BS EN 62271-206:2011

BSI Standards Publication

High-voltage switchgear and controlgear

Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV

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National foreword

This British Standard is the UK implementation of EN 62271-206:2011. It is identical to IEC 62271-206:2011. It supersedes BS EN 61958:2001, which will be withdrawn on 3 March 2014.

The UK participation in its preparation was entrusted by Technical Committee PEL/17, Switchgear, controlgear, and HV-LV co-ordination, to Subcommittee PEL/17/1, High-voltage switchgear and controlgear.

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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Appareillage à haute tension -
Partie 206: Systèmes indicateurs de présence de tension assignées supérieures à 1 kV et inférieures ou égales à 52 kV
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Hochspannungs-Schaltgeräte und -Schaltanlagen -
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CENELEC

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Foreword

The text of document 17C/491/FDIS, future edition 1 of IEC 62271-206, prepared by SC 17C, High-voltage switchgear and controlgear assemblies, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62271-206 on 2011-03-03.

This European Standard supersedes EN 61958:2001.

The main changes with respect of EN 61958:2001 are an actualization of references and the degree of protection which has been changed from IPXXB to IP2X.

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

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-12-03
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-03-03

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62271-206:2011 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-75	-	Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests	EN 60068-2-75	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	-	-
IEC 61243-1 (mod)	-	Live working - Voltage detectors - Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.	EN 61243-1	-
IEC 61243-2 (mod)	-	Live working - Voltage detectors - Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c.	EN 61243-2	-
IEC 61243-5 (mod)	-	Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS)	EN 61243-5	-
IEC 62271-1	2007	High-voltage switchgear and controlgear - Part 1: Common specifications	EN 62271-1	2008
IEC 62271-200	-	High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	EN 62271-200	-
IEC 62271-201	-	High-voltage switchgear and controlgear - Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	EN 62271-201 + corr. November	-

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV

1 General

1.1 Scope

This part of IEC 62271 is applicable to voltage presence indicating systems (VPIS) incorporated in a.c. switchgear and controlgear covered by IEC 62271-200 or IEC 62271-201.

Voltage presence indicating systems are devices used to provide information to operators about the voltage condition of the main circuit of the switchgear in which they are installed.

The indication of VPIS alone is not sufficient to prove that the system is dead: if operating procedures make it mandatory, relevant voltage detectors according to IEC 61243-1, IEC 61243-2 and IEC 61243-5 should be used.

This standard is also applicable to phase comparators specifically designed for use with VPIS.

1.2 Normative references

The following referenced documents are indispensable for the application 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 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

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

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-200, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-201, *High-voltage switchgear and controlgear – Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 61243-1, *Live working – Voltage detectors – Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c.*

IEC 61243-2, *Live working – Voltage detectors – Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c.*

IEC 61243-5, *Live working – Voltage detectors – Part 5: Voltage detecting systems (VDS)*

2 Service conditions

VPIS are designed to be used under the same service conditions as the switchgear in which they are installed, as defined in Clause 2 of IEC 62271-1.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
voltage presence indicating system (VPIS)
device used to indicate the presence of operating voltage

NOTE 1 VPIS may also be used in conjunction with phase comparators.

NOTE 2 VPIS are not designed to detect reliably the absence of voltage: for this purpose, only voltage detectors or voltage detecting systems (VDS according to IEC 61243-5) should be used.

3.2
coupling element
part of the VPIS connected to the main circuit which transmits to the indicating element a signal related to the voltage condition of this circuit. Different physical principles can be used for the coupling element, for example, capacitive, resistive, optical, etc.

3.3
indicating element
part of the VPIS which gives a visual indication depending on the input signal received from the coupling element

3.4
connecting point
point of the indicating element where a suitable phase comparator may be connected

3.5
phase comparator
apparatus which indicates the phase relationship between the connecting points of two VPIS

3.6
nominal voltage (U_n)
suitable approximate value of voltage used to identify a system or device
[IEC 60050-601:1985, 601-01-21, modified]

NOTE 1 The nominal voltage of the VPIS is the parameter associated with its clear indication. VPIS may have one nominal voltage U_n, or a nominal voltage range. Limit values of the nominal voltage range are named U_{nmin} and U_{nmax}.

NOTE 2 In this standard, the nominal voltage of a three-phase system is the normal phase-to-phase voltage. The nominal voltage of a single-phase system is the normal voltage between lines.

3.7
voltage limiting device
protective device that limits the voltage at the output terminal of the coupling element in the case of insulation failure

4 Ratings

The following ratings of the switchgear shall also be applicable to the VPIS incorporated in it:

– rated voltage;
– rated insulation level;
– rated frequency(ies).

In addition, the nominal voltage, or nominal voltage range, of the systems on which the VPIS can be used, shall be defined.

4.1 Rated voltage

Refer to 4.1 of IEC 62271-1.

4.2 Rated insulation level

Refer to 4.2 of IEC 62271-1.

4.3 Rated frequency

Refer to 4.3 of IEC 62271-1.

5 Design and construction

5.1 General

5.1.1 Parts of VPIS

A VPIS includes

– a coupling element;
– an indicating element;
– a connecting point (optional).

