BS EN 62744:2015

BSI Standards Publication

Representation of states of objects by graphical symbols

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National foreword

This British Standard is the UK implementation of EN 62744:2015. It is identical to IEC 62744:2014.

The UK participation in its preparation was entrusted to Technical Committee GEL/3, Documentation and graphical symbols.

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

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EN 62744

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English Version

Representation of states of objects by graphical symbols (IEC 62744:2014)

Représentation d'états d'objets par des symboles graphiques
(IEC 62744:2014)

Darstellung von Objektzuständen mittels grafischer Symbole
(IEC 62744:2014)

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

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Foreword

The text of document 3/1194A/FDIS, future edition 1 of IEC 62744, prepared by IEC/TC 3 "Information structures, documentation and graphical symbols" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62744:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-10-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-01-01

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Endorsement notice

The text of the International Standard IEC 62744:2014 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:

IEC 60447:2004	NOTE	Harmonized as EN 60447:2004 (not modified).
IEC 61082-1:2006	NOTE	Harmonized as EN 61082-1:2006 (not modified).
IEC 61310-1:2007	NOTE	Harmonized as EN 61310-1.
IEC 61355	NOTE	Harmonized as EN 61355.
IEC 61966-2-1:1999	NOTE	Harmonized as EN 61966-2-1:2000 (not modified).
IEC 61966-2-1:1999/A1:2003	NOTE	Harmonized as EN 61966-2-1:2000/A1:2003 (not modified).
IEC 62542:2013	NOTE	Harmonized as EN 62542:2013 (not modified).
IEC 62682:2014	NOTE	Harmonized as EN 62682:2014 [1)] (not modified).
IEC 80416-1:2008	NOTE	Harmonized as EN 80416-1:2009 (not modified).
IEC 81346-1:2009	NOTE	Harmonized as EN 81346-1:2009 (not modified).

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IEC 81714-2:2006	NOTE	Harmonized as EN 81714-2:2007 (not modified).
ISO/IEC 81714-1:2010	NOTE	Harmonized as EN ISO 81714-1:2010 (not modified).
ISO 7731:2003	NOTE	Harmonized as EN ISO 7731:2008 (not modified).
ISO 24502:2010	NOTE	Harmonized as EN ISO 24502:2010 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60073	2002	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002
IEC 60417	-	Graphical symbols for use on equipment	-	-
IEC 60617	-	Graphical symbols for diagrams	-	-
IEC 61360-4	-	Standard data element types with associated classification scheme for electric components - Part 4: IEC reference collection of standard data element types and component classes	EN 61360-4	-
IEC Guide 108	-	Guidelines for ensuring the coherency of IEC publications - Application of horizontal standards	-	-
ISO 7000	-	Graphical symbols for use on equipment - Registered symbols	-	-
ISO 14617	series	Graphical symbols for diagrams	-	-

CONTENTS

INTRODUCTION

This international standard deals with the representation of operational states of objects by standardized graphical symbols. The graphical symbols presented in standards like IEC 60417, IEC 60617 and ISO 14617 are actually presented in a static form. This standard establishes rules and recommendations for how objects being represented by graphical symbols can be presented with a dynamic behaviour indicating the operational states of objects occurring in practice. This standard provides guidance for developers and designers of graphical symbols, for example in IEC 60617, ISO 14617, IEC 60417 or any other pictorial representation of an object if being requested to consider additional forms for the presentation of operational states.

This standard also provides information relevant to designers of HMI systems, to be installed in rooms with appropriate ambient conditions (e.g. used for supervising systems).

This standard does not define rules for the design of static graphical symbols for diagrams as provided in IEC 61082 and the ISO/IEC 81714 series or for icons and graphical symbols for use on equipment as provided in IEC 60417, ISO 7000 and in the ISO/IEC 11581 series.

This standard does not define a list indicating which existing graphical symbols are available to be used to represent objects in their operational states following the rules established in this standard.

REPRESENTATION OF STATES OF OBJECTS BY GRAPHICAL SYMBOLS

1 Scope

This international standard provides generic rules for the representation of states of objects by graphical symbols standardized in IEC 60617, ISO 14617, IEC 60417, for example, and for future graphical symbols included in these standards.

NOTE 1 Graphical symbols in IEC 60617, ISO 14617 and IEC 60417 are mostly presented with a single graphic, not representing the different operational states of objects occurring during their life cycle, e.g. in operation, of the object that the graphical symbol represents.

NOTE 2 The graphical symbols in IEC 60617 and ISO 14617 are – at the time of writing of the first edition of this standard – generally shown in the operational state “not energized”.

NOTE 3 Within the different periods of an object within its life cycle, i.e. design, manufacturing, operation, disposal, each period counts with different states. However, this standard focuses only on those states occurring during the active operation period from an object put into service until it is taken out of service.

This horizontal standard has the purpose of:

- ensuring the coherence of the corpus of standardization documents;
- avoiding duplication of work and contradictory requirements.

The standard provides operational states of an object as examples that typically occur and which need to be represented by standardized graphical symbols and defines generic rules to be applied. It specifies which types of presentation facilities are recommended to present the different operational states to humans.

States concerning the different types of alarm, their classification and management are not dealt with in this standard.

This standard does neither define rules for the design of static graphical symbols for diagrams as provided in IEC 61082 and the ISO/IEC 81714 series nor for icons and graphical symbols for use on equipment as provided in IEC 60417, ISO 7000 and in the ISO/IEC 11581 series.

This horizontal standard is primarily intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 108.

One of the responsibilities of a technical committee is, wherever applicable, to make use of horizontal standards in the preparation of its publications. The content of this horizontal standard will not apply unless specifically referred to or included in the relevant publications.

