

Emergency Stop Devices

More than an OFF Switch



Picture 1: A typical red E-Stop button mounted in a yellow housing

Emergency Stop (E-Stop) buttons are arguably the most identifiable element on a piece of machinery and serve a specific function which is universally known. This is not by chance, but instead a requirement as called out by governing bodies such as OSHA and in consensus standards. NFPA 79 defines an Emergency Stop as “a device designed to be used in reaction to an incident or hazardous situation.”

They are not considered machine safe-guarding devices because an Emergency Stop neither detects nor prevents employee exposure to machine hazards; rather they initiate an action to stop hazardous motion when an employee recognizes a hazard and activates the Emergency Stop.

In other words, an Emergency Stop is a *secondary* safety measure. Being a separate secondary safety function it is good practice to not wire an Emergency Stop in series with the primary safety functions, but to wire it in its own safety circuit.

Standard Requirements

Similar to any safety device, an Emergency Stop must fulfill specific standard requirements. When looking at the installation of an Emergency Stop, governing bodies such as OSHA and standards such as IEC 60204-1 state that it must be readily accessible to the operator. This means that every operator station or any area of the machine worked on which is considered part of the normal operating procedure needs a means for an emergency stop, also referenced by National Fire Protection Association under the NFPA79 standard. It should be unobstructed and easily accessible without having to reach over, under or around to actuate.



Picture 2: machine controls with emergency stop, mounted at a safety guard access door.

Proper use

Being an easy one-step process by design, an Emergency Stop is often misused as an OFF switch. At first glance one may think this is acceptable and may even use the argument that it brings the machine to a safe condition anyway. In reality, using an Emergency Stop

device as an OFF switch will do more harm than good; enough harm which may lead to a devastating failure.

An Emergency Stop device is only meant to be used in just that - an “emergency”. As such, this secondary safety device will have different requirements than an ON/OFF switch or even a safety rated guard switch. For example, when looking into ISO13849 the highest achievable performance level for an E-STOP will be a PL_d. This is because the probability of a dangerous failure is based on the fact that it will not be actuated frequently. If this frequency parameter is altered and increased due to the misuse of the E-STOP then its probability of a dangerous failure will increase. Meanwhile the measure to protect against such a failure remains unchanged, thus leading to the possibility that it will not perform when actually needed.

E-Stop devices

An Emergency Stop can include, but are not limited to, devices such as pull cord operated switches, foot operated switches without a mechanical guard and, most common, push button operated switches.



Picture 3: an emergency cable pull device

Physical requirements

NFPA79 and ISO 13850 detail the physical characteristics of a push button E-Stop, which will include a RED mushroom operator head with YELLOW background. They must also be self-latching, meaning that once actuated the Emergency Stop will remain in the actuated state until a voluntary and deliberate action is performed, such as twisting and/or pulling of the palm button for reset. In addition, this resetting of the E-Stop alone should not resume operation; instead a second deliberate action is needed, such as the pressing of a RESET button.



Picture 4: an emergency stop main switch with Lockout/Tagout capability

Types of stopping

IEC 60204-1 and NFPA79 also describe the different types of emergency stopping - which are Category 0, Category 1 and Category 2, not to be confused with Control Categories of ISO13849.

Every machine must have at least one Category 0 means of an Emergency Stop, also called an *uncontrolled stop* which is defined by the immediate removal of power to the machine actuators.

Category 1, or a *controlled stop*, is where power remains at the machine actuators as they are needed to bring the machine to a stop.

A Category 2 stop is a controlled stop where power remains at the actuators even once the machine is stopped.

The determination on which type of Category Stop to implement is dependent on a Risk Assessment accompanied with a stop time analysis.

Conclusion

An Emergency Stop device is one of the most crucial elements within the safety related parts of the control system. In most cases it is the last resort to safely bring hazardous conditions under control. Although the overall ideal scenario is that we will never have to use such a device, reality is that accidents do happen, machinery and machine process may not function as intended. It is important that the Emergency Stop and its functions are understood and respected enough to where it is not misused.

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