Both the coupling and indicating elements are fixed and incorporated in switchgear (see Figure 1).

5.1.2 Phase comparison

VPIS should allow checking of phase relationship by means of a suitable phase comparator. The characteristics of the phase comparator shall be defined by the manufacturer of the VPIS.

5.1.3 Degree of protection (IP code)

Parts of the VPIS which contribute to the switchgear enclosure shall meet the degree of protection defined for the switchgear.

If the VPIS includes hazardous parts when in service, it shall provide at least an IP2X degree of protection according to IEC 60529, even when replaceable parts are removed.

5.1.4 Impact resistance

Accessible parts of VPIS shall be resistant to mechanical impact.

5.1.5 Testing element

VPIS with a built-in power source shall be equipped with a testing element to check the condition of the battery.

5.2 Threshold values for voltage presence indication

The threshold values for voltage presence indication are shown in the following Table 1.

Table 1 – Indication corresponding to "voltage present"

	The indication corresponding to "voltage present"	
	shall appear	**shall not appear**
in three-phase systems	when the actual line-to-earth voltage is between 45 % of the nominal voltage and the rated voltage	when the actual line-to-earth voltage is less than 10 % of the nominal voltage
in single-pole earthed single-phase systems	when the actual line-to-earth voltage is between 78 % of the nominal voltage and the rated voltage	when the actual line-to-earth voltage is less than 17 % of the nominal voltage
in mid-point earthed single-phase systems	when the actual line-to-earth voltage is between 39 % of the nominal voltage and 50 % of the rated voltage	when the actual line-to-earth voltage is less than 9 % of the nominal voltage

5.3 Indication and perceptibility

5.3.1 General

The indicating element of a VPIS shall provide a clear visual indication of the voltage state.

The indication shall be clearly perceptible to the user when in the recommended operating position and under practical lighting conditions.

Some types of VPIS are restricted to indoor use, and others are suitable for indoor and outdoor use.

5.3.2 Frequency of repetition

In the case of a repetitive visual indication, the frequency of repetition shall be at least 1 Hz. This requirement shall be met for an actual line-to-earth voltage equal to, or greater than, 45 % of the nominal voltage. For a line-to-earth voltage lower than 10 % of the nominal voltage, the indication corresponding to "voltage not present" shall appear with no active signal allowed for a VPIS having no built-in power source.

For single-phase systems, the applicable threshold values according to Table 1 shall be used.

5.3.3 Response time

The indicating element of a VPIS shall indicate the change of state of voltage within 1 s.

5.3.4 Indication until power source is exhausted

VPIS with a built-in power source shall give a clear indication of voltage presence until the power source is exhausted, unless their usage is limited by an indication of non-readiness or automatic shut-off.

5.4 Coupling element and voltage limiting device

5.4.1 Insulation of coupling element

The coupling element shall provide adequate insulation between its output terminal and the main circuit.

5.4.2 Voltage limiting device

To provide protection for operators against the presence of operating voltage on the connecting point, it shall be ensured that any insulation failure of the coupling element will necessarily cause a permanent earth fault.

This shall be achieved by connecting the coupling element output terminal to earth via a voltage limiting device.

The voltage limiting device can be a specific component (for example, spark gap) or be one of the components permanently connected to the coupling element (for example, an indicating element component).

The effects caused by the response of the voltage limiting device shall be taken into account when determining the protection concept of the installation.

5.4.3 Threshold voltage of voltage limiting device

The threshold voltage of the voltage limiting device shall comply with the following requirements:

– it shall be lower than 30 % of the nominal voltage of the power system;
– it shall be less than the lowest limiting value of the dielectric strength in the remaining components of the VPIS.

5.4.4 Earth fault conditions

For systems with insulated or resonant earthed neutral, earth fault currents are limited to low values and the equipment can be maintained in operation for a long period of time under these conditions.

In such cases, additional precautions shall be taken to ensure that either the earth fault condition can easily be observed by operators, or no dangerous voltage can occur on the connecting point for the earth fault duration.

5.4.5 Maximum current delivered by the connecting point

The current delivered by the connecting point when it is short-circuited to earth and with rated frequency and rated voltage between conductor and earth shall not exceed 2 mA. If the degree of protection of the connecting point is lower than IP2X, the current value shall be limited to 0,5 mA.

5.5 Marking

Marking shall be legible and permanent. It may be printed, engraved or moulded on the VPIS casing or switchgear front panel in the vicinity of the indicating element and connecting point.

The following markings, at least, shall be assigned to the indicating element and connecting point in a perceptible manner with characters of at least 3 mm high:

– IEC 62271-206;
– nominal voltage(s) (or range of nominal voltages) of VPIS;
– phase designation (L1, L2, L3).

As an alternative, the first two items may be added to the nameplate of the switchgear.

5.6 Phase comparator and connecting point

5.6.1 General

The manufacturer of VPIS shall state which types of phase comparators are suitable for use with the VPIS.

