

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. 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 38 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. Constant voltage power supplies (welder or converter) are now also being widely used.

For AC transformer welding machines, ANSI Z49.1, *Safety in Welding and Cutting*, prescribes a maximum open circuit voltage of 80 volts on manuals, 100 volts on automatics.

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 where the probability of contact with the open circuit voltage may be greater.

Heavy duty AC welding machines (ratings usually over 500 amp for automatic machine welding) are also built with open circuit voltages of 75 to 80 volts with a special tap to provide 100 volts where necessary. The tap may be needed to obtain rated output from the machine if the line voltage is low or if the voltage of the secondary circuit drops. The tap should not be accessible to the welder for current adjustment but should be under the control of a responsible electrician or supervisor.

Open circuit voltages should be as low as 50 volts on small AC welding machines used without expert supervision. Since these machines are often used with low arc voltage electrodes and with leads not more than 20 ft long, the probability of a large voltage drop in the welding circuit is small.

For other manual and automatic welding and cutting processes in which the work