APPLICATION NOTE - 1011

Topic: CONTROLLING MOLYBDENUM DISILICIDE HEATING ELEMENTS WITH ZERO-CROSSING POWER CONTROLS

Author - George A. Sites, VP AMETEK HDR Power Systems

INTRODUCTION

Historically, Molybdenum Disilicide (Moly) heating elements have been controlled with either contactors or Phase-Fired SCR Power Controllers. Due to its resistance being nearly zero when cold, a Phase-Fired SCR can regulate it's output voltage into zero ohms avoiding extremely high surge currents normally associated with energizing Moly loads. As the heating element's temperature rises, so does its resistance. In turn, the Power Controller increases output voltage to maintain or increase temperature as required. This continues until the desired temperature is reached.

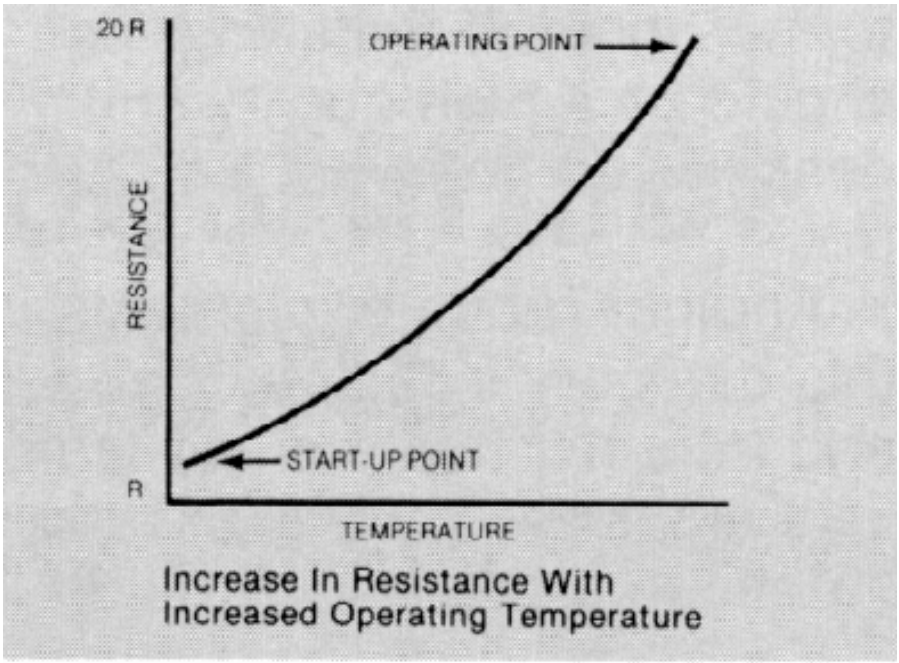

Figure 1 - Resistance Characteristics of Molybdenum Disilicide Heating Elements

AMETEK HDR POWER SYSTEMS 3563 Interchange Rd. Columbus, OH 43204
Telephone 614-308-5500 Fax 614-308-5506

1-888-797-2685

However, this low resistance time period is a problem area for using Zero-Fired SCR Power Controls. Since a Zero-Fired SCR Power Controller's output is either full voltage or zero voltage, high surge currents occur when the SCR turns on. These surge currents can damage the heating element, the Power Control or both. However, once a Molybdenum Disilicide load element has reached the desired operating temperature, it can be controlled with a Zero-Fired SCR Power Controller.

SOLUTION

AMETEK HDR's new Phase-Zero-Adapter (PZA) is designed to fit directly onto either the PF1 or PF3 firing circuit. The PZA circuit causes the firing circuit to operate in the Phase-Firing mode until an on-board adjustable timer or a user supplied contact closure causes the SCR Power Controller to switch to Zero-Firing.

The on-board timer is set by the user based upon the actual time required to reach a nearly stabilized temperature. The external contact closure is normally from a temperature control or any device that is actually monitoring the load element's temperature. Once up to temperature (usually above 1600 C) the contact closes and the Power Controller switches to Zero-Firing. Figure 2 illustrates the operation of the Phase-Zero-Adapter.

