

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

Evaluation of a Bradford Stuart Industries  
BVR 400 amp AC/DC  
Welding Voltage Reduction Device  
Technical Assistance PAR 0090676  
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## **Abstract**

A Bradford Stuart Industries voltage reduction safety device, available for use with arc welders, was investigated to determine its ability to improve welding safety. This device limits 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 manufacturer's specifications, and conducting performance tests. This device, working in concert with current safeguards, good welding practices, and adequately maintained equipment can reduce the occurrences of welding shock accidents.

## **Introduction**

Jim Ball, Bradford Stuart Industries, requested that the Approval and Certification Center (A&CC) evaluate a BVR 400 amp AC/DC voltage reduction safety device.

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 confined 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 a Voltage Reduction Device (VRD). It is a device that reduces open-circuit voltage (OCV) 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 begins.

VRD technology is not new. These devices have been used in South Africa 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 VRDs utilize 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 re-strike
- 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**

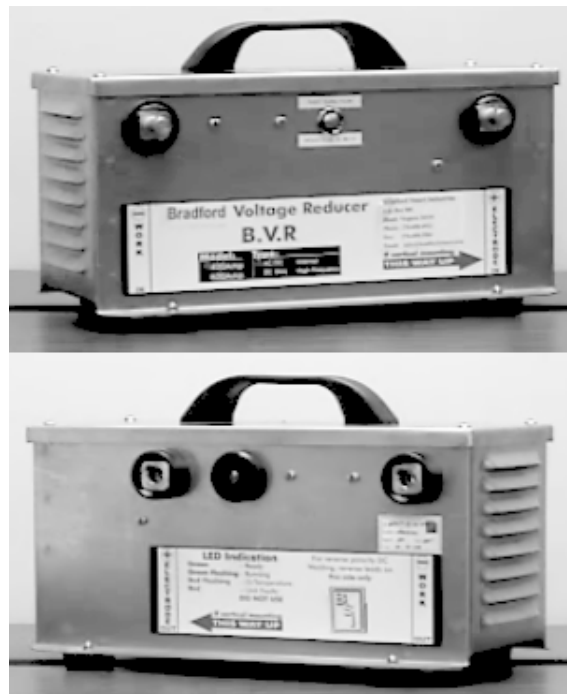
- Cooling is not a consideration
- No external components or connections

#### **Disadvantages**

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

### **Descriptions of Product Tested**

The Bradford Stuart Industries, BVR 400 amp AC/DC, is a secondary, solid-state device connected to both legs of the welder output. It is designed to operate on any constant current welding machine (stick welder) with an OCV of 40 to 90 volts AC or 40 to 120 volts DC. Until the arc is struck, the output voltage is maintained under 6 volts to prevent the operator from receiving a shock.

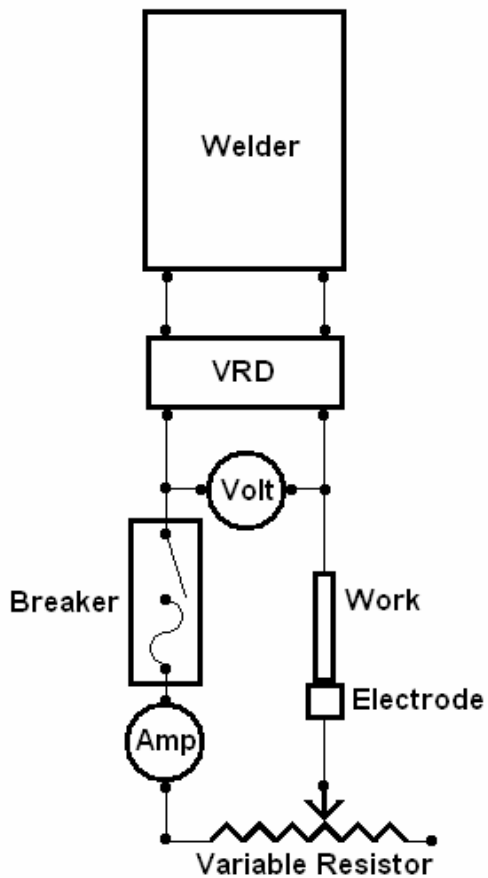


The Bradford Stuart Industries, BVR 400 amp AC/DC

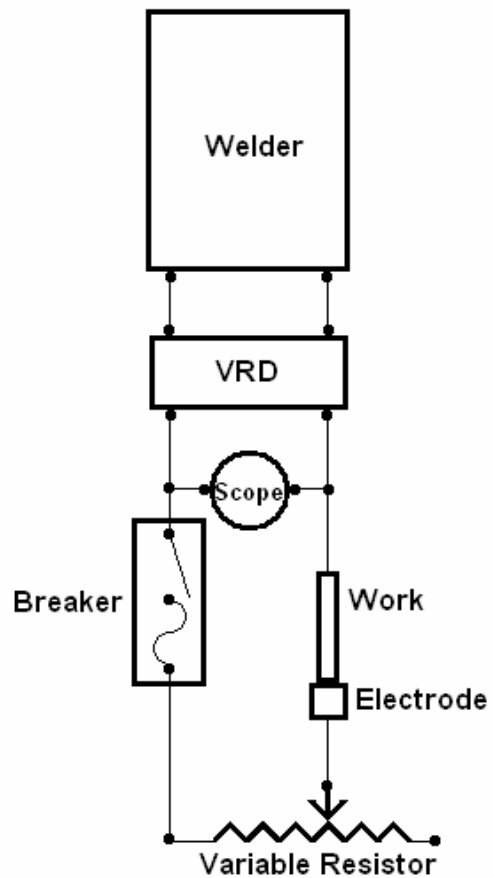
## Tests And Results

Stephen M. Murtaugh, and David Fortney at the Approval and Certification Center evaluated the Bradford Stuart unit. The following parameters were examined:

