



DPC: 24/30473653 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 29 March 2024

Origin: International

Latest date for receipt of comments: 22 May 2024

Project No. 2020/01112

Responsible committee: TCT/7 Telecommunications - Installation requirements

Interested committees:

Title: Draft BS ISO/IEC 11801-6/A1 BS ISO/IEC 11801-6 Amendment 1 - Information technology - Generic cabling for customer premises. Part 6: Distributed building services.

Please notify admin.start@bsigroup.com if you are aware of any keywords that might assist in clarifying or identifying the standard or of the content of this standard:

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 22 May 2024

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER: IEC 62246-4 ED1	
DATE OF CIRCULATION: 2020-12-18	CLOSING DATE FOR COMMENTS: 2021-02-12
SUPERSEDES DOCUMENTS: 94/477/CD, 94/486/CC	

IEC TC 94 : ALL-OR-NOTHING ELECTRICAL RELAYS	
SECRETARIAT: Austria	SECRETARY: Mr Bernhard Spalt
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 9,TC 13,TC 17,SC 17A,TC 18,TC 44,TC 61,TC 62,TC 65,TC 69,TC 80,SC 121A	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:
Reed switches – Part 4: Application in conjunction with magnetic-actuator used for Magnetic Sensing Protective Equipment (MSPE)

NOTE FROM TC/SC OFFICERS:

CONTENTS

1		
2	FOREWORD.....	8
3	INTRODUCTION.....	10
4	1 Scope.....	11
5	2 Normative references	12
6	3 Terms and definitions	13
7	3.1 Definitions of a Magnetic-Sensing Protective Equipment (MSPE).....	13
8	3.2 Definitions of magnetic switching devices	14
9	3.3 Elements of an MSPE	14
10	3.4 Connections.....	15
11	3.5 Operation of an MSPE	15
12	3.6 MSPE	16
13	4 Influence quantities	16
14	5 Rated values	17
15	5.1 General.....	17
16	5.2 Rated insulation voltage (U_i).....	17
17	5.3 Rated operating voltage (U_e).....	17
18	5.4 Rated operating current (I_e).....	17
19	5.5 Contact ratings	17
20	5.6 Number of operations	17
21	5.7 Rated operating distance (S_n)	17
22	5.8 Climatic category	18
23	5.9 Environmental severities	18
24	5.10 Response speed	18
25	5.11 Frequency operating cycles	18
26	6 Types	18
27	7 General provisions for testing	19
28	7.1 General.....	19
29	7.2 Type tests	19
30	7.3 Routine tests	20
31	7.4 Special tests	20
32	8 Documentation and marking	21
33	8.1 Data.....	21
34	Repeatability (R)	21
35	8.2 Marking.....	22
36	8.3 Symbols.....	22
37	9 Test and measurement procedures.....	23
38	9.1 General.....	23
39	9.2 Visual inspection and check of dimensions	23
40	9.2.1 Visual inspection	23
41	9.2.2 Outline dimensions	23
42	9.2.3 Mass	23
43	9.3 Functional tests	23
44	9.3.1 General	23
45	9.3.2 Operating distance	23
46	9.3.3 Deviation of operating distance.....	24
47	9.3.4 Differential travel (H)	24

48	9.3.5	Repeatability (<i>R</i>).....	24
49	9.3.6	Magnetic interference	25
50	9.3.7	Response speed (if applicable).....	25
51	9.3.8	Frequency operating cycles (<i>f</i>) (if applicable).....	26
52	9.3.9	Functional test by temperature change	28
53	9.3.10	Contact circuit resistance	28
54	9.3.11	Temperature rise	29
55	9.4	Insulation resistance	29
56	9.4.1	Procedures	29
57	9.4.2	Requirements	29
58	9.5	Dielectric test.....	30
59	9.5.1	Procedures	30
60	9.5.2	Requirements	30
61	9.6	Endurance tests	30
62	9.6.1	General	30
63	9.6.2	Procedures of electrical endurance test	31
64	9.6.3	Requirements	31
65	9.6.4	Procedures of mechanical endurance test	31
66	9.6.5	Requirements	31
67	9.7	External connections.....	32
68	9.7.1	General	32
69	9.7.2	Robustness of terminal with lead wire (if applicable).....	32
70	9.7.3	Robustness of terminal (if applicable)	32
71	9.7.4	Soldering terminals (if applicable).....	33
72	9.7.5	Connector (if applicable).....	33
73	9.8	Mechanical stresses tests	33
74	9.8.1	General	33
75	9.8.2	Mounting	33
76	9.8.3	Vibration.....	33
77	9.8.4	Shock	34
78	9.8.5	Rough handling shocks.....	35
79	9.9	Environmental tests	35
80	9.9.1	General	35
81	9.9.2	Cold	35
82	9.9.3	Dry heat	36
83	9.9.4	Damp heat, steady state	36
84	9.9.5	Mould growth.....	36
85	9.9.6	Fluid contamination	37
86	9.9.7	Salt mist	37
87	9.10	Enclosure protection tests.....	38
88	9.10.1	General	38
89	9.10.2	Degree of enclosure	38
90	9.10.3	Pressurized water.....	38
91	9.10.4	Explosion proofness	38
92	9.11	Sealing	39
93	9.12	Heat and fire resistance	39
94	9.12.1	General	39
95	9.12.2	Glow-wire	39
96	9.12.3	Ball pressure	39

