BS EN 14459:2015

BSI Standards Publication

Safety and control devices for burners and appliances burning gaseous or liquid fuels — Control functions in electronic systems — Methods for classification and assessment

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National foreword

This British Standard is the UK implementation of EN 14459:2015. It supersedes BS EN 14459:2007 which is withdrawn.

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

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Safety and control devices for burners and appliances burning gaseous or liquid fuels - Control functions in electronic systems - Methods for classification and assessment

Dispositifs de commande et de sécurité pour brûleurs et appareils utilisant des combustibles gazeux ou liquides - Fonctions de commande des systèmes électroniques - Méthodes de classification et d'évaluation

Sicherheits- und Regeleinrichtungen für Brenner und Brennstoffgeräte für gasförmige oder flüssige Brennstoffe - Regel- und Steuerfunktionen in elektronischen Systemen - Verfahren für die Klassifizierung und Bewertung

This European Standard was approved by CEN on 19 September 2015.

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Contents

Page

Tables

Figures

European foreword

This document (EN 14459:2015) has been prepared by Technical Committee CEN/TC 58 “Safety and control devices for burners and appliances burning gaseous or liquid fuels”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2016, and conflicting national standards shall be withdrawn at the latest by May 2016.

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

This document supersedes EN 14459:2007.

Control systems are designed to control and protect gas and/or oil appliances and the combustion process. All functions are performed depending on their safety relevance within a specific tolerance of measures and time with a specific certainty under external influences and internal failures.

It was concluded by CEN/TC 58 that it is not always necessary to protect against the consequences of hazardous events with uniform measures as hazards differ in severity and the probability of unwanted occurrences may differ. As there exist large differences of interpretation on what level of protection is necessary against certain hazards, there is a need for guidance to bring the safety philosophy for gas and oil appliances and controls in line. The discussions of CEN/TC 58 regarding safety related control functions and the use of controls systems in the appliances show that it is worthwhile to refine the basic safety philosophy of gas and oil appliances into different risk levels.

For the evaluation of preventative measures concerning fault tolerance and avoidance of hazards, it is essential to classify control functions with regard to their fault behaviour. For the classification of control functions, their integration into the complete safety concept of the appliance should be taken into account.

In the appliance standards, only specific fault conditions are considered when controls conforming to CEN/TC 58 standards are used, e.g. flame simulation and air proving before each new start. In some cases (e.g. switch contacts) shorting is excluded, when certain tests have proven that the probability of a fault occurrence is low. For gas valves, a single shut-off valve is considered insufficient.

This standard will give methods for the assessment of products in the field of gas and oil applications and control solutions for which no specific product standards are actually available. The assessment is described in three steps:

— assessment of the application,

— translation into control requirements,

— assessment of the control solution,

leading to a defined safety class and a set of safety measures with additional/modified construction and test requirements for the application and/or the specified control function.

The assessment is focused on the controlled parameters (e.g. high/low temperature, pressure, flow, combustion quality) in the combustion process and in the functionality of the controls (e.g. open/closed; lock/unlock; start/stop). Each control function needs to be classified according to the required safety aspects (Class A, B, C).

To analyse the effect of fault conditions it is essential to know the specific application and the related risk.

It should be noted that the following significant editorial changes compared to the previous edition have been incorporated in this European Standard:

a) methods for classification and risk assessment are more detailed;

b) methods are described starting on appliance level;

c) controls for burners and appliances burning liquid fuels (electronic) added;

d) introduction of new informative annexes based on the determination of basic risks:

— Annex AA "Example of a risk assessment method",

— Annex BB "Example of a risk assessment with the method described in Annex AA" (former Annex M),

— Annex CC "Realisation of a protective measure",

— Annex DD "Hazards in gas and oil appliances handled by control functions" and

— Annex EE "Classification of control functions based on the determination of basic Annex EE "Classification of control functions".

e) deletion of the following annexes which shall be included into a new standard on temperature control functions (TCF) in CEN/TC 58:

— Annex I "Combustion product discharge function (TTB)",

— Annex K "Temperature control functions (TCF)",

— Annex N "Control standards for gas burners and gas burning appliances".

f) deletion of Annex L "Gas shut-off function" (content moved into EN 161);

g) deletion of the former Annex O "Examples of new solutions" (content moved into EN 161).

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

1 Scope

This European Standard specifies methods for the classification and assessment of function blocks designed to operate burners and appliances burning gaseous or liquid fuels with particular regards to their fault behaviour and preventative measures.

