AVW Technical Guide

Emergency Stop Systems in Stage Automation

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1. Introduction

Emergency stop systems are one of the most critical safety features in stage automation. They provide a means for operators, technicians, or performers to immediately halt machinery when a hazardous situation occurs.

Unlike normal operational controls, an emergency stop system is designed to override all other control commands and bring the system into a safe condition as quickly as possible.

In environments such as theatre stages, where performers and crew often work close to moving machinery, emergency stop systems play a vital role in preventing serious injury or equipment damage.

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2. What is an Emergency Stop?

An **Emergency Stop (E-Stop)** is a manually operated safety control that immediately stops hazardous machine motion.

Emergency stop systems are intended for situations where:

- an operator loses control of machinery
- a performer enters a hazardous area
- a mechanical fault occurs
- unexpected movement is detected

E-Stops must always be **readily accessible**, **clearly identifiable**, and **simple to operate**.

Most emergency stop buttons are designed as **large red mushroom pushbuttons on a yellow background**, which is a widely recognised international safety convention.

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3. Standards Related to Emergency Stop Systems

Several safety standards define requirements for emergency stop systems.

Important standards include:

- ISO 13850 – emergency stop principles
- EN ISO 13849 – safety-related control systems

- BS EN 17206 – stage machinery safety
- EN IEC 60204-1 – electrical safety of machinery

These standards describe how emergency stop systems should be designed, implemented, and tested.

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4. E-Stop Behaviour

An emergency stop must bring machinery to a **safe condition**. The exact behaviour depends on the machine and hazard.

Typical responses include:

- stopping motors immediately
- applying mechanical brakes
- removing drive power
- activating **Safe Torque Off (STO)** in motor drives

In some systems, emergency stop behaviour may involve a **controlled stop**, particularly where an immediate stop could create additional hazards.

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5. Stop Categories

Emergency stop systems typically fall into three categories defined by machine safety standards.

Stop Category	Description
Category 0	Immediate removal of power to the machine
Category 1	Controlled stop followed by power removal
Category 2	Controlled stop with power maintained

Most emergency stop systems use **Category 0 or Category 1**.

Category 2 stops are generally **not suitable for emergency stop functions**.

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6. E-Stop Systems in Stage Automation

Stage automation systems may include multiple emergency stop stations located at:

- stage manager desks
- control consoles
- backstage areas
- stage wings

- orchestra pits
- fly galleries

Emergency stop systems are often connected through a **safety relay or safety PLC** that monitors the emergency stop circuit.

Typical architecture includes:

E-Stop Buttons
↓
Safety Circuit
↓
Safety Controller / Safety Relay
↓
Drive Shutdown (STO)
↓
Mechanical Braking

This ensures that pressing any emergency stop immediately stops motion.

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7. Resetting an Emergency Stop

Resetting an emergency stop system should always require **deliberate operator action**.

Typical reset procedure:

1. Identify the cause of the stop
2. Ensure the hazard is removed
3. Reset the E-Stop button
4. Reset the safety system
5. Restart the automation system

Automatic restart after an emergency stop should **never occur**.

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8. Common Mistakes

Using E-Stops as normal stop controls

Emergency stops should only be used for **emergency situations**, not routine machine stopping.

Poor button placement

Buttons must be located where operators can reach them **quickly and easily**.

Lack of redundancy

Safety circuits should include **redundancy and monitoring** to detect faults.

Inadequate testing

Emergency stop systems must be **regularly tested** as part of maintenance procedures.

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9. Practical Takeaways

- Emergency stop systems are a **last line of defence** in automation safety.
- Buttons must be **clearly visible and accessible**.
- E-Stop circuits should be designed using **safety-rated components**.
- Systems must be **tested regularly**.
- Emergency stop activation should always require **manual reset**.

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10. Further Reading

- ISO 13850 – Emergency Stop Function
- EN ISO 13849 – Safety of Machinery Control Systems
- BS EN 17206 – Machinery for Stages and Production Areas
- IEC 60204-1 – Electrical Equipment of Machin

About the Author

Anton Woodward works in theatre engineering and stage automation systems.

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