BRITISH STANDARD

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12952-9:2002

Water-tube boilers and auxiliary installations —

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

The European Standard EN 12952-9:2002 has the status of a British Standard

ICS 27.040

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 12952-9:2002.

When reference to this European Standard has been published in the Official Journal (OJ) of the European Communities, 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

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Water-tube boilers and auxiliary installations - Part 9: Requirements for firing systems for pulverized solid fuels for the boiler

Chaudières à tubes d'eau et installations auxiliaires - Partie 9: Exigences pour les équipements de chauffe pour combustibles pulverisés de la chaudière

Wasserrohrkessel und Anlagenkomponenten - Teil 9: Anforderungen an Staubfeuerungsanlagen für den Kessel

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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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Contents

Foreword

This document (EN 12952-9:2002) 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 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC [1].

For relationship with EU Directive 97/23EC, see informative Annex ZA, which is an integral part of this document.

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 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 fluidized bed-firing systems for solid fuels for the boiler*

CR 12952-17, *Water-tube boilers and auxiliary installations — Part 17: Guideline for the involvement of an inspection body independent of the manufacturer.*

Although these parts may be obtained separately, it shall 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 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 European Standard applies to pulverized fuel firing systems of steam boilers and hot water generators and commences at the filling equipment for the boiler bunkers or for the pulverized fuel storage system and ends at the ash extraction plant. For multifuel firing systems using separate or combined burners, these requirements apply to the pulverized fuel firing part involved. For other fuels or firing systems used in combination, other requirements apply e.g. EN 12952-8.

1.2 Fuels

These requirements cover the use of pulverized fuels originating from coal ranging from low to high volatile matter content. This includes e.g. coke, anthracite, bituminous coal or hard coal, lignite or brown coal, petrol coke and oil shale.

1.3 Operation

Requirements for operational equipment apply for steam boilers and hot water generators with permanent supervision by properly trained persons.

As firing systems using pulverized fuel may be designed either as direct-firing or as indirect-firing systems, operational requirements have to be differentiated. Annex A summarizes the operational requirements for firing systems including the pulverizing system.

1.4 Boundary of pulverizing system

A pulverizing system is bounded by:

— the outlet of the fuel bunkers feeding the mill;

— the outlet of the burners fed from that mill;

— the points at which the hot air or flue gas and tempering air or flue gas leave their main supply ducts including the primary air fan if associated individually with the mill.

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 1127-1, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*.

EN 12952-8, *Water-tube boilers and auxiliary installations — Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 12952-8 and the following apply.

3.1
back-up firing system
separate firing system to maintain safe ignition and stable combustion of the pulverized fuel

3.2
burner group
burners operated in forced unison and controlled jointly and the burners supplied by the same mill or the same pulverized fuel feeder

3.3
burner management system
burner management system performs a predetermined sequence of actions and always operates in conjunction with a flame monitor. It reacts to signals from control and safety devices, gives control commands, controls the start-up sequence, supervises the burner operation, and causes controlled shutdown and lock-out

3.4
carrier gas
transport medium for pulverized fuel through mill, classifier, and pulverized fuel lines. It may consist of primary air and/or inert gas

3.5
clearing
removal of accumulation or settlement of pulverized fuel in the case of insufficient purging of the pulverizing system

3.6
coal bunker
bunker for the storage of raw coal for an individual mill

3.7
coal feeder
installation for the extraction of coal from the coal bunker and the controlled feeding of coal into the mill

3.8
combustion air
total air supplied to the firing system for combustion

3.9
conveying plant (Coal handling plant)
installation for conveying and distributing raw coal to the individual coal bunkers

3.10
direct-firing system
system where the fuel is ground and dried in the mill and then is fed directly to the burners

3.11
explosion
unintentional instantaneous combustion phenomenon occurring in a confined space with considerable pressure build-up

NOTE A weak explosion is called puffing.

3.12
explosion pressure resistant design
installations that are dimensioned so as to withstand the maximum explosion pressure without substaining permanent deformation

3.13
explosion pressure shock resistant design
installations that are dimensioned so as to withstand the pressure surge occurring during an explosion without rupture although permanent deformation may occur

3.14
firing rate during start-up
firing rate of a burner or a burner group forming part of a pulverizing system of a direct-fired system during start-up

3.15
firing system
equipment for the combustion of fuels, including the installations for the storage in the boiler house, preparation and supply of fuels, the combustion air supply, the burner(s), the flue gas discharge, and all related control and monitoring devices

NOTE A flue gas recirculation system can be installed as an integral part of the firing system.

3.16
firing system heat input
heat input into the combustion chamber, normally calculated as the mass flow of the fuel supplied multiplied by its net calorific value

3.17
flame monitor
device that detects the presence or absence of the flame and transmits a signal to the control device

For a pulverized fuel firing system the flame can be defined as:

— an individual flame of a single burner,

— the flame of a burner group for instance all burners connected to a pulverizing system,

— the flame of all burners in one combustion chamber.

3.18
flame-resistant material
flame-resistant material that is combustible only when subjected to a continual supply of heat energy and extinguishes upon removal of the ignition source

3.19
flue gas recirculation
return of flue gas from downstream of the flame zone or from the flue gas exit

NOTE This can be achieved by pressure difference or the use of a separate fan or fans into the pulverizing system, the air register of the burner, or directly into the combustion chamber.