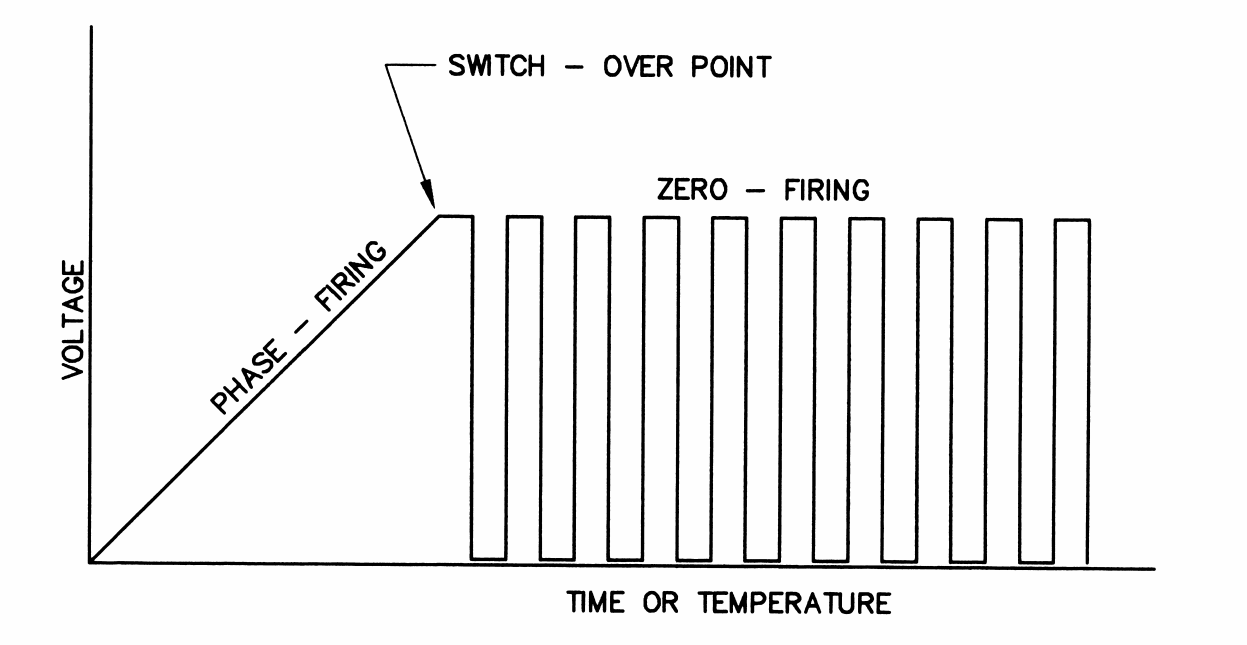

Figure 2 – Typical SCR Power Controller's output with the Phase-Zero-Adapter

If the timer is set for too short of time or the external contact closes too early the optional current limit will hold the Power Control's output voltage to a level that prevents a over-current condition.

BENEFITS

One of the most common complaints of Phase-Firing is reduced Power-Factor (PF) and increased harmonic currents. Both are the results of the chopped sine-wave caused by Phase-Firing.

The use of the PZA reduces the amount of Phase-Firing time to a small percentage of the total operating time. While operating in the Zero-Firing mode the Power-Factor will be near Unity and the harmonic currents will be greatly reduced. Both benefit the user.

SIZING THE SCR POWER CONTROLLER

When sizing the Power Controller for use with the Phase-Zero-Adapter, determine the load's resistance at the time/temperature you want to switch over to Zero-Firing. Using this resistance value calculate the maximum current draw based as if the full line voltage is being applied.

> NOTE: By closely evaluating your process and understanding the Molybdenum Disilicide's resistance characteristics, you can easily size the SCR Power Controller. Keep in mind, the lower the switch-over temperature, the higher the Power Control's current rating needs to be.

CONCLUSION

Although AMETEK HDR's Phase-Zero-Adapter (PZA) is not Zero-Firing in the true sense it is a inexpensive method that can help improve Power-Factor and reduce Harmonic Currents in many applications using Molybdenum Disilicide heating elements that previously could not be helped without using expensive Power-Factor-Correction-Capacitors and harmonic filters.