



BSI Standards Publication

Electromechanical switches for use in electrical and electronic equipment

Part 1: Generic specification

National foreword

This British Standard is the UK implementation of EN IEC 61020-1:2019. It is identical to IEC 61020-1:2019. It supersedes BS EN 61020-1:2009, which will be withdrawn on 20 February 2022.

The UK participation in its preparation was entrusted to Technical Committee PEL/23, Electrical accessories.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Electromechanical switches for use in electrical and electronic
equipment - Part 1: Generic specification
(IEC 61020-1:2019)

Interrupteurs électromécaniques pour équipements
électriques et électroniques - Partie 1: Spécification
générique
(IEC 61020-1:2019)

Elektromechanische Schalter zur Verwendung in Geräten
der Elektrotechnik und Elektronik - Teil 1:
Fachgrundspezifikation
(IEC 61020-1:2019)

This European Standard was approved by CENELEC on 2019-02-20. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 23J/443/CDV, future edition 3 of IEC 61020-1, prepared by SC 23J "Switches for appliances" of IEC/TC 23 "Electrical accessories" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61020-1:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2019-11-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-02-20

This document supersedes EN 61020-1:2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61020-1:2019 was approved by CENELEC as a European Standard without any modification.

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

IEC 60062:2016	NOTE	Harmonized as EN 60062:2016 (not modified)
IEC 60065	NOTE	Harmonized as EN 60065
IEC 60068-3-13	NOTE	Harmonized as EN 60068-3-13
IEC 60512 (series)	NOTE	Harmonized as EN IEC 60512 (series)
IEC 60664-1	NOTE	Harmonized as EN 60664-1
IEC 60695-11-10	NOTE	Harmonized as EN 60695-11-10
IEC 61190-1-3	NOTE	Harmonized as EN IEC 61190-1-3
ISO/IEC 17050-1	NOTE	Harmonized as EN ISO/IEC 17050-1
ISO/IEC 17050-2	NOTE	Harmonized as EN ISO/IEC 17050-2
ISO 129-1	NOTE	Harmonized as EN ISO 129-1 ¹
ISO 286-1	NOTE	Harmonized as EN ISO 286-1
ISO 1101	NOTE	Harmonized as EN ISO 1101
ISO 9001	NOTE	Harmonized as EN ISO 9001

¹ Under preparation. Stage at the time of publication: prEN ISO 129-1:2018.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

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

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60027	series	Letter symbols to be used in electrical technology	EN IEC 60027	series
IEC 60050-581	-	International Electrotechnical Vocabulary - Part 581: Electromechanical components for electronic equipment	-	-
IEC 60068-1	2013	Environmental testing - Part 1: General and guidance	EN 60068-1	2014
IEC 60068-2-1	-	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	-
IEC 60068-2-2	-	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	-
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-10	-	Environmental testing - Part 2-10: Tests - Test J and guidance: Mould growth	EN 60068-2-10	-
IEC 60068-2-11	-	Basic environmental testing procedures - Part 2-11: Tests - Test Ka: Salt mist	EN 60068-2-11	-
IEC 60068-2-13	-	Basic environmental testing procedures - Part 2-13: Tests - Test M: Low air pressure	EN 60068-2-13	-
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-17	-	Basic environmental testing procedures - Part 2-17: Tests - Test Q: Sealing	EN 60068-2-17	-
IEC 60068-2-20	2008	Environmental testing - Part 2-20: Tests - Test T: Test methods for solderability and resistance to soldering heat of devices with leads	EN 60068-2-20	2008
IEC 60068-2-21	-	Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	-
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	-

EN IEC 61020-1:2019 (E)

IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60068-2-38	2009	Environmental testing - Part 2-38: Tests - Test Z/AD: Composite temperature/humidity cyclic test	EN 60068-2-38	2009
IEC 60068-2-42	-	Environmental testing - Part 2-42: Tests - Test Kc: Sulphur dioxide test for contacts and connections	EN 60068-2-42	-
IEC 60068-2-43	-	Environmental testing - Part 2-43: Tests - Test Kd: Hydrogen sulphide test for contacts and connections	EN 60068-2-43	-
IEC 60068-2-45	-	Basic environmental testing procedures - Part 2-45: Tests - Test XA and guidance: Immersion in cleaning solvents	EN 60068-2-45	-
IEC 60068-2-46	-	Basic environmental testing procedures - Part 2-46: Tests - Guidance to test Kd: Hydrogen sulphide test for contacts and connections	HD 323.2.46 S1	-
IEC 60068-2-49	-	Basic environmental testing procedures - Part 2-49: Tests - Guidance to test Kc: Sulphur dioxide test for contacts and connections	-	-
IEC 60068-2-58	2015	Environmental testing - Part 2-58: Tests - Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)	EN 60068-2-58	2015
+ A1	2017		+ A1	2018
IEC 60068-2-61	1991	Environmental testing - Part 2-61: Test methods - Test Z/ABDM: Climatic sequence	EN 60068-2-61	1993
IEC 60068-2-68	1994	Environmental testing - Part 2-68: Tests - Test L: Dust and sand	EN 60068-2-68	1996
IEC 60068-2-77	-	Environmental testing - Part 2-77: Tests - Test 77: Body strength and impact shock	EN 60068-2-77	-
IEC 60068-2-78	-	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	-	-
IEC 60617	-	Graphical symbols for diagrams (available at: http://std.iec.ch/iec60617)	-	-
IEC 60721-3-3	-	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations	EN 60721-3-3	-
IEC 61058-1	2016	Switches for appliances - Part 1: General requirements	EN IEC 61058-1	2018
IEC 61058-1-1	2016	Switches for appliances - Part 1-1: Requirements for mechanical switches	EN 61058-1-1	2016
ISO 80000-1	-	Quantities and units - Part 1: General	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROMECHANICAL SWITCHES
FOR USE IN ELECTRICAL AND ELECTRONIC EQUIPMENT –****Part 1: Generic specification****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.
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International Standard IEC 61020-1 has been prepared by subcommittee 23J: Switches for appliances, of IEC technical committee 23: Electrical accessories.

This third edition cancels and replaces the second edition published in 2009.

This edition includes the following significant technical changes with respect to the previous edition:

- a) In accordance with the ISO/IEC Directives, Part 2:2016, Clause 2 General has been replaced by two new clauses: Clause 2 Normative references and Clause 3 Terms, definitions, units and symbols.
2.4 Preferred values and 2.5 Marking have been moved to Clauses 5 and 6. In addition, 6.2 Markings on packaging has been added.
- b) Clause 3 Quality assurance procedures and Annex A have been deleted.
- c) 4.3.6.3 Returning force has been added.
- d) 4.3.6.4 Travel (movement of the actuator) has been added.
- e) 4.12 Environmental testing:

4.12.1.3 and 4.12.1.5 have been renumbered 4.12.2 and 4.12.3, respectively. 4.12.1.4 and 4.12.1.7 have been integrated in 4.12.5. 4.12.10 Salt mist has been added.

f) Following publication of IEC 61058-1-1:2016, some cross-references to IEC 61058-1 have been updated.

g) The following items have been updated with respect to the second edition.

– Tables and figures:

Tables 1 and 3 have been deleted, Table 4 has been renumbered to Table 10. New Tables 2, 3, 4, 5, 6, 7, 8 and 9 have been added.

Figure 1 has been renumbered to Figure 3, Figure 2 renumbered to Figure 4, Figure 3 renumbered to Figure 9 and Figure 4 renumbered to Figure 12. Added new Figures 1, 2, 5, 6, 7, 8, 10 and 11 have been added.

– Specific words and common names have been unified.

The text of this International Standard is based on the following documents:

CDV	Report on voting
23J/443/CDV	23J/448/RVC

Full information on the voting for the approval of this International Standard 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 in the IEC 61020 series, published under the general title *Electromechanical switches for use in electrical and electronic equipment*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This document covers the general requirements and test methods for electromechanical switches with optional quality assurance procedures. It provides the general requirements and test methods for use in any detail specifications for pushbutton switches, rotary switches, sensitive switches, toggle switches, and other electromechanical switches.

Where it is intended that an electromechanical switch comply with requirements related to safety, the specific safety requirements will be specified in IEC 61058-1.

ELECTROMECHANICAL SWITCHES FOR USE IN ELECTRICAL AND ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 Scope

This part of IEC 61020 specifies the terminology, symbols, test methods and other necessary information to provide consistency in detail specifications for electromechanical switches.

This document relates to electromechanical switches intended for use in electrical and electronic appliances. Switches covered by this document:

- a) are devices which open, close, or change the connection of a circuit by the mechanical motion of conducting parts (contacts);
- b) have a maximum rated voltage of 480 V;
- c) have a maximum rated current of 63 A.

This document does not include keyboards and keypads which are intended for use in information-handling systems. Electromechanical key switches can be included under the scope of this document.

Switch families will be described in any detail specifications that reference this document.

This document is a performance standard intended to describe evaluation methods to better clarify the capabilities of a switch.

NOTE 1 Safety requirements for switches for household and similar fixed electrical installations are given in IEC 60669 (all parts).

NOTE 2 Safety requirements for appliance switches are given in IEC 61058 (all parts).

