BRITISH STANDARD

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12952-8:2002

Water-tube boilers and auxiliary installations —

Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler

The European Standard EN 12952-8:2002 has the status of a British Standard

ICS 27.040

National foreword

This British Standard is the official English language version of EN 12952-8:2002.

When the reference to this European Standard has been published in the Official Journal of the European Communities (OJ), compliance with it will confer a presumption of conformity with the essential requirements covered by the standard in respect of the Pressure Equipment Directive.

The UK participation in its preparation was entrusted to Technical Committee PVE/2, Water-tube boilers, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Water-tube boilers and auxiliary installations - Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler

Chaudières à tubes d'eau et installations auxiliaires - Partie 8: Exigences pour les équipements de chauffe pour combustibles gazeux et liquides de la chaudière

Wasserrohrkessel und Anlagenkomponenten - Teil 8: Anforderungen an Feuerungsanlagen für flüssige und gasförmige für den Kessel

This European Standard was approved by CEN on 15 May 2002.

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

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This document (EN 12952-8:2002) has been prepared by Technical Committee CEN/TC 269 "Shell and water-tube boilers", the secretariat of which is held by DIN.

This European Standard 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 Annex ZA, which is an integral part of this standard.

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 November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

The European Standard EN 12952 concerning "*Water-tube boilers and auxiliary installations*" consists of the following Parts:

— *Part 1: General.*

— *Part 2: Materials for pressure parts of boilers and accessories.*

— *Part 3: Design and calculation for pressure parts.*

— *Part 4: In-service boiler life expectancy calculations.*

— *Part 5: Workmanship and construction of pressure parts of the boiler.*

— *Part 6: Inspection during construction, documentation and marking of pressure parts of the boiler.*

— *Part 7: Requirements for equipment for the boiler.*

— *Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*

— *Part 9: Requirements for firing systems for pulverized solid fuels for the boiler.*

— *Part 10: Requirements for safeguards against excessive pressure.*

— *Part 11: Requirements for limiting devices of the boiler and accessories.*

— *Part 12: Requirements for boiler feedwater and boiler water quality.*

— *Part 13: Requirements for flue gas cleaning systems.*

— *Part 14: Requirements for flue gas DENOX-systems.*

— *Part 15: Acceptance tests.*

— *Part 16: Requirements for grate and fluidised bed firing systems for solid fuels for the boiler.*

CR 12952 Part 17: Guideline for the involvement of an inspection body independent of the manufacturer.

Although, these Parts can be obtained separately, it should be recognized that the Parts are interdependent. As such, the design and manufacture of water-tube boilers requires the application of more than one Part in order for the requirements of the standard to be satisfactorily fulfilled.

NOTE Parts 4 and 15 are not applicable during the design, construction and installation stages.

Annex A of this European Standard is normative and Annex B is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 Firing systems

This Part of this European Standard specifies requirements, for oil and gas firing systems of steam boilers and hot water generators as defined in EN 12952-1.

These requirements also apply to firing systems of chemical recovery boilers (black liquor boilers) with the additions and amendments specified in Annex A of this standard.

NOTE 1 This standard is not applicable to coil type boilers (flash boilers/small boilers) that use burners in accordance with EN 12953-7 apply for single burner installations.

1.2 NOTE 2 This standard is not applicable to the storage of liquid fuels and to transfer stations of long-distance gas pipelines. Fuels

This Part of this European Standard specifies requirements, which cover the use of liquid and gaseous fuels as defined in this standard. Fuels deviating from standardized commercially available types may require additional or alternative safety measures. For black liquor these safety measures are given in Annex A.

1.3 Operation

This Part of this European Standard specifies requirements for operational equipment in clauses 4 to 8 which apply to steam boilers and hot water generators with permanent supervision by properly trained personnel familiar with the special conditions of the firing system and the type of fuel being fired.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 161, *Automatic shut-off valves for gas burners and gas appliances.*

EN 264, *Safety shut-off devices for combustion plants using liquid fuels — Safety requirements and testing.*

EN 287-1, *Approval testing of welders — Fusion welding — Part 1: Steels.*

EN 751-1, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 1: Anaerobic jointing compounds.*

EN 751-2, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 2: Non-hardening jointing compounds.*

EN 751-3, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes.*

EN 1044, *Brazing — Filler metals.*

EN 12952-1, *Water-tube boilers and auxiliary installations — Part 1: General.*

EN 12952-5:2001, *Water-tube boilers and auxiliary installations — Part 5: Workmanship and construction of pressure parts of the boiler.*

EN 13480-2, *Metallic industrial piping — Part 2: Materials.*

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

EN ISO 3677, *Filler metal for soft soldering, brazing and braze welding — Designation (ISO 3677:1992).*

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

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

3 Terms and definitions

For the purposes of this Part of this European Standard and the following terms and definitions apply.

3.1
black liquor
spent liquor from the pulp cook

3.2
black liquor gun
device for the introduction of the black liquor as a spray of droplets into the furnace. The black liquor gun is not a burner

3.3
high volume low concentration odorous gas
mixtures of air and a low concentration of odorous gases collected from the pulp mill processes, where the concentration of the combustible odorous gas is always kept below the lower explosion limit

3.4
burners
devices (including main or igniter burners) for the introduction of fuel and air into a combustion chamber at required velocities, turbulence and local fuel concentration to establish and maintain proper ignition and stable combustion of the fuel. Burners are differentiated by their mode of operation

3.4.1
automatic burners
burners equipped with automatic ignition, flame monitoring and safety control devices that control the firing rate without the intervention by operating personnel

3.4.2
semi-automatic burners
burners equipped with automatic ignition, flame monitoring and safety control devices which are started and stopped by the intervention of operating personnel

3.4.3
chemical recovery boiler start up burner
oil- or gasfired burner mainly intended for the initiation of the black liquor combustion process. The chemical recovery boiler start up burners are located in and integrated with a combustion air register, like the primary or the secondary air register of the furnace. Thus they have no individual air supply and no individual combustion air control

