8.3.3.2.3 OFF-STATE CURRENT (I_r)

With the circuit in figure 8 and the switch S closed, the load R_2 is adjusted to obtain the rated operational current I_e when the supply voltage is the highest U_e. The target is then moved in a position such that the switching element is in the OFF-state.

The (I_r) current shall be measured with supply voltage U_e + 10 % or with the maximum value of the supply voltage U_B where it is specified as a range. The (I_r) current shall not exceed the value specified in 7.2.1.13.

8.3.3.2.3DV D2 *Delete 8.3.3.2.3:*

Subclause 8.3.3.2.3 does not apply.

8.3.3.2.4 Independent (snap) action

Independent (snap) action shall be checked at maximum and minimum operating load currents at both maximum and minimum rated operating voltages. Resistive loads of appropriate value shall be used for each of the four tests.

These tests shall be carried out by moving the target from a position where the switching element is in the OFF-state to a position where the switching element is in the ON-state and observing the output on an oscilloscope. The SWITCHING ELEMENT FUNCTION shall be substantially independent from the velocity of the target and the output shall switch between the ON and the OFF states without oscillating, or holding at any intermediate level.

8.3.3.2.4DV D2 *Delete 8.3.3.2.4:*

Subclause 8.3.3.2.4 does not apply.

8.3.3.2.5 Voltage drop (U_d)

The voltage drop is measured across the active outputs of the PROXIMITY SWITCH when the switching element is in the ON-state and carrying the rated operational current (I_e) at 23 °C ± 5 °C ambient temperature and at the lowest rated frequency. This measurement is performed with the circuit in figure 8 and the switch S closed. The load R_2 is adjusted to obtain the rated operational current (I_e) with the supply voltage U_e. The voltage drop U_d is measured:

– at U_e + 10 % and U_e – 15 %,

– or $U_{e\ max}$ + 10 % and $U_{e\ min}$ – 15 %,

– or $U_{B\ max}$ and $U_{B\ min}$

The measured voltage drop shall not exceed the values specified in 7.2.1.15.

8.3.3.2.5DV D2 *Delete 8.3.3.2.5:*

Subclause 8.3.3.2.5 does not apply.

8.3.3.3 Temperature rise

The PROXIMITY SWITCH, installed in free air, is supplied with its rated operational voltage (U_e) (or the highest operational voltage of its voltage range), and connected to a load corresponding to its rated operational current (I_e) until the thermal equilibrium is reached.

The temperature rise, measured on the terminals when applicable, and on any point of the enclosure shall not exceed 50 K (see 7.2.2).

The length of conductor connected to each terminal shall be $2^{+0,1}_{0}$ m.

8.3.3.3DV D2 *Modify 8.3.3.3 by including the following:*

Temperature rise of components shall not exceed the limits specified in Tables 3 and 27DV of Part 1.

8.3.3.4 Dielectric properties

The test for verifying dielectric properties shall be made:

– in accordance with 8.3.3.4 of IEC 60947-1 for the rated impulse withstand voltage U_{imp} (see 4.3.1.3), and

– in accordance with 8.3.3.4.1 and 8.3.3.4.2 and 8.3.3.4.3 of this standard.

For class II PROXIMITY SWITCHES insulated by ENCAPSULATION, see annex B.

8.3.3.4DV DR *Modify 8.3.3.4 by adding the following:*

Class 2 devices are exempt.

8.3.3.4.1 Application of the test voltage

This test is to be carried out under circumstances approaching actual service conditions e.g. with conductors attached. The external surface of all insulating parts likely to be touched in service shall be made conducting by being closely covered by a metal foil.

The PROXIMITY SWITCH shall be capable of withstanding the test voltage applied for 1 min for a type test, and 1 s for routine test with the following conditions:

– between live parts of the switching element and parts of the PROXIMITY SWITCH intended to be earthed;

– between live parts of the switching element and surfaces of the PROXIMITY SWITCH likely to be touched in service, conducting or made conducting by metal foil;

– between live parts belonging to electrically separated switching elements, if any.

