

## Emergency Stops – make sure yours comply

As Emergency Stops are the last line of defence in machine safety it is imperative that they operate correctly when/if required.

So what are some of the things you can do to ensure the E-Stop will work when called upon? This month we take a detailed look at the different types of Emergency Stop Devices and what you can do to ensure their effectiveness.

The Occupational Health and Safety Regulations covering Plant outline specific duties relating to Emergency Stop devices for designers and employers. Each State’s wording is slightly different on some points, but each document states that the device must:

- Be easily accessible;
- Be **coloured red**; and
- Either that the device “*operate reliably and be fail-safe*” or “*that the device will not be affected by electrical or electronic circuit malfunction*”.

The first two points are easily understood, but the third point raises debate. The definition of Failsafe is: *guaranteed to work; totally reliable*. And what are some of the faults that may cause electrical or electronic circuit malfunction? Consider Figures 1 to 3.

Figure 1 - A short to 240V (or whatever the circuit voltage is), or a faulty switch contact will render the E-Stop useless.

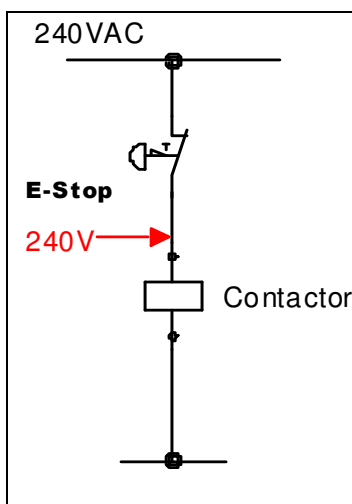


Figure 1 - Single channel E-Stop

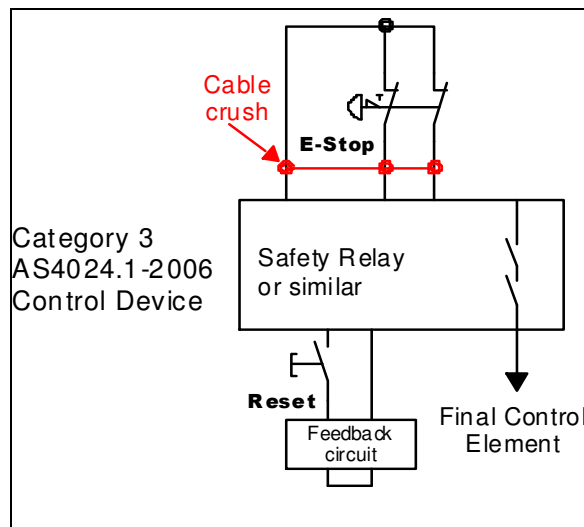


Figure 2 - Dual channel E-Stop without cross short detection

Figure 2 – The E-Stop filling with water or a loose wire/cable crush may short all wires within the switch together, again rendering the E-Stop useless.

Figure 3 – The safety monitoring device will detect the faults shown in figures 1 and 2 – the device is fail-safe.

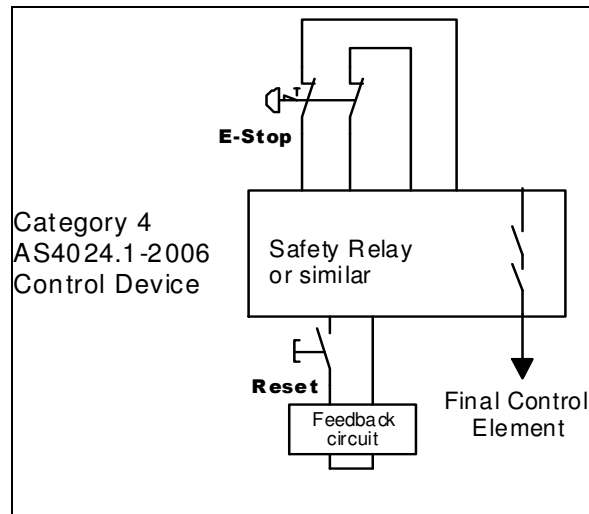


Figure 3 - Dual channel E-Stop with cross short detection

A risk assessment should be performed (in all state regulations this is mandatory) on any hazards identified with the piece of plant. We must point out that if a rigorous risk assessment of the plant shows that there is no serious injury risk (i.e. only reversible injuries such as a scratch or bruise) then the need to have a failsafe Emergency Stop is contentious since the law is unlikely to be concerned or involved, nor will the company be overly concerned about the potential of such a minor injury.

