U.S. Department of Labor
Mine Safety and Health Administration
Technical Support
Approval and Certification Center
Division of Electrical Safety

Evaluation of the "Shock-Stop" Welding Voltage Reduction Device

Technical Assistance PAR 0088369
March 24, 2003

Prepared by:
Stephen M. Murtaugh
Electrical Engineering Technician

Abstract

Voltage reduction safety devices, available for use with arc welders, were evaluated and tested to determine their ability to improve welding safety. These devices limit the maximum unloaded open-circuit voltage to a safe level with little noticeable difference while actually welding. The investigation consisted of checking electrical measurements against the manufacturers specifications, and conducting performance tests. These devices, working in concert with current safeguards, good welding practices, and adequately maintained equipment can reduce the welding shock accidents.

Introduction

Tom Loyd, Metal and Non-Metal Safety and Health, Safety Division, requested that the Approval and Certification Center (A&CC) evaluate a voltage reduction safety device manufactured by DDC Technology and marketed as a "Shock Stop" unit.

The mining industry has experienced incidents of workers getting injured, sometimes fatally, when contacting the electrode of an electric arc welder. Workers in the mining industry are very susceptible to these hazards since typically they need to weld in tight areas where heat and humidity can be a factor. Although arc welding can be performed safely, there are circumstances where there is a substantial risk of electric shock. Properly understanding the hazards and adopting effective safeguards is necessary to prevent potentially fatal incidents.

When welding, a person may contact the electrode of the welder. The person may or may not get shocked as a result of this contact. The severity of the shock received when a person becomes part of an electric circuit is affected by several factors. These include the amount of current flowing through the body of the person, the path of the current through the body, and the length of time the body is in the circuit. The current level (measured in milliamperes) is a function of both the voltage at the electrodes and the resistance of the person's body. The resistance of the person's body is much lower when the individual is perspiring, which results in a greater current flow and a greater shock hazard.

Discussion

A product that assists in the reduction of electrical shock to personnel involved in welding activities is known as Voltage Reduction Device (VRD). It is a device that reduces open-circuit voltage to a safe value until welding commences. Upon arc strike, full selected current becomes available. Upon completion of welding, the open-circuit voltage is returned to a safe value until the next welding cycle.

VRD Technology is not new. South Africa has used these devices for over thirty years. The advent of solid state switching has enabled many companies to employ VRD's in hazardous environments. There are two categories of VRD's:

1. Primary-Connected VRD's.

Primary-connected VRD's use a current transformer in the output circuit that switches on and off one leg of the primary supply. The advantages and disadvantages are:

Advantages

- Lower costs, because switching currents are smaller.

Disadvantages

- Can only operate on AC power sources.
- Cannot be used with power factor correction capacitors
- Required to be wired into the circuit by a qualified electrician.
- Cannot be used on portable welders.

2. Secondary-Connected VRD's

Secondary VRD's are connected to the welder output. The three types of secondary connected units are listed below with their advantages and disadvantages:

A. Contactor Type

Advantages

- Rugged.
- Insensitive to polarity.

Disadvantages

- Difficulty in arc strike and restrike.
- Bulky.
- Usually require an external power supply.
- Subject to contact & bearing wear.
- Contacts can, and do, weld closed.

B. Solid-State Type

Advantages

- No wear problems.
- Fail safe operation.
- Very fast response time.

Disadvantages

- Dissipate power and affected by heat.
- Polarity sensitive.

C. Built-in Units

Advantages

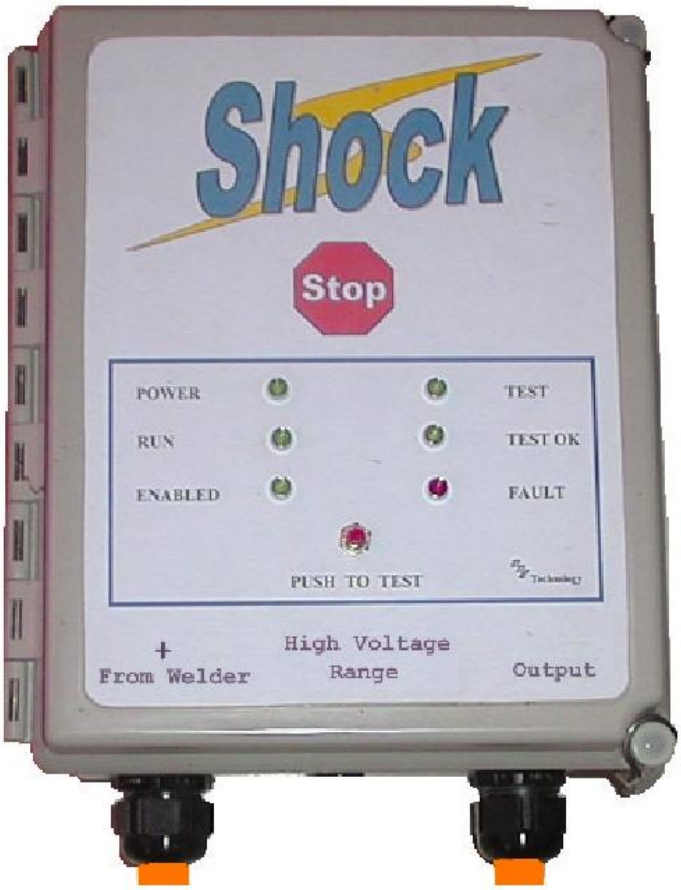
- Cooling is not a consideration
- No external components or connections

Disadvantages

- Retrofitting is not always possible and may void manufacturers warranty.
- Limited range currently available.

Descriptions Of Product Tested

The DDC Technology Shock Stop is a secondary connected, solid-state unit that is connected to one leg of the DC power supply, and may be connected for use with either reverse or straight polarity. The unit evaluated was a high-voltage model suitable for operating voltages over 50 volts. The Shock Stop acts as a block on the output voltage of the welder. As a result, the potential at the electrode is reduced to a low voltage, greatly reducing any shock hazard. This unit also holds full output voltage for three seconds in order to establish the arc and facilitate stitch welding.



DDC Technologies Shock Stop Unit

Tests And Results

The unit was examined and the following parameters recorded:

- Input voltage to the VRD,
- Output voltage from VRD during operation,
- Output voltage from VRD, through and during fault conditions,
- Load required to initiate a fault condition.

The following values were recorded:

Input voltage	80 volts, 125 amp
Output voltage	80 volts
Reduced Output	10 volts, <10 milliamp
Load required	100 ohms

Additionally the Shock Stop was used during an actual welding operation, where both skip and continuous welding passes were conducted. The unit behaved as specified, and was essentially "transparent" to the welder operator. Upon failure, this unit goes to a closed circuit status, acting as though the unit was not installed. Indicator lights show the status of the unit.

Conclusions

Voltage reduction safety devices are available for use with arc welders that safely limit the maximum unloaded open-circuit voltage. These devices, working in concert with current safeguards, good welding practices, and adequately maintained equipment can contribute to improved welding safety.