8.3.3.4.2 Value of the test voltage

A sinusoidal voltage of power frequency is applied according to 8.3.3.4.1.

The test voltages are given in table 6.

Table 6 – Test voltages

Rated insulation voltage		Dielectric test voltage
DC V	AC V	AC (r.m.s.) V
75	50	500
150	125	1 250
300	250	1 500

8.3.3.4.2DV D2 *Modify 8.3.3.4.2 by adding the following:*

8.3.3.4.2DV.1 The test potential shall be alternating-current, or 1,414 times the values for direct-current.

8.3.3.4.2DV.2 A component normally connected between lines of opposite polarity may be disconnected from one side of the line during the test.

8.3.3.4.2DV.3 For use in pollution degree 2 location the test value is 1 000 V AC for equipment rated 51 V – 250 V AC.

8.3.3.4.3 Results to be obtained

There shall be no unintentional disruptive discharge during the test.

NOTE 1 Exception is an intentional disruptive discharge designed for the purpose, e.g. transient overvoltage suppressing means.

NOTE 2 The term ″disruptive discharge″ relates to a phenomenon associated with the failure of insulation under electrical stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly to zero.

NOTE 3 The term ″sparkover″ is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

NOTE 4 The term ″flashover″ is used when a disruptive discharge occurs over the surface of a dielectric in a gaseous or liquid medium.

NOTE 5 The term ″puncture″ is used when a disruptive discharge occurs through a solid dielectric.

NOTE 6 A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength; in a liquid or gaseous dielectric, the loss may be only temporary.

8.3.3.4.4 Impulse voltage withstand test

The test is performed according to 7.2.3.1 with the following additional requirement:

– the proximity device is not powered during the test;

– the impulse test shall be applied:

a) between all terminals connected together and earth;

b) between terminals intended to be connected to the power supply;

c) between each output terminal and each terminal intended to be connected to the power supply.

– three positive and three negative pulses shall be applied between each two points at intervals of not less than 5 s.

NOTE The impulse voltage withstand test is designed as a type test.

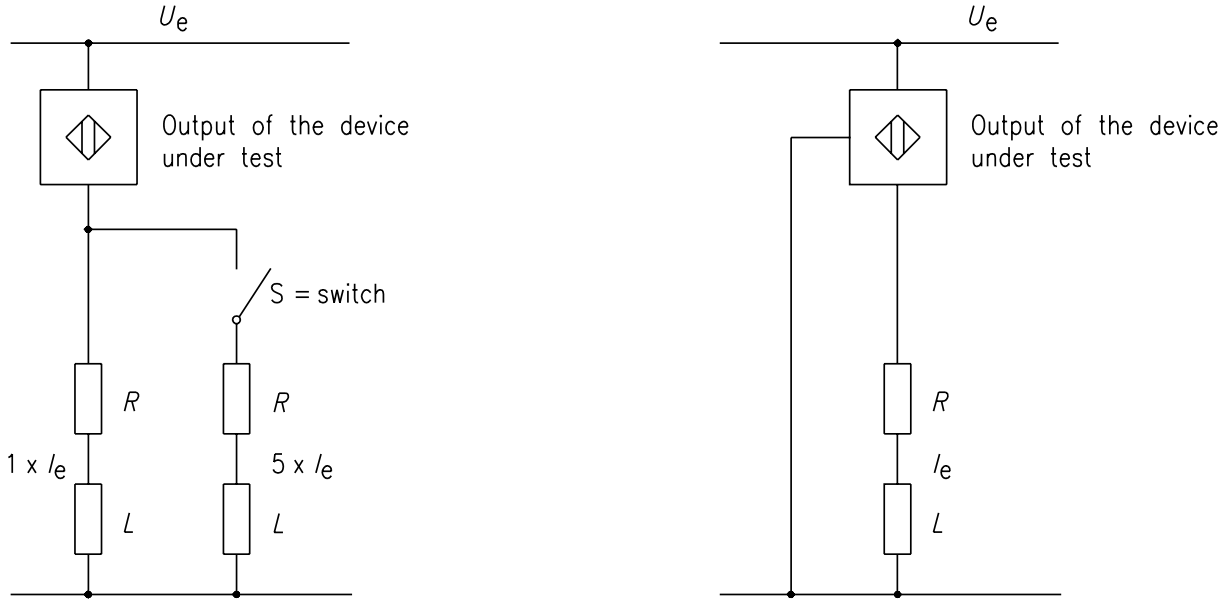
8.3.3.5 Making and breaking capacities

Tests for verification of making and breaking capacities shall be made according to the general test requirements stated in 8.3.2.1.

8.3.3.5.1 Test circuits

The load impedance shall be placed on the load side of the device as shown in figure 9. The circuit voltage with the test current flowing shall not be less than U_e.

Figure 9 – Test circuit for the verification of making and breaking capability (see 8.3.3.5)



a) 2 terminal a.c. or 2 terminal d.c.

b) 3 terminal d.c.

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8.3.3.5.2 Making and breaking capacities under normal conditions

The load circuitry shall be adjusted to give the values shown in table 4.

8.3.3.5.2DV D2 *Modification of 8.3.3.5.2 by addition of the following:*

Clause 8.3.3.5.2DV of Annex 101.DVB, Reference No. 3 applies. As an option, the switching elements may also be tested in accordance with the requirements in 8.3.3.5.2.

8.3.3.5.3 Making and breaking capacities under abnormal conditions

The load circuitry shall be adjusted to give the values shown in table 5.

8.3.3.5.3DV D2 *Modify 8.3.3.5.3:*

Clause 8.3.3.5.3 is optional.

8.3.3.5.4 Results to be obtained

After the test, the EFFECTIVE OPERATING DISTANCE of the PROXIMITY SWITCH shall be measured and remain within the limits given in 7.2.1.3.1.

8.3.3.5.4DV D2 *Delete 8.3.3.5.4:*

Subclause 8.3.3.5.4 does not apply.

8.3.4 Performance under short-circuit current conditions

8.3.4DV D2 *Delete 8.3.4:*

Subclause 8.3.4 does not apply.

8.3.4.1 Test circuit and test procedure

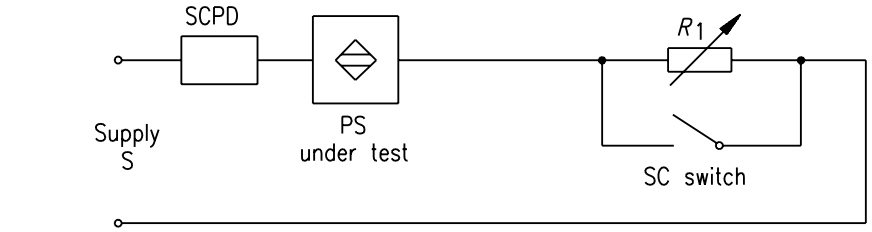
The PROXIMITY SWITCH ″PS″ in new condition shall be mounted as in service, in free air, and connected to the test circuit with the same size wire as used in service, see figure 10.

The short-circuit protective device ″SCPD″ shall be of the type and rating stated by the manufacturer. This ″SCPD″ shall be omitted if the PROXIMITY SWITCH is integrally protected against short circuits.

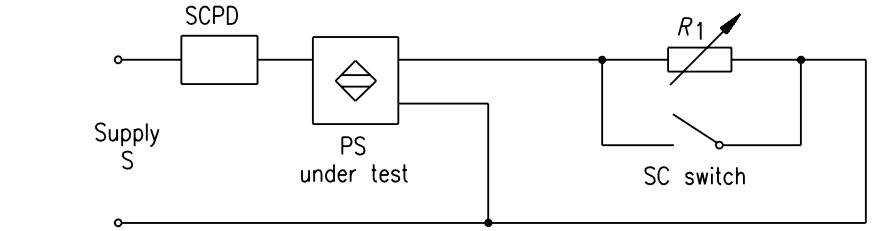
The target is placed in a position such that the switching element is in the ON-state, R_1 is selected so that the current flowing through the PROXIMITY SWITCH is equal to its rated operational current. The supply S shall be adjusted to 100 A prospective short-circuit current. The ″SC″ switch, parallel with R_1 load, is intended to cause the short circuit. The open circuit voltage shall be 1,1 times the rated operational voltage or the maximum value of the voltage range.

The test shall be performed three times by randomly closing the ″SC″ switch. The test current is maintained until the SCPD or the internal short-circuit protection in the PROXIMITY SWITCH has operated. The interval between each of the three tests shall be not less than 3 min. The actual time between tests shall be stated in the test report. After each test, the ″SCPD″ shall be replaced or reset.

Figure 10 – Short-circuit testing (see 8.3.4.2)



a) 2 terminal a.c. or 2 terminal d.c.



b) 3 terminal d.c.

8.3.4.2 Results to be obtained

After the test, the OPERATING DISTANCE of the PROXIMITY SWITCH shall be measured and remain within the limits given in 7.2.1.3.1.

8.101DV D2 *Addition of the Printed Wiring Board Abnormal Operation Test:*

8.101DV.1 Printed Wiring Board Abnormal Operation Test

8.101DV.1.1 As a result of this test:

a) The overcurrent protection in the branch circuit to which the equipment is connected shall not open.

b) The cheesecloth or tissue paper shall not glow or flame.

c) The 3-ampere fuse connected in the equipment grounding circuit shall not open.

8.101DV.1.2 Operation of an overcurrent protection device, other than the branch circuit overcurrent protection device, before any abnormal condition results is acceptable. When a wire or a printed wiring board trace opens, the gap shall be electrically shorted and the test continued. This applies to each occurrence. When the circuit is interrupted by the opening of a component, the test shall be repeated twice, using new components as necessary.

8.101DV.1.3 A sample of the equipment employing the printed wiring board shall be wired as intended to an electrical supply circuit sized and protected to simulate end-use conditions.

8.101DV.1.4 A 3-ampere fuse shall be connected between the supply circuit pole least likely to arc to ground and the outer enclosure and grounded or exposed dead metal parts. Where the enclosure is of polymeric construction, the enclosure shall be wrapped in metal foil.

8.101DV.1.5 The equipment shall be placed on a white-tissue-paper covered softwood surface. A single layer of cheesecloth shall be draped loosely over the entire enclosure.

8.4 Testing of OPERATING DISTANCES

8.4DV D2 *Delete 8.4:*

Subclause 8.4 does not apply.

8.4.1 Inductive, capacitive, non-mechanical magnetic and ULTRASONIC PROXIMITY SWITCHES

8.4.1.1 Test conditions

A PROXIMITY SWITCH in new condition is mounted according to the relevant annex and the target is moved, not faster than 1 mm/s, towards and away from the SENSING FACE of the PROXIMITY SWITCH in an axial direction. The OPERATING DISTANCES are measured as shown in figures 3 and 4.

8.4.1.2 EFFECTIVE OPERATING DISTANCE (s_r)

The EFFECTIVE OPERATING DISTANCE is measured at the rated voltage or at any voltage within the voltage range and at 23 °C ± 5 °C ambient air temperature. The measured value shall be within the limits given in 7.2.1.3.1.

8.4.1.3 DIFFERENTIAL TRAVEL (H)

The DIFFERENTIAL TRAVEL is defined as a percentage of the EFFECTIVE OPERATING DISTANCE (s_r). The measurement is made at the ambient temperature of 23 °C ± 5 °C at rated supply voltage. The target shall be moved towards the PROXIMITY SWITCH within the (s_r) range and then be moved away from the PROXIMITY SWITCH. The measured value shall be according to 7.2.1.5.

8.4.1.4 USABLE OPERATING DISTANCE (s_u)

USABLE OPERATING DISTANCE is measured over the –25 °C to +70 °C ambient TEMPERATURE RANGE with the supply voltage at 85 % and 110 % of its rated value. The target shall be moved towards the PROXIMITY SWITCH. The measured value shall be within the limits given in 7.2.1.3.2.

