BS EN 1643:2014

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Safety and control devices for gas burners and gas burning appliances — Valve proving systems for automatic shut-off valves

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National foreword

This British Standard is the UK implementation of EN 1643:2014. It supersedes BS EN 1643:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GSE/22, Safety and control devices for gas and oil burners and gas burning appliances.

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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Compliance with a British Standard cannot confer immunity from legal obligations.

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Safety and control devices for gas burners and gas burning appliances - Valve proving systems for automatic shut-off valves

Systèmes de contrôle d'étanchéité pour robinets automatiques de sectionnement pour brûleurs et appareils à gaz

Sicherheits-, Regel- und Steuereinrichtungen für Gasbrenner und Gasgeräte - Ventilüberwachungssysteme für automatische Absperrventile

This European Standard was approved by CEN on 27 December 2013.

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Foreword

This document (EN 1643:2014) has been prepared by Technical Committee CEN/TC 58 “Safety and control devices for burners and appliances burning gaseous or liquid fuels”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2014, and conflicting national standards shall be withdrawn at the latest by March 2017.

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This document supersedes EN 1643:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2009/142/EC.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

This document refers to clauses of EN 13611:2007+A2:2011 or adapts it by stating “with the following modification”, “with the following addition”, “is replaced by the following” or “is not applicable” in the corresponding clause. This document adds clauses or sub-clauses to the structure of EN 13611:2007+A2:2011 which are particular to this standard, i.e. sub-clauses or annexes which are additional to those in EN 13611 are numbered starting from 101 or are designated as Annex AA, BB, CC etc. It should be noted that these clauses and sub-clauses are not indicated as an addition. If by reference to EN 13611 the term “control” is given, this term should be read as valve-proving systems.

Note that the following provides details of significant technical changes between this document and the previous edition:

a) Alignment with EN 13611:2007+A2:2011;

b) Integration of the requirements from ISO 23551-4.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies safety, constructional and performance requirements of valve-proving systems, hereafter referred to as VPS, intended for use with gas burners and gas-burning appliances. It also describes the test procedures for checking compliance with these requirements and provides information necessary for the purchaser and user.

This European Standard applies to all types of VPS which are used for the automatic detection of leakage in a gas burner section having at least two valves designed in accordance with EN 161 and which give a signal if the leakage of one of the valves exceeds the detection limit.

This European Standard applies to VPSs with a maximum working pressure up to and including 500 kPa for use in systems using fuel gases of the 1st, 2nd or 3rd families.

This European Standard does not apply to VPSs for use in explosive atmospheres.

This European Standard is applicable to AC and DC supplied VPS (for VPS supplied by stand-alone battery system, battery systems for mobile applications or systems which are intended to be connected to DC supply networks VPS see Annex I).

Provisions for production control are not part of this European Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 161, *Automatic shut-off valves for gas burners and gas appliances*

EN 1854, *Pressure sensing devices for gas burners and gas burning appliances*

EN 13611:2007+A2:2011, *Safety and control devices for gas burners and gas burning appliances - General requirements*

EN 14459:2007, *Control functions in electronic systems for gas burners and gas burning appliances - Methods for classification and assessment*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60730-1:2011, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1:2010, modified)*

EN 60730-2-5:2002, *Automatic electrical controls for household and similar use — Part 2-5: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5:2000, modified)*

EN 60947-5-1:2004, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices (IEC 60947-5-1:2003)*

EN 61810-1, *Electromechanical elementary relays — Part 1: General requirements (IEC 61810-1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13611:2007+A2:2011 and the following apply.

3.101
valve proving system
VPS
system to check the effective closure of automatic shut-off valves by detecting leakage, that often consists of a programming unit, a measuring device, valves and other functional assemblies

3.102
VPS programming unit
unit which follows a predetermined sequence of valve proving actions

3.103
detecting device
device for direct or inferential detection of leakage

EXAMPLE Leakage is detected by measuring flow or pressure.

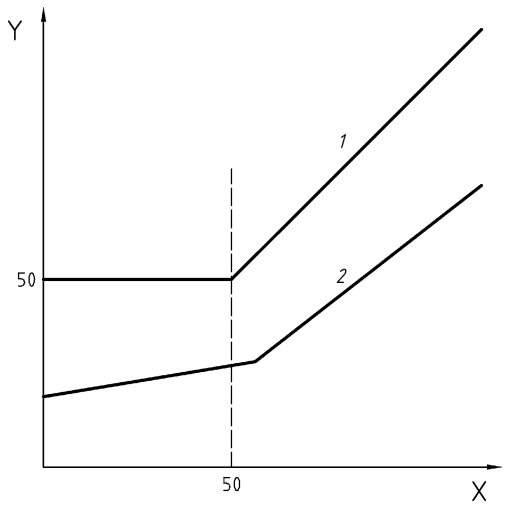
3.104
VPS operational time
time taken by the VPS to perform its entire cycle of operation

3.105
detection limit
maximum amount of leakage that can occur before the VPS is required to give a signal

Note 1 to entry: See Figure 1.

3.106
detection setting
actual leakage rate at which the VPS gives a signal

Note 1 to entry: See Figure 1.



Key

X burner heat, gas flow, expressed in m^3/h

Y detected leakage rate, expressed in dm^3/h

1 detection limit, see 3.105

2 detection setting, see 3.106

Figure 1 — Illustration of detection limit and detection setting

3.107
leakage testing time
time in which the VPS monitors a gas valve for leakage

3.108
safety shut-down
process which is effected immediately following the detection of a leakage exceeding the detection limit, or detection of an internal fault, disabling energisation of the ignition and of the automatic shut-off valves

3.109
volatile lock-out
safety shut-down condition of the system where a restart can only be accomplished by either the manual reset of the system, or an interruption of the main power and its subsequent restoration

3.110
non-volatile lock-out
safety shut-down condition of the system, where a restart can only be accomplished by the manual reset of the system and by no other means

4 Classification

4.1 Classes of control

EN 13611:2007+A2:2011, 4.1 is not applicable.