3.20
implosion
unintentional instantaneous negative pressure build-up

NOTE This can occur as a consequence of an explosion in a confined space, by rapid closing of dampers, or by rapid reduction in temperature, e.g. flame out.

3.21
indirect-firing system
system where the fuel that has been ground and dried in the mill is intermediately stored in bins and the vapours are separated

NOTE The pulverized fuel is extracted from the bin and fed to the burners.

3.22
inerting
dilution of the oxygen content of an air/fuel mixture by the addition of an inert gas or steam to a level where it is no longer ignitable

3.23
lighting-up equipment
facility to achieve safe ignition of pulverized fuel at the burner. It may also be used for the provision of heat to initiate the drying process during start-up of a mill in a direct-firing system

3.24
limiter
transducer, which, on reaching a fixed value (e.g. pressure, temperature, flow, water level) is used to interrupt and lockout the energy supply and requires manual unlocking before restart

3.25
lockout
interruption of the energy supply. Manual unlocking is required before restart

3.26
master fuel trip
device for rapid automatic shutoff of all fuel supplies to the boiler area and power to the electrical igniters in the event of danger

3.27
maximum heat input of the firing system
maximum heat input including the reserves required for load control at which the firing system can be safely operated including all reserves

3.28
mill
installation for grinding and drying the raw coal and for classifying and conveying the pulverized fuel

3.29
minimum heat input of the firing system
minimum heat input at which the firing system can be safely operated

3.30
monitor
limit transducer that 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

3.31
multi-fuel burners
burners in which more than one fuel is burned either simultaneously or alternately

3.32
multi-fuel firing system
firing system where, in a common combustion chamber, more than one fuel can be burned simultaneously or alternately by separate or multi-fuel burners

3.33
primary air
part of the combustion air flow fed to the mill for the drying and conveying of pulverized fuel. This primary air may be mixed with flue gas

3.34
pulverized fuel bin
bin (silo) for the intermediate storage of pulverized fuel

3.35
pulverized fuel burner
device for the introduction of fuel and air into a combustion chamber at required velocities, turbulence, and local fuel concentration in order to establish and maintain proper ignition and stable combustion of the fuel

3.36
pulverized fuel feeder
device for the controlled feeding of pulverized fuel from the pulverized fuel bin into the pulverized fuel supply lines to the burners or other equipment

3.37
pulverizing system heat input
firing system heat input of a direct-fired system divided by the number of pulverizing systems in operation

3.38
purging of the flue gas passes
flow of air through the combustion chamber, flue gas passes and associated ducts, which effectively removes any gaseous combustibles and replaces them with air

3.39
purging of the pulverizing system
removal of any accumulation or settlement of pulverized fuel from inside the pulverizing system

3.40
safety time
time period during which the effectiveness of the safety device may be inhibited without a hazardous condition occurring

4 Fuel bunkers with conveying plant

4.1 General

4.1.1 The conveyance of raw coal, temporary storage in bunkers, and extraction shall be arranged such that the flow of the fuel is ensured as far as possible.

4.1.2 Coarse coal lumps, foreign matter, and tramp metal shall be removed to avoid damage or blockage of the pulverizing system.

4.1.3 Access to the coal handling plant area shall be limited to authorized staff (see annex A).

4.1.4 Dangerous areas of the coal handling plant shall be marked by warning signs.

4.2 Conveying plant

4.2.1 Automatic facilities for the conveyance and distribution of coal into the bunkers shall only be started if visual and/or audible warning signals have been given beforehand. Precautions necessary for the protection of personnel against injury by moving components shall be taken. Sufficient waiting time between warning signal and start-up shall be provided (see A.4).

4.2.2 Several continuous conveyors arranged in series to form one conveying line shall be interlocked such that the normal operation of any conveyor is possible only if the downstream conveyors are in operation and the storage facility is ready to accept the coal.

4.3 Coal bunkers

4.3.1 The coal bunkers shall be built to achieve uniform discharge by the selection of proper shape and design in order to ensure a continuous uniform flow of the coal and to avoid segregation.

4.3.2 To avoid ingress of hot air/gas into the bunker or the suction of leakage air into the pulverizing system, a minimum fuel level shall be maintained in the bunker, unless other suitable measures are taken.

4.3.3 The minimum filling level of coal bunkers shall be monitored and an alarm activated when the level falls below the predetermed level.

4.3.4 The inner surface of the coal bunker roof shall be designed so as to avoid the accumulation of dust and gas in dead pockets.

4.3.5 Bunker charging openings shall be guarded to prevent personnel from falling in (see A.5).

4.3.6 Fuel bunkers shall be equipped with fire fighting or fire prevention equipment. Coal bunkers may be emptied by use of emergency chutes.

5 Pulverizing system and pulverized fuel system

5.1 General

5.1.1 The pulverizing system shall be readily accessible to enable cleaning operations to be carried out. Pressurized systems shall be dust-tight and gas-tight.

5.1.2 All practicable steps should be taken to eliminate sites in the pulverizing system where pulverized fuel and raw coal may become lodged.

5.1.3 If there is a possibility of settlement of pulverized fuel on components that have become hot during operation, facilities shall be provided for purging and clearing after shut-down.

5.1.4 The system shall include throughout indicators and annunciators which will provide the operator with adequate information about significant operating conditions, both normal and abnormal.

5.1.5 To avoid the build up of electrostatic charges, all components shall be earthed unless forced and faultless earthing is inherent in the design.