97	9.13	Making and breaking capacity	39
98	9.13.1	General	39
99	9.13.2	Procedures	39
100	9.13.3	Requirements	39
101	9.14	Conditional short-circuit current test.....	40
102	9.14.1	General	40
103	9.14.2	Procedures	40
104	9.14.3	Requirements	40
105	10	Additional requirements for magnetic switching devices used in SRCS	40
106	10.1	General.....	40
107	10.2	Application of the design of the E/E/PE safety-related control system	40
108	10.3	Electromagnetic compatibility (EMC).....	40
109	10.4	Application to ISO 13849 (all parts), IEC 62061 and IEC 61508 (all parts)	40
110	10.4.1	General	40
111	10.4.2	Calculation procedures for target PL/SIL level	41
112	10.4.3	Calculation procedures of failure rates for magnetic switching devices	41
113	10.4.4	Use of automatic monitoring	41
114	Annex A (normative)	Explanations regarding magnetic proximity switches	42
115	A.1	General.....	42
116	Annex B (normative)	Explanations regarding operation of magnetic switching device –	
117	Example		43
118	Annex C (normative)	Explanations regarding sensing distances.....	44
119	C.1	General.....	44
120	C.2	Magnetic safety switches, proximity switches (separate type)	44
121	C.2.1	Operation	44
122	C.2.2	Axial approach.....	44
123	C.2.3	Lateral approach	45
124	C.3	Magnetic proximity switches (Latching type)	45
125	C.3.1	Operation	45
126	C.3.2	Specified directions	45
127	C.4	Magnetic proximity switches (vane type)	46
128	C.4.1	Operation	46
129	C.4.2	Specified directions	46
130	C.5	Magnetic position switches, <reed switch type>	46
131	C.5.1	Operation	46
132	C.5.2	Specified directions	46
133	C.6	Magnetic float liquid level switches, <reed switch type>	47
134	C.6.1	Operation	47
135	C.6.2	Specific directions	47
136	Annex D (informative)	Typical examples of magnetic switching devices	48
137	D.1	Rectangular types	48
138	D.1.1	(Types A, B and C) examples	48
139	D.2	Cylindrical type	49
140	D.2.1	(Type D) Examples	49
141	D.3	Rectangular types	49
142	D.3.1	(Types E to H) Examples	49
143	D.4	Cylindrical type	50
144	D.4.1	(Types I and J) Examples	50

