



DPC: 20/30422983 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: 26 June 2020

Origin: International

Latest date for receipt of comments: 22 July 2020

Project No. 2020/01718

Responsible committee: EPL/94 General purpose relays and reed contact units

Interested committees:

Title: Draft BS EN 62246-4 Ed.1.0 Reed switches. Part 4: Application in conjunction with magnetic-actuator used for Magnetic Sensing Protective Equipment (MSPE).

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if 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 July 2020

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	Commend (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.	



94/477/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 62246-4 ED1

DATE OF CIRCULATION:

2020-06-26

CLOSING DATE FOR COMMENTS:

2020-08-21

SUPERSEDES DOCUMENTS:

94/469/NP, 94/476/RVN

IEC TC 94 : ALL-OR-NOTHING ELECTRICAL RELAYS

SECRETARIAT:

Austria

SECRETARY:

Mr Bernhard Spalt

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 9, TC 17, TC 44, TC 61, TC 62, TC 65

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:

Please also to ISO TC199

Copyright © 2020 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

1		
2	FOREWORD.....	8
3	INTRODUCTION.....	10
4	1 Scope.....	11
5	2 Normative references	11
6	3 Terms and definitions	11
7	3.1 Definitions of a Magnetic-Sensing Protective Equipment (MSPE).....	12
8	3.2 Definitions of functions.....	12
9	3.3 Elements of a MSPE	13
10	3.4 External connections.....	13
11	3.5 Operation of a MSPE	13
12	3.6 Abbreviations related to MSPE	15
13	4 Normal service conditions and transport conditions	15
14	4.1 Normal service conditions	15
15	4.2 Conditions during transport and storage.....	15
16	5 Rated values	15
17	5.1 General.....	15
18	5.2 Rated insulation voltage (U_i).....	15
19	5.3 Rated operating voltage (U_e)	16
20	5.4 Rated operating current (I_e).....	16
21	5.5 Contact ratings	16
22	5.6 Number of operations	16
23	5.7 Rated operating distance (S_n)	16
24	5.8 Climatic category	16
25	5.9 Environmental severities	16
26	5.10 Surge voltage (V_{imp})	16
27	5.11 Contact data	16
28	6 Types	16
29	7 Design guidance.....	17
30	7.1 Materials.....	17
31	7.2 Classes of enclosure safety levels and explosion protections.....	17
32	7.3 Mounting.....	17
33	7.4 Operating functions.....	17
34	7.5 External connections.....	17
35	8 General provisions for testing	18
36	8.1 General.....	18
37	8.2 Type tests	18
38	8.3 Routine tests	19
39	8.4 Special tests	19
40	9 Documentation and marking	19
41	9.1 Data.....	19
42	9.2 Marking.....	21
43	9.3 Symbols.....	21
44	10 Test and measurement procedures.....	22
45	10.1 General.....	22
46	10.2 Influence quantities.....	22

47	10.3	Visual inspection and check of dimensions	23
48	10.4	Functional tests	23
49	10.4.1	General	23
50	10.4.2	Operating distance	23
51	10.4.3	Deviation of operating distance.....	23
52	10.4.4	Response (hysteretic distance) (<i>H</i>).....	24
53	10.4.5	Repetitive detection accuracy (<i>R</i>)	24
54	10.4.6	Magnetic interference	24
55	10.4.7	Response speed.....	24
56	10.4.8	Frequency operating cycles (<i>f</i>).....	25
57	10.4.9	Functional test by temperature change	27
58	10.4.10	Contact circuit resistance	27
59	10.5	Insulation resistance	28
60	10.6	Dielectric test.....	28
61	10.7	Vibration	29
62	10.8	Shock	30
63	10.9	Cold.....	31
64	10.10	Dry heat.....	31
65	10.11	Damp heat, steady state	32
66	10.12	Degree of protection	32
67	10.13	Explosion protection	32
68	10.14	Robustness of terminals.....	32
69	10.15	Soldering terminals	33
70	10.16	Connectors	33
71	10.17	Sealing	34
72	10.18	Endurance tests.....	34
73	10.19	Making and breaking capacity	35
74	11	Selection of protective measures (risk assessment).....	35
75	12	General safety requirements.....	35
76	13	Application requirements	35
77	Annex A (normative)	Explanations regarding MSPE.....	36
78	A.1	General.....	36
79	A.2	Magnetic properties of permanent magnets.....	36
80	Annex B (normative)	Explanations regarding sensing distances.....	37
81	B.1	General.....	37
82	B.2	Magnetic safety switches, proximity switches (separate type)	37
83	B.2.1	Operation	37
84	B.2.2	Axial approach.....	37
85	B.2.3	Lateral approach	37
86	B.3	Magnetic proximity switches (Latching type)	38
87	B.3.1	Operation	38
88	B.3.2	Specified direction	38
89	B.4	Magnetic proximity switches (vane type)	38
90	B.4.1	Operation	38
91	B.4.2	Specified direction	38
92	B.5	Magnetic position switches, <reed switch type>	39
93	B.5.1	Operation	39
94	B.5.2	Specified direction	39

