This version is produced based on the decision of CEN TC 47 WG 2 from the last meeting, that the convenor will after finalizing the EN 298 merge the relevant parts into the prEN 230-2001-02 version which was the outcome of the last WG2 meeting in Berlin.

I have used the prEN 298 2002-07 Version, which is the version for formal vote. The voting results are expected in the first quarter of 2003. To avoid a further delay of the publication of the EN 230 I decided to use this 298 version, than WG 2 can take the parallel approach.

Eckhard Schwendemann
Convenor CEN TC 47 WG2
28.8.2002

CEN TC 47

Date: ~~2001-02~~2002-08

prEN 230

CEN TC 47

Secretariat~~:~~ :DIN

Automatic burner control systems for oil burners —

Feuerungsautomaten für Ölbrenner —

ICS:

Descriptors:

Document type: European Standard
Document subtype:
Document stage: CEN Enquiry
Document language: E
U:\WIK\TEXTE\WORD\CEN\TC47\WG 2\Allgemein\prEN_230_(E) 020828 update to 298-2002-07 by E. Schwendemann.doc STD Version 2.0

Contents

Foreword

This document has been prepared by CEN /TC 47, "Atomizing oil burners and their components - Function - safety - testing".

This document is currently submitted to the CEN Enquiry.

This European Standard covers type testing only.

According to edition 1990 the following fundamental changes are foreseen:

— ***Protection against environmental influences;***

— ***Additional requirements for complex electronics.***

— ***The structure and were ever posible the definitions and requirements are taken over from prEN 298: 2002-07***

Introduction

Whilst this European Standard is written primarily for Automatic Gas Burner Control Systems used on or in appliance for cooking, heating, hot water production, refrigeration, lighting or washing and having, where applicable, a normal water temperature not exceeding 105 °C, it may be usefully quoted, as a whole or in part, by standards for other equipment.

The functional characteristics of the automatic burner control systems, programming units, and their associated flame detector devices, in so far as they are not laid down in this standard, are given by the standards for the appliances for which the automatic burner control systems are intended.

This standard deals with immunity aspects of Electromagnetic Compatibility (E.M.C.) only. Since automatic burner control systems are intended for use as an integrated or incorporated part of an appliance, further EMC tests (both immunity and emission) may be required for the intended use.

1 Scope ✔

This European Standard specifies the requirements, operating conditions and test methods for burner control systems for automatic and semi-automatic oil burners with or without fans.

It also applies to dual fuel burners, for use with either oil or gaseous fuels, when operating on oil.

This standard also applies to automatic burner control systems, programming units or flame detector devices that include additional functions.

Automatic burner control systems utilizing thermo-electric flame supervision devices are not covered by this standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 267 : 1999, *Forced draught oil burners – Definitions, requirements, testing, marking.*

EN 60068-2-6 : 1995, *Enviromental testing – Part 2: Tests - Test Fc: Vibration (sinusoidal).*

EN 60335-1 : 1994, *Safety of household and similar electrical appliances – Part 1: General requirements (IEC 60335-1 : 1991, modified).*

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

EN 60730-1 : ~~1995~~2000, *Automatic electrical controls for household and similar use – Part 1: General requirements (IEC 60730-1:1993, modified).*

EN 60730-2-5 : ~~1995~~2001, *Automatic electrical controls for household and similar use – Part 2: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5 : 1993, modified).*

EN 60742 : 1995, *Isolating transformers and safety isolating transformers – Requirements (IEC 60742 : 1983 + A1 : 1992), modified).*

EN 61000-4-2 : 1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 2: Electrostatic discharge immunity test – Basic EMC publication (IEC 61000-4-2:1995).*

EN 61000-4-3 : 1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test – (IEC 61000-4-3 : 1995, modified).*

EN 61000-4-4 : 1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 4: Electrical fast transient/burst immunity test – Basic EMC publication (IEC 61000-4-4 : 1995).*

EN 61000-4-5 : 1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 5: Surge immunity test (IEC 61000-4-5 : 1995).*

EN 61000-4-6 : 1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6 : 1996).*

EN 61000-4-11 : 1994, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11 : 1994).*

EN 61558-2-6:1997, *Safety of power transformers, power supply units and similar – Part 2-6: Particular requirements for safety isolating transformers for general use (IEC 61558-2-6:1997).*

EN 61558-2-17:1997, *Safety of power transformers, power supply units and similar — Part 2-17: Particular requirements for transformers for switch mode power supplies (IEC 61558-2-17:1997).*

ENV 50204 : 1995, *Radiated electromagnetic field from digital radio telephones – Immunity test.*

~~IEC 60068-2-6 : 1995, *Enviromental testing – Part 2: Tests - Test Fc: Vibration (sinusoidal).*~~

IEC 60384-14 : 1993, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains.*

IEC 60384-16 : 1982, *Fixed capacitors for use in electronic equipment – Part 16: Sectional specification: Fixed metallized polypropylene film dielectric d. c. capacitors.*

3 Terms and definitions ✔

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

3.1
flame detector device
a device by which the presence of a flame is detected and signalled.

It can consist of a flame sensor, an amplifier and an element for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit

3.2
flame sensor
the actual flame-sensing element, the output signal or value of which is used as the input for the flame detector amplifier.

3.3
sensed flame and flame signal
3.3.1
sensed flame
physical value monitored by the flame sensor.

3.3.2
flame signal
the signal given by the flame detector device in case of sensed flame.

3.4
flame simulation
signal indicating the existence of a flame when no flame is present.

3.5
programming unit
a programming unit reacts to signals from control and safety devices, gives control commands, controls the start-up sequence, supervises the burner operation and causes controlled shut-down, and if necessary safety shut-down and lock-out. The programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device.

3.6
automatic burner control system
an automatic burner control system comprises at least a programming unit and all the elements of a flame detector device. The various functions of an automatic burner control system may be in one or more housings.

3.7
start position
the system is not in lock-out position, has not yet received the start signal but can proceed with the start-up sequence when required. At this stage, the output terminals for any automatic shut-off valve and ignition device are not energized.

3.8
start signal
the signal e.g. from a regulating device, which releases the system from its start position and commences the predetermined programme.

3.9
burner ignition systems
3.9.1
automatic electrical ignition
system in which the fuel is ignited using only electrical energy.

3.9.1.1
ignition by controlled spark
system which allows the fuel to be released only when the presence of the ignition spark has been proven.

3.9.1.2
ignition by non controlled spark
system in which the fuel may be released when the ignition spark is not controlled.

3.9.2
automatic ignition with liquid or gaseous fuel
system by which the fuel is ignited by a pilot burner using liquid or gaseous fuel; the operation of the pilot burner may be either interrupted or intermittent.

Interrupted pilot burners may be operated manually.

Intermittent pilot or first stage burners are operated automatically.

3.9.2.1
ignition by controlled pilot burner
system which allows the main fuel to be released only when the flame of the ignition burner is present.

3.9.2.2
ignition by non-controlled pilot burner
system in which the release of the main fuel is not prevented by the absence of the flame of the pilot burner.

3.10
start-up sequence
the sequence of actions executed by the system which brings the burner from the start position to the running position.

3.11
programme
the sequence of control operations determined by the programming unit involving switching on, starting up, supervising and switching off the burner (see diagrams in annex ~~D~~C).

3.12
waiting time
for burners without fans, this is the interval between the start signal being given and the energization of the ignition device. During this time natural ventilation of the combustion chamber and the flue passages may take place.

3.13
purge time
period during which the combustion chamber is compulsorily ventilated without any fuel being supplied.

3.13.1
pre-purge time
period preceeding the signal to open the valve.

3.13.2
post-purge time
period following the signal to close the fuel valve.

3.14
ignition
3.14.1
total ignition time
period during which the ignition device is in operation. Pre-ignition, actual ignition and post-ignition times make up the total ignition time.

3.14.2
pre-ignition time
period between the start of the ignition cycle and the signal to open the valve.

3.14.3
ignition time
period between the signal to open the valve and the first indication of the flame signal.

3.14.4
post-ignition time
period between the first indication of the flame signal and the shut-off signal to the ignition device.

3.15
safety time
is the duration of the maximum permissible time during which the burner control unit gives the signal to open the fuel valve without there being a flame signal.

3.15.1
start-up safety time
3.15.1.1
first safety time
time starting from the signal for release of the fuel and terminating at the moment at which the signal for interrupting the fuel supply is given.

NOTE Where there is no second safety time, this is called the safety time.

3.15.1.2
second safety time
where there is a first safety time applicable to either a pilot or start flame only, the second safety time is the interval between the main valve being energized and the main valve being de-energized if the flame detector signals the absence of a flame.

3.15.2
safety time during operation
the safety time during operation is the time starting at the moment the sensed flame is extinguished and ending at the moment the signal for interrupting the fuel supply is given.

3.16
pilot or start flame proving period
the interval between the end of the first safety time and the beginning of the second safety time which is used to prove that the pilot or start flame is stable.

3.17
intermitted pilot or first stage
an intermittent pilot or first stage that is ignited prior to ignition of the main flame and is shut off simultaneously with it.

3.18
interrupted pilot or first stage
a pilot or first stage that is ignited each time the burner is started up and which is extinguished at the end of the second safety time.

3.19
running position of the system
state beginning with the presence of flame signal after the safety time has expired; it is the end of the starting process. Starting is, however, not considered to have taken place if the fuel release is not authorized or if it is interrupted after expiry of the safety time by the lock-out of the burner.

NOTE This definition corresponds with the definition of "the operational state" of the burner standard.

3.20
controlled shut-down
the process by which the power to the shut-off valve(s) is removed before any other action takes place, e. g. as a result of the action of a controlling function.

3.21
safety shut-down
the process which is effected immediately following the response of a protection device or the detection of a fault in the automatic burner control system and which prevents the burner from going into operation or puts the burner out of operation. The resulting state of the system is defined by deactivated terminals for the shut-off valves and the ignition.

3.22
lock-out
3.22.1
non-volatile lock-out
the safety shut-down condition of the system, such that a restart can only be accomplished by a manual reset of the system and by no other means.

3.22.2
volatile lock-out
the safety shut-down condition of the system, such that 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.

3.23
ignition-restoration
the process by which, following loss of flame signal, the ignition device will be switched on again without total interruption of the fuel supply.

3.24
recycling
the process by which, after a safety shut-down, a full start-up sequence is automatically repeated.

3.25
operation systems
3.25.1
non-permanent operation
systems that are designed to remain in the running position for less than 24 h.

3.25.2
permanent operation
systems that are designed to remain in the running position for longer than 24 h without inetrruption.

3.26
self-checking function of the automatic burner control and the flame detector
an automatic internal function of the device which checks the operation of the automatic burner control and the flame detector.

3.27
flame simulation
a condition which occurs when the flame signal indicates the presence of a flame when in reality no flame is present.

3.28
burner without fan
a burner where the primary air required for combustion is provided by the action of the fuel and the secondary air is freely available from the surroundings.