Indeed the cost of implementing a failsafe emergency stop may be prohibitive for minimal gain (prevention prevention of scratches and minor bruises).

The point is a formal, careful Risk Assessment must be conducted first, and this will in turn determine the design of the circuitry for the Emergency Stop device.

Emergency Stop devices are not just for the safety of workers. The Emergency Stop can also be used to protect a machine or work piece from being damaged, in cases such as jamming etc.

## Standards

Australian Standard “AS4024.1-2006 Safety of Machinery Part 1604: Design of controls, interlocks and guarding – Emergency stop – Principles for design” gives a good grounding for what should be done with emergency stop devices.

The main points from the standard are:

Standard – AS4024.1604-2006	Pilz translation
<b>5.1.1</b> The emergency stop function shall override all other functions in all operating modes of the machine.....	The emergency stop device must be monitored separately to any other devices.
<b>5.1.2</b> The emergency stop function shall not be applied for use as a substitute for safeguarding measures....	An emergency stop should only be used as an emergency stop – not for normal operational stop or isolation.
<b>5.4.2</b> Emergency Stop devices shall be located at each operator station and at other location where emergency stop is required....	Every operator station must have an emergency stop device, as well as other logical positions e.g. along a conveyor.
<b>5.4.3</b> The emergency stop device shall apply the principle of positive mechanical action.	Devices with normally closed positive actuation contacts should be used.
<b>5.4.4</b> Once the emergency stop command has been generated during actuation of the emergency stop device, the command shall be maintained by engagement (latching-in) of the actuation means.....	Only emergency stop devices approved to IEC/EN 60947 and ISO/IEC 13850 (EN 418) may be used.
<b>5.4.5</b> Resetting of the emergency stop device shall only be possible as the result of a manual action on the emergency stop device itself. Resetting the emergency stop device shall not by itself cause a restart command....	The E-Stop must be manually reset, such as by releasing the push button by pulling or twisting of the actuator. There must be a manual reset command for the control system <i>after</i> the emergency stop device has been reset.

In addition, the actuator of the device must be **coloured red** and if a background exists behind the actuator it should be **coloured yellow**, as far as practicable.

The words ‘Emergency Stop’ may be useful as an indicator for the device, or the universal symbol for emergency stop as shown in Figure 4.

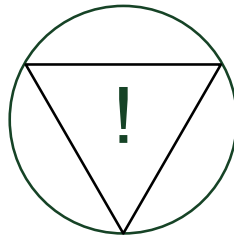


Figure 4- Label for emergency stop devices (IEC 417-5638)

**Pilz Safe Automation (VIC)**  
PO Box 739  
Mt. Waverley VIC 3149  
Tel: 03 9544 6300

**Pilz Safe Automation (NSW)**  
19/3 Kelso Crescent  
Moorebank NSW 2170  
Tel: 02 9601 4249

**Pilz Safe Automation (QLD)**  
PO Box 4535  
Springfield QLD 4300  
Tel: 0425 818 898

**Pilz Safe Automation (New Zealand)**  
PO Box 59-202  
Mangere Bridge Auckland  
Tel: (64) 09 634 5350

## E-Stop Devices

### Emergency Stop Buttons

The most common Emergency Stop device is the E-Stop button. E-Stop buttons can be seen at baggage conveyors and escalators at airports and of course within many workplaces on just about every piece of machinery.

As per AS4024.1604-2006 Part 5.4.1, emergency stop buttons must be a mushroom-type (proud - not recessed) push button operable by the palm. The button must be **coloured red** and any box the button it is mounted in or on should be **coloured yellow**.

As mentioned above, emergency stop buttons should be approved to IEC/EN 60947 and ISO/IEC 13850 (EN 418).

Some emergency stop buttons are now available that will ensure the operation of the device cannot be mechanically jammed if an object is placed on the emergency stop button (such as a rope, roll of tape etc.). The actuator of these E-Stop buttons goes inside the collar, preventing the possibility of jamming.

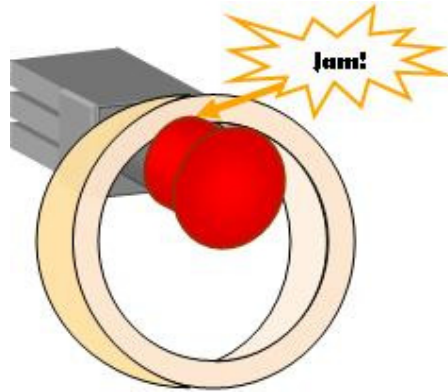


Figure 5 - E-Stop that may be jammed



Figure 6 - E-Stop that cannot have its actuator jammed

It is also imperative to ensure that any Emergency Stop buttons mounted onto panels or control cabinets etc. have a contact block that prevents the contact elements of the E-Stop button from working loose *without* detection. Situations such as the contact block falling off inside the cabinet, leaving the button behind, will be detected by the special contact block.