95	B.6	Magnetic float liquid level switches, <reed switch type>	40
96	B.6.1	Operation	40
97	B.6.2	Specific direction	40
98	Annex C (informative)	Typical dimensions of MSPE	41
99	C.1	Rectangular types – Magnetic safety switches	41
100	C.1.1	(Types A, B and C) Dimensions	41
101	C.1.2	Install dimensions	42
102	C.2	Cylindrical type – Magnetic safety switches with threaded barrel.....	42
103	C.2.1	(Type D) Dimensions	42
104	C.2.2	Install dimensions	43
105	C.3	Rectangular types – Magnetic proximity switches.....	43
106	C.3.1	(Types E to H) Dimensions	43
107	C.3.2	Install dimensions	44
108	C.4	Cylindrical type – Magnetic proximity switches with threaded barrel (Type I) or smooth barrel (Type J).....	45
110	C.4.1	(Types I and J) Dimensions	45
111	C.4.2	Install dimensions	45
112	C.5	Magnetic position switches, <reed switch type>	46
113	C.5.1	Dimensions.....	46
114	C.5.2	Install dimensions	46
115	C.6	Magnetic float liquid level switches, <reed switch type>	47
116	C.6.1	Dimensions.....	47
117	C.6.2	Install dimensions	47
118	Annex D (informative)	External connections.....	48
119	D.1	General.....	48
120	D.2	Connections.....	48
121	D.3	Connections and wiring identification	48
122	Annex E (informative)	Selection of protective measures (Risk reduction)	50
123	E.1	General	50
124	E.2	Procedures to select MSPE	51
125	E.3	Machine characteristics	52
126	E.4	Environmental characteristics	52
127	E.5	Human characteristics	52
128	E.6	Functions of MSPE(s)	53
129	E.7	MSPE characteristics.....	54
130	Annex F (informative)	Procedures to select MSPE	56
131	Annex G (informative)	Considerations for safety related performance	58
132	G.1	General.....	58
133	G.2	Environmental conditions	58
134	G.3	Positioning and configuration	59
135	G.4	Immunity.....	60
136	G.5	Tamper-proof mechanism	60
137	G.6	Integration with the safety-related control system	61
138	G.7	Points to consider for use of MSPE.....	62
139	G.8	Commissioning	64
140	Annex H (informative)	Application requirements.....	66
141	H.1	General.....	66
142	H.2	Machinery safety.....	66

143	H.3	Factory automation and robotics	68
144	H.4	Fluid power systems	69
145	H.5	Road vehicles	69
146	H.6	Electrical equipment and systems for railways	70
147	H.7	Utility and smart grid	72
148	H.8	Electrical equipment in medical practice	73
149	H.9	Household and similar electric appliances	74
150	H.10	Lifts	75
151	H.11	Industrial process measurement, control and automation	77
152	H.12	Petrochemical plants	78
153	H.13	Transportation (Aircraft and space vehicles, Electrical installations of ships)	79
154		Bibliography	81
155			
156		Figure 1 – Methods for measuring the response speed	25
157		Figure 2 – Methods for measuring the operating frequency (f)	26
158		Figure 3 – Output signal during the measuring of operating frequency (f)	27
159		Figure A.1 – Driven method of MSPE by magnetic-actuator	36
160		Figure B.1 – Sensing distances referred axial approach	37
161		Figure B.2 – Sensing distances referred lateral approach	37
162		Figure B.3 – Sensing distances and contact states referred specified direction	38
163		Figure B.4 – Sensing distances referred specified direction	39
164		Figure B.5 – Sensing distances	39
165		Figure B.6 – Sensing distances on liquid level	40
166		Figure C.1 – (Type A) – Dimensions	41
167		Figure C.2 – (Type B) – Dimensions	41
168		Figure C.3 – (Type C) – Dimensions	42
169		Figure C.4 – (Type D) – Dimensions threaded barrel	43
170		Figure C.5 – (Types E to H) – Dimensions	44
171		Figure C.6 – (Type I) – Dimensions threaded barrel	45
172		Figure C.7 – (Type J) – Dimensions smooth barrel	45
173		Figure C.8 – Dimensions for magnetic position switch	46
174		Figure C.9 – Dimensions for magnetic float liquid level switches	47
175		Figure E.1 – Risk reduction process	50
176		Figure F.1 – Typical selection process for MSPE and machine actuator	56
177		Figure F.2 – Typical selection process for MSPE and liquid level	57
178		Where E : supply voltage, l : cable length (sealed wire)	58
179		Figure G.1 – Test circuit	58
180		Figure G.3 – Relationship between U_E and U_B	62
181		Figure G.4 – Turn-on and turn-off times	63
182		Figure H.1 – MSPE lay-out for photo-electric sensor	67
183		Figure H.2 – Safety system for the roller-mill with the floating function	68
184		Figure H.3 – Railway passenger door control system	70
185		Figure H.4 – MSPE lay-out for railway doors	71
186		Figure H.5 – MSPE lay-out for monitoring of HV disconnect switch and contact arrangement	72

188	Figure H.6 – MSPE lay-out for ME equipment component (foot control device) and	
189	contact arrangement	73
190	Figure H.7 – MSPE lay-out for water level sensing	75
191	Figure H.8 – MSPE lay-out for specific distance sensing device in lifts	76
192	Figure H.9 – MSPE lay-out for car position detection in lift	77
193	Figure H.10 – MSPE lay-out for crane	78
194	Figure H.11 – MSPE lay-out for valve position indicator and contact arrangement	78
195	Figure H.12 – MSPE lay-out for fuel level monitoring and contact arrangement	80
196		
197	Table 1 – Reference values of influence quantities	15
198	Table 2 – Rated insulation voltage	16
199	Table 3 – Rated operating voltage	16
200	Table 4 – Rated operating distance	16
201	Table 5 – Output function of MSPE	17
202	Table 6 – Length of lead wire	17
203	Table 7 – Type testing	18
204	Table 8 – Routine tests	19
205	Table 9 – Required MSPE data	19
206	Table 10 – Symbols	21
207	Table 11 – Examples for indication of rated values	22
208	Table 12 – Reference values of influence quantities	22
209	Table 13 – Functional tests	23
210	Table 14 – Deviation of operating distance	24
211	Table 15 – Value of response (hysteretic distance)	24
212	Table 16 – Typical rated speeds	25
213	Table 17 – Frequency operating cycles	27
214	Table 18 – Function test by temperature change	27
215	Table 19 – Deviation of operating distance	27
216	Table 20 – Test current	27
217	Table 21 – Rated voltage of insulation resistance test	28
218	Table 22 – Dielectric test voltage	28
219	Table 23 – Minimum clearances and creepage distances	29
220	Table 24 – Vibration test	29
221	Table 25 – Shock test	30
222	Table 26 – Torque severity	33
223	Table 27 – Value of applied force for test U_{a1}	33
224	Table 28 – Verification of electrical endurance tests	34
225	Table 29 – Number of cycles for endurance test	34
226	Table 30 – Failure criteria for electrical endurance tests	35
227	Table A.1 – Magnetic properties of typical magnet materials	36
228	Table C.1 – Dimension of mounting pitch	42
229	Table C.2 – Dimension to sensing face	42
230	Table C.3 – Mounting hole diameter	42

231	Table C.4 – Nominal diameter of outer peripheral screw and full length	43
232	Table C.5 – Dimension of mounting pitch	44
233	Table C.6 – Dimension to sensing face	44
234	Table C.7 – Mounting hole diameter	44
235	Table C.8 – Diameter and Full length	45
236	Table C.9 – Nominal diameter of outer peripheral screw and full length	45
237	Table C.10 – Dimension of mounting pitch	46
238	Table C.11 – Dimension to sensing face and operating force	46
239	Table C.12 – Mounting hole diameter	46
240	Table C.13 – Install dimensions	47
241	Table C.14 – Dimension to sensing face	47
242	Table C.15 – Mounting hole diameter (according to ISO 228-1:1994)	47
243	Table D.1 – Connection and wiring identification	48
244	Table E.1 – Examples of design concept for MSPE safety system	55
245	Table G.1 – Measurement results for inrush current	59
246	Table G.2 – Immunity tests	60
247	Table G.3 – Example of tamper-proof mechanism with the MSPE and Safety PLC	61
248	Table G.4 – Emission limits with respect to MSPE	64
249	Table H.1 – Required degree of protection	66
250	Table H.2 – Specific explosive atmosphere (IEC zone system gas and dust groups)	67
251	Table H.3 – The safe conditions of the roller-mill	68
252	Table H.4 – Specific explosive atmospheres (Class, Zone and groups)	79
253		

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 main task of IEC technical committees is to prepare International Standards.

IEC 62246-4, which is an International Standard, has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This document is a CD created by JP based on observations of 94_469e_CC. The highlighted in red font has been changed from the 94_469_NP document.

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

New work item proposal	Report on voting
94/469/NP	94/476/RVN

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.

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

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

- 309 • reconfirmed,
- 310 • withdrawn,
- 311 • replaced by a revised edition, or
- 312 • amended.

313 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.

314

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 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:
 - degrees of protection are determined;
 - recommended operating distances are determined as rated values;
 - typical values are determined for dimension of mounting pitch, dimension to sensing face and mounting hole diameter.
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);
 - approach speed and operating time of load are determined when used as trip function or presence sensing function according to the relevant standards.
3. To provide design concept of safety system with MSPE:
 - to provide evaluation index for safety and reliability to reduce risk quantitatively such as a relationship between occurrence probability of failure to danger of the protective equipment, monitoring interval and tamper-proof mechanism.
4. To clear the safety requirements used as a trip device or presence sensing device from typical application examples.

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. ISO 13849 series).

Typical application examples for in-scope products are given in [Annex H](#).

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 (all parts), *Explosive atmosphere*

[IEC 60404-8-1:2015, Magnetic material – Part 8-1: Specifications for individual materials – Magnetic hard materials](#)

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, *Degree of protection provided by enclosure (IP code)*

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

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

IEC 61810 (all parts), *Electromechanical elementary relays*

IEC 62246 (all parts), *Reed switches*

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 reed switch;
- a magnetic-actuator;
- an output signal switching device.

Note 1: Output switching device may be reed switch.

Note 2: 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: Explanations regarding MSPE are given in Annex A.

[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 “reed switch” and “magnetic-actuator” in the definition and Notes 1 and 2 have been added.]

3.2 Definitions of functions

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 (see IEC 60947-5-3:2013 and ISO 14119:2013)

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

Note 2: The operating principles are described in Annex B.2.

[SOURCE: IEC TR 62246-3: 2018, 4.2 d]

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; they can detect the presence of magnetic objects without contact (see IEC 60947-5-2:2007)

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

Note 2: The operating principles are described in Annexes B.2 and B.3.

