

GUIDELINE FOR
MANUFACTURERS
AND END USERS

Cableless control of machinery



ABBREVIATIONS

CCS	Cableless control system
ATS	Automatic stop
MD	Machinery Directive 2006/42/EU
MR	Machinery Regulation 2023/1230/EU

PREFACE

The purpose of this document is to describe requirements and limitations in the Cableless Control of machinery through devices that are not primarily designed for this purpose (e.g. mobile phones, tablets, etc.).

Requirements are taken from current standards & regulations (status March 2023) that refer to cableless control of machinery.

Current standards and regulations do not specifically exclude or differentiate mobile devices (e.g. mobile phone, tablet, laptop etc.). In general, these devices are not designed and suitable for safety-related machine control without additional measures.

This document aims to describe what type of functions can be executed with these mobile devices and distinguishing between safety related and non-safety related functions, and whether or not additional measures are required. Furthermore describing what technical requirements need to be met when using these devices in machinery control.

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FME-RNCM is FME's core group of machinery manufacturers and represents the interests of the machinery sector in the field of regulation, standardization and certification.



1 Introduction & scope

A Cableless Control System is defined in this document as an HMI (*Human-Machine-Interface*) that is connected to the controls of machinery where signals are not transferred through wires / cables.

'Cableless' can also be referred to as 'wireless' in other documentation; both refer to the same in this document.

The (portable) device to control machinery can be:

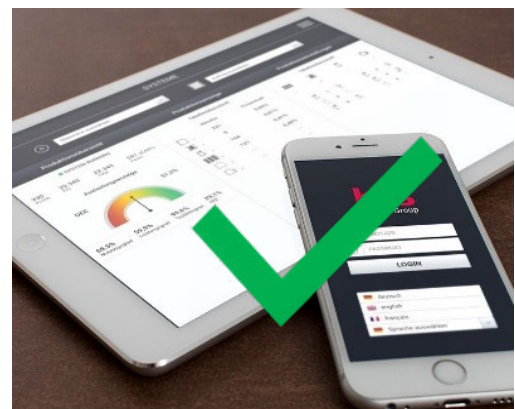
- **a device specifically designed for this purpose** (e.g. dedicated devices for overhead cranes)
- **a readily available device** (e.g. mobile phone, tablet, laptop etc.).

The scope of this document excludes:

- Cableless Control System elements specifically designed to operate as such; these are subject to standards (e.g. IEC 60447) and need to be used as indicated by the manufacturer.
- Hard-wired HMI solutions that include a touch screen with 'buttons' displayed on the HMI.
- Autonomously operating machines.



NOTE : This document does not aim to be complete, and no legal rights can be taken from it. It is the responsibility of the 'user' to fulfil rules and regulations. It r aims to provide guidance and direction for the design and use of a Cableless Control System.



2 Requirements when designing cableless control

SYSTEM / HARDWARE

- The use of a Cableless Control System requires always additional a hardwired start / stop control panel.
- An automatic stop shall be installed on the Cableless Control System and shall have a performance level that is the same or higher than the highest safety integrity provided by any other safety related stop initiated by the Cableless Control System. To determine the required level, applicable standards shall be used.
- There shall always be an emergency stop available on a fixed position on the machine, not being part or can be overruled by the the Cableless Control System.

CONTROLLING

- The Cableless Control System shall not be used to start the machinery. However it can be used to control movement (start / stop / speed / etc.) of the machinery when the (safety) initialization and main start have been executed by the main control system.
- *Note there is a difference between starting the machine and starting 'movement' of (parts of) the machine.* See table for an informative overview of functions that can be controlled by the Cableless Control System.
- The use of a Cableless Control System shall not override any part or function of the safety system.
- Only a deliberate and conscious action shall allow mobile devices to control machinery.
- Only one Cableless Control System device shall be allowed to actively control the machinery; using multiple Cableless Control System devices simultaneously is not allowed.
- The use of a Cableless Control System shall not de-activate any other emergency stop function.

CONNECTION

- Monitoring shall take place to assess the availability of an active connection, with an indication of the state of this connection. Indication of the state of the connection shall be unambiguous and available on the Cableless Control System (e.g. status light).
- A short time can be permitted for the Cableless Control System to not be 'connected'. This is based on a risk analysis but shall not exceed 0.5sec. An automatic stop shall be initiated when any other loss or fault in the communication is detected (e.g. when the disconnected time exceeds 0.5sec). To avoid hazardous situations, the control system can initiate a controlled stop instead of an emergency stop.
- Restoring a lost connection (due to e.g. temporary communication fail, reconnecting the wireless communication, power up of wireless communication, etc.) shall not initiate a start of the machinery, not initiate any hazardous function or motion (e.g. homing or move to initial position), nor shall it reset an (emergency) stop.
- Connecting to the control system shall only be possible via authorized mobile devices.
- Mobile devices shall be protected against unauthorized use.

