NOTE 2 For small helical springs and the like, and for parts exposed to abrasion, a layer of grease can provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film, and the test is then made without removal of the grease.

23 Electromagnetic compatibility (EMC) requirements – Emission

See also Clause H.23.

23.1 FREE-STANDING and INDEPENDENTLY MOUNTED CONTROLS, which cycle during normal OPERATION, shall be so constructed that they do not generate excessive radio interference. INTEGRATED and INCORPORATED CONTROLS are not subjected to the tests of 23.1, as the result of these tests can be affected by the incorporation of the CONTROL in equipment. They may, however, be carried out on such CONTROLS if requested by the manufacturer.

Equipment that uses integrated or INCORPORATED CONTROLS should comply with its relevant product EMC standard. INTEGRATED and INCORPORATED CONTROLS are tested in the end use equipment.

Compliance is checked by one of the following methods:

a) Testing in accordance with CISPR 14-1, with the following modification and/or CISPR 22, class B. In 4.2.3.3 of CISPR 14-1:2005, the value of 200 ms is replaced by 20 ms.

b) Testing as detailed in 23.1.1 and 23.1.2, resulting in a maximum duration of radio frequency emission of 20 ms. Where such CONTROLS have a click rate greater than 5, method a) shall be followed.

c) Examination and/or tests to show that the minimum time between contact OPERATIONS during normal OPERATION cannot be less than 10 min.

Compliance with method b) or c) shows compliance with method a).

23.1.1 Test conditions

One previously untested sample is subjected to the test.

The electrical and thermal conditions are as specified in 17.2 and 17.3, except as follows:

– for SENSING CONTROLS, the rate of change of activating quantities is α_1 and β_1;

– for non-SENSING CONTROLS, the CONTROLS are caused to operate at the lowest contact operating speed possible during normal OPERATION;

– for CONTROLS declared for use with inductive loads, the power factor is 0,6, unless declared otherwise in Table 1, requirement 7. For CONTROLS declared with purely resistive loads, the power factor is 1,0.

23.1.2 Test procedure

The CONTROL is operated for five CYCLES OF CONTACT OPERATION.

The duration of radio interference is measured by an oscilloscope connected to the CONTROL so as to measure the voltage drop across the contacts.

NOTE For the purpose of this test, radio interference is any observed fluctuation of voltage across the contacts which is superimposed on the supply waveform as a result of contact OPERATION.

23.2 CONTROLS for ISM (Industrial, Scientific and Medical) equipment and free-standing, independently mounted and IN-LINE CORD CONTROLS for use with ISM equipments shall comply with the requirements of CISPR 11.

NOTE See also Table 1, requirement 89.

24 Components

24.1 Transformers intended to supply power to a SELV-circuit or PELV-circuit shall be of the safety isolating type and shall comply with the relevant requirements of IEC 61558-2-6.

Capacitors connected between two line conductors or between a line conductor and the neutral or between HAZARDOUS LIVE PARTS and protective earth shall be in accordance with IEC 60384-14 and shall be used in accordance with its rated values.

Fuses shall comply with the requirements of IEC 60127-1 or IEC 60269-1, as appropriate.

If varistors are used as surge protective devices, they shall be selected to withstand the impulses corresponding to the installation class for which is intended to be used. Additionally, if they are connected to the supply mains, they shall comply with IEC 61051-1, IEC 61051-2 or IEC 61051-2-2.

24.1DV D2 *Modification of 24.1 by adding the following text after the first paragraph:*

Transformers shall comply with the relevant requirements of the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3. Fuses shall comply with the requirements of the relevant standard for low-voltage fuses, UL 248-14. Other fuses are considered to be intentionally weak parts and shall be evaluated in accordance with H.27.1.1.

Thermistors shall either comply with UL 1434 or Annex J of this standard.

24.1.1 CONTROLS that incorporate a transformer as the source of supply to a SELV-circuit or PELV-circuit are subjected to an output test with the primary energized at the upper limit of the rated voltage as indicated in 17.2.2, 17.2.3.1 and 17.2.3.2.

