



BSI Standards Publication

Forced draught burners for gaseous fuels

National foreword

This British Standard is the UK implementation of EN 676:2020, incorporating corrigendum November 2022. It supersedes BS EN 676:2003+A2:2008, BS 5885-2:1987 and BS 5885-1:1988, which are withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum November 2022 is indicated in the text by AC AC.

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

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English Version

Forced draught burners for gaseous fuels

Brûleurs à air soufflé pour combustibles gazeux

Gebläsebrenner für gasförmige Brennstoffe

This European Standard was approved by CEN on 9 October 2019 and includes the Corrigendum issued by CEN on 9 November 2022.

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European foreword

This document (EN 676:2020+AC:2022) has been prepared by Technical Committee CEN/TC 131 “Gas burners using fans”, 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of an identical text or by endorsement, at the latest by July 2020 and conflicting national standards shall be withdrawn at the latest by January 2023.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 676:2003+A2:2008.

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 and ZB, which are an integral part of this document.

This document includes the corrigendum EN 676:2020/AC:2022 issued by CEN on 9 November 2022, which corrects Formulae (8), (9) and (11).

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

Compared to EN 676:2003 and its amendments A1 and A2 the following fundamental changes have been made:

- a) based on ISO 22967 where different to EN 676 such as:
 - 1) update of definitions;
 - 2) test rig < 2,4 MW and > 2,4 MW;
 - 3) electrical interfaces for burners;
- b) modification:
 - 4) replacement of EN 50156-1 by EN 60204-1 to include international available requirements for the electrical safety of machines; see Annex L with editorial allocation in Annex K;
 - 5) Annex J is adapted to the new EN ISO 12100 which is substituting EN 292 which is currently referenced to in Table J.1;
 - 6) normative formulation of Annex A 'Combustion characteristics';
- c) new functions / requirements:
 - 7) remote reset;
 - 8) environmental aspects (environmental checklist);

- 9) increase of burner efficiency;
- 10) terminology for burner load control;
- 11) implementing new requirements to comply with the 2013/813 (ErP);
- 12) requiring of a risk assessment as required by EU Directives 2014/35/EU for LVD and EU Regulation 2016/426 for GAR.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, 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, Türkiye and the United Kingdom.

Introduction

This document is primarily intended for forced draught gas burners having a combustion air fan, operated with gaseous fuels, and intended to be marketed as a complete assembly.

EN 437 sets out a system of classification of appliances into categories defined according to the gases and pressures for which they are designed.

Such a system of classification, when applied to forced draught burners, can lead to difficulties in defining the precise category to which a particular burner should be allocated. For example many burners are designed to operate on a wide range of fuel gases with little or no modification other than adjustment of air supply.

The technical committee responsible for the standard decided that the following appliance categories for forced draught burners should apply:

- single categories: I_{2R} for natural gas and I_{3R} for liquefied petroleum gas;
- dual category: II_{2R/3R} for natural and liquefied petroleum gas.

All the burners of this standard marked with these categories are commissioned on site and the measured values are recorded in a commissioning report.

However it should be noted that the Gas Appliance Directive requires the specification of the type of gas and the supply pressure used as well as the burner category.

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

Principal requirements for installation and construction of gas burners used in industrial thermal processes are covered by EN 746-2 *Industrial thermoprocessing equipment — Safety requirements for combustion and fuel handling systems*.

Special requirements for forced draught burners for industrial premises will carry a prefix, “Industrial application”.

Further information and application limitation for EN 676 forced draught burners which are used for industrial application are given in informative Annex I.

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 gas burners and also the provision of control and safety devices, and the test procedure for these burners.

This document is applicable to:

- automatic gas burners with a combustion air fan (hereinafter called “burners”) and gas line components, intended for use in appliances of different types, and that are operated with gaseous fuels;
- pre-mixed burners and nozzle mixed burners;
- single burners with a single combustion chamber;
- single-fuel and dual-fuel burners when operating only on gas;
- the gas function of dual-fuel burners designed to operate simultaneously on gaseous and liquid fuels, which, for the latter, the requirements of EN 267 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 specifies the requirements to ensure the safety during commissioning, start-up, operation, shut-down and maintenance.

This document does not apply to burners specifically designed for use in industrial processes carried out on industrial premises.

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

This document deals also with forced draught burners intended to be used with biogenous gaseous fuels, mixtures with line-conveyed gas and special gaseous fuels.

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 88-1:2011+A1:2016, *Pressure regulators and associated safety devices for gas appliances — Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*

EN 88-2:2007, *Pressure regulators and associated safety devices for gas appliances — Part 2: Pressure regulators for inlet pressures above 500 mbar up to and including 5 bar*

EN 126:2012, *Multifunctional controls for gas burning appliances*

EN 161:2011+A3:2013, *Automatic shut-off valves for gas burners and gas appliances*

EN 267, *Forced draught burners for liquid fuels*

EN 298:2012, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*

EN 334:2005+A1:2009, *Gas pressure regulators for inlet pressures up to 100 bar*

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

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 1643:2014, *Safety and control devices for gas burners and gas burning appliances — Valve proving systems for automatic shut-off valves*

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

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

EN 10216-1:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-1:2002+A1:2005, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

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

EN 12067-2:2004, *Gas/air ratio controls for gas burners and gas burning appliances — Part 2: Electronic types*

EN 12516-3:2002, *Valves — Shell design strength — Part 3: Experimental method*

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

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

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

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

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*

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

EN 60529:1991/A1:2000, *Degrees of protection provided by enclosures (IP Code) (IEC 60529/A1:1999)*

EN 60529:1991/A2:2013, *Degrees of protection provided by enclosures (IP Code) (IEC 60529/A2:2013)*

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

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

EN 62061:2011, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*

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 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes (ISO 3166-1:2013)*

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

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

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

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

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)*

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

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:

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

3.1 General terms and 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

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

dual-fuel burner

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

3.1.4

pre-mixed burner

burner in which part, or all, of the air for complete combustion of the gas is mixed with the gas upstream of the mixture outlet ports

3.1.5

nozzle mixed burner

burner in which part, or all, of the air required for combustion of the gas is mixed with the gas at, or downstream of, the air and gas ports

3.1.6

Ignition burner

3.1.6.1

integrated ignition burner

burner for direct main burner ignition at reduced rate with by-pass start gas supply

3.1.6.2

independent ignition burner

burner for indirect main burner ignition with independent flame supervision and independent gas supply

3.1.7

start gas rate

gas rate ignited by the ignition device during the start-up of the burner

3.1.8

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.