[SOURCE: IEC TR 62246-3: 2018, 4.2 c]

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; they can detect the presence of magnetic objects without contact (see IEC 60947-5-2:2007)

Note 1: The operating principles are described in Annex B.4.

[SOURCE: IEC TR 62246-3: 2018, 4.2 c]

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

Note 2: The operating principles are described in Annex B.5.

[SOURCE: IEC 60050-441: 2000, 441-14-49, modified – “a pilot switch” has been modified with “electromechanical control circuit device without external power supply, consisting reed switches and magnetic-actuator used” in the definition]

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

Note 2: The operating principles are described in Annex B.6.

3.3 Elements of an MSPE**3.3.1****switching element**

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: 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 External connections

design is to be such that output signals from the element of MSPE 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. It does not consider either manufacturing tolerances or variations due to external conditions such as temperature

[SOURCE: IEC 60947-5-2: 2019, 3.3.1.1, modified – “voltage” has been removed from the definition]

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

[SOURCE: IEC 60947-5-2: 2019, 3.3.1, modified – “change” has been replaced with “turn on” in the definition]

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

[SOURCE: IEC 60947-5-2: 2019, 3.3.1, modified – “change” has been replaced with “turn off” in the definition]

3.5.4**sensing distance**

operating distance or releasing distance

3.5.5**response (hysteretic distance) (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 are placed near to each other

3.5.8**response time**

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. 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 it is possible to handle MSPE output in accordance with the speed at which an object enters the sensing area

3.5.10**turn-on time**

time required for the switching element to respond after the magnetic-actuator or sensing **ferromagnetic** plate enters the sensing distance

3.5.11**turn-off time**

time required for the switching element to respond after the magnetic-actuator or sensing ferromagnetic plate exits the sensing distance

3.5.12**lateral approach**

approach of the magnetic-actuator perpendicular to the reference axis

[SOURCE: IEC 60947-5-2: 2019, 3.3.2, modified – “target” has been replaced with “magnetic-actuator”]

3.5.13**axial approach**

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

[SOURCE: IEC 60947-5-2: 2019, 3.3.3, modified – “target” has been replaced with “magnetic-actuator”]

3.6 Abbreviations related to MSPE**3.6.1****contact arrangement**

actual arrangement of output contacts

3.6.2**contact ratings**

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

3.6.3**operational ratings**

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 Normal service conditions and transport conditions**4.1 Normal service conditions**

The MSPE complying with this document shall be capable of operating at least **under** the following standard conditions.

If the **actual operating conditions** differ from the normal service conditions, the user shall state the tolerance range from the normal service conditions and consult the manufacturer on the tolerance ranges listed in **Table 1** apply.

Table 1 – Reference values of influence quantities

Influence quantity	Normal service conditions	Tolerance range of service conditions
Ambient temperature	-10 °C to +40 °C	-40 °C to +150 °C
Atmospheric pressure	96 kPa	80 kPa to 1 MPa (with plastic enclosure)
Relative humidity	45 % to 85 %	25 % to 95 %
Pollution degree	2	up to 3 (refer to IEC 61810-1:2015, Annex H.)

4.2 Conditions during transport and storage

A special agreement shall be made between the user and the manufacturer if the conditions during transport and storage, e.g. temperature and humidity conditions, differ from those defined in 4.1.

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; 24; 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.

5.10 Surge voltage (V_{imp})

The surge voltage values are recommended **based** on 4.10 of IEC 62246-1: 2015.

5.11 Contact data

The characteristic values are recommended **based** on clause 5 of IEC 62246-1-1: 2018.

6 Types

The types of MSPE are classified according to output **format** are given in **Table 5**.

Table 5 – 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 Design guidance

7.1 Materials

Materials shall be suitable for the application and shall enable the requirement to comply with relevant test requirements.

7.2 Classes of enclosure safety levels and explosion protections

The classes of enclosure safety levels are in accordance with Clause 5 and Clause 6, IEC 60529: 2013.

The classes, zones and groups for explosive atmospheres are in accordance with IEC 60079 (all parts).