3.29
burner with fan
a burner in which some or all of the air required for the combustion is supplied by means of a fan (i. e. forced draught or induced draught).

3.30
nominal fuel throughput (see clauses 7 and 8)
fuel throughput of the burner, expressed in kg/h.

4 Classification

To assist with the specification of systems with regard to particular applications, the following codes shall be used.

The letter O shall be used for any character that is not relevant.

Table 1 – Classification codes

1st character	denotes as: fanned atmospheric both	 F A B
2nd character	denotes method of ignition: interrupted pilot intermittent pilot or first stage direct main burner ignition at full rate	 I T M
3rd character	denoted first action following flame failure: non-volatile lock-out volatile lock-out recycling ignition restoration	 L V C R
4th character	denotes type of final action: non-volatile lock-out volatile lock out ignition restoration	 L V R
5th character	denotes: fixed times adjustable times both	 X J B
6th character	denotes: self-check as required in 7.4.5 non-self-check both	 K N B
7th character	"S" denotes: a device with a special system deviating from the specification of this standard "WLE" denotes: a device suitable for an application combined with air-heaters (see 7.1; 7.8).	
NOTE: Other required specification data are given in clause 11.		

5 Normal conditions for testing and measuring tolerances ✔

All the tests shall be carried out under normal conditions unless otherwise specified. The normal conditions are:

- rated voltage or rated voltage range;
- rated frequency;
- ambient temperature of (20 ± 5) °C.

The error of measurement shall not exceed:

- for time measurements: ± 0,1 s;
- for temperature measurements: ± 1 K;
- for supply frequency measurements: ± 0,1 Hz;
- for electrical supply measurements: ± 0,5 %.

All measurements shall be made after stable temperature conditions have been achieved.

The tests shall be carried out in the mounting position specified by the manufacturer.

When several mounting positions are specified, the tests shall be carried out with the system installed in the least favourable position.

6 Constructional requirements

6.1 General ✔

The quality of the materials, the design and the structure of the components used shall be such that the automatic burner control systems and flame detector devices will operate safely and in accordance with the requirements of this standard – for a reasonable period of time (service life) under the normally expected mechanical, chemical, thermal and environmental conditions, even in the event of such carelessness as may occur in normal use, provided that the manufacturer's instructions for installation, adjustment, operation and maintenance are complied with. Compliance is checked by carrying out the tests specified in this standard.

The system shall be designed such that changes in critical circuit component values (such as those affecting timing or sequence) within the component manufacturer's declared worst case tolerances, including the long term stability, shall result in the system continuing to function in accordance with this standard. Compliance shall be checked by worst case analysis.

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

The system shall include at least two operating elements to directly de-energize the safety relevant gas valve terminals.

NOTE A single relay switching two independent contacts is considered to be only one operating element.

~~A single operating element shall not be used to energize safety relevant fuel valve terminals.~~

6.2 Protection provided by the enclosure ✔

The class of protection for systems with their own enclosure shall be a minimum of EN 60529 : 1991 IP 40.

For systems for use in the open air the protection shall conform to at least EN 60529 : 1991 IP 54.

For systems without enclosure, protection shall be provided by the burner in which it is installed.

6.3 Electrical equipment ✔

The electrical equipment shall comply with the requirements of EN 60730-2-5 : ~~1995~~ 2001 clauses 8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23 and 24.

Safety isolating transformers shall meet the requirements of EN 60742 : 1995 as applied to safety isolating transformers of the associated transformer type. (See 4.12 of EN 60742.)

If the supply voltage polarity can affect the safety either provisions to avoid an uncontrolled opening of an oil valve shall be provided or clear warnings shall be given to the user of the control system of the burner.

6.4 Long-term performance ✔

6.4.1 General

All components of the system, and its associated flame detector device shall be able to withstand 250 000 burner start-up operations (255 000 where resistance to vibration is declared) and still comply with this standard. This requirement shall be attested by the manufacturer by following the requirements detailed in 6.4.2.2.

6.4.2 Long-term performance test

6.4.2.1 General

The test of 6.4.2.2 and the test of 6.4.2.3 shall not be carried out on the same test sample. The tests as described in 7.6 shall be carried out before and after the long-term performance tests of 6.4.2.2 and 6.4.2.3.

Additionally, on completion of the tests described in 6.4.2.3, the tests described in EN 60730-1 : ~~1995~~2000, 13.2.2 through 13.2.4 shall be carried out.

6.4.2.2 Tests to be carried out

The test of burner start-up operations shall be carried out with the terminals loaded with the loads and power factors as declared by the manufacturer.

The system and its flame detector device shall be tested under the following conditions:

a) the purpose of the test is to cycle components of an electronic circuit between the extremes of temperature likely to occur during normal use and which may result from ambient temperature variation, mounting surface temperature variation, supply voltage variation, or the change from an operating condition to a non-operating condition or vice versa.

   The following conditions shall form the basis of the test:

   Duration of test: 14 days.

   Electrical conditions:

   the system is loaded according to the ratings declared by the manufacturer, the voltage then being increased to 110 % of maximum declared rated voltage except that for 30 min during each 24 h period of the test the voltage is reduced to 90 % of minimum declared rated voltage. The change of voltage shall not be synchronized with the change of temperature. Each 24 h period shall also include at least one period in the order of 30 s during which the supply voltage is switched off.

   Thermal conditions:

   the ambient temperature and/or the mounting surface temperature are varied between the maximum declared ambient temperature or 60 °C, whichever is higher, and the minimum declared ambient temperature or O °C, whichever is lower, to cause the temperature of the components of the electronic circuit to be cycled between

the resulting extremes. The rate of ambient and/or mounting surface temperature change shall be in the order of 1 °C/min and the extremes of temperature maintained for approximately 1 h.

NOTE Care should be taken to avoid the occurrence of condensation during this test.

Rate of operation:

during the test the system shall be cycled through its operational modes at the fastest possible rate up to a maximum of six cycles/min subject to the need to cycle components between their temperature extremes.

The number of cycles of operation completed during this test shall be recorded and if this number is less than 45 000 the remaining cycles shall be executed at the declared rated voltage and at ambient temperature.

b) 2 500 operations at the maximum declared ambient temperature or 60 °C, whichever is higher, and at 110 % of maximum declared rated voltage;

c) 2 500 operations at the minimum declared ambient temperature or 0 °C, whichever is lower, and at 85 % of the minimum declared rated voltage:

d) the system shall also be tested under the following conditions:

1) 2 500 cycles without flame presence;

2) 2 500 cycles with the flame signal disappearing during operation;

e) when resistance to vibration is declared by the manufacturer, the following sinusoidal vibration test is to be carried out.

The object of the test is to demonstrate the ability of the system to withstand the long-term effects of vibration at levels declared by the manufacturer.

During the exposures the system shall be mounted on a rigid fixture by means of the specified fastening arrangement.

The test shall be performed in accordance with ~~IEC~~ EN 60068-2-6 : 1995, test Fc.

The test is performed with the following minimum severity conditions:

Frequency range:	10 Hz to 150 Hz
Acceleration amplitude:	1.0 g or higher if declared by the manufacturer
Sweep rate:	1 octave per minute
Number of sweep cycles:	10
Number of axes:	3, mutually perpendicular

The systems shall be in the start position during the exposure. A performance test as described in 7.3 shall be carried out towards the end of each exposure. A visual inspection shall be carried out after the termination of the exposure. No mechanical damage shall be found.

NOTE By agreement between the manufacturer and the test authority the safety and purge times used during the above tests may be chosen to be as short as practicable so that the endurance test is not unnecessarily prolonged.

During the tests a), b) c) and d) described above, the system shall be operated in such a way that the normal start-up sequence is performed. The time that the system is held in the running position and the time that the control loop is interrupted before the cycle is repeated shall be agreed between the manufacturer and the test authority.

If times have been shortened (see note above), on completion of the endurance test, the purge times shall not have decreased nor the safety times have increased from those times measured before the commencement of the test.

6.4.2.3 Test to be carried out by the system manufacturer

The system manufacturer shall carry out and declare that the system has completed a minimum of 250 000 burner start-up operations with the terminals loaded with the loads and power factors as declared, without failure.

The system and its flame detector device shall have been tested under the following conditions:

a) the number of operations at the declared rated voltage and at ambient temperature shall be 225 000;

b) the number of operations at the maximum declared ambient temperature or 60 °C, whichever is higher, and at ***120 %*** of the maximum declared rated voltage shall be 12 500 operations;

c) the number of operations at the minimum declared ambient temperature or 0 °C, whichever is lower, and at ***75 %*** of the minimum declared rated voltage shall be 12 500 operations.

NOTE The safety and purge times used during the above tests may be chosen to be as short as practicable so that the endurance test is not unnecessarily prolonged.

During the tests described above, the system shall be operated in such a way that a complete start-up sequence is performed.

If times have been shortened (see note above), on completion of the endurance test the purge times shall not have decreased nor the safety times have increased from those times measured before the commencement of the test.

7 Functional requirements

7.1 General ✔

Any additional functions included in the automatic burner control system, programming unit or flame detector for which no provisions exist in this standard, shall be such that they do not degrade the safe and correct operation of the automatic burner control system, programming unit or flame detector.

If there are no particular requirements concerning safety shut-down in the relevant appliance standard a non-volatile lock-out is required.

If the functional behaviour deviates from this standard the manufacturer has to declare this by giving detailed information and reasons for the deviation.

7.2 Programme

7.2.1 General ✔

7.2.1.1 The programme shall be in accordance with the details provided by the manufacturer's instructions.

7.2.1.2 The programme shall be such that it is not possible to perform two or more actions which in combination will cause injury to persons or damage to property. The order of the actions shall be fixed in such a manner that it is not possible to change their order.

7.2.1.3 The automatic shut-off valve(s) for the fuel shall not be energized before the ignition device.

7.2.1.4 When a system has a start flame proving period it shall be not less than that declared by the manufacturer.

7.2.1.5 In case of spark supervision, this function shall be performed prior to the release of fuel.

7.2.1.6 During each start-up sequence, the system shall check for a flame signal. If a flame signal occurs the system shall either not initiate the next step in the start-up sequence, or proceed to safety shut-down. This checking operation shall take place before release of fuel and shall be of sufficient duration to ensure a safe and reliable check (see 7.6).

7.2.2 Safety actions ✔

The required checks in the programme shall lead to the following actions :

- if an air-supervision device is indicating an inadequate air supply during the period between pre-purge time and running position, the system shall directly proceed to at least safety shut-down before release of fuel;

- if inadequate air supply is indicated while the system is in the running position, the system shall directly proceed to at least safety shut-down;

- if no flame signal is sensed at the end of the first or second safety time, the system shall proceed to lock-out or recycle, if applicable;

- the action of an external protection device shall lead to at least safety shut-down

- if a spark supervision device is utilized, failure to detect a spark during the manufacturer's declared spark supervision period shall lead to at least safety shut-down before fuel is released.