NOTE Further information is given in CENELEC Report R 044-001 [2].

5.2 Coal feeders

5.2.1 Coal feeders and chutes shall be designed to provide a uniform flow of coal into the mill.

5.2.2 Means shall be provided for monitoring the flow of coal. In the event of loss of flow an audible or visible alarm shall be acturated.

5.3 Mills

5.3.1 Mills shall be designed to withstand the mechanical and thermal loadings which occur during operation.

Pulverising mills are machines within the meaning of Council Directive 98/37/EC and should be designed and constructed to comply with specified essential safety requirements, in particular requirements to avoid risks from fire or explosion. Equipment within coal pulverising mills and associated control devices may also fall within the scope of European Council Directive 94/9/EC on equipment and protective systems for use in potentially explosive atmospheres. Manufacturers of pulverised fuel systems shall follow the requirements of EN 1127-1, where applicable to ensure that the risks from coal dust explosions are eliminated or properly controlled.

5.3.2 The temperature downstream of the mill or classifier shall be continuously measured. If the allowable operating temperature is exceeded, this shall be annunciated by an optical and/or accoustic alarm. Suitable automatic devices shall prevent the upper temperature limit from being exceeded.

5.3.3 The allowable operating temperature and the upper temperature limit depend on design, mode of operation and type of fuel. These temperatures shall be determined by the manufacturer upon agreement with the user of the plant.

5.3.4 A means for inerting the pulverizing system shall be provided unless the risk of explosions and fire hazards are prevented by other means, which are also valid in the case of upset conditions. Appropriate precautions shall be adopted under these circumstances.

NOTE If the pulverizing system cannot be made inert after an emergency shoutdown, there will be a risk of explosion during the shutdown period if the mill is disturbed, e.g. by opening of the mill, starting the primary air supply, or starting the mill motor. Suitable inerting mediums are steam or inert gases, e. g. flue gas with low oxygen content.

5.3.5 A fire-extinguishing system shall be provided.

5.3.6 To isolate the mill for repair purposes during boiler operation, appropriate shut-off devices shall be provided upstream and downstream of the mill.

5.4 Pulverized fuel bins

5.4.1 Pulverized fuel shall only be stored in a dust-tight bin (silo). Charging and extraction devices shall be designed to prevent the formation of a direct pathway between the contents of the silo and the atmosphere during charging and extraction operations.

5.4.2 Pulverized fuel bins shall be readily accessible and shall be designed to aid discharge by the selection of adequate shape and design. The design of the bins and their internals shall be such as to prevent any inadmissible dust deposits from occurring. Bins and accessories shall be designed to prevent the escape of pulverized fuel and inerting gas into the surrounding operating areas.

5.4.3 On completion of erection of the plant, a leakage test shall be performed by the manufacturer.

5.4.4 Access doors shall be secured against unintentional opening.

5.4.5 Pulverized fuel bins shall be protected against inadmissible heating from the outside. Negative pressures which can occur shall be taken into account in the design.

5.4.6 Pulverized fuel bins shall be equipped with a connection for protective equipment, e.g. for the introduction of inert gas or fire extinguishing foam.

Pulverized fuel bins shall be automatically monitored for interior fire, e.g. by temperature or CO measurements, unless they are operated under inert conditions, or fire hazards are excluded by other means.

5.4.7 When a pulverized fuel bin is equipped with an additional discharge system, this system shall only be designed as a closed system.

5.4.8 The filling level of the pulverized fuel bin shall be monitored.

5.4.9 With regard to fuel feeding into the burners the requirements given in 5.2 shall be applied accordingly.

5.4.10 Shutoff devices shall be provided at the extraction points of pulverized fuel bins. The gaskets shall be made of flame resistant material.

5.5 Pulverized fuel supply pipes and shutoff devices

5.5.1 Pulverized fuel shall only be conveyed in closed pipes which shall be dust-tight if operated under internal pressure.

5.5.2 The transport velocities and the pulverized fuel concentrations in the pulverized fuel pipes on a running mill shall be sufficient to minimize deposition of pulverized fuel in the pipes and to avoid unsteady pulverized fuel delivery to the burner.

This shall also apply to installations where the pulverized fuel flow is directed into multiple pipes.

5.5.3 All piping system components shall be capable of being purged of pulverized fuel.

5.5.4 Pulverized fuel pipes shall be manufactured using appropriate materials so as to withstand mechanical and thermal stresses occuring during operation, including operation under particular conditions.

NOTE The design of industrial piping system is covered in EN 13480-3 [3].

5.5.5 Devices shall be installed to isolate idle pulverized fuel pipes or pulverizing systems from the furnace.

If one device is used to isolate more than one pulverized fuel pipe, means shall be provided to prevent circulation between the different pulverized fuel pipes across the burners.

5.5.6 Stoppage of pulverized fuel supply to all burners associated with a mill shall be effected by the controlled shut down of the associated coal feeder, and primary air supply.

NOTE The shut down of the primary air supply can be achieved by

— stopping the primary air fan, and/or

— closing the damper in the primary air supply duct.

For tube bore mills, closing dampers in one or more pulverized fuel lines directly on top of mills, provided no pulverized fuel can accumulate, and no excess pressure can occur in the pulverizing system.

The primary air supply and the coal feeder shall be capable of being stopped even in the event of loss of control power.