5.6.2 Clear indication of phase comparators

Phase comparators shall indicate "incorrect phase relationship" if the phase shift between line-to-earth voltages exceeds 30° and shall indicate "correct phase relationship" if the phase shift is less than 10°.

Phase comparators used on VPIS shall comply with these requirements for line-to-earth operating voltages in the range of $U_n / \sqrt{3} \pm 8$ %.

The clear indication of a phase comparator shall not be affected by the difference between signals delivered on connecting points which can result from

– a difference of up to 5 % between operating voltages,
– construction tolerances of identical VPIS.

NOTE Other threshold values for phase angles may be agreed between the manufacturer and the user according to the intended application, for example:

– if the purpose of phase comparison is to check that there are no interchanged connections before closing a circuit, then the upper threshold value can be increased from 30° to, for example, 60° because the resulting phase shift would be 120°;

– in some specific situations, two different systems can be out of phase by exactly 30°; in that case, the upper threshold value should be reduced from 30° to, for example, 25°.

5.6.3 Perceptibility of indication

Phase comparators shall indicate "incorrect phase relationship" by means of an active signal.

Phase comparators with a built-in power source shall indicate both "correct phase relationship" and "incorrect phase relationship" by means of active signals. The two active signals shall not rely solely on light of different colours for perceptibility. Additional characteristics, such as spatial separation of the light sources, distinctive form of the light signals, flashing light or audible signals with full sound pressure level, shall be used.

5.6.4 Indication in case of absence of voltage on one side

For phase comparators providing only one active signal, a voltage less than 10 % of U_n on one side and more than 45 % of U_n on the other shall lead to the indication "incorrect phase relationship". For phase comparators providing two or more active signals, absence of voltage on one side shall result in either no indication or a specific active signal.

5.6.5 Indication in case of absence of voltage on both sides

Voltages of less than 10 % of U_n on both sides shall lead to no indication.

5.7 Electromagnetic compatibility (EMC)

A VPIS is a part of the secondary system of switchgear as defined in 5.18 of IEC 62271-1. Therefore, 5.18 and 6.9 of IEC 62271-1 shall be applicable to VPIS.

6 Type tests

6.1 General

6.1.1 Sequence of tests

The tests for VPIS are given in Table 2. The tests shall be carried out in the sequence given in this table. All tests shall be carried out on the same specimen, except for test of 6.7.3, which may be performed separately.

Where the following test requirements do not allow tests on individual parts, the respective tests shall be performed on complete devices.

Single-phase tests are normally sufficient. Three-phase tests are prescribed where needed.

6.1.2 Test specimens

Type tests shall be performed on three test specimens and/or three complete devices. If a test specimen does not pass one of the type tests, the entire type test programme shall be repeated on three more specimens. If a specimen again does not pass one type test, the equipment has failed the test.

NOTE An individual type test need not be repeated for a change of construction detail, if the manufacturer can demonstrate that this change does not influence the result of that individual type test.

6.1.3 Conditioning procedure

Prior to type tests, all test specimens shall be subjected, as a conditioning procedure, to a change of temperature test Nb according to IEC 60068-2-14 with the following test parameters:

– the lower temperature T_A shall be equal to the minimum ambient air temperature specified in the service conditions;
– the higher temperature T_B shall be 15 K over the maximum ambient air temperature specified in the service conditions;
– the rate of change of temperature shall be 0,5 °C/min;
– the exposure duration t_1 shall be equal to 3 h;
– two cycles shall be performed.

6.1.4 Test voltages

Voltage tests shall, if not otherwise specified below, be performed with alternating voltages at rated frequency complying with the requirements of IEC 60060-1.

6.1.5 Test conditions

Unless otherwise specified in the individual test subclauses, the electrical tests shall be performed under the following standard atmospheric conditions:

– ambient temperature: 15 °C to 35 °C;
– relative humidity: 45 % to 75 %;
– atmospheric pressure: 86 kPa to 106 kPa.

For dielectric tests, atmospheric correction factors according to IEC 60060-1 shall be used when applicable.

6.1.6 Values of currents and voltages

All a.c. currents and voltages are defined as, and shall be expressed as, r.m.s. values.

6.1.7 Tolerances

For all values required, deviations of ±5 % are permissible, unless otherwise specified in the individual test subclauses. For dielectric tests, tolerances on test voltages defined by IEC 60060-1 are applicable.

6.2 Arrangement, assembly, marking, and instructions for use

It shall be verified whether the following requirements are fulfilled if applicable, either by visual inspection, measuring or other method of checking:

– arrangement according to 5.1.1;
– characteristics of phase comparator according to 5.1.2;
– degree of protection according to 5.1.3;
– testing element according to 5.1.5;
– type of VPIS according to 5.3.1;
– protection concept according to 5.4.2;
– marking according to 5.5;
– indication of phase comparator according to 5.6.4 and 5.6.5;
– instructions for use according to Clause 10.

6.3 Clear indication of VPIS

If VPIS are used in three-phase systems, the following test shall be performed on a three-phase basis.

A three-phase voltage source shall be connected to the main circuit of the switchgear containing the coupling element and its neutral point to the earthing connection of the switchgear. No other equipment, for example, phase comparators or other measuring devices, shall be connected to the connecting point.

