



BSI Standards Publication

Forced draught burners for liquid fuels

National foreword

This British Standard is the UK implementation of EN 267:2020. It supersedes BS 799-3:1981, BS 799-4:1991 and BS EN 267:2009+A1:2011, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/13, Liquid fuel firing.

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association. It is intended to support requirements of the EU legislation detailed in the European Foreword. A European Annex, usually Annex ZA or ZZ, describes how this publication relates to that EU legislation.

For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

© The British Standards Institution 2024
Published by BSI Standards Limited 2024

ISBN 978 0 539 30040 6

ICS 27.060.10

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2020.

Amendments/corrigenda issued since publication

Date	Text affected
31 January 2024	Correction to supersession details and addition of designated standard text in national foreword

English Version

Forced draught burners for liquid fuels

Brûleurs à air soufflé pour combustibles liquides

Gebläsebrenner für flüssige Brennstoffe

This European Standard was approved by CEN on 8 October 2019.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword.....	4
Introduction	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	12
3.1 General definitions.....	12
3.2 Fuel flow rate and heat input.....	13
3.3 Combustion chamber, burner head and test rig	14
3.4 Composition of the gaseous combustion products	15
3.5 Adjusting, control and safety devices	16
3.6 Sequencing.....	17
3.7 Diagrams	20
4 Classification, constructional and operational requirements – safety requirements and/or protective measures	21
4.1 Types of atomization.....	21
4.2 Methods of control of automatic or semi-automatic oil burners.....	21
4.3 Means of ignition	21
4.4 Construction.....	22
4.5 Equipment	24
4.6 Functional and operational requirements	30
4.7 Working diagram and test diagram	34
4.8 Combustion products quality	36
4.9 Machine safety requirements and/or protective measures.....	39
5 Testing.....	39
5.1 General.....	39
5.2 Test room	40
5.3 Test rig	40
5.4 Measuring equipment	44
5.5 Measuring accuracy.....	45
5.6 Test conditions.....	46
5.7 Test programme	47
5.8 Replacement of individual parts and equivalent components.....	56
6 Marking and labelling.....	56
6.1 General.....	56
6.2 Data plate	56
6.3 Other marking	56
6.4 Instructions for installation, adjustment, maintenance and operation.....	57
6.5 Packaging	58
Annex A (normative) Smoke number	59
Annex B (normative) Determination of combustion characteristics — Carbon monoxide and nitrogen oxides, conversion and corrections	61
Annex C (informative) Void	65
Annex D (normative) FID measuring method for recording the unburned hydrocarbons.....	66

Annex E (informative) Conformity evaluation.....	67
Annex F (informative) Examples for equipping of burners.....	70
Annex G (informative) Other fuels	74
Annex H (informative) Specific additional requirements and limitations for use of EN 267 burners for industrial applications.....	75
Annex I (informative) Check of the air proving device	76
Annex J (normative) Machine related hazards - additional safety requirements and/or protective measures.....	77
Annex K (normative) Additional requirements for burners with pressurized parts and burners firing pressurized bodies as defined in the Pressure Equipment Directive (PED) 2014/68/EU	82
Annex L (normative) Electrical requirements – modifications to EN 60204-1	90
Annex M (normative) Equipment to increase the efficiency of the burner - boiler installation	105
Annex N (informative) Electrical interfaces for burners.....	106
Annex O (informative) Environmental checklist EN 267	111
Annex P (informative) Guide for the applicability of the different standards on electrical safety	113
Annex Q (informative) Verification procedures for market surveillance purposes (ErP)	115
Annex ZA (informative) Relationship between this European Standard and the ecodesign requirements of Commission Regulation (EU) No 813/2013 aimed to be covered	116
Bibliography	117

European foreword

This document (EN 267:2020) 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 July 2020, and conflicting national standards shall be withdrawn at the latest by January 2023.

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

This document supersedes EN 267:2009+A1:2011.

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 Directives.

For relationship with EU Directives, see informative Annex ZA, which are integral parts of this document.