7.2.3 Flame failure ✔

Depending on the design of the system, one of the following actions shall occur following loss of flame signal during burner operation:

- safety shut-down and recycling (see 7.2.4 and 7.4);

- spark restoration (see 7.2.5 and 7.4);

- lock-out (see 7.4).

7.2.4 Recycling ✔

Systems with recycling shall be designed such that they meet the requirement of 7.4 and the subsequent start-up sequence shall be that which is normally performed by the system.

Following this action, the flame signal shall be present by the end of the first safety time of the last permitted ignition attempt; if not, the system shall proceed to lock-out.

7.2.5 Ignition restoration ✔

Systems with ignition restoration shall be designed such that the ignition device shall be energized within 1 s, from the loss of the flame signal.

Following this action, the flame signal shall be present at the end of the first safety time; if not, the system shall proceed to lock-out.

7.2.6 Supervision of the combustion air supply ✔

The supervision of the combustion air supply for burners with fans shall be achieved in such a manner and by using such devices as are prescribed in the relevant burner and/or appliance standards.

When a system performs a check for air supply simulation, burner start-up shall be prevented in case of a failure of this device.

7.2.7 Supervision of other external devices during the start-up sequence ✔

If the system controls and/or supervises external devices (e. g. air damper actuators, auxiliary contacts of oil valves, automatic leakage test devices, other contacts which shall be position-checked prior to or during each start-up sequence), the start-up sequence shall continue only after these external devices have been successfully checked.

7.2.8 Operation of the burner under extreme conditions

Burner control units shall be protected against low voltage supply. Extreme voltage drop shall not endanger the operation of the installation (see 8.2).

If a burner control system is to be applied outside a temperature range of 0 °C to 60 °C only those units specified for such use by the manufacturers and successfully tested by the testhouse shall be used (see 8.1).

7.3 Timings and operational sequences

7.3.1 General

Adjustment of timings or parameters which may lead to hazardous conditions shall require the use of tools and be impossible from outside the enclosure in which the component is housed.

For software based systems adjustment of those timings and parameters from outside the enclosure is permitted with the use of a password.

Adjustment of timings and parameters which will not lead to hazardous conditions (e. g. extension of the pre-purge time) are permitted without the use of tools.

Unauthorized entry to the means of adjustment shall be clearly visible, e. g. by the breaking of a seal.

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).

7.3.2 Safety times

The safety times given below are maximum permissible values under normal operating conditions (rated voltage U_N and ambient temperature approximately 20 °C).

Table *2* – Safety times

Nominal fuel throughput kg/h	Safety time max. (s)		
	at ignition	during operation ignition restoration	during operation for recycling
Up to and including 30	10	10	1
above 30	5	1	1

It is permitted, however, under limit operating conditions (voltage between ***0,75 and 1,2*** U_N, at ambient temperatures between 0 °C and 60 °C) that the safety times given in the table may be increased by 100 % for burners with nominal throughput up to and including 30 kg/h and by 25 % for burners with nominal throughput in excess of 30 kg/h in case where the appliance standard has no special requirements.

For burners with a nominal throughput equal to or less than 30 kg/h not provided with pre-purge, or where the pre-purge is less than 5 s, the safety times may be increased without however exceeding 20 s under limit operating conditions.

7.3.3 Pre-purge time

The requirements of EN 267 : 1999, 5.2.4, shall be met.

The electric ignition device shall be operating from the start of pre-purge period.

This requirement is not applicable to burners:

- either fitted with a device which during the pre-purge period prevents the operation of the ignition means when the fuel pressure upstream of the shut-off valve does not exceed 20 % of the atomizing pressure;
- or fitted with two shut-off valves in series;
- or mounted on generators which are subject to special requirements such as ovens, kilns, air heaters, steam boilers or used in multiburner installations.

Finally, the ignition device for gas-fired pilot burners shall not be energised during the pre-purge time.

7.3.4 Ignition by pilot burner (see also operating examples in annex)

7.3.4.1 Ignition by non-supervised gas-fired pilot burner ✔

If an ignition system incorporating a non-supervised gas-fired pilot burner is used, the period during which the supply of fuel to the pilot burner is allowed shall not exceed 5 s. This period is limited by the signal for releasing the fuel to the pilot burner and the main burner. In addition, the electrical ignition device of the pilot burner shall not assist in the ignition of the main burner.

7.3.4.2 Ignition by supervised gas-fired pilot burner

If an ignition system incorporating a supervised pilot burner is used, the supply to the pilot burner valve(s) shall be interrupted if the pilot burner flame has not been established within 5 s. The supply of fuel to a permanent pilot burner shall be cut off within 5 s after loss of the pilot flame.

7.3.4.3 Ignition by oil-fired pilot burner

The requirements of 7.3.4.1 and 7.3.4.2 also apply to oil fired pilot burners. For the periods during which these burners are allowed to be in operation without a flame being present, the values contained in the table in 7.3.2 with reference to the nominal fuel throughput of the pilot burner are applicable.

7.3.5 Post-ignition

It is allowed to run the ignition into operating period if there is no flame simulation caused by the ignition system.

~~For burners with a fuel throughput ≤ 30 kg/h, the post ignition period may be extended during the operating period of the burner provided that there is no flame simulation caused by the ignition system.~~

7.4 Ignition-restoration, recycling and shut-down after flame extinction

7.4.1 Safety shut-down of burners with a throughput ≤ 30 kg/h ✔

The fuel supply shall be automatically cut off and safety shut-down shall occur not later than at the end of the safety time, if:

a) during burner start-up, the flame has not been established on expiry of the safety time;

b) during operation the flame is extinguished, and is not apparent at the end of the safety time, following one attempt at ignition restoration or recycling, which shall take place not later than 1 s after the loss of flame.

A new start of the burner shall not be possible until the burner control unit has been manually reset.

7.4.2 Safety shut-down of burners with a throughput > 30 kg/h ✔

The fuel supply shall be automatically cut off and safety shut-down shall occur not later than at the end of the safety time, if:

a) during burner start-up, the flame had not been established on expiry of the safety time;

b) during operation the flame is extinguished, and is not apparent at the end of the safety time, following one attempt at recycling, which shall take place not later than 1 s after the loss of flame.

A new start of the burner shall not be possible until the burner control unit has been manually reset.

7.4.3 Reaction time to achieve lock-out ✔

Whenever lock-out is required, it shall be achieved within ~~1~~ ***30 s*** after safety shut-down.

7.5 Flame detector and automatic burner control

7.5.1 Sensors for visible light ✔

These considerations apply to the mean value of the appliances or sensors to be tested.

If the illumination intensity is < 0,5 lx during operation, sensors for visible light are not allowed. When using flame detection devices equipped with sensors for light, the maximum response of which is within the visible spectrum, these devices shall fulfil the requirements as detailed in a) to c).

a) For an illumination intensity of the burner flame during operation of less than 3 lx at 2856 K the requirements shown in figure 1 shall be met.

   Any signal for presence of light before release of fuel (spurious light signals) shall be at a lower level of illumination than that for the signal for absence of light by extinguishing of the flame during operation (negative switching differential). The switching circuit for the negative switching differential shall be checked against possible interruptions, by the implementation of suitable measures, e. g. at least simple active or passive redundancy. Such flame detectors shall be tested together with the burner to which they are fitted

b) in case of an illumination intensity of the burner flame during operation of less than 7 lx at 2856 K the requirements shown in figure 2 shall be met.

   Any signal for presence of light before release of fuel (spurious light signals) shall be at a lower level of illumination than that for the signal for absence of light by extinguishing of the flame during operation (negative switching differential). The switching circuit for the negative switching differential shall be checked against possible interruptions, by the implementation of suitable measures, e. g. at least simple active or passive redundancy. Operation as detailed under a) is also permissible;

c) for an illumination intensity of the burner flame during operation in excess of 7 lx at 2856 K the requirements shown in figure 3 shall be met.

   The requirements for the relation B/A include also the deviations in the supply voltage in the range +10 % to -15 %. Operation as detailed under a) and b) is also permissible;

d) burners with an illumination intensity of the burner flame of less than 3 lx at the flame detector are checked together with the flame supervision device. The burner is searched by an illumination intensity of 20000 lx at 2856 K. The flame supervision device shall not show any spurious light signals during the test.

7.5.2 Flame detectors for invisible radiation

For detectors which operate in the invisible range of radiation, the following shall apply:

Flame detector devices using infra-red sensors shall have the maximum sensitivity at wavelength larger than 800 nm. They shall only react to the flicker property of the flame.

Flame detector devices using UV sensors shall have the maximum sensitivity at wavelength *less* than 400 nm and shall not react to infra-red light. If the flame detector device using UV sensors shall have a part-sensitivity in the visible range of radiation, the requirements of cl. 7.5.1 a), b) and c) shall be fulfilled.

7.5.3 Ionization flame detector devices shall only make use of the rectification property of the flame. The minimum value of the rectification current for a positive flame signal shall be declared by the manufacturer.

7.5.4 When discharge tubes are used for flame supervision, the programme shall include a check for ageing of the tube, i. e. striking without flame presence. Examples of suitable techniques are:

— periodic, automatically executed supervision of the sensor function;

— application of a voltage prior to fuel release which is at least 15 % higher than the voltage applied to the tube during the remainder of the sequence;

— a check that the flame relay with the amplifier continually powered has dropped out after each controlled shut-down.

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

7.5.5 *Acoustic flame supervision*

Flame detectors used for detecting the noise of the flame may not be affected by other noise sources in a way that they will simulate a flamme. This requirement is considered to be complied with when the following criteria are satisfied:

a) Noise sensors may only be used in connection with burners whre each heat source uses only one burner and each flue gas system is connected to only one heat source;

b) Noise sensors used for the detection of flammes must have an upper limit of max.40 Hz while observing a filter slope of at least 18 dB per octave, thus enabling the sensor to respond selectively to the noise generated by the flame;

c) The lower response threshold of the noise shall be higher than a sound pressure level of 80 dB (linear) in the range between 10 and 40 Hz;

d) The supplier of the noise sensor must specify an adequate minimum sound pressure differential between prepurging status P2 (see figure 1) and the flame off switching threshold P1 (see figure 1).The manufacturer of the appliance (e.g burner/boiler combination) has to ensure that the sound pressure differential of the application is larger or equal the specified sound pressure differential (delta P) in every operational status of the burner,

e) For all running positions after loss of flame, the noise has to be below P2, which has to be proved in the applicance (e.g. burner/boiler combination).

