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Shell boilers - Part 12: Requirements for grate firing systems for solid fuels for the boiler

Großwasserraumkessel - Teil 12: Anforderungen an Rostfeuerungsanlagen für feste Brennstoffe für den Kessel

Chaudieres a tubes de fumée - Partie 12: Exigences pour les équipements de chauffe a grille pour combustibles solides de la chaudiere

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This European Standard was approved by CEN on 12 June 2003.

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Foreword

This document EN 12953-12:2003 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of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by March 2004.

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

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

The European Standard EN 12953 concerning shell boilers 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: Workmanship and construction of pressure parts of the boiler*

— *Part 5: Inspection during construction, documentation and marking of pressure parts of the boiler*

— *Part 6: Requirements for equipment for the boiler*

— *Part 7: Requirements for firing systems for liquid and gaseous fuels for the boilers*

— *Part 8: Requirements for safeguards against excessive pressure*

— *Part 9: Requirements for limiting devices of the boiler and accessories*

— *Part 10: Requirements for feedwater and boiler water quality*

— *Part 11: Acceptance tests*

— *Part 12: Requirements for grate firing systems for solid fuels for the boiler*

— *Part 13: Operating instructions*

CR 12953 Part 14: *Guideline for the involvement of an inspection body independent of the manufacturer (TR)*

Although these Parts may be obtained separately, it should be recognized that the Parts are interdependent. As such, the design and manufacture of shell boilers requires the application of more than one Part in order for the requirements of the European Standard to be satisfactorily fulfilled.

The annex A of this European Standard is informative.

This document includes a Bibliography.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 Firing systems

This part of this European Standard specifies the requirements for internal or external grate firing systems commencing at the fuel bunkers and ending at the ash extraction plant. For combination of various firing systems, the individual requirements of each system also apply.

If several fuels are burnt simultaneously or if a fuel quality varies considerably (e.g. moisture content), additional safety measures can be necessary, especially with respect to limitation of the fuel flow into the firing system and ensuring proper air supply to the individual fuels.

1.2 Fuels

The solid fuels covered are:

— all coal qualities, e.g. lignite or brown coal, sub-bituminous or hard brown coal, bituminous coal or hard coal, pitch coal, anthracite, coke, coal culm, coal sludge;

— other fossil solid fuels (e.g. petrol coke peat, oil shale);

— biomass solid fuels (e.g. wood, wood wastes [bark], energy plants [miscanthus], harvest wastes [straw]);

— municipal waste solid fuels (e.g. garbage, sewage sludge, refuse derived fuels [RDF]);

— industrial waste solid fuels (e.g. petrol coke, soot, tyres, paper wastes, coated wood chips, spent wood, animal product wastes).

Fuel blends from two or more of these groups (see 4.1.7), or fuels of unconventional or unknown quality can require special safety measures which can be proved either by practical experience gained from comparable fuels, or by suitable tests, e.g. in accordance with EN 26184-1. Such measures should be documented by the manufacturer.

Fuels on which the design is based should be *specified* in the operating instructions (see 11.2). This should include the fuel data for 100 % input of the basic fuel and the data for any supplementary fuels together with their maximum thermal input percentage.

1.3 Operational equipment

The requirements for operational equipment in clauses 4 to 10 apply to steam boilers and hot water generators with permanent supervision by properly trained personnel familiar with the special conditions of the firing systems and the type of fuel.

Annex A contains the operational requirements for permanent supervision.

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 12952-8:2002, *Water-tube boilers and auxiliary installations – Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*

EN 12952-9:2002, *Water-tube boilers and auxiliary installations — Part 9: Requirements for firing systems for pulverized solid fuels for the boiler.*

EN 12953-7, *Shell boilers — Part 7: Requirements for firing systems for liquid and gaseous fuels for the boiler.*

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

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 following terms and definitions apply.

3.1
back-up firing system
separate firing system to maintain safe ignition and stable combustion. The lighting-up equipment can be used for this purpose

3.2
basic fire
layer of glowing fuel, fire bed or flame of the fed fuel. The basic fire can also perform the duty of the lighting-up equipment, or the back-up firing system (mostly air)

3.3
carrier gas
transport medium for pneumatic conveying

3.4
combustion air
total air supplied to the firing system for combustion

3.5
firing systems
can be distinguished in accordance with the type and structure of the fuel, the feeding procedure and the process of combustion. Fuel and air can be introduced in the combustion chamber in different ways to establish and maintain proper ignition and stable combustion. Combustion of the fuel is performed on grates

3.6
fuel bin
silo

dust-tight container for temporary storage of combustible solids in the boiler room

3.7
fuel bunker
open storage of solid fuel

3.8
fuel feeding system
device to transport fuel into the combustion chamber

NOTE This can be effected directly by feeders through ports in the furnace walls, by means of chutes or through the bottom grate

3.9
fuel handling plant
installation for conveying, mixing and distributing solid fuels to the individual fuel bunkers or fuel bins

3.10
grate firing system
fuel is burnt in a layer supported by a system of firebars which may have a cooling system

NOTE The firebars should be so spaced as to admit the undergrate combustion air supply in proper distribution. Other means of admitting and distributing the combustion air supply can be provided.