Switch mode power supplies or transformers used in converters shall comply with the requirements of IEC 61558-2-16.

Under any non-capacitive conditions of loading (from no load to the short-circuiting of any or all secondary SELV- or PELV-circuit terminals) and without disturbing internal connections, the secondary output voltage shall not be greater than that defined in 2.1.5.

If a converter or switch mode power supply is used as the source of supply to a SELV-circuit or PELV-circuit, Clause T.3 applies.

The secondary output power at the terminals to an ISOLATED LIMITED SECONDARY CIRCUIT shall not exceed 100 VA and the secondary output current shall not exceed 8 A after 1 min of OPERATION with overcurrent protection, if provided, bypassed.

24.1.1DV D2 *Modification of 24.1.1 by adding the following text after the first paragraph:*

In addition, the transformer shall also comply with the requirements of the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

24.2 Components other than those detailed in 24.1 are checked when carrying out the tests of this standard.

24.2.1 However, for components which have previously been found to comply with a relevant IEC safety standard, to reduce the testing necessary, assessment is limited to the following:

a) the application of the component within the CONTROL is checked to ensure that it is covered by previous testing to the IEC safety standard;

b) testing according to this standard of any conditions not covered by the previous testing to the IEC safety standard.

See also Annex J.

24.2.1DV D2 *Modification of 24.2.1 by adding 24.2.1DV.1 :*

24.2.1DV.1 A component of a product covered by this standard shall comply with the requirements for that component, and shall be used in accordance with its recognized rating and other limitations of use. A list of standards covering various components are referenced in 1.2DV. A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

24.2.1DV.2 *Deleted*

24.2.1DV.3.1 *Deleted*

24.2.1DV.3.2 *Deleted*

24.2.1DV.3.3 *Deleted*

24.2.1DV.3.4 *Deleted*

24.2.1DV.3.5 *Deleted*

24.2.1DV.3.6 *Deleted*

24.2.1DV.3.7 *Deleted*

24.2.1DV.3.8 *Deleted*

24.2.1DV.3.9 *Deleted*

24.2.1DV.3.10 *Deleted*

24.2.1DV.3.11 *Deleted*

24.3 Annex U is not applicable to relays used as components in a CONTROL.

24.4 Switch mode power supplies not covered by 24.2.1, including their peripheral circuitry, used in ELECTRONIC CONTROLS shall comply with the tests of 24.4.1 and all of the applicable requirements of this standard.

NOTE Subclause 24.4.1.11 gives the compliance criteria for the tests.

24.4.1 Overload tests for switch mode power supplies

24.4.1.1 *Each output winding, or section of a tapped winding, is overloaded in turn, one at a time, while the other windings are kept loaded or unloaded, whichever load conditions of NORMAL USE is the least favourable.*

24.4.1.2 *The overload is carried out by connecting a variable resistor (or an electronic load) across the winding or the rectified output. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 min to maintain the applicable overload. No further readjustments are then permitted.*

24.4.1.3 *For this test, any protective devices such as a fuse, manual reset circuit protector, thermal protector, etc. are allowed to remain in the circuit.*

24.4.1.4 *If overcurrent protection is provided by a current-breaking device, the overload test current is the maximum current which the overcurrent protection device is just capable of passing for 1 h. If this value cannot be derived from the specification, it is to be established by test.*

24.4.1.5 *If no overcurrent protection is provided, the maximum overload is the maximum power output obtainable from the power supply.*

24.4.1.6 *In case of voltage foldback, the overload is slowly increased to the point which causes the output voltage to drop by 5 %. The overload is then established at the point where the output voltage recovers and held for the duration of the test.*

24.4.1.7 *The duration of the test is to be for 1 h or until ultimate results are reached.*

24.4.1.8 *The maximum open-circuit voltage of each winding (directly at the winding of the transformer) and the maximum load current are measured and recorded such that the maximum output power may be determined.*