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050-581, *International Electrotechnical Vocabulary – Part 581: Electromechanical components for electronic equipment*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry Heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-10, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mechanical shock*

IEC 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-13, *Environmental testing – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-38:2009, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-42, *Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-43, *Environmental testing – Part 2-43: Tests – Test Kd: Hydrogen sulphide test for contacts and connections*

IEC 60068-2-45, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-46, *Basic environmental testing procedures – Part 2-46: Tests – Guidance to test Kd: Hydrogen sulphide test for contacts and connections*

IEC 60068-2-49, *Basic environmental testing procedures – Part 2-49: Tests – Guidance to Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-58:2015, *Environmental testing Part 2-58: Tests, Tests Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-58:2015/AMD1:2017

IEC 60068-2-61:1991, *Environmental testing – Part 2-61: Test methods; Test Z/ABDM: Climatic sequence*

IEC 60068-2-68:1994, *Environmental testing – Part 2-68: Tests – Test L: Dust and sand*

IEC 60068-2-77, *Environmental testing – Part 2-77: Tests – Test 77: Body strength and impact shock*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests, Test Cab: Damp heat, steady state*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60617, *Graphical symbols for diagrams* (available at: <http://std.iec.ch/iec60617/>)

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

IEC 61058-1:2016, *Switches for appliances – Part 1: General requirements*

IEC 61058-1-1:2016, *Switches for appliances – Part 1-1: Requirements for mechanical switches*

ISO 80000-1, *Quantities and units – Part 1: General*

3 Terms, definitions, units and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581 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>

Note 1 to entry: Terminology peculiar to a particular switch subfamily is defined in the applicable detail specification. Terminology peculiar to a group of structurally similar switches is defined in the detail specification.

Note 2 to entry: The following terminology is common to all electromechanical switches. Where the definition is compatible with an established IEC 60050 definition, the IEC 60050 reference for the related definition is given as source information.

3.1.1

category temperature range

range of ambient temperature for which the switch has been designed to operate continuously

3.1.2

clearance

shortest distance in air between two conductive parts

3.1.3

contact bounce

intermittent and random opening of closed contacts and closing of open contacts which may occur after contact transfer and which is caused by the switch mechanism

3.1.4

contact bounce time

time period measured from the moment of first closure of two mating contacts or first opening of two closed contacts to the moment when all contact bounce ceases

3.1.5

contact disturbance

intermittent and random closing of open contacts and/or opening of closed contacts caused by external influences such as shock and vibration

3.1.6

creepage distance

shortest distance along the surface of the insulation material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50, modified – “a solid insulating material” has been replaced by “the insulation material”.]

3.1.7

detail specification

declarations of switch parameters including ratings, test conditions and performance criteria, agreed upon by the manufacturer and/or all interested parties

3.1.8

duty cycle

ratio of conducting (ON) time to the total time for one cycle

EXAMPLE 30 % ON.

3.1.9

electrical load

element connected to a circuit to pass a certain current through a specimen switch

Note 1 to entry: Resistor, coil and capacitor are examples of elements.

3.1.10

electromechanical switch

switch which opens, closes, or changes the connection of an electrical circuit by the mechanical motion of conducting parts (contacts)

3.1.11

latch

latching mechanism for holding the button at the position when the operating button of a switch is pushed down

3.1.12

lever switch

switch where the actuating member is a lever which has to be moved (tilted) to one or more indexed positions in order to achieve a change in contact state

3.1.13

lower category temperature

minimum ambient temperature for which a switch has been designed to operate continuously

3.1.14

mounting bushing

component of a switch by which the switch is mounted on an equipment and which also serves as a bearing

3.1.15

operating cycle

succession of operations from one position to another and back to the first position through all other positions, if any

[SOURCE: IEC 60050-441:2000, 441-16-02]

3.1.16

operation

movement of a contact from a position to an adjacent position

3.1.17

operation test

test in which a switch is operated with the electric load connected under the simulated state of actual use

3.1.18**pole**

<of a switch> part associated exclusively with one, electrically separated, conducting path of the switch

Note 1 to entry: Those parts that provide a means for mounting and operating all poles together are excluded from the definition of a pole.

Note 2 to entry: A switch is called "single-pole" if it has only one pole. If it has more than one pole, it may be called "multi-pole" (two-pole, three-pole, etc.) provided that the poles are coupled in such a manner as to operate together.

3.1.19**push-button switch**

switch where the actuating member is a button which has to be pushed in order to achieve a change in contact state

3.1.20**rated current**

current assigned by the manufacturer for a specified operating condition

3.1.21**rated voltage**

voltage assigned by the manufacturer for a specified operating condition

3.1.22**returning force**

force possessed by the automatic returning mechanism which returns the actuator to the position before operation when the operating force is removed

3.1.23**rocker switch**

switch where the actuating member is a low profile lever (rocker) which has to be tilted to one or more indexed positions in order to achieve a change in contact state

3.1.24**rotary switch**

switch where the actuating member is a shaft or a spindle which has to be rotated to one or more indexed positions in order to achieve a change in contact state

Note 1 to entry: The rotation of the actuating member may be unlimited or restricted in either direction.

