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Welding

Red hot savings – Eco-efficient welding

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Eco-efficiency for the Marine Industry Fact Sheet

Do you want to

- reduce the amount you spend on electricity and consumables for welding?
- reduce unnecessary rework?
- reduce welding emissions and improve your work conditions?

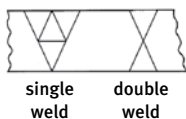
Welding of aluminium consumes large amounts of electricity and consumables such as filler material and electrodes, while the fumes released into the air can be harmful to human health and the environment. Improving welding practices not only improves the work environment, but can lead to significant financial savings.

Reduce weld size^[1]

Fillet welds—a small increase in fillet leg length has a dramatic increase in the volume welded. The weld volume is proportional to the square of the leg length, that is, doubling the weld length increases the weld volume four times, tripling increases the volume nine times.



Included angle—reducing the included angle of V-type weld preparations reduces the weld volume (shaded area). However, the welder must have sufficient access to the side walls of the weld preparation, and contract specifications should be checked first.



Double weld preparations—for the same parent metal thickness, a double weld preparation normally halves the total weld volume. If the weld is back-gouged, weld volumes are normally reduced when the parent material is 20 mm or thicker.

Case study: Increasing efficiency through better operating practices^[2]

The Bender Shipbuilding and Repair Company Inc. in Alabama, USA, conducted a review of the efficiency of welding practices and found potential savings of AU\$22,800 per welder per year! The savings identified were:

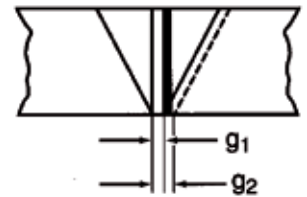
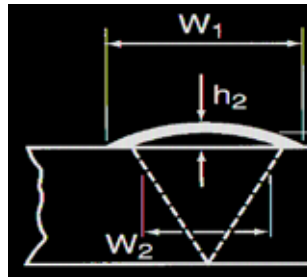
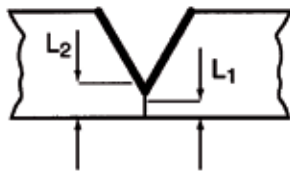
- AU\$4,500 per welder per year from a reduction in weld metal volume by reducing arc time, reducing weld length and number, and eliminating excessive volume in fillet welds.
- AU\$5,800 per welder per year through the reduction of arc time per weld by developing the use of proper work area layouts, setups, methods and welding materials.
- AU\$8,500 per welder per year through the reduction of work effort, unnecessary motion and delays. These savings were achieved through the redesign of fixtures and tooling that allowed quick changes, reduced time for assembly of parts, redesign of welds (to reduce their number) and additional training to reduce start-up times.



U or J shaped weld preparations—on thicker parent metals, weld volumes can be reduced by U or J shaped weld preparations. The machinery costs are offset by the savings through reduced welding volumes (shaded area).



Root face, root gap and welding cap—small changes to the root face size (L_1 to L_2), welding cap (W_1 to W_2) and root gap (G_1 to G_2) can decrease the total weld size dramatically.



Improve quality

Some tips for quality control that will save time, money, electricity and consumables, while keeping quality high, include:

- Minimise the welding you need to do. Aluminium extrusions or prefabricated parts can eliminate the need for welding in some parts of the boat. Keep up to date with your suppliers about the extrusions or prefabrications that might be relevant to you.
- Have a weld map for repetitive work. Having a set plan for welding reduces errors and time spent correcting faulty work.
- Consider installing a surge turbine that provides a readout of gas feed rate, and a surge guard that will help to minimise excess gas pressure, thereby reducing the consumption of welding materials.



