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SAFETY PHILOSOPHY

Interlocked Barrier Guards: Risk-Taking Philosophy

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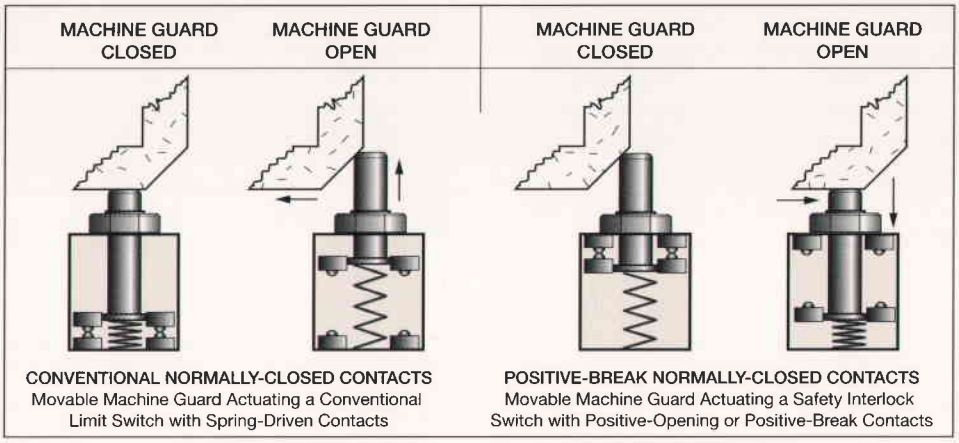

Figure 1 - Conventional and Positive-Opening Contacts

Abstract

Interlocking is a safety philosophy; it is not just the use of interlock devices. Interlocks are used almost exclusively as countermeasures against risk-taking. To entertain their universal adoption is nothing short of a societal commitment to extend protection to individuals engaged in determined advertent multiple misuses of technology.

I. Introduction

Barrier guards provide personnel protection by one or more of the properties shown in Table I:

Table I: Properties of Barrier Guards

- Block corridors leading to hazards.
- Prevent missiles from escaping machine.
- Define the safe from the unsafe regions of the machine (awareness barrier function).

When the barriers are movable, they are typically hinged in position or placed in tracks to be slid into and out of protective position. They may also hook into place or be fastened in location by screws, clips, cotter pins and the like. When they are closed, properly designed barriers almost always provide complete protection against injury.

Go/No Go devices such as electric interlocks may be incorporated into a barrier guard system to reflect two different changes in state. The first is barrier closed (protective) to barrier open (unprotective). The second is hazard active to hazard inactive, e.g., mechanical hazards in motion or motionless. The signals from the electric interlocks monitoring these states may be processed to provide four distinct safety functions:

1. *Power Shut Off*: When a barrier is opened the control or primary input power is instantly interrupted. Examples include, opening a microwave oven or opening the door on a washing machine during the spin cycle. Safety derives from the timely dissipation of any hazards before a human comes into harm's way. The delay in the cessation of hazardous motion, or the disintegration of radiant waves, or the cooling of fluids, or the elimination of dangerous suction depends on the characteristics of the system.

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Operators almost always know when a mechanical system is in motion because they receive visual, audible and tactile feedback. Furthermore, natural selection, in the Darwinian sense, has produced a community of machine users that recognize immediately certain hazards that are described in the legal literature as "open and obvious" or "patent." Breaching a barrier guard on a moving machine, therefore, is blatant risk-taking. The *power shut off* feature of interlocked barriers is a possible countermeasure.

2. *Reminder:* When a machine is in its benign state, operations may be performed in the normally guarded hazard zones that include workpiece placement and removal, set-up, adjustment, or lubrication. After exiting the zone, operators must replace the barriers or their associated interlocks will not give permission for the machine to resume operation. The inability to restart the machine reminds the operator to replace the guard. The interlocked door on a clothes dryer serves this reminder function; the door must be closed before the dryer can be restarted. The reminder function protects both operators and bystanders against the risk of inadvertent contact with the erstwhile guarded hazard.