Compared to EN 267:2009+A1:2011 the following fundamental changes have been made:

- based on ISO 22968 where different to EN 267:2009+A1:2011 such as:
 - flow rate from 100 kg/h to 30 kg/h requires a second valve, where the 30 kg/h are replaced by 400 kW;
 - update of definitions;
 - electrical interfaces for burners;
- modification:
 - test and working diagram NO_x emission calculation;
 - replacement of EN 50156-1:2004 by EN 60204-1 to include international available requirements for the electrical safety of machines; see Annex L with editorial allocation in Annex K;
 - Annex J is adapted to the new ISO EN 12100 which is substituting EN 1050 which is currently referenced to in Table J.1;
 - mass flow rate is changed into heat input;
- new functions / requirements:
 - remote reset;
 - environmental aspects (environmental check list);
 - increase of burner efficiency;
 - terminology for burner load control;
 - NO_x mean value for evaluating the NO_x classes;
 - implementing new requirements to comply with the 2013/813 (ErP);

- requiring of a risk assessment as required by EU directive 2014/35/EU for LVD and EU Directive 2014/30/EU for EMC.

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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is primarily intended for 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 document are also 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 characterized 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 are given in the form of notes and identified by “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 746-2.

This document is a type C standard as stated in EN ISO 12100.

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

This document applies to forced draught oil burners supplied with:

- fuel based on first raffinates and their mixtures with biogenous liquid fuels 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 atomization.

This document is applicable to:

- single burners fitted to a single combustion chamber;
- single burners fitted to an appliance with additional requirements;

NOTE When additional requirements which are not identified or specified in this standard apply, the specification of the required safety measures and/or protective devices and compliance with them is outside the scope of this standard.

- single-fuel and dual-fuel burners when operating on oil only;
- the oil function of dual-fuel burners designed to operate simultaneously on liquid and gaseous fuels, which, for the latter, the requirements of EN 676 also apply.

This document 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, see Annex J.

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

This document specifies the requirements to ensure the safety during commissioning, start-up, operation, shut-down and maintenance.

This document deals also with forced draught burners intended to be used with biogenous liquid fuels, mixtures.

This document deals also with burners and their equipment to increase the total appliance efficiency, see Annex M.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 298:2012, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*

EN 676:2017, *Forced draught burners for gaseous fuels*

EN 1057:2006+A1:2010, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1092-1:2007+A1:2013, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1092-2:1997, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

EN 1092-3:2003, *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 1254-4:1998, *Copper and copper alloys — Plumbing fittings — Part 4: Fittings combining other end connections with capillary or compression ends*

EN 1854:2010, *Pressure sensing devices for gas burners and gas burning appliances*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10220:2002, *Seamless and welded steel tubes — Dimensions and masses per unit length*

EN 10305-1:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 1: Seamless cold drawn tubes*

EN 10305-2:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 2: Welded cold drawn tubes*

EN 10305-3:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 3: Welded cold sized tubes*

EN 10305-4:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems*

EN 10305-5:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 5: Welded cold sized square and rectangular tubes*

EN 10305-6:2016, *Steel tubes for precision applications — Technical delivery conditions — Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems*

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

EN 15035:2006, *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 15456:2008, *Heating boilers — Electrical power consumption for heat generators — System boundaries - Measurements*

EN 50156-1:2015, *Electrical equipment for furnaces and ancillary equipment — Part 1: Requirements for application design and installation*

EN 50205:2002, *Relays with forcibly guided (mechanically linked) contacts*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005)*

EN 60335-2-102:2016, *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)*

HD 60364-4-41:2007, *Low-voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock (IEC 60364-4-41:2005)*

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

EN 60664-1:2007, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests (IEC 60664-1:2007)*

EN 60721-3-1:1997, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Section 1: Storage (IEC 60721-3-1:1997)*

EN 60721-3-2:1997, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Section 2: Transportation (IEC 60721-3-2:1997)*

EN 60721-3-3:1995, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Section 3: Stationary use at weatherprotected locations (IEC 60721-3-3:1994)*