2 Normative references

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

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60417, *Graphical symbols for use on equipment*. Available from http://www.graphical-symbols.info/equipment

IEC 60617, *Graphical symbols for diagrams*. Available from IEC 60617 – Graphical Symbols for Diagrams

IEC 61360-4, *Standard data element types with associated classification scheme for electric components – Part 4: IEC reference collection of standard data element types and component classes*. Available from http://std.iec.ch/iec61360

IEC Guide 108, *Guidelines for ensuring the coherency of IEC publications - Application of horizontal standards*

ISO 14617 (all parts), *Graphical symbols for diagrams;*

ISO 7000, *Graphical symbols for use on equipment – Index and synopsis; Registered symbols*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
graphical symbol
visually perceptible figure with a particular meaning used to transmit information independently of language

Note 1 to entry: The graphical symbol may represent objects, such as products, functions or requirements for manufacturing and use, quality control, etc.

Note 2 to entry: A graphical symbol is not to be confused with the simplified representation of products which is normally drawn to scale and which can look like a picture.

[SOURCE: ISO 81714-1:2010, 3.1, modified – "and use" added in Note 1, "...like a graphical symbol" replaced by "...like a picture" in Note 2.]

3.1.2
presentation set (of objects)
set of discrete presentation forms of a graphical symbol representing an object, each form representing a defined operational state of the object, used for dynamic presentation

Note 1 to entry: The different forms of a graphical symbol are derived from a basic graphical symbol, such forming a symbol family.

Note 2 to entry: According to IEC 61082-1 a *graphical symbol* will represent the object in a de-energized *operational state*, i.e. in the position OFF.

Note 3 to entry: This includes audible and visible but not tangible (e.g. BRAILLE) presentation facilities

3.1.3
operational state
defined states within the being-in-service period which an *object* can have

3.1.4
acoustic signal; auditory signal
message conveyed by means of tone, frequency and intermittency, emanating from a sound source

[SOURCE: IEC 60073:2002, 3.2.1]

3.1.5
tactile signal
message conveyed by means of vibration, force, surface roughness, contour or position

[SOURCE: IEC 60073:2002, 3.2.2]

3.1.6
visual signal
message conveyed by means of brightness, contrast, colour, shape, size or position

Note 1 to entry: Flashing visual characteristics may be used to attract attention, and especially to give additional emphasis

[SOURCE: IEC 60073:2002, 3.2.3, modified – Note 1 to entry added.]

3.1.7
actuator
part of the actuating system which receives a human actuating action

Note 1 to entry: For the purposes of this standard, the actuator in the case of an interactive screen display is considered to be that part of the screen display which represents the actuator functions.

[SOURCE: IEC 60447:2004, 3.1, modified – The notes have been replaced by Note 1 to entry.]

3.1.8
man-machine interface
MMI
human-machine interface
HMI
part of the equipment intended to provide a direct means of communication between the operator and the equipment, and which enables the operator to control and monitor the operation of the equipment

Note 1 to entry: Such parts may include manually operated actuators, indicators and screens.

[SOURCE: IEC 60447:2004, 3.3, modified – addition of "human-machine interface (HMI)".]

3.1.9
brightness
attribute of a visual sensation according to which an area appears to emit more or less light

[SOURCE: IEC 60050-845:1987, 845-02-28]

3.1.10
contrast
1) in the perceptual sense: Assessment of the difference in appearance of two or more parts of a field seen simultaneously or successively (hence: brightness contrast, lightness contrast, colour contrast, simultaneous contrast, successive contrast, etc.)
2) in the physical sense: Quantity intended to correlate with the perceived brightness contrast, usually defined by one of a number of formulae which involve the luminance of the stimuli considered, for example: ΔL / L near the luminance threshold or L_1/L_2 for much higher luminance

[SOURCE: IEC 60050-845:1987, 845-02-47]

3.1.11
perceived colour
colour
attribute of visual perception consisting of any combination of chromatic and achromatic content. This attribute can be described by chromatic colour names such as yellow, orange, brown, red, pink, green, blue, purple, etc., or by achromatic colour names such as white, grey, black, etc., and qualified by bright, dim, light, dark, etc., or by combinations of such names.

Note 1 to entry: Perceived colour depends on the spectral distribution of the colour stimulus, on the size, shape, structure and surround of the stimulus area, on the state of adaptation of the observer's visual system, and on the observer's experience of the prevailing and similar situations of observation.

Note 2 to entry: See Notes 1 and 2 to IEC 60050-845:1987, 845-03-01.

Note 3 to entry: Perceived colour may appear in several modes of colour appearance. The names for various modes of appearance are intended to distinguish among qualitative and geometric differences of colour perceptions. Some of the more important terms of the modes of colour appearance are given in IEC 60050-845:1987, 845-02-19, 20, 21.

Other modes of colour appearance include film colour, volume colour, illuminant colour, body colour, and Ganzfeld colour. Each of these modes of colour appearance may be further qualified by adjectives to describe combinations of colour or their spatial and temporal relationships. Other terms that relate to qualitative differences among colours perceived in various modes of colour appearance are given in IEC 60050-845:1987, 845-02-22, 23, 24, 25.

[SOURCE: IEC 60050-845:1987, 845-02-18, modified (addition of "colour" to term)]

3.1.12
contrast sensitivity
S_c
reciprocal of the least perceptible (physical) contrast, usually expressed as L / ΔL, where L is the average luminance and ΔL is the luminance difference threshold

Note 1 to entry: The value of contrast sensitivity S_c depends on the luminance and on the viewing conditions, including the state of adaptation.

[SOURCE: IEC 60050-845:1987, 845-02-48]

3.1.13
spatial frequency
inverse of the period of a repetitive spatial phenomenon. The dimension of the spatial frequency is inverse length.

[SOURCE: IEC 62220-1:2003, 3.15]

3.1.14
signal light
object or apparatus designed to emit a light signal

[SOURCE: IEC 60050-845:1987, 845-11-05]

3.1.15
object
entity treated in a process of development, implementation, usage and disposal

Note 1 to entry: The object may refer to a physical or non-physical “thing”, i.e. anything that will exist, exists or existed.

Note 2 to entry: The object has information associated to it.

[SOURCE: IEC 81346-1:2009, 3.1, Note 1 to entry modified]

3.1.16
instructions for use
information provided by the supplier of a product to the user, containing all the necessary provisions to convey the actions to be performed for the safe and efficient use of the product

Note 1 to entry: Instructions for use of a single product comprise one or more documents.