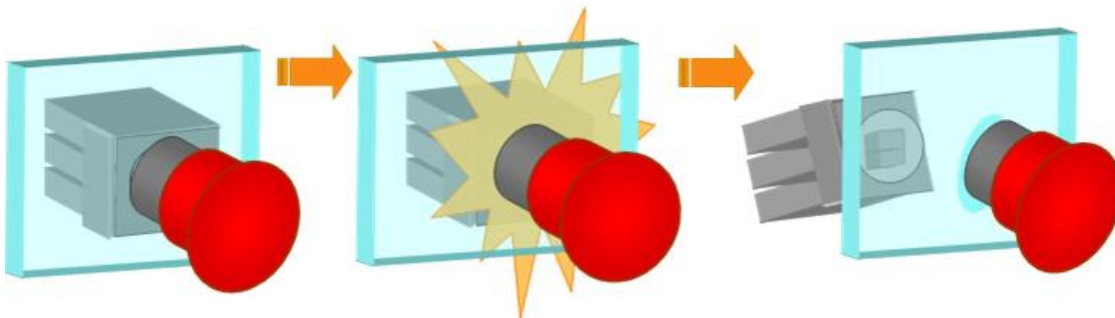


Figure 7 - E-Stop contact block falls away from the button – situations such as this *must* be detected

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## Lanyards/Pull Wires

Emergency Stop lanyards are very common with conveyor applications and other applications where there may not be any particular operator locations.

A lanyard that will allow actuation from any direction should be used, and any bends use a spring loaded pulley, to ensure tension within the wire and also that any attempt to operate the lanyard will be recorded. It is a common problem that installed emergency stop lanyards will only be operated if the wire is pulled in a certain direction – a trapped worker will not think about the direction they are pulling as they are dragged into a machine!

The manufacturer's directions should be followed closely, as there are a number of different types of lanyards available and incorrect installation can result in non-operation during an emergency.

The lanyard wire/rope should be **coloured red** and if possible the background should be **coloured yellow**. It may be useful to attach marker flags to improve visibility.

There should be ample room between the wire/rope and any objects in the vicinity to allow the device to be operated.

The whole length of the wire or rope should be visible from the location where the device will be reset. If this is not practicable, instructions for use should state that after actuation and before reset the machinery should be inspected along the whole length of the wire/rope to detect the reason for actuation.

**“AS 1755-2000 Conveyors – Safety requirements”** Section 2.7.9 covers pull wire requirements for conveyors and includes example diagrams for installation – this standard is also useful for non-conveyor installations.

Some of the main points are:

### 2.7.9.1

- (a) Breaking, slackening or removal of the pull wire shall activate the device.
- (c) The force required to operate the pull wire activated device shall not exceed 70 N when applied midway between supports and at right angles to the axis of the pull wire with less than 300 mm movement and 230 N along the axis of the wire.
- (f) The switch shall be activated when the pull wire is pulled in any direction.

## Series Wiring

To implement the requirement of AS4024.1-2006 cost effectively, the individual E-Stop devices can be connected in series. All the actuators in one line are electrically interconnected and operate with a common monitoring device.

This can be applied on E-Stop devices up to the highest Category 4 of AS4024.1-2006. The E-STOP is designed to be operated in case of danger and is not a primary protective device like a safety gate. It can therefore be assumed that several E-STOP buttons will not be operated simultaneously. The frequency with which the function is requested can also be considered low.

It is essential that E-Stop devices **not** be connected in series with any other devices to satisfy the requirements of *AS4024.1604-2006 section 5.1.1* that “the Emergency stop must remain active at all times”.

## References

### State Regulations and Codes of Practice

Victoria – Occupational Health and Safety Regulations 2007

South Australia – Occupational Health, Safety and Welfare Regulations 1995

New South Wales – Occupational Health and Safety Regulation 2001

Queensland – Plant Code of Practice 2005

Western Australia – Occupational Safety and Health Regulations 1996

National – National Standard for Plant NOHSC:1010(1994)]

### National Standards

AS4024.1-2006 – Safety of Machinery

AS 1755-2000 Conveyors – Safety requirements

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