

Automatic forced draught burners for liquid fuels

ICS 27.060.10

National foreword

This British Standard is the UK implementation of EN 267:2009+A1:2011. It supersedes BS EN 267:2009 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee GSE/27, Automatic gas and oil burners.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2010

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ISBN 978 0 580 72223 3

Amendments/corrigenda issued since publication

Date	Comments
30 September 2011	Implementation of CEN amendment A1:2011

English Version

Automatic forced draught burners for liquid fuels

Brûleurs automatiques à air soufflé pour combustibles
liquides

Automatische Brenner mit Gebläse für flüssige Brennstoffe

This European Standard was approved by CEN on 5 October 2009 and includes Amendment 1 approved by CEN on 21 July 2011.

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Foreword

This document (EN 267:2009+A1:2011) has been prepared by Technical Committee CEN/TC 47 “Atomizing oil burners and their components - Function - Safety - Testing”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.

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 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annexes ZA, ZB and ZC, which are integral parts of this document.

This document includes Amendment 1, approved by CEN on 2011-07-21.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

This document supersedes A1 EN 267:2009 A1.

According to EN 267:1999 the following fundamental changes are given:

- inclusion of hazards by burners considered as machinery according to Directive 98/37/EC Machinery Directive and Directive 2006/42/EC Machinery Directive;
- additional requirements for burners in the scope with pressurised parts and/or firing pressurised bodies according to Directive 97/23/EC Pressure Equipment Directive (PED);
- in accordance with EN 676 requirements for electrical safety and industrial applications added;
- requirements for higher boiling petroleum based first raffinates added;
- standard structured as EN 676.

Following a request from CEN/TC 47, CEN has agreed to defer the date of withdrawal of EN 267:1999 for a transition period of 24 months.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is primarily intended for automatic forced draught oil burners having a combustion air fan, operated with liquid fuels, and intended to be marketed as a complete assembly.

Forced draught oil burners according to this European Standard are often used in industrial applications. The safety principles are the same as for forced draught oil burners used for household/commercial applications. Industrial forced draught oil burners however need to operate safely in their industrial environment and the risks involved can differ from those for household applications. These industrial forced draught oil burners can be characterised by the ability to withstand industrial environmental influences, like moisture, high temperature, electrical and magnetic phenomena, vibrations, etc.

Special requirements for forced draught burners for industrial premises will be given as a note with the addition "Industrial application".

Further information and application limitations for forced draught burners, which are used for industrial application, are given in informative Annex H.

Principal requirements for installation of oil burners for industrial thermal processing are covered by EN 746-1 to -8.

This document is a type C standard as stated in EN ISO 12100-1 and EN ISO 12100-2.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standard, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This European Standard specifies the terminology, the general requirements for the construction and operation of automatic forced draught oil burners and also the provision of control and safety devices, and the test procedure for these burners.

This European Standard applies to automatic forced draught oil burners supplied with:

- a fuel having a viscosity at the burner inlet of 1,6 mm²/s (cSt) up to 6 mm²/s (cSt) at 20 °C; and
- higher boiling petroleum based first raffinates (viscosity greater than 6 mm²/s), that require preheating for proper atomisation.

This European Standard is applicable to:

- single burners fitted to a single combustion chamber;
- single burners fitted to an appliance with additional requirements, then the relevant standard of this appliance shall be taken into account;
- single-fuel and dual-fuel burners when operating on oil only;
- the oil function of dual-fuel burners designed to operate simultaneously on gaseous and liquid fuels, in which case the requirements of EN 676 will also apply in respect of the gaseous fuel function.

This European Standard deals with all significant machine hazards, hazardous situations and events relevant to burners, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer, see Annex J.

This European Standard also deals with the additional requirements for the burners in the scope with pressurised parts and/or firing pressurised bodies, see Annex K.

This European Standard specifies the requirements to be met by the manufacturer to ensure the safety during commissioning, start-up, operation, shut-down and maintenance.

This European Standard does not deal with hazards due to specific applications.

This European Standard is not applicable to automatic forced draught oil burners which are manufactured before the date of its publication as European Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references only the edition cited applies. For undated references the latest edition of the referenced document (including any amendments) applies.

EN 230, *Automatic burner control systems for oil burners*

EN 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 676:2003+A2:2008, *Automatic forced draught burners for gaseous fuels*

EN 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 1044, *Brazing — Filler metals*

EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1088:1995+A2:2008, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories PN designated — Part 3: Copper alloy flanges*

EN 1254-1, *Copper and copper alloys — Plumbing fittings — Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes*

EN 1254-4, *Copper and copper alloys — Plumbing fittings — Part 4: Fittings combining other end connections with capillary or compression ends*

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

EN 10204, *Metallic products — Types of inspection documents*

EN 10220, *Seamless and welded steel tubes — Dimensions and masses per unit length*

EN 10305-1, *Steel tubes for precision applications — Technical delivery conditions — Part 1: Seamless cold drawn tubes*

EN 10305-2, *Steel tubes for precision applications — Technical delivery conditions — Part 2: Welded cold drawn tubes*

EN 10305-3, *Steel tubes for precision applications — Technical delivery conditions — Part 3: Welded cold sized tubes*

EN 10305-4, *Steel tubes for precision applications — Technical delivery conditions — Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems*