[SOURCE: IEC 82079-1:2012, 3.19]

3.1.17
process flow diagram
representation of a process or a process plant by means of graphical symbols, interconnected by flow lines; the graphical symbols represent equipment and the lines represent flows of mass and energy or energy carriers

[SOURCE: IEC 61355-D00042 (2008-04), modified – "The process flow diagram depicts" was replaced by "representation of".]

3.1.18
continuous process
process in which an item is produced without interruption

Note 1 to entry: Although chemicals are mainly manufactured in batches, this is still considered a continuous process since the variables that control the process can be varied continuously.

3.1.19
glare
condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or to extreme contrasts

[SOURCE: IEC 60050-845:1987, 845-02-52]

3.1.20
achromatic (perceived) colour
perceived colour devoid of hue. The colour names white, grey and black are commonly used or, for transmitting objects, colourless and neutral

[SOURCE: IEC 60050-845:1987, 845-02-26, modified – Part 2 has been deleted.]

3.1.21
state
mode of being

3.1.22
signal word
word that calls attention to a product safety label and designates a category of risk

[SOURCE: ISO 3864-2:2004, 3.14]

3.1.23
safety colour
colour with special properties to which a safety meaning is attributed

[SOURCE: ISO 17724:2003, 66]

3.1.24
visual danger signal
visual signal indicating imminent onset or actual occurrence of a dangerous situation, involving risk of personal injury or equipment disaster, and requiring some human response to eliminate or control the danger or requiring other immediate action

Note 1 to entry: A distinction is made between two types of visual danger signal: visual warning signal and visual emergency signal.

[SOURCE: ISO 11428:1996, 3.1]

3.1.25
visual warning signal
visual signal indicating the imminent onset of a dangerous situation requiring appropriate measure for the elimination or control of the danger

[SOURCE: ISO 11428:1996, 3.1.1]

3.1.26
visual emergency signal
visual signal indicating the beginning or the actual occurrence of a dangerous situation requiring immediate action

[SOURCE: ISO 11428:1996, 3.1.2]

3.2 Abbreviations

SCADA Supervision, Control And Data Acquisition

HMI Human Machine Interface

CAE Computer Aided Engineering

4 General

Visual displays are widely used for human interaction for many types of products and systems. Typically for the modern type of display is that the graphic representation of an object is not static but will react dynamically due to the automatic behaviour of the product/system or due to manual actions by the operator leading to change, for example colour, shape, etc. In the case that standardized graphical symbols, as presented in IEC 60617, ISO 14617, or IEC 60417, are used on these displays, it is often required that the dynamic behaviour of the represented object needs to be reflected by an identified change of the related graphical symbol.

Some examples including time- and state-dependent graphical symbols for use on screens and displays are:

– icons used on screens of personal computers, mobile equipment, mobile phones and touch screens;
– dynamic graphical symbols used on console and monitor screens of Human-Machine Interface (HMI) systems and Supervisory Control and Data Acquisition System (SCADA);
– icons and graphical symbols used in “interactive” documents, such as instruction for use and process flow diagrams, presented in electronic form, and
– engineering tools, for example Computer Aided Engineering tool (CAE), including test features with visual presentation of simulated or actual engineering result.

5 Reasons for dynamic representation of objects

5.1 General

This clause describes the reasons for a change of the presentation form of a graphical symbol in order to indicate to the human which operational state of the object is represented.

5.2 Change of state of an object in the supervised process

The reason for using a dynamic graphical symbol is the case where the graphical symbol is used in a supervisory system to represent an object, which, by changing its operational state, will influence the supervised process. This is applicable for SCADA system and other industrial processes like process control systems, etc.

It is recognized that even if the supervision basically uses only two states (e.g. ON/OFF) it is required also to indicate the other occurring states.

Table 1 provides examples of generically defined operational states of an object.

Table 1 – Generic operational states used during operation of an object (informative / exemplary)

Nr.	Term	Definition
1	OFF; DISCONNECTED	state of an object de-energized, passive or not running NOTE 1 The term OFF MODE is used in the context of describing the state of an object concerning its power demands (see IEC 62542), and is not corresponding to the operational state defined in this standard. NOTE 2 The term DISCONNECTED is used in the context of describing the state of an object concerning its power demands (see IEC 62542), and does not correspond to the operational state defined in this standard.
2	CLOSING DOWN	state of an object preparing for the OFF state NOTE This can for example be cleaning the process details of the object so it can be used for processing again the next day. This can be automatically or manually performed
3	STOPPED	state of a process manually or automatically aborted and made passive or not running
4	FINISHED	state of a process having fulfilled its assigned task and made de-energized, passive or not running
5	SELECTED	state of an object chosen and waiting for a command NOTE After execution of the command, the operational state SELECTED is finished. If the command is not executed within a defined period of time, the selected object will return into the operational state it had before the last selection occurred. For a new action the object needs to be selected again.
6	COMMAND ACKNOWLEDGED	state of an object having received a check back indication confirming that the actual action command for changing the operational state of the object has been accepted NOTE The accepted action is based on the previous command for changing the operational state of the object.
7	IN TRANSITION	state of an object having received an accepted command for execution NOTE The transition period is finished when the object has reported that it has changed from its previous state.
8	ON	state of an object energized, active or running. NOTE The term ON MODE is used in the context of describing the state of an object concerning power demands (see IEC 62542), and is not corresponding to the operational state defined in this standard.
9	AUTO	the object (with its sub-objects) is under automatic control
10	MANUAL	the object (with its sub-objects) is under manual control

Nr.	Term	Definition
11	STEPPING	the stepping of a step by step sequence for an object is under manual control
12	HOMERUN	the step by step sequence of an object is brought back to its home/start step
13	UNDER MAINTENANCE	state of an object (for a specified time) not available due to planned or unplanned maintenance or repair activities
14	OUT OF SERVICE	state of an object taken by intention out of operation
15	FAULTY	state of an object taken out of service by manual or automatic means for malfunctioning caused by technical troubles of the object itself or of controlling or supervising other objects
16	NO INFORMATION	state of an object encountered with communication problems NOTE The term NO INFORMATION implies that there is at a given point of time none, no confirmed or no secured information about the actual status of the object available.
17	MANUALLY ENFORCED	state of an object previously encountered with communication problems and enforced by the operator into a specified operational state, either ON or OFF
18	COLD STAND-BY	state of an object prepared to be put into operation within a defined period of time
19	WARM-UP	state of an object preparing itself for operation NOTE This can for example be a state before entering HOT STAND-BY.
20	HOT STAND-BY; IDLE MODE	state of an object energized and ready for immediate operation without interruption of the ongoing process NOTE IEC 62542:2013, 5.13 defines "idle mode" as the "condition during which the equipment can promptly provide a primary function but is not doing so".
NOTE IEC 62542 provides additional stages related to power consumption of equipment.		