3.1.25**slide switch**

switch, the actuating member of which is a button which has to be displaced laterally in order to achieve a change in contact state

3.1.26**surface mounting switch**

small-sized switch which is suitable for surface mounting on the printed wiring board, consisting of terminals and framing parts

3.1.27**upper category temperature**

maximum ambient temperature for which a switch has been designed to operate continuously

3.2 Units and symbols

Units, graphical symbols, and letter symbols shall be, whenever possible, in accordance with ISO 80000-1, IEC 60617 and IEC 60027 (all parts), respectively.

Graphical symbols and letter symbols peculiar to a particular switch subfamily shall be defined in the applicable detail specification. Graphical symbols and letter symbols peculiar to a group of structurally similar switches shall be defined in the detail specification. When additional units or symbols are required, they shall be derived in accordance with the principles of the documents listed above whenever possible.

4 Test and measurement procedures

4.1 General

4.1.1 General requirements to tests and measuring procedures

Any detail specification shall contain tables showing the tests to be conducted, the measurements to be made before and after each test or group of tests, and the sequence in which they shall be carried out. The measuring conditions shall be the same for initial and final measurements. When tests are performed in a sequence, the final measurements of one test may be taken as the initial measurements for the succeeding test.

If national specifications within any quality assessment system include test methods other than those specified in the above documents, the test methods shall be fully described.

Not all the test methods specified in this document are applicable to all types of switches. The detail specification shall specify the test methods which are applicable for that type of switch.

When necessary, additional test methods and/or details of the test methods shall be specified by the detail specification.

Unless otherwise specified by the detail specification, the test sequence shall be as specified in this document.

4.1.2 Tolerances

Unless otherwise specified, the actual value of the parameters, for example test voltage, test current, test force or test torque, shall be within 5 % of the specified values of the switch.

4.1.3 Preconditioning

Unless specified by the test methods, the switches shall not be subjected to any special preparations, such as cleaning, prior to or during the tests.

4.1.4 Mounting

When mounting is specified by the test methods, the switch shall be rigidly mounted by its normal mounting means and connected as specified in the detail specification. The methods of mounting and the materials used for mounting shall not adversely affect the electrical or mechanical performance of the switch.

4.2 Standard atmospheric conditions

The standard atmospheric conditions shall be in accordance with Clause 4 of IEC 60068- 1:2013.

4.3 General examination

4.3.1 Visual examination

4.3.1.1 Method

The visual examination shall be carried out by one of the following methods:

- a) with the naked eye (normal strength of vision, normal colour perception, at the most favourable viewing distance and with suitable illumination);
- b) with magnifiers, if specified.

For the purpose of this document, special methods, for example using polarized light (for observing internal tensions in materials) or other indicators (for observing internal material cracks or pores), are not permitted unless explicitly required by the detail specification.

4.3.1.2 Features

The following features shall be examined without magnification:

- a) markings according to Clause 6;
- b) general appearance;
- c) workmanship.

4.3.1.3 Requirement

The markings shall be correct and legible. The switch shall be manufactured in a careful and workmanlike manner.

4.3.1.4 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be specified:

- a) details to be examined;
- b) features to be checked;
- c) acceptability;
- d) power of magnifier, if specified
- e) any deviation from the standard test methods.

4.3.2 Dimensions

4.3.2.1 Method

The examination of dimensions shall be carried out with appropriate measuring equipment, for example:

- a) with a vernier calliper, a micrometer and a dial gauge;
- b) with a measuring projector with a suitable linear magnification;
- c) with a measuring microscope.

The following details shall apply.

- 1) The specified outline dimensions, detailed dimensions, clearances and creepage distances shall be measured according to Annex A of IEC 61058-1:2016.
- 2) The accuracy and resolution of the measuring equipment (micrometers, callipers, visual comparators, etc.) shall be commensurate with the dimensions being measured.

4.3.2.2 Requirement

The dimensions shall be within the limits specified by the detail specification.

4.3.2.3 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be specified:

- a) features to be checked;
- b) gauging details, if applicable;
- c) type and power of measuring equipment;
- d) acceptability;
- e) any deviation from the standard test methods.

4.3.3 Dimensions, gauging

4.3.3.1 Method

The dimensions specified by the detail specifications as being suitable for gauging shall be checked using the gauges or gauge dimensions specified by the detail specification.

4.3.3.2 Requirement

The switch shall comply with the specified gauging.

4.3.3.3 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be specified:

- a) features to be checked;
- b) gauging details, if applicable;
- c) type and power of measuring equipment;
- d) acceptability;
- e) any deviation from the standard test methods.

4.3.4 Mass

4.3.4.1 Method

The checking of mass should be carried out with appropriate measuring equipment, for example, with a balance.