3.1.9

combustion chamber

part of the appliance in which the combustion takes place

3.1.10**burner head**

device for mixing fuel and air comprising, for example, a stabilizing disc and nozzle, that keeps the flame in its safe position during operation of the burner

3.1.11**heat transfer medium**

gaseous or liquid substance for the transport of heat energy from the appliance

3.1.12**appliance**

heat generator, into which the burner fires, which has a combustion chamber and heat exchanger to indirectly transmit the heat input from the burners combustion gases to the heat transfer medium

3.2 Combustible gases**3.2.1****reference condition**

ambient condition of 15 °C and 1 013,25 hPa

3.2.2**calorific value**

quantity of heat produced by the combustion, at a constant pressure equal to 1 013,25 hPa, of unit volume or mass of gas, the constituents of the combustible mixture being taken at reference conditions and the products of combustion being brought back to the same conditions

Note 1 to entry: A distinction is made between:

- the superior calorific value: in which the water produced by combustion is assumed to be condensed,
- symbol: H_S ,

and

- the inferior calorific value: in which the water produced by combustion is assumed to be in the vapour state,
- symbol: H_I
- units: either,
- megajoules per cubic metre (MJ/m³) of dry gas at the reference conditions, or
- megajoules per kilogram (MJ/kg) of dry gas,
- Kilowatt-hour per cubic meter (kWh/m³) of dry gas at reference conditions,
- Kilowatt-hour per kg (kWh/kg) of dry gas.

Note 2 to entry: Note the term “inferior” is synonymous to “net” and the term “superior” is synonymous to “gross”.

3.2.3

relative density

d

ratio of the masses of equal volumes of dry gas and dry air at the same conditions of temperature and pressure

3.2.4

Wobbe index

ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions

Note 1 to entry: The Wobbe index is said to be superior (W_s) or inferior (W_i) depending on whether the calorific value used is superior or inferior.

Note 2 to entry: The units used for the Wobbe Index are either:

- a) megajoules per cubic metre (MJ/m^3) of dry gas at the reference conditions, or
- b) megajoules per kilogram (MJ/kg) of dry gas.

Note 3 to entry: Adapted from ISO 14532:2014.

3.2.5

gas pressure

static pressure of the moving gas, relative to the atmospheric pressure, measured at right angles to the direction of flow of the gas

Note 1 to entry: Gas pressure is expressed in Pascal (Pa, hPa).

3.2.6

line-conveyed gas

gaseous fuels available on site distributed by supply network on which burners operate under nominal conditions when they are supplied at the corresponding normal pressure

3.2.7

test gases

gases intended for the verification of the operational characteristics of gas appliances. They consist of reference gases and limit gases

3.2.8

reference gases

test gases on which burners operate under nominal conditions when they are supplied at the corresponding normal pressure

3.2.9

limit gases

test gases representative of the extreme variations in the characteristics of the gases for which burners have been designed

Note 1 to entry: The characteristics of the reference and limit gases are given in Table C.1.

3.2.10**normal pressure**

pressure under which the burners operate in nominal conditions when they are supplied with the corresponding reference gas

3.2.11**pressure ranges**

range of pressure between minimum supply pressure and maximum allowable pressure under which the burner reaches the heat input stated in the specification/instruction

Note 1 to entry: See measuring point M1 as specified in Figure 3, at which the nominal conditions are achieved.

Note 2 to entry: The highest value of “supply pressure” is equivalent to “maximum allowable pressure” PS in the PED as used in 6.2 and in Annex K.

Note 3 to entry: The test pressures are given in Table 5.

3.2.12**supply pressure**

pressure measured immediately upstream of all gas line components but downstream of the manually operated shut-off valve

Note 1 to entry: See measuring point M1 as specified in Figure 3, at which the nominal conditions are achieved.

Note 2 to entry: The “supply pressure” is equivalent to “maximum allowable pressure” PS in the PED as used in 6.2 and in Annex K.

3.2.13**inlet pressure**

pressure at the inlet of the gas line components

3.2.14**adjustment pressure**

pressure measured immediately downstream of the pressure regulator

Note 1 to entry: See measuring point M2 as specified in Figure 3, at which the nominal conditions are achieved.

3.2.15**burner head pressure**

pressure measured immediately before the burner head

Note 1 to entry: See measuring point M3 as specified in Figure 3, at which the nominal conditions are achieved.

3.2.16**pressure in the combustion chamber****PF**

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

Note 1 to entry: Combustion chamber pressure is measured in hPa.

3.3 Test rig and combustion chamber

3.3.2

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 or any lateral contraction

Note 1 to entry: The length of the combustion chamber is measured in m.

3.3.3

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 m.

3.3.4

burner flame tube

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

3.3.5

test flame tube

cylindrical part of the test rig where the combustion take place

3.4 Composition of the gaseous combustion products

3.4.1

content of carbon dioxide (f_{CO_2})

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 (f_{O_2})

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 (f_{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 for measuring purpose and in milligrams per kilowatt hours [mg/kWh] related to inferior calorific value (H_i) for calculation purposes and declaring values.

3.4.4**content of nitrogen oxides (Q_{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 for measuring purpose and in milligrams per kilowatt hours [mg/kWh] related to inferior calorific value (H_i) for calculation purposes and declaring values.

3.4.5**excess air ratio**

λ

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

3.5 Burner operation**3.5.1 Gas rate****3.5.1.1****volume flow rate**

q_v

volume of gas consumed by the burner in unit time during continuous operation

Note 1 to entry: The units used for volume flow rate are either:

- a) cubic metres per hour (m^3/h),
- b) litres per minute (l/min),
- c) cubic decimetres per hour (dm^3/h), or
- d) cubic decimetres per second (dm^3/s).

3.5.1.2**nominal volume flow rate**

volume flow rate stated in the technical specifications/instructions

Note 1 to entry: Nominal volume flow rate is expressed in cubic metres per hour (m^3/h).

3.5.1.3**maximum flow rate**

highest flow rate stated in the technical specifications/instructions

Note 1 to entry: Maximum mass flow rate is expressed in cubic metres per hour (m^3/h) at reference conditions.

3.5.1.4**minimum flow rate**

lowest flow rate stated in the technical specifications/instructions

Note 1 to entry: Minimum mass flow rate is expressed in cubic metres per hour (m^3/h) at reference conditions.

3.5.1.5
mass flow rate

q_m

mass of gas consumed by the burner in unit time during continuous operation

Note 1 to entry: The units used for mass flow rate are

- a) kilograms per hour (kg/h), or
- b) grams per hour (g/h).

3.5.1.6
nominal mass flow rate

mass flow rate stated in the technical specifications/instructions

3.5.1.7
heat input

Q_F

heat content of the gas supplied to the burner which is equal to the gas volume flow rate or gas mass flow rate multiplied by its inferior or superior calorific value

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

3.5.1.8
nominal heat input

Q_{FN}

value of the heat input stated in the technical specifications/instructions

Note 1 to entry: It is expressed in kilowatts (kW).