The operational states as given in Table 1, Table 2 and Table 3 are to be understood as examples out of the variety of possibilities of operational states and not representing an exhaustive list. There may exist different terms for the listed operational states, however the listed terms in this international standard are considered to serve as preferred terms. Other terms should be considered synonyms.

If the listed operational states are used in practice, then the preferred terms and definitions shall apply as given in Table 1, Table 2 and Table 3 in conjunction with the graphical symbol in order to avoid multiplicity of operational states with identical meanings.

The different states provided in this standard are presented using upper-case Latin letters.

Additional operational states may be defined according to the needs of specific object types.

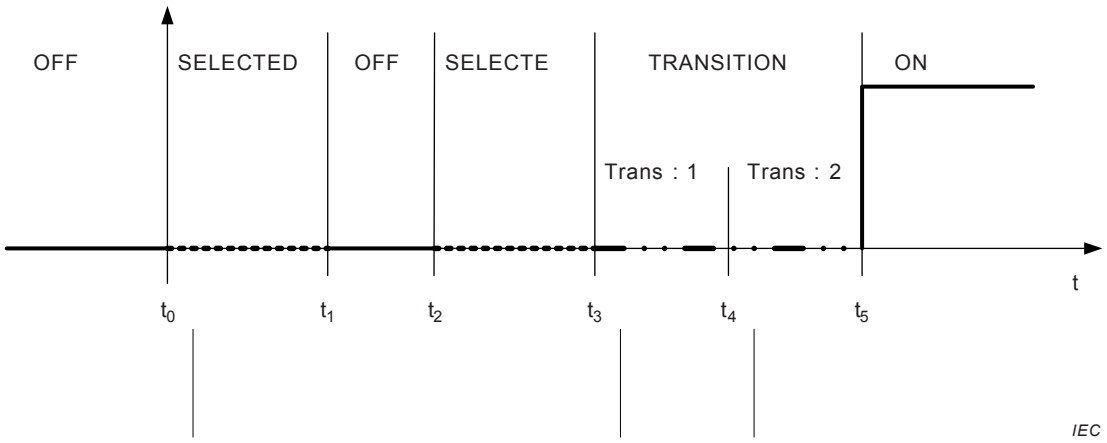
5.3 Operators command/action

In an interactive system with an operator/user interface using a display with graphical symbols, it is required to indicate the action taken by the operator. A typical action is the selection of an object for further action. However, the time difference between the selection of an object for further action and the later possibly executed command to change the state needs to be indicated. The time lapse between the command for execution of the object by an operator to change its state via the command acknowledgment and the new operational state of the current object has to be differently presented, such as indicating the different transition periods (see also Table 1).

If, having selected an object for further action the command action will not executed within a given time period, then the selection of the object will be set inactive and the previous shown graphical symbol will apply again. For a new action the object needs to be selected again.

Between the point in time of selecting an object for further action, the following command and the check back (providing the information that the intended change became effective) is a transition process and may involve different actions of, for example, a SCADA system, considering safety aspects which might have the need to be reflected, for example changing a breaker from OFF into the ON position starting with Object selection, Command execution, Command acknowledgement and Check back indication, indicating the new state.

A typical sequence of “selection before execute” is described in Figure 1.



NOTE It is assumed that once an object has been selected for action and no command will be executed within the specified time period t_1, the state will return to the previous one, i.e. OFF. This is the case between the steps t_0 and t_1. The time t_3-t_2 is less than the time t_1-t_0

Figure 1 – Example of changing the operational state from OFF to ON

Change of operational states of objects typically depends on the operator’s actions, such as changing state from OFF to ON or vice versa. The graphical symbol representing the object may optionally be accompanied by information indicating the type of control executed in conjunction with the relevant objects. For example the additional information “Manual” or “Automatic”, “Local control” or “Remote control” should be indicated.

5.4 Time controlled activities

The form of presentation of a graphical symbol may be time controlled.

The time control may be set to:

- change the form periodically;
- change the form at a specified period of time;
- change the form with a time delay following an activity.

Applications with time-controlled visual changes may optionally indicate the specified time in conjunction with the relevant state representation. Either the elapsed time or the remaining time is indicated depending upon process needs. Once a type of time presentation is chosen within an application, it shall be used consistently for safety reasons within that application.

5.5 Sporadic change

The form of presentation of a graphical symbol may be set to change sporadically as a random time set and be changed due to manual or automatized process activities, related to a supervised object or system.

6 Area of application

6.1 General

Dynamic presentations of graphical symbols are used in many types of user interfaces, for example, computer screens, video display units and graphical displays on products. The form of presentation of the graphical symbols and its associated standardized rules shall be irrelevant of the systems where they will be used.

For better understanding of the usage of this standard this clause includes some examples of the context in which the dynamic presentation of the standardized graphical symbols are intended to be used.

6.2 SCADA user interface

For supervision and control of electric power systems SCADA systems are often used. The HMI used for SCADA and similar systems will typically display the system in a single line-presentation with graphical symbols of the same type as used in drawings.

The graphical symbols applicable in SCADA systems often use different presentation forms indicating different operational states.

6.3 Process control user interface

The HMI of typical process control systems are in similarity to the SCADA systems, often using graphical symbols representing functions or controllable objects in the process. In contrast to the electric power control, the HMI of process control systems makes use of a huge number of variants of graphical symbols and pictures due to the big diversity of supervised systems in industrial applications.