3.4.4
multi-fuel burners
burners in which more than one fuel is burned either simultaneously or alternately

3.4.5
pilot burner
burner which maintains a proper permanent ignition source for one or a group of other non-monitored burners

3.5
burner group
burners operated in unison and controlled jointly. One of the burners can be a master burner

3.6
burner management system
system that performs a predetermined sequence of actions and always operates in conjunction with a flame monitor that reacts to signals from control and safety devices, gives control commands, controls the start-up sequence, supervises the burner operation, and manages controlled shutdown and lockout

3.7
firing system
total equipment required for the combustion of fuels including the installations for the storage, preparation, and supply of fuels, the combustion air supply, the burner(s), the flue gas discharge, and all related control and monitoring devices. A flue gas recirculation system can be an integral part of the firing system

3.8
firing system heat input
heat input into the combustion chamber according to the mass flow of the fuel supplied multiplied by the net calorific value

3.9
flame monitor
device which detects the presence or absence or break-away of the flame and transmits a signal to the control device, and generally consists of a sensing device (with amplifier if necessary) and switching equipment

3.10
flue gas recirculation
return of flue gas from downstream of the flame zone or from the flue gas exit by hydrodynamic pressure difference or a separate fan into the air register of the burner or directly into the combustion chamber

3.11
implosion
unintentional instantaneous negative pressure build-up caused, for example, by an explosion in a confined space, by rapid closing of dampers, or by rapid reduction in temperature (flame out)

3.12
limiters
transducer, which, on reaching a fixed value (e.g. pressure, temperature, flow, water level) is used to interrupt and lock-out the energy supply, and requires manual unlocking before restart

3.13
lock-out
isolation of energy supply which requires a manual intervention to reinstate

3.14
master fuel trip
device for rapid automatic shut-off of all fuel supplies to the boiler area and electrical igniters in the event of danger which may act by automatic, manual or emergency switch initiation even if a possible electrical or mechanical fault occurs

3.15
maximum heat input of the firing system
heat input including the reserve required for load control at which the boiler can be safely operated

3.16
maximum firing rate of the burners
firing rate at which the burner may be operated

3.17
monitor
limit transducer, which senses the reaching of a fixed limit value and initiates an alarm and/or a cut out. The output signal is only cancelled if the cause of the alarm has been removed and the value has returned to within its fixed limits

3.18
multi-fuel firing system
firing system where, in a common combustion chamber, more than one fuel can be burnt simultaneously or alternately by separate or multi-fuel burners

3.19
purge of burner guns
carried out after shutdown of a burner to ensure the removal of residual fuel by the introduction of steam or pressurized air into the fuel lines downstream of the shut-off devices

3.20
purging of the flue gas passes
forced flow of air through the combustion chamber, flue gas passes, and associated ducts which effectively removes any gaseous combustibles and replace them with air

3.21
quick-acting shut-off device
safety trip valve which closes within 1 s

3.22
relative density
ratio of the density of the gas to the density of dry air under equal conditions of pressure and temperature

3.23
liquid fuels
fuels include light fuel oils, and heavy fuel oils which need preheating for proper atomisation. For improvement of atomisation, emulsions of heavy fuel oil with water may be used with appropriate precautions

3.24
gaseous fuels
standardized quality differentiated mainly by their relative density

3.24.1
light gases
with relative density below 1,3 e.g. natural gas, coke-oven gas, blast-furnace gas

NOTE Natural gas in accordance with ISO 6976.

3.24.2
heavy gases
with relative densities exceeding 1,3 e.g. liquefied petroleum gases, the main components of which are propane and butane

3.25
restart
operation where fuel supply shut-off is initiated within 1 s at the latest after extinction of the flame during operation, and a directly following attempt of re-ignition is automatically made in compliance with the start-up sequence. This operation ends with the operating condition being reached or, if the flame is not ignited after expiration of the ignition safety time, with the lock-out

3.26
return-fow atomizer
oil burners, where a portion of the quantity of oil supplied to the burner via the flow line does not flow from a burner gun vortex chamber into the combustion chamber, but flows backwards into the storage tank or to the suction side of the pump via a separate return line. Output is adjusted by a control device in the return line

3.27
safety shut-off device
safety trip valve
valve which automatically and totally cuts off the fuel supply

3.28
safety time
tolerance time during which the effectiveness of the safety device may be inhibited without a hazardous condition occurring

3.28.1
ignition time: When starting-up the burner, the period of time between the first fuel entering the combustion chamber and the first indication of the flame by the flame monitor

3.28.2
ignition safety time: When starting-up the burner, the period of time between the first fuel entering the combustion chamber and the de-energizing of the quick-acting shut-off device if the flame monitor does not indicate a flame

3.28.3
main burner safety time: When there is an ignition safety time applicable to an igniter burner only the period of time between the first fuel of the main burner entering the combustion chamber and the de energizing of the quick acting shut-off device of the main burner if the flame monitor does not indicate a flame

3.28.4
extinction safety time: During operation of the burner the period of time between the extinction of the flame and the de-energizing of the quick-acting shut-off device

3.29
transfer station
one or more lines each including a pressure control valve and a quick-acting shut-off device for the protection of the downstream supply lines and the connected appliances against overpressure. The transfer station may comprise of heating and filtering equipment for the gas supply, measuring equipment for flow and calorific value and noise abatement devices

4 Fuel supply

4.1 General

For multifuel firing systems using separate or combined burners these requirements shall apply to the oil and/or gas firing part involved.

Where several fuels are burnt simultaneously, improved safety measures can be necessary, especially in respect to limitation of heat input into the firing system and proper air supply to the individual fuels.

4.2 Fuel transfer and preparation

4.2.1 The fuel supply line shall be equipped with a reliable quick-acting safety shut-off device (master fuel trip) which shall be positioned in a safe location. It shall reliably cut off the fuel supply to the boiler room or the boiler area and shall be operable manually or by remote control or by an emergency switch (see 6.5).

4.2.2 Some liquid fuels, such as heavy fuel oil, require preheating to achieve the viscosity required for proper atomisation. Where national oil quality standards are in existence, these shall be observed.

Any heat source other than open flames, that can be cut off immediately if required, and the rating of which can be automatically controlled, shall be used for oil preheating.

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

To attain the temperature for the required atomisation viscosity, pressure type preheaters shall be used. The maximum temperature shall be at least 5 °C below the boiling temperature of water in the oil at the connected pressure.

Each fuel oil preheating system shall be automatically temperature controlled. A temperature indicator shall be fitted downstream of the preheating system. Oil temperatures below the temperature prescribed upstream of each burner or burner group shall shut off the burner or burner group.

Oil temperatures above the temperature prescribed upstream of the burners shall shut off the heat supply of the preheater or other suitable measures shall be taken.

For pressurized preheaters, the requirements for pressure vessels shall be applied. Functioning of the necessary overpressure protection shall be ensured by suitable temperature control. Any escaping oil shall be safely discharged.

Where steam heating coils for oil preheating are installed and the condensate is returned to the boiler, the heating coils shall be safely dimensioned and tested to ensure that no oil can escape into the condensate. A means of checking the condensate for oil content shall be provided. When steam lines are connected to fuel oil lines for purging purposes or for steam assisted atomisation, the line shall be protected against back flow from the higher pressured fluid.

4.2.3 For gaseous fuels, a pressure controller shall be provided in the supply line to each firing system unless this task is performed by the transfer station.

The reliability of the gas pressure controller and its related safety device shall be proved by component testing or an individual test within the system acceptance test.

4.3 Fuel lines

4.3.1 Fuel lines, including gaskets and valves shall be designed and laid out to withstand the mechanical, chemical and thermal loads to which they are exposed in service. Only fire resistant piping material shall be permitted.

4.3.2 The fuel lines shall be tight and properly fixed. In systems subjected to vibrations the resulting stresses shall be minimized to avoid leakage.

4.3.3 Connections shall preferably be welded or brazed. Threaded joints or bolted flanges shall also be used.

Welded joints shall only be made by welders approved to the appropriate standards (see EN 287-1).

Brazed joints shall be permitted in oil lines for pipe diameters < DN 25 and/or operating pressure < 10 bar provided the brazers shall be approved and the filler materials have been certified, e.g. by a certificate of a specialized manufacturer (see EN ISO 3677 and EN 1044). They shall also be permitted in gas lines for pipe diameter < DN 80 and/or operating pressure < 5 bar.

For threaded joints the requirements of ISO 7-1 and ISO 228-1 shall apply. Thread joints shall be used up to DN 50 and shall be sealed by metal to metal contact, or sealed by non-hardening sealing materials. Hemp shall only be used as a sealant support. The use of PTFE sealing materials shall be restricted as indicated in EN 751.

Compression-type fittings in accordance with appropriate standards may be used up to DN 25, provided they shall be not to be dismantled for maintenance purposes.

Flanged connections on apparatus, equipment and valves shall be permitted for all diameters.

Material shall be in accordance with EN 13480-2.

4.3.4 Flexible lines shall be used for connecting the burner to the fixed piping. For fuel oil in the preheated state only jacketed metallic hoses shall be permitted.

Furthermore, flexible lines may be used instead of expansion joints at protected locations. For oil, these lines should be jacketed metallic hoses, otherwise they shall be provided with a protective device consisting of e.g. a double line with an oil monitor which switches off the oil supply pump in case of an oil leakage. For gas, these lines shall be corrugated steel pipes.

All flexible lines shall be as short as possible, be readily visible, and shall be installed with adequate bending radii. The flexible lines and the connections shall carry the manufacturer's symbols and indication of the nominal pressure. The design pressure shall be at least 1,5 times the maximum allowable pressure. The lines shall be protected against unacceptable external heating.

4.3.5 To protect fuel lines against unacceptable high pressure, automatic control and safety devices shall be provided. For oil lines, pressure relief valves shall be installed. Protection of oil pumps and the effect of pressure rise in lines between closed shut-off devices due to heating shall also be taken into consideration. For gas lines the necessary protection against overpressure shall be performed by a safety shut-off valve plus a pressure relief valve.

4.3.6 On completion of installation, all fuel piping including valves and other equipment within the fuel lines up to the burner nozzles shall be cleaned to remove any weld spatter, corrosion products and foreign matter. The type and performance of the cleaning process shall also be recorded. In addition leakage testing and strength testing in accordance with a good engineering practice shall be performed.

For oil and gas, each safety shut-off device shall be subject to internal leakage testing, to confirm that fuels does not leak through the device.

After any welding work or replacement of components on fuel lines, the aforementioned tests shall be repeated.

The performance of the tests shall be authenticated by certificates recording the test procedure, the medium used, the test pressure and the test results obtained.

The certificates shall be issued by the person responsible for the testing.

4.3.7 Gas escape lines for intermediate venting and for purging or charging shall be arranged such, that the escaping gas is either reliably ignited and burnt off with a flame trap installed in the pipe where the gases are transferred to the burning device or is safely discharged to the atmosphere if unburnt. The joining together of these lines shall only permitted if no dangerous operating conditions are expected. When necessary, gas escape lines shall be equipped with the necessary draining facilities. Connections for test devices shall be provided so that the adequacy of venting can be checked.

For oil, intermediate drains shall be provided to ensure the safe discharge of escaping oil.

4.4 **Safety shut-off devices** (Safety trip valves)

4.4.1 The fuel supply line shall be equipped with two safety shut-off devices arranged in series immediately upstream of each burner, or burner group. One of these safety shut-off devices shall be of quick-acting design, and correspond with group A of EN 161. The second safety shut-off device may also be used as a fuel mass flow actuator for the control of the firing rate of the burner, but its closing time shall not exceed 5 s. For gas, these devices shall also correspond with group A of EN 161.