7.3 Mounting

The mounting dimensions and conditions shall be specified by the manufacturer.

Typical mounting dimensions including dimension between the mounting pitch and sensing face are given in Annex C.

7.4 Operating functions

Typical operating functions for MSPE are given in Annex B.

7.5 External connections

7.5.1 General

In principle, output signals from the switching element(s) of MSPE should be extracted directly from the lead wire, terminal or connector method.

7.5.2 Lead wire (if applicable)

a) Connection identification and marking

Unless otherwise stated in the detail specifications, the connection and wiring identification of MSPE based on the contact arrangement, should be in accordance with Table D.1.

Unless otherwise stated, the polarity shall be specified by the manufacturer.

b) Length

Recommended length values are listed in Table 6.

Table 6 – Length of lead wire

Length of lead wire (m)
0,1; 0,2; 0,25; 0,3; 0,5; 1; 2; 3; 5; 10

7.5.3 Terminal (if applicable)

The terminal must be able to connect electrically and mechanically, there should be no deformation of the terminals that adversely affects operation, performance or insulation distance.

7.5.4 Connector (if applicable)

The connector must be properly secured so as not to come off easily in the state of use, it must have a structure that prevents incorrect connection when inserting the connector.

7.5.5 Leaded connectors for quick disconnect magnetic proximity switches (if applicable)

M5, M8 and/or M12 integral connectors used for plug-in safety switches and/or leaded quick disconnect types shall be in accordance with relevant parts of the IEC 61076-2 (all parts). They shall provide a minimum protection rating of IP65 when correctly coupled with their mating connector.

The pin identification numbering is not necessary.

7.5.6 Fuses (if applicable)

When used in safety systems, switching elements should be fused externally in accordance with [Clause G.2.2](#) and [Table E.1](#) of this document.

8 General provisions for testing

8.1 General

In the subsequent [clauses](#), the requirements to be checked as well as the related tests are specified.

8.2 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	9	IEC 60417
	Functional tests	10.4	
2	Insulation resistance	10.5	
	Dielectric strength	10.6	
3	Vibration	10.7	IEC 60068-2-6
4	Shock	10.8	IEC 60068-2-27
5	Cold	10.9	IEC 60068-2-1
6	Dry heat	10.10	IEC 60068-2-2
7	Damp heat, steady heat	10.11	IEC 60068-2-78
8	Degree of protection	10.12	IEC 60529
	Explosion protection (if applicable)	10.13	IEC 60079

Table 7 – Type testing (continued)

Inspection lot	Tests	Clause	Additional references
9	Robustness of terminal (if applicable)	10.14	IEC 60068-2-21
	Solder terminals (if applicable)	10.15	IEC 61810-1:2015, 14.4
	Connectors (if applicable)	10.16	
	Sealing (if applicable)	10.17	IEC 60068-2-17 IEC 62246-1
10	Electrical endurance (per contact load) Mechanical endurance (if applicable)	10.18	IEC 61810-2 IEC 61810-2-1
11	Making and breaking capacities (if applicable)	10.19	IEC 62246-1:2015, 6.26

8.3 Routine tests

The routine tests shall be taken from Table 8.

Table 8 – Routine tests

Inspection lot	Tests	Clause	Additional references
all ^c	Marking and documentation	9	Table 11: 1a; 1b; 1c
	Functional tests	10.4 ^a	
	Contact circuit resistance	10.4.10	
	Sealing (if applicable)	10.17 ^a	IEC 60068-2-17 or IEC 62246-1-1
	Dielectric strength	10.6 ^b	

^a The manufacturer specifies the detail conditions.

^b Dielectric test for routine test could be carried out for duration of 1s in accordance with IEC 61810-7:2006, 4.9. The test voltage shall not have any negative impact on the insulation (further use). Other parameters like current limit or specification of the high-voltage transformers shall be specified by the manufacturer at an appropriate value.

^c For routine tests by definition all products are tested.

8.4 Special tests

These tests are subject to agreement between manufacturer and user.

9 Documentation and marking**9.1 Data**

The manufacturer shall make the following data available (with indication of the units).