Minimise the welding you need to do with extrusions or pre-cut parts

Saving material by design

The Strongall method, developed by French boat builder Meta, employs a self-supporting hull—no ribs and rib bands—reliant on thick aluminium plates. It reduces construction time by up to 25%, including decks^[2] and fittings.^[3] The method is suitable for boats up to 20 m in length. In Queensland, Coracle Marine uses the Strongall method in its manufacturing process.^[4]

Maintain equipment properly

These maintenance tips are from the Welding Technology Institute of Australia's Environmental Improvement Guidelines.^[2]

Machines

- Establish a routine maintenance program in consultation with the supplier.
- Electrical switches and cables should be cleaned routinely.
- Parts such as shafts for guide wheels should be lubricated frequently with the correct machine oil.

Hoses

- Routine checks should ensure that all connections are tight and that there are no leaks or worn parts in the hose.
- Where hoses have been damaged by flashback, the complete length should be discarded, as the inner walls have probably been damaged and coated with carbon, which could lead to future ignitions.
- Where localised damage has occurred (e.g. small cuts or abrasions), the section should be removed and replaced using approved connectors. Wire or tape must never be used as a binding or in any hose repair.
- Where hose has been repaired and a new length inserted, the line should be purged prior to use for approximately 15 seconds with the appropriate gas to remove protective talc and any other debris.

Regulators, valves and fittings

- When connecting up, checks for gas leakage should be carried out at all regulator, cylinder and manifold connections.
- Connections and seatings on regulators should be checked for damage and cleanliness each time they are reconnected.
- Regulators should be checked for accuracy at least annually.
- If a regulator shows excessive creep (i.e. pressure build-up when blowpipe valves are closed), close the cylinder valve and have the regulator repaired immediately.
- If pressure gauges or indicators do not return to zero on the release of the pressure, they should be repaired.

Nozzles

- Nozzle faces showing any sign of roughness should be polished with a smooth file and fine emery cloth.
- Nozzle orifices should be checked at least daily, and if necessary, cleared appropriately (i.e. with suitable stainless steel cleaners that provide a broaching and polishing action). The correct size of cleaner should always be used to ensure that the orifice does not become enlarged or bell-mouthed. Orifices should also be cleaned if preheat flames are observed to be uneven or the oxygen jet is distorted.
- If nozzles become blocked, cleaning drills supplied by the nozzle manufacturer should be used before polishing.
- The nozzle should be kept externally clean so that incorrect selection is avoided.
- Nozzle seals should be carefully protected from damage (e.g. by storage with rubber caps, in protective blocks).



All dirt, metallic particles, oxide etc. should be cleared daily from accessible areas.



Use only as much electricity as you need

- Using a welding machine that is too large wastes electricity and consumables. Use correctly sized equipment. The Welding Technology Institute of Australia's Successful Welding of Aluminium^[5] includes tables that will help you to size your equipment properly.
- Use welding equipment with a high power factor (PF). Ideally, welding equipment should have a power factor (a measure of efficiency) of 0.8 to 0.9. Constant potential gas metal arc welding (GMAW) power supplies typically have a PF of about 0.96, compared to constant current gas tungsten arc welding (GTAW) with a PF of about 0.6. Most manufacturers offer power factor correction equipment for welding equipment that simply attaches to the incoming leads of the power supply.
- Inverter type power sources typically have efficiencies of around 85%, compared to rectifier types at about 75% and converters at around 55%. With welding equipment operating 30% of the time, that's a difference of about \$200 per machine per year between inverters and converters.
- Consider upgrading old equipment. Newer equipment may have much better power factors and lead to significant energy savings. Talk to your supplier about the most energy-efficient models.
- The site www.millerwelds.com/education/library.html provides several articles on saving energy and improving efficiency in welding.

Emerging welding technologies

The Queensland Department of State Development, Trade and Innovation has released a Technology Roadmap for Recreational Boat Builders that provides useful information on the potential efficiency gains that can be achieved by adopting emerging aluminium welding technologies. Contact the Marine Industries Sectoral Development Team at www.sdi.qld.gov.au for more information.

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For further information

Ecobiz can assist you to reduce costs and improve eco-efficiency in your business Call 1300 369 388 for further information.

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