EN 10305-5, *Steel tubes for precision applications — Technical delivery conditions — Part 5: Welded and cold sized square and rectangular tubes*

EN 10305-6, *Steel tubes for precision applications — Technical delivery conditions — Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems*

EN 13611:2007, *Safety and control devices for gas burners and gas burning appliances — General requirements*

EN 15035, *Heating boilers — Special requirements for oil fired room sealed units up to 70 kW*

EN 15036-1:2006, *Heating boilers — Test regulations for airborne noise emissions from heat generators — Part 1: Airborne noise emissions from heat generators*

EN 50156-1:2004, *Electrical equipment for furnaces and ancillary equipment — Part 1: Requirements for application design and installation*

EN 60335-2-102:2005, *Household and similar electrical appliances — Safety — Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IEC 60335-2-102:2004, modified)*

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

EN 60730-1, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1:1999, modified)*

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, auditory and tactile signals (IEC 61310-1:2007)*

EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 1127, *Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length (ISO 1127:1992)*

EN ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 6806, *Plastics hoses and hose assemblies for suction and low-pressure discharge of petroleum liquids — Specification (ISO 6806:1992)*

EN ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (ISO 9606-2:2004)*

EN ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys (ISO 9606-3:1999)*

EN ISO 9606-4, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys (ISO 9606-4:1999)*

EN ISO 9606-5, *Approval testing of welders — Fusion welding — Part 5: Titanium and titanium alloys, zirconium and zirconium alloys (ISO 9606-5:2000)*

EN ISO 11688-1:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15609-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding (ISO 15609-2:2001)*

EN ISO 15609-3, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 3: Electron beam welding (ISO 15609-3:2004)*

EN ISO 15609-4, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 4: Laser beam welding (ISO 15609-4:2009)*

EN ISO 15609-5, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding (ISO 15609-5:2004)*

EN ISO 15612, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure (ISO 15612:2004)*

EN ISO 15614-7, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 7: Overlay welding (ISO 15614-7:2007)*

EN ISO 15614-11, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 11: Electron and laser beam welding (ISO 15614-11:2002)*

EN ISO 23553-1, *Safety and control devices for oil burners and oil-burning appliances — Particular requirements — Part 1: Shut-off devices for oil burners (ISO 23553-1:2007, including Cor 1:2009)*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 1129, *Steel tubes for boilers, super heaters and heat exchangers — Dimensions, tolerances and conventional masses per unit length*

ISO 3183, *Petroleum and natural gas industries — Steel pipe for pipeline transportation systems*

ISO 8217, *Petroleum products — Fuels (class F) — Specifications of marine fuels*

ISO 9329-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Unalloyed steels with specified room temperature properties*

ISO 9330-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Unalloyed steel tubes with specified room temperature properties*

ISO 9330-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties*

ISO 9330-3, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties*

ISO 9330-4, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Submerged arc-welded unalloyed and alloyed steel tubes with specified elevated temperature properties*

ISO 9330-5, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc-welded unalloyed and alloyed steel tubes with specified low temperature properties*

ISO 9330-6, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Longitudinally welded austenitic stainless steel tubes*

ISO 23552-1, *Safety and control devices for gas and/or oil burners and gas and/or oil appliances — Particular requirements — Part 1: Fuel/air ratio controls, electronic type*

3 Terms and definitions

For the purposes of this document the terms and definitions of EN ISO 12100-1:2003 and the following apply.

3.1 General definitions

3.1.1

automatic forced draught burner

burner that is fitted with automatic ignition, flame monitoring and burner control devices

NOTE 1 Ignition, flame monitoring and the on/off switching of the burner occur automatically.

NOTE 2 The heat input of the burner can be adjusted during operation either automatically or manually.

3.1.2

semi-automatic oil burner

burner that differs from the fully automatic burner only in that start-up of the burner is initiated manually by the operating personnel and there is no automatic recycling after switching off the burner

3.1.3

dual-fuel burner

burner in which both gaseous and liquid fuels can be burnt either simultaneously or in succession

3.1.4

burners as a structural unit

individually operating burners that comprise all the devices necessary for operation such as oil atomising, air mixing and recirculating sections, where appropriate internal oil pre-heating devices including oil pressure pump in the case of oil pressure atomisers, combustion air fan (in the case of duo bloc-burners also the combustion air fan delivered separately) and flame detector devices, ignition device and the necessary valves for control and safety shut-down of the burner

3.1.5

industrial applications

the

- extraction,
- growth,
- refining,
- processing,
- production,
- manufacture or
- preparation

of materials, plants, livestock, animal products, food or artefacts

3.2 Fuel throughput and performance

3.2.1

throughput

constant mass of fuel consumed during one hour

NOTE Throughput is expressed in kilograms per hour (kg/h).

3.2.1.1

maximum throughput

mass of fuel consumed during one hour at the highest throughput stated by the manufacturer

NOTE Maximum throughput is expressed in kilograms per hour (kg/h).

3.2.1.2

minimum throughput

mass of fuel consumed during one hour at the lowest throughput indicated by the manufacturer

NOTE Minimum throughput is expressed in kilograms per hour (kg/h).