The following details shall apply.

- a) The accuracy and resolution of the measuring equipment shall be commensurate with the mass being measured.
- b) The measurement shall include all removable parts (mounting hardware, etc.) specified by the detail specification.

4.3.4.2 Requirement

The mass shall be within the limits specified by the detail specification.

4.3.4.3 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be specified:

- a) features to be checked;

- b) gauging details, if applicable;
- c) type and power of measuring equipment;
- d) acceptability;
- e) any deviation from the standard test methods.

4.3.5 Functional operation

4.3.5.1 Objective

The objective of the examination is the assessment of the proper functioning of all switching operations.

4.3.5.2 Method

For logic switches, each switching circuit shall be connected to a monitoring circuit which has a maximum current of 150 mA, and provides an indication of current flow. With the exception of logic switches, the test facility may use the contact resistance test to check the switching circuit.

The correct functioning of all mechanical detents, latching, locking, interlocking, and self-return mechanisms shall be checked.

The correct functioning of all electrical non-switching operations, such as lamp circuits or solenoids, shall be checked at their rated voltage and/or rated current.

4.3.5.3 Requirement

The functional operation of the switch, including the sequence of contact operations, shall comply with the requirements specified by the detail specification.

4.3.6 Operating characteristics

4.3.6.1 Operating force

4.3.6.1.1 Object

The objective of this test is to measure the force to move the actuating part of a switch from any one position to the next.

4.3.6.1.2 Preparation of specimens

The specimens shall be prepared as specified by the detail specification.

The specimens shall be rigidly mounted on a metal plate using the fixing devices specified in the detail specification. The metal plate shall be strong enough to withstand the forces applied. The length and width of the metal plate shall be such that the contour of the specimen is exceeded.

4.3.6.1.3 Method

The force shall be applied to the actuating part in the direction and at the point specified in the detail specification (see Figure 1). Unless otherwise specified, the force shall be applied until the actuating part has travelled from a first stable equilibrium position to its next stable equilibrium position or a stop, and the switch has operated electrically or the specified contact resistance is achieved. The maximum force necessary to move the actuating part to the next stable position or stop shall be measured and recorded. In the case of a switch in which the actuator does not take up a second stable equilibrium position (momentary position), the force required to move the actuator to the operating position shall be measured and recorded.

If appropriate, the measurements of operating force shall be carried out in both directions. In each direction, the number of measurements shall be as specified in the detail specification.

The methods for measuring other mechanical operating characteristics shall be specified by the detail specification. The methods for measuring other operating characteristics such as temperature, air pressure, etc. shall be specified by the detail specification.

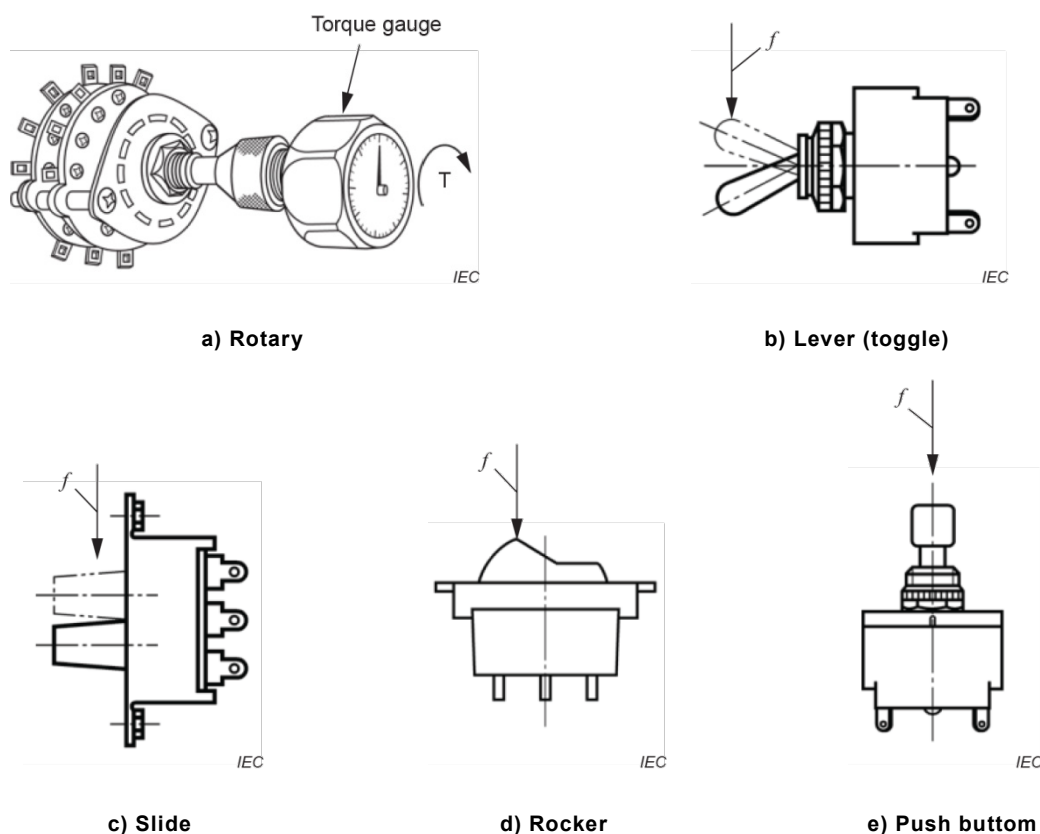


Figure 1 – Measuring direction of operating force and torque

4.3.6.1.4 Requirement

All measured values shall be within the limits specified in the detail specification.

4.3.6.1.5 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be given:

- preparation of specimen;
- number of measurements;
- point and direction of force application;
- rate of increase of force or operating speed;
- permissible minimum and maximum values of force;
- kind of measuring system;
- shape of the actuating tip of the system;
- temperature other than normal ambient, if appropriate;
- any deviation from the standard test methods.

4.3.6.2 Operating torque

4.3.6.2.1 Object

The objective of this test is to measure the maximum torque to move the actuating part of a switch from one stable position to the next position where the switch has operated electrically.

4.3.6.2.2 Preparation of specimens

The specimen shall be prepared as specified by the detail specification.

The specimen shall be rigidly mounted on a metal plate using the fixing devices specified in the detail specification. The metal plate shall be strong enough to withstand the torque applied. The length and width of the metal plate shall be such that the contour of the specimen is exceeded.

4.3.6.2.3 Method

The torque shall be applied to the operating spindle in the direction specified (see Figure 1 a)). Unless otherwise specified, the torque shall be applied until the actuating part has travelled from a first stable equilibrium position to its next stable equilibrium position or a stop, and the switch has operated electrically or the specified contact resistance is achieved. The maximum torque necessary to move the actuating part to the next stable position or stop shall be measured and recorded. In the case of a switch in which the actuator does not take up a second stable equilibrium position (momentary position), the torque required to rotate or pivot the actuator to the next operating position shall be measured and recorded.

If appropriate, the measurements of operating torque shall be carried out in both directions. In each direction, the number of measurements shall be as specified in the detail specification.

The methods for measuring other mechanical operating characteristics shall be specified by the detail specification. The methods for measuring other operating characteristics such as temperature, air pressure, etc. shall be specified by the detail specification.

4.3.6.2.4 Requirement

All measured values shall be within the limits specified in the detail specification.

4.3.6.2.5 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be given:

- a) preparation of specimen;
- b) number of measurements;
- c) direction of operation;
- d) rate of increase of torque or rotary speed;
- e) minimum and maximum values of torque permissible;
- f) kind of measuring system;
- g) shape of the actuating tip of the system;
- h) temperature other than normal ambient, if appropriate;
- i) any deviation from the standard test methods.

4.3.6.3 Returning force

4.3.6.3.1 Object

The objective of this test is to measure the returning force by which the operating part of automatic returning switch returns to the rest position.

4.3.6.3.2 Method

A specimen shall be mounted on a metal plate in normal condition of use.

Unless otherwise specified in detail specifications, the metal plate of push-button or rocker switch shall be set in a horizontal position (see Figure 1 d) and e)).

Switches other than push-button or rocker actuation shall be mounted on the mounting plate in vertical position (see Figure 1 b) and c)).

The test, whether it is conducted with or without a knob or the like, shall be based on the detail specifications.

The test shall be conducted as follows.

- a) Unless otherwise specified in detail specifications, the operating force is applied to the normal operating portion of the specimen and it is operated until its operating limit.
- b) In the process of releasing the operating force gradually and getting the operating parts from the operating limit back to the original position, the following measurement and/or check in 1) and 2), respectively, shall be made (see Figure 2).
 - 1) The returning force which gets the operating portion from the limit to the original position is measured at a point specified in detail specifications.
 - 2) It is checked if the operating portion has returned to the original stop position correctly.

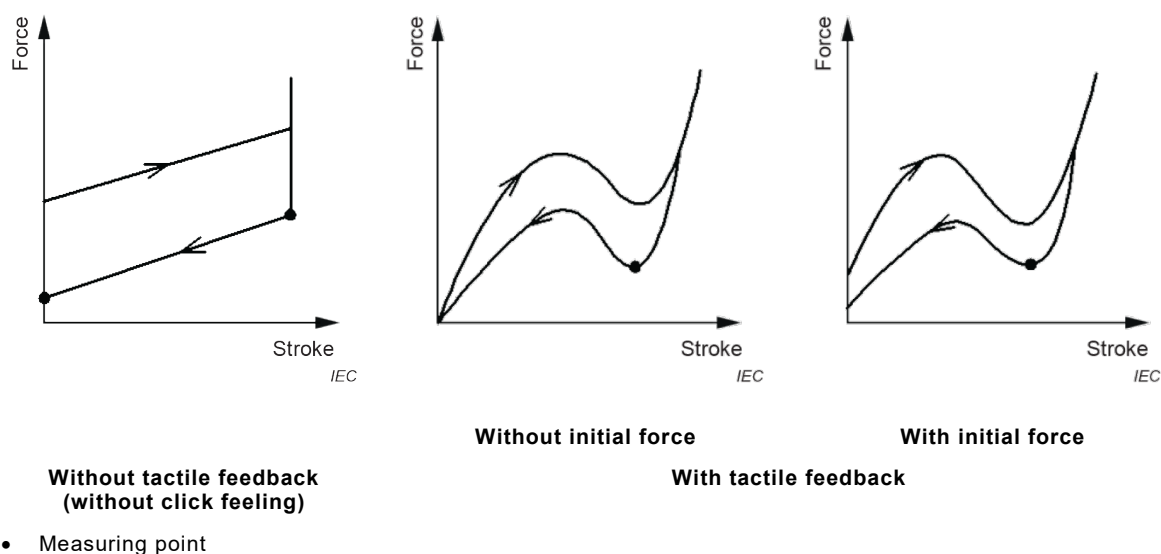


Figure 2 – Example of measuring points specified in detail specifications

4.3.6.3.3 Items to be specified in detail specification

The following items shall be specified in the detail specification:

- a) orientation of mounting (if specified);

- b) with or without knob, etc.;
- c) position and direction of applying force (if specified);
- d) measuring point of a returning force;
- e) any deviation from the standard test methods.

4.3.6.4 Travel (movement of the actuator)

4.3.6.4.1 Object

The objective of this test is to measure the travel from original position to the operating limit position.

4.3.6.4.2 Method

A specimen shall be mounted in normal condition of use and the travel shall be measured by the methods of a) or b).

- a) For switches whose travel is expressed as an angle: moving the operating part gradually, the angle is measured between the specified stop positions in the detail specifications.
- b) For switches whose operating range is expressed as a distance: moving the operating part gradually, the distance is measured between the specified stop positions in the detail specifications.

4.3.6.4.3 Items to be specified in detail specification

The following items shall be specified in the detail specification:

- a) test method 4.3.6.4.2 a) or b);
- b) type of travel;
- c) measuring point (if specified);
- d) number of times of measurement (if specified);
- e) any deviation from the standard test methods.

4.3.7 Contact bounce

4.3.7.1 Object

The objective of the measurement is to determine the duration of the intermittent and random opening of closed contacts and closing of open contacts which may occur after contact transfer and is caused by the switch mechanism. Electronic logic circuits may produce spurious data due to the kinetic behaviour of the switching contacts.

4.3.7.2 Method

The switch shall be mounted in accordance with 4.1.4.

The test circuit shown in Figure 3, or an equivalent, shall be used for detecting contact bounce. The values for the DC test voltage and test current shall be specified in the detail specification, but shall not exceed an open circuit voltage of 10 V DC and a test current of 100 mA.

The detection and display means (oscilloscope or equivalent) utilized in the circuit shall have a band width of 1 MHz or greater, a minimum time base accuracy of $\pm 5\%$, and shall be capable of showing the quiescent contact state prior to contact transfer unless otherwise specified.

The switch shall be actuated at a constant velocity at the rate specified in the detail specification. When the contact bounce is affected by the actuation force and/or actuation characteristic, the limits of the force and the actuation characteristic shall be specified in the detail specification.

The duration of the contact bounce shall be the maximum measurement occurring in five consecutive measurements of contact closure and of contact opening. For the purpose of this test, the contacts shall be open when the voltage drop across the contacts is at least 90 % of the open circuit voltage. The contacts shall be closed when the voltage drop across the contacts is no greater than 10 % of the open circuit voltage. When the contacts are closed, the voltage variations within the 10 % limit are due to variations in the dynamic contact resistance. Contact bounce is the time duration measured from the moment of first closure (or opening) to the moment when the contacts remain closed (or opened). The values for the resistor and the input impedance of the detection and display means shall be specified in the detail specification. See Figures 3 and 4.