4.2 Groups of control

Shall be according to EN 13611:2007+A2:2011, 4.2.

4.3 Classes of control functions

Shall be according to EN 13611:2007+A2:2011, 4.3 with the following addition:

The valve proving system for automatic shut-off valves is a Class C control function.

5 Units of measurement and test conditions

5.1 Dimensions

Shall be according to EN 13611:2007+A2:2011, 5.1.

5.2 Pressures

Shall be according to EN 13611:2007+A2:2011, 5.2.

5.3 Bending moments and torques

EN 13611:2007+A2:2011, 5.3 is not applicable.

5.4 Test conditions and measurement tolerances

Shall be according to EN 13611:2007+A2:2011, 5.4 with the following addition:

All tests are performed in the order written in this European Standard (i.e. EN 1643) except for that of 6.6 and 7.10.

6 Construction requirements

6.1 General

EN 13611:2007+A2:2011, 6.1, applies, with the following addition.

The VPS shall be designed such that changes in critical circuit component values (such as those affecting timing or sequence) within the worst case tolerances of the components specification, including the long-term stability, shall result in the system continuing to function in accordance with this European Standard. Compliance shall be checked by worst-case analysis.

The construction of any additional functions included in the VPS for which no provisions exist in this European Standard shall be such that they do not degrade the safe and correct operation.

Where components are used to complete the VPS, these components shall comply with the relevant harmonized European controls Standard. Valves (e.g. for pressurising and relieving the test section) integrated into the VPS functional sequence shall comply with EN 161 Class A, if not otherwise specified by a relevant appliance standard, and pressure-sensing devices, with EN 1854.

6.2 Mechanical parts of the control

Shall be according to EN 13611:2007+A2:2011, 6.2

6.3 Materials

Shall be according to EN 13611:2007+A2:2011, 6.3

6.4 Gas connections

Shall be according to EN 13611:2007+A2:2011, 6.4

6.5 Electronic parts of the control

6.5.1 General

Shall be according to EN 13611:2007+A2:2011, 6.5.1 with the following addition:

The construction of any additional functions included in the valve proving system, programming unit or flame detector device for which no provisions exist in this standard, shall be such that they do not degrade the safe and correct operation of the valve proving system.

Measures shall be taken to protect against failure of two (or more) switching elements, due to a common cause, by an external short circuit that would prevent the valve proving system from performing a safety shutdown.

Acceptable methods are current limitation, overcurrent protection device or internal fault detecting functions.

The suitability of measures to maintain the capability to interrupt the energisation of the shut-off valve terminals by means of at least one switching element or a non-replaceable overcurrent protection device has been interrupted shall be verified by the following test.

The shut-off valve terminals of the valve proving system are connected to a switch that is intended to switch the short circuit current. With this switch opened, the valve proving system is connected as described in EN 60730-1:2011, H.27.1.1.2 with the outputs energised to simulate normal operation (contacts of the internal switching elements closed).

Where overcurrent protection device are used as the protective measure the power supply to the valve proving system shall have the capability of supplying an inrush current of at least 500 A. Where current limitation techniques are used the power supply to the valve proving system shall not limit the current.

A short-circuit is applied between the shut-off valve terminals of the valve proving system by closing the switch.

The test is terminated if there is no current flow through the switch, or after one hour.

If an overcurrent protection device is replaceable and has operated during the test it shall be replaced and the test is repeated two more times by attempting to restart the valve proving system keeping the switch closed.

A second test procedure is conducted in the same way, with the switch closed prior to the first start-up sequence; a second test sample can be used for this second test procedure.

If an internal fault detecting function of the valve proving system either opens the switching elements or initiates a safety shut-down the test is repeated two times while maintaining the external short circuit by attempting to restart the valve proving system.

Compliance is checked in accordance with EN 60730-1:2011, H.27.1.1.3 and Clause 15.

After the test at least one switching element of the valve proving system shall be able to de-energize the shut-off valve terminals, or a non-replaceable overcurrent protection device has permanently interrupted the supply to the shut-off valve terminals.

Designs where at least two relays are used as switching elements with independent contacts and in series with a non-replaceable fuse (see Table E.1, h) with $I_N < 0{,}6 \cdot I_e$, are considered to comply with the requirements for prevention of common cause error, without further testing.

NOTE I_N values for the fuse (see EN 60127–1:2006, 3.16).
I_e: rated operational current of the contact (see EN 60947–1:2007; 4.3.2.3).

6.5.2 Protection provided by the enclosure

EN 13611:2007+A2:2011, 6.5.2 is replaced by the following:

The class of protection for a system with its own enclosure shall be a minimum of IP 40 as specified in EN 60529:1991 when installed in accordance with the installation and operating instructions. For systems used in the open air, the protection shall conform to at least IP 54 when installed in accordance with the installation and operating instructions. For systems without enclosure, equivalent protection shall be provided by the appliance in which it is installed.

6.5.3 Electrical components

Shall be according to EN 13611:2007+A2:2011, 6.5.3.

6.6 Protection against internal faults for the purpose of functional safety

6.6.1 Design and construction requirements

6.6.1.1 Fault avoidance and fault tolerance

Shall be according to EN 13611:2007+A2:2011, 6.6.1.1.

6.6.1.2 Reset device

Shall be according to EN 13611:2007+A2:2011, 6.6.1.2 with the following modification:

The last paragraph shall be substituted by:

For remote reset functions EN 14459:2007, Annex J applies.

6.6.1.3 Documentation

Shall be according to EN 13611:2007+A2:2011, 6.6.1.3.

6.6.2 Class A

EN 13611:2007+A2:2011, 6.6.2 is not applicable.

6.6.3 Class B

EN 13611:2007+A2:2011, 6.6.3 is not applicable.