- 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
- Time required for Voltage reduction



Voltage and Amperage

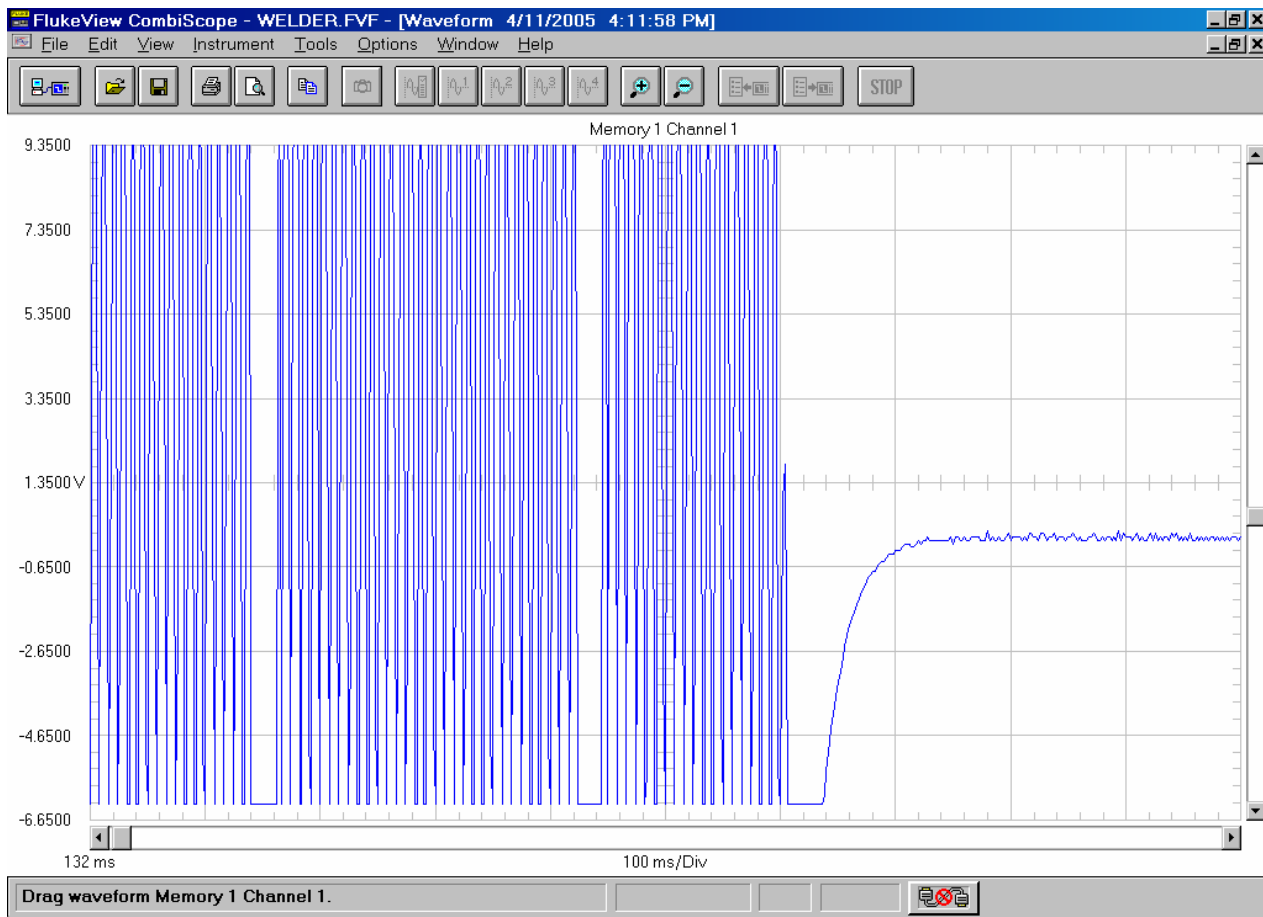


Voltage Reduction Time

## Test Setup Wiring Diagrams

## Tests Conducted

Condition	Observation	Measurement
Initiation	Solid Green Light	4.6 VDC on output
Test 1 [111.5Ω]	Flashing Green changing to Solid Red after 5 sec.	Intermittent 70 VDC {welding}
Test 2 [135.6Ω]	Flashing Green changing to Solid Red after 5 sec.	Intermittent 70 VDC {welding}
Test 3 [152Ω]	Flashing Green changing to Solid Red after 5 sec.	Intermittent 70 VDC {welding}
Test 4 [156Ω]	Solid Green Light	<1 VDC at 70 ma on output [no welding]



**Timing Curve**

The following values were recorded:

Input voltage to VRD	70 volts
Output voltage of VRD	70 volts
Reduced Output	<1 volts, 70 milliamp
Time to reduce	100 ms
Load required to reduce	156 ohms

The unit behaved as specified, and was essentially "transparent" to the welder operator. Indicator lights show the status of the unit.

### **Conclusions**

The Bradford Stuart Industries BVR 400 amp AC/DC Welding Voltage Reduction Device was found to perform as specified by the manufacturer to safely limit the maximum unloaded open-circuit voltage. This device, working in concert with current safeguards, good welding practices, and adequately maintained equipment can contribute to improved welding safety.