145	D.5	Magnetic position switches, <reed switch type>	50
146	D.5.1	Examples	50
147	D.6	Magnetic float liquid level switches, <reed switch type>	51
148	D.6.1	Examples	51
149	Annex E (informative)	Risk assessment	52
150	E.1	General.....	52
151	E.2	Risk assessment procedure	52
152	E.3	Achieving tolerable risk	53
153	E.4	An application of risk assessment procedures (proposal for the user)	55
154	Annex F (informative)	Descriptions of applications.....	57
155	Annex G (informative)	Test procedures regarding response speed	60
156	G.1	General.....	60
157	G.2	Test circuit.....	60
158	G.3	Test sequence	60
159	Annex H (normative)	Application of the design of the E/E/PE safety-related control system.....	61
161	Annex I (informative)	Electromagnetic compatibilities (EMC).....	62
162	I.1	General.....	62
163	I.2	EMC immunity	62
164	I.3	EMC radiated and conducted emission	64
165	Annex J (normative)	Calculation procedures of B_{10d} values for magnetic switching devices.....	65
167	J.1	General.....	65
168	J.2	Calculation procedures	65
169	J.3	Requirements	65
170	Annex K (informative)	Estimation of field failure rates for magnetic switching devices.....	66
171	K.1	General.....	66
172	K.2	Estimation of field failure rates.....	66
173	K.3	Requirements	66
174	Bibliography.....		68
175			
176	Figure 1 – Methods for measuring the response speed		25
177	Figure 2 – Output signal.....		25
178	Figure 3 – Methods for measuring the operating frequency (f)		28
179	Figure 4 – Output signal during the measuring of operating frequency (f).....		28
180	Figure A.1 – Driven method of magnetic proximity switch by permanent magnetic- actuator		42
182	Figure B.1 – Diagram explaining terms related to operation by magnetic-actuator.....		43
183	Figure C.1 – Sensing distances referred axial approach		44
184	Figure C.2 – Sensing distances referred lateral approach		45
185	Figure C.3 – Sensing distances and contact states referred specified direction.....		45
186	Figure C.4 – Sensing distances referred specified direction		46
187	Figure C.5 – Sensing distances		47
188	Figure C.6 – Sensing distances on liquid level		47
189	Figure D.1 – (Type A) – Examples		48
190	Figure D.2 – (Type B) – Examples		48

191	Figure D.3 – (Type C) – Examples	49
192	Figure D.4 – (Type D) – Examples of barrel switches	49
193	Figure D.5 – (Types E to H) – Examples	50
194	Figure D.6 – (Type I) – Examples for threaded barrel	50
195	Figure D.7 – (Type J) – Examples for smooth barrel	50
196	Figure D.8 – Examples for magnetic position switch	51
197	Figure D.9 – Examples for magnetic float liquid level switches	51
198	Figure E.1 – Iterative process of risk assessment and risk reduction	52
199	Figure E.2 – Risk reduction	54
200	Figure G.1 – Test circuit – Example	60
201	Figure G.2 – Measurement data by oscilloscope – Example	60
202	Figure J.1 – B_{10} value estimated by Weibull analysis – Example	65
203		
204	Table 1 – Reference values of influence quantities	16
205	Table 2 – Rated insulation voltage	17
206	Table 3 – Rated operating voltage	17
207	Table 4 – Rated operating distance	18
208	Table 5 – Rated maximum working pressure	18
209	Table 6 – Output function of MSPE	18
210	Table 7 – Type testing	19
211	Table 8 – Routine tests	20
212	Table 9 – Required data	21
213	Table 10 – Symbols	22
214	Table 11 – Examples for indication of rated values	23
215	Table 12 – Deviation of operating distance	24
216	Table 13 – Remanence value	24
217	Table 14 – Typical rated speeds	26
218	Table 15 – Typical operating times of switching loads	26
219	Table 16 – Frequency operating cycles	28
220	Table 17 – Function test by temperature change	28
221	Table 18 – Deviation of operating distance	28
222	Table 19 – Test current	29
223	Table 20 – Rated voltage of insulation resistance test	29
224	Table 21 – Dielectric test voltage	30
225	Table 22 – Minimum clearances and creepage distances	30
226	Table 23 – Number of cycles for endurance test	31
227	Table 24 – Failure criteria for electrical endurance tests	31
228	Table 25 – Torque severity	32
229	Table 26 – Value of applied force for test U_{a1}	32
230	Table 27 – Vibration test	34
231	Table 28 – Shock test	34
232	Table E.1 – Examples for the relation between failure mode, consequences and hazard	55
233	Table E.2 – Severity of harm	56

234	Table E.3 – Probability of harm.....	56
235	Table E.4 – Risk category	56
236	Table F.1 – Applications and relevant standards – Examples.....	57
237	Table H.1 – Maximum allowable safety integrity level for a safety function carried out	
238	by a type A safety-related element or subsystem	61
239	Table H.2 – Performance level.....	61
240	Table H.3 – Architectural constraints on subsystems: maximum SIL that can be claimed	
241	for a safety-related control function (SRCF) using this subsystem.....	61
242	Table I.1 – Environmental conditions influencing EMC	62
243	Table I.2 – Immunity tests for industrial environments.....	63
244	Table I.3 – Immunity tests for residential, commercial and light-industrial environments	63
245	Table K.1 – Analysis chart of the initial field data – Example.....	67
246		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

REED SWITCHES –

**Part 4: Application in conjunction with magnetic-actuator used for
Magnetic-Sensing Protective Equipment (MSPE)**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The International Standard of the IEC 62246-4 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This document is a 2nd CD based on the observations of 94_486_CC. The blue text has been changed from the document of 94_477_CD.