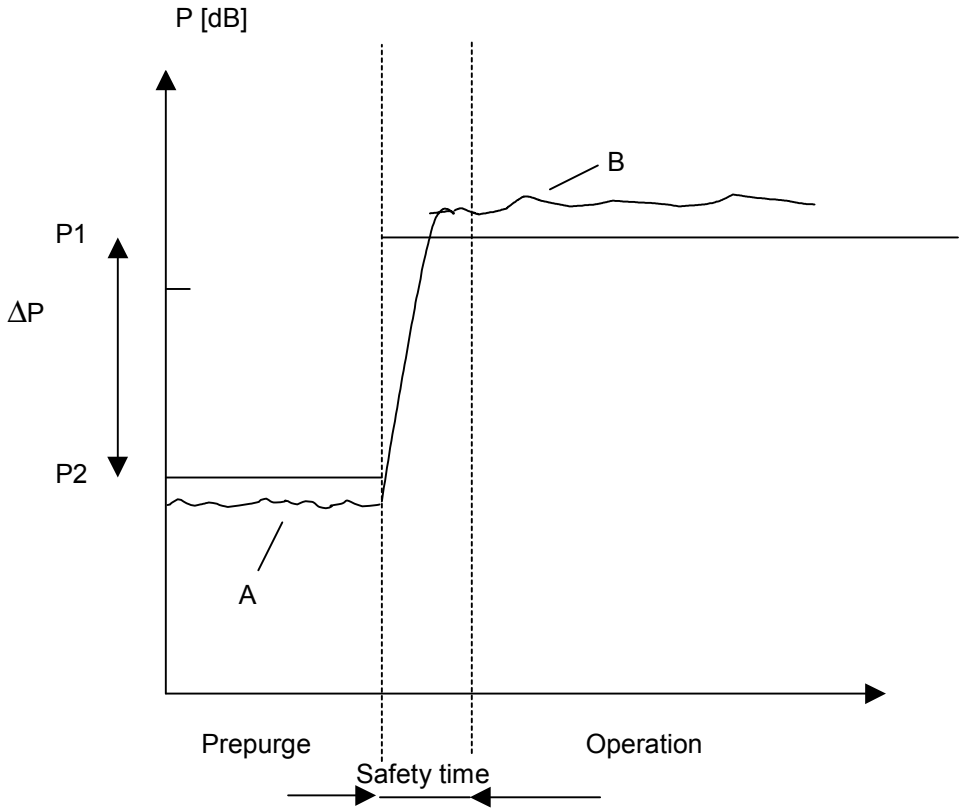


Figure 1 — Acoustic sensor

7.5.~~5~~6 In addition to all other applicable requirements, in case of a system designed for permanent operation, the flame detector or the automatic burner control shall also be provided with a self-checking function that operates at least once in every hour when the device is in the running position. The test shall be carried out in accordance with clause 9. ✔

7.5.~~6~~7 Open circuiting of the sensor or its connecting cable shall cause loss of flame signal. ✔

7.6 Safety against flame simulation and extraneous light signals

If there is continuous flame simulation or if extraneous light is present before the release of fuel, safety shall be provided as follows:

a) for burners with a throughput ≤ 30 kg/h safety shut-down shall apply. The following are exempt:

— burners without pre-purge;

— burners in which the fuel pressure during pre-purge at the main valve is less than 20 % of the atomizing pressure. In both cases, starting shall be prevented.

b) for burners with a throughput > 30 kg/h:

— safety shut-down shall always occur.

The requirements are checked with steady light and light flickering at a frequency within the frequency response of the flame detector.

7.7 Lock-out and reset device

7.7.1 Lock-out device

The electric circuit of the actuating element of any lock-out device shall be checked during each start-up sequence.

Failure of the electric circuit of any lock-out device shall not prevent the system from performing at least a shut-down when required by the action of any controlling element, limiter or sensor or power failure.

A break in this electrical circuit shall prevent starting.

7.7.2 Reset device

The system shall be so constructed that a restart attempt following non-volatile lock-out shall only be possible following a manual reset, e. g. with an integrally or remotely mounted reset button.

NOTE A power failure and its subsequent restoration following volatile lock-out may result in resetting of the system (see 7.1).

Interference with the reset device, whether integrally or remotely mounted (e. g. continuous pressing of the manual reset button) or shorting of the connecting cables to the reset system, or between the connecting cables and earth, shall not cause the system to operate outside the requirements of this standard or prevent it from going to shut-down or lock-out.

For burners which are not provided with a pre-purge facility, the interval between the safety shut-down and the re-start attempt shall be **more** than 30 s.

7.8 Control systems for air heaters (WLE)

The burner control system shall comply with the requirements of this standard at an ambient temperature of -20 °C and shall accordingly bear the marking "WLE" (air heater).

For air heaters with a fuel throughput up to 30 kg/h, automatic burner control systems as used for burners with a fuel throughput exceeding 30 kg/h shall be used.

Any ignition restoration is not allowed.

7.9 Performance tests

7.9.1 At ambient temperature

The switching times and sequence of a complete programme are measured in the delivered state. The system is connected and installed according to the manufacturer's instructions.

These tests shall be performed under test conditions (see clause 5):

— at the manufacturer's declared rated voltage(s), or if this is a range, at the lowest and highest rated voltages;

— at ***75 %*** of the lowest declared rated voltage;

— at ***120 %*** of the highest declared rated voltage.

The switching times and order of actions recorded shall comply with the requirements of 7.2, 7.3, 7.4 and 7.7.

7.9.2 At low temperature

The tests according to 7.9.1 shall be repeated at 0 °C or at the lowest declared ambient temperature when this is lower than 0 °C.

7.9.3 At high temperature

The tests according to 7.9.1 shall be repeated at +60 °C or at the highest declared ambient temperature where this is higher than +60 °C.

8 Protection against environmental influences

NOTE 1 In the basic EMC publications EN 61000-4-xx "systems" is commonly referred to EUT (Equipment under test).

NOTE 2 The assessment criteria a) and b) mentioned in clauses 8.3 to 8.8 are corresponding to the severity levels 2 and 3 in the basic EMC publications EN 61000-4-xx.

NOTE 3 Any components which are specifically intended for protection against EMC disturbances that fail during any of this test, will lead to non compliance of this standard.

8.1 Temperature range

The system and its flame detector shall meet the requirements of this standard over the ambient temperature range from 0 °C to 60 °C or wider if so declared by the manufacturer (see **7.9.~~1~~2 and 7.9.3**).

8.2 Supply voltage variations ✔

8.2.1 General

For voltage variations between ***75 % and 120 %*** of the rated voltage or voltage range declared by the manufacturer, the system shall meet the requirements of this standard (see 7.*9*).

At voltages lower than ***75 %*** of the rated voltage the system shall comply with 8.2.2.

8.2.2 Requirements for operation below *75 %* of rated voltage

If the system initiates a signal to energize the fuel valves at less than ***75 %*** rated voltage for a.c. and less than 80 % of rated voltage for d. c. the system shall comply with the requirements of subclauses 8.2.2.1 to 8.2.2.8.

8.2.2.1 Being in the running position the system shall proceed to safety shut-down or operate with timings as declared by the manufacturer.

8.2.2.2 Being in any other position the operating sequence shall comply with the declared programme. The safety time shall not exceed twice the declared value under worst case conditions as described in clause 7.*9*.

Compliance is checked by the following:

8.2.2.3 The system shall be connected to a variable voltage supply means. This supply voltage shall be connected to a voltmeter while the system is maintained at the lowest declared ambient temperature.

For the test purpose precautions shall be taken to assure that there will be a normal flame signal at any level of the supply voltage. The signal may be artificially simulated to prevent that the burner control system de-energizes the *fuel* valves as a result of flame disappearance instead of low supply voltage at the *fuel* valves being reduced to zero. This actual closing of the *fuel* valves shall be ignored.

8.2.2.4 The system shall be operated in its running position for at least 2 minutes at rated voltage after which the supply voltage shall be gradually decreased at 25 %/minute of its rated value until the voltage at the output terminals for the valve is reduced to zero. During the decrease no abnormalities shall occur. The value of the supply voltage where de-energization of the output terminals for the valve takes place shall be recorded.

8.2.2.5 The supply voltage of the system shall be reduced to zero for at least 2 minutes, and then, after having removed the flame signal and with the heat demand being present, the supply voltage shall be increased gradually at 25 %/minute of its rated value until the system starts and the output terminals for the valve are energized. The value of the supply voltage where energization of the output terminals for the valve takes place shall be recorded.

8.2.2.6 The supply voltage shall then be restored to rated voltage, the system operated for at least 2 minutes in its running position and the supply voltage shall be adjusted to 1,05 times the value identified in 8.2.2.4. At this voltage and at the lowest declared ambient temperature the operating sequence shall continue to comply with the declared programme, and the safety time shall not exceed twice the declared value under worst case conditions as described in clause 7.*9*.

8.2.2.7 The supply voltage shall be reduced to zero for at least 2 minutes and then the supply voltage shall be adjusted at 1,05 times the value identified in 8.2.2.5. At this voltage and at the lowest declared ambient temperature the operating sequence shall continue to comply with the declared programme, and the safety time shall not exceed twice the declared value under worst case conditions as described in clause 7.*9*.

8.2.2.8 Clauses 8.2.2.1 to 8.2.2.7 shall be repeated at the highest declared ambient temperature.

8.3 Supply voltage dips, short interruptions and voltage variations immunity test

8.3.1 General

The system shall tolerate voltage dips, short interruptions and voltage variations in the electricity supply so that when tested in accordance with 8.3.2:

a) for the values of table ~~2~~ *3 line* a): it shall continue to function in accordance with requirements of this standard. It shall neither proceed to safety shut-down or lock-out, nor shall it reset from lock-out;

b) for the values of table ~~2~~*3 line* b): it shall either perform as in a) 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.

Requirement b) can be ignored, provided that the power failure occurs during the start-up sequence and is shorter than 60 s. On restoration of the power the programme may be continued from the point at which it was interrupted.

A shortened start-up sequence, e. g. a start-up sequence without pre-purge or waiting time, is allowed provided that the power failure occurs within 60 s, after the end of the start-up sequence and is shorter than 60 s.

Table 3 – Voltage dips, short interruptions and voltage variations

Assessment criteria	Period of time	Percentage of the rated voltage or mean value of rated voltage range	
	ms	50 %	0 %
a)	10		x
	20		x
b)	50	x	x
	500	x	x
	1 000	x	x

The test shall be performed in accordance with 8.3.2.

8.3.2 Supply voltage dips, short interruptions and voltage variations test

The system is tested in accordance with EN 61000-4-11 : 1994.

The supply voltage to the system shall be reduced according to the values shown in table *3*. The periods of times are examples only; intermediate as well as higher values may be used. The voltage dips, short interruptions and voltage variations at random phase with respect to the mains frequency shall be performed three times in each of the following operating conditions:

a) during pre-purge or waiting time;

b) during first and (where applicable) second safety time;

c) in the running position;

d) in the lock-out position.

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

8.4.1.1 Variations

If the system incorporates clock circuitry which is synchronized with or compared against the supply frequency, it shall be designed so that in the event of variations in the mains supply frequency, it complies with 8.4.1.2 and 8.4.1.3.

