BRITISH STANDARD

BS EN
60447:2004

Basic and safety principles for man-machine interface, marking and identification — Actuating principles

The European Standard EN 60447:2004 has the status of a British Standard

ICS 29.020

National foreword

This British Standard is the official English language version of EN 60447:2004. It is identical with IEC 60447:2004. It supersedes BS EN 60447:1994 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/16, Terminal marking and other identifications, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

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EUROPEAN STANDARD **EN 60447**

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English version

Basic and safety principles for man-machine interface, marking and identification – Actuating principles
(IEC 60447:2004)

Principes fondamentaux et de sécurité pour l'interface homme-machine, le marquage et l'identification – Principes de manoeuvre
(CEI 60447:2004)

Grund- und Sicherheitsregeln für die Mensch-Maschine-Schnittstelle, Kennzeichnung – Bedienungsgrundsätze
(IEC 60447:2004)

This European Standard was approved by CENELEC on 2004-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

The text of document 16/419/FDIS, future edition 3 of IEC 60447, prepared by IEC TC 16, Basic and safety principles for man-machine interface, marking and identification, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60447 on 2004-03-01.

This European Standard supersedes EN 60447:1993.

This European Standard includes the following significant changes with respect to EN 60447:1993:

- requirements concerning rotating actuators have been added;
- requirements concerning work with display screen equipment have been added.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-12-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-03-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60447:2004 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

ISO 9241-15	NOTE	Harmonized as EN ISO 9241-15:1997 (not modified).
ISO 9241-17	NOTE	Harmonized as EN ISO 9241-17:1998 (not modified).
ISO 11064-1	NOTE	Harmonized as EN ISO 11064-1:2000 (not modified).
ISO 11064-2	NOTE	Harmonized as EN ISO 11064-2:2000 (not modified).
ISO 11064-3	NOTE	Harmonized as EN ISO 11064-3:1999 (not modified).

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CONTENTS

INTRODUCTION

This basic safety publication is intended for use by technical committees in the preparation of standards; it is not intended to be used on its own except in the absence of such standards.

Where no safety consideration is involved, the relevant technical committee may permit specific exclusions within the framework of this basic safety publication, and according to the rules given in IEC Guide 104 and ISO/IEC Guide 51.

Different kinds of actuators enable electrical equipment and processes to be operated and maintained under normal and fault conditions.

In modern equipment, the moving of an actuator in a certain direction is only one method of actuation. In addition, actuators or data input devices arranged in the form of function or alphanumeric keyboards, or other kinds of actuator (e.g. light pen, touch sensitive screen, mouse), are in general use for computerized equipment.

Actuators as a part of the man-machine interface may have a different importance in the dialogue between the operator and the equipment or machine.

Standardization is especially important where safety is concerned (e.g. where an incorrect actuation may cause damage, or where a frequent or rapid actuation is necessary, such as in the operation of cranes or transport vehicles), and is particularly necessary in the case of equipment likely to be operated by unskilled persons.

Ergonomic aspects should also be taken into account.

BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE, MARKING AND IDENTIFICATION – ACTUATING PRINCIPLES

1 Scope

This International Standard establishes general actuating principles for manually operated actuators forming part of the man-machine interface associated with electrical equipment, in order to:

– increase the safety (e.g. of persons, property, environment) through the safe operation of the equipment;

– facilitate the proper and timely operation of the actuators.

These principles apply, not only for the operation of electrical equipment, machines, or complete plant under normal conditions, but also under fault or emergency conditions.

This standard is for general application, from simple cases such as single actuators (e.g. push-buttons) to multiple actuators, forming part of a large assembly of electrical and non-electrical equipment, or part of a central process control station.

This standard establishes correlations between the function of an actuator and its direction of actuating or location in relation to other actuators.

In the absence of particular rules, this standard may also be applied to actuators operated by a part of the human body other than the hand (e.g. to foot-operated devices).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050(721), *International Electrotechnical Vocabulary (IEV) – Chapter 721: Telegraphy, facsimile and data communication*

IEC 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
actuator
part of the actuating system which receives a human actuating action

NOTE 1 The actuator may take the form of a handle, knob, push-button, push-push button, push-pull button, roller, plunger, mouse, light pen, keyboard, touch sensitive screen.

NOTE 2 The definition of an actuator is based on IEV 441-15-22 and, for the purposes of this standard, is narrowed to human actuation.