The fuel supply lines shall be provided with devices for removing those impurities from the fuel which may impair the functioning of the safety shut-off devices.

The safety shut-off devices shall automatically and reliably cut off the fuel supply to the burner. An adequate auxiliary power source, e.g. a spring, shall be permanently available to assure this occurs. The reliability of the automatic shut-off devices shall be proved. This proof shall be performed by component testing as specified in EN 264 for liquid fuels or in EN 161 for gaseous fuels.

Leakage testing of each of the safety shut-off devices shall be possible in its installed condition at regular time intervals. For gas, the connection line between these two safety shut-off devices shall be equipped with an intermediate venting or a leakage detection device.

Oil burners of special design such as return-flow atomizers, burners with a tip shut-off device etc., using return-flow lines shall be provided with additional double shut-off valves in these lines.

For gaseous fuels with low calorific value and with very low supply pressure, e.g. below 200 mbar, the duty of the aforementioned safety shut-off devices may be performed by equivalent devices, e.g. rotary slide valves with sealing water, or double-seat valves with an intermediate venting.

4.4.2 The fuel supply shall not be released during the start-up operation until

a) the ignition device is ready for ignition (see 6.1.5);

b) purging is completed (see 6.5.2 and 6.5.3) or there is fire in the combustion chamber;

c) the minimum preheating temperature required for the oil has been reached;

d) the safety shut-off devices proved to be closed or the leakage test proved to be successful;

e) the fuel control valve(s) and the air damper(s) are in the start position;

f) functional control of the flame monitor proves no defect to be present, and in the case of individual flame monitoring detects there is no flame present prior to ignition.

4.4.3 The automatic safety shut-off devices shall be operated such that they do not release the fuel supply to the burners during the start-up operation, and cut it off during operation whenever

1) the control power for the safety devices fails;

2) the flue gas damper is not fully open or the induced draught fan fails, or the combustion chamber pressure is to high;

3) the combustion air fails to be supplied (see 5.1.1);

4) the combustion air flow is insufficient (see 5.2);

5) the pressure is:

   a) the pressure of the atomising medium is less than that required (for steam and pressure-air atomizers),

   b) the fuel pressure is less than the minimum pressure (for gas burners, and oil burners with pressure atomizers),

c) the maximum fuel return flow pressure is exceeded (for oil burners with return-flow atomizers),

6) the speed of rotation of the atomising cup is insufficient (for oil burners with rotary atomizers). Where the atomising cup is on the same shaft as the fan, it will suffice to monitor the fan air pressure.

7) there is an unacceptably high fuel flow rate in the burners; if necessary cut-off may be effected with a delay in time;

8) the ratio of flue gas recirculation flow/burner firing rate is unacceptable (see 6.2);

9) the flue gas recirculation fan, if fitted, fails and the ratio of flue gas recirculation flow/burner firing rate is unacceptable (see 6.2);

10) cut off switches are actuated;

11) the emergency switch is actuated (see 6.4.3);

12) any of the limiters responds (e.g. for water level, temperature);

13) burners (also burner guns) which can be swung out or retracted without the aid of tools are swung out or retracted;

14) the flame monitor responds due to the absence or extinction of the flame.

4.4.4 As soon as the causes for conditions a) to f) of 4.4.2 and 1) to 9) of 4.4.3 have been removed, the burners may automatically restart by following the regular start-up programme if this shall be permitted for the plant.

Where the conditions 10) to 14) of 4.4.3 apply, lock out shall always occur. Restarting shall only be possible by manual intervention.

Where plants have multiple burners, if the conditions mentioned in 1), 3), 4), 5), 7), 8), 9), 10) and 14) of 4.4.3 occur only on one burner or one burner group, it shall suffice if the fuel supply to the respective burner or burner group is not released during start-up and is interrupted during operation. This shall also apply to 12) of 4.4.3 if a hazardous escape of flames and flue gases is prevented.

4.4.5 One manually operated emergency shut-off device shall be arranged immediately upstream of the burner, or each burner group. A manually operated emergency shut-off device is for example:

— a stop cock;

— a stop valve provided the open cross-section can be completely closed by a maximum of two hand-wheel rotations; or

— an automatic safety shut-off device according to 4.4.1 if it can be additionally operated by hand at the location of operation.

4.4.6 All safety related valves shall be durably marked with regard to their intended use.

5 Equipment for air supply and flue gas discharge

5.1 Air supply

5.1.1 The combustion air fan shall be monitored by the air flow and one of the following criteria:

a) speed of the forced draught fan;

b) pressure downstream of the forced draught fan;

c) differential pressure at the forced draught fan;

d) power input of the forced draught fan motor.

5.1.2 Where there are several burners with a common fan each shall be equipped with a pressure gauge or flowmeter in the air supply line. This does not apply to burners with a common wind box.

5.1.3 In the case of firing systems with several burners to which combustion air is supplied by a common control device, each burner shall be equipped with a shut-off device (e.g. damper) in the air duct except when all burners fire in unison.

Shut-off devices in the air line to the burner shall be protected against unintentional mal-adjustment. The positions during normal operation and ignition shall be checked.

In the case of interruption of fuel supply to the burner, this shut-off device shall also cut off the air supply automatically (if necessary, only to provide a minimum opening). This shall ensure sufficient air supply for the burners still in operation in the case of failure and shutdown of a burner or burner group. The position of the shut-off device shall be identifiable.

In the case of interruption of fuel supply to all burners, it can be necessary to avoid the risk of implosion in the combustion chamber.

5.2 Air/fuel ratio

The air/fuel ratio shall be controlled within admissible limits. The predetermined values of the air/fuel ratio and the admissible limits shall be stated in the operating manual.