3.2.2

heat input

Q_F

quantity of energy used in unit time corresponding to the volumetric or mass flow rates, the calorific value used being either the net or gross calorific value

NOTE 1 Burners with fixed heat input or single stage burners have a single heat input.

NOTE 2 Range-rated burners have a maximum heat input and a minimum heat input declared by the manufacturer.

NOTE 3 Heat input is expressed in kilowatts (kW) or in kilograms/hour (kg/h) multiplied with the net calorific value (e.g. 11,86 kW h/kg).

3.2.2.1

maximum heat input

Q_{Fmax}

highest value of the heat input declared by the manufacturer

NOTE Maximum heat input is expressed in kilowatts (kW).

3.2.2.2

minimum heat input

Q_{Fmin}

lowest value of the heat input declared by the manufacturer

NOTE Minimum heat input is expressed in kilowatts (kW).

3.2.2.3

start heat input

Q_s

input of the burner during start-up position as a function of the maximum heat input

NOTE Start heat input is expressed in percent (%).

3.2.2.4

nominal heat input

Q_{FN}

value of the heat input declared by the manufacturer

NOTE 1 Fixed heat input or range-rated burners have a single nominal heat input.

NOTE 2 Range-rated burners can be adjusted between the maximum nominal heat input and the minimum nominal heat input stated by the manufacturer.

NOTE 3 Nominal heat input is expressed in kilowatts (kW).

3.3 Combustion chamber, burner head and test rig

3.3.1

pressure in the combustion chamber

p_F
pressure or depression, relative to atmospheric pressure, prevailing in the combustion chamber

NOTE Pressure in the combustion chamber is expressed in kilopascals (kPa).

3.3.2

length of the combustion chamber

l

distance between the face of the nozzle or the fuel outlet and the rear wall of the test flame tube or combustion chamber

NOTE Length of the combustion chamber is expressed in millimetres (mm).

3.3.3

combustion chamber

part of the appliance in which the combustion takes place

3.3.4

burner head

mixing device consisting of an atomizing system (s) and other components for the mixing of air and fuel, e.g. stabilizing disc, blast tube

3.3.5

test rig

combustion chamber defined by the manufacturer

NOTE In the case where the manufacturer has not defined a combustion chamber, the test is carried out on test rigs with the test flame tubes according to 5.3.

3.4 Composition of the gaseous combustion products

3.4.1

CO₂ content

quantity of carbon dioxide (CO₂) in the dry gaseous products expressed as a proportion of the total volume

NOTE CO₂ content is expressed in percent (%).

3.4.2

O₂ content

quantity of oxygen (O₂) contained in the dry gaseous products, expressed as a proportion of the total volume

NOTE O₂ content is expressed in percent (%).

3.4.3

CO content

quantity of carbon monoxide (CO) in the dry gaseous combustion products, measured as volumetric ml/m³

NOTE CO content is expressed in milligrams per kilowatt hour (mg/kWh).

3.4.4

content of nitrogen oxide

quantity of nitrogen oxide (NO and NO₂) in the dry gaseous combustion products, measured as volumetric ml/m³, calculated as NO₂

NOTE Content of nitrogen oxide is expressed in milligrams per kilowatt hour (mg/kWh).

3.4.5

content of unburned hydrocarbons

quantity of unburned hydrocarbons in the wet gaseous combustion products, measured as volumetric ml/m³, calculated as C₃H₈

3.4.6

smoke number

sample reference, the shade of which is closest to that of the test mark

NOTE See Annex A.

3.4.7

air figure

λ

ratio between the effectively introduced quantity of air and the theoretically required quantity of air

3.5 Adjusting, control and safety devices

3.5.1

flame detector device

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

NOTE 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.

3.5.2

automatic burner control system

system which comprises at least a programming unit and all the elements of a flame detector device

NOTE The various functions of an automatic burner control system can be in one or more housings.

3.5.3

programming unit

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 non-volatile lock-out

NOTE The programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device.

3.5.4

safe start check

procedure employing a protection circuit or circuits, to establish whether or not a fault in a safety system or a flame simulating condition exists prior to start-up

3.5.5

controlled shut-down

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

3.5.6

non-volatile lock-out

safety shut-down condition of the system, such that a recycling can only be accomplished by a manual reset of the system and by no other means

3.5.7

safety shut-down

process which is effected immediately following the response of a safety device or the detection of a fault in the automatic burner control system and which puts the burner out of operation by immediately removing the power to the fuel shut-off valve(s) and the ignition device

NOTE Safety shut-down can also occur as a result of an interruption/decrease of the power supply.

3.5.8

safety shut-off device

device that automatically cuts off the fuel supply

3.5.9

ignition-restoration

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

3.5.10

recycling

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

3.5.11

pressure switch

switch which compares the actual value of a pressure with the desired value, gives a signal when the actual value exceeds or drops below the desired value and initiates the shut-off sequence

3.5.12

ignition device

means (flame, electrical ignition or other means) used to ignite the main burner, or the pilot burner if applicable

3.6 Sequencing times

3.6.1

pre-ignition time

period between the start of the ignition cycle and the release of the fuel

NOTE Pre-ignition time is expressed in seconds (s).

3.6.2

safety time

t_s

duration of the maximum permissible time during which the automatic burner control system allows the fuel to be released without there being a flame

NOTE Safety time is expressed in seconds (s).

3.6.3

ignition safety time

first safety time

t_{smax}

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 Ignition safety time is expressed in seconds (s).

3.6.4

safety time during operation

time starting at the moment the sensed flame is extinguished and ending at the moment the signal for interrupting the fuel supply is given

NOTE Safety time during operation is expressed in seconds (s).

3.6.5

purge time

period during which the combustion chamber is compulsorily ventilated without any fuel being supplied

NOTE Purge time is expressed in seconds (s).

3.6.6

pre-purge time

period during which purge takes place at the proven air rate prior to the energisation of the ignition device

NOTE Pre-purge time is expressed in seconds (s).

3.6.7

post-purge time

period between any shut-down and the moment the fan is switched off

NOTE Post-purge time is expressed in seconds (s).

3.6.8

total closing time

according to EN 676:2003+A2:2008

3.6.9

flame simulation

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

3.6.10

operational state

state commencing with the presence of flame after the permissible ignition safety time has expired

NOTE It is the end of the starting process.

3.6.11

intermittent operation

state of operation the duration of which does not exceed 24 h

3.6.12

continuous operation

state of operation the duration of which exceeds 24 h

3.7

working diagram

admissible range of application of the burner (pressure in the combustion chamber as a function of fuel flow)

3.8

test diagram

test range of the burner during the tests (pressure in the combustion chamber as a function of fuel flow)

3.9

maximum oil pressure

pressure which is generated by the oil pump

4 Constructional and operational requirements – safety requirements and/or protective measures

4.1 Types of atomisation

4.1.1 Mechanical atomisation by pressurisation of the combustion liquid

Atomisation of the fuel by means of an atomising nozzle, through pressure release.

4.1.2 Atomisation by auxiliary fluid

Atomisation is obtained by the fuel flow meeting a flow of air, steam, other gases or any other liquid. These types of burner include particularly:

- emulsion burners, in which there is a prior mixing of the fuel with the atomising fluid;
- rotary cup burners in which atomisation is obtained by the fuel, when leaving the edge of a rotating cup, meets a flow of air, steam, other gases or any other fluid.

Burners having other means of preparation are allowed, if they comply in all other respects with the requirements and test conditions of this European Standard.

4.2 Methods of control of automatic or semi-automatic oil burners

4.2.1 On-off control (single stage burner)

Type of control where the oil burner is either in operation at constant throughput or switched off.

4.2.2 Multi-stage control (two and multi-stage burner)

Type of control where several firing stages (steps) can be utilised. Oil burners with only two firing rates are included in this category.

4.2.3 Modulating control (modulating burner)

Type of control where the throughput may be infinitely varied between the lower and upper limits.

4.3 Means of ignition

4.3.1 Automatic electric ignition

4.3.1.1 General

These are systems in which the ignition of the fuel is brought about by means of electrical energy.

4.3.1.2 Ignition by controlled spark

System in which fuel is released when the presence of the ignition spark has been proven.

4.3.1.3 Ignition by non-controlled spark

System in which fuel may be released when the ignition spark is not controlled.

4.3.2 Automatic ignition with liquid or gaseous fuels

4.3.2.1 General

These are systems in which an ignition burner, which uses liquid or gaseous fuels, ignites the main fuel. The operation of these ignition burners may be either permanent or intermittent. Permanent ignition burners may be started manually. Intermittent ignition burners are started automatically.

Requirements for start gas ignition according to EN 676 shall apply.

4.3.2.2 Ignition by controlled ignition burner

System in which the main fuel supply may only be released when the controlled flame of the ignition burner has been proven.

4.3.2.3 Ignition by non-controlled ignition burner

System in which the main fuel supply may be released when the ignition burner flame is not controlled.

4.4 Construction

4.4.1 Design

4.4.1.1 Design related to combustion

The design and construction of the burner shall for its intended application be such that with the intended input or input range and within the prescribed range of pressure, the liquid fuel that is to be used is burned completely and safely.

The length of the burner head can be varied as long as the performance of the burner is not affected in an unsafe manner.

4.4.1.2 Mechanical safety, stability and control devices

Moving parts shall be shielded if the enclosure provided does not ensure adequate protection; see also 4.5.1.

The construction of the burner shall be in such a way that no instability, distortion or breakage likely to impair its safety can occur.

Levers and similar devices which have to be operated by the installer or user shall be appropriately identified.

The design of the burner shall be such that it can be handled safely. It shall be designed and packaged so that it can be stored safely and without damage.

Where the weight, size or shape of the burner or its components prevents them from being moved by hand, they shall be fitted with means to lift them easily.

Constructional parts accessible during use and maintenance shall be free from sharp edges and corners that might cause damage or personal injury during use or maintenance.

4.4.2 Accessibility for maintenance and use

Burners that can be withdrawn or swivelled out of position without the use of tools shall be interlocked (for example, by means of limit switches) in such a way that they cannot be operated in the withdrawn or swivelled position.

The interlock device shall be equipped with positive mode actuation as defined in 3.7 of EN 1088:1995+A2:2008 and the related part of the control system shall not be less than category 1 in accordance with EN ISO 13849-1.

4.4.3 Soundness

The oil carrying parts of the burner, up to atomising device, shall be sound so that no visible leakage shall occur.

The soundness of parts and assemblies making up the fuel circuit and likely to be dismantled during regular maintenance in situ shall be achieved by the use of unlockable connections which are tight after reassembly. All sealing materials shall remain effective under normal conditions of burner use.

4.4.4 Materials

The quality and thickness of the materials used in the construction of the burner shall be selected in such a way that the constructional and performance characteristics of the system do not deteriorate during operation and for suitable periods when they are installed correctly under the operating, maintenance and adjustment conditions specified by the manufacturer. In particular, all the components of a burner shall withstand the mechanical, chemical and thermal loads that may be encountered during operation. Under normal conditions of use, maintenance and adjustment, they shall not show any changes that could affect their normal functioning.

If the housing contains any metal parts not made of corrosion-resistant material, these shall be suitably protected with an effective anti-corrosion coating.

Asbestos or asbestos-containing materials shall not be used.

Solder that has a melting point below 450 °C after application shall not be used for fuel carrying parts.

The pipe work material shall comply with:

EN 1057, EN 1044, EN 1254-1, EN 1254-4, EN 10220, EN 10305-1 to -6, EN ISO 1127, EN ISO 6806, ISO 3183, ISO 9329-1, ISO 9330-1 to -6 or ISO 1129 as appropriate.

4.4.5 Mounting

The burner shall be designed in such a way that it can be effectively mounted on the heat generator.

The burner components shall be arranged and secured in such a manner that their correct operating position, and above all, the correct position of the burner orifices, cannot change during operation. The correct operating position shall be maintained when accessories are dismantled and re-fitted.

Parts of the burner that are set or adjusted at the stage of manufacture and which should not be manipulated by the user or installer shall be sealed.

Components requiring regular maintenance shall be so arranged or so designed that they are easily detachable. Furthermore, incorrect replacement shall be prevented by design or, when this is not possible, by marking and/or instructions.

4.4.6 Connections

Inlet connections with pressure-tight joints made on the threads, connections within the burner with pressure-tight joints made on the threads that are not loosened for maintenance, and connections for parts that are not frequently dismantled and re-fitted shall be designed in accordance with ISO 7-1.

Connections which have to be loosened for maintenance purposes shall be designed in accordance with EN ISO 228-1. Flange connections shall comply with EN 1092-1, EN 1092-2 and EN 1092-3.

4.4.7 Pressure test points

To enable the fuel suction pressure, the fuel adjustment pressure and the air pressure to be checked, test points or pressure measuring devices shall be provided.

4.5 Equipment

4.5.1 Motors, fans and movable parts

Motors, fans and movable parts shall be so protected by suitable guards, shields or grilles of adequate size, strength and durability that they are not liable to be touched accidentally. The degree of protection shall be at least IP 20, according to EN 60529. Removal of such guards, shields or grilles shall be possible only with the use of commonly available tools.

Belt drives, where used, shall be so designed or positioned as to afford protection to the operator.

Means shall be provided to facilitate adjustment of belt tension. Access to such means shall be possible only with the use of commonly available tools.

Motors and fans shall be mounted in such a way as to minimise noise and vibration.

4.5.2 Electrical safety

The electrical safety of

- a) the burner and
- b) the interfaces (e.g. connectors) between control devices

shall comply with EN 60335-2-102.

The electrical safety of control devices shall comply either with EN 60335-2-102, with EN 60730-1 or its relevant part 2 or with the electrical requirements of the standards listed in Annex ZBB of EN 60335-2-102:2005.

The documentation of the electrical connections for the individual components shall be provided by means of an electrical wiring and connection diagram.

NOTE For burners firing pressurised bodies, see Annex K.

4.5.3 Air flow control device

Every burner shall be fitted with an adjustable air damper or a similar device for controlling the air flow. This device shall be adjustable only by means of a tool. The position of the air damper shall be visible, possibly after removal of a cap.

If the burner is provided with a manual means of adjusting the combustion air flow, this means shall be designed so that it is protected against unintended change after adjustment according to the manufacturer's instructions.

4.5.4 Fuel line components

4.5.4.1 General

All fuel line components shall be designed for their individual inlet pressure and temperature or be protected against any excessive increase in pressure and temperature by means of relevant safety devices.

For piping with a pipe diameter $DN \geq 25\text{mm}$, a pressure $\geq 10\text{ bar}$ and a product of (pressure $\times$ diameter) $\geq 2\,000\text{ bar mm}$, Annex K applies.

The used components shall be designed and laid out to withstand the corrosive properties of the fuels to which they are exposed in service.

4.5.4.2 Manually operated shut-off valve

A manually operated shut-off valve shall be provided upstream of all controls to isolate the burner. If this valve is not supplied by the manufacturer appropriate instruction shall be given in the installation instruction, see 6.4. The manual fuel valve shall be readily accessible.

4.5.4.3 Filter and venting device

A filter shall be fitted upstream the burner to prevent the ingress of foreign elements. Adequate means to vent the fuel supply shall be provided. If these devices are not supplied by the manufacturer appropriate instruction shall be given in the installation instruction, see 6.4.

4.5.4.4 Fuel pressure or flow adjustment device

A fuel pressure adjustment device shall be provided to allow the fuel rate to be achieved with the fuel intended by the manufacturer and over the relevant range of pressures. Adjusters shall require a tool for adjustment.

4.5.4.5 Safety shut-off devices

4.5.4.5.1 General

Safety shut-off devices shall comply with EN ISO 23553-1.

4.5.4.5.2 Burners with a flow rate $\leq 100\text{ kg/h}$

The safety shut-off devices for burners with a flow rate $\leq 100\text{ kg/h}$ shall be provided between the pump and the nozzle corresponding to the burner system as shown in Figures F.1 to F.4. It is permissible that the safety shut-off device be integrated with the oil-pump.

In addition:

- a) single-stage burners shall be provided with one safety shut-off device in accordance with EN ISO 23553-1;
- b) two-stage or multi-stage burners shall be fitted with one safety shut-off device for each nozzle (see Figure F.2);
- c) burners with spill back nozzle shall be fitted with a safety shut-off device complying with EN ISO 23553-1 in the feed line and in the return line. The nozzle shut-off valve may be fitted in lieu of one each of the safety shut-off devices in the feed line and in the return line, on conditions that nozzle shut-off valve is tested and approved as a safety shut-off device in accordance with EN ISO 23553-1. For atomizing oil burning with spill back nozzle and an oil throughput $> 30\text{ kg/h}$ a pressure switch in the return line shall be provided. The pressure switch has to monitor the pressure in the return line (see Figures F.3 and F.4);
- d) in the case of a burner with a nozzle head it may be necessary to have oil circulation up to the nozzle head, e.g. for preheating purposes. Since there is only a nozzle shut-off device in service, it shall be ensured by a second independent measure that an unsafe fuel discharge is prevented. In case of a nozzle shut-off device in accordance with EN ISO 23553-1 a second measure is not necessary. It shall be ensured that the nozzle shut-off device cannot be opened by the return pressure.

4.5.4.5.3 Burners with a flow rate > 100 kg/h

Two series-connected safety shut-off devices shall be provided in the flow of oil burners with a flow rate > 100 kg/h, see Figure F.5. One of the devices shall be of the fast closing type. The second device may also be used, as a final controlling element for the combustion chamber input and the closing time shall not exceed 5 s.

In the case of burners with a spill back nozzle, two safety shut-off devices shall be provided in the return line and one pressure switching device between the power regulator and the shut-off device (see Figures F.6 and F.7). A nozzle shut-off valve may replace a safety shut-off device in each line, one in the flow and one in the return line, provided it has been tested and certified as a safety shut-off device in accordance with EN ISO 23553-1.

The safety shut-off devices shall be interlocked so that when the flow is open the return is not closed (does not apply to the full-load stage in the case of step-regulated return burners). This can be done, for example, by

- a mechanical connection between the safety shut-off devices in the flow and return by means of an actuator; or
- electric or pneumatic interlocking of the safety shut-off devices in the flow and return.

It shall be ensured that no excessive pressure builds up between the two shut-off devices.

In the case of a burner with a nozzle head it may be necessary to have oil circulation up to the nozzle head, e.g. for preheating purposes. Since there is only a nozzle shut-off device in service, it shall be ensured by a second independent measure that an unsafe fuel discharge is prevented. In case of a nozzle shut-off device in accordance with EN ISO 23553-1 a second measure is not necessary. It shall be ensured that the nozzle shut-off device cannot be opened by the return pressure.

4.5.5 Fuel preheating

4.5.5.1 General

Burner using higher boiling petroleum based first raffinates (viscosity greater than 6 mm²/s) shall be provided with the following features according to 4.5.5.2 to 4.5.5.5.

4.5.5.2 Heat sources

The heat source for oil preheating

- shall be capable of being cut off immediately if required, and
- shall have a heating output which is automatically controlled.

Open flames shall not be permitted.

4.5.5.3 Preheating temperature

In the unpressurised condition the fuel oil temperature shall not attain the fuel oil flash point and in any case shall not exceed 90 °C.

To attain the temperature for the required atomisation viscosity, pressure type preheaters shall be used. The maximum temperature shall not exceed a temperature which is 5 K below the boiling temperature of water at the connected pressure.

4.5.5.4 Control of preheating temperature

Each fuel oil preheating system shall be automatically controlled.

Systems for preheating nozzle holder or different components of hydraulics circuits (e.g. pumps, piping, filters) are excluded.

Shut down devices (e.g. thermostat) should prevent a temperature rise above 220 °C of the preheating systems surface within unpressurised oil fuel vessels, in case if it is not being wetted with oil fuel.

4.5.5.5 Pressurised preheaters

NOTE For pressurised vessels and preheaters, the requirements for pressure vessels should be applied. Preheaters should be designed for 1,43 time the permissible operating pressure.

If the preheater is used in a closed system, an overpressure protection by constructional means or a pressure switch shall be provided.

Functioning of the necessary overpressure protection shall be ensured by suitable temperature control. Any escaping oil shall be safely discharged.

4.5.6 Ignition device

4.5.6.1 General

The ignition device shall ensure safe ignition of the ignition and/or main burner under the specified conditions of operation.

4.5.6.2 Flame detector device

The main flame and the flame of any ignition burner shall be monitored by a flame detector device. The flame detector device shall be in accordance with EN 230.

The mounting of the flame sensors on the burner shall be such that the flame sensors do not receive any extraneous signal.