Note 2 to entry: Burners with fixed heat input or single stage burners have a single nominal heat input. Range-rated burners can be adjusted between the maximum nominal heat input and the minimum nominal heat input given in the instructions.

3.5.1.9
maximum heat input

Q_{Fmax}

highest value of the heat input stated in the technical specifications/instructions

3.5.1.10
minimum heat input

Q_{Fmin}

lowest value of the heat input stated in the technical specifications/instructions

3.5.1.11
start heat input

Q_s

maximum heat input at the start of ignition as a percentage of the maximum heat input

3.5.2 Permanent and intermittent burner operation

3.5.2.1
burners for permanent operation

burners that are designed to remain in the running position for more than 24 h without interruption

3.5.2.2**burners for intermittent operation**

burners that are designed to remain in the running position for less than 24 h

3.6 Gas line components**3.6.1****gas line**

part of the burner which is made up of the valves and controls and safety devices in which gas is conveyed between the inlet connection and the burner head

3.6.2**range-rating device**

component on the burner intended to be used for adjusting the heat input, within a range of heat inputs stated in the technical specifications/instructions, to suit the actual heat requirements of the installation

Note 1 to entry: This adjustment can be progressive or in discrete steps.

3.6.3**automatic shut-off valve**

valve which opens when energised and closes automatically when de-energised

3.6.4**filter strainer**

device that enables foreign elements, which might otherwise cause failures in the system, to be collected

3.6.5**pressurised parts**

pipework components and devices having pressure bearing housings with a pressure greater than 500 hPa and a size greater or equal to DN 100 mm

Note 1 to entry: See EU Directive 2014/68/EU.

3.6.6**means for draining and venting**

devices to allow harmless draining and venting of the pressurised fuel supply lines

3.7 Adjusting, control and safety devices**3.7.1****pressure regulator**

device which maintains the downstream pressure constant to within fixed limits independent of variations, within a given range, of the upstream pressure

3.7.2**adjustable pressure regulator**

pressure regulator fitted with a means of adjusting the loading on the diaphragm and thus the downstream pressure

3.7.3

gas pressure protection device

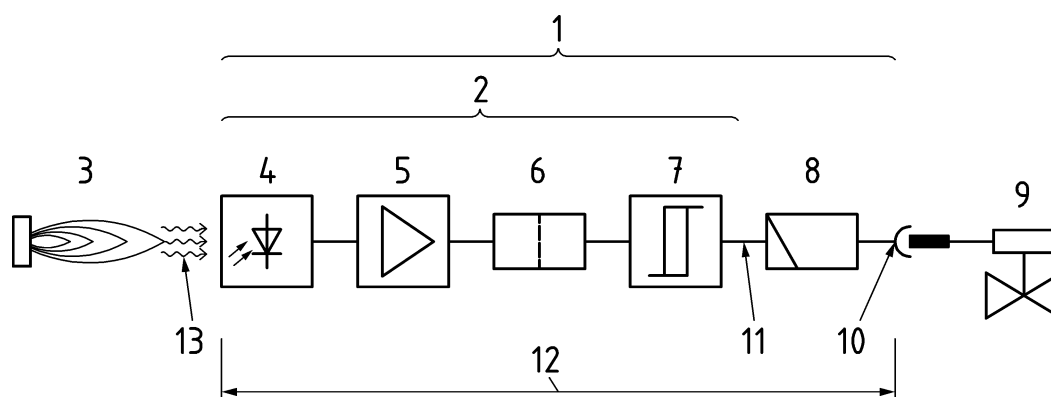
device which compares the actual value of the pressure with the desired value, gives a signal when the actual value exceeds or drops below the desired value and initiates the controlled shut-down

3.7.4

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 for use in conjunction with a programming unit.

**Key**

- | | |
|---|--|
| 1 automatic burner control system (see 3.7.7) | 8 programming unit (see 3.7.8) |
| 2 flame detector device (see 3.7.4) | 9 automatic shut-off valve (see 3.6.3) |
| 3 flame | 10 shut-off valve terminal |
| 4 flame sensor (see 3.7.6) | 11 flame signal (see 3.8.10) |
| 5 amplifier | 12 flame failure response time (see 3.8.8.1) |
| 6 filter | 13 sensed flame (see 3.8.9) |
| 7 threshold | |

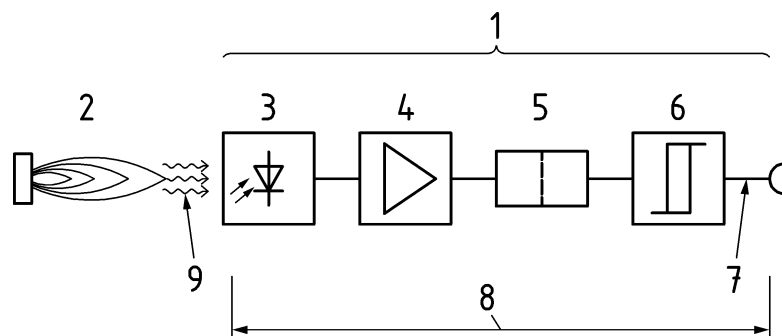
Figure 1 — Basic functional chain of a typical flame supervision

3.7.5

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 3.7.5)	6	threshold
2	flame	7	flame signal (see 3.8.10)
3	flame sensor (see 3.7.6)	8	flame failure detection time (see 3.8.8.2)
4	amplifier	9	sensed flame (see 3.8.9)
5	filter		

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

3.7.6**flame sensor**

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

3.7.7**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.

3.7.8**programming unit**

unit which 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.

3.7.9**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

3.7.10**controlled shut-down**

process by which the power to the gas shut-off valve(s) is removed based on the removed heat demand

3.7.11

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 gas 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.

3.7.12

non-volatile lock-out

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

3.7.13

start signal

signal (e.g. from a thermostat) which releases the system from its start position and commences the predetermined programme

3.7.14

recycling

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

3.7.15

valve proving system

system to check the effective closure of the start gas or main gas safety shut-off valves, and which is capable of detecting small gas leakage rates

3.7.16

ignition device

means used to ignite the fuel at the ignition burner or at the main burner

EXAMPLE Flame, electrical ignition with spark or hot surface.

3.7.17

running position of the burner system

position of the system in which the burner is in normal operation having successfully finalized the first and/or second safety time (if applicable) and is under the supervision of the programming unit and its flame detector device

3.7.18

purge

forced introduction of air into the combustion chamber and flue passages, in order to displace any remaining fuel/air mixture and/or products of combustion

3.7.18.1

pre-purge

purge which takes place between the start signal and the energisation of the ignition device

3.7.18.2

post-purge

purge which takes place immediately following a controlled shut-down

3.7.19**monitoring device**

device used for monitoring and controlling the burner when firing pressurised equipment

Note 1 to entry: For the purpose of this document, monitoring devices serve for safe use and operation of the burner. They are not safety accessories for the purpose of the Pressure Equipment Directive (PED) 2014/68/EU.