The text of this document is based on the following documents:

CD	CC
94/477/CD	94/486/CC

Full information on the voting for the approval of this document can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62246 series, published under the general title *Reed switches* can be found on the IEC website.

298 The committee has decided that the contents of this document will remain unchanged until the
299 stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to
300 the specific document. At this date, the document will be

- 301 • reconfirmed,
- 302 • withdrawn,
- 303 • replaced by a revised edition, or
- 304 • amended.

305 A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

306

INTRODUCTION

Most of the reed switches have been applied to magnetic-sensing protective equipment (MSPE) because of its simplicity, high reliability and zero power for operation. The MSPE is used for sensing devices or [measurement/control/monitoring devices](#) and/or output switching devices in variety of industrial applications (e.g. safety of machinery, alarm detectors, factory automation and robotics, cylinders, railways, automotive, utilities and smart grid, healthcare, consumer electronics and appliances, lifts, construction, iron, steel, cement making and petrochemical plants, aerospace and marine etc.). As new technologies emerge and diversify, standardization has been requested from various parties concerned.

Typical related standards (e.g. ISO 6432/ISO 15552 (Cylinders), ISO 8100/ISO 25745 (Lifts) and IEC 60355-2 series (Household and similar electric appliances)) specify the requirements for environmental service conditions, specific sensing distances, actuator speeds, and so on. Furthermore, the target categories and types of sensing devices and their E/E/PE systems are defined in accordance to functional safety standards (e.g. ISO 13849 series).

There are a few standards like IEC 62046 of “*Application of protective equipment to detect the presence of persons*” published in 2018. It specifies requirements for the selection, positioning, configuration and commissioning of protective equipment to detect the momentary or continued presence of persons in order to protect those persons from dangerous part(s) of machinery in industrial applications.

The intention of this document is:

1. To define the functions, types, characteristics, product information etc. for MSPE:

- [classes of enclosure, degrees of protection to \(e.g., dust, cleaning methods using water, hazardous atmospheres\) are determined \(e.g., IEC 60529 or IEC 60079 series\);](#)
- recommended operating distances are determined;
- [recommended response speed and frequency operating cycles are determined](#) as rated values.

2. To specify the test and measurement procedures for MSPE:

- functional tests and frequency operating cycles are determined in accordance with proximity switches (e.g. IEC 60947-5-2 or [ISO 6859-1](#));
- [response](#) speed and operating time of load are determined when used as trip function or presence sensing function according to the relevant standards.

3. [To specify the additional requirements for magnetic switching devices used for safety-related control systems:](#)

- [depending on the target PL/SIL level of the SRCS, give guidance on the calculation procedures of dangerous failure rates \(e.g., \$B_{10d}\$ values and/or field data\);](#)
- [considers requirements to evaluate the safety of the magnetic switching devices and important influence factors in the system.](#)

4. [To support the user in performing the needed activities from the relevant standards.](#)

REED SWITCHES –

Part 4: Application in conjunction with magnetic-actuator used for Magnetic-Sensing Protective Equipment (MSPE)

1 Scope

This part of IEC 62246 provides guidance on the selection, positioning, configuration and commissioning, design concept to design validation and environmental conditions for reed switches used with magnetic-actuator for typical applications like Magnetic Sensing Protective Equipment (MSPE) when used in conjunction with functional safety standards (e.g. IEC 62061 or ISO 13849 series).

The following are examples of such applications:

- machinery safety;
- factory automation and robotics;
- fluid power systems;
- road vehicles;
- electrical power/energy transfer systems for EV;
- electrical equipment and systems for railways;
- auxiliary switches in low-voltage and high-voltage switchgears;
- electrical equipment in medical practice;
- household and similar electric appliances;
- electricity metering equipment;
- electrical equipment in lifts, escalators;
- industrial process measurement, control and automation;
- equipment for explosive atmospheres;
- transportation engineering in aircrafts and space vehicles;
- electrical installations of ships.