Table 9 – Required MSPE data

N°	Data	Notes	Place of indication
1 Identification data			
1a	Manufacturer's name, identification code or trade mark		MSPE
1b	Type designation	It shall be unambiguous and ensure identification of the product by respective documentation	MSPE
1c	Manufacturing date	May be coded if specified in the documentation	MSPE (preferred) or package

Table 9 – Required MSPE data (continued)

N°	Data	Notes	Place of indication
2 Operating distance data			
2a	Targets marking		MSPE (preferred) or catalogue or instruction sheet
2b	Rated operating distance	May be coded if specified in the documentation	MSPE (preferred) or catalogue or instruction sheet
2c	Contact arrangement	May be coded if specified in the documentation	MSPE (preferred) or catalogue or instruction sheet
2d	Sensing range		Catalogue or instruction sheet
2e	Repeat accuracy		Catalogue or instruction sheet
2f	Response (hysteretic distance)		Catalogue or instruction sheet
2g	Recommended setting gap		Catalogue or instruction sheet
2h	Response speed	If applicable	Catalogue or instruction sheet
2i	Frequency of operating cycles	If applicable	Catalogue or instruction sheet
2j	Tolerance to misalignment		Catalogue or instruction sheet
2k	Recommended sensing ferromagnetic plate	If applicable	Catalogue or instruction sheet
3 Contact data			
3a	Rated operational voltage	May be coded if specified in the documentation	MSPE or catalogue or instruction sheet
3b	Rated operational current	May be coded if specified in the documentation	MSPE or catalogue or instruction sheet
3c	Number of cycles for electrical endurance		Catalogue or instruction sheet
3d	Duty factor		Catalogue or instruction sheet
3e	Number of cycles for mechanical endurance	If applicable	Catalogue or instruction sheet
3f	Minimum operational current		Catalogue or instruction sheet
3g	Rated conditional short-circuit protective device		Catalogue or instruction sheet
3h	Initial contact resistance		Catalogue or instruction sheet
4 Insulation data			
4a	Insulation resistance	For all circuits	Catalogue or instruction sheet
4b	Enclosure protection (IP code)		MSPE (preferred) or catalogue or instruction sheet
4c	Pollution degree	Of MSPE environment	Catalogue or instruction sheet
4d	Impulse withstand voltage(s)	For all circuits	Catalogue or instruction sheet
4e	Rated insulation voltage(s)	For all circuits	Catalogue or instruction sheet
5 General data			
5b	Ambient temperature range		Catalogue or instruction sheet
5c	Mounting position	If applicable	Catalogue or instruction sheet
5d	Data to permit suitable connection of the MSPE	Including polarity	Catalogue or instruction sheet
5e	Accessories	If essential to the MSPE performance	Catalogue or instruction sheet
5f	Data concerning earthing or grounding of metal parts	If applicable	Catalogue or instruction sheet
5g	Duty restrictions	If any	Catalogue or instruction sheet
5h	Mounting distance	See Annex C	Catalogue or instruction sheet

674

Table 9 – Required MSPE data (continued)

N°	Data	Notes	Place of indication
5i	Specific maximum torque	See Annex C	Catalogue or instruction sheet
5i	Maximum permissible steady-state temperature of the terminals (if applicable), and/or material combination for flat quick-connect terminations	Applies also to the combination of MSPE and mating socket	Manufacturer documentation
5j	Resistance to soldering heat	Including reference to the test procedure	Manufacturer documentation
5k	Operating fluid temperature range	Magnetic float liquid level switches	Catalogue or instruction sheet
5l	Operating fluid viscosity range	Magnetic float liquid level switches	Catalogue or instruction sheet
5m	Operating fluid specific gravity range	Magnetic float liquid level switches	Catalogue or instruction sheet
6 Explosion protection data			
6a	Class, zone and groups	If applicable	MSPE or catalogue or instruction sheet

9.2 Marking

The data of 1a) to 1c), 2a) to 2c), 3a), 3b), 4b) and 6a) of Table 9 shall be marked on the MSPE so that they are legible and durable.