3.7.20**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.

3.8 Sequencing times**3.8.1****pre-purge time**

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

Note 1 to entry: It is expressed in seconds (s).

3.8.2**post-purge time**

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

Note 1 to entry: It is expressed in seconds (s).

3.8.3**ignition period**

period starting with energizing the pilot gas valve, the start gas valve or main gas valve(s), as applicable until the end of the safety time or if applicable until the end of the 2nd safety time

Note 1 to entry: It is expressed in seconds (s).

3.8.4**first safety time**

period between the pilot gas valve, the start gas valve or main gas valve(s), as applicable, being energised and the pilot gas valve, start gas valve or main gas valve(s), as applicable, being de-energised if the flame detector device signals the absence of a flame

Note 1 to entry: Where there is no second safety time, this is called the safety time.

Note 2 to entry: It is expressed in seconds (s).

3.8.5**second safety time**

period, in the case of a first safety time applicable to either a pilot or start gas flame only, between the energizing and de-energizing of main gas valves if the flame detector device signals the absence of a flame

Note 1 to entry: It is expressed in seconds (s).

3.8.6

extinction safety time

period that starts with the signal that the flame has been extinguished and ends with the signal to de-energize the safety shut-off valve of the gas supply

Note 1 to entry: It is expressed in seconds (s).

3.8.7

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: It is expressed in seconds (s).

3.8.8

time in case of flame failure

3.8.8.1

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.

3.8.8.2

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

3.8.9

sensed flame

physical value monitored by the flame sensor

3.8.10

flame signal

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

3.8.11

start-up sequence

sequence of actions executed by the system which brings the burner from the start position to the running position

Note 1 to entry: See Annex B.

3.8.12

start gas flame proving period

interval between the end of the first safety time and the beginning of the second safety time which is used to prove that the start gas flame is stable

3.9 Combustion

3.9.1

flame stability

capacity of flame to remain on the burner head or in the flame reception zone intended by the design

3.9.2

flame lift

total or partial lifting of the base of the flame away from the burner head or the flame holding zone provided by the design

3.9.3

light back

unintended movement of the flame front to a point upstream of its normal stable operating position

3.9.4

firing intensity

heat release rate

value of the heat input divided by the volume of the combustion chamber describing the load intensity and the compression of the combustion

Note 1 to entry: It is expressed in Megawatt per cubicmetre (MW/m³).

3.10 Diagrams

3.10.1

working diagram

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

3.10.2

test diagram

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

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

4.1 Conversion to different gases

The precautions to be taken when converting from a gas of one group or family to a gas of another group or family and/or to adapt for different gas supply pressures shall be given in the instructions for operation.

4.2 Construction

4.2.1 General

A risk assessment shall be performed.

4.2.2 Design

4.2.2.1 Combustion

The design and construction of the burner shall be such that within the intended input range and within the prescribed pressure range, the used fuel gas is burned completely and safely.

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

4.2.2.2 Mechanical safety, stability and control devices

Moving parts shall be shielded if the enclosure provided does not ensure adequate protection. See also 4.3.1.

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.

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.

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.

4.2.3 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.

4.2.4 Soundness

Holes for screws, studs, etc. intended for the assembly of parts shall not open into gas bearing parts and components. The wall thickness between drillings and gas bearing parts and components shall be at least 1 mm. This requirement shall not apply to orifices for measurement purposes or to components within the burner head.

The soundness of parts and assemblies making up the gas circuit and likely to be dismantled during regular maintenance *in situ* shall be achieved by means of mechanical joints, for example metal-to-metal joints, gaskets, or O-ring joints, but excluding the use of all sealing materials such as tape, paste or liquids. All sealing materials shall remain effective under normal conditions of burner use.

4.2.5 Materials

It is recommended that materials are selected to optimize product durability and lifetime and that considerations are made to avoid the selection of rare or hazardous materials.

It is recommended that considerations are made using recycled or re-used materials, and to the selection of materials which can then be subsequently recycled.

It is recommended that the possibility of marking components to aid to their sorting for disposal/recycling at end of life may 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. 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.

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

Asbestos or asbestos-containing materials shall not be used.

Copper shall not be used for gas carrying parts where its temperature is likely to exceed 100 °C. Solder that has a melting point below 450 °C after application shall not be used for gas carrying parts.

The pipework material shall comply with EN ISO 3183:2012, EN 10216-1:2013, EN 10217-1:2002 or EN 10220:2002, as appropriate.

4.2.6 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 not intended to be set, adjusted or manipulated by the user or installer shall be sealed.

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

4.2.7 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.

NOTE Attention is drawn to Annex D which sets out the connection method permitted or prohibited in certain countries.

4.3 Equipment

4.3.1 Motors and fans

Motors and fans 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 and amendments. 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 minimize noise and vibration.

4.3.2 Electrical safety and EMC related to safety

The electric safety including the effect of EMC to the electrical and functional safety of

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

shall comply with EN 60335-2-102:2016.

The electrical safety including the effect of EMC to the electrical and functional 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 ZB.

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.

4.3.3 Adjustable air damper

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 adjusting positions 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 so designed that, after adjustment according to the technical instructions, it is capable of being set and sealed.

4.3.4 Gas line components

4.3.4.1 General

All gas line components downstream the manually operated shut-off valve shall be designed for the supply pressure or be protected against any excessive increase in pressure by means of relevant safety devices.

Requirements for gas line components are described in the relevant product standard such as EN 88-1:2011+A1:2016, EN 126:2012, EN 161:2011+A3:2013 and general requirements are given in EN 13611.

For piping with a pressure > 500 hPa and a pipe diameter DN ≥ 25 mm excluding cat. I (see Diagram 6 Annex II PED) Annex K applies.

All gas line components in case of aggressive gases shall be made of materials for appropriate lifetime. The maintenance instructions shall specify periods of service and maintenance and appropriate lifetime or cycles to maintain safety.

4.3.4.2 Manually operated shut-off valve

A quick-acting manually operated shut-off valve shall be provided upstream of all controls to isolate the burner. If this valve is not supplied with the equipment of the burner, appropriate information shall be given in the installation instructions, see 6.4.

In addition burners shall be provided with such manually operated shut-off valves as are essential for their commissioning and normal operation.

The manual gas valve shall be readily accessible and capable of rapid action (e.g. 90° turn valve). The manual valve shall be capable of operating at a pressure equal to 1,5 times the maximum supply pressure.

The manual valves shall be so designed as to prevent inadvertent operation but shall be easy to operate when required. They shall be so designed that in operation the “OPEN” and “CLOSED” positions are readily distinguishable.

Manual valves used solely for OPEN/CLOSED operation shall be provided with mechanical stops at the “OPEN” and “CLOSED” positions.

4.3.4.3 Filter/strainer

A filter/strainer shall be fitted at the inlet of the safety shut-off valve system to prevent the ingress of foreign elements.

The maximum strainer hole dimension shall not be greater than 1,5 mm and the mesh shall not permit the passage of a 1 mm pin gauge.

4.3.4.4 Gas pressure regulator

The gas supply for operation and start-up shall be controlled by a pressure regulator to ensure that the pressure at the burner head of the main burner or any ignition burner greater than 2 kW heat input remains stable. The heat input shall not vary by more than $\pm 5\%$ from the specified value if the supply pressure changes within the limits of Table 5. The main burner and any ignition burner may also be governed separately.

The gas pressure regulator shall comply with EN 88-1:2011+A1:2016, EN 88-2:2007 or EN 334:2005+A1:2009, whichever is applicable. Where the operating pressure falls outside of the scope of these standards, the gas pressure regulator shall be suitable for its purpose.

The accessibility of the pressure regulator shall be such that it can be easily adjusted or put out of operation for use with another gas, but precautions shall be taken to make unauthorised adjustment difficult.

If the outlet side of the gas pressure regulator and/or the gas valve of the following gas line section with its equipment up to the burner is/are not designed for the maximum supply pressure under fault conditions:

- a high gas pressure shut-off valve shall be applied upstream of the gas pressure regulator, shutting off the gas supply before an excessively high pressure occurs;

and

- a safety relief valve shall be installed down-stream of the gas pressure regulator. The safety valve shall be vented to a safe area.

The high gas pressure shut-off valve and the safety relief valve may be integrated in one apparatus with the gas pressure regulator.

The high gas pressure shut-off valve shall close before the permitted operation overpressure of the downstream gas line components is exceeded.

The safety relief valve can operate before the high gas pressure shut-off valve closes. Excessive operation of the safety relief valve should be avoided preventing the release of unburned gases to the atmosphere.

NOTE For the requirements of PED see Annex K.

4.3.4.5 High gas pressure over load protection device

High gas pressure over load protection device shall be fitted where no gas pressure regulator is used in compliance with EN 88-1:2011+A1:2016 or EN 88-2:2007 except when:

- a) the pressure drop across the gas pressure regulator(s) is less than 30 % of the nominal adjustment pressure, and
- b) any regulator failure shall not result in an unsafe start-gas rate being obtained.

Where a high gas pressure over load protection device is fitted, it shall cause a non-volatile lock-out:

- 1) if the heat input to the burner exceeds 1,15 times the nominal input, or
- 2) if the burner head pressure exceeds 1,3 times the nominal burner head pressure, see Figure 3, M3.

The high gas pressure over load protection device shall comply with EN 1854:2010.

4.3.4.6 Low gas pressure protection device

The burner shall be fitted with a low gas pressure protection device to cause controlled safety shut-down when the supply pressure falls below a pre-determined value.

The low gas pressure protection device may be omitted, if the following conditions are fulfilled:

When the inlet pressure falls to 25 % of the nominal value the burner shall

- a) continue to operate safely and the CO-content shall not exceed 1 % by volume of the dry, air-free combustion products,
- or
- b) proceed to non-volatile lock-out.

Low gas pressure sensing devices shall comply with EN 1854:2010.

4.3.4.7 Adjustment devices

An adjustment device shall be provided to allow the gas rate to be achieved with the fuel gases given by the technical specifications and over the relevant range of pressures. This adjustment device may be that of the gas pressure regulator. Adjusters shall require a tool for adjustment.

4.3.4.8 Automatic safety shut-off valves

All burners shall be fitted with two automatic safety shut-off valves in series as defined in Table 1 and complying with EN 161:2011+A3:2013.

Where the main flame establishment is by means of a start-gas flame, the start gas supply shall be either:

- a) under the control of the downstream main gas safety shut-off valve incorporating a start gas limit position, or
- b) under the control of safety shut-off valves as indicated in Table 1.

Table 1 — Safety shut-off valve requirements

Heat input kW	With pre-purge			Without pre-purge		
	Main gas ^e	Start gas ^c		Main gas ^e	Start gas ^d	
		≤ 10 %	> 10 %		≤ 10 %	> 10 %
≤ 70	2 × B	B ^a	2 × B	2 × A or 2 × B + VP	A ^b	2 × A
> 70 ≤ 1 200 ^d	2 × A	2 × A	2 × A	2 × A + VP	2 × A	2 × A
> 1 200 ^c	2 × A + VP	2 × A	2 × A	2 × A + VP	2 × A	2 × A
^a for third family gases: two class B valves are required ^b for third family gases: two class A valves are required ^c if start gas > 1 200 kW, VP is required and ^d if start gas > 70 kW, VP is required ^e VP = valve proving system						

4.3.4.9 Ignition device

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

4.3.4.10 Flame detector device

The main flame and the flame of any ignition burner shall be monitored by a flame detector device.

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

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 gas 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 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 and amendments.

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 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 4.4.1.7.3

4.3.4.11 Air proving device

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 (see 4.4.1.3).

For burners of heat input up to and including 120 kW safety shut-down followed by a single attempt at re-start is permitted. If this re-start 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;
- b) by flow sensing;
- 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 before the CO content f_{CO} at the controlled stage of the combustion products exceeds 1 % by volume, air-free/dry.

Where the burner is fitted with automatic air/gas 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 gas valves 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 air flow will be ensured as required by 4.3.4.11.

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 gas opening occurs, and
- a device for a positive coupling between motor/fan, and
- a device for fuel release via gas /air ratio control, and
- a device which shall close the gas 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 air flow is in principle the same as for a burner according to this document, 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 (Annex H).

4.3.4.12 Air/gas ratio control devices

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

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

For burners with intermittent operation, the function of the air/gas ratio control system, except for pneumatically operated devices, shall be checked during the start sequence, e.g. by means of pressure or position switches.

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

- a) air lead on increasing firing rate and gas lead on reducing firing rate, or
- b) sufficient excess air to prevent incomplete combustion.

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.

- 1) Where a pneumatically operated air/gas ratio device is fitted it shall comply with the requirements of EN 88-1:2011+A1:2016.
- 2) Where an electronic operated air/gas ratio device is fitted it shall comply with the requirements of EN 12067-2:2004.

Where a combustion quality control system influencing the ratio between the gas and air supply is used it shall conform to the requirements of EN 12067-2:2004.

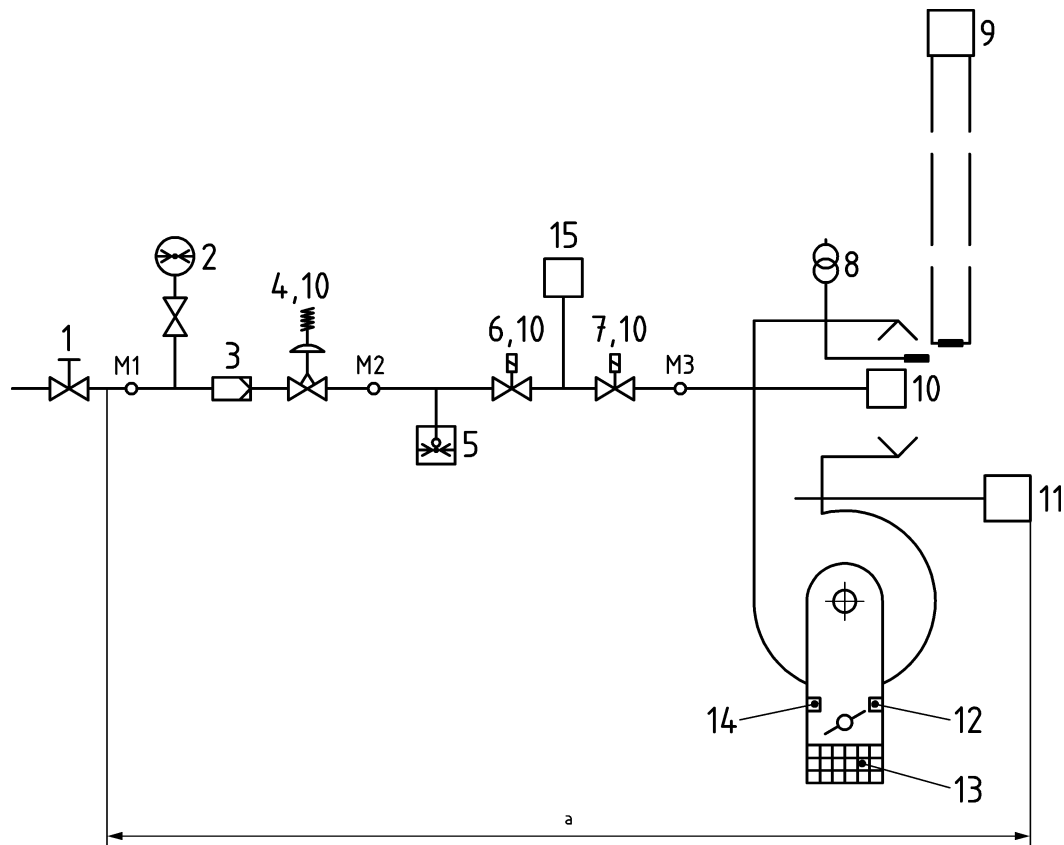
4.3.4.13 Pressure test points

Pressure measuring devices or test points shall be provided to measure the following pressures:

- gas supply pressure,
- the gas adjustment pressure,
- the gas pressure in the burner head, and
- the air pressure.

NOTE A single pressure test point can be provided for the measurement of both the adjustment pressure and the pressure in the burner head.

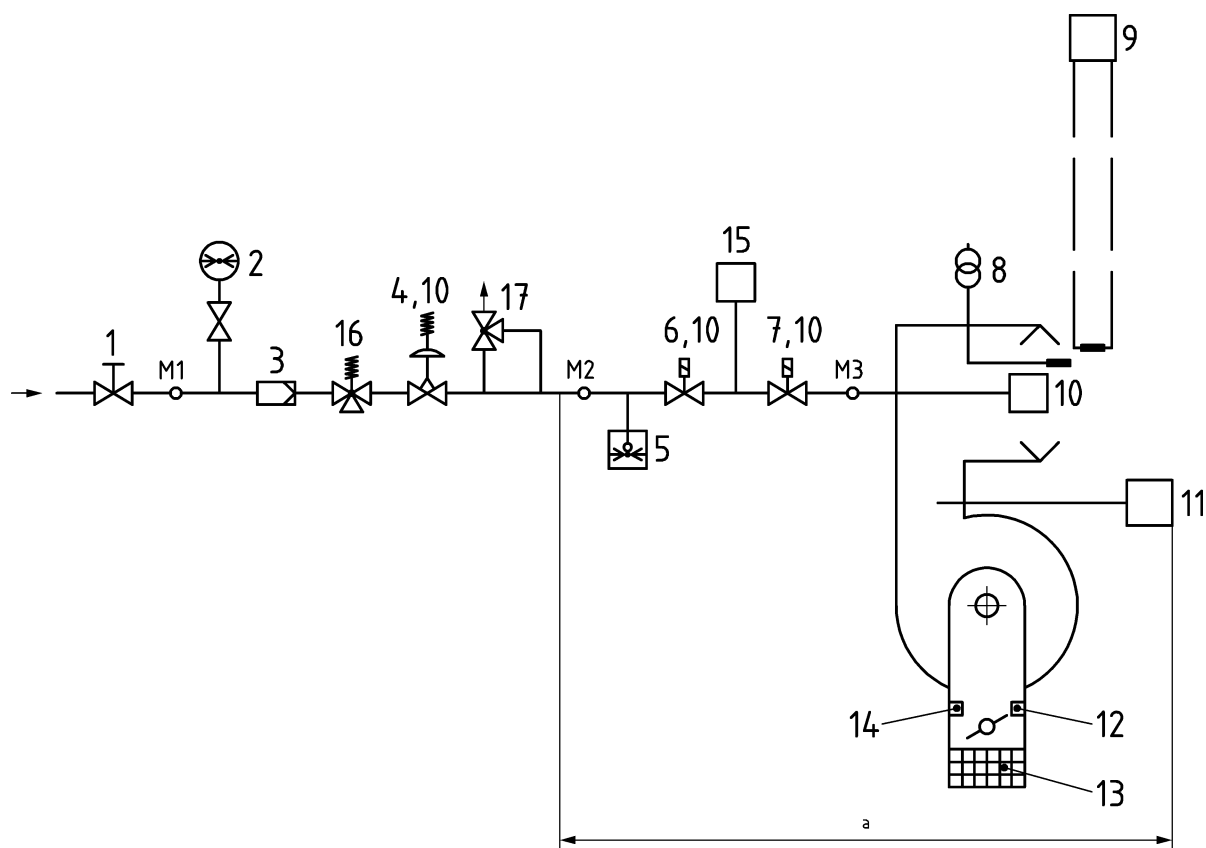
Pressure test points, with a maximum internal diameter of 1 mm, an external diameter of $\left(9_{-0,5}^0\right)$ mm and a length of 10 mm, shall be such that they can be tightly closed, or shall be self-sealing.



Key

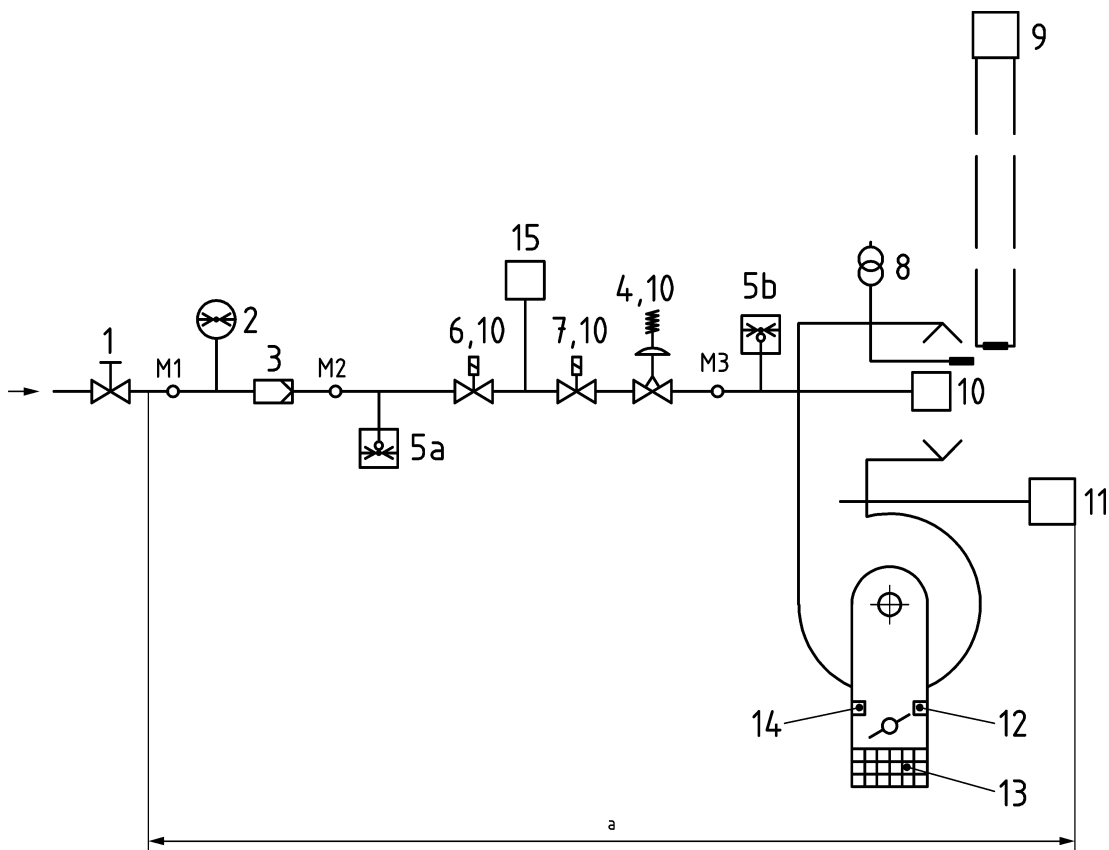
- 1 manually operated shut-off device
- 2 gas pressure gauge
- 3 Filter
- 4 gas pressure regulator according to EN 88-1:2011+A1:2016 or EN 334:2005+A1:2009
- 5 low gas pressure protection device
- 6 1st safety shut-off device
- 7 2nd safety shut-off device
- 8 ignition device
- 9 flame detector
- 10 preliminary adjusting device
- 11 fan proving device
- 12 low air flow position switch
- 13 safety device for moving parts e.g. grille
- 14 high air flow position switch
- 15 valve proving system (>1,2 MW)
- M1 measuring point for supply pressure
- M2 measuring point for adjustment pressure
- M3 measuring point for burner head pressure
- A minimum equipment for type testing

Figure 3 a) Example of equipment for a forced draught gas burner: Gas supply pressure not exceeding inlet pressure of gas line components used

**Key**

- 1 manually operated shut-off device
- 2 Gas pressure measuring device
- 3 filter
- 4 gas pressure regulator according to EN 88-1:2011+A1:2016, EN 88-2:2007 or EN 334:2005+A1:2009
- 5 low gas pressure protection device
- 6 1st safety shut-off device
- 7 2nd safety shut-off device
- 8 ignition device
- 9 flame detector
- 10 preliminary adjusting device
- 11 fan proving device
- 12 low air flow position switch
- 13 safety device for moving parts e.g. grille
- 14 high air flow position switch
- 15 valve proving system (>1,2 MW)
- 16 high gas pressure shut-off valve
- 17 safety relief valve
- M1 measuring point for supply pressure
- M2 measuring point for adjustment pressure
- M3 measuring point for burner head pressure
- a minimum equipment for type testing

Figure 3 b) Example of equipment for a forced draught gas burner - gas supply pressure exceeding inlet pressure of gas line components used



Key

- | | |
|----|---|
| 1 | manually operated shut-off device |
| 2 | gas pressure measuring device |
| 3 | filter |
| 4 | gas pressure regulator according to EN 88-1:2011+A1:2016, EN 88-2:2007 or EN 334:2005+A1:2009 |
| 5a | low gas pressure protection device |
| 5b | high gas pressure over load protection device |
| 6 | 1st safety shut-off device |
| 7 | 2nd safety shut-off device |
| 8 | ignition device |
| 9 | flame detector |
| 10 | preliminary adjusting device |
| 11 | air proving device |
| 12 | low air flow position switch |
| 13 | safety device for moving parts e.g. grille |
| 14 | high air flow position switch |
| 15 | valve proving system (>1,2 MW) |
| M1 | measuring point for supply pressure |
| M2 | measuring point for adjustment pressure |
| M3 | measuring point for burner head pressure |
| a | minimum equipment for type testing |

Figure 3 c) Example of equipment for a forced draught gas burner - gas supply pressure not exceeding inlet pressure of gas line components used downstream M1 with high gas pressure overload protection device

Figure 3

4.3.4.14 Automatic burner control unit

The automatic burner control unit shall comply with the requirements of EN 298 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).

Industrial application: The burner control unit should be tolerable for EMC severity level 3, assessment criteria a) and b) of EN 298:2012, Table 4.

4.3.4.15 Valve proving system

Where a valve proving system is fitted it shall comply with the requirements of EN 1643:2014.

The downstream valve of two gas valves in series shall not be permitted to open for a period of more than 3 s before or during the pre-purge or during the post-purge as part of a valve proving system that vents into the combustion chamber.

After a lock-out or power failure of the gas burner the valve proving shall be carried out prior to, or during the pre-purge of the next burner start.

4.3.4.16 Electrical interfacing with appliances

The electrical interfacing between the burner and the appliance is given in Annex N as an example.

NOTE This recommendation can facilitate the on-site assembly of burners and gas appliances.

4.4 Functional and operational requirements

4.4.1 General function requirements

4.4.1.1 General

The components specified in 4.3 shall be mechanically or electrically designed such that the requirements laid down in the following clauses are satisfied.

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

4.4.1.2 Burner start-up

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

- a) any burner mounting interlock (see 4.2.3) is indicating correct location for the safe operation of the burner;
- b) any installation interlock (e.g. flue damper) is indicating its correct position;
- c) the flame detector has been checked for flame simulation. This check may also be carried out during the pre-purge or after a controlled shut-down;
- d) any valve proving system has completed its check successfully. This check may also be carried out during the pre-purge or after a controlled shut-down;
- e) the air flow proving device has been proved to be functioning correctly.

4.4.1.3 Pre-purge

Before energizing the ignition device the combustion chamber shall be pre-purged.

The duration of the pre-purge shall be either:

- a) at least 20 s at the full combustion air rate corresponding to the maximum heat input, or
- b) where the air rate is reduced, a time period increased by an amount inversely proportional to the reduced air rate.

e.g. 100 % air rate	– at least 20 s pre-purge time;
50 % air rate	– at least 40 s pre-purge time;
33 % air rate	– at least 60 s pre-purge time.

This reduced air flow rate shall not be less than 33 % of the full combustion air rate.

The pre-purge air flow rate shall at least correspond to the adjusted heat input.

If the pre-purge air flow falls below the required rate at any time during the pre-purge either

- c) the burner shall proceed to at least safety shut-down, and restart, or
- d) the pre-purge shall be continued until the required air rate is restored, provided that the total controlled pre-purge time is not reduced.

Two stage or multi-stage burners with air dampers driven by servo drivers of any kind shall have low and high air flow positions. Depending on the selected air flow rate, one of these positions indicates the correct location during the pre-purge sequence. If this position is incorrect during the pre-purge it shall cause a stop in the pre-purge sequence and prevent the burner to start-up until it is re-established.

The duration of the pre-purge may be different or the pre-purge may be omitted if this is permitted in the appropriate heat generator standard.

After a controlled shut-down a restart without a pre-purge may be achieved as follows:

- e) with burners of heat input up to and including 70 kW fitted with either two class A safety shut-off valves in series, or with two class B safety shut-off valves in series plus a valve proving system;
- f) with burners of heat input greater than 70 kW fitted with two class A safety shut-off valves in series plus a valve proving system.

A pre-purge shall be carried out after:

- g) non-volatile lock-out;
- h) standstill of more than 24 h;
- i) after electrical power failure;
- j) shut-down by lack of gas;
- k) safety shut-down.

Industrial application: The content of the combustion chamber should be purged at least 5-times by the burners pre-purge.

4.4.1.4 Start heat input

Burners shall start-up at an excess air ratio value equal or greater than those in Table 7. Burners with a maximum heat input up to and including 120 kW may be ignited directly.

For burners with a maximum heat input exceeding 120 kW, the start heat input shall not exceed 120 kW or the value given by the formula:

$$t_s \times Q_s \leq 100 \quad (1)$$

If burners are ignited by an independent ignition burner, the start heat input of the ignition burner shall not exceed the value given by the formula:

$$t_s \times Q_s \leq 150 \quad (2)$$

where

t_s is the safety time in seconds (s);

Q_s is the maximum start heat input expressed as a percentage of the main gas rate.

Maximum start heat input and safety times see Table 2.

Industrial application: Burners should have no limitation in start-up heat input when the applied ignition system is reliable. They should have enough energy to ensure rapid, low noise and smooth ignition of the main burner without excessive pressure increase.

4.4.1.5 Start gas ignition

The start gas valves shall not be energised before the ignition spark (or other means of ignition) is energized, except for purposes of valve proving.

Where a hot surface ignition system is used, the ignition system shall be energised so that the ignition source is capable of igniting incoming gas before the start gas valve(s) are opened.

The start gas flame proving period shall establish that the flame is stable on its own. If the flame fails during this period the system shall react as given in 4.4.1.8.

For burners with a heat input of 120 kW and above, and on which the start gas supply is taken from between the main gas safety shut-off valves, the downstream main gas safety shut-off valve shall be de-energised prior to start-up.

Where the start gas rate is controlled by a start gas rate position contained within the downstream main safety shut-off valve any means of adjustment of the start gas rate shall comply with 4.3.4.7.

4.4.1.6 Main burner ignition

4.4.1.6.1 Establishment by means of a start gas flame

If the start gas flame has been ignited at a separate ignition burner and proved, the second safety time shall be not more than 5 s at the end of which time sensing of the main flame shall begin. If the main flame is not detected at the end of this period, non-volatile lock-out shall result.

4.4.1.6.2 Direct establishment of the main gas flame

The ignition source shall not be energized before completion of the pre-purge period and shall be de-energised at, or before, the end of the safety time.

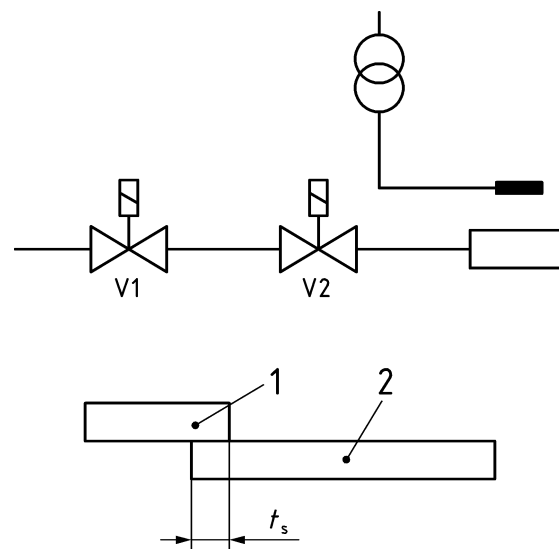
Where a hot surface ignition system is used, the ignition system shall be energised so that the ignition source is capable of igniting incoming gas before the main gas valves are opened.

4.4.1.6.3 Energizing of the main gas safety shut-off valves

The main gas safety shut-off valve immediately up-stream of the burner shall not be energised:

- before the ignition spark or other means of ignition is energised (in the case of direct main flame ignition) (see Figure 4 a));
- after ignition other than to permit flow of start gas (in the case of staged opening valves) (see Figure 4 b));
- until the start gas flame has been established (see Figures 4 c) and 4 d)).

Exception: During the valve proving sequence according to 4.3.4.15.



Key

V1, V2	main gas safety shut-off valve
t_s	safety time
1	ignition
2	main gas valves

Figure 4 a) Direct main burner ignition at full rate