The graphical symbols applicable for these HMIs will often be presented in dynamic forms indicating the operational states.

6.4 Engineering and configuration tool interface

For the engineering of modern configurable systems or products, engineering tools with graphical presentation will often be used. The graphical presentation will typically show the functions of system parts or programmes, as well as the communication between the functional parts or components.

An engineering tool can be of the traditional CAE type, meaning that its purpose is to produce documents which later on will be used for the design. Alternatively or in addition the tool could include simulation, debugging facilities or be on-line connected to the actual process. Such often-used application of an engineering tool requires dynamic presentation of graphical symbols.

The engineering in a modern configuration tool may result in an electronic document (file) intended for machine-to-machine communication, for example from the tool to the running system or to another tool.

In the case of an electronic exchange of graphical symbols intended for a dynamic representation of a given product type, the set of graphical symbols representing the different operational states of this product type should include with each graphical symbol information on its associated operational state. See examples in Annex A.

6.5 Different operator displays of product with interactive functions

Graphical user interfaces look very different among products.

It is not the intention of this international standard to standardize such displays. However, graphical symbols used in these displays shall be based on graphical symbols standardized by IEC 60417, IEC 60617, ISO 14617 or ISO 7000.

6.6 Graphical symbols related to safety signal words such as danger, warning and caution

6.6.1 Graphical symbols related to safety

To represent any operational state of the process or equipment, graphical symbols shall be in accordance with a graphical symbol in IEC 60417, IEC 60617, ISO 14617 or ISO 7000. Table 2 shows basic shapes to transmit the meanings for safety related operational states, such as danger, warning/caution and safe (normal operation) in accordance with Table 2 of IEC 60073:2002.

Although IEC 60073 requests the shapes for safety related applications to be bold-rimmed, this standard specifies, due to conflict with the use of colours, that these shapes should be bold-rimmed where appropriate.

If no standardized graphical symbol for a representation of operational states of objects exists in IEC 60417, IEC 60617, ISO14617 or ISO 7000, the basic shapes shown in Table 2 shall be applied.

If the basic shapes from Table 2 are used to represent signal words (representing danger, warning/caution, safe) then no other graphical shapes shall be used in the application to express the same meaning.

NOTE For signal words and translations of signal words see ISO 3864-2.

To represent the operational states of EMERGENCY or FAULTY of the process or equipment, graphical symbols in combination with the basic shape shown in row 1 of Table 2 shall be applied.

To represent the abnormal operational states NO INFORMATION or MANUALLY ENFORCED of the process or equipment, graphical symbols in combination with the basic shape shown in row 2 of Table 2 shall be applied.

Alternately to the use of standardized graphical symbols, representing the normal operating states of the process or equipment, the shape can also be chosen from the shapes as shown in row 3 of Table 2

Table 2 – General principles for meaning of basic shapes

Shape	Meaning		
	Safety of persons or environment	Condition of process	State of equipment
 [a]	Danger	Emergency	Faulty
 [a]	Warning/caution	Abnormal	Abnormal
 [a]	Safe	Normal	Normal
[a] Only the shape for safety-related applications shall be bold-rimmed.			

6.6.2 Symbols in alarm and signalling displays

An alert system should provide information on the reason for the alert system being triggered. This might be in the form of a message on a graphic display representing for example a signal light or via changes in a graphic display (graphical symbol presented in dynamic form). Alert display systems can draw attention to alarms using change of colour, changes in symbol forms and dynamics (e.g. flashing).

Wherever colour is used, the possibility of the users having impaired colour vision has to be taken in consideration.

Application designer should adopt a policy of ensuring that the colours used on graphic displays representing for example a signal light are standardized and conform to international criteria. When using safety colours ISO 3864-4 should be applied. Furthermore IEC 60073 provides general guidance on colour coding.

When performing an operation command of equipment from the visual display unit, the usage of actuator and its sensitive areas (hot spots) shall be in conformance with IEC 60447:2004, 7.7.5.

NOTE 1 Concerning general requirements, design and testing of visual danger signals (visual warning signal light, visual emergency signal light) see also ISO 11428 and ISO 11429.

NOTE 2 As dynamic graphical symbols are used in the control of a process, the following guidelines have to be considered: *Alarm systems – A guide to design, management and procurement*; The Engineering Equipment and Material User's Association, Pub. 191, 1999; www.eemua.co.uk.

NOTE 3 For alarm states, their classification and management in process systems see IEC 62682.

6.7 Representation of actuators

6.7.1 General

Objects being presented on video display units need for their operation by a mouse or by a touch screen unit associated actuators. Their position should be once defined and be near to the visual presentation of the operated object. The chosen location shall be consistently applied independent of the operated object type throughout the application.

When performing an operation command of equipment from the visual display unit, the usage of actuator and its sensitive areas shall be in conformance with IEC 60447:2004, 7.7.5.

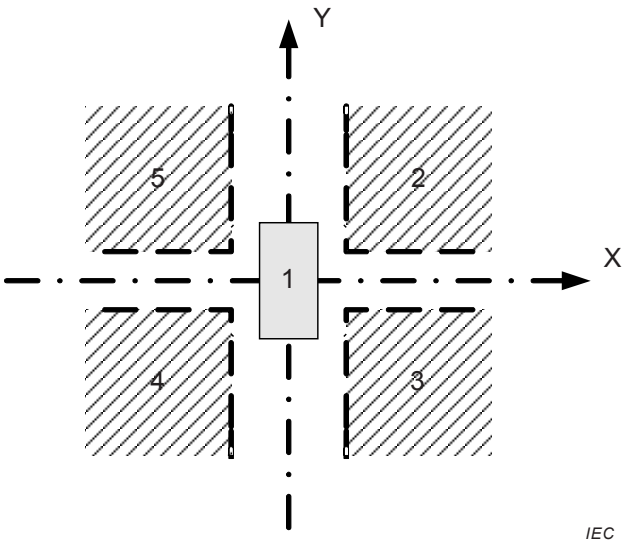
Concerning the presentation of actuators on video display units, the usage of colours and their associated meanings shall be in conformance with IEC 60073:2002, 5.2.2, considering that actuators are self-luminous.