The test voltage shall be increased until the indication "voltage present" appears. The applied line-to-earth voltage U_{vp} shall be recorded. The line-to-earth test voltage shall then be increased up to the rated voltage (U_r).

The test is considered as passed if the voltage U_{vp} is between 10 % of U_{nmax} and 45 % of U_{nmin} in three-phase systems and if a clear indication "voltage present" is given in the voltage range from U_{vp} to U_r.

Additionally, in the case of a repetitive indication, it shall be verified that the frequency of repetition is equal to, or higher than, 1 Hz in the voltage range from 45 % of the nominal voltage to U_r.

NOTE For systems other than three-phase, the applicable phase-to-phase or phase-to-earth voltage should be used to determine the upper limit for U_{vp}, for example 78 % of the nominal voltage in single-pole earthed single-phase systems, 39 % of the nominal voltage in mid-point earthed single-phase systems.

6.4 Response time of VPIS

The VPIS shall be connected according to 6.3 to a line-to-earth voltage equal to 45 % of U_n.

The test voltage shall be switched on and off five times. The duration of the on and off periods shall be varied and be at least 3 s long. The voltage conditions (on/off) of the voltage source and the indications shall be recorded as a function of time (see Figure 2).

The response time t_r, as defined in Figure 2, according to the type of indication shall be determined from the records.

The test is considered as passed, if none of the measured response times is longer than 1 s.

6.5 Dielectric strength of the coupling element of VPIS

The lightning impulse voltage withstand test and the power-frequency voltage withstand test defined in IEC 62271-1 shall be applied to the VPIS or to the switchgear including the VPIS.

The values of test voltage shall be those corresponding to the rated voltage of the VPIS or switchgear according to IEC 62271-1.

The test voltage shall be applied to the main circuit and the VPIS shall be connected to earth as in practice.

The tests shall be carried out and assessed in accordance with IEC 62271-1.

During the tests, operation of the voltage limiting device may occur. This shall not cause any damage to the VPIS.

6.6 Maximum current delivered by the connecting point

A single-phase voltage source shall be connected between all main circuits of the switchgear containing the VPIS and the earthing connection of the switchgear. The connecting point of the VPIS shall be connected to earth via a current measuring device. The rated voltage of the VPIS shall be applied as the test voltage.

The test is considered as passed, if the measured current does not exceed the value specified in 5.4.5.

6.7 Voltage limiting device

6.7.1 General

The tests shall be performed on the complete VPIS.

6.7.2 Threshold voltage

The a.c. test voltage shall be applied to the output terminal of coupling element and steadily increased until flashover, breakdown or voltage limitation occurs in the VPIS.

The test is considered as passed, when flashover, breakdown or limitation has occurred at the voltage limiting device and the test voltage has been not more than 30 % of U_{nmin}.

6.7.3 Current-carrying capacity

The current-carrying capacity of the voltage limiting device shall be proven by the following test.

An a.c. voltage source shall be connected between the output terminal of the coupling element and earth. The voltage shall be adjusted to $U_n / \sqrt{3}$, and the prospective current shall be set at 50 A with a power factor less than 0,15 inductive.

The following test sequence shall be performed:

– current duration: 1 s;
– pause 2: min;
– current duration: 1 s.

The test is considered as passed if in the above test sequence the voltage limiting device functions correctly and carries the current. During or after the test, the voltage limiting device may be damaged. In such a case, the test according to 6.7.2 shall be repeated in order to verify that voltage limitation is still effective.

Additionally, in the case of VPIS intended for use on systems with insulated or resonant earthed neutral, it shall be verified that either earth fault condition is clearly observable, or the voltage at connecting point does not exceed 50 V r.m.s. for the fault duration.

NOTE Other test conditions, for example a higher current or a different test sequence, may be chosen upon agreement between the manufacturer and the user.

6.8 Clear perceptibility of visual indication

6.8.1 Test voltages

The VPIS shall be connected according to 6.3 to a line-to-earth voltage of 0,45 × U_{nmin}, U_{nmin} being the minimum value of the nominal voltage range.

For a VPIS with a built-in power source, the voltage supply shall be set during indication at 5 % ± 1 % above the voltage at which the VPIS shuts off or gives an indication of non-readiness. This voltage may be taken from another electrical energy source.

6.8.2 Test set-up

The indicating element shall be placed in front of the centre of an unpolished grey screen of at least 1 000 mm in diameter with a reflectivity index of 18 % or mounted on the switchgear front panel as in practice. The indicating element shall be illuminated with diffuse white light from two light sources, which shall be at least 1 000 mm from it, as shown in Figure 3, so that the illuminance on the test specimen is the following:

– 1 000 lx ± 10 % for VPIS assigned for indoor use;
– 25 000 lx ± 10 % for VPIS assigned for outdoor use.

At a distance of 750 mm from the indicating element, a perforated front plate according to Figure 3 shall be arranged.