24.4.1.9 *The maximum open circuit voltage measurements shall be made during normal OPERATION and under single component FAILURE, see Table H.24.*

24.4.1.10 *For SELV applications, where the maximum open circuit voltage measured directly at the secondary of the transformer exceeds the limits specified in 2.1.5, the measurement of the maximum output voltage of each winding may be made after certain PROTECTIVE IMPEDANCES. In this case, the limits shall be in accordance with H.8.1.10.1.*

24.4.1.11 *Following each test (while still in a heated condition), the transformer is to be subjected to the electric strength test of 13.2.*

24.4.1.12 *Compliance shall be in accordance with items a), b), c), d), e) and f) of H.27.1.1.3.*

24.5 Annex J is not applicable to THERMISTORS used in a circuit which meets all of the following requirements:

– type 1 CONTROL as declared in Table 1, requirement 39;

– connected to a SELV/PELV circuit as specified in Clause T.1, or protected against the risk of electric shock through double or reinforced insulation, or by means of PROTECTIVE IMPEDANCE;

– low power circuit as specified in H.27.1.1.1, or the CONTROL or final equipment complies with Clause H.27.1.1.5 when the THERMISTOR is open or short circuited;

– the CONTROL or final equipment complies with Clause H.27 when the THERMISTOR is open or short circuited;

– CONTROL with CLASS A CONTROL FUNCTIONS as declared in Table 1, requirement 92.

25 Normal operation

25.1 General

See Annex H.

25.2 Overvoltage and undervoltage test

A CONTROL incorporating an electro-magnet shall operate as intended at any voltage within the range of 85 % of the minimum rated voltage and 110 % of the maximum rated voltage, inclusive.

Compliance is checked by subjecting the CONTROL to the following tests at the maximum and minimum operating conditions declared, except that only a CONTROL having T_{min} less than 0 °C is tested at T_{min}:

The CONTROL is subjected to 1,1 $V_{R\ max}$ until equilibrium temperature is reached and then tested immediately for OPERATION at 1,1 $V_{R\ max}$ and at rated voltage.

The CONTROL is also subjected to 0,85 $V_{R\ min}$ until equilibrium temperature is reached and then tested immediately for OPERATION at 0,85 $V_{R\ min}$.

26 Electromagnetic compatibility (EMC) requirements – Immunity

See Clause H.26.

NOTE In general, the tests of Clause H.26 are not applicable to non-electronic CONTROLS because of their tolerance to such perturbations. The appropriate tests for specific types of non-electronic CONTROLS are typically included in other clauses of the appropriate part 2.

27 Abnormal operation

27.1 See Annex H and Annex J.

27.2 Burnout test

CONTROLS incorporating electro-magnets shall withstand the effects of blocking of the CONTROL mechanism.

Compliance is checked by the tests of 27.2.1 and 27.2.2.

NOTE For relays and contactors, compliance with this requirement is established by successful completion of the tests of Clause 17.

27.2.1 *The CONTROL mechanism is blocked in the position assumed when the CONTROL is de-energized. The CONTROL is then energized at rated frequency and rated voltage as indicated in 17.2.2, 17.2.3.1 and 17.2.3.2.*

The duration of the test is either 7 h; or until an internal protective device, if any, operates; or until burnout, whichever occurs first.

27.2.2 *After this test, the CONTROL shall be deemed to comply if:*

– there has been no emission of flame or molten metal, and there is no evidence of damage to the CONTROL which would impair compliance with this standard;

– the requirements of 13.2 are still met.

NOTE The CONTROL need not be operative following the test.

27.2.3 Blocked mechanical output test (abnormal temperature test)

CONTROLS with motors, such as electric actuators, shall withstand the effects of blocked output without exceeding the temperatures indicated in Table 26. Temperatures are measured by the method specified in 14.7.1. This test is not conducted on CONTROLS with motors, such as electric actuators, where, when tested under blocked output conditions for 7 h, any protective device, if provided, does not cycle under stalled conditions, and which do not exceed temperature limits in Table 13.

