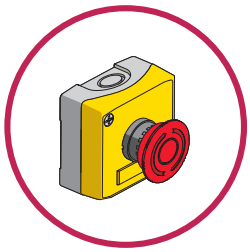
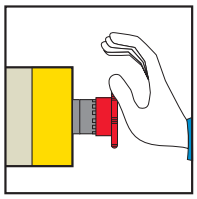
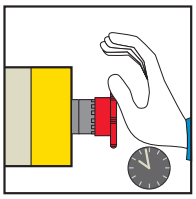
Safety functions
Emergency stop

Emergency stop

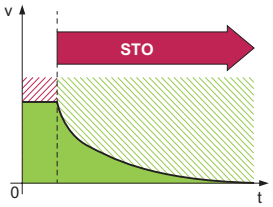




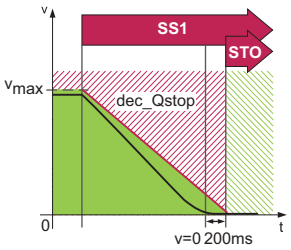
Stop category 0:
Emergency stop function



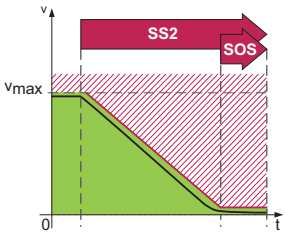
Stop category 1



STO: Safe Torque Off



SS1: Safe Stop 1, STO: Safe Torque Off



SS2: Safe Stop 2, SOS: Safe Operating Stop

Explanation of function

International standard EN/ISO 13850 (replaces standard EN 418) specifies the functional requirements and design principles of emergency stop devices.

Stop types:
Stop category 0 and/or stop category 1 and/or stop category 2 stop functions shall be provided as indicated by the risk assessment and the functional requirements of the machine:

Stop Category 0:
Stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop – stopping of machine motion by removing electrical power to the machine actuators)
Stop Category 1:
A controlled stop (stopping of machine motion with electrical power to the machine actuators maintained during the stopping process) with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved
Stop Category 2:
A controlled stop with power left available to the machine actuators

For the Emergency stop function either Stop Category 0 or Stop Category 1 is chosen according to the risk assessment results.
It applies to all machines, whatever type of energy is used to control this function.
When the emergency stop instruction ceases, the effect must be maintained until it is reset. Manual resetting must only be possible in the location where the instruction was given. Resetting must not start the machine, but simply enable the starting cycle.
Restarting of the machine must not be possible until the emergency stop has been reset.
Where required, facilities to connect protective devices and interlocks shall be provided. If such a protective device or interlock causes a stop of the machine, it may be necessary for that condition to be signalled to the logic of the control system. The reset of the stop function shall not initiate any hazardous situation.
Where more than one control station is provided, stop commands from any control station shall be effective when required by the risk assessment of the machine.
In addition to the requirements for the emergency stop function has the following requirements:
- ◻ It shall override all other functions and operations in all modes
- ◻ Power to the machine actuators that can cause a hazardous situation(s) shall be either removed immediately (stop category 0) or shall be controlled in such a way to stop the hazardous motion as quickly as possible (stop category 1) without creating other hazards
- ◻ Reset shall not initiate a restart

The choice between these two stopping methods is determined by an evaluation of the machine-related risks.
This function includes several sub-functions either Safe Torque off (stop category 0), Safe Stop 1 (stop category 1) or Safe Stop 2 (stop category 2) and is represented by the drawings opposite.
The operator interface may be:
- ◻ Pushbutton equipped with a mushroom head
- ◻ Cable actuated switch
- ◻ Foot switch

Typical architecture

Safety chain solution:
- > Emergency Stop with Embedded Safety Module / Emergency Stop Pushbutton / Contactor / Cat.3 PL d, SIL2, Stop Category 0
- > Emergency Stop with Embedded Safety Module / Emergency Stop Pushbutton / Contactor / Cat.4 PL e, SIL3, Stop Category 0
- > Emergency Stop with Modular Safety Controller / Emergency Stop Pushbutton / Contactor / Cat.4 PL e, SIL3, Stop Category 0
- > Emergency Stop with Embedded Safety PLC / Emergency Stop Pushbutton / PacDrive 3 drive STO / Cat.4 PL e, SIL3 / Stop Category 0