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

EN 60730-2-5:2015, *Automatic electrical controls — Part 2-5: Particular requirements for automatic electrical burner control systems (IEC 60730-2-5:2013)*

EN 60947-4-1:2010, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters (IEC 60947-4-1:2009)*

EN 60947-2:2016, *Low-voltage switchgear and controlgear — Part 2: Circuit-breakers (IEC 60947-2:2016)*

EN 61000-4, *Electromagnetic compatibility (EMC) — Testing and measurement techniques*

EN 61000-4-13:2002, *Electromagnetic compatibility (EMC) — Part 4-13: Testing and measurement techniques — Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests (IEC 61000-4-13:2002)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61558-2-3:2010, *Safety of transformers, reactors, power supply units and combinations thereof — Part 2-3: Particular requirements and tests for ignition transformers for gas and oil burners (IEC 61558-2-3:2010)*

EN 61558-2-6:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V — Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers (IEC 61558-2-6:2009)*

EN 61810-1:2015, *Electromechanical elementary relays — Part 1: General and safety requirements (IEC 61810-1:2015)*

EN 62061:2005, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2005)*

EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 1127:1996, *Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length (ISO 1127:1992)*

EN ISO 3183:2012, *Petroleum and natural gas industries — Steel pipe for pipeline transportation systems (ISO 3183:2012)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 6806:2014, *Rubber hoses and hose assemblies for use in oil burners — Specification (ISO 6806:2014)*

EN ISO 9606-1:2013, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1:2012 including Cor 1:2012)*

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

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

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

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

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

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

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

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

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

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

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

EN ISO 15609-5:2011, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding (ISO 15609-5:2011, Corrected version 2011-12-01)*

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

EN ISO 15614-7:2016, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 7: Overlay welding (ISO 15614-7:2016)*

EN ISO 15614-11:2002, *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 17672:2016, *Brazing — Filler metals (ISO 17672:2016)*

EN ISO 23553-1:2014, *Safety and control devices for oil burners and oil-burning appliances — Particular requirements — Part 1: Automatic and semi-automatic valves (ISO 23553-1:2014)*

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 1129:1980, *Steel tubes for boilers, superheaters and heat exchangers — Dimensions, tolerances and conventional masses per unit length*

ISO 8217:2017, *Petroleum products — Fuels (class F) — Specifications of marine fuels*

ISO 9329-1:1989, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Unalloyed steels with specified room temperature properties*

ISO 9330-1:1990, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Unalloyed steel tubes with specified room temperature properties*

ISO 9330-2:1997, *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 9330-3:1997, *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 9330-4:2000, *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 9330-5:2000, *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 9330-6:1997, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Longitudinally welded austenitic stainless steel tubes*

ISO 23552-1:2007, *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 given in EN ISO 12100:2010 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 General definitions

3.1.1

forced draught burner

burner in which the total air for combustion is supplied by means of a fan

3.1.2

automatic forced draught burner

forced draught burner that is fitted with an ignition, and automatic burner control system where the ignition, flame monitoring and the on/off switching of the burner occurs automatically

Note 1 to entry: The heat input of the burner can be adjusted during operation either automatically or manually.

3.1.3

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

3.1.4

dual-fuel burner

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

3.1.5

industrial application

forced draught burner utilization and operation in industrial environment

EXAMPLE industrial application in:

- the extraction,
- growth,
- refining,
- processing,
- production,

- manufacture, or
- preparation of materials, plants, livestock, animal products, food or artefacts.

3.2 Fuel flow rate and heat input

3.2.1

fuel flow rate

constant volume or mass of fuel consumed during a period of time

Note 1 to entry: Fuel flow rate is expressed in kilograms per hour (kg/h) as mass flow rate.

Note 2 to entry: Fuel flow rate is expressed in litre per hour (l/h) as volume flow rate.

