in Minneapolis, (612) 934-6000