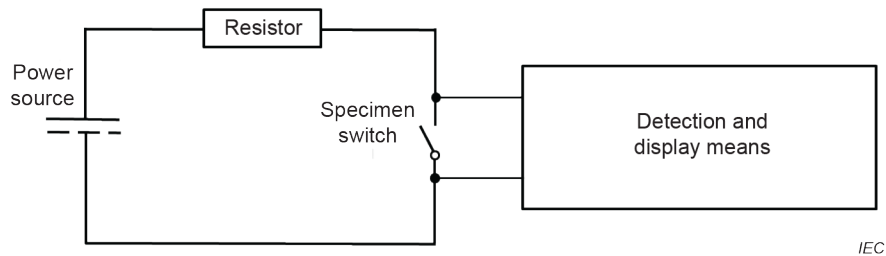


Figure 3 – Contact bounce test circuit

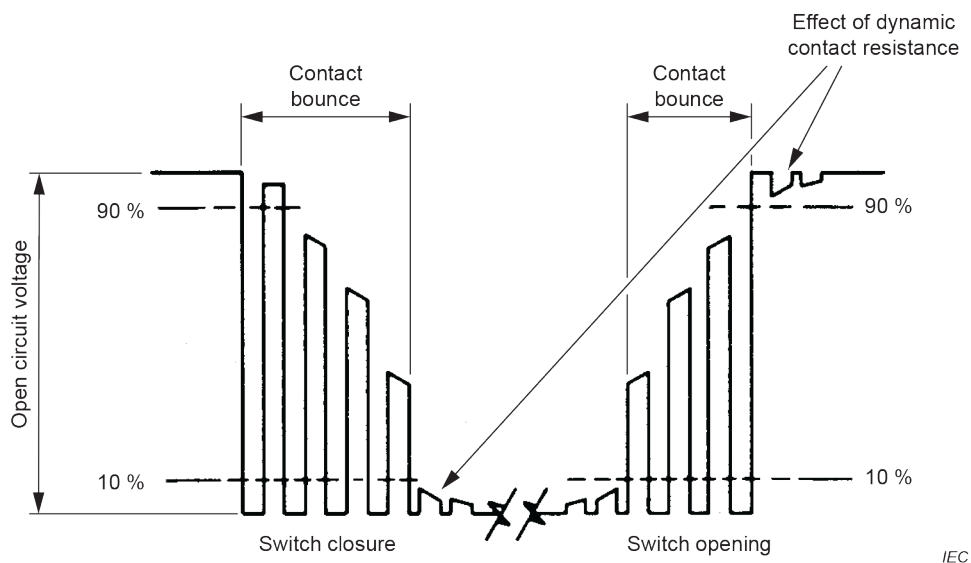


Figure 4 – Typical trace of contact bounce

4.3.7.3 Requirement

The duration of the contact bounce shall be within the limits specified by the detail specification.

4.3.7.4 Items to be specified in the detail specification

When this test is required by the detail specification, the following details shall be given:

- a) preparation of specimen;
- b) speed of operation;
- c) point and direction of force application;
- d) test voltage and current;
- e) any deviation from the standard test methods.

4.4 Resistance measurements

4.4.1 Contact resistance – Millivolt level

4.4.1.1 Object

The objective of the measurement is the determination of the total electrical resistance of the conducting switching circuits, including the switch terminations, at a voltage which has no electrical effect on the contact material.

4.4.1.2 Method

The measurement shall be performed as follows.

- a) Measurements may be carried out with alternating current or preferably, direct current. For AC measurements, the frequency shall not exceed 2 kHz, see Figure 6 for the test circuit. For DC measurements, see Figure 5 for the test circuit.
- b) The accuracy of the measuring apparatus shall be such that the total error does not exceed 1 %.
- c) The contact resistance shall be derived normally from the voltage drop measured between the zones intended for connection of the wiring to the contacts at the points specified in the detail specification.
- d) The contact shall not be operated while the measuring voltage is applied. During the measurement, avoid exerting abnormal pressure on the contacts under test and avoid movement of the test cables.
- e) Where the connection points specified in the detail specification are not directly accessible, the resistance of the cable or wire used shall be subtracted from the measured value. The corrected value shall be recorded.
- f) The contacts to be measured shall be chosen in accordance with the detail specification.
- g) Test current and voltage: In order to prevent the breakdown of insulating films on the contacts, the open circuit voltage of the measuring circuit shall not exceed 20 mV DC or AC peak. The test current shall not exceed 100 mA, AC or DC.
- h) One measuring cycle shall be performed on each switching circuit, where one measuring cycle for DC consists of
 - application of the voltage,
 - measurement with current flowing in one direction,
 - measurement with current flowing in the opposite direction, and
 - disconnection of the voltage source;and one measuring cycle for AC consists of
 - application of the voltage,
 - making the measurement, and
 - disconnection of the voltage source.

Unless otherwise specified, the made contact(s) should not be disturbed between the end of the preceding test and the application of the voltage in this test.

- i) When contact resistance is dependent upon the operating force, the contact resistance shall be measured at the operating force specified by the detail specification.

4.4.1.3 Requirement

The contact resistance shall be within the limits specified by the detail specification.

The contact resistance measurement with DC shall be the average of the two readings obtained with forward and reverse current.