Where the ignition burner and the main burner are each provided with their own flame monitor the ignition burner flame shall not influence the detection of the main flame. The main fuel supply shall be opened only after the ignition means is switched off and the ignition burner flame has been established and detected.

For systems where the ignition burner remains in use during main burner operation, separate flame sensors to monitor the ignition and main flames shall be fitted. The main flame sensor shall be so positioned that it cannot in any circumstance detect the ignition burner flame.

For systems where the ignition burner is extinguished during main burner operation a single sensor will suffice. The ignition burner flame shall not influence the detection of the main flame.

The flame detector device shall be such that upon flame failure there is no noticeable delay between the flame extinction and the failure of the flame signal.

The flame detector device shall be suitable for the particular thermal rating and mode of operation of the burner (intermittent or permanent operation). When installed on the burner it shall comply at least with protective category IP 40, and with protective category IP 54 for installations in the open air, in accordance with EN 60529.

The flame detector device shall be subjected to a safe start check which shall lead to safety shut-down or non-volatile lock-out, if the flame detector device signals flame presence at any time during the pre-purge. The safe-start check may cease during the 5 s preceding an attempt at ignition. If a flame simulating condition exists, non-volatile lock-out shall occur.

The time for the safety shut-off valves to be de-energised upon flame failure shall be not more than 1 s during normal operation and not more than 2 s where a self-checking test is made at the same time as the flame failure.

4.5.6.3 Air proving device

An air proving device is not necessary if there is a motor-fan-pump assembly in the case of a single shaft motor output or a fan-motor-oil pump assembly in the case of a double ended shaft motor output. There shall be a positive coupling between the motor and the fan.

To the above named requirements equivalent is a safety related speed monitoring of the fan which fulfils the requirements according to EN 13611, class C.

If a burner, depending on his design, requires an air proving device the following applies:

The burner shall be fitted with a device for proving adequate air flow during the pre-purge, ignition and operation of the burner. Air flow failure at any time during the ignition or operation of the burner shall cause non-volatile lock-out.

Air flow failure during pre-purge shall at least proceed to safety shut-down.

For burners of heat input up to and including 120 kW a safety shut-down followed by a single attempt at recycling is permitted. If this recycling attempt fails then non-volatile lock-out shall occur.

Proof of adequate air flow may be achieved by one of the following methods:

- a) by pressure sensing using a pressure switch according to EN 1854. By using electronic pressure sensors these shall be carried out in class C according to EN 13611;
- b) by flow sensing; design in analogy to EN 1854. By using electronic pressure sensors these shall be carried out in class C according to EN 13611;
- c) by any other system which does not rely only on fan rotation. An air damper interlock or an air damper actuator interlock alone is not sufficient.

The air proving device shall be proved in the no flow state prior to start-up. Failure to prove the device in the no flow state shall prevent start-up or cause non-volatile lock-out.

This check is not necessary if failure of the air proving device leads to a safe condition.

The air proving device shall be adjusted in such a way that if there is insufficient air supply at the highest or lowest burner operating stage, the device operates so that no critical operating mode is reached.

Where the burner is fitted with automatic fuel/air ratio control in which an air flow device provides the lead signal, continuous monitoring of the air flow by the air proving device during the operation of the burner is not necessary. In the event of the failure of the air lead signal the safety shut-off device shall be closed.

NOTE For multi-stage and modulating burners only one air proving device is necessary to control the air flow. In such cases adequate airflow will be ensured as required by this clause.

An air proving device may be omitted if the burners are fitted with:

- a device for checking the actual fan speed if no safety shut-down or blocking occurs, and
- a device for checking the state of the adjustable air damper during pre-purge, if no oil opening occurs, and
- a device for a positive coupling between motor/fan, and
- a device for fuel release via fuel/air ratio control, and
- a device which shall close the oil valve in the event of the failure of the air reference signal.

If separate combustion air fan to the burner is used, proof of adequate airflow is in principle the same as for a burner according to this European Standard, only the positioning of the safety devices can be dependent on the situation on site. The air proving device shall be located in such a position, that sufficient air combustion supply is detected.

The test method for the air proving device shall be effective and comply with the special design of the burner.

4.5.6.4 Air/fuel ratio control devices

Each burner shall be provided with an adjustment device for the airflow.

For two-stage or multi-stage burners the flow rate of combustion air and fuel oil shall be controlled in tandem by a sequential switching system. The air and fuel adjustment devices shall be interconnected (e.g. by mechanical, electric or electronic means) such that the relationship between combustion air and fuel is fixed in a repeatable way at any operating point of the burner.

On multi-stage or modulating burners where the air and fuel flows are not altered simultaneously, there shall be either:

- a) air lead on increasing firing rate and fuel lead on reducing firing rate; or
- b) sufficient excess air to prevent fuel-rich firing.

The combined control or the sequential switching shall be effected in such a manner that, even in the case of fault, the system will tend towards higher excess air or proceed to safety shut-down.

Where an electronic operated fuel/air ratio device is fitted it shall comply with the requirements of ISO 23552-1.

NOTE Even for burners used for intermittent operation, the electronic fuel/air ratio control system, have to fulfil the requirements of the above mentioned International Standard.