6.8.3 Test procedure

The test shall be performed by three observers, each with average eyesight, looking at the indicating element through the holes in the front plate. The test voltage shall be switched on and off several times at irregular time intervals not known to the observers.

6.8.4 Test assessment

The test is considered as passed, when each of the three observers has perceived all indications without doubt or error through each hole.

6.8.5 Perceptibility of indication at maximum applied voltage

Indicating elements whose indicating characteristics depend on the applied test voltage shall be tested again according to 6.8.1 to 6.8.4, with a test voltage of 1,2 × U_{nmax}.

6.8.6 Perceptibility of indication at low light level

On indicating elements with non-actively light-emitting indication, the test shall be repeated according to 6.8.1, 6.8.3, 6.8.4 and 6.8.5 in the test assembly according to 6.8.2, but with an illuminance of the accompanying light of 10 lx.

6.9 Impact resistance

The accessible part of the VPIS shall be subjected to an impact test according to IEC 60068-2-75. The specified impact level is 1 J.

Three blows shall be applied to the points that are likely to be the weakest. The use of a spring-operated hammer is recommended.

After the test, the specimen shall show no breaks, and any deformation shall not affect the normal function or the degree of protection specified in 5.1.3. Superficial damage shall be ignored.

6.10 Clear indication of phase comparators

6.10.1 Test set-up

The phase comparator shall be connected to the connecting points of two VPIS.

The primary line-to-earth voltages applied to each VPIS are respectively U_1 and U_2.

6.10.2 Incorrect phase relationship

In the first test run, U_1 and U_2 shall be set at $0{,}92 \times U_{\text{nmin}} / \sqrt{3}$, U_{nmin} being the minimum value of the nominal voltage range. A phase difference of 30° shall be adjusted between U_1 and U_2.

The test is considered as passed if the indication "incorrect phase relationship" appears.

NOTE Different phase values may be considered, as stated in the note of 5.6.2.

6.10.3 Correct phase relationship

In the second test run, U_1 shall be set at $1{,}08 \times U_{\text{nmax}} / \sqrt{3}$, U_{nmax} being the maximum value of the nominal voltage range, and U_2 shall be set at $0{,}95 \times U_1$. A phase difference of 10° shall be adjusted between U_1 and U_2.

The test is considered as passed if the indication "incorrect phase relationship" does not appear. In the case of a phase comparator with two active signals, the indication "correct phase relationship" shall appear.

6.10.4 Absence of voltage on one side

In the third test run, the terminal connected to U_1 shall be disconnected and earthed and U_2 set to $U_{\text{nmax}} / \sqrt{3}$, U_{nmax} being the maximum value of the nominal voltage range.

The test is considered as passed if the following conditions are fulfilled:

– for phase comparators with only one signal, no indication of "correct phase relationship" is permitted;
– for phase comparators with two active signals, no indication is permitted;

– for phase comparators with a specific active signal, the indication shall be that the voltage is less than 10 % of U_n.

6.10.5 Absence of voltage on both sides

In the fourth test run, U_1 and U_2 shall be set at 0,07 × U_{nmax}, U_{nmax} being the maximum value of the nominal voltage range. A phase difference of 120° shall be adjusted between U_1 and U_2.

The test is considered as passed if no indication appears.

6.11 Electromagnetic compatibility tests (EMC)

If the VPIS includes electronic equipment or components, it shall be submitted to EMC tests according to 6.9 of IEC 62271-1.

Test voltages shall be applied to the output terminal of the coupling element of the VPIS.

For assessment of tests according to 6.9.2.3 and 6.9.2.4 of IEC 62271-1, criterion B as defined in 6.9.2.5, Table 16, of IEC 62271-1 shall be used.

6.12 Indication until power source is exhausted

This test shall be performed on a VPIS with a built-in power source.

6.12.1 Test set-up

A constantly controlled voltage source in series with a resistor which is approximately equal to the internal resistance of the built-in power source at the end of its scheduled service life shall be substituted for the built-in power source. The initial value of the voltage of the controlled voltage source shall be set at the nominal voltage of the built-in power source.

6.12.2 Determination of test voltage

The threshold voltage U_{vp} according to 6.3 shall be determined. For the following tests, the test voltage shall be set at 10 % above U_{vp}.

6.12.3 Test procedure

The test voltage shall be switched on. The voltage of the controlled voltage source shall be measured and set at 5 % below the initial value. Then the test voltage shall be switched off. The on-duration shall be at least 10 s. This test step shall be repeated, reducing the voltage of the controlled voltage source in steps of 5 % of the initial value, until the VPIS shuts off or gives an indication of non-readiness.

The indications shall be observed to verify that there is no ambiguity.

6.12.4 Repetition of test

The voltage of the controlled voltage source shall be reset to the initial value according to 6.12.1, and the entire test according to 6.12.3 repeated twice.

6.12.5 Multiple power sources

For a VPIS having several power sources independent from each other, the test shall be performed according to 6.12.1 to 6.12.4 on each of the power sources separately and then with all of them together.

6.12.6 Test assessment

The test is considered as passed if all indications are unambiguous.

7 Routine tests

7.1 General

The VPIS shall be installed in the switchgear or controlgear. Then the dielectric tests according to 7.1 and 7.2 of IEC 62271-1 shall be applied to the complete switchgear or controlgear including the VPIS.

7.2 Clear indication

A clear indication test according to 6.3 shall be carried out. If it has been demonstrated during type testing that the indication of the VPIS is not severely affected by the voltage condition of adjacent phases, then the routine test may be carried out as a single-phase test.

8 Guide to the selection of VPIS

It is the responsibility of the switchgear manufacturer to ensure that the VPIS is suitable for the ratings and service conditions determined for the switchgear according to Clause 8 of IEC 62271-200 or IEC 62271-201.

Additionally, it is necessary to consider

– the nominal voltage of the system;
– the type of system neutral earthing;
– the type of VPIS (indoor or outdoor use).

9 Information to be given with enquiries, tenders and orders

Information regarding VPIS shall be included in general information to be supplied for switchgear according to Clause 9 of IEC 62271-200 or IEC 62271-201.

Of particular interest for VPIS is information about

– characteristics of the system on which the switchgear is to be used (nominal and highest voltage, frequency, type of system neutral earthing);
– ratings;
– service conditions;
– type of VPIS (indoor or outdoor use).

10 Instructions for use

10.1 General

VPIS and phase comparators shall be accompanied by the manufacturer's instructions for use. These instructions may be included in the instructions for use for the switchgear in which the VPIS is installed.

10.2 Instructions for use of VPIS

Instructions for use of VPIS shall include at least the following explanations and instructions:

– explanation of labels and markings;
– explanation of indications;
– statement that the clear indication "voltage present" is ensured in the voltage range according to IEC 62271-206;
– the following warning: "The indication of VPIS alone is not sufficient to prove that the system is dead: if operating procedures make it mandatory, relevant voltage detectors according to IEC 61243-1, IEC 61243-2 and IEC 61243-5 shall be used";
– explanation of the purpose of the connecting points;
– statement of the type of phase comparator suitable for use with the VPIS;
– if applicable, statement of which parts of the indicating element can be replaced by the user and their specifications (for example, type of battery for indicating elements with built-in power source);
– statement that it might be necessary under extra-bright illumination to improve the visible perceptibility by additional means, for example, by shadowing the indication.

10.3 Instructions for use of phase comparators

Instructions for the use of phase comparators shall include at least the following explanations and instructions:

– explanation of use;
– explanation of indications, including indication when built-in power source is exhausted, when applicable;
– statement on nominal frequency;
– statement on which specific VPIS the phase comparator is applicable;
– statement on the indication ranges of correct and incorrect phase relationship according to IEC 62271-206; if applicable, statement on voltage difference or nominal frequency deviation that is allowed before an erroneous indication of phase angle occurs;
– statement on possible indications depending on situations (such as correct, incorrect phase relationship, missing voltage(s));
– statement concerning possible effects of interference voltages (harmonics);
– elements with built-in power source: statement of the type of battery to be used;
– statement on storage and care, for example, temperature range;
– prescription of how to test the correct functioning of the comparator.

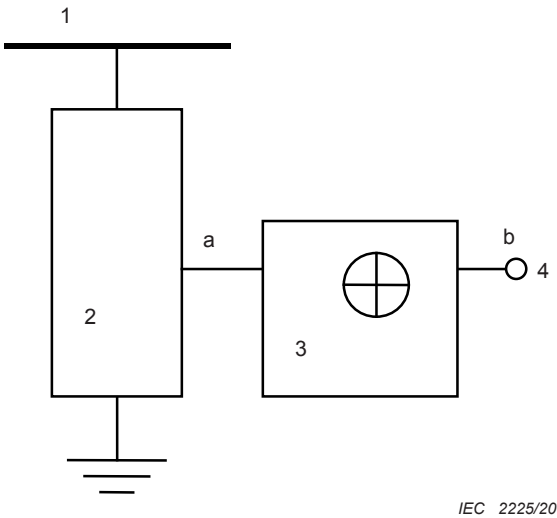
11 Safety

General recommendations of Clause 11 of IEC 62271-1 and IEC 61243-1, IEC 61243-2 and IEC 61243-5 also apply to VPIS.

In this standard, safety aspects are covered by the requirements of 5.4.

Table 2 – Sequence of type tests for VPIS and phase comparators (PC)

Order of test	Subclause	Test	Part to be tested	Requirements
1	6.2	Arrangement, assembly, marking, and instructions for use	VPIS PC	5.1.1, 5.1.2, 5.1.3, 5.1.5, 5.3.1, 5.4.5, 5.5, 11.2 5.6.4, 5.6.5, 11.3
2	6.5	Dielectric strength of the coupling element of VPIS	VPIS	5.4.1
3	6.6	Maximum current delivered by the connecting point	VPIS	5.4.5
4	6.7	Voltage limiting device	VPIS	5.4.2, 5.4.3, 5.4.4
5	6.9	Impact resistance	VPIS	5.1.4
6	6.11	EMC	VPIS	5.7
7	6.3	Clear indication of VPIS	VPIS	5.2, 5.3.2
8	6.4	Response time of VPIS	VPIS	5.3.3
9	6.8	Clear perceptibility of visual indication	VPIS	5.3.1
10	6.12	Indication until power source is exhausted	VPIS	5.3.4
11	6.10	Clear indication of phase comparators	PC	5.6.2, 5.6.3, 5.6.4, 5.6.5



Key

1 main circuit

2 coupling element

3 indicating element

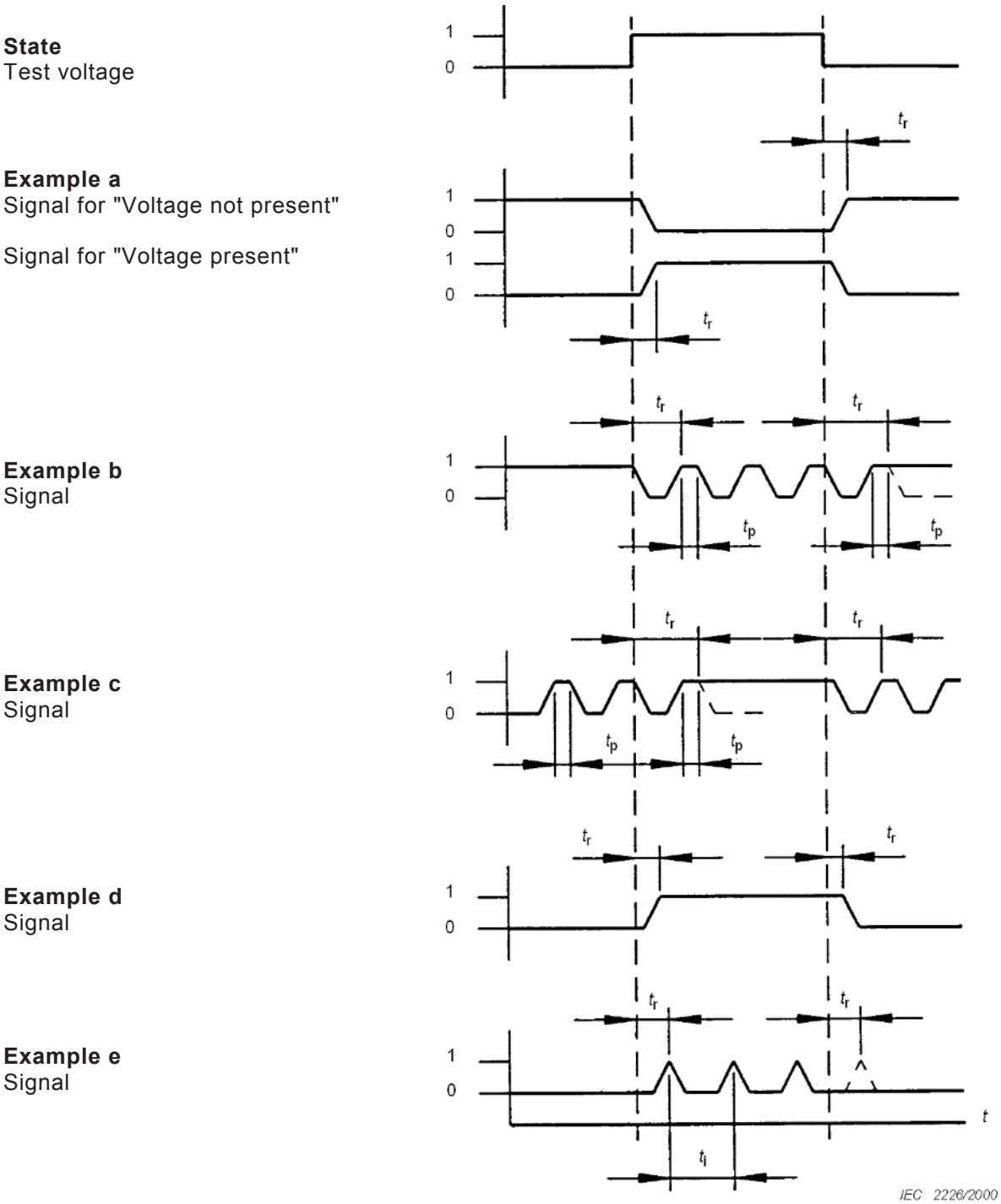
4 connecting point (optional)

a signal from coupling element

b signal at connecting point

NOTE Connection to earth may be physically located on the indicating element.