Magnetic proximity switches fall within the scope of the ISO 6859-1 – *Aircraft – Proximity switches – General requirements* – developed by Technical Committee ISO/TC 20 and are covered in the document.

Magnetic float liquid level switches fall within the scope of the IEC 61010-1 – *Safety requirements for electrical equipment for measurement, control, and laboratory use – General requirements* – developed by Technical Committee IEC/TC 66 and are covered in the document.

Magnetic safety switches fall within the scope of the ISO 14119 of standard – *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection* – developed by Technical Committee ISO/TC 199 and are covered in the document.

Magnetic proximity switches and magnetic position switches do not fall within the scope of the IEC 60947-5 series of standards – *Low voltage switchgear and controlgear* – developed by Technical Subcommittee IEC/SC 121A and are covered in the document.

Information contained in this document is relevant to the application of MSPE on new installations as well as modifications to existing installations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068 (all parts), *Environmental testing*

IEC 60079-0: 2017, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1:2014, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosure “d”*

IEC 60079-1:2014/COR1:2018

IEC 60079-10-1: 2015, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmosphere*

IEC 60079-11: 2011, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”*

IEC 60079:2011/ISH4:2019

IEC 60079-15: 2017 RLV, *Explosive atmospheres – Part 15: Equipment protection by type of “n”*

IEC 60079-18: 2014, *Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”*

IEC 60417 (all parts), *Graphical symbols for use on equipment (available at <http://www.grapical-symbols.info/equipment>)*

IEC 60445: 2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60529:1989, *Degree of protection provided by enclosure (IP code)*

IEC 60529:1989/AMD2:2013

IEC 60529:1989/COR1:2019

IEC 60721-3-3: 1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Selection 3: Stationary use at weatherprotected locations*

IEC 60947-5-1: 2016, *Low voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60947-5-2: 2019, *Low voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61010-1:2010/AMD1:2016 CSV

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61076-2 (all parts), *Connectors for electronic equipment – Product requirements – Part 2: Circular connector*

IEC 61810-1:2015+AMD1:2019, *Electromechanical elementary relays – Part 1: General and safety requirements*

IEC 61810-2:2017, *Electromechanical elementary relays – Part 2: Reliability*

IEC 61810-2-1:2017, *Electromechanical elementary relays – Part 2-1: Reliability – Procedure for the verification of B_{10} values*

IEC 61810-7:2006, *Electromechanical elementary relays – Part 7: Test and measurement procedures*

IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

IEC 62061:2005/AMD1:2012

IEC 62061:2005/AMD2:2015

IEC 62246-1:2015, *Reed switches – Part 1: Generic specification*

IEC 62246-1-1:2018, *Reed switches – Part 1-1: Generic specification – Blank detail specification*

IEC TR 62246-3:2018, *Reed switches – Part 3: Reliability data for reed switch-devices in typical safety applications*

ISO/IEC 80079-20-1: 2017, *Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test method and data*

ISO 6859-1:1982, *Aircraft – Proximity switches – Part 1: General requirements*

ISO 13849-1:2015, *Machine Safety – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13849-2:2012, *Machine Safety – Safety-related parts of control systems – Part 2: Validation*

ISO 14119:2013, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62246 (all) , and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Definitions of a Magnetic-Sensing Protective Equipment (MSPE)

3.1.1

Magnetic-Sensing Protective Equipment MSPE

assembly of devices and/or components working together for protective tripping or presence sensing purposes and comprising as a minimum of

- a magnetic switching device (reed contact);
- a magnetic-actuator;
- an output signal switching device;
- a safety related monitoring and control sub-system, performing appropriate PL/SIL level according to IEC 62061 or ISO 13849-1.

Note 1 to entry: Output switching device may be reed switch.

Note 2 to entry: A description of the functions is given in sub-clause 3.2, the one of the elements in sub-clause 3.3, the one of the external connections in sub-clause 3.4 and the one of the operation in sub-clause 3.5.

Note 3 to entry: Explanations regarding magnetic proximity switch are given in Annex A.

Note 4 to entry: Explanations regarding operation of magnetic switching device are given in Annex B.

[SOURCE: IEC 62046: 2018, 3.1.7, modified – “electro” and “ESPE” have been replaced with “magnetic” and “MSPE” in the term. “sensing device” and “control/monitoring devices” have been replaced with “**magnetic switching device**” and “magnetic-actuator” in the definition and Notes 1 to 4 have been added.]