3.2.1.1

maximum fuel flow rate

mass or volume of fuel consumed during a period of time at maximum heat input

3.2.1.2

minimum fuel flow rate

mass or volume of fuel consumed during a period of time at minimum heat input

3.2.2

heat input

Q_F

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

Note 1 to entry: Heat input is expressed in kilowatts (kW) and is calculated as fuel flow rate multiplied with the net calorific value.

3.2.2.1

maximum heat input

Q_{Fmax}

highest value of the heat input given in the instructions

Note 1 to entry: Maximum heat input is expressed in kilowatts (kW).

3.2.2.2

minimum heat input

Q_{Fmin}

lowest value of the heat input given in the instructions

Note 1 to entry: 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 ratio of the maximum heat input

Note 1 to entry: Start heat input is expressed in percent (%).

3.2.2.4

nominal heat input

Q_{FN}

value of the heat input given in the instructions

Note 1 to entry: Fixed heat input burners have a single nominal heat input.

Note 2 to entry: Range-rated burners can be adjusted between the maximum nominal heat input and the minimum nominal heat input given in the instructions.

Note 3 to entry: Nominal heat input is expressed in kilowatts (kW).

3.3 Combustion chamber, burner head and test rig

3.3.1

combustion chamber

part of the appliance in which the combustion takes place

3.3.2

pressure in the combustion chamber

p_F

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

Note 1 to entry: Pressure in the combustion chamber is expressed in kilopascals (kPa).

3.3.3

length of the combustion chamber

l_1

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

Note 1 to entry: Length of the combustion chamber is expressed in metres (m).

3.3.4

diameter of the combustion chamber

d_1

inner diameter of the combustion chamber around the flame tube of the burner

Note 1 to entry: The diameter of the combustion chamber is measured in metres (m).

3.3.5

burner head

mixing device consisting of an atomizing system and other components for the mixing of air and fuel

EXAMPLE Stabilizing disc.

3.3.6

burner flame tube

device which hosts the mixing device and the root of the flame

3.3.7

test flame tube

cylindrical part of the test rig where the combustion takes place

3.4 Composition of the gaseous combustion products

3.4.1

content of carbon dioxide (CO₂)

ratio of the volume of carbon dioxide to the total volume of dry gaseous products in which it is present

Note 1 to entry: The carbon dioxide content is expressed as a percentage volume fraction.

3.4.2

content of oxygen (O₂)

ratio of the volume of oxygen to the total volume of dry gaseous products in which it is present

Note 1 to entry: The oxygen content is expressed as a percentage volume fraction.

3.4.3

content of carbon monoxide (CO)

ratio of the volume of carbon monoxide to the total volume of dry gaseous products in which it is present

Note 1 to entry: The carbon monoxide content is expressed as a volume fraction, in units of millilitres per cubic metre (ml/m³) for measuring purposes and in milligrams per kilowatt hour (mg/kWh) related to inferior calorific value (*Hi*) for calculation purposes and declaring values.

3.4.4

content of nitrogen oxides (NO_x)

ratio of the combined volume of nitrogen oxides to the total volume of dry gaseous products in which they are present

Note 1 to entry: The nitrogen oxides content is expressed as a volume fraction, in units of millilitres per cubic metre (ml/m³) for measuring purposes and in milligrams per kilowatt hour (mg/kWh) related to inferior calorific value (*Hi*) for calculation purposes and declaring values.

3.4.5

content of unburned hydrocarbons

ratio of the volume of unburnt hydrocarbons to the total volume of wet combustion products in which they are present on an air free basis

Note 1 to entry: It is expressed in millilitres per cubic metre (ml/m³), calculated as C₃H₈.

3.4.6

smoke number

sample reference, the shade of which is closest to that of the comparison scale

Note 1 to entry: See Annex A.

3.4.7

excess air ratio

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 1 to entry: 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, can be assembled in a single housing together 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 1 to entry: The various functions of an automatic burner control system can be in one or more housings.

