

# Use of illumination to differentiate between active and inactive emergency stop devices

Position of the IFA on identifiability and quality of monitoring

Malfunctioning machinery may give rise to hazards to persons. To enable a machine to be halted immediately and at any time in the event of actual or impending danger presented by it, the Machinery Directive [1] requires all machines to be equipped with one or more emergency stop devices. The Machinery Directive further imposes requirements upon the design of these components. One of these requirements is that emergency stop devices must have control devices that are clearly identifiable, clearly visible and quickly accessible.

Further requirements to be met by emergency stop devices and their function can be found in ISO 13850 [2], and for electrical devices, also in IEC 60947-5-5 [3].

Clause 10.4 of IEC 60204-1 [4] further requires the actuator of an active emergency stop device to be red, irrespective of whether its light is on:

*"The colour of active emergency stop actuators shall remain RED regardless of the state of the illumination."*

It thus follows that on an emergency stop device on which the red colour is achieved by means of illumination, this visualization constitutes a safety function, and accordingly must be implemented by safety technology.

The above standards are listed under the Machinery Directive [1] and thereby harmonized. They thus give rise to the presumption of conformity. This means that when a harmonized standard has been applied, it can be assumed during examination that all essential health and safety requirements of the Machinery Directive are satisfied.

Where emergency stop devices are fitted to detachable or wireless control stations, one of the requirements of ISO 13850 [2] is that measures must be taken to prevent confusion between active and inactive emergency stop devices. One of the possible measures listed in [2] is for the colour of the emergency stop device to be changed by illumination when it is active.

The position of the IFA is that the following should be considered when the state of the emergency stop device (active/inactive) is signalled by means of illumination.

## 1 Identifiability of an emergency stop

The identifiability of the active state of the emergency stop device, signalled by active illumination, must be assured under the following conditions:

- During normal use
- Up to a maximum distance corresponding to that of normal use
- Up to a viewing angle (horizontal, vertical) corresponding to that of normal use

The following aspects must also be considered:

- Evaluation of the minimum brightness must show it to be directly comparable to a conventional emergency stop device (coloured red) under unfavourable lighting conditions (e.g. in direct sunlight).
- The ASR A3.4 technical rules for workplaces and the European Standard EN 12464-1 governing the illuminance for normal industrial environments must be considered in this context (ASR A3.4 states approximately 1500 Lux as the normal illuminance).
- The components used must be designed to deliver their light intensity for an operation time of 20 years (at maximum ambient temperature). It must be considered that natural and temperature-induced ageing processes in the lighting elements (e.g. light-emitting diodes/LEDs) may influence their brightness. If the required quality cannot be demonstrated, the brightness of the light elements must be monitored in the plant.
- Possible ambient influences upon the materials used must also be considered, such as clouding of transparent plastic.

A distinction is made between the following two applications with respect to the identifiability of the emergency stop state:

### Stationary application:

If the emergency stop device is installed permanently or fitted to a control device that is *also used in a stationary application*, the requirements applicable to conventional emergency stop devices (actuators coloured red) must be met. This means for example that greater distances from the device must be considered (e.g. adequate brightness at distances of up to 5 m, viewing angles of  $\pm 90^\circ$  to the frontal view at a mounting height of between 0.6 and 1.7 m above the access level).

### Mobile application:

If the illuminated emergency stop device is fitted to a mobile control device and the mobile control device is used *only in hand-held applications*, the identifiability is deemed adequate when the requirements with respect to position, distance and viewing angle are limited to those **for the operator** (e.g. sufficient brightness at distances of up to 1 m, viewing angles of  $\pm 90^\circ$  from the frontal view of the emergency stop device, etc.).

## 2 Quality of monitoring

Owing to the requirement that *distinction must be possible between active and inactive emergency stop states* (ISO 13850:2015), the quality of monitoring of the illumination must also be evaluated.

Distinction can be made here between two fault cases:

- a. Emergency stop is inactive (the device is switched off or a malfunction has occurred), but the illumination of the emergency stop device indicates that it is active.
- b. Emergency stop is active, but the illumination indicates that it is not active.

In this context, Recommendation for Use (RfU) sheet<sup>1</sup> CNB/M/11.066 Rev02 [5] provides guidance on ISO 13850:2015 and proposes a qualitative distinction between the two cases:

*EN ISO 13850:2015, subclause 4.3.8, requires a measure to avoid confusion between active and inactive emergency stop devices. One of the possibilities given in the standard is device colour changing through illumination of the active emergency stop device.*

*Are there requirements for the functional safety of this illumination?*

*Solution:*

*Yes.*

*Critical situations are:*

*The illuminating element is active by fault, but the emergency stop device is inactive. This could lead to the operator trying to actuate the emergency stop with no effect.*

*The illuminating element has failed while the emergency stop device is still active. This could lead to the operator not using the emergency stop. This is a minor hazard.*

*Therefore, detecting whether the illumination is working correctly is safety-related.*

However, the RfU sheet does not consider the above requirement concerning the red colour of the active emergency stop device (IEC 60204-1:2016; clause 10.4).

In the IFA's view, distinction must also be made here between the following applications:

### **Stationary application:**

The emergency stop device is located in a *stationary position* on a machine.

- In this case, a qualitative distinction cannot be made between the two fault cases a) and b) stated above.
- The illumination must be monitored with the same quality (safety level) as the emergency stop function.
- Should a malfunction of the illumination be detected, the emergency stop function must be triggered as rapidly as possible and without other hazards being created.

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<sup>1</sup> Recommendations for use (RfU) sheets are drawn up by the Coordination Group for the Notified Bodies in Europe, and confirmed by the European Machinery Committee.

### Mobile application:

The emergency stop device is fitted to a mobile control device.

In this case, the view of the IFA is that based upon the RfU referred to above, distinction between the two fault cases a) and b) is possible.

- *Fault case a:* The emergency stop device is inactive, but the illumination of the device indicates that it is active.

For this case, the illumination must be monitored in the same quality as execution of the emergency stop function itself.

Should a malfunction of the illumination be detected, the emergency stop function must be triggered as rapidly as possible and without other hazards being created.

- *Fault case b:* The emergency stop device is active, but the illumination indicates that it is inactive.

Monitoring of the illumination may be implemented one quality level lower than the safety implementation of the emergency stop function itself; it must however satisfy at least Performance Level (PL) c.

Should a malfunction of the illumination be detected, the emergency stop function must be triggered without other hazards being created.

Should the mobile control device also be used in a stationary application, the same requirements apply as those for a stationary emergency stop device. Alternatively, an additional emergency stop device suitable for fixed installation may be fitted in direct proximity to the site of installation.

#### Note:

*The distinction between a mobile and a stationary emergency stop device is based upon the assumption that the emergency stop device on the mobile control device supplements the permanently installed emergency stop devices that are required in any event, and that it is intended primarily for the operator, to whom it must be identifiable, and not for further, uninvolved persons.*

- [1] Machinery Directive: [Directive 2006/42/EC](#) of the European Parliament and of the Council. May 2006. OJ EU L 157, 9 June 2006, pp. 24–86
- [2] ISO 13850:2015: Safety of machinery – Emergency stop function – Principles for design
- [3] IEC 60947-5-5:1997 + A1:2005 + A2:2016: Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function.
- [4] IEC 60204-1:2016 Safety of machinery – Electrical equipment of machines – Part 1: General requirements.
- [5] Co-ordination of Notified Bodies Machinery Directive 2006/42/EC + Amendment: RfU CNB/M/11.066 Rev02. June 2017