6.6.4 Class C

6.6.4.1 Design and construction requirements

Shall be according to EN 13611:2007+A2:2011, 6.6.4.1 with the following modification:

Replace the second and third paragraph by the following:

At least the following states are defined as unsafe states:

a) if during burner shut-down, the gas flow through a valve or by-passing valve is higher than the detection limit value of that valve except for the function of the VPS;

b) if a test for leakage is outside the limits defined in 3.105 or 3.106;

c) overriding the VPS sequence control of the safety shut-off valves by the burner control unit, except for the normal function of the VPS;

d) preventing the VPS from going to a defined fault response.

VPS or safety-related (hardware) parts of the VPS that are not powered during the stand-by and the running state of the appliance shall execute all relevant internal tests during powering-up of the VPS. Once the VPS is operational, the required internal test to detect the first faults leading to one of the unsafe states as mentioned in above shall be executed every 3 s.

For this type of VPS system, the second fault shall only be considered to occur when a start-up sequence has been performed between the first and the second fault.

VPS systems that are powered during stand-by or running state of the appliance shall comply with the following:

— reaction time to detect the first faults leading to one of the unsafe states as mentioned in above are ≤ 3 s;

— reaction time to detect second independent fault ≤ 24 h.

Software shall conform to software Class C of EN 60730-2-5:

The VPS shall be fail-safe. Systems which meet the requirements of this clause and, if applicable, 6.6.1.1 are considered to be inherently fail-safe.

The circuitry and the construction of the system shall be such that they meet the requirements of 7.101 and shall be appraised according to the requirements to 6.6.4.2, 6.6.4.3 and 6.6.4.4 and under the test conditions and criteria of 6.6.5.

Components shall be dimensioned on the basis of the worst-case conditions which can arise in the system, as stated within the design documentation.

6.6.4.2 First fault

EN 13611:2007+A2:2011, 6.6.4.2 is replaced by the following:

Any first fault (see Annex E) in any one component or any one fault together with any other fault arising from that first fault shall result in either:

a) the VPS becoming inoperative with all valve terminals de-energised;

b) the system proceeding to safety shut-down within 3 s followed by a non-volatile or volatile lock-out. The lock-out may be executed by the VPS, or by another control within the appliance preventing the burner start up. During subsequent reset action, the VPS shall not operate any valves or the pressurising pump belonging to the valve. Subsequent reset from the lock-out condition under the same fault condition results in the VPS returning to the volatile or non-volatile lock-out condition; continue with fault assessment during lock-out or safety shut-down according to 6.6.4.4.3;

c) the VPS continuing to operate, the fault being identified during the next start-up sequence, the result being a) or b);

d) the VPS remaining operational in accordance with all other requirements of this standard (see 7.101).

For VPS designed for use on non-permanent operating appliances list item c) is applicable whereas list item c) is not applicable for VPS designed for use on permanent operating appliances.

6.6.4.3 Second fault

Shall be according to EN 13611:2007+A2:2011, 6.6.4.3 with the following addition:

For VPS designed for use on non-permanent operating appliances EN 13611:2007+A2:2011, 6.6.4.3 a) is applicable whereas EN 13611:2007+A2:2011, 6.6.4.3 b) is applicable for VPS designed for use on permanent operating appliances.

6.6.4.4 Faults during lock-out or safety- shut-down

6.6.4.4.1 General

Shall be according to EN 13611:2007+A2:2011, 6.6.4.4.1.

6.6.4.4.2 First fault introduced during lock-out or safety- shut-down

EN 13611:2007+A2:2011, 6.6.4.4.2 is replaced by the following:

During assessment, the first fault shall not be considered to occur within 24 h after lock-out or safety shut-down is reached without an internal fault.

Any first fault (together with any other fault arising from that fault) in any one component (see Annex E), induced while the VPS is in the safety shut-down or lock-out position, shall result in either:

a) the system remaining in safety shut-down or lock-out, with the shut-off valves remaining de-energised;

b) the system becoming inoperative with the shut-off valves remaining de-energised;

c) the system coming into operation again resulting in a) or b) as mentioned in this clause under the condition that the shut-off valve terminals are energised not longer than the 3 s. If the cause of the original safety shut-down or lock-out condition is no longer present and the valve proving system resumes operation, it shall operate in accordance with the safety related functional requirements of this standard and the second fault assessment shall be carried out in accordance with 6.6.4.3.

While conducting this test, the fault can be applied at any time during the lock-out or safety shut-down condition. It is not necessary to wait 24 h before applying the fault. If the fault was applied before 24 h and unacceptable results were obtained, the fault should be applied 24 h after reaching lock-out or safety shut-down.

6.6.4.4.3 Second fault introduced during lock-out or safety shut-down

Shall be according to EN 13611:2007+A2:2011, 6.6.4.4.3 with the following addition:

While conducting this test, the second fault can be applied at any time during the lock-out or safety shut-down condition. It is not necessary to wait 24 h before applying the second fault. If the second fault was applied before 24 h and unacceptable results were obtained, the initial fault should be applied and then wait 24 h before applying the second fault.

6.6.5 Circuit and construction evaluation

6.6.5.1 Test conditions

Shall be according to EN 13611:2007+A2:2011, 6.6.5.1.

6.6.5.2 Test criteria

Shall be according to EN 13611:2007+A2:2011, 6.6.5.2.

6.6.5.3 Assessment

Shall be according to EN 13611:2007+A2:2011, 6.6.5.3.

6.101 Additional constructional requirements for VPS systems

6.101.1 Signal for indication

A signal for indication, e.g. optical indication, shall be given when the leakage exceeds the detection limit.

6.101.2 VPS setting

The setting of a detecting device shall require the use of tools. If the VPS is adjustable, the installation and operating instructions shall provide information for this setting, e.g. detection setting.

7 Performance

7.1 General

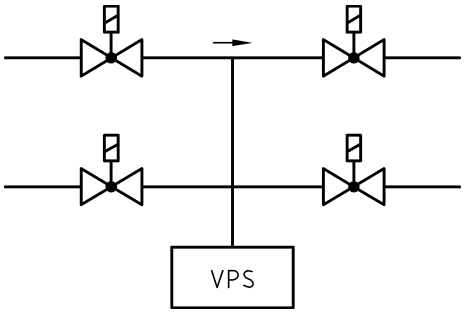
Shall be according to EN 13611:2007+A2:2011, 7.1.