   The most elementary notion in safety is to operate machines only when functional safeguards are in place. To do otherwise is to contravene commonsense and the expectation of technology. Such misuse is addressed by the reminder function of interlocks.

3. *Sentinel:* There are many sensible reasons why operators or maintenance personnel must work within hazard zones. During these periods they frequently rely on energy control to provide for their safety. For example, as a precursor to their entry into the machine, the power may be shut off using ordinary stop controls, disconnect switches, automatic machine shut down functions, or perhaps by opening an interlocked barrier guard anywhere on the machine.

   Unfortunately, workers are in jeopardy whenever they work in hazard zones that have been rendered temporarily harmless by the elimination of power. If power is suddenly restored or released, the re-energized hazards produce injury or death. To prevent this unexpected start-up, interlocked guards are called into duty as sentinels. The interlocked drain plug on a typical garbage disposal precludes operation by the wall switch whenever it's not *in situ*.

   The most advanced safety philosophy available in this country for performing maintenance activities is Zero Mechanical State (ZMS) [Ref. 1,2]. Under the name Lock Out/Tag Out, this universally embraced and codified concept is the maintenance protocol required by State and Federal rulemakers. It is not only misuse to perform maintenance without the protocol, it is usually against the law. Nevertheless, the interlocked barrier is frequently proposed as a substitute safety strategy; O.S.H.A. specifically prohibits its use. [3]

4. *Restrict Access*: In situations where danger persists after power is interrupted by breaching a barrier (drifting, rundown, residual voltage), another interlocking concept may be employed that operates on the change of state of the hazard rather than the change of state of the guard. Very simply, the barrier remains locked until the hazard becomes inactive. In a laundromat, the access door to a clothes washer will not unlatch until enough time elapses from the stop command for all hazardous motion to subside. Commercial extractors (spin dryers) often use motion detectors which release a locked access door only after the clothes drum becomes stationary.

   Would anyone sanction breaching a guard and reaching into a moving machine? This activity is not only misuse, it rises to the level of risk-taking. Restricting access to hazards with interlocked and latched barriers is a safety countermeasure for this bizarre behavior.

II. Risk-Taking

This century has been witness to three massive attacks on the problem of personnel safety; training, guarding and warning. In the last twenty-five years it has been almost impossible to find an unguarded machine or one without on-product warnings. Indeed, to receive a traumatic injury now requires the victim to deliberately reach into a moving machine; it demands that a guard be bypassed and it requires that the on-product warnings be ignored, i.e., "Do Not Touch Moving Parts" and "Do Not Remove Guards." In spite of this, the safety and legal communities have completely lost the battle; the number of disabling injuries per million hours of machine exposure has over doubled since 1962 [Ref. 4]. To deal with this tragedy, the plaintiff's bar is pressuring society to adopt the Fourth Protocol – the interlock.

In the previous section it was established that the role of interlocked barriers is strictly to prevent misuse and risk-taking. On this basis, the following may be asserted:

> **To invoke a universal policy that requires all barrier guards to be interlocked is equivalent to a societal commitment to extend protection to machine users engaged in advertent multiple misuse and risk-taking adventures.**

The goal of this policy is to make the safeguarding of machinery foolproof. Unfortunately, as Henry David Thoreau observed,

"It is impossible to make anything foolproof because fools are so ingenious."

III. Closing Remarks

To extend protection to risk-takers is an overwhelming technical challenge; it calls for a lock which can't be picked. Fortunately, the European Community snatched up this gauntlet in 1988 and can provide a blueprint which we can modify to account for differences in our legal, governmental and safety systems. One embarks on an enterprise of this kind knowing only that costs will increase dramatically; whether safety will be improved or compromised cannot be predicted.

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