INSTRUCTIONS (E.G. USER MANUAL)

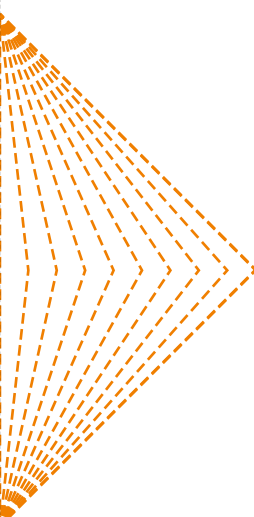
- The instructions shall describe how to use the Cableless Control System.
- The instructions shall adequately describe the responsibilities of the end-user / customer in training the operators using the Cableless Control System, including (but not limited to) granting access levels, training the operator, storage of Cableless Control Systems, respecting safety measures and distances when operating the Cableless Control System and arranging regular inspection intervals.

The table below gives an indication of what type of function can be allowed to be operated from approved devices (e.g. according to IEC 60447), non-approved devices (e.g. mobile phone tablet, laptop etc.) and non-approved devices with additional measures.

The table does not provide a complete overview of all functions but aims to indicate the applicability towards the various device executions.

Although not in scope, the approved devices are added for reference purpose.

Function	Approved Device	Non-approved Device	Non-approved Device with additional measures	
Safety functions			Additional Measure	
Initializing				Signal verification
Reset				Signal verification
System start / Initial start	✓	✗	✓	Signal verification
Emergency Stop	✓	✗	✓	Signal verification, additional hardware to include e-stop
Setting operating mode				Signal verification
Non-safety functions *)				
Process settings				None required
Process start (after system / initial start)	✓	✓	✓	
Controlled stop	✓	✓	✓	
Movement in manual mode	✓	✓	✓	
*) note: Safety related functions are handled in systems designed for fulfilling these functions appropriately.				



3 Standards and Regulations for Cableless Control

This section indicates standards and regulations that refer to Cableless Control System, with citations of the relevant sections in the standard or regulation.

MACHINERY DIRECTIVE (2006/42/EC)

1.2. Control systems

1.2.1. Safety and reliability of control systems.
...
For cable-less control, an automatic stop must be activated when correct control signals are not received, including loss of communication.

MACHINERY REGULATION 2023/1230/EU

1.2. Control systems

1.2.1. Safety and reliability of control systems. Control systems shall be designed and constructed in such a way as to prevent hazardous situations from arising.
...
For wireless control, a failure of the communication or connection or a faulty connection shall not lead to a hazardous situation.

EN ISO 12100:2010

General principles for design – Risk assessment and risk reduction

6.2.11 Applying inherently safe design measures to control systems
6.2.11.8 Principles relating to manual control
...
h) *For cableless control, an automatic stop shall be performed when correct control signals are not received, including loss of communication (see IEC 60204-1).*

EN IEC 60204-1:2018

Electrical equipment of machines - Part 1: General requirements

9.2 Control functions

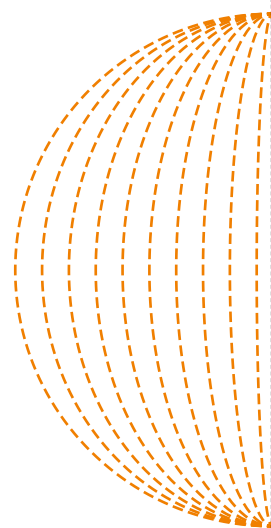
9.2.4 Cableless control system (CCS)
9.2.4.2 Monitoring the ability of a cableless control system to control a machine
The ability of a cableless control system (CCS) to control a machine shall be automatically monitored, either continuously or at suitable intervals. The status of this ability shall be clearly indicated (for example, by an indicating light, a visual display indication, etc.).

If the communication signal is degraded in a manner that might lead to the loss of the ability of a CCS to control a machine (e.g., reduced signal level, low battery power) a warning to the operator shall be provided before the ability of the CCS to control a machine is lost.

When the ability of a CCS to control a machine has been lost for a time that is determined from a risk assessment of the application, an automatic stop of the machine shall be initiated.