7.2 Leak-tightness

Shall be according to EN 13611:2007+A2:2011, 7.2, with the following modification

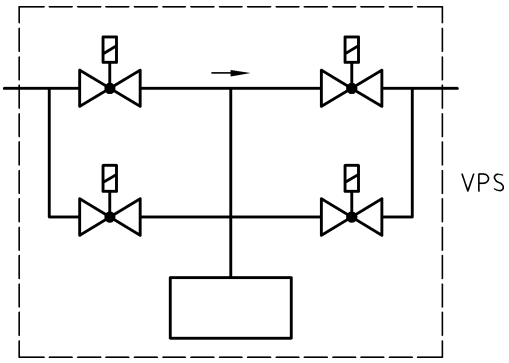
The external leak-tightness requirements are replaced by the following:

A VPS according to Figure 2 a) is considered to be externally leaktight, if no single component of a VPS has an external leakage rate not higher than 60 $cm^3 \cdot h^{-1}$.

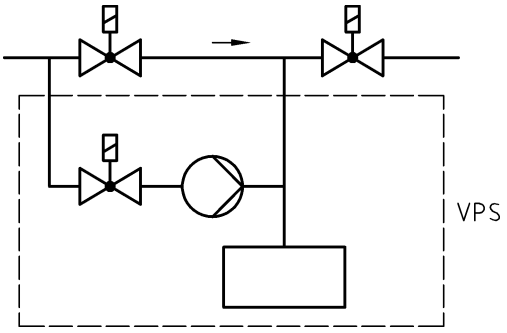


a) External valves supervised by a VPS

A VPS with integrated or partly integrated actuators (e.g. valves, pumps), according to Figure 2 b) and c) is considered to be a single component and shall have an external leakage rate not higher than 120 $cm^3 \cdot h^{-1}$.



b) VPS with integrated valves



c) VPS with partly integrated valves

Figure 2 — Examples of VPS configurations

7.3 Test for leak-tightness

7.3.1 General

Shall be according to EN 13611:2007+A2:2011, 7.3.1, with the following modification.

The 3rd paragraph does not apply.

7.3.2 External leak-tightness

Shall be according to EN 13611:2007+A2:2011,7.3.2.

7.3.3 Internal leak-tightness

Shall be according to EN 13611:2007+A2:2011,7.3.3.

7.4 Torsion and bending

Shall be according to EN 13611:2007+A2:2011, 7.4.

7.5 Torsion and bending tests

Shall be according to EN 13611:2007+A2:2011, 7.5.

7.6 Rated flow rate

EN 13611:2007+A2:2011, 7.6 is not applicable.

7.7 Test for rated flow rate

EN 13611:2007+A2:2011, 7.7 is not applicable.

7.8 Durability

Shall be according to EN 13611:2007+A2:2011, 7.8.

7.9 Performance tests for electronic controls

Shall be according to EN 13611:2007+A2:2011, 7.9.

7.10 Long-term performance for electronic controls

7.10.1 General

Shall be according to EN 13611:2007+A2:2011, 7.10.1.

7.10.2 Stress test

7.10.2.1 Thermal stress test

Shall be according to EN 13611:2007+A2:2011, 7.10.2.1.

7.10.2.2 Vibration test

Shall be according to EN 13611:2007+A2:2011, 7.10.2.2 with the following modification:

Replace the 5th paragraph and its indents by the following:

The test is performed at least with the following severity conditions:

Frequency range: 10 Hz to 150 Hz

Acceleration/Amplitude: 10 Hz to 58 Hz: 0,075 mm or higher if specified in the installation and operating instructions
58 Hz to 150 Hz: 10 m/s^2 or higher if specified in the installation and operating instructions

Sweep rate: 1 octave per minute

Number of sweep cycles: 10

Number of axes: 3, mutually perpendicular

7.10.3 Long term performance test

Shall be according to EN 13611:2007+A2:2011, 7.10.3.

7.101 Functional requirements

7.101.1 General

The VPS shall allow the opening of the valves to the burner and subsequent ignition below the detection limit. The VPS shall prevent the opening of the valve and operation of the ignition system when the detection limit is exceeded.

Interruption of the mains supply and its restoration shall not affect the safety of the programme sequence. If mains interruption and its restoration result in automatic recycling and overriding of any interlock, the VPS shall restart from the beginning of the programme sequence.

7.101.2 Programme sequence

The programme sequence for the VPS shall enable ignition and opening of the valves to operate the burner below the detection limit, and shall prevent ignition and opening of the valves when the detection limit is exceeded, in accordance with 7.101.5, followed by a lock-out. The lock-out may be executed on the system application direct or by the VPS itself. An automatic start-up attempt by a control function shall not override the lock-out conditions.

Any gas necessary for the operation of the VPS may be discharged into the combustion chamber during the programme sequence if the maximum release volume, expressed in litres per switching sequence, does not exceed 0,083 % of the burner heat input referred to the nominal volume flow, expressed in cubic metres per hour.

NOTE 0,083 % is based on the quantity within 3 s.

However, when the VPS is used as an alternative for pre-purge or post-purge, discharge of the gas necessary for the operation of the VPS into the combustion chamber might not be allowed; the gas shall be vented into the atmosphere at a safe location.

If the actuating energy in the safety circuit fails, the VPS shall close the main gas valves and any ignition gas valve or give a shut-down signal to the automatic gas-burner control system.

7.101.3 Timing

The leakage testing time and the pressure pump time (if applicable) shall be specified in the installation and operating instructions.

Adjustment of safety critical timing is permitted but shall be possible only by means of tools.

Where these times can be adjusted using an existing scale on the component, the scale shall be accurate to ± 10 % of the indicated value. The means of adjustment shall be readily identifiable (e.g. colour-coded).

Shortening of leakage testing time, causing conflict with 7.101.5, shall not take place due to internal failures such as wear and tear, drop in accuracy of adjustments and similar causes.