5.5.7 For mills which generate their own carrier flow, e.g. fan type, beater mill, stopping only the coal feeder shall be sufficient.

6 Explosion prevention measures for pulverizing systems and pulverized fuel systems

6.1 General

6.1.1 Pulverized fuels have different propensity to ignition and may form explosive mixtures with air.

A pulverized fuel explosion is to be expected, if pulverized fuel is dispersed in a confined space containing air or oxygen in concentrations within the upper and lower explosion limits, and if an ignition source is present. For primary prevention of explosions, at least one of these conditions shall be safely excluded at any time. If this can not be accomplished completely, one of the following protective measures to restrict the effects of an explosion shall be applied in the order of preference given:

— the operation with inert gas protection in accordance with 6.3;

— the restriction of the effects of explosions. Any endangered components shall be designed to resist the explosion pressure or the explosion pressure shock;

— the reduction of the blast pressure of an explosion by pressure relief vents. Only automatically closing pressure relief devices shall be used. Escaping gases shall be safely discharged into the open atmosphere outside the boiler house.

The prevention of explosion propagation into other components shall be done by isolating devices e.g. quick-acting shutoff devices, rotary feeders, or automatic fire extinguishing equipment.

NOTE Further information is given in EN 1127-1.

6.1.2 Electrostatic ignition sources shall be avoided, see 5.1.5.

6.1.3 Protective measures as specified in 6.2 and 6.3 may be waived for fuels with low K_{St}-values (defined by EN 26184-1 [4]), e. g. fuels with a volatile matter content lower than 10 % on dry and ash free basis or as long as a water content higher than 45 % is maintained during process.

6.2 Plants operated without inert gas protection

6.2.1 For direct-firing systems with pulverizing systems normally not being operated under inert conditions, primary prevention of explosions shall be achieved, if purging and starting-up is performed in accordance with 8.7.2.2. With these provisions it shall suffice, if the following components are of explosion pressure shock resistant design for a gauge pressure of at least 1 bar:

— coal feeders and chutes upstream of the mill;

— mills, classifiers, mechanical separators, and other components connected to the gas side;

— pulverized fuel pipes including installed valves and expansion joints;

— air ducts and installed equipment upstream of the mill for a length of at least 8 times the hydraulic diameter. (Hydraulic diameter is four times the cross-section area of the duct divided by the perimeter of the duct.).

6.2.2 Pulverized fuel bins, and pulverized fuel separators directly attached to them, shall be of explosion pressure shock resistant design for a gauge pressure derived from the dimensioning of the automatically closing pressure relief devices in accordance with the relevant standards (e.g. prEN 1268-1 [5]).

Electrostatic precipitators shall not be permitted for pulverized fuel separation.

6.2.3 For tube ball mills the requirements of 6.2.1 and 6.2.2 may be waived, if due to special measures taken or implied by the inherent properties of the system, a critical explosion pressure cannot occur.

6.3 Plants operated with inert gas protection

6.3.1 For the purpose of explosion prevention, the atmosphere shall be regarded as inert if a mixture of pulverized fuel/ air cannot be ignited. Under normal atmospheric conditions, the oxygen limit concentrations are 14 % by volume for hard coal and 12 % by volume for brown coal.

With regard to the above, the following oxygen concentrations measured by volume in humid conditions shall be allowed:

— 12 % for hard coal;

— 10 % for brown coal pulverized in fuel bins; and

— 12 % for raw brown coal in fan type mills.

6.3.2 The oxygen concentration shall be continuously monitored, if inert conditions can not be ensured as inherent to the system.

6.3.3 When the allowable oxygen concentration is exceeded, it shall immediately be diminished automatically to an allowable value, e.g. by steam injection. If the oxygen concentration fails to be reduced to a permitted level, the plant shall be shut down automatically within a predefined time.

6.3.4 The inert gas protection shall be maintained during start-up and shutdown periods as long as pulverized fuel is present.

6.3.5 If flue gases or steam are used as a medium for inert operation, the temperature of the medium should be maintained above dew point in order to maintain the inert gas protection.

6.3.6 Coal feeders and chutes serving pulverizing systems under inert gas protection need not be operated under an inert atmosphere unless the raw coal contained is not explosive, see 6.1.3. The requirements of 6.2.1 shall not apply to these coal feeders and chutes.

7 Equipment for air supply and flue gas discharge

7.1 Air supply

7.1.1 Air ducts shall be capable of withstanding the mechanical and thermal stresses occuring during operation e. g. gauge and vacuum pressures resulting from closed dampers, implosions and rapid temperature changes.

7.1.2 Air ducts shall be gas-tight.

7.1.3 Where the air flow is directed into multiple ducts or a common windbox, the system shall be such as to divide the flow into the proper ratio among the various ducts or burner air ports.

7.1.4 For boilers with several burners to which combustion air is supplied by a common control device, each burner or burner group connected to a unit pulverizing system shall be equipped with a shut-off device (e.g. damper).

7.1.5 If there is an interruption of the fuel supply to the burner or the burner group of a pulverizing system, this shut-off device shall also cut off the air supply automatically. Where required, the shut-off device shall permit a minimum air flow.

7.1.6 Shut-off devices in the air ducts shall be protected against unintentional maladjustment. Open and start-up positions shall be capable of being recognized, checked and monitored.