27.2.3.1 *CONTROLS with motors, such as electric actuators, are tested for 24 h with the output blocked at rated voltage and in a room temperature in the range of 15 °C to 30 °C, the resulting measured temperature being corrected to a 25 °C reference value.*

NOTE In Canada and the USA, the test is conducted at the voltages indicated in 17.2.3.1 and 17.2.3.2.

For CONTROLS with motors declared for three-phase OPERATION, the test is to be carried out with any one phase disconnected.

Table 26
(27.2.3 of edition 3) – Maximum winding temperature (for test of mechanical blocked output conditions)

Condition	Temperature of insulation by class °C							
	A	E	B	F	H	200	220	250
If impedance protected:	150	165	175	190	210	230	250	280
If protected by protective devices:								
During first hour								
– maximum value	200	215	225	240	260	280	300	330
After first hour								
– maximum value	175	190	200	215	235	255	275	305
– arithmetic average	150	165	175	190	210	230	250	280

27.2.3.2 The average temperature shall be within the limits during both the second and the twenty-fourth hours of the test.

NOTE The average temperature of a winding is the arithmetic average of the maximum and minimum values of the winding temperature during the 1 h period.

27.2.3.3 During the test, power shall be continually supplied to the motor.

27.2.3.4 Immediately upon completion of the test, the motor shall be capable of withstanding the electric strength test specified in Clause 13, without first applying the humidity treatment of 12.2.

27.3 Overvoltage and undervoltage test

Void.

27.4 See Annex H.

27.5 Overload tests

27.5.1 General

The tests are conducted as follows.

– CONTROLS as specified without protective devices and without incorporated fuses are loaded for 1 h with the conventional tripping current for the fuse which in the installation will protect the CONTROL.

– CONTROLS protected by protective devices (including fuses) are loaded in such a way that the current through the CONTROL is 0,95 times the current with which the protective device releases after 1 h. The temperature rise is measured after a steady state has been reached or after 4 h, whichever is the shorter time.

– CONTROLS protected by incorporated fuses complying with IEC 60127-1 shall have those fuses replaced by links of negligible impedance and shall be loaded in such a manner that the current through the links shall be 2,1 times the rated current of the fuse. The temperature rise is measured after the CONTROL has been loaded for 30 min. The value 2,1 times can be de-rated by 0,5 %/K, if the overload test is carried out at a higher temperature compared to normal room temperature.

– CONTROLS protected both by incorporated fuses and by protective devices are loaded either as described above with incorporated fuses or with another protective device, choosing the test requiring the lower load.

– CONTROLS protected by protective devices which will short-circuit only in case of overload shall be tested both as CONTROLS with protective devices and as CONTROLS without protective devices.

27.5.2 Overload tests carried out on in-line cord controls as indicated in 11.10.2 and provided with a plug and socket outlet

The tests according to 27.5.1 shall be carried out.

The temperature shall not exceed those indicated in Table 13.

27.5.3 For controls not covered by 27.5.2

The tests according to 27.5.1 shall be carried out at ambient temperature (20 ± 5) °C. If declared in requirement 97 of Table 1, the test will not be done for INCORPORATED CONTROLS and INTEGRATED CONTROLS.

The compliance with items a) to g) of H.27.1.1.3, where applicable, is verified.

27.5.101DV D2 *Addition:*

For controls intended for fixed wiring or independently mounted controls where the load is either integrated in the control or fixed, the tests of 27.5 are not applicable.

27.6 Battery short-circuit test

For CONTROLS having batteries that can be removed without the aid of a TOOL and having terminals that can be short-circuited by a thin straight bar, the terminals of the battery are short-circuited with the battery being fully charged.

The duration of the test is either 1 h or until ultimate condition exists, whichever occurs first.

27.6.1 *After this test, the CONTROL shall be deemed to comply if:*

– there has been no emission of flame or molten metal, and there is no evidence of damage to the CONTROL which would impair compliance with this standard;

– the requirements of 13.2 are still met.

NOTE The CONTROL need not be operative following the test.

28 Guidance on the use of electronic disconnection

See Annex H.

Dimension in millimetres

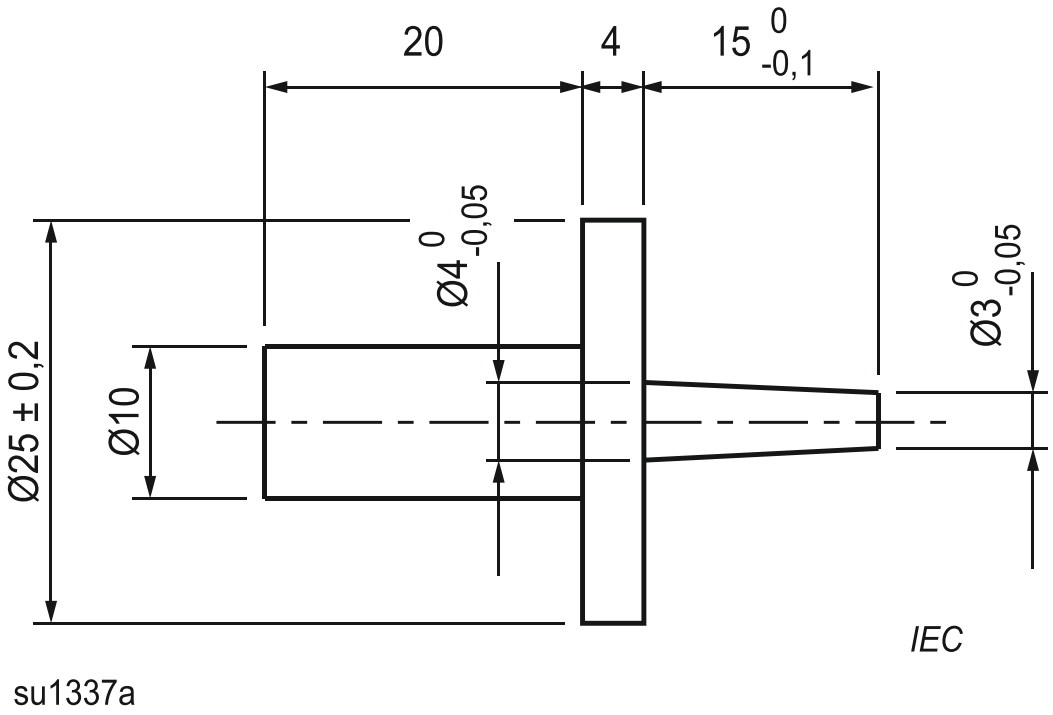
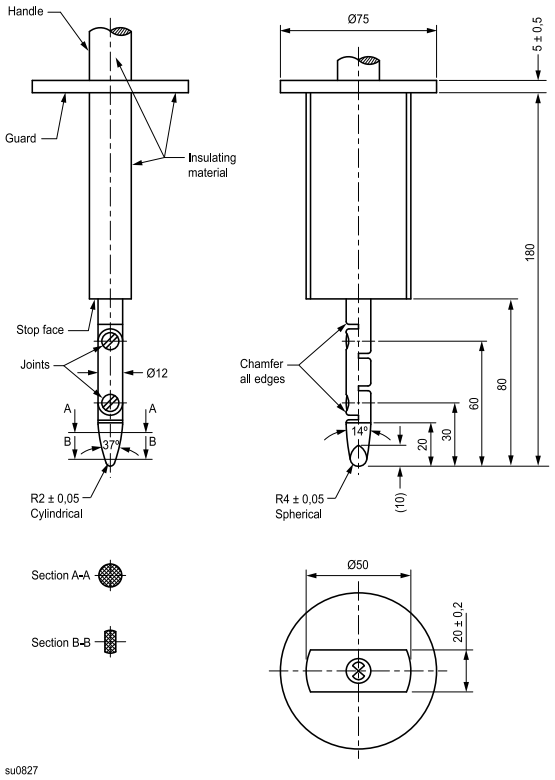


Figure 1

Test pin



Tolerances on dimensions without specific tolerance:

on angles $^{0}_{-10°}$

on linear dimensions:

up to 25 mm: $^{0}_{-0,05}$

over 25 mm: ±0,2

Material of finger: for example, heat-treated steel.

