Large weldment, built up by automatic submerged arc and semiautomatic welding, is given finishing touches by manual stick-electrode welding.

How to Boost Your Welding Profits

It pays to examine the practices and equipment for what are usually regarded as simple, routine processes. Studying its stick-electrode welding cut one company's welding costs by $100,000 per year and added dollars to the profit column.

Most weldment fabricators know how mechanized welding processes can cut costs. But, if all their cost-reduction thinking centers on automatic and semiautomatic processes, they'll lose golden opportunities for increasing their welding profits.

Stick-electrode welding, too, has excellent cost-cutting possibilities. Significantly, these savings can be made at little extra expense.

Kewaunee Engineering Corp. (Kewaunee, Wis.) is a case in point. It's about as mechanized as a highly diversified weldment fabricator can be. "About" is correct, because this fabricator of parts for heavy construction, *Weldors by not following recommended current settings and specified*

road building and farm machinery hopes to raise its proportion of mechanized welding from 66% to 75%. But, at present, one-third of all welding is by stick electrode; the best expected for the near future is that one-fourth will have to remain stick electrode.

This being so, can costs be cut in stick-electrode welding?

Kenneth E. Trakel, Kewaunee vice president and director of manufacturing, posed this question. Don Wells, his welding superintendent, and Jack R. Barckhoff, area technical representative of the Lincoln Electric Co., answered it.

The answer evolved from a thorough survey of how Kewaunee's 139 stick-electrode weldors were using their equipment. It was a resounding "Yes." There were opportunities of reducing the cost of stick-electrode welding. And savings could amount to more than $100,000 per year.

The study at various stick-electrode stations zeroed in on two important factors: (1) how closely were weldors following recommended current settings, and (2) how closely were they following specified weld sizes.

From the data collected, Wells and Barckhoff estimated what the firm was losing because of deviations from specified welding practices. Every cent of loss because of faulty practices can, of course, be made a cent of "no-cost" profit.

At this point, it should be noted that the "faulty" practices are no reflection on the weldors at Kewaunee or on product quality. The overwelding represented, as it does in all plants, the intent of workers to be sure that welds are adequate.

Production weldors tend to make welds better than specified. They do not realize that the designer has added a safety factor. They also tend to set current and voltages to their personal

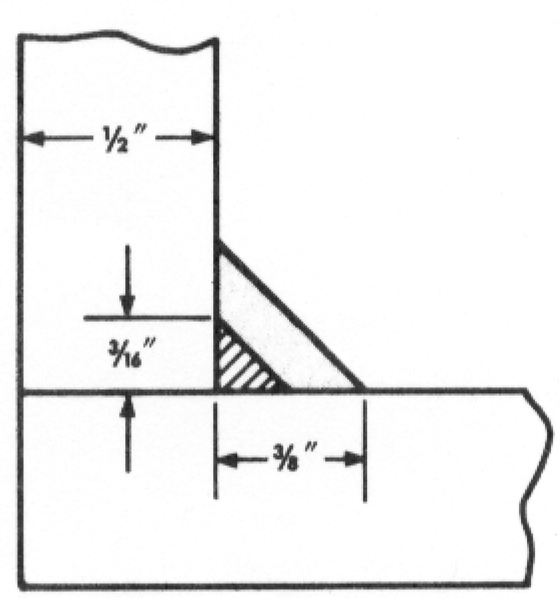
Table I — How Current Affects Deposition

Electrode	Actual		Recommended		
Type & Diameter	Welding Current (Meter Measured, amp)	Deposition Rate-lb/hr (100% O.F.)	Welding Current amp	Deposition Rate-lb/hr (100% O.F.)	Potential Deposition Increase
5/32-in. E7024	185	4.7	225	5.9	1.2
3/16-in. E7024	230	6.1	275	7.5	1.4
7/32-in. E7024	240	6.3	325	9.1	2.8

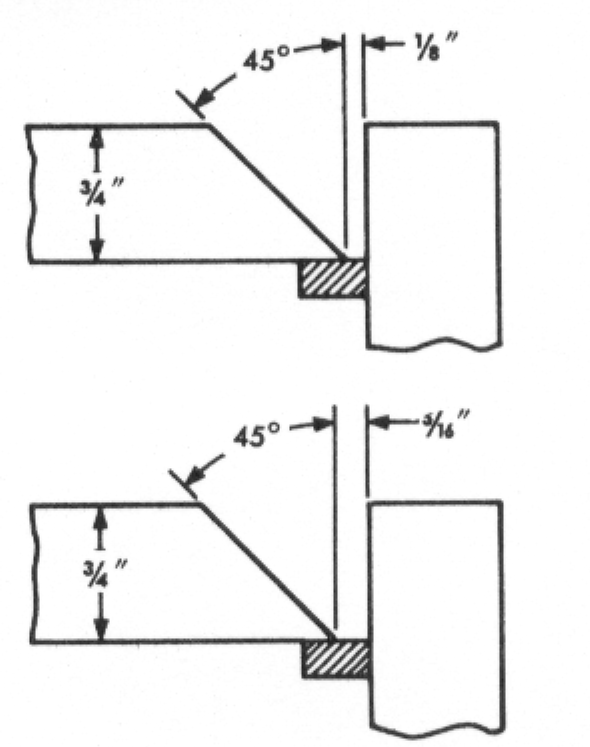
Table II — How Much Deposited Weld Metal Costs

Deposition Method	Operating Factor	Labor* (per hr)	Material (per lb)	Total cost (per lb)
3/16-in. E6010 170 amp	35%	$2.95	$0.22	$3.17
3/16-in. E6014 200 amp	35	2.26	0.24	2.50
5/32-in. E6024 225 amp	35	1.40	0.24	1.64
1/4-in. E6024 410 amp	35	0.97	0.24	1.21
Semiautomatic open arc 500 amp	50	0.37	0.36	0.73
Single sub arc 1,025 amp	60	0.30	0.24	0.54
Twin arc 1,350 amp	60	0.16	0.22	0.38
Tandem arc 1,950 amp	60	0.13	0.20	0.33

*Labor rate = $3.75 per hr. Labor cost = labor rate ÷ deposition rate × operating factor × deposition efficiency.