This European Standard is applicable to control function blocks, not covered by a dedicated control standard (e.g. EN 88-1:2011, EN 88-2:2007, EN 125:2010, EN 126:2012, EN 126:2012/prA1:2014, EN 161:2011+A3:2013, EN 257:2010, EN 298:2012, EN 1106:2010, EN 1643:2014, EN 1854:2010, EN 12067-2:2004, EN 16304:2013 and EN 16340:2014, EN ISO 23553-1:2014).

2 Normative references

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

EN 13611:2015, *Safety and control devices for burners and appliances burning gaseous and/or liquid fuels — General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13611:2015, Clause 3 and the following apply.

3.101
function block
part of an electric or electronic system which realises at least one control function with one input and one output signal

4 Classification

4.1 Classes of control

Shall be according to EN 13611:2015, 4.1.

4.2 Groups of control

Shall be according to EN 13611:2015, 4.2.

4.3 Classes of control functions

Shall be according to EN 13611:2015, 4.3 with the following addition:

The class of the control function shall be determined from the results of the risk assessment in 6.101 and specified in the installation and operating instructions.

4.4 Types of DC supplied controls

Shall be according to EN 13611:2015, 4.4.

5 Units of measurement and test conditions

Shall be according to EN 13611:2015, Clause 5.

6 Construction requirements

6.1 General

Shall be according to EN 13611:2015, 6.1 with the following addition:

The outcome of the specific assessment in 6.101 can modify or extend the requirements of 6.1 to 6.6.

6.2 Mechanical parts of the control

Shall be according to EN 13611:2015, 6.2.

6.3 Materials

Shall be according to EN 13611:2015, 6.3.

6.4 Gas connections

Shall be according to EN 13611:2015, 6.4.

6.5 Electrical parts of the control

Shall be according to EN 13611:2015, 6.5.

6.6 Protection against internal faults for the purpose of functional safety

Shall be according to EN 13611:2015, 6.6.

6.101 Requirements for new control solutions

6.101.1 General

Appliance designs are based on safe operation avoiding any harm for persons, domestic animals or property when normally used. Possible hazards arising from the appliance can be expressed in inherent risks, being considered in relation to the combustion (use) of gas and oil and heating of water.

For known control and appliance solutions, risks are considered to be covered by requirements in the available control and appliance standards.

For new control solutions, there is a need for further risk assessment depending on the appliance design for which they are developed for, either:

— well-known appliance designs, or

— new appliance solutions.

6.101.2 Assessment of the appliance

The required protective measures, resulting from a risk assessment on the new or existing appliance design or solution are the basis for the assessment of new control solutions. The risk assessment shall be performed and documented in order to identify the risks and the required protective measures covering these risks.

At least the following information shall be included:

— classification of basic hazard;

  — Annex AA gives examples of existing basic hazards in gas and/or oil appliances.

— risk assessment and the resulting protective measures;

  — Annex EE specifies a method for classification of control functions.

— classification of protective measures;

— fault tolerating time for specific faults;

— additional requirements for the application.

Based on this information the following measures may be taken:

— specification of controls according known control standards; and/or

— additional appliance construction requirements; and/or

— specification of new type of control based on the required protective measure and/or the additional requirements.

In Annex AA, a risk assessment method on appliance level is given.

In Annex BB and Annex DD examples are given for the method described in Annex AA.

6.101.3 Translation to control requirements

If a new type of control is required which is based on the outcome of the risk assessment on the appliance, the protective measures and, where possible the additional requirements from this risk assessment, have to be translated in control requirements.

A further assessment on the foreseen control solution shall be performed and documented including the assumptions made and reasoning how the required safety level is achieved.

This outcome shall lead to a conclusion:

— on relevant safety class according to 4.3;

— on additional or modified construction, performance or EMC requirements;

— on further fault modes for consideration in the fault assessment of 6.6;

— on the need to extend the list of markings and the contents of installation and operating instructions.

For specific faults, a fault reaction time shall be specified for the control, taking into account the fault tolerating time of the application as a maximum.

Annex CC provides guidance for the realisation of protective measures by controls.

7 Performance

7.1 General

Shall be according to EN 13611:2015, 7.1 with the following addition:

The outcome of the specific assessment in 6.101 can modify or extend the requirements of 7.1 to 7.8.

7.2 Leak-tightness

Shall be according to EN 13611:2015, 7.2.

7.3 Torsion and bending

Shall be according to EN 13611:2015, 7.3.