8.4.1.5 REPEAT ACCURACY (R)

The REPEAT ACCURACY of the EFFECTIVE OPERATING DISTANCE (s_r) is measured over an 8 h period with an enclosure temperature within 23 °C ± 5 °C and with supply voltage U_e ± 5 % or at any voltage ±5 % within the rated operational voltage range. The target shall be moved towards the PROXIMITY SWITCH. The measured value shall be within the limits given in 7.2.1.4.

8.4.2 PHOTOELECTRIC PROXIMITY SWITCHES

8.4.2.1 Determination of the EXCESS GAIN values

– TYPE D

The STANDARD TARGET is positioned at the stated sensing distance. The reduction of luminance which is necessary to deactivate the PROXIMITY SWITCH is determined with NEUTRAL DENSITY FILTERS. The EXCESS GAIN is then calculated.

– TYPES R AND T

The EMITTER or the REFLECTOR is positioned at the stated OPERATING RANGE. The reduction of luminance which is necessary to activate the PROXIMITY SWITCH is determined with NEUTRAL DENSITY FILTERS. The EXCESS GAIN is then calculated.

EXAMPLE To determine the distance at which an EXCESS GAIN of 2 is achieved, a 50 % neutral density filter may be used for type T, and a 70 % neutral density filter may be used for TYPES R AND D. The filter should be as close as possible to the SENSING FACE.

The neutral density filter measurement technique is the preferred method. Other techniques leading to similar results may be used and shall then be stated by the manufacturer.

NOTE Care needs to be taken to avoid erroneous results due to reflections from the filter.

8.4.2.2 Testing of the operating / SENSING RANGE and/or OPERATING DISTANCE

This test is performed at rated voltage or at any voltage within the voltage range with new PHOTOELECTRIC PROXIMITY SWITCHES, except when specified as verification after another test, in clean air conditions, at any ambient temperature between 23 °C ± 5 °C, both in darkness (less than 300 lx) and at an AMBIENT LIGHT of 5 000 lx obtained as per 8.4.2.3.

The EXCESS GAIN, as stated by the manufacturer in the documentation, shall be achieved.

8.4.2.3 Source for AMBIENT LIGHT

A light source with a colour temperature between 3 000 K and 3 200 K shall be used. The light intensity is measured with a luxmeter and obtained by varying the distance between the light source and the luxmeter.

8.4.2.4 TYPE T

In the vicinity of the maximum and MINIMUM OPERATING DISTANCES, the EMITTER is moved, not faster than 1 mm/s in an axial direction, towards the RECEIVER and the maximum and MINIMUM OPERATING DISTANCES are measured:

a) without AMBIENT LIGHT (300 lx);

b) with AMBIENT LIGHT (5 000 lx).

The light source is positioned at an angle of 5° ± 1° to the REFERENCE AXIS and is aimed at the RECEIVER (see figure 11a, TYPE T).

8.4.2.5 TYPE R

The REFLECTOR is installed on the REFERENCE AXIS at the maximum of the OPERATING RANGE r_o.

The light source is positioned at an angle of 5° ± 1° to the REFERENCE AXIS and is aimed at the PHOTOELECTRIC PROXIMITY SWITCH (see figure 11b, TYPE R).

8.4.2.6 TYPE D

a) For OPERATING DISTANCES not exceeding 400 mm:

The light source is positioned at an angle of 15° ± 1° to the REFERENCE AXIS and is aimed at the target (see figure 11d, TYPE D).

The device is moved, not faster than 1 mm/s in an axial direction, towards the target and the sensing distance is measured:

1) without AMBIENT LIGHT (300 lx);

2) with AMBIENT LIGHT (5 000 lx).

b) For OPERATING DISTANCES above 400 mm:

The light source is positioned at an angle of 15° ± 1° to the REFERENCE AXIS and is aimed at the device (see figure 11c, TYPE D).