3.5.3

programming unit

device that 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 1 to entry: 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 removed based on the removed heat demand

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 activated 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 1 to entry: 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

3.5.13**remote reset**

manual reset after a lock-out carried out from a location different from the safety related device

Note 1 to entry: The connection between the place of reset and the safety related device on the application can be by electrical or electronic circuit. It complies with the single fault criterion.

3.6 Sequencing**3.6.1****pre-ignition time**

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

Note 1 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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 1 to entry: 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 energization of the ignition device

Note 1 to entry: 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 1 to entry: Post-purge time is expressed in seconds (s).

3.6.8

total closing time

period that starts with the signal that the flame has been extinguished and ends with the shut-off valves being closed

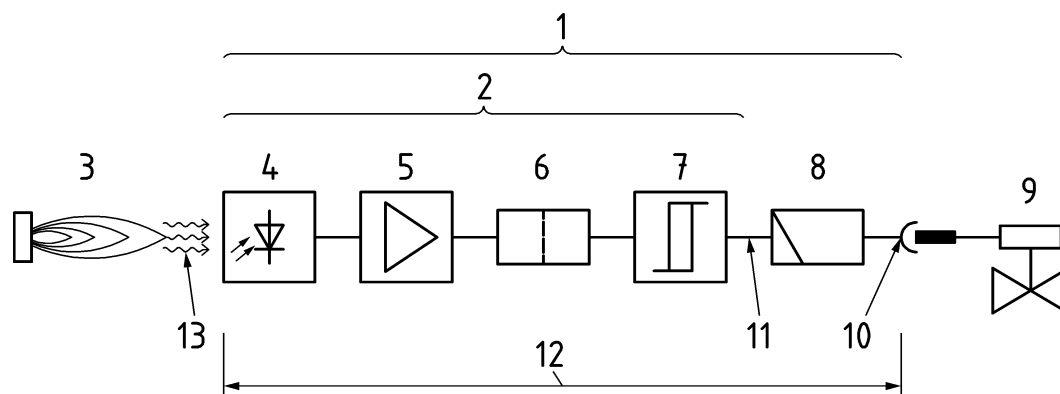
Note 1 to entry: The total closing time is expressed in seconds (s).

3.6.9

flame detector device

device by which the presence of a flame is detected and signalled (see Figure 1)

Note 1 to entry: Flame detector devices can consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, can be assembled in a single housing together with a programming unit.

**Key**

1	automatic burner control system (see 3.5.2)	8	programming unit (see 3.5.3)
2	flame detector device (see 3.6.9)	9	shut-off valve (see 3.5.8)
3	flame	10	shut-off valve terminal
4	flame sensor (see 3.6.11)	11	flame signal (see 3.6.14)
5	amplifier	12	flame failure response time (see 3.6.12.1)
6	filter		
7	threshold		

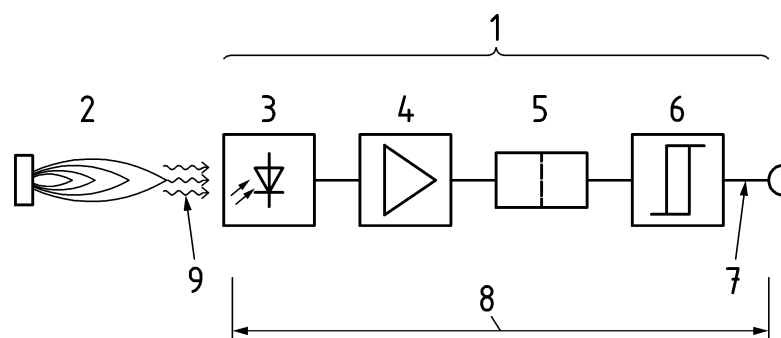
Figure 1 — Basic functional chain of a typical flame supervision

3.6.10

independent flame detector device

flame detector device which operates independent of the programming unit to provide the class C control function (see Figure 2)

Note 1 to entry: Self-checking functions are incorporated in this type of flame detector device.