3.1.1
monofunction actuator
one or a set of actuators correlated to one final effect (e.g. by direction of movement, or by disposition of actuators)

3.1.2
multifunction actuator
one or a set of actuators alternately correlated to different final effects (e.g. by direction of movement, or by disposition of actuators)

3.2
keyboard
arrangement of keys (typing or function keys) laid out in a specified manner

3.2.1
numeric keyboard
arrangement of keys representing numerals

3.2.2
alphanumeric keyboard
arrangement of keys representing a set of characters, e.g.:

– letters of the latin alphabet (A to Z);
– digits (0 to 9);
– non-printing graphic space;
– punctuation signs and other graphics, as required

3.2.3
function keyboard
arrangement of keys representing certain equipments, machines, functions or commands

3.3
man-machine interface (MMI)
parts of the equipment intended to provide a direct means of communication between the operator and the equipment, and which enable the operator to control and monitor the operation of the equipment

NOTE Such parts may include manually operated actuators, indicators and screens.

3.4
signal
visual, acoustic or tactile message conveying information

3.4.1
visual signal
message conveyed by means of brightness, contrast, colour, shape, size or position

3.4.2
acoustic signal
message conveyed by means of tone, frequency and intermittency, emanating from a sound source

3.4.3
tactile signal
message conveyed by means of vibration, force, surface roughness, contour or position

3.5
visual display terminal (VDT)
equipment by which users interact with a computer system. The term VDT includes both the visual display unit (VDU) and means for inputting information to a computer system, most commonly by means of a keyboard. The term VDT also includes any other electronic equipment (e.g. mouse, light pen, track ball) required to support the terminal

3.6
XY-VDU controller
free moving actuator to select a specific area on a screen, which represents a certain equipment or command

NOTE This actuator may take the form of a joystick, mouse, track ball, light pen or touch sensitive screen.

3.7
message
group of characters and function control sequences which is transferred as an entity from a transmitter to a receiver, where the arrangement of the characters is determined at the transmitter

[IEV 721-09-01]

4 General requirements

4.1 Basic principles

4.1.1 The application of the actuating principles, disposition and sequence of actuators given in this standard shall be considered at an early stage of equipment design, and shall be applied in an unambiguous manner, especially within the same plant or installation. The type, form, and size of an actuator, and its arrangement, shall be chosen to meet the requirements of its intended function and the servicing and operating conditions. It shall take into account the skill of the user, limitations in manoeuvrability, ergonomic aspects and the required level of prevention of unintended operation. Signals presented should meet the needs of the users for the monitoring and control tasks which they are required to perform.

NOTE A list of some relevant standards is given in the bibliography.

4.1.2 Actuators shall be unambiguously identifiable (see Clause 6) under all specified conditions, and shall be positioned to permit safe and timely operation.

4.1.3 It shall be possible to execute a command only by the intended operation of an actuator provided for this purpose. Measures should be provided to reduce the probability of inadvertent operation.

4.1.4 It should not be possible for the action of the user to lead to an undefined or hazardous state of the equipment or condition of process. Measures shall be provided to prevent an inadvertent, undefined or hazardous state.

4.1.5 Actuators and their corresponding indicators shall be arranged according to the principles of this standard, and preferably according to their functional correlation.

4.1.6 The method of dialogue used in the man-machine interface shall take into account the ergonomic aspects relevant to the task.

4.1.7 To avoid the consequences of operator errors, it is recommended to consider the following measures:

– defined command priority (e.g. stop to have priority over start);
– simplification of actuator operating sequence (e.g. through automation);
– control interlocking (e.g. two-hand control);
– starting under reduced hazard conditions (e.g. reduced travel, reduced speed, reduced pressure, reduced torque).

4.1.8 Actuators shall be logically grouped, according to their operational or functional correlation, for controlling a process, machine or equipment. These principles shall be consistently applied within all operating areas of a process, machine or equipment.

The arrangement shall be structured to simplify the identification and to minimize the probability of incorrect actuation arising from human errors.

One or more of the following grouping principles shall be used:

– grouping by function or interrelationship;
– grouping by sequence of use;
– grouping by frequency of use;
– grouping by priority;
– grouping by operating procedures (normal or emergency);
– grouping by modelling the plant/machine layout.

The grouping principles used should be such as to enable the user, when suitably trained, to form a mental model of the system.

All start actuators shall be positioned in association with the stop actuator for the same function.

Mirror symmetric layouts of panels, controls and indicators shall be avoided.

Associated sets of actuators shall be arranged according to their priority levels, e.g.:

highest priority: top/left;

lowest priority: bottom/right.

4.1.9 Actuators having a rotating operation shall be mounted to prevent rotation of the stationary member. Friction alone shall not be considered to be sufficient.

4.2 Operating sequence

A three-step principle characterizes the sequence of actuations and the correlated indications:

– step 1: selection of a function/equipment/device;

– step 2: selection of the appropriate command;

– step 3: execution of the command.

The three steps may be applied as follows.

a) With discrete groups of actuators: each group being concerned with one function or equipment, including the execution of the command (monofunction). An example of this application is given in Figure 1.

b) With two groups of actuators: the first being for the selection of the function/equipment/ device, and the second for the selection of the appropriate command; and with an additional actuator separated from these groups for the execution of the command (multifunction). An example of application is given in Figure 2.