3.11
indicator
measuring instrument which indicates a variable value (e.g. pressure, temperature, flow, level). It can be equipped with an annunciator

3.12
lighting-up equipment
facility to achieve safe ignition of the feed fuel

3.13
limiter
transducer, which, on reaching a fixed limit value (e.g. pressure, temperature, flow, level) is used to interrupt and lockout the energy supply and It requires manual unlocking before restart

3.14
lockout
interruption of the energy supply. Manual unlocking is required before restart

3.15
master fuel trip
device located at a safe place for rapid automatic shutoff of all fuel supplies to the grate and electrical igniters in the event of danger

3.16
maximum continuous rating (MCR)
allowable heat output

steam boiler or hot water heat output that can be generated during continuous operation and at which the steam or hot water generator may be operated, taking the specified steam condition or hot water condition (water mass flow times the difference between outlet and inlet enthalpy) into consideration

3.17
monitor
transducer that senses the reaching of a fixed limit value and initiates an alarm and/or a shut-down. The output signal only reverses if the causing value has changed at a defined range

3.18
purging of the flue gas passes
flow of air through combustion chamber, flue gas passes, and associated ducts including flue-gas treatment systems, which effectively removes any gaseous combustibles and replace them with air

3.19
start-up condition
the plant can be started

— **cold** (temperature of ceramic lining is at ambient value);

— **hot** (temperature of ceramic lining is above the minimum ignition temperature of the basic fuel); or

— **warm** (temperature of ceramic lining in between the ambient and minimum ignition temperature)

4 Fuel bunkers with conveying plant

4.1 General

4.1.1 All facilities shall be designed so as to withstand mechanical and thermal stresses. Fuel shall not be heated to an unacceptable level. Sites where fuel may accumulate shall be avoided.

4.1.2 Conveyance, temporary storage, and extraction of the fuel shall be arranged such that sufficient flow of the fuel and additives is ensured.

4.1.3 The fuel storage capacity shall be determined in accordance with the fuels used.

NOTE It is recommended that the storage of fuel within the boiler room itself is minimized.

4.1.4 Measures to prevent fire, explosion and injuries to personnel shall be provided for volatile fuels and those capable of pyrolysis in the absence of external heating. As an example wet sludges can have an inherent explosion risk due to the release of volatiles (e.g. methane)when stored. Dried sludges have a fire and dust explosion risk.

4.1.5 Sludge storage in bins shall be preferred to storage in bunkers (see 4.4.1).

4.1.6 The storage of fuels supplied in small grain sized particles or fibres which can be stirred up and become airborne shall only be permitted in bins (silos).

4.1.7 If different types of fuels are used, dangerous operating conditions due to blending shall be excluded, e.g. by the use of separate bunkers or bins and separate feeding systems.

4.1.8 If there is a risk of blockage of conveying systems or firing systems by coarse lumps of fuel, foreign matter and tramp metal, then means for the removal of those objects shall be provided, preferably before entering the bunker.

4.1.9 Dangerous areas accessible to personnel shall be marked with warning signs.

4.1.10 Outdoor storage facilities and fuel bearing components as well as buildings for indoor installation shall be equipped with a lightning protective system in accordance with relevant European Standards.

4.2 Conveying plant

4.2.1 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 normal operation and the storage facility is ready to accept the fuel.

4.2.2 Precautions shall be taken for the protection of personnel against injury from moving components. Sufficient time shall be provided between the warning signal and starting of the plant.

4.2.3 If the type and format of the fuel requires bins (silos) for temporary storage in accordance with 4.1.5 or 4.1.6, subsequent conveyance shall be performed in a closed system, which shall be gas-tight if operated under internal pressure.

4.2.4 Piping used for conveyance shall be designed with a high resistance to wear.

4.2.5 For conveyance of fuel in closed pipes, deposition shall be prevented by sufficient velocity of the carrier gas depending on the type and format of the fuel.

4.2.6 All piping system components of a conveying system shall be capable of being purged of fuel.

4.2.7 If multiple lines are installed, devices shall be provided to isolate idle conveying lines from the downstream storage facility or the furnace.

4.3 Fuel bunkers

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

4.3.2 To avoid ingress of hot air/gas into the bunker, a minimum level of fuel shall be maintained and monitored in the bunker, or other suitable measures shall be taken, see also 6.1 and 6.4.

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

4.3.4 Bunker charging openings shall be adequately guarded to prevent personnel from falling in.

4.3.5 Fuel bunkers shall be equipped with fire fighting or fire preventing equipment. Fire fighting by sprinkler systems is allowed but the use of concentrated water jets is prohibited. Bunkers may be emptied by use of emergency chutes.