**Key**

1	independent flame detector device (see 3.6.10)	6	threshold
2	flame	7	flame signal (see 3.6.14)
3	flame sensor (see 3.6.11)	8	flame failure detection time (see 3.6.12.2)
4	amplifier	9	sensed flame (see 3.6.13)
5	filter		

Figure 2 — Basic functional chain of an independent flame detector device

3.6.11

flame sensor

device which reacts to the presence of the flame by providing an output signal that is used for further signal processing

3.6.12

time in case of flame failure

3.6.12.1

flame failure response time

FFRT

response time between the loss of a sensed flame and the resulting de-energizing of the shut-off valve terminals

Note 1 to entry: FFRT may be referred to as “extinction safety time” in appliance standards.

3.6.12.2

flame failure detection time

FFDT

response time of an independent flame detector device between the loss of a sensed flame and the flame signal indicating the absence of a flame

3.6.13

sensed flame

physical value monitored by the flame sensor

3.6.14

flame signal

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

3.6.15

flame simulation

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

3.6.16

operational state

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

Note 1 to entry: It is the end of the starting process.

3.6.17

intermittent operation

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

3.6.18

continuous operation

state of operation the duration of which exceeds 24 h

3.7 Diagrams

3.7.1

working diagram

admissible range of application of the burner (pressure in the combustion chamber as a function of heat input)

3.7.2**test diagram**

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

3.8**maximum oil pressure**

highest oil pressure which is declared in the technical documentation

Note 1 to entry: This is PS as defined in the PED.

4 Classification, constructional and operational requirements – safety requirements and/or protective measures

4.1 Types of atomization

4.1.1 Mechanical atomization by pressurization of the combustion liquid

Atomization of the fuel is obtained by means of an atomizing nozzle, through pressure release.

4.1.2 Atomization by auxiliary fluid

Atomization of the fuel 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 atomizing fluid;
- rotary cup burners in which atomization 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 with all other requirements and test conditions of this documents.

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 heat input or switched off.

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

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

4.2.3 Modulating control (modulating burner)

Type of control where the heat input 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 676:2017 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 General

A risk assessment shall be performed.

4.4.2 Design

4.4.2.1 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 burner head may be lengthened as long as the performance of the burner is not effected in an unsafe manner. The geometry of the mixing device and its position in the burner flame tube shall remain unchanged.

4.4.2.2 Mechanical safety and stability

Guards shall be provided to prevent access to moving parts if adequate protection is not provided by enclosure of the burner/appliance or if access to moving parts can be reached without using tools; 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 be lifted.

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.

4.4.3 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 of EN ISO 14119:2013 and the related part of the control system shall not be less than category 1 in accordance with EN ISO 13849-1:2015.

4.4.4 Soundness

The oil carrying parts of the burner, up to atomizing 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.

4.4.5 Materials

Materials should be selected to optimize product durability and lifetime and consideration should be made to avoid the selection of rare or hazardous materials.

Consideration should be made to using recycled or re-used materials, and to the selection of materials which can then be subsequently recycled.

The possibility of marking components to aid to their sorting for disposal/recycling at end of life should also be reviewed.

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 in the instructions. 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 non-corrosion-resistant material, these shall be suitably protected with an effective anti-corrosion coating.

If aggressive media is used, the materials used shall be resistant to this media.

If fuels complying with ISO 8217:2017 are used special care for the selection of the material shall be taken.

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 1057:2006+A1:2010, EN ISO 17672:2016, EN 1254-1, EN 1254-4:1998, EN 10220:2002, EN 10305-1, EN 10305-2, EN 10305-3, EN 10305-4, EN 10305-5 and EN 10305-6, EN ISO 1127:1996, EN ISO 6806:2014, EN ISO 3183:2012, ISO 9329-1:1989, ISO 9330-1:1990, ISO 9330-2:1997, ISO 9330-3:1997, ISO 9330-4:2000, ISO 9330-5:2000 and ISO 9330-6:1997 or ISO 1129:1980 as appropriate.

4.4.6 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.

4.4.7 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 7-1:1994.