Doubling leg size—for "safety sake" or appearance—quadruples weld cross section and cost of deposited metal.



Poor fitup boosts welding costs. Increasing spacing from ⅛ to 5/16 in. on ¾-in. plate raises metal cost by 38%.

likings. This is done not to slow the work, but because they feel that they get better results with such settings.

Thirty-three stick-electrode stations were surveyed during the Kewaunee cost study. The survey disclosed that most weldors were using incorrect current settings, either because of personal preference or because the welding machines were not delivering the proper current. It also showed that oversizing was prevalent at some stations and that closer supervision and worker education on weld sizing were needed.

WELDING-CURRENT EFFECT

From the meter-measured current at each station, the pounds of weld metal deposited per hour at 100% operating factor were found. They were compared with the deposition rate possible with the recommended current. The difference represented the potential deposition increase per hour; this could be translated directly into dollars of possible cost savings.

The significance of correct machine settings can be shown by taking one electrode type used at Kewaunee. By working from the survey data, annual savings were calculated. The survey showed that the average current settings used with 5/32, 3/16 and 7/32-in. E7024 electrodes were as given in Table I.

With these electrode diameters, the potential increase in deposition rate ranged from 1.2 to 2.8 lb per hr.

Kewaunee has been using about 12,500 lb of 5/32-in. E7024 electrode per year, 60,000 lb of 3/16 in., and 31,000 lb of 7/32 in. The actual arc times to deposit these amounts of electrode can be obtained by dividing electrode weights by deposition rates per hour for the respective current settings. Thus, the actual arc times would be:

5/32 in.: 12,500 ÷ 4.7 = 2,660 hr
3/16 in.: 60,000 ÷ 6.1 = 9,836 hr
7/32 in.: 31,000 ÷ 6.3 = 4,920 hr

Total 17,416 hr

Had recommended currents been used, the arc times would have been:

5/32 in.: 12,500 ÷ 5.9 = 2,118 hr
3/16 in.: 60,000 ÷ 7.5 = 8,000 hr
7/32 in.: 31,000 ÷ 9.1 = 3,406 hr

Total 13,524 hr

The difference is 3,892 hr of "pure" arc time lost because of improper welding currents. At a $6-per-hr figure for labor and overhead, the extra annual cost would be $23,352. At a 100% operating rate, costs would be far higher.

Kewaunee found its approximate losses because of incorrect current settings with all types of electrodes have cost the company well over $100,000 per year. A program of weldor education, close supervision and frequent meter checking of delivered welding currents has been instituted to prevent this loss and thus reduce welding costs.

Smaller welding fabricators can't expect savings of such size. But most high-production shops can save hundreds of dollars per weldor per year by making sure the currents and voltages are correct. Not a single dollar need be spent for new equipment to make these savings.

OVERWELDING COSTS HIGH

Reducing overwelding also reduces welding cost. Weldors should realize that *deposited* weld metal approaches the precious metal category. Table II shows the cost of a pound of *deposited* weld metal by various welding methods when the labor rate is $3.75 per hr.

A pound of deposited weld metal—a little chunk 3.4 x 1 x 1 in. in size—is shown here to cost as much as $3.17. By not "giving away" extra deposited metal, the worker helps his firm make a greater profit.

It is not uncommon for a weld, as made, to cost three or four times what it should. A chain of human judgments can lead to this wastage.

First, the designer over-specifies, say, by raising a correct 3/16-in. fillet to 1/4 in. Then the production engineer, thinking the 1/4-in. weld looks too small, changes it to 5/16 in. Finally, the weldor, to be safe, raises it to 3/8 in.

Sounds insignificant, but is it? Doubling the weld leg size increases the volume of deposited metal by 300%. Adding the first 1/16 in. increases costs by 79%. Doubling to 3/8 in. boosts costs an unnecessary 300%. Final cost: Four times what it should have been.

Informing weldors about the cost of overwelding and close supervision can result in substantial cost savings. Equipping supervisors with fillet gages is a good way to bring fillet sizing under control. No weldor can argue with an easily read gage that proves he is not following instructions.

The design of groove joints also affects the volume of weld metal deposited and thus the cost. Careful control of fitup can reduce groove weld costs. If root spacing in a groove joint is even slightly too wide, welding costs rise. When welding a 45° single-bevel joint between 3/4-in plate, for example, a root spacing of 3/16 in. more than required raises the cost 38%.

It takes courage for a company such as the Kewaunee Engineering to question the efficiency of its "humblest" welding process. But cost control is critical to a contract fabricator. If there are wasted costs, they either show up immediately in the bid price for the job or as deductions from profit. To survive, the contract fabricator must watch for all the ways that profits can leak down the drain. ●