It can be necessary to indicate the status of the selected equipment as a basis for the next requested command.

It can be necessary to confirm each selected step.

After executing the command, a clear and unambiguous confirmation of the final effect of the processing of the command shall be provided as rapidly as necessary.

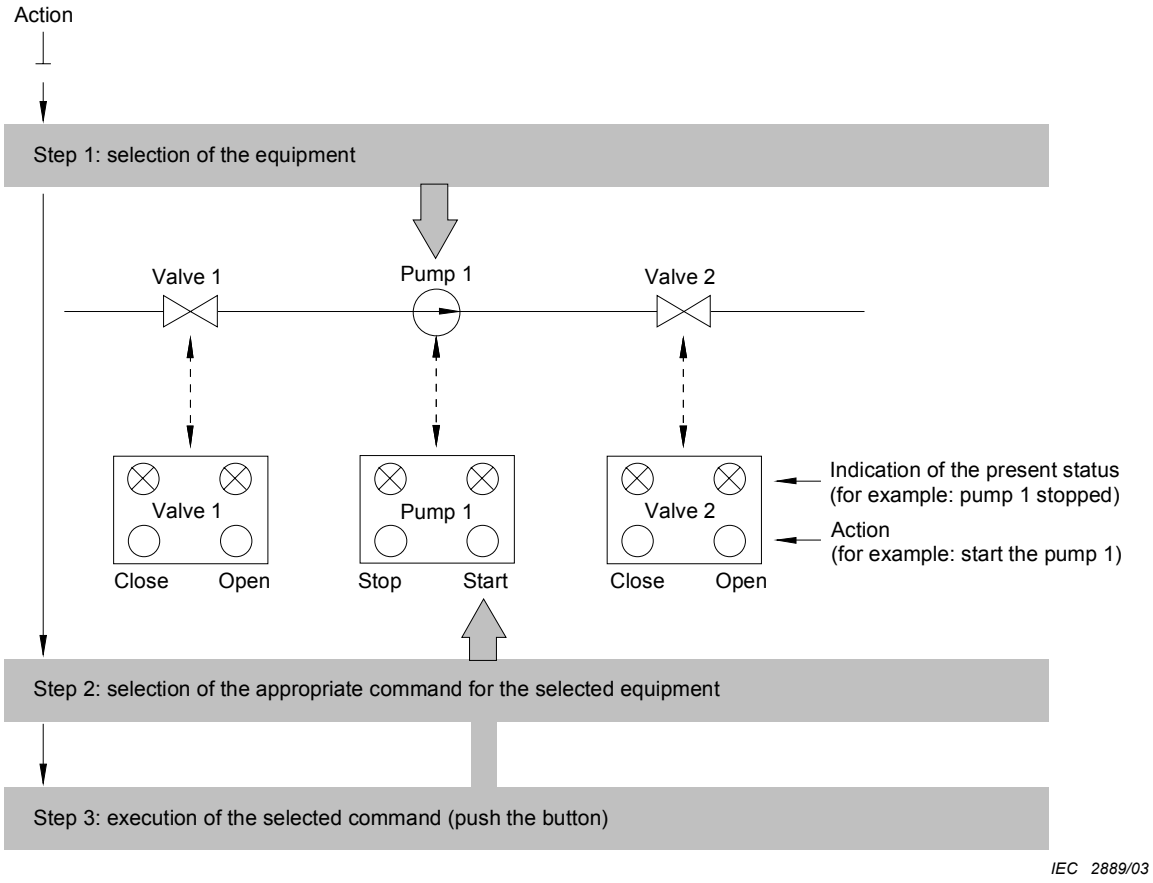


Figure 1 – Three-step actuation sequence for monofunction application

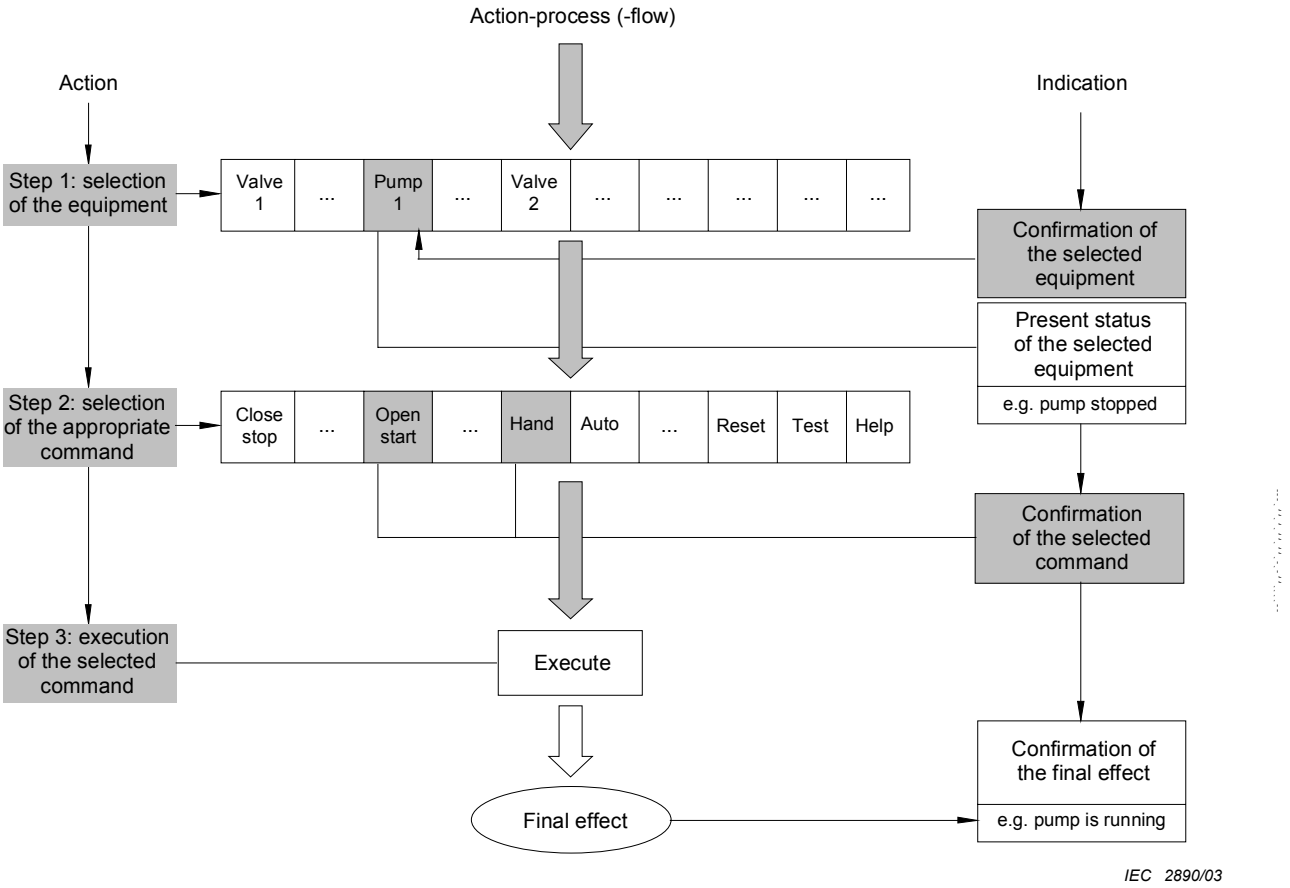


Figure 2 – Three-step actuation sequence for multifunction application

5 Actions and effects

As far as possible, the necessary action of an actuating system should be correlated to the required final effects, according either to the operating direction (movement) of an actuator or to the relative location of actuators.

The final effects (in many cases physical or mechanical effects) resulting from actions on actuators can be classified normally into two groups of final (mostly opposite) effects (see 5.1):

– increasing effects;
– decreasing effects (see Table A.2).

In many cases an actuator is related to a final effect which cannot be classified (see 5.4).

5.1 Actions to initiate opposite effects

Two opposite actions can be performed by using one of the following methods (see also 7.1):

a) Using one actuator with two operating directions (e.g. handwheel).
b) Using a set of actuators, each with only one operating direction (e.g. push-buttons).

5.1.1 Correlation according to the operating direction (movement) of an actuator

The final effect should be increased when the actuator is operated or moved in the following directions, e.g.:

– left to right;
– bottom to top;
– clockwise;
– away from the operator (exception: pull in the case of push-pull buttons, see 7.2).

The final effect should be decreased by the opposite action.

When the final effect is a motion visible to the operator, it is recommended that the movement of the actuating hand be in the same direction as the intended motion (see Table A.1: Direction of action).

NOTE The movement of an XY-VDU controller is correlated to the movement of the cursor on a screen.

5.1.2 Correlations according to the relative location of actuators

Associated actuators controlling the same equipment should be arranged so that actuators causing an increase in the final effect are located, e.g.:

– on the right of;
– above;
– behind their associated actuators;
(see Table A.1: Point of application of action).