NOTE For the rules of safety principles see IEC 60447:2004.

6.7.2 Recommended location of information associated with graphical symbols

Based on IEC 61082-1 and IEC 81714-2 and keeping consistency with representations of objects in drawings and video display units, it is recommended to follow the arrangement of information for monitoring purposes as provided in Figure 2.

NOTE 1 The term "hot spot" in the key to Figure 2 indicates an active area on the video display unit. By clicking or moving the cursor within this area or by any other triggering mechanism, a separate sizable or fixed window pops up presenting on-line the desired information associated with the object. A permanent presentation of such information may stress the operator.



Key

1 = Area reserved for graphical symbols representing the object;

2 = Area reserved for supplementary text, graphics associated with the object;

3 = Area reserved (as hot spots) for the presentation of actuators for execution of commands;

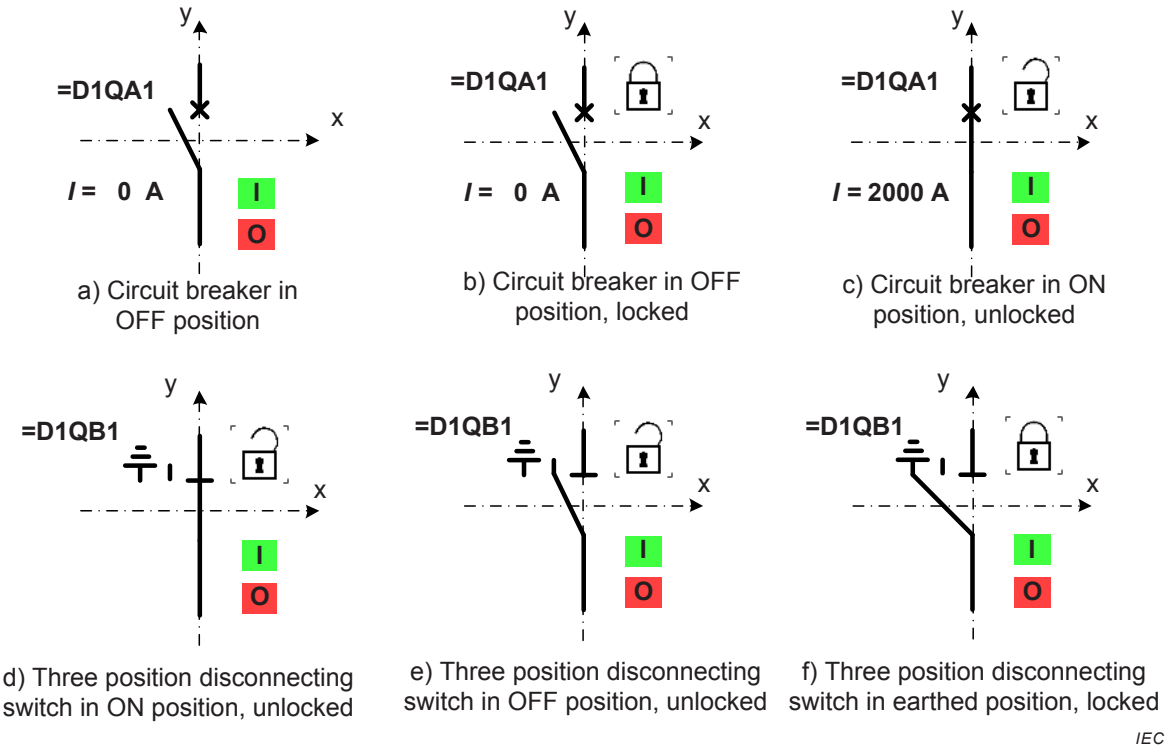
4 = Area reserved (as hot spot) for the presentation of technical data of the object;

5 = Area reserved for the presentation of the designation of the object within a system.

Figure 2 – Recommended location of information associated with graphical symbols

The graphical symbol representing an object can in most cases be selected from IEC 60617, provided that the object has an electric function. The purpose of an associated symbol is to represent a function such as mode or state in a process. Graphical symbols to be used as supplementary symbols can typically be selected from IEC 60417 or ISO 7000.

NOTE 2 The difference between graphical symbols presented in IEC 60617 and IEC 60417 as well as ISO 7000 is defined by its intended area of application, i.e. “for diagrams” or “for use on equipment”. These areas of application do not automatically appoint the symbols from IEC 60617 to represent an object and others to represent associated functions.



NOTE Text and symbols surrounding the graphical symbols representing the object are examples of the kind of information that can be presented in areas 2 to 5. The presentation of actuators in area 3 is only exemplarily indicating that this area is foreseen as preferred area for the arrangement of actuators for exerting commands. Figures a) through f) do not prescribe that both ON and OFF actuators are to be available at the same time.

Figure 3 – Examples of graphical symbols including related information

6.8 Instructions for use in electronic form

Instructions for use are traditionally distributed in conjunction with the relevant object as documents in paper format or in electronic copies (e.g. PDF). In modern products or systems it is more and more common to include additionally interactive instructions including movies, animated pictures or graphics showing the system's response.

Instructions for use will have a very close connection to the output from an engineering and configuration tool. If representation of operational states of objects is used, this standard shall apply.

7 Types of presentation – Rules and examples

7.1 General

The form for presenting dynamic changes in the graphical symbols may differ a lot from application to application. This clause describes those types of presentation of the dynamic behaviour that has been considered in this standard.

The presentation forms actually used for dynamic presentation of operational states of an object in a specific application of a graphical symbol are collected in a presentation set,

7.2 Change of shape

7.2.1 General

The graphical symbol may change, but other features (e.g. colour) being constant, among a number of predefined graphical shapes to indicate the different operational states of the object being represented by the graphical symbol.

NOTE Example is given in Annex A, where the specific example of dynamic changed of shape and colour is shown.