7.4 Rated flow rate

Shall be according to EN 13611:2015, 7.4.

7.5 Durability

Shall be according to EN 13611:2015, 7.5.

7.6 Performance test for electronic controls

Shall be according to EN 13611:2015, 7.6.

7.7 Long-term performance for electronic controls

Shall be according to EN 13611:2015, 7.7.

7.8 Data exchange

Shall be according to EN 13611:2015, 7.8.

7.101 Combined apparatus

If a system consists of two or more combined apparatuses with different control functions, the interconnection and interference of the involved apparatus shall be considered during fault assessment.

Safety of a control function shall not be impaired by its integration in a gas or oil appliance or system.

Responsibilities and safety critical interface parameters shall be declared for incorporating the control in an over-all-system.

8 Electrical requirements

8.1 General

Shall be according to EN 13611:2015, 8.1 with the following addition:

The outcome of the specific assessment in 6.101 can modify or extend the requirements of Clause 8.

8.2 Protection by enclosure

Shall be according to EN 13611:2015, 8.2.

9 Electromagnetic compatibility (EMC)

9.1 Protection against environmental influences

Shall be according to EN 13611:2015, 9.1 with the following addition:

The outcome of the specific assessment in Clause 6 can modify or extend the requirements of Clause 9.

9.2 Supply voltage variations below 85 % of rated voltage

Shall be according to EN 13611:2015, 9.2.

9.3 Voltage dips and interruptions

Shall be according to EN 13611:2015, 9.3.

9.4 Supply frequency variations

Shall be according to EN 13611:2015, 9.4.

9.5 Surge immunity tests

Shall be according to EN 13611:2015, 9.5.

9.6 Electrical fast transient/burst

Shall be according to EN 13611:2015, 9.6.

9.7 Immunity to conducted disturbances induced by radio frequency fields

Shall be according to EN 13611:2015, 9.7.

9.8 Immunity to radiated disturbances induced by radio frequency fields

Shall be according to EN 13611:2015, 9.8.

9.9 Electrostatic discharge test

Shall be according to EN 13611:2015, 9.9.

9.10 Power frequency magnetic field immunity tests

Shall be according to EN 13611:2015, 9.10.

9.11 Harmonics and interharmonics including mains signalling at a. c. power port, low frequency immunity tests

Shall be according to EN 13611:2015, 9.11.

10 Marking, installation and operating instructions

10.1 Marking

Shall be according to EN 13611:2015, 10.1 with the following addition:

Further requirements for marking shall be determined from the specific assessment in 6.101.

10.2 Installation and operating instructions

Shall be according to EN 13611:2015, 10.2 with the following addition:

Further requirements for information in installation and operating instructions shall be determined from the specific assessment in 6.101.

10.3 Warning notice

Shall be according to EN 13611:2015, 10.3.

Annex A
(informative)

Abbreviations and symbols

Shall be according to EN 13611:2015, Annex A.

Annex B
(informative)

Leak-tightness test for gas controls – Volumetric method

Shall be according to EN 13611:2015, Annex B.

Annex C
(informative)

Leak-tightness test for gas controls – Pressure loss method

Shall be according to EN 13611:2015, Annex C.

Annex D
(normative)

Conversion of pressure loss into leakage rate

Shall be according to EN 13611:2015, Annex D.

Annex E
(normative)

Electrical/electronic component fault modes

Shall be according to EN 13611:2015, Annex E.

Annex F
(normative)

Additional requirements for safety accessories and pressure accessories as defined in EU Directive 97/23/EC

EN 13611:2015, Annex F does not apply.

Annex G
(normative)

Materials for pressurised parts

EN 13611:2015, Annex G does not apply.

Annex H
(normative)

Additional materials for pressurised parts

EN 13611:2015, Annex H does not apply.

Annex I
(normative)

Requirements for controls used in *DC* supplied burners and appliances burning gaseous or liquid fuels

Shall be according to EN 13611:2015, Annex I.

Annex J
(normative)

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

Shall be according to EN 13611:2015, Annex J.

Annex K
(normative)

Method for the determination of a Performance Level (PL)

Shall be according to EN 13611:2015, Annex K.

Annex L
(informative)

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

Shall be according to EN 13611:2015, Annex L.

Annex M
(normative)

Reset functions

Shall be according to EN 13611:2015, Annex M.

Annex N
(informative)

Guidance document on environmental aspects

Shall be according to EN 13611:2015, Annex N.

Annex O
(normative)

Seals of elastomer, cork and synthetic fibre mixtures

Shall be according to EN 13611:2015, Annex O.

Annex AA
(informative)

Example of a risk assessment method

Risk assessment on appliances is done by starting at the basic hazard and from that point go top down in the risk analysis tree (see Figure AA.1) up to the actual sub-source for this risk.

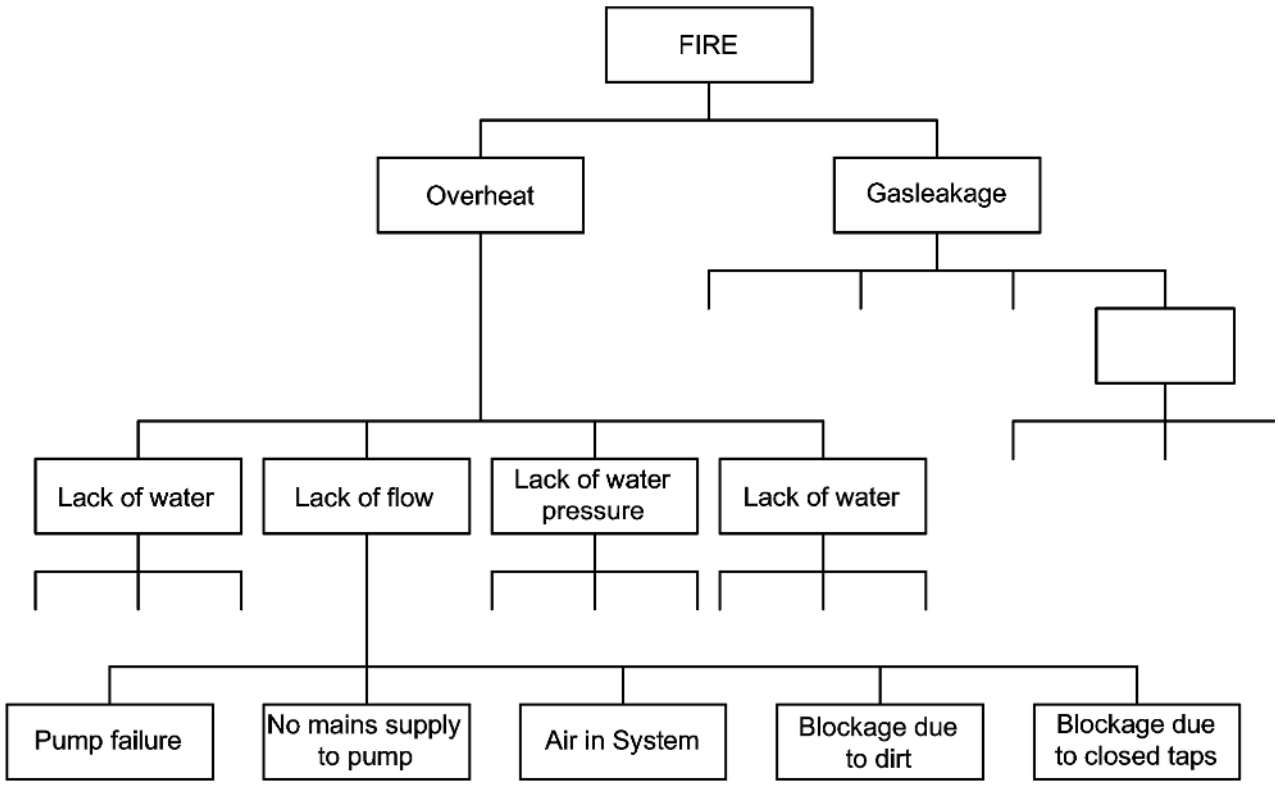

Figure AA.1 — Example of a risk assessment method

For practical examples of this failure tree, see Annex BB.

The assessment methodology for gas and oil appliances using alternative constructions, consists of the following steps:

1) In this step the basic hazards with overall classification are identified.

   Basic hazards, which are currently known:

   a) fire;

   b) explosion (gas, oil or steam);

   c) poisoning;

   d) suffocation.

   For above basic hazards, an overall safety Class C is assumed based on practice.

2) In this step the sources and sub-sources of the basic hazards are identified. Basic hazards can have various sources each of their own and individual origin. Furthermore each of these sources can have various sub-sources.

3) In this step the condition of the sources or sub-sources is identified in being normal or abnormal.

Abnormal condition is a condition of the appliance under the effect of a foreseeable but unlikely situation. This implies that following the abnormal condition the appliance remains safe.

List of examples of abnormal conditions (not exhaustive):

— line voltage larger than 0 V and smaller than (U_n – 15 %);

— line voltage above (U_n + 10 %);

— gas or oil pressure higher than 0 mbar and lower than p_{min};

— gas pressure above p_{max};

— blocked flue with regular maintenance;

— false flame simulation;

— to be continued.

Normal condition is a condition of the appliance under the effect of a foreseeable and likely situation. This implies that following the normal condition the appliance remains safe and functions correctly.

List of examples of normal conditions (not exhaustive):

— loss of line voltage;

— line voltage between 0,85 U_n and 1,1 U_n;

— gas or oil pressure between p_{min} and p_{max};

— loss of gas or oil pressure;

— lack of water pressure;

— blocked flue without regular maintenance;

— loss of flame;

— to be continued.

In this step the classification of the necessary protective measure is identified, making use of the described safety philosophy.

For classification of the protective measure, an abnormal condition is considered as a first fault. This means that for a normal condition, the protective measure has to be classified according the basic hazard and for an abnormal condition the protective measure may be classified one level lower than the basic hazard.

For background on realisation of protective measures, see Annex CC.

Annex BB
(informative)

Example of a risk assessment according to method described in Annex AA

BB.1 Introduction

A recent development, at least in the Netherlands, is that for type C_4 and type C_8 appliances the possibility is foreseen to connect them to an overpressure common exhaust flue (see Figure BB.1).

Advantages:

a) easier to apply in existing buildings;

b) cheaper (less material).

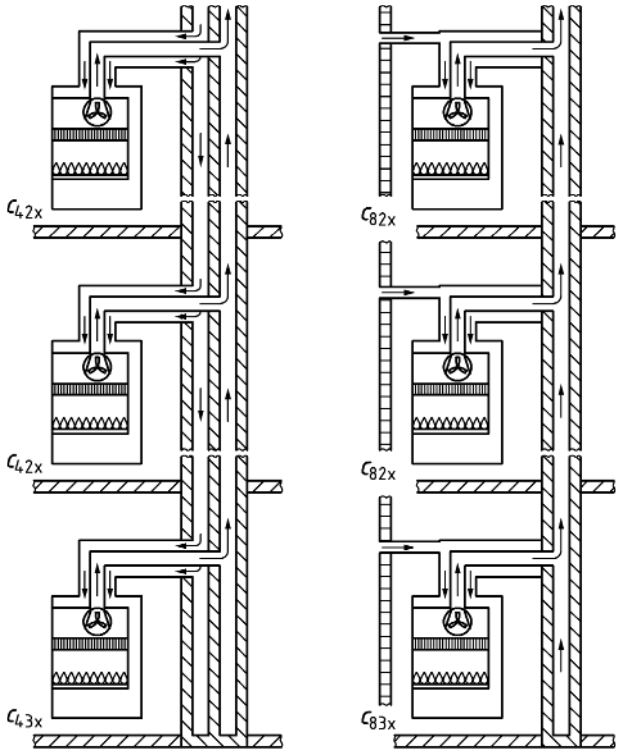

Figure BB.1 — Common systems for C_4 Types, examples of risk assessment

BB.2 Risks

If one of the appliances, connected to the common flue, is not operating for some period, the exhaust gases in the overpressure exhaust flue, produced by the other appliances, tend to flow into this appliance.

The exhaust gases, coming into the appliance, will cool down and form condensate. This condensate will settle on parts in the appliance. These parts may be electric wiring, printed circuit boards and control and safety devices.

The effect will be unpredictable. It can be a short circuit, which may cause fire or damage a safety device, or a malfunctioning of a safety device, which may cause poisoning.

BB.3 Risk assessment

See Table BB.1.

Table BB.1 — Example of risk assessment

Typical risks for type C_4 and C_8 appliances connected to overpressure exhaust flue, with possible backflow of flue gases in appliance.

Potential hazards related to safe use of gas	**Classification of overall risk**	**Source of the risk**	**Sub-source**	**Sub-source**	**Normal or abnormal condition**	**Classification of safety measure**	**Technical examples to cover the risk**
SxOxD for the situation of backflow flue gas from one appliance into another appliance causing condense, resulting in fire = (7 - 9) x 4 x 7 = 196 – 252 = C							
Fire	C	Short circuit in electric circuits	Water on electric components	Condensation on cold surfaces due to backflow flue gasses	Normal	C	No cold surfaces Condense cannot reach electric components No / limited amount of flue gas flowing back
		Blocked fan	Corrosion of fan motor	Condense on link between motor and fan	Normal	C	Electrical protection means Fan inherent safe for blocked rotor Choose corrosion resistant material
							Failure detected in class C system should result in either: shut down of appliance shut down of other appliances
Poisoning due to bad combustion	B	Corroded burner surface	Condense dripping o burner surface	Backflow of flue gas, condensing on cold	Normal	B	Burner surface resistant to corrosion

				surfaces			Heated burner surface (heating element) No / limited amount of flue gas backflow
		Wrong gas/air mixture Lambda < 1	Corrosion in gas/air control	Backflow of flue gas, condensing in or on gas/air control	Abnormal	A	Corrosion resistant material No / limited amount of flue gas backflow - Heated control (heating element)
		Recirculation of flue gas	Backflow of flue gas		Normal		Backflow valve in all boilers of the system $CO_2 > O_2$ generator - Activate fan for Δp
							Failure detected in class C system should result in either: shut down appliance shut down other appliances

Annex CC
(informative)

Realisation of a protective measure

When the need for a protective measure has been identified and the classification has been determined, the measure has to be realised in the appliance.

A Class B or C protective measure can be realised in a number of layers as shown in Figure CC.1.

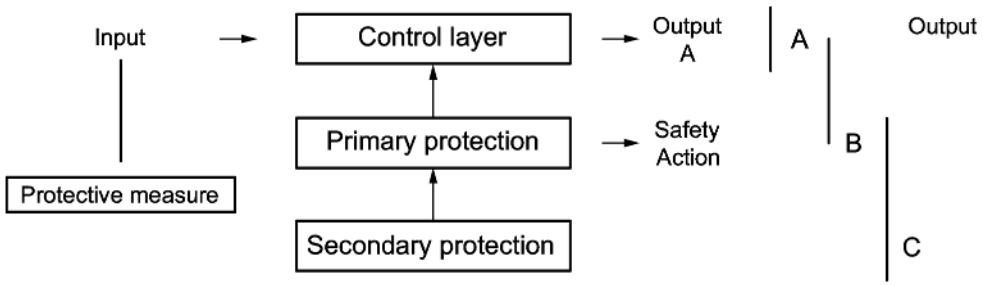

Figure CC.1 — Layers of a safety system

Class A requires no protection layers and therefore no failure assessment is done.

Class B requires just a primary protection layer. In practice this means that a single failure assessment needs to be performed.

Class C requires a primary and a secondary protection layer. In practice this means that a two failure assessment needs to be performed.

a) The first layer comprises the components necessary for the control tasks, such as reading in signals from sensors and sending control signals to actuators. This is therefore referred to as the control layer. In the absence of any protective measures, failures in combination with normal conditions in the control layer could lead directly to a hazardous situation, such as sending a spurious control signal to operate a valve. Such failures are considered as 'critical failures'.

b) It will be necessary to implement safety measures to detect critical failures. These measures can be considered as forming the second functional layer (primary protection) whose task is to initiate a protective action in the event of a critical failure in combination with all defined ‘normal conditions’. By implementation of a control layer and a primary protection, a Class B protective measure is realised.

c) Malfunctions, which remain undetected, are considered as ‘dormant failures’. This kind of failure, either occurring in the protective function or in the control function, could nevertheless lead to a hazardous situation, even years later, in combination with a second failure. It will be necessary to incorporate safety measures, which prevents such a situation. In order to prevent a drop out of the primary protection due to a dormant failure, the proper functioning of the safeguards is supervised. The necessary function can be considered as a third functional layer (secondary protection). By implementation of a secondary protection, a Class C protective measure is realised.

d) Safety systems (including various layers) can have the various principles of operation e. g.:

Class C:

1) One single device being inherently fail safe (so without integrated primary or secondary protection).

2) One single device with periodic self-testing and monitoring; the control layer, primary and secondary protection are integrated in one single device.

3) Two independent devices with comparison, using the same or different technology. the secondary protection is provided by the comparison.

4) Three independent devices without comparison, using the same or different technology.

Class B:

1) One single device with periodic self-testing and without monitoring; the control layer and primary protection are integrated in one single device.

2) Two independent devices without comparison, using the same or different technology.

Annex DD
(informative)

Hazards in gas and oil appliances handled by control functions

In Table DD.1 functions of the process within burners and appliances burning gaseous or liquid fuels are listed together with the safety related functional blocks of the control that should guarantee and control these functions.

Table DD.1 also indicates fault conditions which can impair such functions. The result of such failures can be hazardous situations which are also indicated together with corresponding preventative measures.

Table DD.1 gives a guideline and may be used in conjunction with Clauses 6 and 7 or with other standards which are referenced, and gives an overview of the use of specific electronics and their preventative measures.

Where clarification seems to be useful, remarks are made in a separate column.

Table DD.1 — Gas and oil burning process and safety control functions

Hazard	Control function	Function of the system/process	Fault condition	Preventative measures	Remark	References
Unacceptable spillage of combustion products (insufficient Combustion flow through exhaust)	TTB	Prevention of spillage of combustion products	Short circuit or damage of the sensing element	Detection of fault and measure(s) according to classification (A, B, C)	Depending function and application according to Clause 4 a safety class shall be fixed	
			Wrong construction	Design/ manufacturing/ assembling according to instruction		
			Wrong use because of lost marking	Appropriate marking		
			Breakdown of materials	Mechanical and thermal endurance	Choose number of cycles according to this standard or the relevant appliance standard whichever is higher	
				Long term performance		
			Loss of function caused by humidity	Resistance to humidity	Depending on the application	
			Deviation and drift	Appropriate design		
			Electrical failures			
				Electrical integrity		
			EMC-Phenomena	No unsafe reaction and deviation under electromagnetic phenomena		
Fire or electric shock			Wrong use	Appropriate operation manual	Depending on the application	
			Breakdown of materials, fault	Mechanical and thermal endurance, electrical integrity		

Hazard	Control function	Function of the system/process	Fault condition	Preventative measures	Remark	References
			behaviour			
Unburned gas or oil, explosion	Remote Reset	Safe reset from lock-out	Power failure and following restoration	Remain in lock-out (not required for volatile lock-out)	Depending on function and application according to 4.3 a safety class shall be fixed	
			Switching action of a thermostat or similar device	Remain in lock-out (not required in specific applications)		
			Continuous pressing of reset button, shorting of connecting cables to the reset device, or between reset device and earth	Fault detection before next start		
			Automatic reset instead of manual reset after introduction of a single electronic fault in accordance with EN 60730-1:2015, H.27 or introduction of a single fault for components covered by EN 60730-1:2015, H.11.12	Fault detection before next start or before a limited number of resets		
			Electrical failures			
				Electrical integrity		
			EMC-Phenomena	No unsafe reaction		
Fire or electric shock			Break down of materials, fault behaviour	Mechanical and thermal endurance, electrical integrity		

Hazard	Control function	Function of the system/process	Fault condition	Preventative measures	Remark	References
Overheat	Thermal limiter	Prevent overheat	Component behaviour according to EN 60730-1:2015, Annex K	Mechanical and thermal endurance, electrical integrity -automatic reset from lock-out-		
Fire, explosion, overpressure	Thermal cut-outs		deviation and drift	Mechanical and thermal endurance, electrical integrity - manual reset from lock-out -		
Depending on application: bad burning, overheat, CO-emission	flow supervision by pressure transmitter analysis flow supervision by analysis of rotation	Provide sufficient flow of air or fuel Supervision of leakage	Component behaviour according to EN 60730-1:2015, Annex K	Mechanical and thermal endurance, electrical integrity -automatic reset from lock-out-		
Unburned gas, explosion (Leakage through the fuel means)	Automatic shut off valves	Safe shut off of fuel means	See EN 161:2011+A3:2013	According to EN 161:2011+A3:2013, EN 126:2012		
Unburned gas or oil, explosion	Gas and oil burner controls	Supervise the flame and shut off in case of no flame detection within defined times	See EN 298:2012	According to EN 298:2012		
	Flame supervision devices		See EN 298:2012	According to EN 298:2012		
Too high pressure	Pressure regulator	Regulation of pressure in the relevant parts of the appliance				

Annex EE
(informative)

Classification of control functions based on the determination of basic risks

The determination of the basic risk should be performed without taking into account any possible preventive measures. Only after risk assessment of the control functions any preventive measure should be determined and validated in respect to the classification result.

Factors relevant for risk assessment of applications are:

Parameter S: — seriousness of defects and effects of failures;

In estimating the risk arising from a failure of a safety function only slight injuries (normally reversible or curable) and serious injuries (normally irreversible/ remaining) and death of one or more persons are considered.