5.2 Stopping an effect

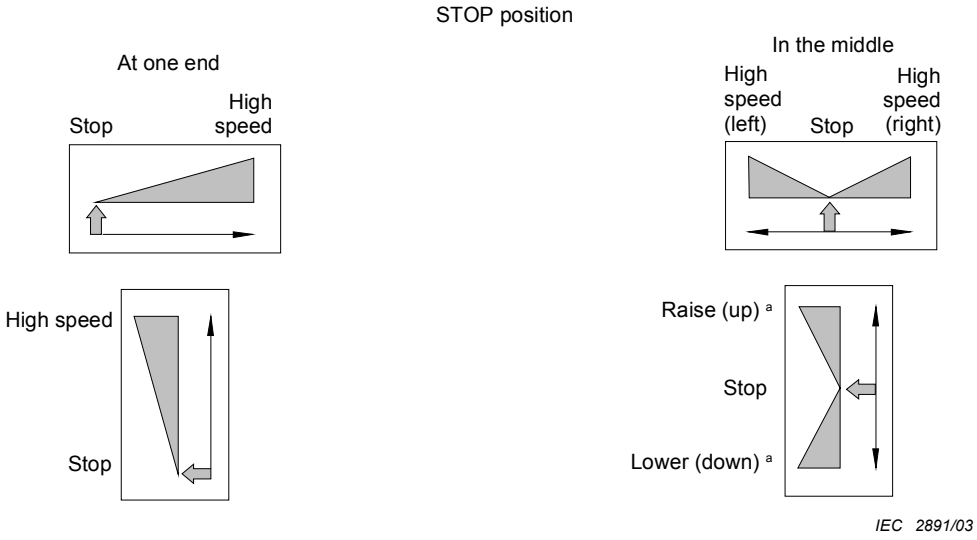
In some cases, a certain position of an actuator may correspond to the desired STOP effect (for emergency STOP see 5.3).

a) If the effect resulting from the operation of an actuator depends on its linear or angular movement (see Figure 3), then the STOP position shall be:
   - at the left, lower or anticlockwise end of the range of movement where movement away from the STOP position is possible in one direction only;
   - in the middle of the range of movement where movement away from the STOP position is possible in two opposite directions.

b) For a set of actuators (e.g. set of push-buttons) which causes one effect only (with or without intermediate steps; see Figure 4, left), the actuator for the operational STOP shall be positioned at the left, or the lower end of the set.

   For a set of actuators which causes opposite directions of an effect, the actuator for the operational STOP shall be positioned between the opposing actuators (see Figure 4, right).

NOTE In the USA, the actuator for the operational STOP is positioned at the right, or the lower end of the set.



a For the purposes of this standard, this resulting effect can only be obtained if the actuator is moved vertically.

Figure 3 – STOP position as part of a moving actuator (example for a linear motion)

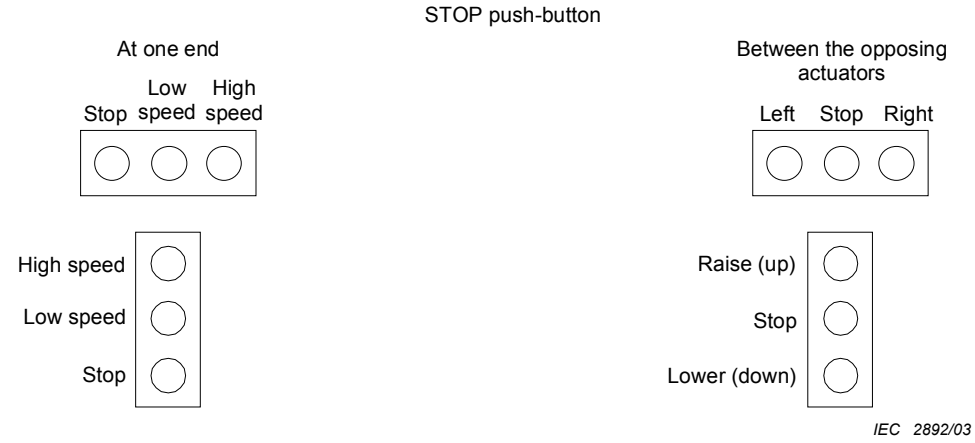


Figure 4 – STOP push-button as part of a set of actuators

5.3 Emergency STOP actuator

An emergency STOP actuator is a special case of an actuator intended to initiate a STOP function in order to avoid a hazardous condition, damage to a machine or work in progress.

Requirements for emergency STOP actuators:

– the emergency STOP function shall be available at all times;
– the emergency STOP actuator shall be located where emergency shutdown is required in such a manner as to ensure easy access and non-hazardous operation;
– when actuated, the actuator system shall remain in that state until it is reset manually;
– the actuator shall be clearly visible and identifiable.

If the actuator is a pushbutton, the emergency STOP function shall be achieved by pressing the button.

NOTE For special requirements for the use of colours (e.g. for emergency STOP actuator and its immediate background), see IEC 60073.

5.4 Actions to initiate only one effect

In many cases an actuator is related to one final effect only, such as reset, test, help, alarm, acknowledgement.

These final effects of given commands by an actuator cannot be classified as increase/ decrease effects. The arrangement of these actuators should follow the basic principles of actuators given in 4.1.

6 Actuator identification requirements

Actuators relevant to safety shall be identified on or near the actuator by visual information (e.g. graphical symbols, colours, letters according to ISO or IEC standards, if available).

NOTE A list of some relevant standards is given in the bibliography.

Additional tactile or acoustic information may also be provided, in accordance with IEC 60073. This identification shall be easy to recognize and unambiguous concerning its meaning, the final effect, and its correlation to the actuator and, if relevant, to the position thereof.

6.1 Visual signal

In order to be received, a visual signal shall fall within the visual field of the operator during the necessary operation.

A visual signal should only have one meaning but may have different meanings under specified conditions. In the case of a special safety meaning, the colours of an actuator and its background colour, if any, shall comply with IEC 60073.

6.2 Acoustic signal

An acoustic signal may be given as a response to the operation of an actuator, especially for routine actions. The use of an acoustic signal as the sole means of identifying an actuator is not recommended.

If used, the nature and volume of an acoustic signal shall be adequate for the anticipated ambient noise level and the distance from the operator's intended operating position.

To ensure recognition of the acoustic signal, the signal should persist or be repeated until the intervention of the operator, when used to indicate safety-related information which requires an operator action. When an acoustic signal is used to indicate safety-related information, no means should be provided to reduce the volume of the signal to an inaudible level.

The meaning of an acoustic signal should be clear and unambiguous to the operator.

6.3 Tactile signal

Tactile signals can be necessary under certain conditions:

– where it is necessary to identify safety-related actuators under conditions of reduced visibility (e.g. darkness, smoke);
– under normal conditions where the operator is unable to keep the actuator within his field of view;
– under normal conditions for ergonomic reasons, to avoid operator errors.

The information transmitted through the tactile sense to the operator shall be independent of the use of the operator's visual or audible senses.

Tactile identification shall clearly and unambiguously identify the necessary element(s) for actuation.

The information given by a tactile signal should be clear and unambiguous to the operator.

The meaning of each tactile identification shall be described on the equipment and in the operating instructions to be provided with the equipment.

7 Requirements for special kinds and particular use of actuators

7.1 Single actuator for combined start/stop control

Such actuators may be used for non safety-related functions where it is required to operate two opposite effects by means of one actuator (e.g. push-button) only.

Where such actuators are used, it is recommended to provide a continuous indication of the relevant equipment or machine status in order that the final effect of a subsequent command can be foreseen.

7.2 Push-pull buttons

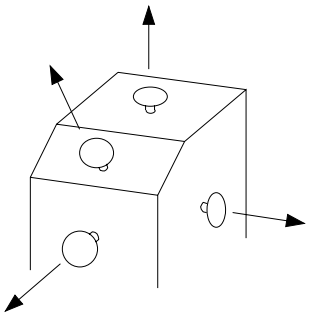
The direction of actuating push-pull buttons shall considered in relation to the surfaces on which they are mounted:

– movement away from the surface, or pull, is an increasing action, as is shown in Figure 5;

– movement towards the surface, or push, is a decreasing action.

NOTE A push-pull emergency stop button is in line with the requirements of this standard as “PUSH” initiates the action “stop” and “PULL” terminates the action “stop”.

The arrows in the figure are related
to an increasing final effect

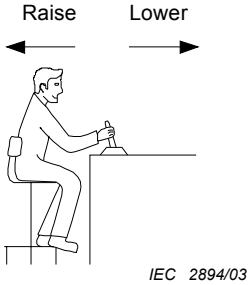


IEC 2893/03

Figure 5 – Push-pull buttons

7.3 Raise and lower with a lever

To raise and lower an object by means of an actuator (lever) for which the motion of the hand is practically horizontal, going forward or backward, the practice shown in Figure 6 is usual and recommended.



IEC 2894/03

Figure 6 – Raise-lower with a horizontal mounted lever

7.4 Foot-operated actuators

Foot-operated actuators used as start devices shall be constructed and mounted so as to minimize inadvertent operation.

The foot shall be guided, e.g. by a mechanical guard.

For emergency stop devices, the pedal shall not be fitted with a mechanical guard.

7.5 Numeric/alphanumeric keys

The use of these keys as actuators requires a coding system to correlate a key or a successive use of keys to a certain command or function, which should be clear, unequivocal, and easy for the user to learn in relation to the process.

The coding system shall be clearly described in the associated documentation.

This kind of key shall not be used for safety related commands, or functions which require a quick operation.

7.6 Function keys

Function keys form part of a keyboard, and consist of keys or push-buttons which are used to activate a special function or command in a particular application. They are usually correlated to repeatedly used functions. The correlated commands or allocated functions shall be in line with the requirements of Clause 5.