3.2 Definitions of **magnetic switching devices**

3.2.1

magnetic safety switch

guard interlocking devices that are designed to protect both people and machines, consisting of reed switches, overcurrent protection, non-coded or coded magnetic-actuator in a separate housing which could be of plastic or metal

Note 1 **to entry**: A magnetic safety switch consists of one or more reed contact elements with a specific magnetic-actuator.

Note 2 **to entry**: The operating principles are described in [Annex C.2](#).

Note 3 **to entry**: see IEC 60947-5-3:2013 and ISO 14119:2013.

3.2.2

magnetic proximity switch, <separate type>

electromechanical control circuit devices without external power supply, consisting of reed switches and magnetic-actuator, separated housing which could be plastic or metal

Note 1 **to entry**: A magnetic proximity switch consists of one or more reed contact elements with a specific magnetic-actuator.

Note 2 **to entry**: The operating principles are described in [Annexes C.2 and C.3](#).

Note 3 **to entry**: they can detect the presence of magnetic objects without contact (see IEC 60947-5-2:2019).

3.2.3

magnetic proximity switch, <vane type>

electromechanical control circuit devices without external power supply, consisting of reed switches and magnetic-actuator in the same housing which could be plastic or metal

Note 1 **to entry**: The operating principles are described in [Annex C.4](#).

Note 2 **to entry**: they can detect the presence of magnetic objects without contact (see IEC 60947-5-2:2019).

3.2.4

magnetic position switch, <reed switch type>

electromechanical control circuit device without external power supply, consisting reed switches and magnetic-actuator used the actuating system of which is operated by a moving part of machine, when this part reaches a predetermined position

Note 1 **to entry**: A magnetic position switch consists of one or more reed contact elements with a specific magnetic-actuator.

Note 2 **to entry**: The operating principles are described in [Annex C.5](#).

3.2.5

magnetic float liquid level switch, <reed switch type>

electromechanical control circuit device which is consist of reed switch(s) and float(s) without external power supply for sensing the height of liquid

Note 1 **to entry**: A magnetic float liquid level switch consists of one or more reed contact elements with a specific magnetic-actuator.

Note 2 **to entry**: The operating principles are described in [Annex C.6](#).

3.3 Elements of an MSPE

3.3.1

switching element, <for reed switch type>

reed switch that drives magnetically and switches the current of electric circuit

3.3.2

magnetic-actuator

polarized permanent magnet used to operate the MSPE switches (e.g. magnetic safety switches, magnetic proximity switches and magnetic position switches)

Note 1 **to entry**: Standard magnetic-actuator for comparative measurement of operating distance and releasing distance.

3.3.3**float, <magnetic float liquid level switch>**

spherical, cylindrical, oblong or similarly shaped object with a polarized permanent magnet built to float on water and other liquids

3.3.4**sensing face**

surface of the separate type magnetic proximity switch which the magnetic field emerges

3.3.5**sensing ferromagnetic plate**

plate for the vane type magnetic proximity switch to cut off the magnetic field of in-side magnetic-actuator

3.4 Connections**3.4.1 External connections**

output signals from the element of MSPE

Note 1 to entry: The design is such as the external connections may be extracted directly from the lead wire, terminal, connector and/or leaded connector.

3.5 Operation of an MSPE**3.5.1****rated operating distance (S_n)**

conventional value used to designate the operating distances.

Note 1 to entry: It does not consider either manufacturing tolerances or variations due to external conditions such as temperature.

3.5.2**operating distance (S_{on})**

distance at which the target approaching the sensing face along the reference axis causes the output signal to turn on for NO contacts, turn off for NC contacts

3.5.3**releasing distance (S_{off})**

distance at which the target leaving the sensing face along the reference axis causes the output signal to turn off for NO contacts, turn on for NC contacts

3.5.4**sensing distance**

operating distance or releasing distance

3.5.5**differential travel (H)**

absolute value of the difference between the operating distance and releasing distance

3.5.6**sensing area**

area of operating or releasing as obtained using a predetermined object

3.5.7**magnetic interference**

state in which the performance or characteristics of MSPEs are affected when 2 or more MSPEs is placed near to each other

3.5.8**response time, <for output of MSPE>**

length of the delay from the instant when an object enters or leaves the sensing area until a change is completed in the output of a MSPE.