The test indicated below is carried out when only additional material(s) are used for marking (e.g. inkjet or pad printing).

Compliance with the durability requirements for the marking is checked by inspection and by rubbing the marking by hand as follows:

- a) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with distilled water, followed by
- b) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with petroleum spirit.

During the tests, the soaked piece of cloth shall be pressed on the marking with a pressure of about 2 N/cm².

After these tests, the marking shall still be legible.

9.3 Symbols

When symbols are used, they shall be in line with those given in Table 10.

Rated values of switching voltage and switching current may be indicated as given in Table 11.

692

Table 10 – Symbols

Volt	V
Ampere	A
Frequency of the supply	Hz
Volt-ampere	VA
Watt	W
Direct current (IEC 60417-5031)	— — — or DC
Alternating current (single-phase) (IEC 60417-5032)	~ or AC
Alternating/direct current (IEC 60417-5033)	⎓ or DC/AC

693

Table 10 – Symbols (continued)

Protective earth (IEC 60417-5019)	
Make contact (normally open contact)	NO
Break contact (normally closed contact)	NC
Change-over contact	CO

Table 11 – Examples for indication of rated values

5 A 250 V ~
or 5 A 250 V AC
or 5 A 250 V ~ cos φ 0,4

10 Test and measurement procedures

10.1 General

This Clause specifies general test and measurement procedures to confirm the functions of MSPE according to **Table 7**.

The recommended test and measurement procedures listed below do not comprise all technical possibilities and other test and measurement procedure may be adopted according to conditions of operation and use.

10.2 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 12** apply.

Table 12 – 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	$0 \pm 5 \times 10^{-4}$ T in any direction
Position	As indicated by the manufacturer	According to 8.2 ^a
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 % ^b
AC component in DC (ripple)	0	Maximum 6 % ^c
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 The test may be carried out with other values of the influence quantities, provided **that** the quantitative relationship between one or more influence quantities and the value of the considered characteristic is known.
- ^b 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.
- ^c **AC component including ripple of DC power supply is defined as follows and expressed in percent:**
- $$\frac{\text{maximum value} - \text{minimum value}}{\text{d.c. component}} \times 100$$

10.3 Visual inspection and check of dimensions

10.3.1 Visual inspection

Unless otherwise prescribed in the detail specification, inspection shall be performed under normal visual conditions. The **finishing, sealing** and marking shall be prescribed in the detail specification.

10.3.2 Outline dimensions

The outline dimensions shall be checked and shall comply with those prescribed in the detail specification.

10.3.3 Mass

The normal mass shall be prescribed in the detail specification whenever required.

10.4 Functional tests

10.4.1 General

The functional tests shall be specified in **Table 13** by the manufacturer.

Table 13 – Functional tests

Functions of MSPE	Functional tests
Magnetic safety switches	10.4.2 to 10.4.10 are applicable.
Magnetic proximity switches	10.4.2 to 10.4.10 are applicable.
Magnetic position switches	10.4.2 to 10.4.10 are applicable, without 10.4.7 and 10.4.8.
Magnetic float liquid level switches	10.4.2 to 10.4.10 are applicable, without 10.4.7 and 10.4.8.

The MSPE shall be mounted in accordance with the instructions in the relevant specifications **given** by the manufacturer.

For the functional tests, the contact turn-on and turn-off shall be confirmed by monitoring a current, typically, 10 mA at 24 V DC max.

10.4.2 Operating distance

10.4.2.1 Procedures

Typical explanations regarding **sensing distances** are given in **Annex B**.

10.4.2.2 Requirements

The MSPE shall operate at the rated operating distance.

10.4.3 Deviation of operating distance

10.4.3.1 Procedures

The moving speed of magnetic-actuator is set such that the measured value of operating distance is not affected by the response time of the MSPE. The effective operating distance is measured at ambient temperature of 23 °C ± 5 °C.

10.4.3.2 Requirements

The MSPE shall operate less than or equal to any value in **Table 14** for the rated operating distance.