8.4.1.2 Variations of up to 2 % in supply frequency

When tested in accordance with 8.4.2.1, the system shall continue to function in accordance with this standard without safety shut-down or volatile or non-volatile lock-out. Variation in programme timings shall not exceed the percentage of the applied frequency variations.

8.4.1.3 Variations of between 2 % and 5 % in supply frequency

When tested in accordance with 8.4.2.2, the control system shall:

a) continue to operate in accordance with 8.4.1.2; or

b) proceed to safety shut-down provided that on restoration of the nominal supply frequency this is followed by an automatic restart; or

c) proceed to lock-out.

8.4.2 Supply frequency variations test

8.4.2.1 Variations up to 2 % in supply frequency

Vary the main supply frequency about the nominal 50 Hz, within the range 49,0 Hz to 51,0 Hz. Sequence the system through its complete start-up and shut-down programme a minimum of three times at each of the following supply frequencies: 49,0, 49,5, 50,5 and 51,0 Hz.

8.4.2.2 Variations of between 2 % and 5 % in supply frequency

Vary the mains supply frequency about the nominal 50 Hz, within the range 47,5 Hz to 52,5 Hz. Sequence the system through its complete start-up and shut-down programme a minimum of three times at each of the following supply frequencies: 47,5, 48,0, 48,5, 51,5, 52,0 and 52,5 Hz.

8.5 Surge immunity test

8.5.1 General

The system shall tolerate voltage surges on the mains supply and relevant signal terminals, so that when tested in accordance with 8.5.2:

a) for the values of table 4, line a): it 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;

b) for the values of table *4*, line b): either it shall perform as in a) 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.

Table 4 – Open circuit test voltage ±10 % for AC mains systems

Assess-ment criteria	Severity level	Mains	Mains	DC inputs and DC outputs power ports		ports for process measurement and control lines [sensors and actuators]	
		line to line	lines to earth	line to line	lines to earth	line to line	lines to earth
a)	2	0,5 kV	1,0 kV	***0,5 kV***	***1,0 kV***	***No test***	***1,0 kV***
b)	3	1,0 kV	2,0 kV	***1,0 kV***	***2,0 kV***	***no test***	***2,0 kV***

8.5.2 Surge immunity test

The system is tested in accordance with EN 61000-4-5 : 1995.

The tests shall be carried out by subjecting the system to five pulses and with the voltage and current values listed in table 4 a) and b) at intervals not less than 60 s. Shorter intervals are allowed if specified by the manufacturer.

The five pulses of each polarity (+, -) and each phase angle as described in EN 61000-4-5 : 1995 are delivered in the following order:

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

— 1 pulse with the system in the running position;

— 2 pulses randomly applied during the start-up sequence.

The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 10 m (see 11.2 k).

8.6 Electrical fast transient/burst

8.6.1 General

The system shall tolerate electrical fast transient/bursts on the mains supply and signal lines, so that when tested in accordance with 8.6.2:

a) for the values of table *5*, line a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shut-down or lock-out, nor shall it reset from lock-out;

b) for the values of table *5*, line b): either it shall perform as in a) 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*.

Table 5 – Open circuit output test voltages ±10 % and repetition rate of the impulses ±20 %

		L1, L2, PE	L1, L2, PE	I/0	I/0
Assessment criteria	Severity level	Voltage peak kV	Repetition rate kHz	Voltage peak kV	Repetition rate kHz
a)	2	1	5	0,5	5
b)	3	2	5	1	5

8.6.2 Electrical fast transient/burst test

The system is tested in accordance with EN 61000-4-4 : 1995.

The test shall be performed for 20 cycles with the system after having reached the running position, remaining in the running position for a minimum of 30 s within each cycle. 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 stand-by position.

The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 3 m (see 11.2 k).

8.7 Electromagnetic conducted and radiated disturbances induced by radio-frequency fields

NOTE Tests in this clause are limited to the frequency bands specified in the tables, however with the introduction of equipment assuming other frequencies and power ratings e. g. mobile phones it may be necessary to consider the effects on the EUT of this frequencies.

8.7.1 Immunity to conducted disturbances, induced by radio-frequency fields

8.7.1.1 General

The system shall tolerate conducted disturbances, induced by radio-frequency fields on the main supply and relevant control lines so that when tested in accordance with 8.7.1.2:

a) for the values of table *6*, line a): it shall continue to function in accordance with the requirements of this standard.

It shall neither go to safety shut-down or lock-out, nor shall it reset from lock-out;

b) for the values of table 6, line b): either it shall perform as in a) 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*.

Table 6 – Test voltages for conducted immunity on mains and I/0 lines

Frequency range		150 kHz – 80 MHz	
Assessment criteria	Severity level	Voltage level (emf) Uo [V]	
		150 kHz – 80 MHz	ISM and CB bands
a)	2	3	6
b)	3	10	20
The levels in the ISM, and CB bands are chosen to be 6 dB higher. ISM: Industrial, scientific and medical radio frequency equipment (13,56 ± 0,007) MHz, (40,68± 0,02) MHz CB: Citizen Band: (27,125 ± 1,5) MHz			

The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 1 m (see 11.2 k).

8.7.1.2 Immunity to conducted disturbances, induced by radio-frequency fields, test

The system is tested in accordance with EN 61000-4-6 : 1996.

The system has to be swept through the complete frequency range at least once with the system in each of the following positions:

— start position;

— running position;

— lock-out position.

NOTE During sweeping through the frequency range the dwell time at each frequency shall not be less than the time necessary for the system to be exercised and be able to respond. Sensitive frequencies or the frequencies of dominant interest may be analysed separately.

8.7.2 Radiated, radio frequency, electromagnetic field immunity test

8.7.2.1 General

The system shall tolerate radiated electromagnetic fields so that when tested in accordance with 8.7.2.2:

a) for the values of table 7, line a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shut-down or lock-out, nor shall it reset from lock-out;

b) for the values of table 7, line b): either it shall perform as in a) 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*.

Table 7 – Test levels for radiated immunity

Frequency range		80 MHz - 1 000 MHz ~~and 1 890 MHz~~	
Assessment criteria	Severity level	Test field strength [V/m]	
		80 MHz - 1 000 MHz	ISM, GSM ~~and DECT~~ bands
a)	2	3	6
b)	3	10	20
The levels in the ISM~~,~~ and ~~CB,~~ GSM ~~and DECT~~ bands are chosen to be 6 dB higher. ISM: Industrial, scientific and medial radio-frequency equipment (433,92 ± 0,87) MHz According to ENV 50204 : 1995: GSM: Group Special Mobile: (900 ± 5,0) MHz, modulated by 200 Hz±1 % pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off) NOTE For DECT(Digital European Cordless Telephone) (1 890 ± 10) MHz, modulated by (200 ± 2) Hz pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off) values of field strength are under consideration. ~~DECT: Digital European Cordless Telephone: (1 890±10) MHz, modulated by 200 Hz±1 % pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off)~~			

8.7.2.2 Radiated, radio-frequency, electromagnetic field immunity, test

The system is tested in accordance with EN 61000-4-3 : 1996.

The system has to be swept through the complete frequency range at least once with the system in each of the following positions:

— start position;

— running position;

— lock-out position.

NOTE During sweeping through the frequency range the dwell time at each frequency shall not be less than the time necessary for the system to be exercised and be able to respond. Sensitive frequencies or the frequencies of dominant interest may be analysed separately.

8.8 Electrostatic discharge immunity test

8.8.1 General

The system shall tolerate electrostatic discharges so that when tested in accordance with 8.8.2:

a) for the values of table *8*, line a): it shall continue to function in accordance with the requirements of this standard.

It shall neither go to safety shut-down or lock-out, nor shall it reset from lock-out;

b) for the values of table *8*, line b): either it shall perform as in a) 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*.

This requirement is applied only to automatic burner control systems or units having their own protective enclosure.

Table 8 – Test voltages for direct and indirect electrostatic discharges

Assessment criteria	Severity level	Contact discharge	Air discharge
a)	2	4 kV	4 kV
b)	3	6 kV	8 kV

8.8.2 Electrostatic discharge immunity, test

The system is tested in accordance with EN 61000-4-2 : 1995.

The system has to be tested in each of the following positions:

— start position;

— running position;

— lock-out position.

NOTE The object of this test is to demonstrate the immunity of the automatic burner control system to electrostatic discharges caused by personnel who may have become electrostatically charged, touching the system or other equipment nearby. The tests are therefore performed using representative operation conditions for the equipment under test.

9 Protection against internal faults ✔

9.1 Internal faults

9.1.1 General

The automatic burner control and/or the flame detector shall be fail-safe. Systems which comply with this clause and if applicable, cl. 10.3.1 are considered to be inherently fail-safe.

The automatic burner control unit shall check the flame detector and sensor during the course of each operational cycle. In any case where flame simulation due to a fault or unacceptable operational conditions is signalled this shall result either in lockout or alternatively burner start-up shall be prevented.

Safeguard against extraneous light and flame simulation are considered to have been achieved when its signal initiates safety lock-out. Verification is carried out over a given period, stated by the manufacturer. This period shall not, however, be less than 5 s. Safety lock-out shall then occur not later than 60 s after the starting of the burner control unit.

The circuitry and the construction of the system shall be such that they meet the requirements of clause 7 and shall be appraised according to the requirements of 9.1.2, ~~and~~ 9.1.3 and 9.1.6 or 9.1.4, ~~and~~ 9.1.5 and 9.1.6.

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

Internal faults of the checking circuit for discharge tubes (see 7.4.4) shall not be considered.

NOTE A component failure could cause a degradation of safety critical insulation. This should be considered when making assessment against this clause.

The fault assessment of the burner control unit, which includes the fault assessment during lock-out or safety shut-down is based on a second fault analysis. A third independent fault is not considered.

A repaired or re-manufactured burner control system shall be deemed not to conform to this standard unless:

a) the work has been undertaken by the original manufacturer or his approved agent, or

b) it can be verified that the *repaired* or re-manufactured control system complies with this clause and if applicable, cl. 10.3.1, and that the repairer, in the context of this standard, shall be considered as the original manufacturer.

9.1.2 Automatic burner controls and/or flame detectors for non-permanent operation: First fault

Any fault (see annex A~~.1~~) in any one component or any one fault together with any other fault arising from that first fault shall result in either:

a) the automatic burner control becoming inoperative with all valve terminals de-energized at least at the end of the first safety time;

b) the system proceeding to safety shut-down within a time according to the first safety time, or to volatile, or to non-volatile lock-out, provided that subsequent reset from the volatile or non-volatile lock-out condition under the same fault condition results in the system returning to the volatile or non-volatile lock-out condition, continue with fault assessment during lock-out or safety shut-down according to 9.1.6.2;

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

d) the system remaining operational in accordance with the functional requirements of this standard (see 7.2 to 7.8).

9.1.3 Automatic burner controls and/or flame detectors for non-permanent operation: Second fault ✔

If, when appraised according to the test conditions and criteria of 9.2, a fault results in the system remaining operational in accordance with the requirements of this standard, any further independent fault considered together with the first fault shall result in either 9.1.2 a), b) c) or d).

During assessment, the second fault shall only be considered to occur when a start-up sequence has been performed between the first and second fault.

~~A third independent fault is not considered.~~

9.1.4 Automatic burner controls and/or flame detectors for permanent operation: First fault ✔

For systems for permanent operation, any fault (see annex A~~.1~~) in any one component or any one fault together with any other fault arising from that first fault shall result in either:

a) the system becoming inoperative with all valve terminals de-energized within a time according to the first safety time after the fault manifesting itself;

b) the system, within a time according to the first safety time after the fault manifesting itself in such a way that the system fails to comply with the requirements of this standard, proceeding to safety shut-down, or to volatile, or to non-volatile lock-out, provided that subsequent reset from the volatile or non-volatile lock-out condition under the same fault condition results in the returning to the volatile or non-volatile lock-out condition, continue with fault assessment during lock-out according to 9.1.6.2;

c) the system remaining operational in accordance with the functional requirements of this standard (see 7.2 to 7.8).

Systems for permanent operation shall also comply with 7.5.5.

9.1.5 Automatic burner controls and / or flame detectors for permanent operation: Second fault ✔

If, when appraised according to the test conditions and criteria of 9.2, a fault results in the system remaining operational in accordance with the requirements of this standard, (see 9.1.4 c), any further independent fault considered together with the first fault shall result in either 9.1.4 a), b) or c).

During assessment, the second fault shall not be considered to occur within 24 h of the first fault.

~~A third independent fault is not considered.~~

~~NOTE The flow chart in annex C is provided as an aid to fault assessment.~~

9.1.6 During assessment, the second fault shall not be considered to occur within 24 h after the first fault. Systems for permanent and non-permanent operation: faults during lock-out or safety- shut-down

If lock-out or safety shut-down occurs an additional fault assessment shall be performed in that stage.

Whenever lock-out or safety shut down is reached without an internal fault, an assessment according to 9.1.6.1 and 9.1.6.2 shall be performed.

Whenever lock-out or safety shut down is reached with an internal fault, an additional single fault assessment according to 9.1.6.2 shall be performed.

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

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

a) The system remaining in safety-shut-down or lock-out, valve terminals remaining de-energized;

b) the system becoming inoperative with all valve terminals remaining de-energized;

c) in case of a subsequent restart: the system during one single restart resulting in a) or b) as mentioned in this clause under the condition that the valve terminals are energized not longer than the safety time. If the cause of the original safety shut-down or lock-out condition no longer remains the system may perform a full restart in accordance with the functional requirement of this standard and the second fault assessment shall be carried out in accordance with 9.1.3 or 9.1.5.

9.1.6.2 Second fault during lock-out or safety- shut-down

Any second fault (together with any other fault arising from that fault) in any one component (see annex A), induced while the system is staying in the safety-shut-down or lock-out position, shall result in either 9.1.6.1 a), b) or c).

During assessment, the second fault shall not be considered to occur within 24 hours after the first fault.

9.2 Circuit and construction evaluation

9.2.1 Test conditions ✔

The effect of internal faults shall be assessed by simulation and/or by an examination of the circuit design.

The fault shall be considered to have occurred at any stage in the system programme sequence.

When carrying out the appraisal described in 9.1, the system shall be operated or be considered to operate under the following conditions:

a) at the most unfavourable voltage in the range 85 % to 110 % of the rated supply voltage;

b) loaded with the most unfavourable load declared by the manufacturer;

c) in an ambient temperature of (20 ± 5) °C, unless there are significant reasons for conduction of the test at another temperature within the manufacturer's declared range;

d) with any actuating member placed in the most unfavourable position;

e) with tissue paper placed on the supporting surface(s) of the system;

f) with sparks of about 3 mm in length and having an energy of not less than 0,5 J applied to those components which are likely to liberate flammable gases during the test.

9.2.2 Test criteria ✔

During the appraisal, it shall be verified that under the conditions described in 9.2.1, the following criteria are satisfied.

a) The system shall not emit flames, hot metal or hot plastics, the tissue paper shall not ignite, no explosion shall result from the liberation of flammable gases and any flame produced shall not continue to burn for more than 10 s after switching off the spark generator. When a system is submitted with any appliance, any enclosure afforded by the appliance is taken into consideration;

b) if the system continues to function, it shall comply with clauses 8 and 13 of EN 60730-1 : ~~1999~~2000. If it ceases to function, it shall still continue to comply with clause 8 of EN 60730-1 : ~~1999~~2000.

After the tests there shall be no deterioration of the various parts of the system that would result in failure to comply with clause 20 of EN 60730-1 : ~~1999~~2000.

NOTE Heating elements consisting of wire-wound resistors are considered to be short-circuit proof. (See annex A~~.1~~.)

10 Additional requirements for complex electronics

10.1 General ✔

10.1.1 Complex electronics denote assemblies which use electronic components with the following characteristics:

a) the component provides more than one functional output;

b) it is impractical or impossible to represent the failure mode of such a component by stuck-ats and cross-links at the pins or by other failure modes which are described in annex A~~.1~~.

10.1.2 Failures of complex electronics can be caused by either systematic errors (built into the design) or by random faults (component faults). The system shall be designed in such a way that systematic errors are avoided (fault avoidance, see 10.2). Random faults shall be dealt with by a proper system configuration (fault tolerance, see 10.3).

10.2 Fault avoidance ✔

10.2.1 Design

10.2.1.1 The design of the software and hardware shall be based on the functional analysis of the burner control system and / or flame detector resulting in a structured design explicitly incorporating the control flow, data flow and time related functions required by the application. In the case of custom-chips special attention shall be given to measures taken to minimize systematic errors.

10.2.1.2 Code and data shall be structured. This shall be achieved by the division of the programmes into independently testable blocks, each having a single entry point and one normal exit point, and if necessary one error/fault exit point. It shall be clear which data are assigned to which block and with which hardware function the block is associated.

10.2.1.3 If the processing of any time-related function is not predefined in the sequential programme flow, e. g. interrupt or event driven, then additional measures of fault tolerance shall be provided by the system (see also 10.3).

10.2.1.4 Where labels are used for memory locations, these labels shall be unique. Each memory location shall be used for only one type of data, e. g. as is predefined by high-level languages.

10.2.1.5 The software shall be constructed such that end-user alteration of safety-critical segments and data in software logic is not possible.

10.2.1.6 The software and safety-critical hardware under its control shall be in a known safe state during initialisation, termination and during any self-test.

10.2.1.7 The software shall be designed in such a way that writing to safety-critical pre-set data is not allowed during operation.

10.2.1.8 The processing sequence shall not be dependent upon variables, such as a jump address which is computed within the program during execution. Conditional jumps are permitted.

10.2.2 Documentation

NOTE Well written and well structured documentation is a very useful tool to prevent and to detect systematic errors.

10.2.2.1 The functional analysis of an automatic burner control system and/or flame detector and the safety related programmes under its control shall be documented in a clear hierarchical way in accordance with the safety philosophy and the programme requirements.

As a minimum, the following documentation shall be provided with any system submitted for assessment:

a) a description of the system philosophy, the control flow, data flow and timings;

b) a clear description of the safety philosophy of the system with all safety control devices and safety functions clearly indicated. Sufficient design information shall be provided to enable the safety control devices or safeguards to be assessed;

c) documentation for any software within the system.

10.2.2.2 Programming documentation shall be supplied in a programming design language declared by the manufacturer.

10.2.2.3 Safety related data and safety related segments of the operating sequence shall be identified.

10.2.2.4 There shall be a clear relationship between the various parts of the documentation, for example the interconnections of process, hardware and the labelling used in software documentation.

10.2.2.5 If a manufacturer provides documentation of the analytical measures taken during the development stage of the hardware and software, this documentation shall be used by the test house as part of the assessment procedure.

10.3 Fault tolerance ✔

10.3.1 Configuration

10.3.1.1 The system configuration shall be designed in accordance with clause 9 and taking into account the failure modes of annexes A~~.1 and A.2~~. This shall result in a system configuration which is either inherently fail-safe or in which components with direct safety-critical functions (e. g. gas valve drivers, microprocessors with their associated circuits) are guarded by safeguards. These safeguards shall be built into hardware (e. g. watch-dog, supply voltage supervision) and can be supplemented by software (e. g. ROM-test, RAM-test). It is important that these safeguards shall be capable of causing a completely independent safety shut-down. Reaction times of these (primary) safeguards shall be in accordance with the requirements of this standard.

If a single fault in a primary safeguard can render the safeguard inoperative a secondary safeguard shall be provided. The reaction time of the secondary safeguard shall be in accordance with clause 9.

NOTE The secondary guarding can be realised by:

a) a physically separate circuit monitoring the primary safeguard; or

b) mutual action between the circuit being safeguarded and the primary safeguard (e. g. watch-dog guarded by the microprocessor); or

c) action between primary safeguards (e. g. ROM-test guarding a RAM-test).

10.3.1.2 If time slot monitoring is used, it shall be sensitive to both an upper and a lower limit of the time interval. Faults resulting in shift of the upper and/or lower limit shall be taken into account.

10.3.1.3 Safeguards shall respond to all faults for which they have been designed.

10.3.1.4 If the signals at the output terminals are not in accordance with the programme as defined in 7.2, the system shall proceed to at least safety shut-down. Examples of suitable techniques are:

a) comparison of input and output conditions;

b) comparison of output conditions and programme logic state;

c) interlocking of output circuiting within the system.

10.4 Assessment ✔

10.4.1 A thorough appraisal of the circuit shall be carried out to determine its performance under the specified fault conditions. This appraisal shall take the form of a theoretical analysis and a component failure simulation test. Fault simulations may also be carried out to simulate faults within complex systems, e. g. EPROM emulation tests.

10.4.2 Only the safety related software as identified according to 10.2.2.3 shall be subjected to further assessment. For the identification, a fault tree analysis may be used.

11 Marking, installation and operating instructions (see also annex ~~D~~C)

11.1 Marking

The system and/or its components shall be marked in clear and indelible characters with:

— the name of the manufacturer and/or registered trade mark;

— a discrete reference, i. e. model number;

— a date-code or a serial number.

— safety time for start-up (SZA)

— the rated voltage(s) or rated voltage range and frequency, if applicable.

— special certification mark "S" for systems not according to this standard or "WLE" for systems used for air heaters.

The following shall be clearly indicated on the system:

— the value of the replaceable fuse(s) and its characteristic, if applicable, on or near each fuse holder;

— designation, e. g. reference numbers on or near the terminals of the system.

A durability test on the marking shall be carried out according to annex A of EN 60730-1 : ~~1991~~2000.

A principle circuit diagram shall be on the device.

11.2 Installation and operating instructions

Installation and operating instructions shall be available.