4.5.7 Automatic burner control unit

The automatic burner control unit shall comply with the requirements of EN 230 and shall be suitable for the individual output stages of the burner. The automatic burner control unit shall be suitable for the mode of burner operation (intermittent or permanent).

4.6 Functional and operational requirements

4.6.1 General function requirements

4.6.1.1 General

The equipment specified in 4.5 shall be mechanically or electrically designed such that the requirements laid down in the following sub-clauses are satisfied.

The functioning of any safety device shall not be overridden by that of any control device.

4.6.1.2 Burner start-up

Burner start-up shall be possible only if the following conditions have been complied with:

- a) any burner mounting interlock (see 4.4.2) is indicating correct location for the safe operation of the burner;
- b) the flame detector device has been checked according to EN 230 for flame simulation;
- c) the air flow proving device, if necessary, has been proved to be functioning correctly;

- d) the required pre-heating temperature, if necessary, has been reached.

4.6.1.3 Pre-purge

4.6.1.3.1 For nominal fuel throughputs ≤ 30 kg/h:

- a) natural ventilation of the combustion chamber is sufficient if the air regulation elements are fixed permanently in their operating positions;
- b) arrangements shall be made to ensure a mechanical pre purge (by fan) of at least 5 s if air registers with positive control (e.g. electro-hydraulic) are used. This mechanical pre purge may be replaced by a natural ventilation of the combustion chamber (by means of the flue draught) for a period of at least 30 s;
- c) mechanical pre-purge is not required in the case of air registers operated by vacuum if the closed damper blade allows sufficient openings for an air flow of at least 20 % of the maximum fan flow;
- d) where positively operated registers are situated in the flue gas side the conditions stated under b) shall be applied in a corresponding manner.

4.6.1.3.2 For nominal fuel throughputs > 30 kg/h:

- a) the pre-purge time is fixed at 15 s minimum with an air rate of at least 30 % of the air rate corresponding to the maximum heat input of the heat generator to be equipped. For special cases which are submitted to testing, a pre-purge time shorter (e.g. steam generators) or longer (e.g. shell boilers) than 15 s may be required;
- b) if the positively operated registers are situated on the flue gas side, the conditions given in a) shall be applied accordingly.

NOTE Industrial application: The content of the combustion chamber/connected spaces and flue duct should be purged at least five times by the burners pre-purge as given in EN 746-2.

4.6.2 Ensuring adequate oil pre-heating

If fuel oil pre-heaters are used, suitable automatic devices shall be installed to ensure that the oil burner is not started up before the required fuel oil temperature has been reached and is shut down if this temperature is not reached, provided that the preheating is necessary for correct operation.

4.6.3 Start heat input and safety times

The safety equipment for the flame supervision system shall ensure that the safety times for ignition given in Table 1 are adhered to.

Table 1 — Maximum start heat input Q_{smax} and ignition safety times t_{smax}

Heat input Q_F kg/h	Direct main burner ignition at full rate t_{smax} s	Direct main burner ignition at reduced rate Q_s t_{smax} in s Q_{smax} in %	Reduced rate Q_s by ignition burner t_{smax} in s Q_{smax} in %
≤ 30	$t_{smax} = 10$	$t_{smax} = 10$	$t_{smax} = 10$
$> 30, \leq 100$	$t_{smax} = 5$	$t_{smax} = 5$	$t_{smax} = 5$
$> 100, \leq 500$	not permitted	$t_{smax} = 5$ ≤ 100 kg/h or $Q_{smax} \leq 70$	$t_{smax} = 5$ ≤ 100 kg/h
> 500	not permitted	$t_{smax} = 5$ $Q_{smax} \leq 35$	$t_{smax} = 5$ $Q_{smax} \leq 50$

In the case of an ignition burner ignited by electric energy, supervision of the pilot flame is necessary if the time between opening of the fuel shut-off valve of the ignition burner and opening of the main oil valve of the main burner is more than 5 s.

Separate supervision of the pilot flame is not necessary up to 5 s pre-ignition time if the oil supply is cut off and the pilot valve closed within the safety time in the case of non-ignition of the oil flame. In this case, the ignition fuel is permitted to flow for a maximum of 10 s (5 s pre-ignition time and 5 s safety time).

4.6.4 Non-volatile lock-out, recycling and ignition restoration of the oil burner

The oil supply shall be cut off automatically and non-volatile lock-out occurs not later than at the end of the safety time if one of the following conditions apply:

- a) during the oil burner start-up, no flame has been established at the end of the safety time;
- b) the flame is extinguished during operation:
 - 1) in this case, a re-cycling attempt is allowed;
 - 2) for burners ≤ 30 kg/h, one ignition restoration is allowed (see EN 230).

A recycling of the oil burner may not be possible until the burner control unit has been manually reset.

NOTE Industrial application: Burners do not need a limitation in start-up heat input when the applied ignition system is reliable. They should have enough energy to ensure a safe ignition of the main burner without excessive pressure increase.

4.6.5 Start gas ignition

Requirements for start gas ignition according to EN 676 shall apply.

4.6.6 Main burner ignition

If the start flame has been ignited and proved, the second safety time shall be not more than 5 s. At the end of this time the main flame shall be detected. If the main flame is not detected at the end of this period, non-volatile lock-out shall result.