Leakage testing time shall not be less than the specified value.

Lengthening of valve energisation time or pumping time, causing conflict with 7.101.5 of this standard, shall not take place due to internal failures such as wear and tear, drop in accuracy of adjustments and similar causes.

During the programme, the main valve shall not be energised longer than 3 s. Bypass-valves may be energised longer than 3 s, as long as the limit of 0,083 % (see 7.101.2) is not exceeded.

Pressure pump time shall not be greater than the specified time.

The response time to achieve safety shutdown, whenever this is required, shall not exceed 1 s after a functional failure has been detected.

The reaction time to achieve volatile lock-out or non-volatile lock-out, whenever required, shall be in accordance with the relevant appliance standard. However, this time shall be achieved within 30 s of the safety shut-down.

The VPS operational time shall not change by more than ± 50 % under test conditions specified in Clause 5.

7.101.4 Testing of the programme sequence and timing

The test is performed on one VPS. The VPS is tested in a suitable testing unit.

With the VPS in the delivered state, the entire programme sequence (7.101.2 and 7.101.3) of the VPS is started at the rated voltage and at ambient temperature.

The programme sequence shall be tested over the voltage and temperature ranges in accordance with Clause 5.

If appropriate, the programme sequence of the VPS shall be assessed with the automatic burner control system.

7.101.5 Detection limit

7.101.5.1 General

The VPS shall prevent ignition and the opening of the burner valves at a leakage-rate limit depending on the burner heat input, starting over 50 $dm^3 \cdot h^{-1}$ and up to a minimum value of 0,1 % of the burner heat input.

7.101.5.2 Test of the detection limit

Conformity is checked by measuring the actual or inferred detection limit at three values; at 50 $dm^3 \cdot h^{-1}$, at the maximum value and at the midpoint and/or the minimum value.

7.101.6 Self-checking

The VPS shall have an automatic internal self-checking function for each cycle. Where gas pressure switches are used, the contact position shall be checked. If internal faults simulate a correct function, the signal for ignition and the opening of the valves (see 6.6) shall not be given.

7.101.7 Lock-out and reset device

7.101.7.1 General

The lock-out may be executed at a system-application level or by the VPS itself.

A lock-out caused by the VPS can be either a non-volatile or a volatile lock-out action (depending on the requirements of the relevant appliance standard).

7.101.7.2 Lock-out function

The lock-out function shall be checked for proper operation during each start-up sequence.

The capability of the valve proving system to store the non-volatile lock-out status shall be checked at least during each main power restoration.

The failure modes as described in Annex E shall be taken into consideration during the analysis of the electronic circuit.

In the case of a mechanical actuator a test up to but not including the switching contacts is sufficient.

If the test of the lock-out function fails, the system shall proceed to safety shut-down.

NOTE Internal faults on components of the checking circuit are not considered.

8 EMC/Electrical requirements

8.1 Protection against environmental influences

EN 13611:2007+A2:2011, 8.1 is replaced by the following:

NOTE EN 13611:2007+A2:2011, 8.1 states that the “specific control standard” specifies the applicable Assessment Criterion I and II. The specific Assessment Criteria I and II for this European Standard (i.e. EN 1643) are listed below.

Any components which are specifically intended for protection against EMC disturbances failing during any of these tests, will lead to non-compliance with this standard.

As a minimum for the tests given in 8.2 to 8.10 the tests shall be performed in the following operating phases:

a) start position,

b) during the VPS sequence,

c) in the lock-out position.

Additional operating phases in which the tests shall be performed may be given in the individual sub-clauses.

The following Assessment Criteria I and II are applicable for 8.2 to 8.10 unless specified otherwise:

Assessment Criterion I:

When tested at the severity levels according to 8.2 to 8.10, the VPS shall continue to function in accordance with the requirements of this standard. It shall neither proceed to safety shut-down or lock-out, nor shall it reset from lock-out.

Assessment Criterion II:

When tested at the severity levels according to 8.2 to 8.10, the VPS shall

a) either perform as Assessment Criterion I or it may proceed to safety shut-down which may be followed by an automatic restart, or if in volatile lock-out it may proceed to an automatic restart. If in non-volatile lock-out it shall remain in that condition or

b) where severity level 4 testing is required in addition to Level 3, either it shall perform as above or the control shall become inoperative with all safety related output terminals de-energised or assuming a status in which they ensure a safe situation; complying with 6.6.5.2.

8.2 Supply voltage variations below 85 % of rated voltage

Shall be according to EN 13611:2007+A2:2011, 8.2 with the following modification:

Assessment Criteria II is replaced by the following:

Assessment Criteria II:

The VPS shall either perform as in Criteria I or it may proceed to safety shut-down followed by an automatic restart, or if in volatile lock-out it may proceed to an automatic restart. If in non-volatile lock-out it shall remain in that condition.

8.3 Short-term voltage interruptions and decreases

Shall be according to EN 13611:2007+A2:2011, 8.3, with the following replacement:

Replace the last two paragraphs in EN 13611:2007+A2:2011, 8.3 by the following:

For interruptions or decreases up to and including 1 period, the VPS shall conform to the Assessment Criterion I as specified in 8.1 of this European Standard (EN 1643).

For interruptions or decreases exceeding 1 period the VPS shall conform to Assessment Criterion II.

Assessment Criterion II:

The system shall conform to Assessment Criterion I or it may proceed to safety shut-down which may be followed by an automatic restart, or if in volatile lock-out it may proceed to an automatic restart. If in non-volatile lock-out it shall remain in that condition.

When the power supply is restored, the automatic restart shall comply with the requirements for a normal start-up sequence.

The system shall be tested in each of the operating phases as given in 8.1.

Between the voltage dips, short interruptions and voltage variations, a waiting time of at least 10 s shall be observed.

8.4 Supply frequency variations

8.4.1 General

Shall be according to EN 13611:2007+A2:2011, 8.4.1.

8.4.2 Variations up to 2 %

Shall be according to EN 13611:2007+A2:2011, 8.4.2 with the following modification:

Replace the 1st paragraph of EN 13611:2007+A2:2011, 8.4.2 by the following paragraph:

Vary the mains supply frequency about the nominal frequency *f* within the range –2 % to +2 %. Sequence the system through its complete start-up, running position and shut-down programme a minimum of three times at each of the following supply frequencies: 0,98 *f*, 0,99 *f*, 1,01 *f*, 1,02 *f*.

Replace the 2nd paragraph in EN 13611:2007+A2:2011, 8.4.2 by the following:

During the tests the VPS shall conform to Assessment Criterion I as specified in 8.1 of this European Standard (EN 1643).

The operating phases given in 8.1 do not apply for this test.

8.4.3 Variations between 2 % and 5 %

EN 13611:2007+A2:2011, 8.4.3 is replaced by the following:

Vary the mains supply frequency about the nominal frequency *f* within the ranges –5 % to –2 % and +2 % to +5 %. Sequence the system through its complete start-up and shut-down program a minimum of three times at each of the following supply frequencies: 0,95 *f*, 0,96 *f*, 0,97 *f*, 1,03 *f*, 1,04 *f*, 1,05 *f*.

During the tests the control shall conform to Assessment Criterion II as specified in 8.1 of this European Standard (EN 1643).

The operating phases given in 8.1 do not apply for this test.

8.5 Surge immunity test

Shall be according to EN 13611:2007+A2:2011, 8.5, with the following addition:

Test conditions:

The five pulses of each polarity (+, –) and each phase angle are delivered in the following order:

— 2 pulses with the system in the lock-out position;

— 1 pulse with the system in start position (if applicable);

— 2 pulses randomly applied during the VPS sequence.

The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.6 Electrical fast transient/burst

Shall be according to EN 13611:2007+A2:2011, 8.6, with the following addition:

If the test at the highest severity level complies with the Assessment Criterion I tests at lower severity levels need not be performed. Test conditions:

The test shall be performed for 20 cycles during the VPS sequence. Remaining for a minimum of 30 s each cycle in the position which is reached after successful completion of the VPS sequence. The test shall also be performed for a minimum of 2 min with the system in the lock-out position and with the system in the start

position (if applicable).The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.7 Immunity to conducted disturbances

Shall be according to EN 13611:2007+A2:2011, 8.7, with the following addition:

If the test at the highest severity level complies with the Assessment Criterion I tests at lower severity levels need not be performed.

Test conditions:

The system has to be swept through the complete frequency range at least once with the system in each of the operating phases as given in 8.1.

The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.8 Immunity to radiated fields

Shall be according to EN 13611:2007+A2:2011, 8.8, with the following addition:

If the test at the highest severity level complies with the Assessment Criterion I tests at lower severity levels need not be performed.

Test conditions:

The system has to be swept through the complete frequency range at least once with the system in each of the positions as given in 8.1.

The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.9 Electrostatic discharge immunity test

Shall be according to EN 13611:2007+A2:2011, 8.9, with the following addition:

If the test at the highest severity level complies with the Assessment Criterion I tests at lower severity levels need not be performed.

Test conditions:

The system has to be tested in each of the operating phases as given in 8.1 whereas the discharges during the VPS sequence are randomly applied.

The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.10 Power frequency magnetic field immunity test

Shall be according to EN 13611:2007+A2:2011, 8.10 with the following addition:

If the test at the highest severity level complies with the Assessment Criterion I tests at lower severity levels need not be performed.

Test conditions:

The system has to be tested in each of the operating phases as given in 8.1.

The Assessment Criteria I and II as specified in 8.1 of this European Standard (EN 1643) are applicable.

8.11 Electrical requirements

Shall be according to EN 13611:2007+A2:2011, 8.11 with the following modification:

Replace the first paragraph of EN 13611:2007+A2:2011, 8.11 by the following: The electrical equipment shall comply with the relevant requirements of

a) EN 60730-2-5:2002, Clauses 8, 9, 10, 11, 12, 13, 14, 18, 19, 21, 22 and 24, except 11.3.4, 11.3.105 to 11.3.108, 11.3.110 to 11.3.113, 11.4.101 to 11.4.107, 11.101 and 12.1.1 which are covered by this standard,

b) EN 60730-1:2011, Clause 20.

The VPS shall either comply with the requirements of EN 60730-2-5:2002, Clause 23, or the installation and operating instructions shall provide a clear indication that the EMC emission requirements have to be tested after incorporation of the VPS into the equipment.

9 Marking, installation and operating instructions

9.1 Marking

Shall be according to EN 13611:2007+A2:2011, 9.1 with the following addition:

a) maximum working pressure, expressed in pascals or kilopascals;

b) nature of supply and frequency;

c) rated voltage or rated voltage range;

d) degree of protection;

e) maximum load rating of outputs.

9.2 Installation and operating instructions

Shall be according to EN 13611:2007+A2:2011, 9.2 with the following addition:

a) type reference;

b) electrical data, including maximum ratings of loads on output terminals;

c) maximum and minimum permissible ambient temperature;

d) wiring diagram with clear terminal markings for the connection of the mains and/or battery supply and external wiring;

e) information on interlocks and how to reset them when the mains supply is interrupted;

f) permissible installation position;

g) diagram of the programme sequence;

h) all adjustment and setting information;

i) length and the type of cable for the connection of external components.

9.3 Warning notice

Shall be according to EN 13611:2007+A2:2011, 9.3.

Annex A
(informative)
Gas connections in common use in the various countries

EN 13611:2007+A2:2011, Annex A is applicable.

Annex B
(informative)
Leak-tightness test − volumetric method

EN 13611:2007+A2:2011, Annex B is applicable.

Annex C
(informative)
Leak-tightness test − pressure loss method

EN 13611:2007+A2:2011, Annex C is applicable.

Annex D
(normative)
Conversion of pressure loss into leakage rate

EN 13611:2007+A2:2011, Annex D is applicable.

Annex E
(normative)
Electrical/electronic component fault modes

Shall be according to EN 13611:2007+A2:2011, Annex E with the following additions and modifications:

Modification:

The Footnotes g), h) and m) of EN 13611:2007+A2:2011, Table E.1 are replaced by the Footnotes g), h) and m) of the below Table E.1.

Addition:

EN 13611:2007+A2:2011, Table E.1 is applicable with the following modification and the addition of footnotes aa) and bb).

Table E.1 — Electrical/electronic component faults modes

Component type	Short	Open	Remarks
Relays			
Coils	X	X	If the relay complies with EN 61810–1 the failure mode short circuit need not be considered.
Contacts	X g,h,aa	X	
Reed-relays	X	X	Contacts only
Printed circuit board conductors	X m	X l	
Electromechanical lock-out elements			
Coils	X	X	
Contacts	X bb	X	

g The failure modes “short circuit” and “mechanical break-down” need not be considered when the system – including the relay – successfully completed the long-term performance tests of 7.10 (under nominal load of relay contacts) and if the relay is successfully tested for 3 million cycles under no load condition in compliance with EN 60947–5-1:2004, C.2 and if special precautions have been taken to prevent welding of contacts (see 6.5.1). All of the following special precautions shall be fulfilled:

1. Measures to avoid welding:
1.1 Contacts closing on short-circuit:
Rating of the fuse: $(I_N) < 0{,}6 \cdot (I_e)$.
NOTE I_N values for the fuse (see EN 60127–1:2006, 3.16).
I_e: rated operational current of the contact (see EN 60947–1, 4.3.2.3).
1.2 Lifetime/loadcycle rating: proof that the contact does not weld after 1 000 000 cycles (fourfold safety) on max. rated contact load as stated in the installation and operating instructions based on a test of 3 samples.
2. Measures to avoid microwelding:
2.1 Proof that the permissible (maximum) capacitance loads have been part of the lifetime-test according to 1.2.
2.2 Proof that no mains-synchronous switching occurs, or the mains synchronous switching has not resulted in non-compliance with the lifetime test according to 1.2 (see also 7.10.1).
Spontaneous closing of a relay contact without energy is not considered, if the relay is designed for the mechanical stress and the rating of the relay is appropriate to avoid mechanical breakdown.

h If a fuse is used to protect against the hazard of relay contact welding either the fuse shall not be replaceable, or

Component type	Short	Open	Remarks
external measures are necessary to avoid unauthorised replacement. These measures shall be included in the instruction manual, see 9.2 “Installation and operating instructions”.			
l The open circuit failure mode, i.e. interruption of a conductor, is excluded if the thickness of the conductor is equal to or greater than 35 µm and the breadth of the conductor is equal to or greater than 0,3 mm or the conductor has an additional precaution against interruption, e.g. roll-tinned, etc. If a short circuit at the output terminals causes the opening of a printed circuit board conductor, that conductor shall be subject to an open circuit fault analysis.			
m The short-circuit failure mode is excluded if the requirements of EN 60730–1:2011, Clause 20 are met. For the assessment according to 6.6 the short-circuit failure mode is excluded if the requirements of EN 60730–2-5:2002, Clause 20 for overvoltage category III are met.			
aa If no measures to avoid contact welding according to g) are taken, the fault mode “short” shall be considered to occur both on closing of the contact and when the contact is already closed.			
bb 1) The electromechanical lock-out element shall withstand 60 000 cycles without load. 2) The contacts of the electromechanical lock-out element shall be protected against welding by a fuse dimensioned according to footnote g) 1.1. 3) The contacts of the electromechanical lock-out element shall withstand 20 000 cycles according to footnote g) 1.2. 4) Footnotes g) 2.1 and 2.2 shall be fulfilled accordingly. 5) In the operating position the contacts of the electromechanical lock-out element shall withstand 1 000 000 cycles of max. load current in closed position without contact welding. 6) All load conditions shall consider inductive and/or capacitive loads, “cos phi”.			

Annex F
(normative)
Additional requirements for safety accessories and pressure accessories as defined in EU Directive 97/23/EC

Shall be according to EN 13611:2007+A2:2011 Annex F, with the following addition:

This annex applies if the valve proving system is used as a part of safety accessories as defined by EU Directive 97/23/EC.

Annex G
(normative)
Materials for pressurized parts

EN 13611:2007+A2:2011, Annex G is not applicable.

Annex H
(informative)
Additional materials for pressurized parts

EN 13611:2007+A2:2011, Annex H is not applicable.

Annex I
(normative)
Requirements for controls used in DC supplied gas burners and gas burning appliances

I.1 Scope

Shall be according to Clause 1 and to EN 13611:2007+A2:2011, Annex I.

I.2 Thermal stress test

Shall be according to 7.10.2.1 with the following modifications:

Replace “85 % of the minimum declared rated voltage” *by* “80 % of the minimum declared DC voltage”.

Replace “110 % of the maximum declared rated voltage” *by* “120 % of the maximum declared DC voltage”.

I.3 Long term performance test

Shall be according to 7.10.3 with the following modifications:

Replace “85 % of the minimum declared rated voltage” *by* “80 % of the minimum declared DC voltage”.

Replace “110 % of the maximum declared rated voltage” *by* “120 % of the maximum declared DC voltage”.

I.4 At ambient temperature

Shall be according to 7.9.1 with the following modifications:

Replace “85 % of the minimum declared rated voltage” *by* “80 % of the minimum declared DC voltage”.

Replace “110 % of the maximum declared rated voltage” *by* “120 % of the maximum declared DC voltage”.

I.5 Supply voltage variations below 85 % of rated voltage

Shall be according to 8.2 with the following modifications:

Replace “85 % of the minimum declared rated voltage” *by* “80 % of the minimum declared DC voltage”.

I.6 Short-term voltage interruptions and decreases

Shall be according to EN 13611:2007+A2:2011, I.6 with the following modifications:

The assessment criteria given in 8.1 respectively in 8.3 apply.

The tests shall be performed in the operating phases as given in the relevant sub-clauses of 8.3.