Connections which have to be loosened for maintenance purposes shall be designed in accordance with EN ISO 228-1:2003. Flange connections shall comply with EN 1092-1:2007+A1:2013, EN 1092-2:1997 and EN 1092-3:2003.

4.4.8 Pressure test points

To enable the fuel suction pressure, the fuel adjustment pressure and the combustion 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 60529:1991. Removal of such guards, shields or grilles shall be possible only with the use of commonly available tools.

Belt drives, where used, shall be guarded or so positioned as to prevent unintended access.

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 minimize 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 60335-2-102:2016.

The electrical safety of control devices shall comply either with EN 60335-2-102:2016, with EN 60730-1 or its relevant part 2 or with the electrical requirements of the standards listed in EN 60335-2-102:2016, Annex ZBB.

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 pressurized 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 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 including foreseeable over pressure and temperature or excessive increase in pressure and temperature shall be prevented by means of suitable safety devices.

Annex K applies for piping of category II and III as shown in Figure K.1 (as defined by EU Directive 2014/68/EU, Annex II, Table 8).

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 part of the burner or its accessories 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 part of the burner or its accessories 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 specified in the instructions 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 23553-1:2014.

4.5.4.5.2 Burners with a heat input ≤ 400 kW

The safety shut-off devices for burners with a heat input ≤ 400 kW shall be provided between the pump and the nozzle corresponding to the burner system as shown in Figure F.1, Figure F.2, Figure F.3 and Figure 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 23553-1:2014;
- 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 23553-1:2014 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 23553-1:2014. For atomizing oil burning with spill back nozzle and an oil mass heat input > 400 kW a pressure switch in the return line shall be provided. The pressure switch shall monitor the pressure in the return line (see Figures F.3 and Figure 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 23553-1:2014 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 heat input > 400 kW

Two series-connected safety shut-off devices shall be provided in the flow of oil burners with a heat input > 400 kW, 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 addition:

- a) single-stage burners shall be provided with two safety shut-off device in accordance with EN ISO 23553-1:2014;
- b) two-stage or multi-stage burners shall be fitted with two safety shut-off device, in accordance with EN ISO 23553-1:2014, for each nozzle (see Figure F.5);
- c) burners with spill back nozzle shall be fitted with two safety shut-off device complying with EN ISO 23553-1:2014 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 23553-1:2014. A pressure switch in the return line shall be provided. The pressure switch shall monitor the pressure in the return line (see Figure F.6 and Figure F.7).

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 23553-1:2014 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

Burners 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, 4.5.5.3, 4.5.5.4 and 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 atomization 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-off devices (e.g. thermal limiters) shall prevent a temperature rise above 220 °C of the preheating systems surface within unpressurised oil fuel vessels, if not wetted with oil fuel.

4.5.5.5 Pressurized preheaters

For pressurized 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 298:2012 intended to be used on oil burners.

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 60529:1991.

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 flame failure response time 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.

If an independent flame detector device is used for the flame supervision, then the sum of the flame failure detection time, the response time to de-energize the valve terminals and the valve closing time shall not exceed the value given in 4.6.9.

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 13611:2015, class C.

If a burner, depending on its 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 1854:2010. By using electronic pressure sensors these shall be carried out in class C according to EN 13611:2015;
- b) by flow sensing; design in analogy to EN 1854:2010. By using electronic pressure sensors these shall be carried out in class C according to EN 13611:2015;
- 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 Fuel/air 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 incomplete combustion.

The combined control or the sequential switching shall be activated 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 23552-1:2007.

Even for burners used for intermittent operation, the electronic fuel/air ratio control system, shall 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 298:2012 intended to be used on oil burners 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 subclauses 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 4.4.3) is indicating correct location for the safe operation of the burner;
- b) the flame detector device has been checked according to EN 298:2012 considering the intended use on oil burners 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 heat input ≤ 400 kW

- 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 heat input > 400 kW

- 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.