These instructions shall at least include:

a) the supply voltage(s) and frequency;

b) the maximum and minimum ambient temperature(s);

c) an indication of the degree of protection (see 6.2);

d) clear indications for the connection in different supply voltage circuits;

e) a listing and a diagram of the programme times and details of their adjustment range(s) if any;

f) the maximum current rating of the output terminals;

g) the position(s) in which the system can be mounted;

h) the voltage and the frequency of the automatic burner control systems' circuit(s);

i) the type of flame sensor(s) which can be applied. If the adjustment of the flame sensor sensitivity can cause an unsafe situation, the means of adjustment shall be suitably protected by the system installer;

j) the type reference of the corresponding optical flame sensor(s) and the temperature range they can withstand;

k) the length and the type of cable for the connection of the flame sensor and other external components (see also 8.5.2, 8.6.2, 8.71.1);

l) a typical external wiring diagram;

m) the rated input in W of the system itself, if higher than 25 W;

n) the classification in accordance with clause 4.

o) ***the value of the supply voltage where deenergization of the output terminals for the valve takes place.(8.2.2.4)***

p) when an acoustic flame sensor is used, the supplier of the sensor shall give instruction about adjustment and testing of the switching points.

NOTE The following data provided by the manufacturer may be of use to the test authority:

a) operational specification.

A minimum operating temperature range of 0 °C to 60 °C is required. (See 8.1.);

b) declarations as required by table 7.2 of EN 60730-2-5 : ~~1995~~2001;

c) operational life (normally number of cycles). A minimum life of 250 000 is required. (See 6.5.);

d) minimum cycling time from start to start for continued satisfactory operation;

e) a complete fault analysis covering the characteristic failure modes of all components (see annex A.~~1~~ and if applicable A.2) and the effect of such failures on other components and the operation of the system;

f) the procedure for fault finding to be adopted while servicing to the system;

g) sufficient design details to enable assessment of the safety functions. This shall include the manufacturer's design calculation on the effect of tolerance on critical circuit components;

h) installation, servicing and maintenance instructions and details of replacement parts;

i) manufacturer's test schedules and relevant supplementary information;

j) circuit diagram complete with component list with circuit reference, electrical ratings, relevant operating stresses and tolerances;

k) software documentation (where applicable);

l) component specifications including:

type;
values;
tolerances;
ratings;
operating values;
component manufacturer / supplier;

m) the applications for which the system is intended and, where applicable, the type of pilot system for which the system is suitable;

~~n) the value of the supply voltage where deenergization of the output terminals for the valve takes place.~~

NOTE Only the wiring diagram of the burner manufacturer is relevant for the connection of the unit to the appliance.

12 Test report ✔

After successfully passing the test, the test sample supplied as a model is retained by the testing laboratory. The testing laboratory shall prepare a test report in triplicate for:

— the testing laboratory;

— the manufacturer;

— the standardization institute which grants the certification mark.

Annex A
(normative)

Electrical/electronic component fault modes tables

Table A.1 — Electrical/electronic component fault modes

Component type	*Short*	*Open[1)]*	*Remarks*
Fixed resistors:			
Thin film (wound filament)		***X***	***Includes SMD type***
Thick film (flat)		***X***	***Includes SMD type***
Wire-wound (single layer)		***X***	
All other types	***x***	***X***	
Variable resistors (e. g. potentiometer/trimmer):			
Wire-wound (single layer)		***X***	
All other types	***x[2)]***	***X***	
Capacitors:			
X1 and Y types according to IEC 60384-14		***X***	
Metallized film according to IEC 60384-16	***x***	***X***	
All other types		***x***	
Inductors:			
Wire-wound		***x***	
All other types	***x***	***x***	
Diodes: ***All types***	***x***	***x***	
Transistors: ***All types (e. g. Bipolar: LF; RF; microwave; FET; Thyristor; Diac; Triac; Uni junction)***	***x[2)]***	***x***	***[3)]***
Hybrid circuit	***[4)]***	***[4)]***	
Integrated circuits ***All types not covered by clause H 11.12 of EN 60730-2-5***	***x[5])***	***x***	***For IC outputs note [3)] applies***
Opto-couplers ***According to EN 60335-1***	***x[6)]***	***x***	
Relays:			
Coils	***x***	***x***	***If the relay complies with EN 61810-1 the failure mode short circuit need not be considered.***
Contacts	***x[7)8)]***	***x***	
Reed-relays	***x***	***x***	***Contacts only***
Transformers:			
According to EN 61558-2-6:1997 or EN 61558-2-17:1997~~According to EN 60742 or EN 61558-2-17~~		***x***	
All other types	***x***	***x***	

Table A.1 (continued)

Component type	Short	Open[1)]	Remarks
Crystals	x	x	9)
Switches	x	x	10)
Connections (jumper wire)		x	11)
Cable, wiring and connectors		x	
Printed circuit board conductors	x[13)]	x[12)]	

1) Only opening of one pin at a time.

2) Short circuit each pin in turn with every other pin; only two pins at a time.

3) For discrete or integrated thyristor type devices such as triacs and SCRs, fault conditions shall include short circuit of any terminals with the third terminal open circuited. The effect of any fullwave type component, such as a triac going into a halfwave condition, either controlled or uncontrolled (thyristor or diode, respectively) shall be considered.

4) Failure modes for individual components of the hybrid circuit are applicable as described for the individual components in this table.

5) The short circuit of any two adjacent terminals and the short circuiting of:

a) each terminal to the IC-supply, when applicable at the IC

b) each terminal to the IC-ground, when applicable at the IC

The number of tests implied for integrated circuits may normally make it impracticable to apply all the relevant fault conditions or to assess the likely hazards from an appraisal of the circuit diagram of the integrated circuit.

It is therefore permissible first to analyze in detail all the possible mechanical, thermal and electrical faults which may develop either in the control itself or its output, due to the malfunction of the electronic devices or other circuit components, separately or in any combination.

Except for types evaluated by EN 60730-2-5, H11.12, a fault tree analysis shall be conducted to include the results of multiple steady state conditions to outputs and programmed bi-directional terminals for the purpose of identifying additional fault conditions for consideration. The failure mode "short circuit" is excluded between isolated sections for such ICs that have isolated sections. The isolation between the sections shall comply with the requirements of EN 60730-2-5, clause 13.2 for operational insulation.

6) When opto-couplers comply with EN 60335-1, clause 29.2.2, the shorting between the input and output pins is not considered.

7) The failure modes "short circuit" and "mechanical break-down" need not to be considered when the system – including the relay – successfully completed the long-term performance tests of clause 6.5 (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, C.2, and declared by the manufacturer and if special precautions have been taken to prevent welding of contacts (see 6.1). Special precautions are:

1. Measures to avoid welding:

1.1 Contacts closing on short-circuit: Rating of the fuse according to IEC 60127 with $I_{fuse} < I_{the}/2{,}75$.

1.2 lifetime/loadcycle rating: proof that the contact does not weld after 1 000 000 cycle on max rated contact load (4fold safety)

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 6.1)

8) If a fuse is used to protect against the hazard of relay contact welding the fuse shall only be replaced by the manufacturer according to EN 60730-1:~~1995~~2000, clause 2.13.7 .

9) For crystal based clocks, harmonic and sub-harmonic frequency variations affecting the timings should be considered.

10) If switches are applied for the selection of declared safety times, programs and/or other safety related settings, these devices should function so that in the event of their opening, the safest possible condition arises (for example, the shortest safety time or the longest purge time).

The short circuit failure mode is excluded for switches successfully tested to EN 60730-2-5, clause 17. The successful test can be substituted by the use of a switch certified for the application.

11) The requirements are the same as note 10, except they are applied to jumper wires intended for clipping when selecting a setting.

12) 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.

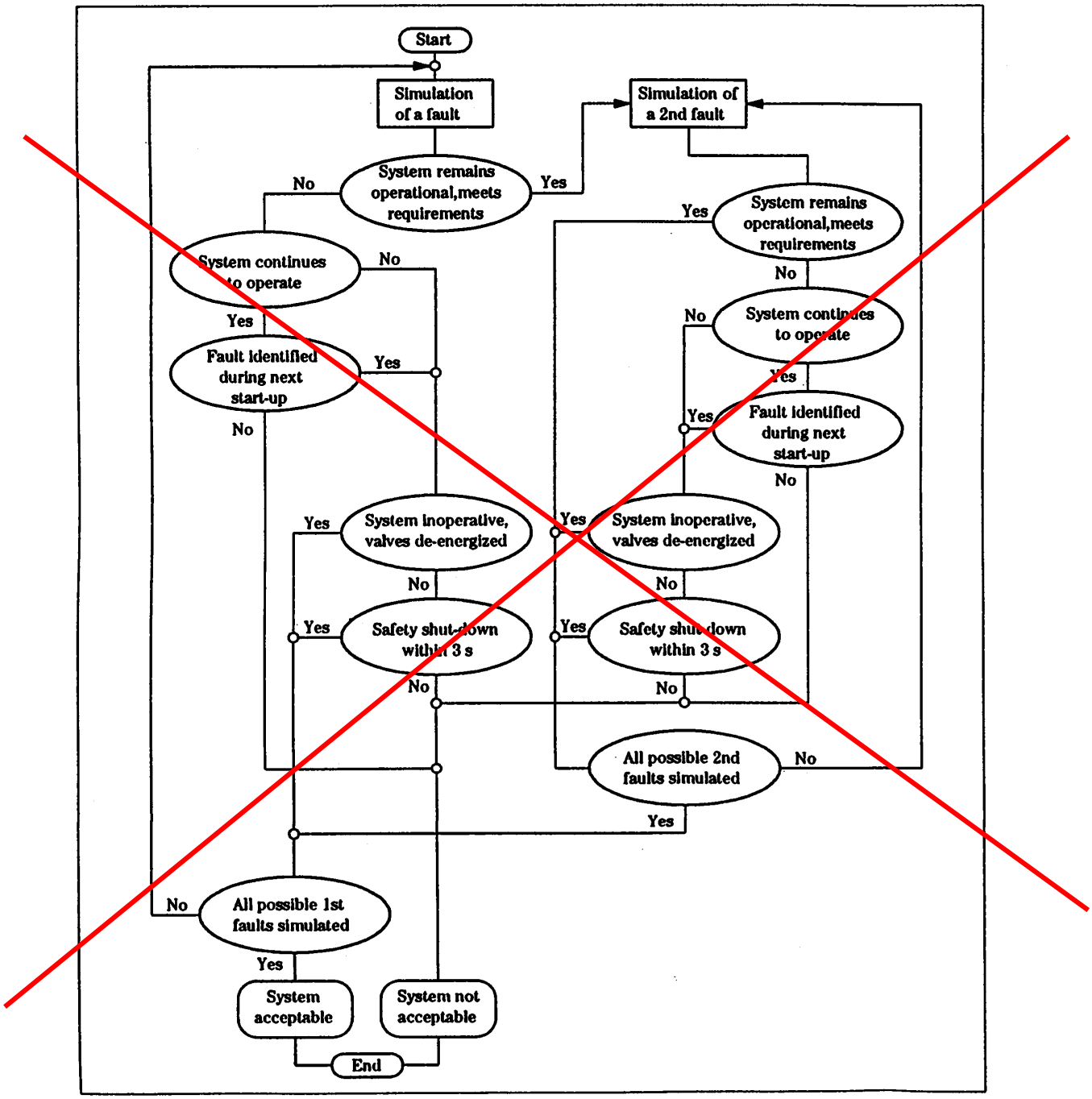
13) The short circuit failure mode is excluded if the requirements of EN 60730-2-5, clause 20 are fulfilled.