4.4 Fuel bins

4.4.1 Some fuels according to their type and format shall be stored in dust-tight bins (silos). The requirements for pulverized fuel bins specified in 5.4 and 6.2.2 of EN 12952-9:2002 apply accordingly.

4.4.2 The permissible maximum storage temperature shall be specified for each single fuel and fuel blends and shall be monitored in the freeboard during the storage, if there is a risk of self-ignition

4.4.3 If combustible gas emanation from the fuel cannot be prevented, silos shall be equipped with suitable gas monitoring and safe venting devices, otherwise an explosion-proof silo or inert gas protection shall be provided.

4.4.4 Fuels as specified in 4.1.4 require bins to be equipped with a stationary nonfreezing fire extinguishing system to enable fire to be fought without opening access doors. The extinguishing compound shall be evenly sprayed and well distributed across the entire cross sectional area of the bin. Spray nozzles shall be protected against blockage by the ingress of dust. Where stationary spray-type extinguishing systems are operated automatically, manual initiation shall be possible.

5 Fuel treatment

5.1 General

5.1.1 The equipment shall be designed so as to withstand mechanical and thermal stresses. It shall be so arranged as to be readily accessible to enable cleaning operations to be carried out. The total system shall be gas tight if operated under internal pressure.

5.1.2 Practicable steps shall be taken to minimize sites in the plant where combustible dust or fuel may become lodged.

5.1.3 Facilities shall be provided for purging and clearing components which are hot during operation. If there is a possibility of settlement of combustible dust on components that have become hot during operation, facilities shall be provided for purging and cleaning after shut down.

5.1.4 Mechanical equipment for fuel treatment shall be designed and operated such that no unacceptable heating of the fuel occurs.

5.1.5 The system shall provide the operator with adequate information about significant operating conditions, both normal and abnormal.

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

5.2 Size reduction of the fuel

5.2.1 If size reduction of the fuel is performed by crushers in the boiler house with the application of hot gas as the carrier gas for combined grinding and drying process, the necessary explosion prevention measures shall be given.

5.2.2 For eventual intermediate storage after size reduction, 4.4 applies.

5.3 Drying of the fuel

When drying fuel prior to combustion, the maximum permissible temperature in accordance with 4.4.2 shall be monitored. The vapours shall be discharged in order to prevent the risk of explosion. For the combined crushing and drying process, 5.2.1 shall apply.

6 Fuel feeding

6.1 Shutoff device shall be installed within the fuel feeding system. This shutoff device shall be closed automatically if the minimum height of the fuel column is lost when mechanical feeding.

Shut off devices need not to be installed if it can be ensured that negative pressure is maintained in the fuel feeding system or a minimum column of fuel (4.3.2) is maintained in the fuel bunker.

6.2 It shall be ensured that after shut-off of the firing system and during outage, no fuel can enter the furnace.

6.3 The feeding of fuel shall be cut off in the event of loss of control power (see 9.2.2), under the start-up conditions in accordance with 9.4.4.1 a), or under shutting-down conditions in accordance with 9.4.5.1 a).

6.4 Fuel feeding systems shall be provided with appropriate sealing which prevents the back flow of hot gases from the boiler, flash-back by flame, or flying sparks or backfire. Egress of hot gases into the boiler house shall be prevented.

6.5 Depending on the type of fuel, fire fighting equipment shall be installed. This equipment shall be activated, when set temperature has been exceeded in the fuel supply equipment. Equipment for monitoring and fire fighting shall be placed in such a way that a fire can be extinguished quickly. The equipment shall be easy to test.

7 Explosion prevention measures

Combustible dusts have different propensities to ignite and can form explosive mixtures with air.

A hazard of combustible dust explosion exists, if the dust is dispersed in a confined space containing air or oxygen in concentrations within the upper and lower explosion limits, and if an ignition source exists. For primary prevention of explosions, at least one of these conditions shall be safely excluded at all time.

Individual components of a firing system require specific protective measures. By preference, explosion protective measures shall be inherent in the design of the components, e.g. the avoidance of leakages, the prevention of deposits, and the exclusion of external heating. For easy reference, an overview of important prevention measures for the different operational areas is given below in Table 7-1:

Table 7-1 — Overview of important prevention measures for different operational areas

Operational area	For explosion prevention measures see clause(s)
Fuel properties	1.2 (see EN 26184-1), 4.1.4 to 4.1.7
Fuel bunkers	4.3.3
Fuel bins	5.4.2, 5.4.5, 5.4.6, 6.2.2 of EN 12952-9:2002, and 4.4.3
Fuel treatment plant	5.1.2 to 5.1.4
Size reduction of fuel	5.3, 6, 8.7.2.2 and 8.7.4 of EN 12952-9:2002
Drying of fuel	5.3
Combustion monitoring	9.2
Purging	9.4.2
Start-up, operation, and shutting down of the combustion process	9.4.3 to 9.4.5
All operating areas	A.6