I.7 Supply frequency, surge immunity, electrical fast transient/burst, electromagnetic conducted disturbances, power frequency magnetic field immunity test

Shall be according to EN 13611:2007+A2:2011, I.7 with the following modifications:

The assessment criteria given in 8.1 respectively in 8.4 to 8.10 apply.

The tests shall be performed in the operating phases as given in the relevant sub-clauses of 8.4 to 8.10.

I.8 Electrical transient conduction immunity for type B only

Shall be according to EN 13611:2007+A2:2011, I.8 with the following modifications:

The assessment criteria given in 8.1 respectively in 8.4 to 8.10 apply.

The tests shall be performed in the operating phases as given in the relevant sub-clauses of 8.4 to 8.10.

Annex J
(normative)

Method for the determination of a Safety Integrity Level (SIL)

Shall be according to EN 13611:2007+A2:2011, Annex J.

Annex K
(normative)

Method for the determination of a Performance Level (PL)

Shall be according to EN 13611:2007+A2:2011, Annex K.

Annex L
(informative)

Relationship between Safety Integrity Level (SIL) and Performance Level (PL)

Shall be according to EN 13611:2007+A2:2011, Annex L.

Annex AA
(informative)
Application Guidance

AA.1 General

The intended use of a valve proving system, as described in this standard, in conjunction with gas burners and gas burning appliances, is to prevent the uncontrolled burning of fuel gas or its leakage to the environment due to failure in one or more of the automatic shut off valves, piping or equipment.

The use of two or more automatic valves in the complete burner system are required.

If one of the automatic valves or its connection or the piping in-between the valves is found to be leaking into the gas burner, the gas appliance or the environment, a signal is given and the start-up sequence of the gas burner has to be stopped by adequate means.

The valve proving may be performed during every start-up, after each shut-down or both.

Due to the design, location and use of the gas burner and gas appliance a valve proving system (VPS) may be required, by e.g.:

— the size of the gas burner, burner heat input, burner capacity;

— the type of the gas appliance, e.g.: steam boiler;

— the type of burner start-up sequence, e.g.: without pre-purge;

— the classification of the used automatic valves, e.g.: 2 Class B valves plus VPS equals 2 x Class A;

— regional legislation, e.g.: discharge of unburned fuel into atmosphere is not permitted.

AA.2 Use of a valve proving system

The use of a valve proving system is prescribed in the relevant appliance standards e.g. EN 676 and EN 746-2.

Annex ZA
(informative)
Relationship between this European Standard and the Essential Requirements of EU Directive 2009/142/EC relating to appliances burning gaseous fuels

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide a means of conforming to Essential Requirements of the New Approach Directive 2009/142/EC relating to appliances burning gaseous fuels.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2009/142/EC relating to appliances burning gaseous fuels

Essential requirement		**Relevant clause** EN 1643:2014
1	**GENERAL CONDITIONS**	
1.1	design and construction	1, 6, 7
1.2		
1.2.1	instructions installer contains - type of gas; - gas supply pressure;	9.2
1.2.2	instructions user contains - all instructions; - restrictions on use;	NA
1.2.3	warning notices with - type of gas; - gas supply pressure; - restrictions;	9.3
1.3	fittings:	6, 7
2	**MATERIAL**	
2.1	appropriate for their purpose	6.1, 6.3, 7.8
2.2	Guarantee of the materials	No product requirement
3	**DESIGN AND CONSTRUCTION**	
3.1	**General**	
3.1.1	safety of construction	6, 7
3.1.2	condensation	NA
3.1.3	risk of explosion at event of external fire	6.6, 7.2, 7.101
3.1.4	water/air penetration in gas circuit	NA
3.1.5	normal fluctuation of auxiliary energy	8

3.1.6	abnormal fluctuation or failure of auxiliary energy	8
3.1.7	hazards of electrical origin	8.11
3.1.8	pressurized parts	6.1, 7
3.1.9	failure of devices	6.6
3.1.10	overruling safety devices	6.6
3.1.11	adjustment protection	6.2.8, 7.101.3
3.1.12	clear marking of devices	9.1
3.2	**Unburned gas release**	
3.2.1	risk of gas leakage:	7.2; 7.3, 7.101
3.2.2	risk of gas accumulation - during ignition; - during re-ignition; - after extinction;	NA
3.2.3	safety device fitted rooms with sufficient ventilation;	NA
3.3	**Ignition**	
	ignition; re-ignition; cross-lighting;	NA NA NA
3.4	**Combustion**	
3.4.1	flame stability; unacceptable concentrations; harmful to health;	NA
3.4.2	no accidental release of combustion products;	NA
3.4.3	no release in dangerous quantity;	NA
3.4.4	CO concentration;	NA
3.5	**Rational use of energy**	NA
3.6	**Temperatures**	
3.6.1	floor and adjacent walls	NA
3.6.2	knobs and levers	NA
3.6.3	external parts	NA
3.7	**Foodstuffs and water used for sanitary purposes**	
	sanitary water	NA
NA = Not applicable		

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

Shall be according to EN 13611:2007+A2:2011, Bibliography with the following addition:

[201] EN 126, *Multifunctional controls for gas burning appliances*

[202] EN 676, *Automatic forced draught burners for gaseous fuels*

[203] EN 746-2, *Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems*

[204] EN 60127-1:2006, *Miniature fuses — Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links (IEC 60127-1:2006)*

[205] EN 60947-1:2007, *Low-voltage switchgear and controlgear — Part 1: General rules (IEC 60947-1:2007)*

[206] EN 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test (IEC 61000-4-2)*

[207] EN 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3)*

[208] EN 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test (IEC 61000-4-4)*

[209] EN 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test (IEC 61000-4-5)*

[210] EN 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6)*

[211] EN 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test (IEC 61000-4-8)*

[212] EN 61000-4-11, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11)*

[213] EN ISO 23553-1, *Safety and control devices for oil burners and oil-burning appliances - Particular requirements - Part 1: Shut-off devices for oil burners (ISO 23553-1)*

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