The air/fuel ratio shall be monitored so, that in the case of unacceptable deviations from the ratio determined by the manufacturer of the firing system and defined within the operational instructions, the fuel supply is cut off. The air/fuel ratio monitoring circuit shall be independent of the control circuit. Monitoring shall not be required if the air/fuel ratio is controlled by mechanical means, and this ratio cannot be changed to exceed the admissible limits as a result of upset or operating conditions.

5.3 Flue gas discharge

5.3.1 Flue gas discharge shall be monitored to ensure it is not unnecessarily restricted. This shall be performed by the following measures:

a) checking the position of the damper(s) during start-up;

b) monitoring of the induced draught fan operation and combustion chamber pressure.

If the relevant combustion chamber pressure is exceeded the firing shall be cut-off and locked-out.

5.3.2 The induced draught fan shall be monitored in accordance with 5.3.1 b) and one of the following criteria:

a) speed of the induced draught fan;

b) pressure upstream of the induced draught fan;

c) differential pressure at the induced draught fan;

d) power input to the induced draught fan motor;

e) power circuit breaker of the induced draught fan motor.

6 Firing system

6.1 Burners

6.1.1 The firing system shall be suitable for the respective boiler and may consist of a single burner or a multiple burner arrangement. The task of the burners and the mode of operation of the burners are defined in 3.2. The requirements specified in clauses 4 and 5 shall be fulfilled by each individual burner. Burners shall be individually tested (but see 6.1.3), at the latest during commissioning, or following any safety relevant modification to the firing system, and shall include:

1) verification of completeness of equipment according to the requirements of this standard;

2) functional testing of all safety-related equipment;

3) testing of burner management system in accordance with 6.4;

4) verification of maximum and minimum burner firing rate, including injection of additives, if used;

5) verification of flame stability during burner start-up, at the conditions given in 4) above, with the flue gas recirculation if any, and in the case of changes in firing rate, taking coincident combustion chamber pressures into consideration. In all these cases, the flame shall be stable without significant pulsations;

6) evidence that the requirements for purging of flue gas passes and the safety times have been met;

7) proof that the required characteristic values relevant to combustion, such as CO_2- or O_2- if any, CO-content by volume, are obtained at the conditions given in 4) and at intermediate firing rates, if applicable. In addition for oil burners unburnt particles (smoke) shall be checked.

6.1.2 The burner individual test and the testing of the burner management system may be simplified by application of type tested equipment according to appropriate standards, e.g. EN 225, EN 230, EN 267, EN 298, EN 676, if they fulfil the requirements described in 6.1.1.

6.1.3 For multi-burner arrangements, the tests in accordance with 6.1.1 shall be performed collectively.

6.1.4 Burners and their guns which operationally or without the aid of tools can be replaced, retracted or swung out, shall be provided with a locking device to cut out the supply of fuel and atomising medium (see 4.4.3, 12)).

6.1.5 Each burner shall be equipped with an igniter.

Admissible igniters are:

1) gas-electric igniters;

2) oil-electric igniters;

3) electric igniters.

The igniter shall provide a sufficient ignition source to light-up the main burner within the safety time.

It shall be ensured that the safety time of the main burner is not extended by influences of the ignition device.

6.2 Flue gas recirculation

6.2.1 Flue gas recirculation shall not influence flame stability adversely. Sufficient flame stability with maximum allowable flue gas recirculation flow shall be proven during burner test in accordance with 6.1.1.

6.2.2 Where the flue gas recirculation flow is controlled as a function of the firing rate, the ratio of flue gas recirculation flow to burner firing rate shall be so monitored that the fuel supply is cut off if unacceptable deviations from this ratio, specified by the manufacturer of the firing system, arise. The monitoring of the ratio of the flue gas recirculation flow to burner firing rate shall be independent of the control circuit. Monitoring shall not be required if

the ratio of the flue gas recirculation flow to burner firing rate is controlled by mechanical means, and if this ratio cannot be changed to exceed the admissible limits as a result of upset operating conditions.

Acceptable deviations from the value predetermined for the ratio of the flue gas recirculation flow to burner firing rate shall be stated in the operating manuals.

The requirements given in 5.4 for the air flow shall be considered for the flue gas recirculation flow.

During start-up of a burner, particularly with a cold combustion chamber, flue gas recirculation shall not be initiated until flame stability and total combustion has been achieved e.g. by a given minimum flue gas temperature or a minimum combustion air temperature.

6.2.3 The requirements of 6.2.2 shall not apply to uncontrolled flue gas recirculation, if flame stability is proven at any firing rate and during start-up, see 6.1.1, 5).

6.2.4 If the flue gas recirculation fan fails, no reverse flow shall occur.

6.3 Control and monitoring

6.3.1 The firing system heat input shall be controlled automatically in relation to the heat demand. To permit visual observation of igniter and main burner flames, inspection openings shall be provided at suitable locations at the combustion chamber or the burner(s). If escape of hot gases is possible, protection for personnel shall be provided.

6.3.2 The suitability of control and monitoring devices relevant to safety which are specified in 4.4.3 shall be proved. This may be done by individual testing or by the application of type tested equipment in accordance with appropriate standards, e.g. EN 267, EN 298, IEC 60730-2-5.

Individual components of control devices having safety functions shall meet the requirements of 6.3.

6.3.3 Flame monitors shall be self-checking during operation.

6.3.4 Flame monitors shall be designed and installed such, that checking by operating personnel can be performed at any time. Functional testing shall be practicable without interfering with the electrical control system.

6.3.5 In firing systems with multiple burner arrangements, the single-burner flame monitoring shall be replaced by a burner group or an overall combustion chamber flame monitoring system. This may be achieved by providing master burners. If flame failure is detected, all burners forming a group with a master burner, or the total of all burners in the combustion chamber shall be cut off by common safety shut-off devices, or their individual safety shut-off devices shall act jointly.

6.3.6 The safety devices shall observe the safety times laid down in Table 6.3-1 for all types of burners when starting-up the burner, or when the flame extinguishes during operation.

Table 6.3-1 — Allowable safety times

Type of burner	Ignition safety time s	Extinction safety time s
Main burner	5	1
Igniter burner	10	1

6.3.7 For large firing systems consisting of multiple burners with a firing rate of more than 3 MW each in a common combustion chamber, the extinction safety time may be increased to a maximum of 3 s for individual burners.

The ignition safety time shall in no case exceed the figures given in Table 6.3-1 for any firing system.

6.3.8 Gas-electric or oil-electric igniters shall be monitored independently of the main flame. This can be accomplished by the main flame monitoring device provided the fuel supplies to both igniter and main burner shall be cut off when the main burner is not ignited within the safety time period.

6.4 Electrical equipment

6.4.1 The electrical equipment of the firing system shall be provided in accordance with prEN 50156-1.

6.4.2 To initiate a master fuel trip independently of the automatic control, at least one emergency switch shall be installed at a readily accessible and safe location, visible and durable marked.

6.5 Safety precautions

6.5.1 The following safety functions shall be described in detail in the operating instructions in accordance with clause 7.

6.5.2 Prior to any firing system start-up, the flue gas passes shall be effectively purged. The combustion chamber and the flue gas passes shall be of such a design as to ensure effective purging.

To avoid ignition sources in an electrostatic precipitator, the precipitator voltage shall be brought down to half of the normal value during purging.

6.5.3 For firing systems equipped with flue gas recirculation, the flue gas recirculation duct shall be included in the purging program of the combustion chamber and the flue gas passes for each start-up.

Generally, purging shall be performed as follows:

— the purging of the combustion chamber and the flue gas passes with the flue gas recirculation duct closed;

— the purging of the flue gas recirculation ducts may be commenced as soon as one part of the purging program for combustion chamber and flue gas passes has been performed, so that both purging operations can finish at the same time. The purging of the flue gas recirculation ducts shall be performed with the flue gas recirculation damper at least 50 % open and with the flue gas recirculation fan running. Three air changes of the volume concerned shall be considered sufficient.

6.5.4 After every safety shut-off, purging shall be necessary prior to any restart.

NOTE Purging in accordance with 6.5.2 and 6.5.3 may be waived if special measures are taken to ensure that after cut out of the firing system no fuel is present in the combustion chamber and the flue gas passes, and it is also ensured that no fuel enters the combustion chamber during the outage.

6.5.5 For burners requiring to be purged after shutdown, it shall be ensured that purged residual fuel will be safely ignited. Safe ignition shall be, for instance, ensured if the required number of monitored master burners are in operation (see 6.3.5).

NOTE After purging of the flue gas passes, the oil guns may be purged one after the other with the assistance of the ignition device in order to burn off the residual fuel. A minimum air flow may maintained during purging of the oil guns.

6.5.6 Upon completion of purging, the ignition process of the first burner shall be initiated within a period of 10 min. This period may be extended to 30 min if, on completion of purging, an air flow of at least 20 % of the total combustion air flow shall be maintained.

6.5.7 A second ignition of an oil burner or an attempt to ignite one other oil burner may be effected without intermediate purging within the times given in 6.5.6. A third ignition of the first oil burner shall be permitted for a furnace with three or more burners.

Re-ignition of gas burners shall not be permitted.

6.5.8 When igniting a main burner the burner firing rate shall be limited so that the pressure shall not exceed the design value for the combustion chamber during the start-up operation.

6.6 Common stack for several firing systems

Flue gas flows from several firing systems shall only be joined in common ducts or stacks if an inadmissible pressure excursion resulting from the ignition of an explosive mixture is prevented. This requirement will be met if the temperature of the flue gas is low enough to avoid selfignition, and if the influence of external ignition sources shall be prevented. Unacceptable backpressure to the combustion chamber of the connected systems shall be prevented.

7 Operating manual

An operating manual shall be provided with the boiler which indicates the schematic arrangement of fuel lines and valves, the test instructions for the flame monitors, the type of fuels to be used, the system maintenance requirements, the start-up and shutdown procedures for the burners as well as the measures to be taken when problems or dangerous condition arise. Operational requirements are given in Annex B.

8 Particular requirements for firing systems burning gaseous fuels with high relative density

8.1 Main firing systems

8.1.1 Supply of gases

Gases in their liquid state shall only be supplied to the boiler room or boiler area if they are supplied to and burned in the burner in their liquid state. Supply lines for gas in its liquid state shall be welded at the points of connection. The piping and gun system downstream of the safety shut-off device shall be as short as possible.

If gases are supplied in their gasified state, a safety device shall be provided to ensure that no gas in its liquid state can enter the burner.

Only certified material shall be used for valves and gaskets.

8.1.2 Safety shut-off device

The components of the safety shut-off devices for heavy gas in its liquid state shall be tested in accordance with EN 264.

8.1.3 Shutdown of burners for heavy gas in its liquid state

After shutdown of the burner, the fuel supply line shall be purged from the safety shut-off device to the burner inlet. A fixed connection for the purging medium shall be provided as close as possible to and downstream of the burner side safety shut-off device. Failure of the purging medium supply during operation shall be indicated to the supervising personnel. It shall be ensured that no gas can enter the lines carrying the purging medium.

For burners which are purged after shutdown, safe ignition of the purged liquid gas shall be ensured. Safe ignition, is ensured if the required number of monitored burners is operating.

After simultaneous shutdown of all burners, the entire flue gas passes shall be adequately vented before purging the liquid gas line. Pipes and burner guns shall only be purged if the ignition device is operating and sufficient air is available.

In the case of firing systems with several main burners, the individual pipes and burner guns shall be purged one after the other.

Gases may also be drained into the storage tank if the burner is equipped for this use.

In case proper shutdown is not performed automatically, a permanent instruction plate shall be provided at a readily visible location to indicate the sequence for start-up and shutdown of the firing system.

8.2 Ignition burner systems

The components of the safety shut-off devices for ignition gases in their liquid state shall be tested in accordance with EN 264.

Annex A
(normative)

Chemical recovery boiler (black liquor boiler)

A.1 General

This annex specifies the special amendments to and exceptions from the requirements for firing systems in this standard, for liquid and gaseous fuels in chemical recovery boilers (black liquor boilers), as defined in EN 12952-5:2001, clause E.2. The properties of the liquor, especially the dry solids content, shall be prepared for firing. The firing liquor is not flammable and it can only be burnt at full furnace temperature.

NOTE When firing the black liquor in a chemical recovery boiler furnace, the cooking chemicals are recovered as a molten salt smelt from the boiler at a temperature at roughly about 900 °C through the smelt openings at the bottom of the furnace and reused.

A.2 Additional requirements for the firing system for black liquor in the chemical recovery boiler

A.2.1 The clauses 4 and 6 and 5.3 do not apply to the firing of black liquor.

A.2.2 The use of flame monitors and igniters are not applicable to black liquor guns.

A.2.3 The operation of the combustion air fan(s) and the operation of the induced draught fan in the flue gas pass shall be monitored and controlled to 5.1 and 5.2.

A.2.4 In addition to the manually operated valve in the black liquor supply pipe at the liquor gun operating place (operating platform), there shall be a safety shut-off device which can be operated manually by the operator from the control room as well as automatically by the boiler safety system.

A.2.5 The written liquor firing start up instruction shall state that the supply of the firing liquor shall not be allowed to be released by the operator during the start-up operation unless:

1) the furnace temperature has reached the ignition temperature of the firing liquor;

2) the minimum preheat temperature for the firing liquor is reached;

3) the firing liquor dry solids content is above the minimum value specified by the manufacturer for the start-up of the boiler;

4) the liquor gun is in the intended operating position;

5) the conditions for continued firing listed in A.2.7 are fulfilled.

A.2.6 Flue gas pass purging shall not be required before the supply of the firing liquor.

A.2.7 The automatic safety shut-off valve for the supply of the firing liquor shall stop the operation whenever:

1) the control power for the safety devices fails;

2) the flue gas damper is not proven to be fully open or the induced draught fan fails, or the pressure in the furnace can not be maintained within the specified limits;

3) sufficient air flow for the combustion cannot be maintained;

4) cut-off switches are actuated;

5) an emergency shut-down is initiated;

6) any one of the limiters specified for the boiler responds.

A.2.8 After a lock-out to A.2.5 or A.2.7 a restart in accordance with the regular start-up instruction shall be permitted as soon as the condition(s) causing the lock-out is resolved.

A.2.9 The liquor guns and the supply piping and tanks for the firing liquor shall be safely protected during boiler operation from any intrusion of or dilution with any other water solution than the firing liquor in a sufficiently concentrated condition.

A.3 Special requirements for oil- or gas firing for chemical recovery boilers

A.3.1 General

Special flue gas pass purging shall not be required prior to the ignition of an oil- or gas fired burner of a chemical recovery boiler provided that a steam generation of at least 50 % of the rated capacity of the boiler shall be established by means of black liquor firing.

However, also during black liquor firing, there shall still be a minimum waiting time of 30 s or more, depending on the size of the boiler and of the burner, after a failed ignition attempt for an oil or gas burner before the re-ignition of the same or any adjacent burner is attempted.

A.3.2 Special requirements for start-up burners

Individual air supply control to start up burners shall not be necessary.

A.3.3 Special requirements for the firing of odorous gases

A.3.3.1 Introduction of any toxic or odorous gas or gas mixture into the furnace shall not be allowed unless at least 50 % of the rated capacity of the boiler is established by means of black liquor firing.

A.3.3.2 Special precautions shall be taken to prevent the introduction of any aqueous condensate or other water solution into the furnace through any device for the supply of a gaseous fuel or fuel mixture.

A.3.3.3 Precautions shall be taken to prevent any escape of toxic or odorous gases into the boiler house.

A.3.3.4 Rules for gas firing systems shall not apply for the destruction of high volume low concentration odorous gases as a mixture in combustion air, see 3.1.2. A.3.3.1 to A.3.3.3 shall apply. Gas supply lines shall be equipped with a safety shut of device.

Annex B
(informative)

Operational requirements for permanent supervised firing systems for liquid and gaseous fuels

B.1 General

For a firing system using liquid and/or gaseous fuels with permanent supervision, the following operational requirements should be adhered to by the operating personnel.

B.2 Operation

The training of the operating persons should refer to the special conditions of the firing system and the type of fuel (see 1.3). This includes the requirements given in clauses 4 to 8 with particular reference to the individual details in the operating manual mentioned in clause 7.

B.3 Fuel preparation

Where condensate from steam heating coils for oil preheating is returned to the boiler (see 4.2), checking of the condensate for oil content should be performed in regular time intervals.

B.4 Safety shutoff devices

Leakage testing of each of the safety shut-off devices in accordance with 4.4.1 should be performed in regular time intervals.

B.5 Air/fuel ratio

The air/fuel ratio may be trimmed manually within the admissible limits.

B.6 Modification of firing, burner or air/fuel ratio setting

A change in firing, burner or air/fuel ratio setting can become necessary due to changed operating conditions or changed flue gas recirculation flow or a change in fuel quality (see 6.1). In this case it can be necessary to modify the air register system or air/fuel ratio control. All such measures are only permissible if they are taken by expert personnel and

1) the maximum firing rate of the burner is not exceeded;

2) flame stability is maintained;

3) criteria relevant to safety are not adversely affected, and

4) the characteristic values relevant to combustion such as CO_2-, CO-contents by volume are kept within acceptable limits. For oil burners this also applies to unburnt particles (smoke).

Modifications should be documented in the operating manual.

B.7 Control and monitoring

Checking and functional testing of flame monitors described in 6.3.4 should be performed according to the advice laid down in the operating manual, see clause 7.

If the flame monitor for a firing system consisting of only one burner is not of self-checking design, increased safety of the flame monitor should be ensured through special measures by the operating personnel, e.g. periodic inspection, shutdown at intervals not longer than 24 h.

B.8 Purging, start-up and shut down

If starting up or shutting down of the firing system is not performed by a function group control system, or by the burner management system, e.g. for semi-automatic burners, the operating personnel should observe the proper sequence for ensuring the required safety functions.

If purging of the flue gas passes and the flue gas recirculation duct is not included in the function group control system, or the burner management system, the requirements in 6.5.1 and 6.5.3 should be observed by the operating personnel. The same applies to for the requirements given in 6.5.5 to 6.5.8.

B.9 Emergency operation

An emergency operation which cannot be avoided and during which a function of a safety device is bridged (see 6.8), necessitates the observation of the following pre-conditions:

1) changeover to emergency operation should only be possible, if a key-operated switch is used;

2) during the entire period of emergency operation, the inoperative safety functions should be replaced by continuous expert supervision;

3) in systems with only one burner per combustion chamber, each of the following safety functions should be maintained:

   a) flame monitoring;

   b) operation of the required limit switches of the water/steam system (e.g. water level limit);

   c) the flue gas damper and the induced draught fan running (see 4.4.3, 2)) and monitoring of the combustion chamber pressure. Any other conditions should be determined together with the responsible shift engineer for each individual case;

4) in systems with several monitored burners in one combustion chamber it is not required to take measures beyond those described in 1) and 2), as long as other monitored burners are still operating and stable combustion conditions exist.

B.10 Operating and maintenance instructions

The functional capability of the control and monitoring devices (see 4.4.3 and 6.3.4) should be checked and a leakage test of the individual safety shut-off devices in accordance with 4.4.1 should be performed at adequate intervals. Defects on equipment having safety functions should be remedied before operating the system further. Otherwise an emergency operation in accordance with 6.8 should be taken into consideration.

B.11 Firing systems burning gaseous fuels with high relative density

B.11.1 The accumulation of heavy gases or mixtures of air and heavy gas in the boiler room, or boiler area in the case of outdoor installations should be avoided by suitable measures.

Such measures are, for example:

1) outdoor installation of boilers without depressions or hollow spaces in the ground within the area of boilers, or

2) installation of boilers in boiler rooms the floor of which being above ground level at least on one side. The boiler rooms should be adequately ventilated and ventilation openings should also be provided at floor level, Depressions or hollow spaces being present in the floor should be avoided.

B.11.2 If the non-availability of purging medium is indicated during operation, the operating personnel should take remedial measures.

B.11.3 Liquid-gas bottles in boiler rooms

1) As a rule, liquid-gas bottles and their related pressure regulators should be installed outside the boiler room above ground level at a distance of at least 3 m from depressions, hollow spaces or ignition sources.

   Downstream of the pressure regulator, a shut-off device of type tested design should be installed in the supply line and should only be opened for the purpose of ignition.

2) Where the measures described in 8.1.1 have been taken, gas bottles with igniter gas may also be installed near the boiler.

3) Irrespective of 1) and 2) gas bottles up to 33 kg may be transported together with the pressure regulator from the location of storage outside the boiler room into the boiler room or boiler area for the purpose of ignition only.

B.11.4 Pump and evaporators units should not be installed in the boiler room. For these units and their installation rooms the explosion protection measures should be taken into account. Where these units are installed in rooms, the entire room should be natural ventilated.

B.11.5 For storage and operation of bottles for liquid-gas particular requirements are in existence which should be taken into consideration.

Annex ZA
(informative)

Clauses of this European Standard addressing essential safety requirements or other provisions of the Pressure Equipment Directives

This European standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential safety requirements of the Pressure Equipment Directive 97/23/EC with regard to requirements for firing systems for liquid and gaseous fuels for the boiler.

WARNING Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard given in Table ZA.1 are likely to support essential safety requirements of the Pressure Equipment Directive 97/23/EC:

Table ZA.1 — Comparison between EN 12952-8 and Pressure Equipment Directive 97/23/EC with respect to requirements for firing systems for liquid and gaseous fuels for water-tube boilers

EN 12952-8 harmonized clauses	Content	Pressure Equipment Directive 97/23/EC Annex I
4.2.1, 4.2.2, 4.2.3, 4.2.5	adequate strength	6
4.2.6	Discharge of pressure relief blow-off	2.3, 2nd indent
4.2.4	Safety accessories	2.10 (a)
4.1.1, 4.1.2, 4.3, 5, 6.1	restrict operating parameters such as heat input, risks of damage from deposits	5 (a), (c)
6.3	dangerous accumulation	5 (e)

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

Bibliography

EN 88, *Pressure governors for gas appliances for inlet pressures up to 200 mbar.*

EN 225, *Atomising oil burners — Pumps with rotating shaft and external drive — Dimensions.*

EN 226, *Atomising oil burners — Connecting dimensions between burners and heat generators.*

EN 230, *Monobloc oil burners - Safety, control and regulation devices and safety times*

EN 267, *Forced draught oil burners — Definitions, requirements, testing, marking.*

EN 293, *Oil pressure atomising nozzles — Minimum requirements — Testing.*

EN 298, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans.*

EN 299, *Oil pressure atomising nozzles — Determination of the angle and spray characteristics.*

EN 676, *Automatic forced draught burners for gaseous fuels.*

ISO 7-2, *Pipe threads where pressure-tight joints are made on the threads — Part 2: Verification by means of limit gauges.*

ISO 228-2, *Pipe threads where pressure-tight joints are not made on the threads — Part 2: Verification by means of limit gauges.*

ISO 6976, *Natural gas — Calculation of calorific values, density, relative density and Wobbe index from composition.*

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

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

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