The following applies:

– each graphical symbol representing an operational state shall be clearly understood, easily recognized, easily differentiated from each other and visually unambiguously differentiated in the context.
– the visual appearance of the graphical symbol, representing the object in the OFF state, shall be consistent with the presentation of the standardized (static) graphical symbol in IEC 60617, ISO 14617, IEC 60417;
– the additional visual appearances representing the other occurring operational states of the object type shall be taken, if available, from international standards. If not, they shall be designed as a family of similar graphical symbols and be based on the standardized basic graphical symbol;
– for safety reasons a visually floating transition between different graphical shapes, each representing a separate operational state of the object, shall not be used.

7.2.2 Usage of symbols

Objects may be associated for their representation by a basic symbol and supplemented by zero or many supplementary symbols.

Figure 3 provides an example of how to indicate the locking of a switch by a supplementary symbol which may change its shape independently of the basic symbol.

Table A.1 provides additional examples of symbols which may be used as supplementary symbols to indicate the temperature related information, for example for the temperature visualization of the transformer oil.

7.3 Change of colours

7.3.1 General

A simple form of dynamic presentation of a graphical symbol is to have a static graphical symbol changing its colour indicating a change from one defined operational state to a different operational state without changing other presentation features.

The change of colour is typically used in tools for electric design or configuration of logic systems to highlight connection lines or terminals when changing from the active/powered (ON) into a passive/de-energized state (OFF).

In the case of a time period occurring between operation states, a separate colour should be defined indicating the transition period (IN TRANSITION) between both states.

For the use of safety and warning colours IEC 60073 and ISO 3864 shall be applied. The selection of colours for use on displays should be referred to a standardized colour space (e.g. IEC 61966-2-1) and shall be consistently applied within the application. If a colour is chosen, its age- related luminance change should be considered, see ISO 24502.

NOTE Example is given in Annex A, where the specific example of dynamic changed of shape and colour is shown.

EXAMPLE Visual warning signal in a human machine display lighting up in yellow, defined by ISO 3864.

7.3.2 Use of background colours

A background colour over which graphical symbols are shown shall be selected so that the graphical symbols are easily perceived.

NOTE 1 The degree of human perception of a graphical symbol depends on the luminous contrast between the background colour and the colour used in the presentation of the graphical symbol.

NOTE 2 The actual luminance is affected by the ambient condition, specifically by a reflected light level from the surface of a display unit incorporated in the system.

The glare effect shall also be taken into account to estimate the actual luminance.

NOTE 3 Luminous contrast sensitivity is the function of spatial frequency of the graphical symbol, which is normalized as spatial frequency by a view angle of one degree. The view angle depends on a viewing distance of the graphical symbol.

NOTE 4 For some application fields, such as electronic visual displays and safety signs, specific values of luminance contrast are required (ISO 9241-303:2011, 5.5.2; ISO 3864-4:2011, Table 3).

NOTE 5 The relationship between the pupillary illuminance required for detectability and the background luminance is given in ISO 11428:1996, Figure 1.

The intended luminance contrast shall be kept appropriate over time for the display covering the operator's need in accordance with ISO 24502.

7.3.3 Colour contrast

In the case that the background colour and the colour used for presentation of a graphical symbol or text are other colours than achromatic colours (black, grey, white), the colour contrast sensitivity function should be taken into account (refer to Gegen Tana and Hiroaki Ikeda, *Colour contrast sensitivity function between a pair of complementary colours Red and Cyan*).

It is recommended that the colour contrast level is taken into account when designing change of colours. The colour contrast level largely depends on the common background lighting level. Excessive ambient lighting level results in deterioration of the colour contrast.

It is advised to apply colour contrast analysers to obtain best visibility and readability between background and presented graphical symbols, text etc.

NOTE Via a search on the Internet of "colour contrast checker" or "colour contrast analyser", several tools can be found.

7.3.4 Operational states and associated recommended colours

In order to have a consistent appearance of the colour on a display, each colour used shall be clearly associated with its meaning in the context of the standard. Each colour shall be defined by its code and its textual name within the code and be based on a publicly available colour coding system.

7.3.5 Flashing

For the use of flashing in the dynamical presentation of graphical symbols ISO IWA 3 should be taken into account in order to avoid undesirable bio-medical effects, such as photosensitive epileptic seizures, visual-induced motion sickness and visual fatigue.

For frequencies of flashing see IEC 60073:2002, 4.2.3.2.

7.4 Change size

A selected graphical symbol in a visual display may change its size in relation to the rest of the presentation for the reason of:

– indicating the importance of the object being represented by a graphical symbol, by raising its size in both directions with the same ratio;

– indicating less importance by reducing the size in both directions with the same ratio;

– indicating that the object has been selected for further action by the combination of highlighting the graphical symbol by the change of its colour and raising its size in both directions with the same ratio.

EXAMPLE A smaller graphical symbol has been selected for execution by the operator. For best usability the selected graphical symbol will blow up to a more readable size.

7.5 Acoustic codes

In addition to the visible appearance of a symbol, a sound may be associated for identification of a specific state of the represented object. The sound is typically used for calling for attention of an operator or other person. The sound is used independent of any other presentation features.

A sound may be used in conjunction with a graphical symbol for the representation of:

- alarm state of the related object and
- abnormal state of the related object.

The use of sound association shall be used in exceptional case only to call for special attention and warning.

For sound for attention, caution, warning and danger, ISO 7731 and ISO 11429 should be applied where appropriate. For the implementation of the sounds as acoustic codes, 4.3 of IEC 60073:2002 shall be used.

7.6 Actuators as parts of a pictorial presentation on a video display unit

For actuators presented on video display units controlling an equipment or process, IEC 60073:2002, 5.2.1 and 5.2.2 apply.

Concerning a recommended location of actuators on a video display unit see 6.7.2

7.7 Add-in or change letters/text

In conjunction with graphical symbols supplementary characters may be applied, providing additional information.

When adding such letters or text in conjunction to a symbol the following shall be considered:

- the character(s) added to a graphical symbol shall not change its meaning;
- in order to separate among different operational states of an object or process by applying the same graphical symbol, different supplementary textual information (abbreviations, codes) shall be added to the graphical symbol;
- if not standardized abbreviations or codes are used, their meaning shall be provided in the user documentation (e.g. instructions for use).

