

Electro-sensitive safety systems for industrial machines —

Part 1: Specification for general requirements

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Committees responsible for this British Standard

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- Amalgamated Union of Engineering Workers
- Associated Offices Technical Committee
- British Box and Packaging Association
- British Carton Association
- British Insurance Association
- British Printing Industries Federation
- British Steel Industry
- British Textile Machinery Association
- Engineering Industries Association
- Health and Safety Executive
- Institution of Electrical Engineers
- Machine Tool Industry Research Association

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Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
0 Introduction	1
1 Scope	1
2 Definitions	1
3 Electro-sensitive safety system (ESSS)	3
4 ESSS control unit	4
5 Sensing units (SU)	5
6 Safety monitoring means (SMM) facilities	5
7 Enclosures	5
8 Stopping performance monitoring	6
9 Testing	6
10 Marking	9
11 Accompanying documents	12
Appendix A Suggested order of inspection and tests	15
Figure 1 — Block diagram of an electro-sensitive safety system illustrating a typical application to a machine	14
Table 1 — Common-mode and differential-mode randomly phased transient overvoltages of either polarity	9
Table 2 — Marking on the outside of equipment	10
Publications referred to	Inside back cover

Foreword

This British Standard has been prepared under the direction of the General Electrotechnical Engineering Standards Committee.

This standard refers only to the technical suitability of the equipment for the electro-sensitive safety system. It may be that its application will require the use of substances and/or test procedures that could be injurious to health if adequate precautions are not taken. Compliance with this standard in no way absolves either the supplier or the user from his statutory obligations relating to the safety and health of employees and others during the manufacture or use of the equipment covered by this standard.

The increasing use within industry of photoelectric devices for safeguarding machinery both cyclic and continuously running has led to a demand for a standard embracing a range of electro-sensitive safety systems. Approaches were made to the BSI to develop a standard acceptable to the makers, industrial users and the safety enforcement authorities.

Part 1 of BS 6491 provides general requirements for electro-sensitive safety systems of various types and employing various methods of presence sensing. The particular requirements for specific types of sensing units will be covered in subsequent Parts of this standard. The first of these giving the requirements for photoelectric sensing units is now in course of preparation and will be published as Part 2.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

0.1 This standard provides general design and performance requirements for electro-sensitive safety systems (ESSS) to be used in a very broad range of applications on industrial machines. However, each type of machine presents its own particular hazards and it is not the intention of this standard to identify those hazards nor to recommend the manner of application of the ESSS to any particular machine.

0.2 The treatment of such applications should be a matter for agreement between the equipment supplier, the machine user and the enforcing authority and in this context attention is drawn to the relevant guidance information note which will be published by HMSO.

0.3 An ESSS is an item of equipment which is intended to be applied to machines that present risk of personal injury. It provides protection by causing the machine to revert to a safe condition before a person can come into contact with hazardous parts.

0.4 The ESSS incorporates a sensing device (or devices) that employs one or more types of radiation, which can be either self-generated in the device or otherwise provided for detecting the proximity of persons to those hazardous parts.

0.5 An essential feature of equipment meeting the requirements of this standard is the high level of safety integrity provided, and to ensure that this level of safety is maintained built-in periodic functional self-checks are required. These self-checks are intended to ensure that failure of all or part of the equipment, interruption of power supply or spurious external electrical interference effects do not reduce the level of protection provided.

NOTE In order to assist in the understanding of the inter-relationship of the various major elements of the ESSS, a block schematic diagram is included as Figure 1.

1 Scope

This Part of BS 6491 specifies the general requirements for electro-sensitive safety systems (ESSS) for the safeguarding of industrial machinery. Requirements for design, construction and testing are given. Special attention is directed to those features that ensure reliability of operation and that ensure any failure of the equipment will not result in danger to persons. This Part of this standard does not include the particular requirements for specific types of sensing units. These requirements will be dealt with in further Parts of the standard.

While compliance with this standard does not require a facility to be incorporated that automatically monitors the stopping performance of the guarded machine, such a facility may be needed when the ESSS is applied to particular types of machine; therefore for use in those cases requirements are specified for a compatible stopping performance monitor.

This standard does not specify the dimensions or configuration of the sensing zone or its disposition in relation to dangerous parts for any particular application, nor what constitutes a dangerous state for any machine. It is restricted to the functioning of the ESSS, the means by which it assesses the condition of the machine and how it interacts with the machine controls.

Systems relying on mechanical means for detection and those employing means other than the interruption of electrical power as the primary output signal, are excluded.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1 electro-sensitive safety system (ESSS)

a safety system comprising:

- a) sensing unit;
- b) safety monitoring means;
- c) safety system control unit;
- d) final switching devices;
- e) secondary switching device.

2.2 automatic check interval

the maximum time between completions of successive automatic or inherent checks which are made to ensure that the sensing unit is operating within the manufacturer's specification

2.3 ON state and OFF state for final switching devices and secondary switching devices

2.3.1

ON state

the output circuit is complete and permits the flow of current

2.3.2

OFF state

the output circuit is broken and interrupts the flow of current

**2.4
defined area**

the boundary within which a response to the specified test piece (see 5.2) will take place

**2.5
failure to danger**

a failure which prevents or delays both final switching devices (see 3.13) going to the OFF state in response to a condition which, in normal operation, would result in their so doing, or a failure to comply with 3.15.6

**2.6
final switching device**

the component of the electro-sensitive safety system which, when the sensing unit or safety monitoring means are actuated, responds by interrupting the circuit connecting it to a machine primary control element

**2.7
lock-out condition**

a condition of the ESSS which is automatically attained both when its supply mains are interrupted and restored and in response to certain failure signals

NOTE From a lock-out condition normal operation can be achieved only by the actuation of a key operated control.