Both joints of this finger may be bent through an angle of 90° but in one and the same direction only.

Using the pin and groove solution is only one of the possible approaches in order to limit the bending angle to 90°. For this reason, dimensions and tolerances of these details are not given in the drawing. The actual design must ensure a 90° bending angle with a 0° to 10° tolerance.

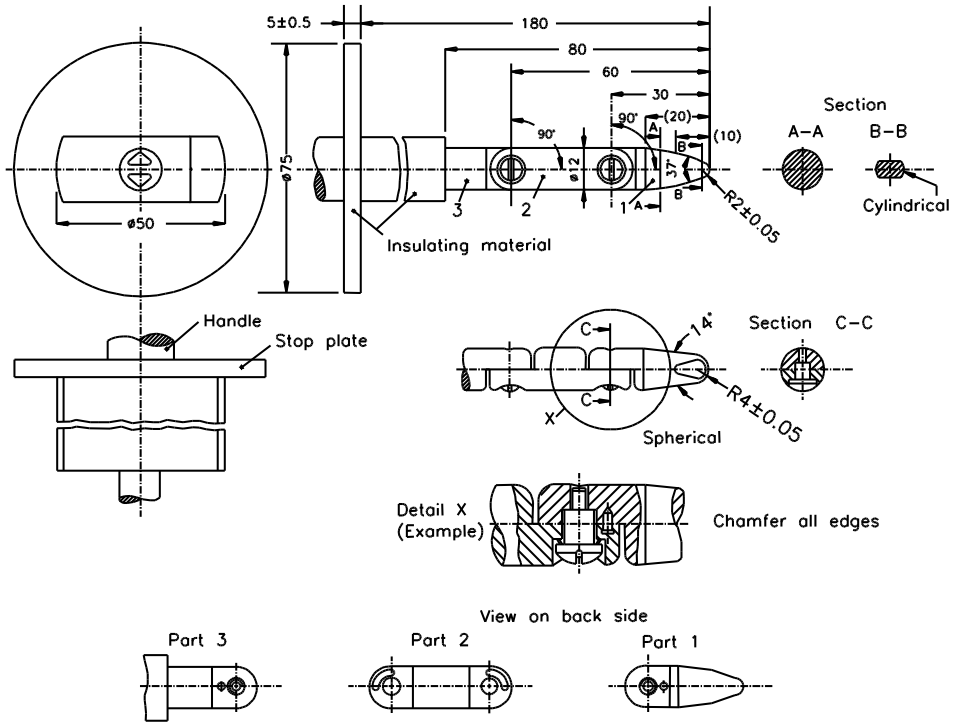
Figure 2

Standard test finger

Figure 2DV D2 *Replacement of Figure 2:*

Figure 2DV

Standard test finger



Dimensions in millimetres

Tolerances on dimensions without specific tolerance:

on angles: $^{0}_{-10}$°

on linear dimensions:

up to 25 mm: $^{0}_{-0,05}$ mm

over 25 mm: ±0,2 mm

Material of finger: heat–treated steel, etc.

Both joints of this finger may be bent through an angle of $(90\ ^{+10}_{0})$° but in one and the same direction only.

Using the pin and groove solution is only one of the possible approaches in order to limit the bending angle to 90°. For this reason dimensions and tolerances of these details are not given in the drawing. The actual design must ensure a $(90\ ^{+10}_{0})$° bending angle.

S4283