7.1.7 The combustion air fan shall be monitored by the combustion 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;

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

7.1.8 During start-up of the pulverized fuel firing system, a minimum combustion air flow shall be maintained in accordance with the requirements given by the manufacturer in the operating manual.

7.2 Air/fuel ratio

7.2.1 The air/fuel ratio shall be controlled automatically or manually. Allowable values including safety margins shall be given by the manufacturer of the firing system in the operating manual (see clause 10).

7.2.2 The air/fuel ratio shall be monitored, e.g. by flue gas analysis.

7.2.3 An air/fuel ratio which is lower than the allowable shall be annunciated both optically and acoustically (see annex A).

7.2.4 When an air/fuel ratio occurs which is lower than that required for safety reasons, the firing system shall be cut off either manually or automatically.

7.3 Flue gas discharge

7.3.1 Unrestricted flue gas discharge shall be monitored. 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 limiters for the combustion chamber pressure.

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

7.3.2 The induced draught fan shall be monitored in accordance with 7.3.1 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 of the induced draught fan motor;

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

8 Firing system

8.1 General

8.1.1 The firing system shall be suitable for the respective steam boiler or hot water generator. It can consist of several pulverizing systems or several pulverized fuel feeders feeding several burners each.

8.1.2 The firing system shall be equipped with lighting-up equipment and monitoring equipment.

If the lighting-up equipment is operated with oil or gas, it shall comply with EN 12952-8. If other fuels are burnt by the lighting-up equipment, e. g. pulverized fuel stored ready to use, the design and operation of the equipment shall be in accordance with the appropriate clauses of EN 12952-8.

8.1.3 To permit visual observation of lighting-up equipment and main burner flames, inspection openings shall be provided at suitable locations on the combustion chamber and the burners.

8.1.4 For the injection of matter, other than the main fuel into the combustion chamber, see A.10.1.

A device to perform controlled injection, e.g. a rotary feeder, shall be installed.

8.2 Burners for pulverized fuel

Pulverized fuel burners shall provide stable and effective combustion over the entire operating range they are designed for. No flashbacks shall occur.

8.3 Flue gas recirculation

8.3.1 Flue gas recirculation shall not adversely influence flame stability. Adequate flame stability shall be proven with maximum allowable flue gas recirculation flow over the total operating range of the burners.

8.3.2 Control of flue gas recirculation flow shall be performed and independently monitored as specified by the manufacturer or the designer of the firing system.

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

8.4 Modification of the firing system setting

For operational requirements, see A.10.2.

8.5 Monitoring and control

8.5.1 Pulverized fuel firing systems shall be equipped with flame monitoring devices unless safe operation is assured by other means, e.g. by ensuring a minimum firing rate. By the aspect of flame monitoring, neighbouring burners may be joined to form a group, provided that mutual ignition is ensured.

The equipment provided for these measures shall also meet the requirements of 8.5.3 to 8.5.5.

8.5.2 For multi-burner arrangements, the flame monitoring shall be performed as single burner, burner group or combustion chamber monitoring.

In the case of burner group monitoring, it shall be proven that all burners forming a group have a reliable mutual ignition source over the total operating range.

In the case of combustion chamber monitoring, it shall be proven that all burners in the combustion chamber have a reliable mutual ignition source over the total operating range.

8.5.3 Flame monitors shall be self-checking during operation, or increased operational safety shall be ensured by special measures.

8.5.4 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.

8.5.5 The suitability of burner management and monitoring devices relevant to safety shall be proved, e.g. by individual testing or application of type tested equipment in accordance with appropriate European Standards (e.g. EN 298 [6]).

Individual components of burner management devices having safety functions shall meet the requirements of 8.6.

8.5.6 The safety devices shall observe the safety time. When the flame extinguishes during continuous operation the extinction safety time shall not exceed 5 s.

In the case of a direct-firing system this means the time period during operation of the pulverized fuel firing system between the extinction of the flame and the initiation of the shutdown of the pulverized fuel firing system.

Depending on fuel type and plant size, it may be necessary to deviate from this extinction safety time by documented agreement with the responsible authority.

8.5.7 Upon expiration of the safety time at the latest, the coal feeding device shall be cut off. In general the pulverized fuel supply into the combustion chamber shall be terminated within 30 s (see 5.5.6). Depending on fuel type and plant size, it may be necessary to deviate from this time period by documented agreement with the responsible authority.

8.6 Electrical equipment

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

8.6.2 The fuel supply to the mills and the pulverized fuel supply to the combustion chamber shall be prevented by a master fuel trip. This device, which should be located in a safe place, shall be actuated by automatic, manual or emergency switch initiation, even if a possible electrical or mechanical fault occurs.

8.7 Safety precautions

8.7.1 Purging of the flue gas passes and lighting-up

8.7.1.1 If the lighting-up equipment is operated with oil or gas, the procedure for purging and lighting-up shall comply with EN 12952-8. If other fuels are burnt in the lighting-up equipment, e. g. pulverized fuel stored ready to use, the purging and lighting-up procedures shall be in accordance with the appropriate clauses of EN 12952-8.

Purging shall be effected with a specified air mass flow (see 10.2.2). Fuel shall not be supplied to the combustion chamber during purging.

8.7.1.2 The lighting-up equipment shall reliably ignite the pulverized fuel/air mixture.

During ignition, the firing rate of the pulverized fuel burners shall be limited so that no inadmissibly high pressure excursions within the combustion chamber can occur.

8.7.2 Start-up

8.7.2.1 Coal or pulverized fuel supply shall not be released during start-up whenever:

a) the control power for the safety devices is not present;

b) there is no positive indication that the flue gas damper(s) are in there correct position or; the induced draught fan required for flue gas discharge is not running in accordance with 7.3.2 or; the combustion chamber pressure is high;

c) combustion air is not supplied in accordance with 7.1.7 and 7.1.8;

d) the individual lighting-up firing system is not in operation except where neighbouring burner levels are in operation and ensure reliable ignition;

e) the shutoff devices in the pulverized fuel supply pipes of the pertinent mill or pulverized fuel feeders are closed;

f) off switches are actuated;

g) the emergency switch is actuated (see 8.6.2);

h) any of the limiters respond (e.g. for water level, temperature).

Where, in plants consisting of several pulverizing systems or several pulverized fuel feeders, the conditions a), d), e) and f) occur on the burner(s) of only one pulverizing system or only one pulverized fuel feeder, it shall then suffice if the coal or pulverized fuel supply pertinent to the respective burner group or burner is not released.

Coal or pulverized fuel supply may be released to the respective burner group or burner again after the condition(s) a), d), e) or f) causing trouble is (are) remedied. If criteria a) and f) for the total system, or b), c), g), h) have occurred, restarting of the firing system shall be performed by manual intervention of the operating personnel only after the cause for the trouble has been remedied, observing the starting-up requirements of the lighting-up equipment.

8.7.2.2 Purging and start-up of a pulverizing system normally not operated with inert gas protection shall be performed under inert gas conditions observing 6.3.5 until pulverized fuel which has settled from the previous shutdown of the mill has been discharged into the combustion chamber. This starting-up with inert gas support may be waived, provided shutting down of the pulverizing system has been performed in accordance with 8.7.4.2 or 8.7.4.3. If such a pulverizing system has been tripped by an emergency shut down in accordance with 8.7.4.4, purging of the pulverized fuel lines by air with additional inert gas injection shall be effected prior to starting-up the mill unless the risk of explosions and fire hazards are prevented by other means.

8.7.3 Operation

The operational safety measures to be taken after start-up of the pulverized fuel firing system and for maintaining a stable flame, see A.10.5.

8.7.4 Shutting down of direct-firing systems

8.7.4.1 General

In direct-firing systems, safety aspects of the combustion chamber and the pulverizing system influence each other and shall be considered interdependent. The procedure for shutting down a pulverizing system shall include purging of residual pulverized fuel from the system into the combustion chamber. The combustion chamber shall be in a condition to safely accept the purged pulverized fuel.

8.7.4.2 Scheduled outage (normal shutdown)

The following procedure shall be performed:

a) ensure ignition shall be maintained by the burners still being operated or by operation of the lighting-up equipment;

b) reduce feeding to a minimum;

c) cut out feeder;

d) purge the residual pulverized fuel from the pulverizing system into the combustion chamber using the highest possible carrier gas flow;

e) cool down the pulverizing system.

For certain types of mills, e.g. tube mills, which contain a large volume of coal in the mill body during normal operation, purging may be limited to the pulverized fuel lines provided the shut down period is of short duration, and adequate precautions are taken to prevent spontaneous ignition in the mill, e. g. by turning slowly a tube mill.

8.7.4.3 Quick cut-out

Quick cut-out of a single or several pulverizing systems shall be permitted, if the combustion chamber is ready to accept the purged residual fuel. This will be the case, if the plant is being operated at more than the minimum firing rate or the lighting-up equipment is in operation to ensure that during the purging time, residual pulverized fuel entering the combustion chamber shall be reliably burnt. The following criteria may initiate a quick cut-out instead of an emergency shutdown (see 8.7.4.4):

a) mill or feeder trip;

b) bunker level is low (4.3.3);

c) classifier temperature is high;

d) the individual coal mass flow is less than that required for combustion stability except when the lighting-up/ back-up firing system is in operation, or neighbouring burners ensure reliable ignition (cut out may be effected with time delay);

e) shutoff devices in the pulverized fuel pipes of mills are not fully open and purging is possible;

f) adaption to rapid boiler load decrease.

If quick cut-out is initiated, the procedure in accordance with 8.7.4.2 c) through e) shall be performed.

8.7.4.4 Emergency shutdown (lock-out)

Emergency shutdown of all pulverizing systems shall be necessary when the combustion chamber is not ready to accept any fuel, and shall result in a lock-out. Any of the following conditions shall initiate an emergency shutdown:

a) the control power for the safety devices fails;

b) the induced draught fan fails (see 7.3.2), or the combustion chamber pressure exceeds the predetermined limiting value;

c) the combustion air fails to be supplied (see 7.1.7), or the combustion chamber pressure is below the predetermind limiting value;

d) the fuel carrier gas fails to be supplied;

e) the shutoff devices in the pulverized fuel pipes of the mills are not fully open and purging is not possible;

f) the emergency switch is actuated (see 8.6.2);

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

h) the flame monitoring equipment responds due to the absence or extinction of flame(s) and the lighting-up equipment/back-up firing system is not in operation.

All quick cut-out conditions (see 8.7.4.3) shall initiate an emergency shutdown unless quick cut-out is performed successfully.