The result of actuation shall be displayed.

The application correlated to the function keys shall be clearly identified on or near the actuator and in the associated documentation.

7.7 Sensitive areas (actuators) on a visual display unit (VDU)

Where an actuator is in the form of a sensitive area on a display screen (e.g. activated with the aid of a cursor or light pen, or by touching with a finger), the following requirements shall be met.

NOTE Further requirements may exists for example in standards listed in the bibliography.

7.7.1 The dimensions of each sensitive area - especially touch fields - shall be sufficiently large to permit rapid and unambiguous identification by the user, and convenient positioning of the relevant means of activation.

7.7.2 An area for a safety function shall be larger than a normal field and spare, or free, positions (horizontal and vertical) shall be provided between this and other actuators.

7.7.3 Actions which could lead to an undefined or hazardous state shall be protected against unintended effects of accidental touching of a sensitive area.

NOTE This can be achieved, for instance, by:

– two-hand control;

– using an enabling device;

– activating the commands when the finger is removed from the appropriate part of the screen surface and not when the finger is applied;

– requiring the operator to confirm the input by a second actuation.

7.7.4 The relationship between the visual confirmation of the selected equipment, machine, or command and the selection area shall be unambiguous, preferably in the same location.

7.7.5 The execute command shall be given by a separate actuator or by a second actuation of the same actuator. Provisions against unintentionally “double-clicks” shall be given.

7.7.6 In the case of a special safety meaning, the colours employed by a display screen shall comply with IEC 60073.

7.7.7 Provision of an emergency stop function on the display does not supersede the requirements of 5.3.

NOTE National legislation may prohibit the application of emergency operation based on actuation on VDUs.

Annex A
(normative)

Classification of, and correlation between, actions and their resulting final effects

Table A.1 – Classification of actions

<table>
<tr><th colspan="2" rowspan="2">Nature of actuator</th><th colspan="2" rowspan="2">Nature of action</th><th colspan="2">Direction of action</th></tr>
<tr><th>Group 1</th><th>Group 2</th></tr>
<tr><td colspan="2">Handwheel, handle, knob, etc.</td><td colspan="2">Rotation</td><td>Clockwise</td><td>Anticlockwise</td></tr>
<tr><td colspan="2" rowspan="3">Grip, lever, push-pull button, etc., with essentially linear motion [a)]</td><td colspan="2">Vertical motion</td><td>Upwards</td><td>Downwards</td></tr>
<tr><td rowspan="2">Horizontal motion</td><td>Right-left</td><td>To the right</td><td>To the left</td></tr>
<tr><td>Forward-backward[b)]</td><td>Away from the operator</td><td>Towards the operator</td></tr>
<tr><th colspan="2" rowspan="2">Nature of actuator set</th><th colspan="2" rowspan="2">Nature of action</th><th colspan="2">Point of application of action</th></tr>
<tr><th>Group 1</th><th>Group 2</th></tr>
<tr><td rowspan="2">Set of grips, push-buttons, rods, pull cords, etc., with opposite effects</td><td>One above the other</td><td colspan="2" rowspan="2">Pressure, traction, etc.</td><td>Action on upper device</td><td>Action on lower device</td></tr>
<tr><td>One beside the other</td><td>Action on right device</td><td>Action on left device</td></tr>
<tr><th colspan="2">Nature of actuator set</th><th colspan="2">Nature of action</th><th colspan="2">Classification of action</th></tr>
<tr><td colspan="2">VDT with XY-VDU controller</td><td colspan="2">Movement and actuation (click)</td><td colspan="2" rowspan="3">Direction of action and point of application: not classified [c)]</td></tr>
<tr><td colspan="2">Keyboard</td><td colspan="2">Typing of keys</td></tr>
<tr><td colspan="2">Sensitive area</td><td colspan="2">Touching</td></tr>
<tr><td colspan="6">[a)] For push-pull buttons, see 7.2.
[b)] For "raise and lower" with a lever, see 7.3.
[c)] As far as possible, the rules of the upper part of Table A.1 shall be applied.</td></tr>
</table>

Table A.2 – Classification of final effects

Nature of effect	Resulting final effect	
	Group 1	Group 2
Modification of a physical quantity (voltage, current, power, speed, frequency, temperature, luminous intensity, etc.)	Increase	Decrease
Change of condition	Put into service Start Accelerate Close an electrical circuit [a)] Ignite	Put out of service Stop Brake Open an electrical circuit [b)] Extinguish
Motion of the object or vehicle controlled in relation to its principal axis	Upwards [c)] To the right Forwards	Downwards [c)] To the left Backwards
Motion in relation to the operator	Away from the operator [c)]	Towards the operator [c)]

a) And open the associated grounding circuit, if combined.

b) And close the associated grounding circuit, if combined.

c) For "raise and lower" with a lever, see 7.3.