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 — Start heat input Q_s and ignition safety times t_{smax}

Heat input Q_F kW	Direct main burner ignition at full rate t_{smax} s	Direct main burner ignition at reduced rate Q_s t_{smax} in s Q_s in %	Reduced rate Q_s by ignition burner t_{smax} in s Q_s in %
≤ 400	$t_{smax} = 10$	$t_{smax} = 10$	$t_{smax} = 10$
$> 400 \leq 1\,200$	$t_{smax} = 5$	$t_{smax} = 5$	$t_{smax} = 5$
$> 1\,200 \leq 6\,000$	not permitted	$t_{smax} = 5$ $\leq 1\,200$ kW or $Q_s \leq 70$	$t_{smax} = 5$ $\leq 1\,200$ kW
$> 6\,000$	not permitted	$t_{smax} = 5$ $Q_s \leq 35$	$t_{smax} = 5$ $Q_s \leq 50$

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 ≤ 400 kW, one ignition restoration is allowed (see EN 298:2012 intended to be used on oil burners).

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

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 impermissible pressure increase.

4.6.5 Start gas ignition

Requirements for start gas ignition according to EN 676:2017 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.

4.6.7 Energizing of the safety shut-off valve for the oil supply

The safety shut-off device of the burner shall not be energized:

- before the ignition spark or other means of ignition is energized (in the case of direct main flame ignition);
- until the start flame has been established.

4.6.8 Flame failure response time

The flame failure response time shall not exceed 1 s.

4.6.9 Total closing time

The total closing time shall not exceed 2 s.

4.6.10 Burner shut-down

4.6.10.1 General

In the case of permanent loss of the actuating energy the burner shall proceed to a safe condition. If an on/off control, switch or limiter operates, the fuel oil supply shall be immediately automatically cut off.

4.6.10.2 Protection of the oil and air supply

The oil supply shall not be released if the atomizing process is not ensured (e.g. failure of the atomizing medium, oil pressure too low, return pressure too high in the case of burners with spill back nozzle, speed too low) or the combustion air is not available. If the atomizing medium or combustion air supply fails during operation, the oil supply shall be automatically cut off immediately. In the case of oil pressure atomizers, if no spring-loaded or other fast closing devices are available in the oil-pump, oil pressure switches or other suitable means shall be used.

Where there are no oil or air supply monitoring devices or spring-loaded fast closing device in the pump, the above requirements are considered to have been met 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. In the latter case, there shall be a positive coupling between the motor and the fan.

The control circuit of the automatic safety shut-off devices shall be so designed that it does not release the oil supply during start-up and cuts off the oil supply during operation:

- a) when the required atomizing pressure is not reached in the case of steam and compressed air atomizers or when the speed of the rotary cup is too low in the case of rotary atomizers (when the coupling between the atomizing cup and fan cannot be detached, monitoring of the fan air pressure is adequate);
- b) when the maximum oil return pressure is exceeded (in the case of spillback nozzle > 400 kW);
- c) when the combustion air fails if the fan is separate;
- d) when the main switch is activated;
- e) when burners (or even burner lances) are swung out or moved out in cases where this can be done without the use of tools;
- f) if the excess air ratio λ under-runs a critical value.

The under-runs of a critical value is avoided by at least the use of one of the following methods:

- the fuel/air ratio is mechanically fixed and the ratio cannot be altered by interference or operating effects, or
- an electronic fuel/air ratio device according to ISO 23552-1:2007 is used.

As soon as the conditions listed under a) to c) no longer pertain, the burners may start up automatically with the start-up programme maintained.

With regard to conditions d) to e), a restart shall only be possible by manual intervention.

4.6.11 Resistance of the burner to over-heating

Under the conditions specified in 5.7.9.1 the component parts of the burner shall not suffer any deterioration other than the superficial alterations inherent in combustion.

4.6.12 Temperatures of the control and safety devices

Under the conditions specified in 5.7.11 the temperature of the adjusting, control and safety devices shall not exceed the value stated in the instructions of the device and their operation shall be according to the instructions.

4.6.13 Surface temperature

The temperature limits according to EN 60335-2-102:2016 apply with the following additions: