BS ISO 22967:2010

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Forced draught gas burners

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National foreword

This British Standard is the UK implementation of ISO 22967:2010.

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

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

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INTERNATIONAL STANDARD

ISO 22967

First edition
2010-11-01

Forced draught gas burners

Brûleurs à air soufflé pour combustibles gazeux

Reference number
ISO 22967:2010(E)

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Foreword

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ISO 22967 was prepared by Technical Committee ISO/TC 109, *Oil and gas burners*.

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Introduction

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

Many burners are designed to operate on a wide range of fuel gases with little or no modification other than adjustment of the air supply.

When applying the requirements specific to a country or region, which are given in the various annexes, it is essential that a level of safety be ensured that is at least equivalent to that provided for by the requirements of the main body of this International Standard.

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INTERNATIONAL STANDARD ISO 22967:2010(E)

Forced draught gas burners

1 Scope

This International Standard specifies the terminology, test procedures and general requirements for the construction and operation of automatic forced draught gas burners, and the provision of related control and safety devices.

It is applicable to the following:

a) automatic gas burners (hereinafter called " burners") fitted with a combustion air fan that are equipped as described in Clause 4, intended for use in appliances of different types and operated with fuel gases;

b) total pre-mixed burners and nozzle mixed burners;

c) single burners with a single combustion chamber, for which, where such burners are fitted to a single appliance, the requirements of the relevant appliance standard also apply;

d) single-fuel and dual-fuel burners when operating only on gas;

e) the gas function of dual-fuel burners designed to operate simultaneously on gaseous and liquid fuels, which, for the latter, the requirements of ISO 22968 also apply.

It is not applicable to burners used in direct fired processes either with defined combustion chamber applications or where the combustion chamber wall surface temperature is greater than 750 °C or the heat-transfer medium temperature is greater than 500 °C.

2 Normative references

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

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

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

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

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

ISO 7005 (all parts), *Pipe flanges*

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

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

ISO 22968, *Forced draught oil burners*

ISO 23551-1, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 1: Automatic valves*

ISO 23551-2, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 2: Pressure regulators*

ISO 23551-3, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 3: Gas/air ratio controls, pneumatic type*

ISO 23551-4, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 4: Valve-proving systems for automatic shut-off valves*

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

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60335-1:2001, *Household and similar electrical appliances — Safety — Part 1: General requirements* , as amended 2004 and 2006

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

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

IEC 60730-2-5:2004, *Automatic electrical controls for household and similar use — Part 2-5: Particular requirements for automatic electrical burner control systems*

IEC 60730-2-6, *Automatic electrical controls for household and similar use — Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 60947-5-1, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*

IEC 61810-1, *Electromechanical elementary relays — Part 1: General requirements*

IEC 60747-5-2, *Discrete semiconductor devices and integrated circuits — Part 5-2: Optoelectronic devices — Essential ratings and characteristics*

3 Terms and definitions

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

3.1 General

3.1.1
forced draught burner
burner in which the total air for combustion is supplied by means of a fan

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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 occur automatically

NOTE 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
total 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
integrated ignition burner
burner with direct main ignition burner at reduced rate with bypass start 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
combustion chamber
part of the appliance in which the combustion takes place

3.1.9
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

3.1.10
heat-transfer medium
gaseous or liquid substance for the transport of heat energy from the appliance

3.1.11
appliance
heat generator into which the burner fires having a combustion chamber and heat exchanger are used to indirectly transmit the heat input from the burner combustion gases to the heat-transfer medium

3.2 Combustible gases

3.2.1
reference conditions
conditions corresponding to a temperature of 15 °C and a pressure of 0,101 325 MPa, unless otherwise specified

NOTE Based on standard reference conditions specified in ISO 13443.

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3.2.2
calorific value
quantity of heat produced by the combustion, at a constant pressure equal to 0,101 325 MPa, 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 A distinction is made between

a) the superior calorific value (H_s) in which the water produced by combustion is assumed to be condensed, and

b) the inferior calorific value (H_i) in which the water produced by combustion is assumed to be in the vapour state.

The units used for calorific value are either

c) megajoules per cubic metre (MJ/m^3) of dry gas at the reference conditions, or

d) megajoules per kilogram (MJ/kg) of dry gas.

See ISO 14532.

3.2.3
relative density
d
⟨fuel gas⟩ ratio of the masses of equal volumes of dry gas and dry air at the same conditions of temperature and pressure

NOTE Adapted from ISO 80000-4:2006, 4-3.

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 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 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 Adapted from ISO 14532:2005, definition 2.6.4.4.

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 Gas pressure is expressed in pascals or units thereof (Pa, kPa, MPa).