Figure 1 – Voltage presence indicating system



t..... time t_i.....interval duration t_p..... pulse duration t_r..... response time

Example	Number of different signals	Signal for the indication "voltage not present"	"voltage present"
a	2	Steady	Steady
b	1	Steady	Intermittent
c	1	Intermittent	Steady
d	1	None	Steady
e	1	None	Intermittent

Figure 2 – Examples for measuring the response time

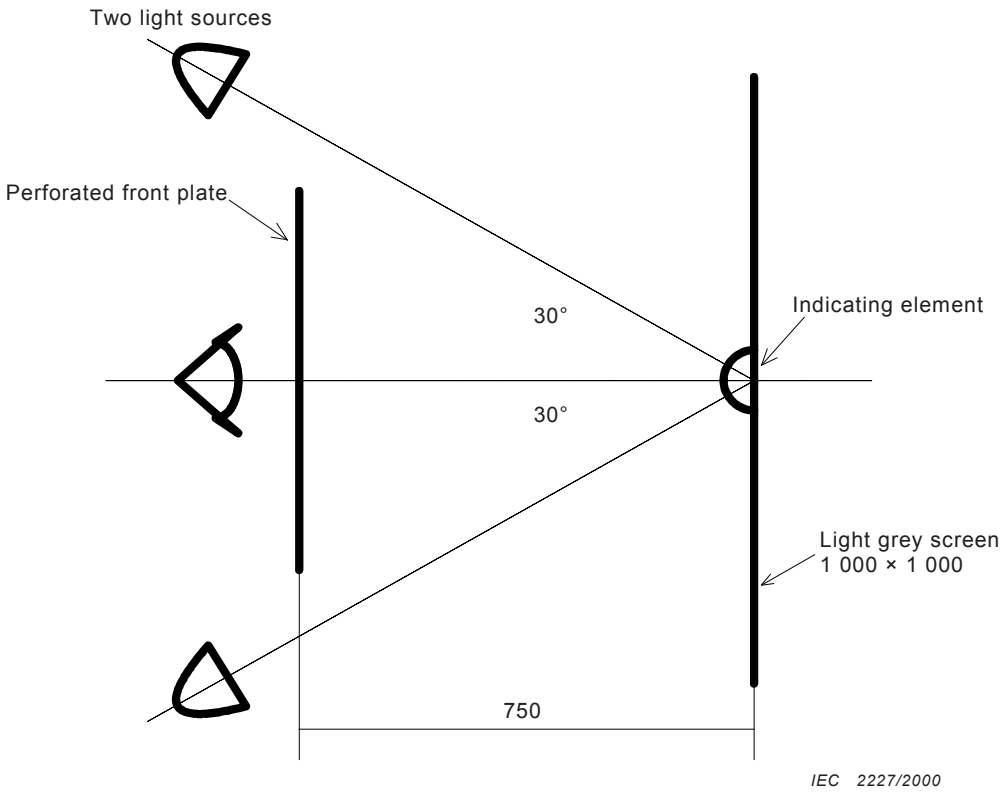


Figure 3a – Top view

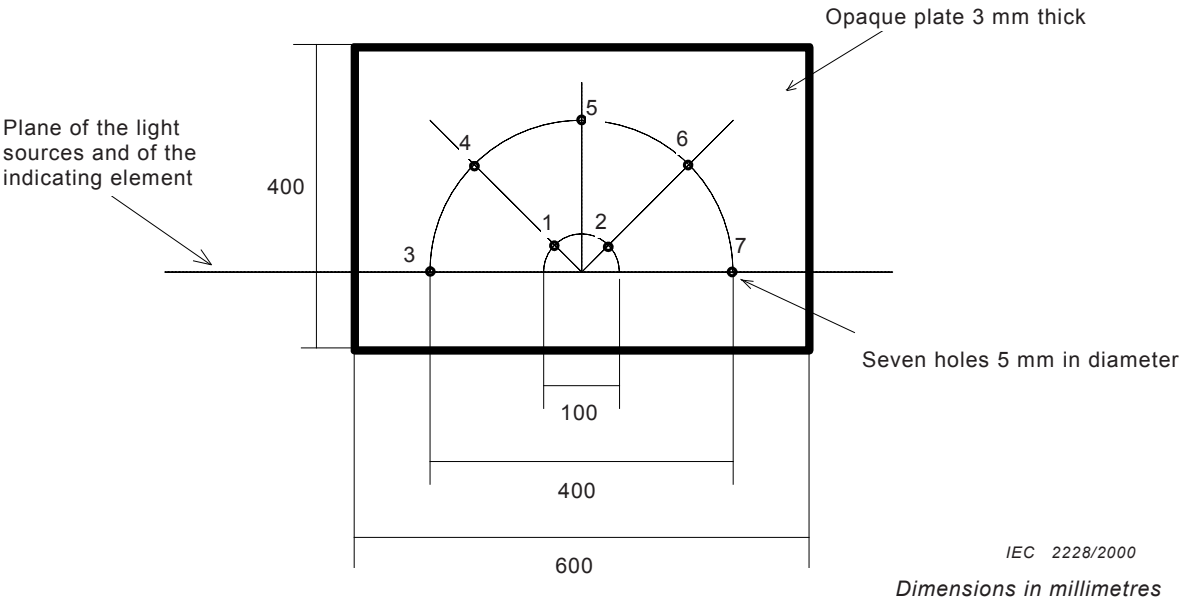


Figure 3b – Front view of the front plate

Figure 3 – Test set-up for perceptibility of visual indication

Bibliography

IEC 60050(601), *International Electrotechnical Vocabulary (IEV) – Chapter 601: Generation, transmission and distribution of electricity – General*

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