Note 1 to entry: The term 'operating response time' is used to refer to response delays during times of operation and the term 'releasing response time' is used to refer to response delays at times of release.

3.5.9**response speed**

speed at which the magnetic-actuator or sensing ferromagnetic plate enters the sensing area that the MSPE can output the pulse signal of predetermined time

3.5.10**turn-on time**

time interval between the application of the specified magnetic-actuator or sensing ferromagnetic plate enters the sensing distance to a reed switch in the release condition and the change of state of the last output circuit (not including time)

3.5.11**turn-off time**

time interval between the removal of the specified magnetic-actuator or sensing ferromagnetic plate exits the sensing distance to a reed switch in the operate condition and the change of state of the last output circuit (not including time)

3.5.12**lateral approach**

approach of the magnetic-actuator perpendicular to the reference axis

3.5.13**axial approach**

approach of the magnetic-actuator with its centre maintained on the reference axis

3.6 MSPE**3.6.1****contact arrangement, <for output of contact>**

actual arrangement of output contacts

3.6.2**contact rating**

rated level at which a MSPE may be directly opened or closed

3.6.3**operational rating**

magnetic characteristics of a MSPE magnetic drive contact may be caused to operate or be reset is calculated as the product the current flowing in a standard coil and the number of coils or energy in the magnetic field formed by a permanent magnet

3.6.4**bias magnet**

magnet which is using to maintain the operation of switch with a magnetic energy level somewhere near the intermediate point between the point of sensitivity and that of release

4 Influence quantities

The specified performance of a MSPE shall be given with respect to the reference conditions, i.e. the set of reference values of all influence quantities.

Unless otherwise explicitly stated by the manufacturer, the tests shall be carried out at the reference values and tolerance ranges listed in Table 1 apply.

Table 1 – Reference values of influence quantities

Influence quantity	Reference value	Tolerance range and conditions for testing ^a
Ambient temperature	23 °C	±5 K
Atmosphere pressure	96 kPa	86 kPa to 106 kPa
Relative humidity	50 %	25 % to 75 %
External magnetic induction	0	0 ± 5 × 10 ⁻⁴ T in any direction

Mounting position	As indicated by the manufacturer	According to Annex C
Voltage/current (load)	As indicated by the manufacturer	±5 % for steady-state conditions
Frequency		Same as reference value with tolerance ±2 %
Waveform	Sinusoidal	Sinusoidal; maximum distortion factor 5 % ^a
AC component in DC (ripple)	0	Maximum 6 % ^b
DC component in AC	0	Maximum 2 % of peak value
Shock and vibration	0	Maximum 1 m/s ²
Industrial and other atmosphere	Clean air	Clean air (pollution not exceeding class 3C2 of IEC 60721-3-3)
^a Distortion factor: The ratio of the harmonic effective value obtained by dividing the effective value of all non-sinusoidal harmonics by the effective value of the fundamental wave. It is usually expressed as a percentage. ^b AC component including ripple of DC power supply is defined as follows and expressed in percent: $\frac{\text{maximum value} - \text{minimum value}}{\text{d.c. component}} \times 100$		

5 Rated values

5.1 General

The recommended values listed below do not comprise all technical possibilities and other values may be adopted according to the conditions of operation and use.

5.2 Rated insulation voltage (U_i)

Recommended rated insulation voltage values are listed in Table 2.

Table 2 – Rated insulation voltage

AC or DC	Rated Insulation voltage (V)			
AC/DC	30	60	125	250

5.3 Rated operating voltage (U_e)

Recommended rated operating voltage values are listed in Table 3.

Table 3 – Rated operating voltage

AC or DC	Rated operating voltage (V)
AC	100; 200; 220; 230; 240
DC	3; 5; 6; 12; 14; 24; 28; 42; 100; 115

5.4 Rated operating current (I_e)

The operating current values are recommended based on 4.5 of IEC 62246-1: 2015.

5.5 Contact ratings

The contact rating values are recommended based on 4.6 of IEC 62246-1: 2015.

5.6 Number of operations

The number of operation values are recommended based on 4.7 of IEC 62246-1: 2015.

5.7 Rated operating distance (S_n)

Recommended operating distance values referred to specified direction are listed in Table 4.