3.2.6
line-conveyed gas
gaseous fuels available by line-conveyed supply on site on which burners operate under nominal conditions when supplied at the corresponding normal pressure

3.2.7
normal pressure
pressure under which burners operate in nominal conditions when supplied with the corresponding line-conveyed gas

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3.2.8
limit pressures
pressures representative of the extreme variations in the burner supply conditions

NOTE The test pressures are given in Table 4.

3.2.9
supply pressure
pressure measured immediately upstream of all gas line components but downstream of the manually operated shut-off valve

3.2.10
adjustment pressure
pressure measured immediately downstream of the pressure regulator

3.2.11
burner head pressure
pressure measured immediately before the burner head

3.3 Test rig and combustion chamber

3.3.1
combustion chamber pressure
p_F
effective positive pressure or negative pressure relative to the atmospheric pressure prevailing in the combustion chamber

NOTE Combustion chamber pressure is measured in kilopascals (kPa).

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 The length of the combustion chamber is measured in metres (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 The diameter of the combustion chamber is measured in metres (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

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3.4 Composition of the gaseous combustion products

3.4.1
content of carbon dioxide
CO_2
ratio of the volume of carbon dioxide to the total volume of dry gaseous products in which it is present

NOTE The carbon dioxide content is expressed as a percentage volume fraction.

3.4.2
content of oxygen
O_2
ratio of the volume of oxygen to the total volume of dry gaseous products in which it is present

NOTE 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 The carbon monoxide content is expressed as a volume fraction, in units of millilitres per cubic metre (ml/m^3) for measuring purposes and in milligrams per kilowatt hour (mg/kWh) related to inferior calorific value (H_i) 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 The nitrogen oxides content is expressed as a volume fraction, in units of millilitres per cubic metre (ml/m^3) for measuring purposes and in milligrams per kilowatt hour (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 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).

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3.5.1.2
nominal volume flow rate
volume flow rate stated by the manufacturer, expressed in cubic metres per hour (m^3/h) at reference conditions

3.5.1.3
maximum flow rate
highest flow rate stated by the manufacturer, expressed in cubic metres per hour (m^3/h) at reference conditions

3.5.1.4
minimum flow rate
lowest flow rate stated by the manufacturer, 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 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 by the manufacturer

3.5.1.7
heat input
Q_F
amount of heat expressed as a function of time released by the burner at a given throughput

NOTE Heat input is expressed in kilowatts (kW) and is calculated as gas flow rate x inferior calorific value ($q_{Vg}H_i$) of the fuel.

3.5.1.8
nominal heat input
Q_{FN}
value of the heat input declared by the manufacturer

NOTE 1 It is expressed in kilowatts (kW).

NOTE 2 Fixed heat input or range-rated 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 declared by the manufacturer.

3.5.1.9
minimum heat input
Q_{Fmin}
lowest heat input specified by the manufacturer at which the burner can operate in accordance with the operational requirements

NOTE It is expressed in kilowatts (kW).

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3.5.1.10
maximum heat input
Q_{Fmax}
highest heat input specified by the manufacturer at which the burner can operate in accordance with the operational requirements

NOTE It is expressed in kilowatts (kW).

3.5.1.11
start heat input
Q_s
maximum heat input at the start of ignition as a percentage of the heat input, Q_F

3.5.2 Running conditions

3.5.2.1
burners for permanent operation
burners that are designed to remain in the running condition for more than 24 h without interruption

3.5.2.2
burners for intermittent operation
burners that are designed to remain in the running condition for less than 24 h

3.6 Gas line components

3.6.1
gas line
part of the burner made up of the valves, 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 by the manufacturer, to suit the actual heat requirements of the installation

NOTE This adjustment may be progressive or in discrete steps.

3.6.3
automatic shut-off valve
valve which opens when energized and closes automatically when de-energized

3.6.4
filter
strainer
device that enables foreign elements, which might otherwise cause failures in the system, to be collected

3.7 Adjustment, 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

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3.7.3
gas pressure protection device
device that 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 shut-off sequence

3.7.4
flame detector device
device by which the presence of a flame is detected and signalled

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

3.7.5
automatic burner control system
system comprising at least a programming unit and all the elements of a flame detector device

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

3.7.6
programming unit
unit 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 The programming unit follows a predetermined sequence of actions and always operates in conjunction with a flame detector device.

3.7.7
safe start check
procedure employing a protection circuit or circuits to establish whether or not a fault in a safety system or flame simulating condition exists prior to start-up

3.7.8
controlled shut-down
process by which the power to the gas shut-off valve(s) is immediately removed before any other action takes place (e.g. as a result of activating a controlling function)

3.7.9
safety shut-down
process that is effected immediately following the response of a safety limiter or the detection of a fault in the automatic burner control system and which puts the burner out of operation by immediately removing the power to the fuel shut-off valve(s) and the ignition device

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

3.7.10
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

3.7.11
start signal
signal (e.g. from a thermostat) which releases the system from its start position and commences the predetermined programme

3.7.12
recycling
process by which, after a safety shut-down, a full start-up sequence is automatically repeated

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3.7.13
valve-proving system
VPS
system used 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

3.7.14
ignition device
any means used to ignite the fuel at the ignition burner or at the main burner

EXAMPLE Flame, electrical ignition.