Annex B
(informative)

Flowchart for fault inspection

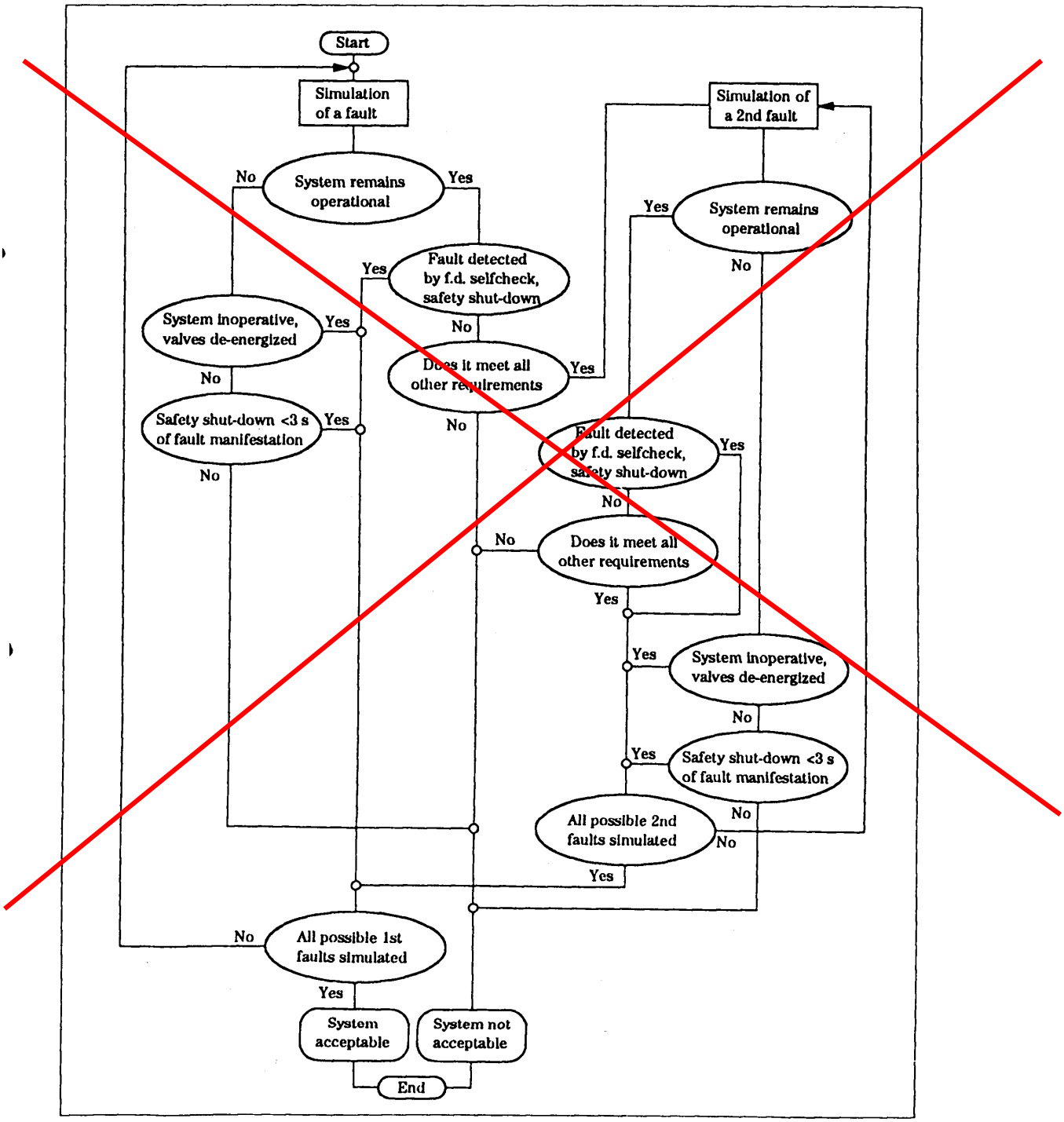
B.1Automatic burner control systems and flame detectors for non-permanent operation

(see 9.1.2, 9.1.3)



~~B.2 Automatic burner control systems and flame detectors for permanent operation~~

~~(see 9.1.4, 9.1.5)~~



~~Annex C~~Annex B
(informative)

Functional characteristics of burner control systems, to be given by the appliance standard

Clause(s)	Item	Remarks
3.12,3.13, 7.3.3	Purge or waiting times	Minimum time
3.22, 7.1	Volatile or non-volatile lock-out	as specified
3.23, 7.2.5	Ignition restoration	Specify if applicable
3.24, 7.2.4	Recycling	Specify if applicable
3.25.2, 7.5.5	Permanent operation	Specify if applicable
3.9.1.1, 7.2.1.5, 7.2.2	Ignition by controlled spark	
3.16, 7.2.1.4	Pilot or start flame proving period	Minimum time, if applicable

Annex C: Requirements for DC supplied burner controls

This annex supplements or modifies the corresponding clause of this standard

1. Scope

addition:

DC supplied controls will fall into one of the three following types:

- stand-alone battery systems; Type A
- battery systems for mobile applications; Type B
- systems which are intended to be connected to DC supply networks; Type C

6.5.2.2.1 Thermal stress test

modification:

replace "85 % of the minimum declared rated voltage" *with* "75 % of the minimum declared DC voltage"

replace "110 % of the maximum declared rated voltage" *with* "120 % of the maximum declared DC voltage"

6.5.2.3 Long term performance test [by the manufacturer]

modification:

replace "85 % of the minimum declared rated voltage" *with* "75 % of the minimum declared DC voltage"

replace "110 % of the maximum declared rated voltage" *with* "120 % of the maximum declared DC voltage"

7.6.1 At ambient temperature

modification:

replace "85 % of the minimum declared rated voltage" *with* "75 % of the minimum declared DC voltage"

replace "110 % of the maximum declared rated voltage" *with* "120 % of the maximum declared DC voltage"

8.2 Supply voltage variations

modification in the complete Clause:

replace "85 % of the minimum declared rated voltage" *with* "75 % of the minimum declared DC voltage"

replace "110 % of the maximum declared rated voltage" *with* "120 % of the maximum declared DC voltage"

8.3 to 8.8

modification:

the following clauses of this standard are applicable:

Clause	stand-alone battery system	battery systems for mobile applications	systems which are intended to be connected to DC supply networks
	Type A	Type B	Type C
8.3 Supply voltage dips, short interruptions and voltage variations immunity	not applicable	not applicable	applicable
8.4 Supply frequency variations	not applicable	not applicable	not applicable
8.5 Surge immunity	applicable (for cables longer than 10m)	not applicable	applicable (for cables longer than 10m)
8.6 Electrical fast transient/burst immunity	applicable (for cables longer than 3m)	not applicable	applicable (for cables longer than 3m)
8.7.1 Immunity to conducted disturbances, induced by radio-frequency fields	applicable (for cables longer than 1m)	applicable (for cables longer than 1m)	applicable (for cables longer than 1m)
8.7.2 Radiated, radio frequency electromagnetic field immunity test	applicable	applicable	applicable
8.8 Electrostatic discharge immunity	applicable	applicable	applicable

addition:

8.9 Electrical transient conduction immunity for Type B only

8.9.1 General

Battery systems for mobile applications Type B shall tolerate electrical transient conduction on the supply lines, so that when tested in accordance with Annex C 8.3.2:

a) for the values of table C.1 line a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shut-down or lock-out, nor shall it reset from lock-out.

b) for the values of table C.1 line b): either it shall perform as in a) 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.

Test pulse / Assessment citeria	Test Level	**2 [V]**	3b [V]	3b [V]	4 [V]	5 [V]	6 [V]	7 [V]
a)	Level I (12V Systems)	+25	-25	+25	-4	-	-50	-
	Level I (24V Systems)	+50	-50	+50	-8	-	-100	-
b)	Level III (12V Systems)	+75	-100	+75	-6	+66,5	-200	-60
	Level III (24V Systems)	+150	-200	+150	-12	+133	-400	-120

Table C.1

8.9.2 Electrical transient conduction immunity test

The system is tested in accordance with ISO 7637-1:1990 if the system is a 12 V system and is tested in accordance with ISO 7637-2:1990, if the system is a 24 V system.

For systems with different power supply voltage levels, the values for test pulses shall be adapted according to the required test level.

Test pulses 5 and 7 shall only be implemented when required by the application. This shall be declared by the manufacturer according to 11.2 q.

Annex D
(informative)

Functional diagrams of oil burner controls

A		Start position
C	*3.19	Beginning of the operational state
E	3.20	Controlled shut-down
X	7.4	Flame extinction
Y	3.22	Safety lock-out
Z		Manual reset
b		Starting process
d	3.19	Operational state
f		Post-purge
t_1	3.13.1	Pre-purge time
t_2	3.14.2	Pre-ignition time (electr.)
t_{2*}	3.14.3	Pilot proving period
t_3	3.14.3	Ignition time (electr.)
t_{3*}	3.14.4	Ignition time (gas) (oil)
t_4	3.14.4	Post-ignition time (electr.)
t_{4*}	3.15.1.1	Post-ignition time (gas) (oil)
t_5	3.15.1.2	1st ignition safety time
t_6	3.15.2	2nd ignition safety time
t_7	3.13.2	Safety time during operation
t_8	7.3.4.1	Post-purge time
t_{10}		Max. permissible period between release of fuel for a non-supervised pilot and release of fuel for the main burner

* see paragraph

Fan motor

Ignition (electric)

Oil valve

Pilot gas valve

Pilot flame signal

Main flame signal

Flame signal, gen.

Failure signal

Air damper

Functional diagrams – Normal operation

Burner without pilot

Operation **without** post-purge

Burner without pilot

Operation **with** post-purge

Burner without pilot

Supervised air damper operation, operation with post-purge

Burner with pilot which operates only during the ignition time

Pilot **supervised**, operation with post-purge

- two main valves in series or see EN 267

Burner with pilot which operates only during the ignition time

Pilot **not** supervised, operation with post-purge

Functional diagrams - Fault conditions

Ignition restoration

after extinction of flame during operation

left: *ignition restoration* with flame re-establishment

right: lock-out due to non-establishment of the flame

Re-*cycling*

after extinction of flame during operation

Safety lock-out

after extinction of flame during operation

Safety lock-out

for the non-establishment of the flame signal (during safety time t_5)