

WELDING AND CUTTING

carbon arc cutting and cutting with heavily coated electrodes. With small diameter electrodes used on thin sheets for manual arc welding, current values vary from 10 to 50 amp. For most manual welding, because the welder must withstand the heat, current values should not exceed 500 or 600 amp.

Automatic machine arc welding may use current values up to 2,000 amp or even higher on special applications. Such operations employ AC only for more than 500 to 600 amp because with AC "arc blow" (swerving of the arc path caused by magnetic forces) is almost completely absent. Arc blow is especially detrimental when higher current values are used.

Converters

Commercial AC and DC power supplies are not suitable for arc welding. Consequently, to convert commercial power for arc welding, a rectifier must be used for DC welding, and a transformer for AC welding. A motor generator may also be used to produce alternating or direct current.

Since these welding converters are subject to abuse and are given little expert attention as compared to ordinary electrical equipment, they should be well protected, both mechanically and electrically. Often the machines are moved about, so convenient primary power receptacles should be provided about the shop or construction operation. Plugs and receptacles should meet the requirements of Underwriters' Laboratories, Inc.

AC transformers for welding are usually air-cooled with two-winding primaries. The transformers should be built in accordance with the high standards of electrical construction used on power or distribution transformers.

A typical industrial-rated AC transformer-type welding unit should be equipped with a voltage-reducing control which automatically reduces the open-circuit secondary voltage to 30 volts during idling. This reduction of the voltage is delayed two to three seconds from the instant the arc is broken to prevent interference with normal welding operations. Contact of the electrode to the work automatically restores normal welding voltage. Other safety features are (a) circuit breaker, integrally mounted on the unit, for providing thermal overload protection

and serving as a convenient disconnect switch, (b) circuit breaker of the automatic type or a fused safety switch mounted on the wall and rated for use with the unit and the power supply circuit, (c) three-conductor power supply cable, one conductor of which is for grounding purposes, between the wall mounted breaker and the unit.

Large welding machines are usually installed as stationary units. Since primary line switches are not normally provided as part of the equipment, they should be installed by the person making the installation.

The smaller machines, which may be used as portable units, customarily have primary switches built into them and are provided with primary cables and attachment plugs of proper capacity. Welding transformers should not be attached to lighting circuits under any circumstance.

If a gasoline-powered welding generator is used inside a building or in a confined area, the engine exhaust should lead to the outside atmosphere. Otherwise, carbon monoxide and other toxic gases may accumulate.

Voltages

The voltage across the welding arc varies from 15 to 40 volts, depending on the type and size of electrode used. The welding circuit must supply somewhat higher voltage to strike the arc. This voltage is called the open circuit or "no load" voltage. After the arc is established, the open circuit voltage drops to a value about equal to the arc voltage plus the lead voltage drop. The open circuit voltages on DC welding machines should be less than 100 volts.

For AC transformer welding machines, American Standard Z49.1, *Safety in Welding and Cutting* prescribes a maximum open circuit voltage of 80 volts.

Some standard heavy duty industrial AC welding machines have open circuit voltages of 65 volts. Reliable control equipment is available which automatically reduces the open circuit voltage to about 30 volts during the "off" arc period, at which time the welder may be exposed to the open circuit voltage. This control equipment is commonly used where welders are working outdoors on wet steel or in confined quarters or under other severe conditions.