If an emergency shutdown is initiated, the following procedure shall be performed:

1) terminate the pulverized fuel supply into the combustion chamber in accordance with 5.5.7 and 8.5.7;

2) make inert the pulverizing system(s) automatically (but see also 5.3.4). Keep the pulverizing system(s) under an inert atmosphere in accordance with 6.3 until the pulverized fuel clearing process 3) has been completed. For exceptions and further advice, see A.10.6.3;

3) clear the remaining pulverized fuel from hot components.

Steps 2) and 3) may be waived for fan type mills, if inert conditions can be assured during a sufficient period after emergency shutdown and before start-up. Step 2) may be waived for tube mills where hot spots are prevented by slowly turning the tube.

8.7.5 Shutting down of indirect-firing systems

Any of the following conditions shall initiate an interruption of the pulverized fuel supply during operation in accordance with 8.5.7 by cutting off the pulverized fuel feeder(s):

a) the control power for the safety devices fails;

b) the induced draught fan fails (see 7.3.2), or the combustion chamber pressure exceeds the predetermined limiting value;

c) the combustion air fails to be supplied (see 7.1.7), or the combustion chamber pressure below the predetermined limiting value;

d) the fuel carrier gas fails to be supplied;

e) the individual pulverized fuel mass flow is less than that required for combustion stability except when the lighting-up/back-up firing system is in operation, or neighbouring burners ensure reliable ignition;

f) the shutoff devices in the pulverized fuel supply pipes of the pulverized fuel feeder are not fully open;

g) off switches are actuated;

h) the emergency switch is actuated (see 8.6.2);

i) any of the limiters respond (e. g. for water level, temperature);

j) the flame monitoring responds due to the absence or extinction of the flame(s) and the lighting-up equipment/back-up firing system is not in operation.

In plants having several pulverized fuel feeders, where the conditions a), d), e), f) and g) occur only on one burner group or single burner, the pulverized fuel supply to the respective burner group or burner shall be cut off. As soon as the conditions a), d), e), f) and g) no longer apply, re-starting shall be effected in accordance with the start-up programme (see 8.7.2).

In the case of the criteria a) for the total system, b), c), d) for the total system, g) for the total system, h), i) and j), the pulverized fuel supply shall be interrupted and locked-out.

9 Ash extraction plant

9.1 Ash extraction devices shall be designed to avoid hazards to personnel.

9.2 If hot ash, slag, gases, steam or water can escape in dangerous quantities from ash extraction devices, the endangered areas shall be marked by caution signs.

9.3 Positive arrangements shall be made to warn personnel engaged on ash removal duties of impending or suspected unstable operating conditions.

9.4 Submerged scraper conveyors shall be designed so that personnel cannot become endangered by the spilling of hot water or the ejection of steam.

9.5 Submerged scraper conveyors shall be retractable, or the hopper of the combustion chamber shall be provided with shutoff devices. It shall be ensured by the design or operational measures that personnel cannot become endangered (see annex A).

10 Operation and maintenance

10.1 General

For outlines of operation and maintenance in the areas of coal handling and pulverizing systems, see annex A.

10.2 Operating manual and instructions

10.2.1 The manufacturer or designer of the firing system shall provide the operator with an operating manual and instructions.

10.2.2 The operating manual and instructions shall include:

a) schematic arrangement drawings of the coal handling, pulverizing and firing systems;

b) test instructions for the flame monitoring devices;

c) plant maintenance requirements;

d) start-up, operational, and shutdown procedures for the coal handling, pulverizing and firing systems;

e) measures to be taken in the case of operating trouble or danger;

f) procedures for opening of the mills;

g) purging air mass flow.

10.2.3 For requirements on checking of operational safety and for maintenance instructions, see annex A.

Annex A
(informative)

Operational requirements for permanently supervised firing system for pulverized fuel

A.1 General

For a firing system using pulverized fuel including pulverizing system with permanent supervision, the following operational requirements shall be adhered to by the operating personnel.

A.2 Operation

The training of the operating persons shall 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 10 with particular reference to the individual details in the operating manual and instructions mentioned in 10.2.

A.3 Coal handling plant

The coal handling plant area shall only be entered by authorized staff (see 4.1.3).

During operation of the coal handling plant authorized staff shall be confined to the access and service area (see 4.1.4).

Maintenance work shall not be done whilst the coal handling plant is in operation. The only exceptions shall be for adjustment activities necessary during operation, and then only when special precautions have been taken.

A.4 Conveying plant

At the sounding or appearance of the warning signal the dangerous area shall be evacuated immediately (see 4.2.1).

A.5 Coal bunkers

Areas not guarded against the danger of personnel falling shall only be entered by personnel individually secured against falling (see 4.3.5).

Burning coal shall not be conveyed into the mill unless the risk of explosion within the mill is safely excluded.

A.6 Mills

If the alarm annunciates that the allowable operating temperature is being exceeded, operating personnel shall take evasive action in due time to avoid automatic intervention which will occur if the upper temperature limit (see 5.3.2) is exceeded.

If a fire occurs, the operating personnel shall extinguish the fire by the injection of inert gases, steam or properly atomized water. High velocity water jets shall be avoided to prevent stiring up the smouldering deposits. For certain mill designs, the use of a low velocity non-atomized water stream for fire extinguishing may be allowed in accordance with the manufacturers instructions.

A.7 Pulverized fuel bins

Opening of access doors shall only be permitted if dangerous quantities of pulverized fuel cannot escape (see 5.4.4).