Annex B
(informative)

Typical examples of monofunction actuators

B.1 Kinds of actuators

In Table B.1, typical examples of actuators are shown; an arrow in each figure shows the classified action which results in the final effect (according to Table A.2).

The operating direction is understood to be determined by a person standing at the operating place and looking towards the actuator. The operating place in each of the figures of the table is indicated by the position of the figure number.

B.1.1 Rotation

If a rotating handle is combined with an angular indicator, the movement is always considered as a rotation (see Example 15 in Table B.1).

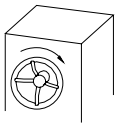
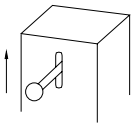
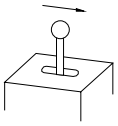
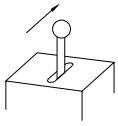
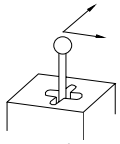
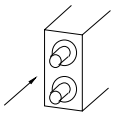
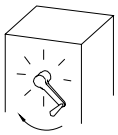
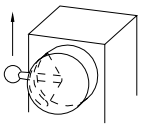
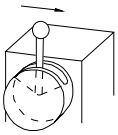
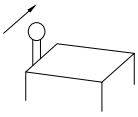
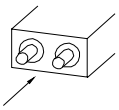
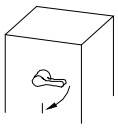
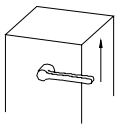
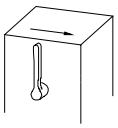
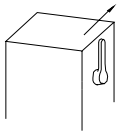
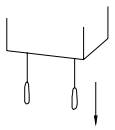
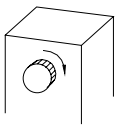
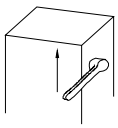
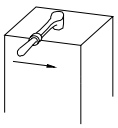
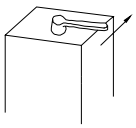
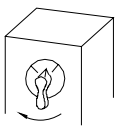
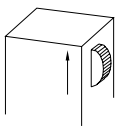
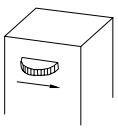
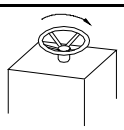
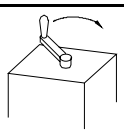
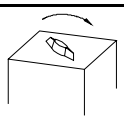
A movement from one of the three principal axes to another, as shown in Example 13, is considered as a rotation.

B.1.2 Linear motion

A movement practically parallel to a principal axis, i.e. equally distributed on both sides of another axis, where the total permissible angular movement does not exceed 120°, is considered a linear motion (see Examples 22, 23, 24, 32, 33, 34, 42, 43 and 44).

Where the angular displacement is small (Examples 21, 31, 41 and 51), or where only a small part of the periphery of a rotating actuator is accessible or visible, such as a handwheel situated partly in an enclosure, or a knob recessed behind a slot (Examples 25 and 35), the actuator is considered as having a linear motion.

Table B.1 – Examples of movement of some types of actuators

Movement [a]					
Angular (rotary)	Linear				Set of actuators
	Vertical [b]	Horizontal: sideways [b]	Horizontal: fore and aft [b]	Combined directions [b]	
 11	 21	 31	 41	 51	 61
 12	 22	 32	 42		 62
 13	 23	 33	 43		 63
 14	 24	 34	 44		
 15	 25	 35			
 16					
 17					
 18					

[a] In each case, the operator is considered to be in the place of the figure number, and the arrow relates to a Group 1 action.

[b] In certain circumstances, an angular (rotary) movement is considered to be linear, see B.1.2.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-721	- [1)]	International Electrotechnical Vocabulary (IEV) Chapter 721: Telegraphy facsimile and data communication	-	-
IEC 60073	- [1)]	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002 [2)]
IEC Guide 104	- [1)]	The preparation of safety publications and the use of basic safety publications and group safety publications	-	-
ISO/IEC Guide 51	- [1)]	Safety aspects - Guidelines for their inclusion in standards	-	-

1) Undated reference.

2) Valid edition at date of issue.

Bibliography

IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

ISO 9241, *Ergonomic requirements for office work with visual display terminals (VDTs) –*
Part 14: Menu dialogues
Part 15: Command dialogues
Part 16: Direct manipulation dialogues
Part 17: Form filling dialogues

ISO 9355-1, *Ergonomic requirements for the design of displays and control actuators – Part 1: Human interactions with displays and control actuators*

ISO 11064, *Ergonomic design of control centres –*
Part 1: Principles for the design of control centres
Part 2: Principles for the arrangement of control suites
Part 3: Control room layout

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