EXAMPLE An object has been taken out of service being indicated by the text “OUT OF SERVICE” in conjunction with the graphical symbol representing the object in a video display unit.

Any object can be additionally associated with a predefined number of technical properties for the presentation of its on-line values. This information may be called upon request in a

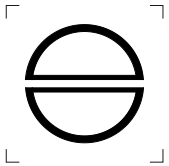
separate window in order not to overload the screen. Technical properties shall preferably be selected from dictionaries containing standardized properties, see IEC 61360-4.

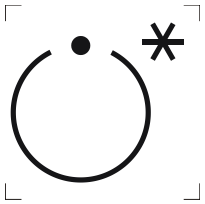
7.8 Combination of presentation types on the same graphical symbol

Clause 7 provides the different types for the representation of operational states of objects. Combinations of the different types are required when the application of a single type is not sufficient or ambiguous in the application to differentiate among the different operational states.

Examples of possible combinations are shown in Table 3.

Table 3 – Meaning of indication codes with respect to the operational states

No.	A	B	C	D	E	F
	Operational state See Table 1 and Table 2	Visual			Acoustic	Explanation
		Shape	Colour	Flashing		
1	OFF; DISCONNECTED	Selected graphical symbol [a]				Normal condition
5	SELECTED	Selected graphical symbol Highlighted sized [c]				Normal condition
6	COMMAND ACKNOWLEDGED	Supplementary symbol [e] 		Period from Command to Command acknowledged		Normal condition
7	IN TRANSITION	Selected graphical symbol [c]		steady lighted		Normal condition
8	ON	Selected graphical symbol [b]				Normal condition
13	UNDER MAINTENANCE	 [d] Supplemented with date of expected reoperation.	Black			Normal condition
14	OUT OF SERVICE	 [d]	Red			Normal condition
15	FAULTY	See Table 2, row 2	YELLOW	f1	Pattern of segments with constant pitch	Fault condition

No.	A	B	C	D	E	F
	Operational state See Table 1 and Table 2	Visual			Acoustic	Explanation
		Shape	Colour	Flashing		
16	NO INFORMATION	See Table 2, row 2	YELLOW		Pattern of segments with constant pitch	Abnormal condition
17	MANUALLY ENFORCED	Supplementary symbol [e] 	YELLOW			Abnormal condition
18	COLD STAND BY	Supplementary symbol [e] 				Normal condition
20	HOT STAND BY; IDLE MODE	Supplementary symbol [e] 				
21	STOPPED	Selected graphical symbol [f]	YELLOW		Pattern of segments with constant pitch	Abnormal condition
22	FINISHED	Selected graphical symbol [f]	GREEN			Normal condition
23	DANGER	See Table 2, row 1	RED		Sweeping sounds Burst of sounds	Abnormal condition

No.	A	B	C	D	E	F
	Operational state See Table 1 and Table 2	Visual			Acoustic	Explanation
		Shape	Colour	Flashing		
24	CAUTION/WARNING	See Table 2, row 2	YELLOW		Pattern of segments with constant pitch	Abnormal condition
25	SAFE	See Table 2, row 3	GREEN		Continuous sound	Normal condition

[a] The graphical symbol should be selected from international standards of IEC and ISO indicating the OFF, de-energized or passive state, e.g. open switch

[b] The graphical symbol should be selected from international standards of IEC and ISO. For indicating the ON, it is recommended that the symbol change its shape for representation of energized or active state in accordance with 7.2. The form of presentation shall be selected for best understanding of the symbol.

[c] The graphical symbol chosen for the presentation of the states SELECTED, COMMAND ACKNOWLEDEGED or IN TRANSITION should be the one chosen for OFF respectively ON, using the presentation of the previous state the object has when SELECT is initiated.

[d] The graphical symbol of a cross under 45° is considered for being superposed upon an existing graphical symbol

[e] A supplementary graphical should be presented in conjunction to the “main” symbol, to the right of the symbol, see Figure 2 area 2.

[f] In process diagrams mostly black boxes with names or designations are shown, so here the same graphical symbol applies however in different colours for each state

NOTE 1 Example is given in Annex A, where the specific example of dynamic changes of shape and colour are shown.

NOTE 2 The numbering of operational states given in the first column of the table refers to the numbering of operational states in Table 1. Not all operational states as listed in Table 1 and Table 2 are shown in this table.

8 Consideration of regional or national legislation

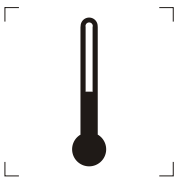
It is strongly recommended that designers of systems as described in this international standard should check whether regional or national directives or laws apply in this context; for example the EU directive about safety of machinery. Regional or national standards have not been listed in this international standard. However, some regional standards concerning safety of machinery and associated issues are provided within the bibliography.

Annex A
(informative)

Example of presentation of a graphical symbol in different forms for use on equipment

Table A.1 shows an example of presentation of the graphical symbol standardized in ISO and IEC. The symbol with identification ISO 7000-0034 represents temperature. The form of dynamic presentation includes changes in shape as well as in colour.

Table A.1 – Example of presentation of the graphical symbol ISO 7000-0034 representing different operational temperature states

Category	Dynamic change of shape and colour	Remarks
Basic symbol (ISO 7000-0034)		Basic graphical symbol with the following original meaning: "To indicate temperature or function associated with temperature, for example temperature indication or temperature monitoring points."
Mandatory significance		In terms of "temperature", Mandatory significance for State of equipment, Condition of process, and Safety of person or equipment. The shape is a circle and the colour is BLUE.
Normal / Safe		In terms of "temperature", State of equipment: Normal; Condition of process: Normal; Safety of person or equipment: Safe. The shape is a square and the colour is GREEN.
Abnormal / Caution/ Warning		In terms of "temperature", State of equipment: Abnormal; Condition of process: Abnormal; Safety of person or equipment: Warning/Caution. The shape is an equilateral triangle and the colour is YELLOW.
Faulty / Emergency/ Danger		In terms of "temperature", State of equipment: Faulty; Condition of process: Emergency; and Safety of person or equipment: Danger. The shape is a hexagon and the colour is RED.

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