NOTE *In some cases, for example, in order to avoid this automatic stop generating an unexpected hazardous condition, it can be necessary for the machine to go to a predetermined state before stopping.*

Restoration of the ability of a CCS to control a machine shall not restart the machine. Restart shall require a deliberate action, for example manual actuation of a start button.



EN 62745:2017**Safety of machinery - Requirements for cableless control systems of machinery**

4.6 Safety-related functions of the CCS
Functions of the CCS that are intended for safety-related applications shall

Functions of the CCS that are intended for safety-related applications shall have an appropriate safety integrity. The requirements of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply. Upon detection of faults, all relevant safety-related output shall be controlled to OFF-state. In addition the detection of a fault in the remote station that can lead to the loss of a safety related function, shall cease the transmission.

4.7.3.5 Automatic stop (ATS) function

The ATS function of the CCS shall initiate an OFF-state of all safety-related stop output(s) at the base station, so as to prevent hazardous operation(s) of the machine. See Table 3.

NOTE 1 The stop outputs affected by the ATS function can be the same as those that are switched to the OFF-state by the GSS function and/or the EMS function.

The ATS function of a CCS is a safety-related control function. The ATS function shall have a safety integrity that is not less than the highest safety integrity of any other safety-related stop functions provided by the CCS. The ATS function of the CCS shall be automatically initiated under conditions that include, but are not limited to:

- when a fault in a safety-related part of the CCS is detected;
- when no valid signal has been detected at a base station (and where necessary in accordance with risk assessment at a remote station in a CCS with bi-directional communication) within a time period declared by the CCS manufacturer.
- This time period shall be determined by a risk assessment at the machine, but should not exceed 0,5 s;
- when transmission ceases (see 4.9).

NOTE 2 Potential consequences of loss of ability to control the machine during this time period and the effect on the overall machine stopping time can be considered by the machine control system designer or manufacturer.

Annex A (informative) Logic of stop functions
Sequence 5 represents a further type of automatic stop (3.19), in which a passive stop and the resulting OFF-state is automatically initiated at the base station. For example, the remote station is moved outside of the operating range, i.e. too far from the base station, which automatically initiates an OFF-state at the base station because a valid signal is absent.

ISO 13850:2015 EN ISO 13850:2015**Safety of machinery - Emergency stop function - Principles for design.****4.3 Emergency stop device**

4.3.8 When emergency stop devices are installed on detachable or cableless operator control stations (e.g. pluggable portable teaching pendants), at least one emergency stop device shall be permanently available (e.g. in a fixed position) on the machine. In addition, at least one of the following measures shall be applied to avoid confusion between active and inactive emergency stop devices:

- device color changing through illumination of the active emergency stop device;
- automatic (self-actuating) covering of inactive emergency stop devices; where this is not practicable, manually-applied covering may be used, provided that the cover remains attached to the operator control stations;
- provision of proper storage for detached or cableless operator control stations.

The instructions for use of the machine shall state, which measure has been applied in order to avoid confusion between active or inactive emergency stop device(s). The correct operation of this measure shall be explained.

4.3.9 Where emergency stop devices are cableless or integrated into cableless operator control stations, the relevant requirements of IEC 60204-1 shall apply in addition to the requirements of this International Standard

4.6 Portable operator control stations

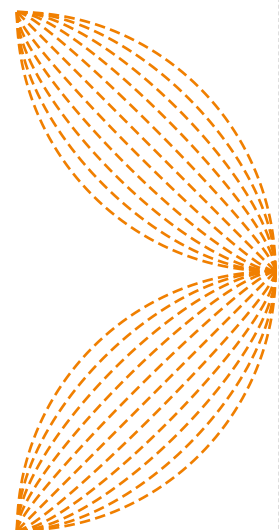
4.6.1 Emergency stop functions on portable operator control stations

While the portable operator control station is in control of a machine, all emergency stop devices shall be active (see also 4.3.8). The effect of unplugging and plugging in of detachable operator control station(s) shall be considered in the risk assessment.

4.6.2 Emergency stop reset for cableless operator control stations

Restoration of power after an interruption or failure of parts of a cableless control system shall not result in a reset of an emergency stop condition previously initiated by a cableless emergency stop device.

When an emergency stop has been initiated with a cableless control device, reset shall be possible only after the emergency stop device is disengaged from the latched-in position. Unless the span of control of the emergency stop device can be observed, in addition to the disengaging of the emergency stop actuator on the portable control station, one or more supplementary fixed reset devices on or around the machinery shall be provided to ascertain that the reason for emergency stopping has been cleared.





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