3.7.15
running position
position of the system in which the burner is in normal operation under the supervision of the programming unit and its flame detector device

3.7.16
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

3.7.17
pre-purge
purge which takes place between the start signal and energizing of the ignition device

3.7.18
post-purge
purge which takes place immediately after a controlled shut-down

3.8 Sequencing times

3.8.1
pre-purge time
period during which purge takes place at the proven air rate prior to energizing the ignition device

NOTE 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 It is expressed in seconds (s).

3.8.3
ignition time
period between the release of the fuel and the first indication of the flame by the flame detector device

NOTE It is expressed in seconds (s).

3.8.4
first safety time
period between the energizing and de-energizing of the pilot gas valve, start gas valve or main gas valve(s), as applicable, if the flame detector device signals the absence of a flame

NOTE Where there is no second safety time, this period is simply called the “ safety time” .

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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

3.8.6
flame 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

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

3.9 Combustion

3.9.1
flame stability
capacity of the 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

3.10 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 requirement

4.1 Operation with different fuels

4.1.1 Conversion to different gases

The types of gas for which the burner is designed shall be declared by the manufacturer on the data plate of the burner and in the instructions.

The precautions to be taken when converting a burner and its equipment from one type of gas to another (e.g. from propane to natural gas supply) and/or to adapt for different gas supply pressures shall be given by the manufacturer in the operating instructions.

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4.1.2 Operation with dual fuel supply or simultaneous supply

Burners shall be designed such that when operating under dual fuel or simultaneous supply no fuel shall adversely influence the flow of the other fuel.

4.2 Construction

4.2.1 Design

The effective lifetime of a burner is primarily controlled by its operation and maintenance.

The design of the burner shall be based on its intended lifetime as declared by the manufacturer. The intended lifetime of the equipment into which the burner is to be installed shall also be taken into account.

NOTE 1 The lifetime of components can differ from that of the burner.

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

NOTE 2 The burner head can 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 flame tube can remain unchanged.

Back-flow prevention devices shall be installed:

a) upstream of automatic shut-off valves when there is the possibility of back-flow of air or other fluid in burners;

b) on combustion airflow when there is the possibility of back-flow of fuel gas into combustion airflow while the burner is operating.

Pre-mix burners shall have an anti-backfiring structure, with two levels of flame arrestor devices located one after the other upstream of the flame zone; alternatively, backfiring detection sensors shall be installed to detect any backfiring and to initiate a safety shut-down followed by non-volatile lock-out.

The pre-mix volume of fuel and air shall be such that no potential risk occurs if flashback happens.

4.2.2 Accessibility for maintenance and use

Components requiring regular maintenance shall be so arranged or designed that they are easily detachable. They shall be designed or marked such that reasonable interpretation of the manufacturer's instructions would provide for proper re-installation.

Constructional parts accessible during use and maintenance shall be free from sharp edges and corners that might cause damage or personal injury. Burners that can be withdrawn or swivelled out of position without the use of tools shall be interlocked (e.g. by means of limit switches) so that they cannot be operated in the withdrawn or swivelled position.

The interlock device shall be fail-safe in design and, if a limit switch, shall conform with IEC 60204-1 or IEC 60947-5-1, depending on the design.

If the burner is installed according to the manufacturer's instructions, the surface temperatures of accessible burner parts not intended to be touched shall not exceed the ambient temperature by more than 60 K.

If, for technical reasons, these temperature limits cannot be respected, adequate warnings shall be provided.

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4.2.3 Soundness

Holes (e.g. for screws and studs) intended for the assembly of parts shall not open into gasways. The wall thickness between drillings and gasways 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 shall be achieved only by means of mechanical joints (e.g. metal-to-metal joints, gaskets or O-ring joints) and not by the use of sealing materials (e.g. tape, paste or liquid).

All sealing materials shall remain effective under normal conditions of burner use.

4.2.4 Materials

The quality and thickness of the materials used in the construction of the burner shall be selected so that the constructional and performance characteristics of the system do not deteriorate during operation. In particular, all burner components shall withstand the mechanical, chemical and thermal loads that can be encountered during operation. Under normal conditions of use, maintenance and adjustment, the burner components shall not show any changes that could affect their normal functioning. The influence of higher heat-transfer media temperatures shall be considered too.

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

Asbestos or materials containing asbestos 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 be in accordance with ISO 3183, ISO 9329-1, ISO 9330-1 or ISO 1129, as applicable.

4.2.5 Mounting

The burner shall be designed such that it can be effectively mounted on the appliance.

The burner shall be mounted on the appliance such that no ejection of high temperature gas or flame can occur.

The burner shall be mounted such that back radiation and high refractory temperatures do not adversely affect the stability and lifetime of the burner parts inside the combustion chamber.

The burner components shall be arranged and secured such that their correct operating position and —above all —the correct position of the burner orifices can not change during operation. The correct operating position shall be maintained when accessories are removed and refitted.

Parts of the burner that are set or adjusted during manufacture and which are not intended to be manipulated by the user or installer shall be sealed.

4.2.6 Connections

The following connections shall be designed in accordance with ISO 7-1:

a) those with inlet gas pressure-tight joints made on the threads;

b) those within the burner with pressure-tight joints made on the threads that are not loosened for maintenance;

c) connections for parts that are not frequently dismantled and refitted.

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Connections which have to be loosened for maintenance purposes shall be designed in accordance with ISO 228-1.

Flange connections shall be in accordance with ISO 7005-1, ISO 7005-2 and ISO 7005-3.

In the USA, Europe and Japan, the specific requirements given respectively in normative Annexes G, H and I apply.

4.3 Equipment

4.3.1 Motors and fans

Guards, grilles and shields shall be used to protect high-temperature or moving parts such that they cannot be touched accidentally. If this protection is not possible, warning signs shall be used.

Removal of such guards, grilles and shields shall be possible only with the use of tools.

The degree of protection provided shall be at least IP 20, according to IEC 60529.

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 tools.

Motors and fans shall be mounted such as to minimize noise and vibration. Lubrication points, if provided, shall be readily accessible.

4.3.2 Electrical safety

4.3.2.1 Controls conformant with IEC 60730 and ISO 23550

The provisions given in 4.3.2.2 are not applicable to controls that conform with the electrical requirements of IEC 60730 and ISO 23550.

4.3.2.2 Electrical safety of the burner

4.3.2.2.1 General

The leakage current and electrical strength tests of the complete burner need not be performed if the components and sub-assemblies have been separately tested and the interconnection is carried out in accordance with the manufacturer's instructions.

If the measurements of the leakage current as required in IEC 60335-1:2001, 13.2 are not possible because the protective impedance circuits or radio interference filters cannot be disconnected, then the limit specified for leakage current shall be calculated taking into account the current through those circuits.

The electrical safety of

a) the burner,

b) those of its control devices not in accordance with IEC 60730 and ISO 23550, and

c) the interface between control devices which do fulfil the requirements of IEC 60730 and ISO 23550

shall be in accordance with IEC 60335-2-102, modified by the additions and replacements given in 4.3.2.2.2.

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4.3.2.2.2 Modifications, additions and replacements

a) **Moisture resistance**

The requirements of IEC 60335-1:2001, Clause 15, apply.

IEC 60335-2-102:2004, 15.2, does not apply.

b) **Leakage current and electric strength**

The following replaces IEC 60335-2-102:2004, 16.2:

For gas burners, the limit is 10 mA.

The following replaces IEC 60335-2-102:2004, 16.3:

Compliance of spark ignition circuits shall be checked by inspection. In case of doubt, spark ignition circuits or crucial parts shall be submitted to an endurance test performed under the following conditions:

i) the maximum duration of switch-on given by the manufacturer (complete switch-on duration shall correspond with the realistic time of use);

ii) the relation between on/off cycles as declared by the manufacturer;

iii) the maximum rated voltage;

iv) the maximum ambient temperature of all parts under test.

During this test no breakdown of other circuits or —if the limits specified in IEC 60335-2-102:2004, 8.101, are exceeded —accessible surfaces shall occur. Breakdown of conductive parts which are connected to earth is allowed if this does not result in a critical failure of a circuit(s) with safety-related functions.

NOTE In case of doubt, compliance can normally be achieved by increasing the clearance at any part of the spark ignition circuit likely to cause an unacceptable breakdown.

c) **Abnormal operation**

In addition to the provisions of IEC 60335-2-102:2004, 19.11.2, the following failure mode applies:

Short-circuit and mechanical breakdown of relay contacts in protective electronic circuits, these failure modes need not be considered if components conform with footnote g) of IEC 60730-2-5:2004, Table H.27.1.

The following replaces the last paragraph of IEC 60335-1:2001, 19.11.2:

In each case, the test is ended if:

i) for risks of electrical origin, interruption of the supply occurs within the appliance;

ii) for risks concerning the fuel, shut-down occurs.

The following is additional to the provisions of IEC 60335-2-102:2004, 19.11.3:

Tests are not to be repeated for protective electronic circuits conforming with the relevant control standard according to 4.3.2.1.

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The following replaces IEC 60335-2-102:2004, 19.13:

During the tests described in 19.11.4, the appliance shall either continue to operate normally or reach a safe situation for risks concerning the fuel safety shut-down or non-volatile lock-out.

d) **Components**

The following is additional to IEC 60335-2-102:2004, 24.1.1:

Relays and optocouplers which ensure electrical isolation between live parts and accessible metal parts shall conform with IEC 61810-1 and IEC 60747-5-2.

e) **IEC 60335-2-102:2004, Annex Q**

The following is additional to the provisions of the annex:

NOTE Repeat testing of a protective electronic circuit is not required where the system has already been certified to conform with published International Standards where compliance requires that the fault behaviour of the fail-safe system is assessed on a second fault analysis basis.

4.3.3 Adjustable air damper

Any adjustable air damper or similar device for controlling the airflow shall be adjustable only by means of a tool. The adjusting positions of the air damper shall be visible (e.g. after removal of a cap).

If the burner is provided with a manual means of adjusting the combustion airflow, this means shall be so designed that, after adjustment according to the manufacturer's instructions, it is capable of being set and sealed.

4.3.4 Installation of the automatic burner control unit

The automatic burner control unit shall be in accordance with IEC 60730-2-5 and, in the installed condition (e.g. in the burner housing/control panel), shall have at least an IP 40 degree of protection, as specified in IEC 60529.

In Japan and Korea, the specific requirements given respectively in normative Annexes I and K apply.

4.3.5 Gas line components

4.3.5.1 General

All gas line components shall be designed for the individual inlet pressure of the burner or shall be protected against any excessive increase in pressure by means of suitable safety devices.

4.3.5.2 Manually operated shut-off valve

A quick-acting, manually operated shut-off valve shall be provided upstream of all controls to isolate the burner. This valve need not be supplied by the manufacturer, but it shall be specified in the manufacturer's installation instructions.

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

The manually operated shut-off valve shall be readily accessible and capable of rapid operation.

The manually operated shut-off valve shall be capable of operating at a pressure equal to 1,5 times the maximum supply pressure.

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The manually operated shut-off valve shall be of the 90° turn type and shall be designed so as to prevent inadvertent operation, shall be easy to operate and the open and closed positions shall be readily distinguishable.

Manually operated shut-off valves used solely for open/close operation shall be provided with mechanical stops at the open and closed positions.

4.3.5.3 Filter/strainer

A filter/strainer shall be fitted immediately upstream of the inlet of the gas line of the burner (see Figure 1) to prevent the ingress of contaminants.

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.

In the USA, the specific requirements given in normative Annex G apply.

4.3.5.4 Gas pressure regulator

The burner gas supply shall be controlled by a pressure regulator to ensure that the pressure at the burner head of the main burner or any ignition burner of greater than 2 kW heat input remains stable.

The burner heat input shall not vary by more than ±5 % from the specified value if the supply pressure changes within the limits shown in Table 4.

The main burner and any ignition burner may be governed separately.

The gas pressure regulator shall be in accordance with ISO 23551-2. Where its operating pressure falls outside the scope of ISO 23551-2, 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 and precautions shall be taken to make unauthorized adjustment difficult.

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

a) a high gas pressure shut-off valve, capable of shutting off the gas supply before an excessively high pressure occurs, shall be installed upstream of the gas pressure regulator, and

b) a safety relief valve, vented to a safe area, shall be installed downstream of the gas pressure regulator.

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

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

In the USA, Japan and Korea, the specific requirements given respectively in normative Annexes G, I and K apply.

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

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4.3.5.5 High gas pressure overload protection device

When a gas pressure regulator is not installed, a high gas pressure protection device in accordance with ISO 23551-2 and IEC 60730-2-6 shall be fitted, except when

a) the pressure drop across the gas pressure regulator(s) is less than 30 % of the normal operating minimum regulator pressure, and

b) the failure of any item in the gas line, including a gas pressure regulator, may result in an unsafe start-gas rate being obtained.

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

a) the heat input to the burner exceeds 1,15 times the nominal input, or

b) the pressure at the burner head exceeds 1,3 times the burner head pressure at the nominal inlet pressure.

4.3.5.6 Low gas pressure protection device

The burner shall be fitted with a low gas pressure protection device conforming to the requirements of IEC 60730-2-6, Type 2, able to initiate a safety shut-down when the supply pressure falls below a predetermined value.

The low gas pressure protection device may be omitted if, when the inlet pressure falls to 25 % of the nominal value, the burner

a) continues to operate safely and the CO content does not exceed 2 000 ml/m^3 by volume of the dry, air-free combustion products, or

b) proceeds to non-volatile lock-out.

In Japan, the specific requirements given in normative Annex I apply.

4.3.5.7 Adjustment devices

An adjustment device shall be provided to allow the specified gas rate to be achieved with the fuel gases intended by the manufacturer and over the intended range of gas pressures. Precautions shall be taken to make unauthorized adjustment of the device difficult.

This adjustment device may be that of the gas pressure regulator.

All adjustment devices shall require a tool for adjustment.

Setting of adjustment devices shall not change easily if properly fastened.

4.3.5.8 Automatic safety shut-off valves

All burners shall be fitted with two automatic safety shut-off valves in accordance with ISO 23551-1 and ISO 23551-4 and installed in accordance with Table 1.

Where main flame establishment is achieved 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, which shall incorporate a start gas limit position, or

b) under the control of safety shut-off valves according to Table 1.

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Table 1 —Safety shut-off valve requirements

Nominal heat input Q_{FN} kW	With pre-purge				Without pre-purge			
	Main gas	Start gas			Main gas	Start gas		
		⩽ 70	> 70 ⩽ 1 200	> 1 200		⩽ 70	> 70 ⩽ 1 200	> 1 200
⩽ 70	2 × B	2 × B	N/A	N/A	2 × A or 2 × B + VTC[b]	2 × A	N/A	N/A
> 70 ⩽1 200	2 × A + VTC[a]	2 × A	2 × A + VTC[a]	N/A	2 × A + VTC[b]	2 × A	2 × A + VTC[b]	N/A
> 1 200	2 × A + VTC[c]	2 × A	2 × A + VTC[a]	2 × A + VTC[c]	2 × A + VTC[c]	2 × A	2 × A + VTC[b]	2 × A + VTC[c]

VTC valve tightness check (see 4.3.5.10).

[a] CPI or POC or VPS.

[b] POC or VPS.

[c] Only VPS.

In the USA and Australia, the specific requirements given respectively in normative Annexes G and J apply.

4.3.5.9 Pressure test points

Test points or pressure measuring devices shall be provided to enable checking of the gas inlet pressure, gas adjustment pressure, the pressure in the burner head and the air pressure. See Figure 1.

NOTE A single pressure test point can be provided for measuring the adjustment and burner head pressures.

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

In the USA, the specific requirements given in normative Annex G apply.

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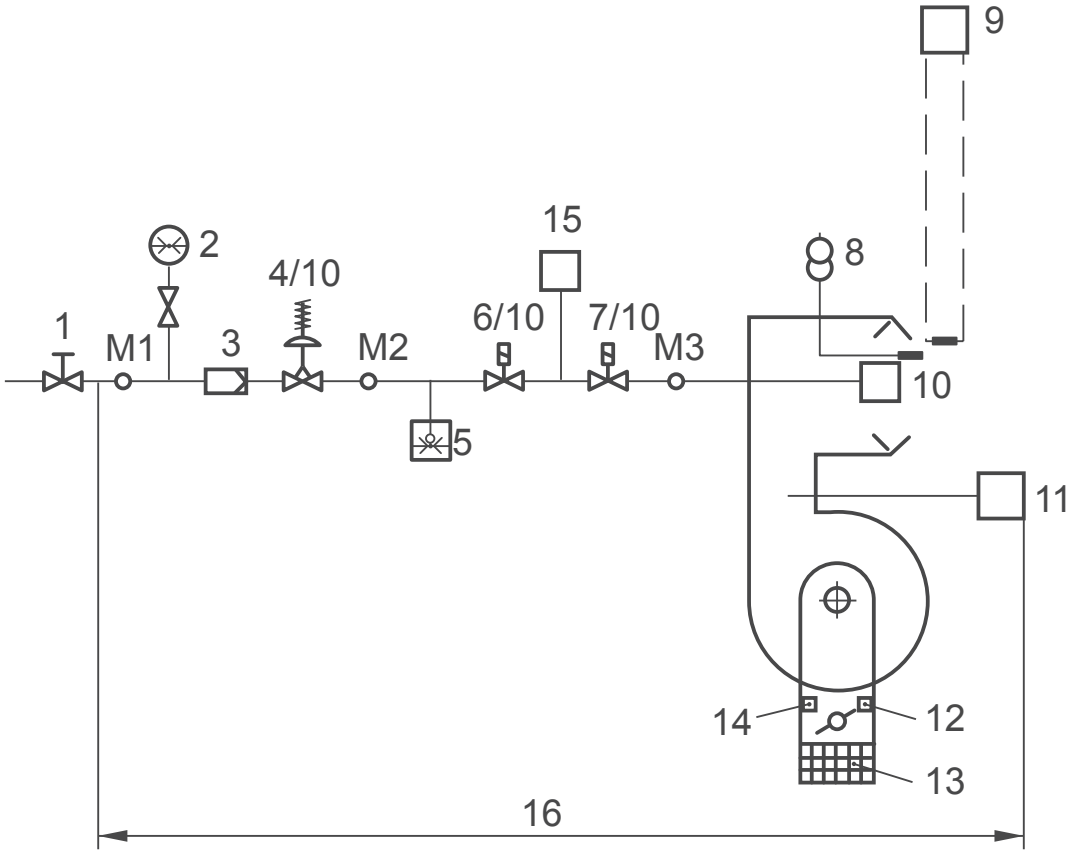

Key

1 manually operated shut-off device
2 gas pressure gauge
3 filter
4 gas pressure regulator according to ISO 23551-2
5 low gas pressure protection device
6 first safety shut-off device[a]
7 second safety shut-off device[a]
8 ignition device
M1 measuring point for supply pressure
M2 measuring point for adjustment pressure
M3 measuring point for burner head pressure
9 flame detector
10 preliminary adjusting device
11 air-proving device
12 low airflow position switch
13 safety device for moving parts, e.g. grille
14 high airflow position switch
15 valve-proving system (> 1,2 MW)
16 minimum equipment for type testing

[a] One or more functions can be incorporated into a single device (e.g. filter and safety shut-off device) and the location of the filter, safety shut-off valves and pressure governor can vary.

a) Gas supply pressure not exceeding design pressure of gas line components used

Figure 1 —Examples of equipment (*continued*)

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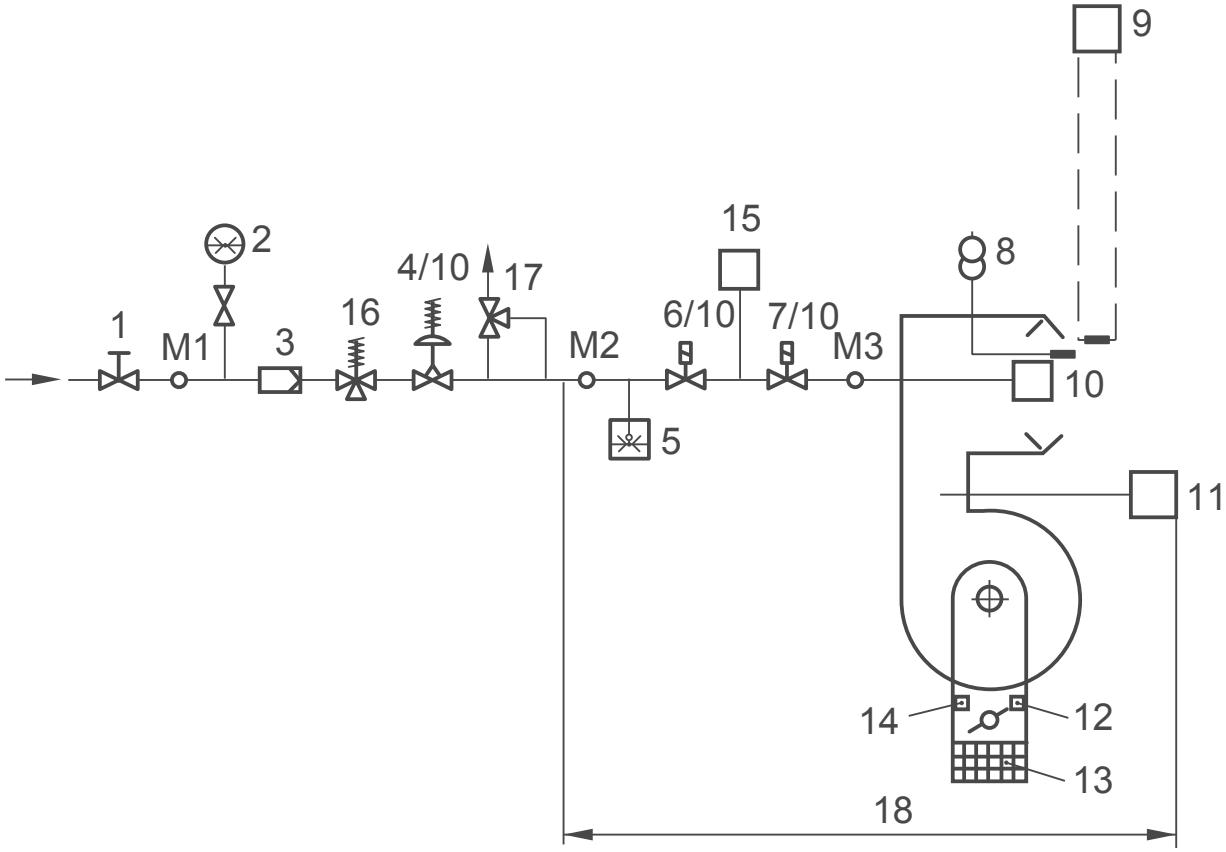

Key

1 manually operated shut-off device
2 gas pressure measuring device
3 filter
4 gas pressure regulator according to ISO 23551-2
5 low gas pressure protection device
6 first safety shut-off device[a]
7 second safety shut-off device[a]
8 ignition device
9 flame detector
M1 measuring point for supply pressure
M2 measuring point for adjustment pressure
M3 measuring point for burner head pressure
10 preliminary adjusting device
11 air-proving device
12 low airflow position switch
13 safety device for moving parts, e.g. grille
14 high airflow position switch
15 valve-proving system (> 1,2 MW)
16 high gas pressure shut-off valve
17 safety relief valve
18 minimum equipment for type testing

[a] One or more functions can be incorporated into a single device (e.g. filter and safety shut-off device) and the location of the filter, safety shut-off valves and pressure governor can vary.

b) Gas supply pressure exceeding design pressure of gas line components used

Figure 1 —Examples of equipment (*continued*)

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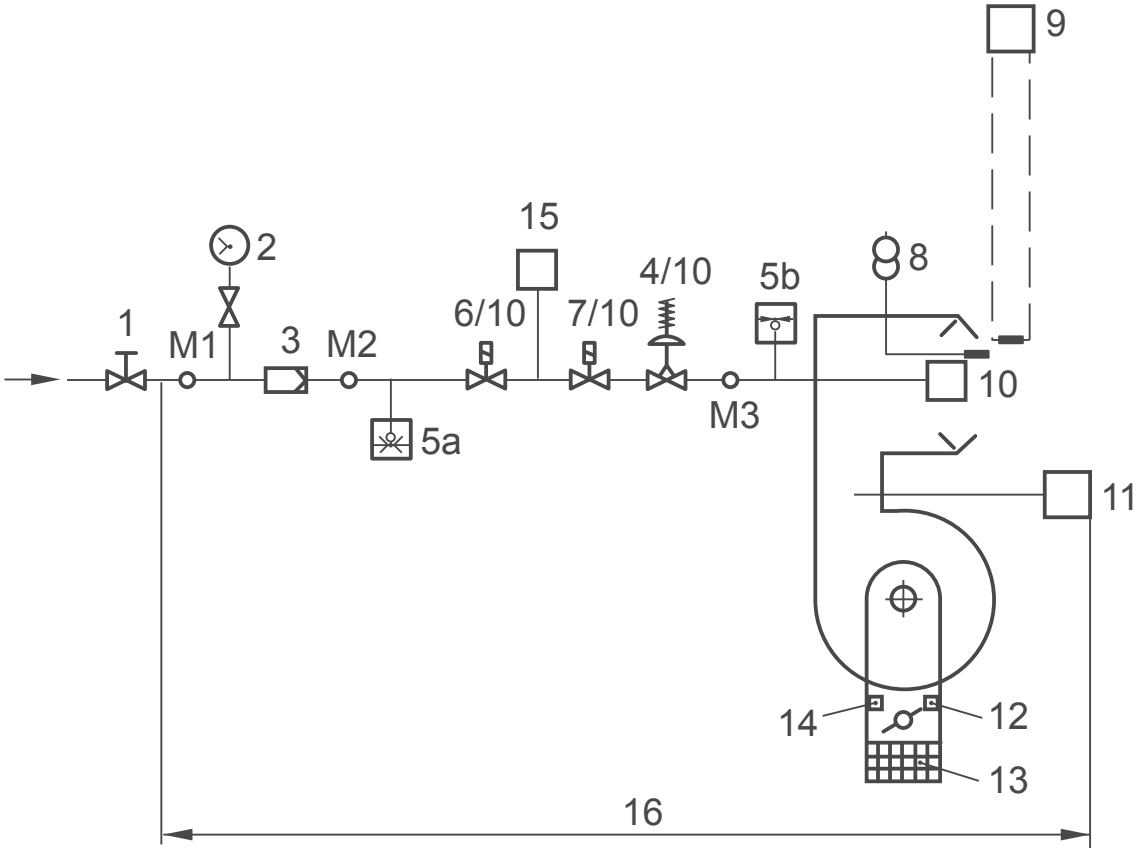

Key

1	manually operated shut-off device	9	flame detector
2	gas pressure measuring device	10	preliminary adjusting or range rating device
3	filter	11	air-proving device
4	gas pressure regulator according to ISO 23551-2	12	low airflow position switch
5 a	low gas pressure protection device	13	safety device for moving parts, e.g. grille
5 b	high gas overload protection device	14	high airflow position switch
6	first safety shut-off device[a]	15	valve-proving system (> 1,2 MW)
7	second safety shut-off device[a]	16	minimum equipment for type testing
8	ignition device		
M1	measuring point for supply pressure		
M2	measuring point for adjustment pressure		
M3	measuring point for burner head pressure		

[a] One or more functions can be incorporated into a single device (e.g. filter and safety shut-off device) and the location of the filter, safety shut-off valves and pressure governor can vary.

c) Gas supply pressure not exceeding design pressure of gas line components used downstream M1 with high gas pressure overload protection device

Figure 1 —Examples of equipment

4.3.5.10 Valve tightness check (VTC)

In Japan, the specific requirements given in normative Annex I apply.

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