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GENERAL SAFETY

Primary vs. Secondary Protection: Why Interlocks Are Not an Acceptable Alternative to Lockout

By William G. Switalski, P.E.*

Occupational Safety and Health Administration regulations state:

"Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures." [29 CFR 1910.333(b)(2)(B)]

The rationale for this prohibition can be found in the National Fire Protection Association *Electrical Standard for Industrial Machinery* (NFPA 79). Control circuit devices including push buttons, selector switches, toggle switches, interlocks, etc., are those items with which the individual controlling the machine must come into physical contact. NFPA 79 requires control circuit devices to operate at low voltage, defined as 120 volts or lower for alternating current equipment¹. In the event a short circuit or ground fault occurs in the control circuitry of a machine, the electrical shock experienced by the user is limited to the low voltage range, or electrical "secondary."

On the other hand, the electrical motor driving the machinery often operates at higher ranges such as 220 or 440 volts. This higher voltage range is known as the electrical "primary." Hence, an electrical motor operating in the high voltage range cannot be part of the control circuitry that operates at a lower voltage level.

An electric motor driven piece of equipment typically has one incoming power source, the electrical primary voltage. Within the primary electrical circuit is a device known as a "transformer" that can reduce the primary voltage to any lower voltage desired for the control circuit supply.

When the machine user activates the "on" control in the secondary electrical control circuit, a low voltage electro-magnet is energized which, in turn, causes another internal switch to complete the primary electrical circuit. This electro-magnet and high voltage switch is known as a "relay." [See Figure 1]

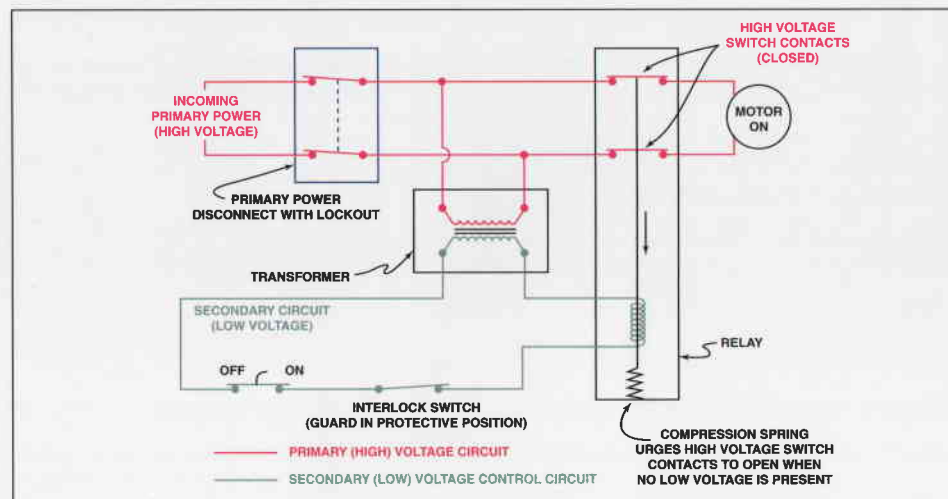


Figure 1

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If the machine user opens up an interlocked guard, the secondary control circuit in the machine is supposed to turn off. This occurs when the electro-magnet of the relay is de-energized and the spring-urged high voltage switch opens. This, in turn, will interrupt power to the motor and the machine comes to a halt. Reliance upon the interlock to stop the machine also includes reliance upon both elements of the relay to function properly, the electro-magnet and the high voltage switch. In the event the interlock switch sticks in the actuated position or either part of the relay fails, the machine may not turn off [See Figure 2]. Hence, the interlock in the electrical secondary control circuit is not considered to provide a high enough level of protection to satisfy OSHA when machine maintenance operations² are in progress.

Even when the interlock and relay function as intended, the high voltage switch portion of the relay can be manually actuated by another individual, causing the motor to start and the machine to activate. Furthermore, the primary voltage remains present in the machine ready to start the motor or cause a high voltage shock in the event someone reaches into the electrical cabinet and touches a high voltage terminal.

Lockout of the electrical power involves disconnecting the primary high voltage. Once this is accomplished, no form of manual bypassing or failure in the primary or secondary electrical circuits can cause the machine to start [See Figure 3]. Hence, locking out the electrical primary provides "**Primary Protection**" and satisfies OSHA's regulations. Turning off a machine through the use of an interlock in the electrical secondary provides "**Secondary Protection**" and does not satisfy OSHA when maintenance is in progress on motor driven equipment.

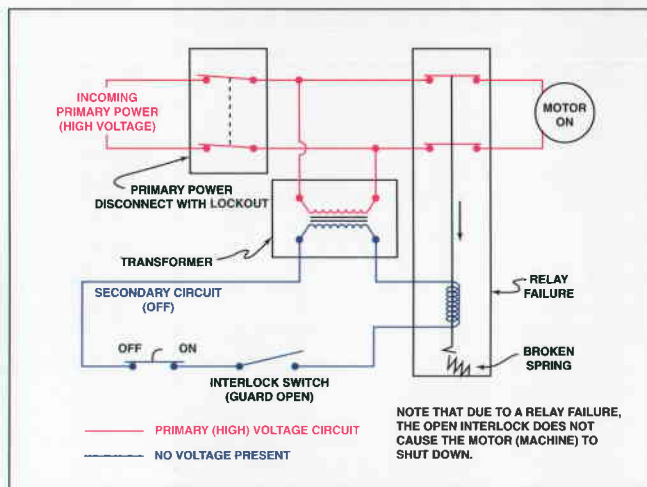


Figure 2

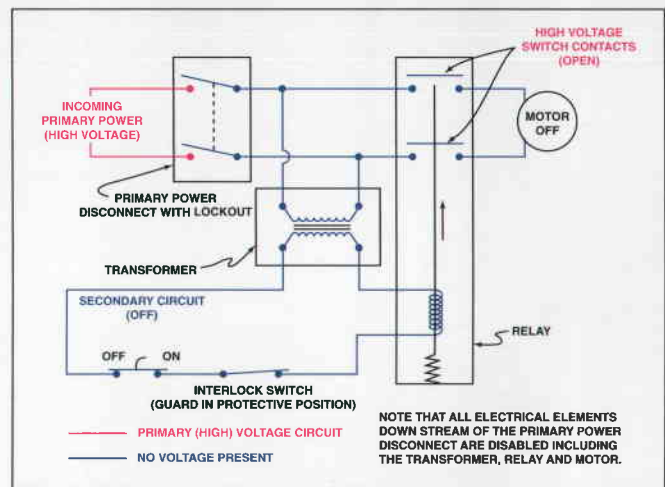


Figure 3

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- ¹ "Electrical Standard for Industrial Machinery," *NFPA 79* Quincy, MA, National Fire Protection Association, 1994 and later. Section 9.2.1.
- ² "The Control of Hazardous Energy (Lockout/Tagout)," 29 CFR 1910.147. Washington, Occupational Safety and Health Administration, 1990 and later. Section (b): Maintenance activities include installing, setting up, adjusting, inspecting, modifying, servicing, lubricating, cleaning, unjamming, tool changes, etc.

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