To make a decision the usual consequences of accidents and normal healing processes should be taken into account for classifying S. For example, bruising and/or lacerations without complications would be classified as a curable injury (factor 5 to 6), whereas amputation or death would be classified with factor 9 or 10.

Further explanations and examples for classification of parameter S are given in Table EE.1.

Parameter O: — probability of occurrence of hazardous incidents;

The probability of occurrence should be estimated under worst case assumptions. This parameter could be estimated as often, occasional or seldom under consideration of

— forecast of the reaction of the appliance in dependency of the operation mode (normal operation, service, fault finding);

— humans behaviour during interaction with the appliance under consideration of attributes as:

  — stress,

  — experience with the appliance,

  — (missing) risk awareness.

Occurrence should be classified as “often” to reflect the worst case assumption. If the parameter is classified as occasional or seldom, a brief analysis of the circumstances which lead to the hazardous incident is necessary. There shall be given good reasons for the classifications below “often”.

Parameter D: — the probability of discovering failures and avoidance of hazards

It is important to know whether a hazardous situation can be recognised and avoided before leading to an accident. For example, an important consideration is whether the hazard can be directly identified by its physical characteristics, or recognised only by technical means, e.g. indicators. Other important aspects which influence the selection of parameter D include, for example:

— operation with or without supervision;

— operation by experts or non-professionals;

— speed with which the hazard arises (e.g. quickly or slowly);

— possibilities for hazard avoidance (e.g. by escaping).

When a hazardous situation occurs, parameter D should only be classified as high if there is a realistic chance of avoiding an accident or of significantly reducing its effect; it should be classified as low if there is almost no chance of avoiding the hazard.

Classification of basic risk

For each parameter (S, O, D) the classification leads to a numeric value according to Table EE.1 (Parameter S), Table EE.2 (Parameter O) and Table EE.3 (Parameter D).

The values are to be added up. According to the result Table EE.4 gives the adequate safety Class A, B or C according to EN 60730-1:2015.

Table EE.1 — Classification of parameter S

Comment	S	Explanation of the seriousness	Example	Repair of defect
Persons injured – death of one or more persons	10	Result of accident/defect locally very restricted more than 1 affected person (death) affected persons are not close to the appliance	Destroyed building by explosion or fire	**Not possible**
	9	Injured person (death or very heavily injuries with disablement) affected persons is close to the appliance at occurrence Building destroyed	fire in building	
Minor or heavy remaining injury	8	Heavy remaining defects of health, still fit for work Local defect of building	Fire in the installation room restoration also necessary in neighbour rooms	**Time for restoring: some weeks**
	7	Minor remaining defects of health, temporary not fit for work Local defect of building	burns with scars destroyed appliance	**Time for restoring: one day after delivery of appliance for exchange**
Curable injury or strong emotions	6	Curable injuries, temporary not fit for work destroyed component	cuts burner, control defect, unclear reason of failure	**Time for restoring: 1 to 2 h** **after delivery for exchange**
	5	No injuries, strong emotions (entitled fear – apparently unsafe state) Defect in a component	Defect of ignitions mean	**Repair by service staff** **Reaction time some hours**
No injuries	4	No injuries. loss of operation Reversible disturbance on appliance	shutdown of burner	**Repair by service staff on place** **Reaction time some hours**
	3	No injuries but dissatisfaction of client Function with reduced system capability and bad main function	Increased emissions	**Repair by service staff on place** **Reaction time few hours**
	2	Complaint on defects Function with reduced system capability and complete main function, but reduced side function	Annoying noise Defect display	**Repair by service staff on place** **Reaction time some days**
	1	Defect without influence on function/utilisation (main and side function completely fulfilled)		**Repair during inspection or service**

Table EE.2 — Classification of parameter O

Parameter O	Classification
10	often
7	occasional
3	seldom

Table EE.3 — Classification of parameter D

Parameter D	Classification	Explanation	Examples
10	low	Failure hidden, nearly not recognised	Small gas leakage
7	moderate	Failure might be noticed	No response on heat demand
3	high	Failure reliable noticed	Flame failure during cooking process

Table EE.4 — Classification result = S + O + D

Parameter S		Classification result (S+O+D)			
	Effect	7 … 13	14 … 19	20 … 25	26 … 30
10	death of one or more persons		C	C	C
9			C	C	C
8	minor or heavy remaining injury		B	C	C
7		B	B	B	C
6	curable injury or strong emotions	A	B	B	C
5		A	A	B	
4	no injury	A	A	A	
3		A	A	A	
2		A	A	A	
1		A	A	A	

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