Table 4 – Rated operating distance

Rated operating distance (mm)
1; 2; 3; 4; 5; 8; 10; 12; 15; 20; 25; 30; 40; 50; 70; 100

5.8 Climatic category

The climatic category is recommended based on 4.8 of IEC 62246-1: 2015.

5.9 Environmental severities

a) Vibration (IEC 60068-2-6: 2007, Test Fc)

The vibration values and ranges are recommended based on 4.9 a) of IEC 62246-1: 2015.

b) Shock (IEC 60068-2-27: 2008, Test Ea)

The shock values are recommended based on 4.9 b) of IEC 62246-1: 2015.

c) Low pressure (IEC 60068-2-13: 2008, Test M)

The low-pressure values are recommended based on 4.9 d) of IEC 62246-1: 2015.

d) High pressure (IEC 60068-2-18:2017, Test R)

The recommended values for the rated maximum working pressure are listed in Table 5.

Table 5 – Rated maximum working pressure

Rated maximum working pressure (MPa)
0,1; 0,5; 1; 2; 3; 4; 5; 6

e) Degree of enclosure (IEC 60529:1989/AMD2:2013/COR1:2019)

The recommended degrees of enclosure shall have minimum IP54 protection.

5.10 Response speed

The recommended response speed is less than 10 000 mm/s.

5.11 Frequency operating cycles

The recommended frequency cycles are less than 1 000 Hz.

6 Types

The types of MSPE are classified according to output format are given in Table 6.

Table 6 – Output function of MSPE

Output function	Definition
Make contact (NO)	contact which is closed (turn-on) when the MSPE is in its operate condition and which is open (turn-off) when the MSPE is in its release condition, there is no applied magnetic field, or contact which is closed when the MSPE is in its operate condition and which is keep closed if there is no applied magnetic field.
Break contact (NC)	contact which is open (turn-on) when the MSPE is in its operate condition and which is closed (turn-off) when the MSPE is in its release condition, there is no applied magnetic field.
Change-over contact (CO)	contact set which contains a make contact and a break contact within a single envelope, one contact blade being common; such that when one of these contact circuits is open, the other is closed when the MSPE is in its operate condition.

7 General provisions for testing

7.1 General

In the subsequent clauses, the requirements to be checked as well as the related tests are specified.

The tests according to this standard are type tests and routine tests.

HAZARDS considered in this standard are hazards from electrical shock, rough handling shocks, fluid contamination, dust, different cleaning methods using water, pressurized water, explosive gasses and vapour, heating, ignition and foreseeable misuse before the end of life.

HAZARDS shall not exceed a tolerable level. For the component, the compliance to the tests specified in Table 7 are considered to represent a tolerable level. For the application of the MSPE, a risk assessment shall be carried out according to Annex E.

7.2 Type tests

Unless otherwise prescribed in the detail specification, the specimens shall be grouped in 11 inspection lots, and the related tests shall be taken from Table 7.

For each inspection lot, the tests shall be carried out in the given order. Sample size should be specified by the manufacturer.

If one or more specimen(s) of an inspection lot do(es) not pass a test, this test as well as every other one that may have influenced the result of this test shall be repeated once with an additional set of specimens of the same design. In case the manufacturer modifies the MSPE(s), all tests technically influenced by the modification shall also be repeated.

Table 7 – Type testing

Inspection lot	Tests	Clause	Additional references
1	Marking and documentation	8	IEC 60417
	Functional tests	9.3	
2	Insulation resistance	9.4	
	Dielectric strength	9.5	
3	Endurance tests	9.6	
	Electrical endurance	9.6.2	IEC 62246-1 IEC 61810-2
	Mechanical endurance (if applicable)	9.6.3	
4	External connections	9.7	
	Robustness of terminal with lead wire (if applicable)	9.7.2	
	Robustness of terminal (if applicable)	9.7.3	IEC 60068-2-21
	Solder terminals (if applicable)	9.7.4	IEC 61810-1:2019, 14.4
	Connector (if applicable)	9.7.5	IEC 61076-2
5	Mechanical stresses	9.8	
	Mounting	9.8.2	
	Vibration	9.8.3	IEC 60068-2-6
	Shock	9.8.4	IEC 60068-2-27
	Rough handling shocks (if applicable)	9.8.5	IEC 60068-2-31:2008
6	Environmental tests	9.9	
	Cold	9.9.2	IEC 60068-2-1
	Dry heat	9.9.3	IEC 60068-2-2