**2.8
machine primary control element**

that electrically powered element which directly controls the machine's normal operating motion in such a way that it is last (in time) to operate when motion is initiated or arrested

NOTE Where more than one such element is provided, designed for all practical purposes to operate simultaneously, each element is defined as a machine primary control element.

**2.9
machine secondary control element**

a machine control element independent of the machine primary control element(s) and capable of removing the source of power from the prime mover of the relevant dangerous parts in an emergency

**2.10
muting**

a facility for automatically switching the ESSS into a condition where the final switching devices do not respond to an actuation of the sensing unit

**2.11
normal operation**

operation of the ESSS in accordance with the manufacturer's instructions and ratings such that its performance complies with the requirements of this standard and is within the manufacturer's specification

**2.12
overall system stopping performance**

the time, or travel occurring from the actuation of the sensing unit, to the cessation of dangerous motion, or to the machine assuming a safe condition

**2.13
safety monitoring means**

devices for generating signals to the safety system control unit to provide information on the status of the machine, the machine primary control element(s), the final switching devices and secondary switching device

**2.14
safety system control unit**

a control unit that controls the monitoring of the sensing unit, receives and processes information from the sensing unit and the safety monitoring means and provides outputs to the final switching devices and secondary switching device

**2.15
safety system response time**

the maximum time between the insertion of the test piece (see 5.2) into the defined area and the output of a signal from the final switching devices

**2.16
secondary switching device**

the component of the ESSS which, in a lock-out condition interrupts the circuit connecting it to the machine secondary control element

**2.17
sensing unit**

an electro-sensitive means that detects the presence of a specified object entering, or in, a defined area

**2.18
sensing unit detection capability**

the minimum size of test piece of specified type stipulated by the manufacturer which, when introduced into any part of the defined area, will cause actuation of the sensing unit. (See 5.2)

**2.19
stopping performance monitor**

a type of safety monitoring means which is designed to be applied to a machine and to signal to the ESSS whether or not the overall system stopping performance is within the preset limit(s)

NOTE The preset limit(s) are those specified by the manufacturer of the stopping performance monitor to comply with the recommendations made for the particular application by a recognized authoritative body.

2.20**class 1 ESSS**

an ESSS in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of accessible conductive parts to the protective (earthing) conductor in the fixed wiring of the installation, so that accessible conductive parts cannot become live in the event of a failure of the basic insulation

2.21**class 2 ESSS**

an ESSS in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions

2.22**permanently affixed**

removable with a tool only or by appreciable force and able to withstand the effects of temperature, moisture (water and alcohol), vibration, fumes and rubbing in normal use

2.23**clearly legible**

affixed in a prominent location and legible with normal vision from a distance which normally may exist between the statement or symbol and the observer(s) for whom the statement is intended

2.24**major part (of the ESSS)**

- a) For warning statements, the part of the ESSS relevant to the warning.
- b) For model or type reference and all markings referring to the supply mains (power input, voltage, current, frequency, classification etc.), the part of the ESSS that contains the supply mains connection.

3 Electro-sensitive safety system (ESSS)

3.1 General. The ESSS shall respond to the presence of a person, or part of a person, entering, or in, the defined area as specified in 5.2.

3.2 Safety system response time

3.2.1 The safety system response time shall not exceed that stated by the manufacturer.

3.2.2 The safety system response time shall be stated by either the manufacturer or the supplier as appropriate.

3.3 Adjustment of safety system response time.

Any means by which the safety system response time can be adjusted shall be in a lockable enclosure.

3.4 Ambient temperature range. The ESSS shall comply with the requirements of this standard when subjected to ambient temperature variations from 0° C to 40° C. Where it is intended for use outside this range the manufacturer shall specify the temperature range over which the system will continue in normal operation.

Compliance with this requirement shall be verified by carrying out the tests specified in 9.2.

3.5 Electrical interference. When tested in accordance with 9.4 there shall be no malfunction of the ESSS, resulting in a failure to danger, as a result of electrical interference. (See also 9.1.8.)

3.6 Electric shock. The ESSS shall comply with the requirements for protection against electric shock given in BS 2771.

3.7 Supply voltage. The manufacturer shall state the nominal supply voltage(s) for the ESSS and the range of supply voltages within which normal operation will be maintained. This range shall not be less than + 10 % to – 15 % of nominal supply voltage. Supply voltages outside this tolerance shall not result in a failure to danger condition.

3.8 Maximum potential difference. The maximum potential difference between live parts or between any live part and earth, except for circuits connected directly to supply mains or to ESSS output terminals, shall not exceed 120 V a.c. r.m.s. or d.c.

3.9 Failure of power supply. Failure of the power supply to any component or sub-system shall not result in a failure to danger.

3.10 Rating of components. Each component shall be operated within the component manufacturer's specified rating.

3.11 Disconnection of sub-system. if access is available to permit disconnection of any sub-system or part of a sub-system, such disconnection shall result in the final switching devices moving to the OFF state.

3.12 Plug-in type relays and circuit modules. Where plug-in type relays and circuit modules are used interchanging plug-in components or alternatively inserting plug-in components incorrectly shall not result in a failure to danger. Disconnection of any plug-in component (e.g. integrated circuit, circuit card, module, relay) shall not result in a failure to danger.