A.8 Air supply

If the required minimum combustion air flow is not ensured by automatic equipment it shall be controlled by the operating personnel (see 7.2.1).

A.9 Air/fuel ratio

If the alarm annunciates a shortfall of combustion air supply which is lower than the allowable, operating personnel shall take evasive action in due time to avoid cut off in accordance with 7.2.4.

If an air/fuel ratio lower than that required for safety reasons occurs, and the necessary cut off is not initiated automatically, the action shall be taken by the operating personnel.

A.10 Firing system

A.10.1 Combustion residues

Injection of combustion residues and other matter into the combustion chamber shall only be performed under normal operating conditions of the firing system, e. g. sufficient firing rate, sufficient residues removal (see also 8.1.4).

A.10.2 Modification of the firing system setting

During operation a change of the firing system setting may become necessary due to changed operating conditions or a change in fuel quality. All such measures shall only be permissible, if they are taken by expert personnel and provided operational safety is not adversely affected (see 8.4).

A.10.3 Flame monitoring

If the flame monitors are not of a self-checking design and increased operational safety is not ensured by installation of special devices, the operating personnel shall perform regular inspections to monitor the flame (see 8.5).

A.10.4 Safety precautions

If purging with a specified air mass flow of the pulverized fuel firing system is not ensured by automatic devices, the operating personnel shall ensure this requirement is achieved. If the absence of fuel supply during purging is not ensured by safety devices, the operating personnel shall ensure the fuel supply is cut-off (see 8.7.1).

If control of the firing rate of the pulverized fuel burners is not performed automatically, e.g. by a function group control system, the firing rate shall be controlled manually by the operating personnel.

A.10.5 Operation

After start-up of the pulverized fuel firing system, the lighting-up equipment shall be kept in operation until a stable flame has been achieved. The lighting-up equipment shall be shut down gradually. Before cutting off the lighting-up equipment, the flame monitoring device in accordance with 8.5.1 and 8.5.2 shall have been activated.

To maintain a stable flame, the lighting-up equipment/back-up firing systems may be used during operation in accordance with the requirements given by the manufacturer in the operating manual.

A.11 Ash extraction plant

Areas identified as dangerous due to the possibility of the escape of hot ash, slag, gases, steam or water from ash extraction devices shall only be entered by personnel wearing appropriate protective equipment.

If danger to personnel from submerged scraper conveyors cannot be excluded by the design operational safety measures will be necessary. Additional precautions may be taken, e.g. drainage of the water content of the through (see 9.5).

A.12 Operating and maintenance

A.12.1 General

All operating areas shall as far as possible be kept clear from pulverized fuel. Deposits of pulverized fuel shall be removed avoiding any stirring-up of the dust.

Leakages from the installation, e. g. at flanged joints or wear locations, shall be remedied as soon as possible.

The operating personnel and other personnel working temporarily in the operating areas of coal handling or pulverizing systems shall be instructed with respect to existing hazards.

Operation and maintenance of coal handling and pulverizing systems shall only be performed from safe locations.

Repair work within the area of coal handling and pulverizing systems capable of generating flames, sparks and hot spots shall only be performed by adhering to appropriate safety precautions (see clause 6). Work shall only be commenced after written permission has been given by staff responsible for the coal handling and pulverizing systems. Precautions which have been taken prior to performing the repair work shall only be modified or cancelled by the person responsible for issuing the precautions.

Before commencing any work on coal handling or pulverizing systems, shutoff devices in accordance with 5.3.6, 5.4.10, 5.5.6 shall be locked.

Components, conveying equipment, and piping, which have to be dismantled for performing repair work, shall be discharged and cleared as far as possible prior to this work. Welding, cutting, and brazing of movable parts shall be performed outside the endangered areas.

Before opening doors or gates, pressure balance shall be secured. If moving parts may endanger personnel at work, shutdown and release of work according to the existing requirements is obligatory.

A.12.2 Operating manual and instructions

The functional capability of the control, safety and monitoring devices shall be checked at adequate intervals. Defects on equipment having safety functions shall be remedied before operating the system further (see 10.2.3).

Annex ZA
(informative)

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

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 the Pressure Equipment Directive 97/23/EC.

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

Compliance with the clauses of this standard given in Table ZA.1 provide one means of conforming to the specific essential requirements of the Directive concerned and associated EFTA regulations.

Table ZA.1 — Comparison between EN 12952-9 and the Pressure Equipment Directive 97/23/EC

EN 12952-9 harmonized clauses	Content	Pressure Equipment Directive 97/23/EC Annex I
4 to 9	Protection against exceeding the allowable limits of pressure equipment	2.10
4 to 10	Minimizing risks from overheating by: Avoidance of accumulation of combustibles Risk of overheating	5 – 2nd para e)
10	Operating instruction	3.4

Bibliography

[1] Directive 97/23/EC of the European Parliment and of the Council of 29 May 1997 on the approximation of the laws of the Members States concerning pressure equipment, OJEC, L181.

[2] CENELEC Report R044-001, *Guidance and recommendation for the avoidance of hazards due to static electritity (1999-02).*

[3] EN 13480-3, *Metallic industrial piping — Part 3: Design and calculation*.

[4] EN 26184-1, *Explosion protection systems — Part 1: Determination of explosion indices of combustible dust in air (ISO 6184-1:1985)*.

[5] prEN 1268-1, *Safety devices for the protection against excessive pressure — Part 1: Safety valves.*

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

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