BRITISH STANDARD

BS EN 12953-9:2007

Shell boilers —

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

The European Standard EN 12953-9:2007 has the status of a British Standard

ICS 27.060.30

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The UK participation in its preparation was entrusted to Technical Committee PVE/2, Water tube and shell boilers.

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

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Foreword

This document (EN 12953-9:2007) 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of an identical text or by endorsement, at the latest by January 2008 and conflicting national standards shall be withdrawn at the latest by January 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative 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 boiler*
— *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.*

Although these Parts may be obtained separately, it should be recognised 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.

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

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Introduction

The types of limiters which shall be fitted to boilers are specified in EN 12953-6 and the design of the safety systems are specified in EN 50156-1.

A limiter (or limiting device) is one element of a shell boiler safety system. It comprises a sensor and monitoring elements to achieve the desired level of reliability.

In order to provide the necessary safety function, for example, to cut off the heat supply to the boiler in the event of a low water fault, the limiter is connected to other elements in the safety system such as actuators and safety logic circuits.

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1 Scope

This European Standard specifies requirements for limiters (or limiting devices) which are incorporated into safety systems for shell boilers as defined in EN 12953-1.

A limiter (or limiting device) can be either:

— a safety accessory as defined in the Pressure Equipment Directive, Article 1, clause 2.1.3, and needs to include the safety logic and final actuator, or

— one element of a safety system, for example, a self-monitoring water level sensor used as part of a safety accessory as defined in the Pressure Equipment Directive, Article 1, clause 2.1.3. The overall boiler protection function needs to be provided in association with additional safety logic (where appropriate) and a final actuator.

The design requirements and examination of functional capability for the limiters are covered in this European Standard.

For an explanation of the extent of the limiter (or limiting device) see Figure A.1.

2 Normative references

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

EN 298:2003, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans*

EN 50156-1:2004, *Electrical equipment for furnaces and ancillary equipment — Part 1: Requirements for application design and installation*

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

EN 60664-1:2003*, Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests (IEC 60664-1:1992 + A1:2000 + A2:2002)*

EN 60730-1:2000, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1:1999, modified)*

EN 61000-4-2:1995, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 2: Electrostatic discharge immunity test — Basic EMC publication (IEC 61000-4-2:1995)*

EN 61000-4-3:2006, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:2006)*

EN 61000-4-4:2004, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test (IEC 61000-4-4:2004)*

EN 61000-4-5:2006, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 5: Surge immunity test (IEC 61000-4-5:2005)*

EN 61000-4-6:1996, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 6: Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:1996)*

EN 61000-4-8:1993, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 8: Power frequency magnetic field immunity test; basic EMC publication (IEC 61000-4-8:1993)*

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EN 61000-4-11:2004, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests (IEC 61000-4-11:2004)*

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

EN 61508-3:2001, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements (IEC 61508-3:1998 + Corrigendum 1999)*

3 Terms and definitions

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

3.1
limiter
limiting device that, on reaching a fixed value (e.g. pressure, temperature, flow, water level) is used to interrupt and lock-out the energy supply

NOTE Limiting device comprises:

— a measuring or detection function and

— an activation function for correction, or shutdown, or shutdown and lockout, and which is used to carry out safety related functions as defined in the PED, on its own or as part of a safety (protective) system (e.g. sensors, limiters) (see also Figure 1). If this is achieved by multi channel systems, then all items or limiters for safety purposes are included within the safety (protective) system

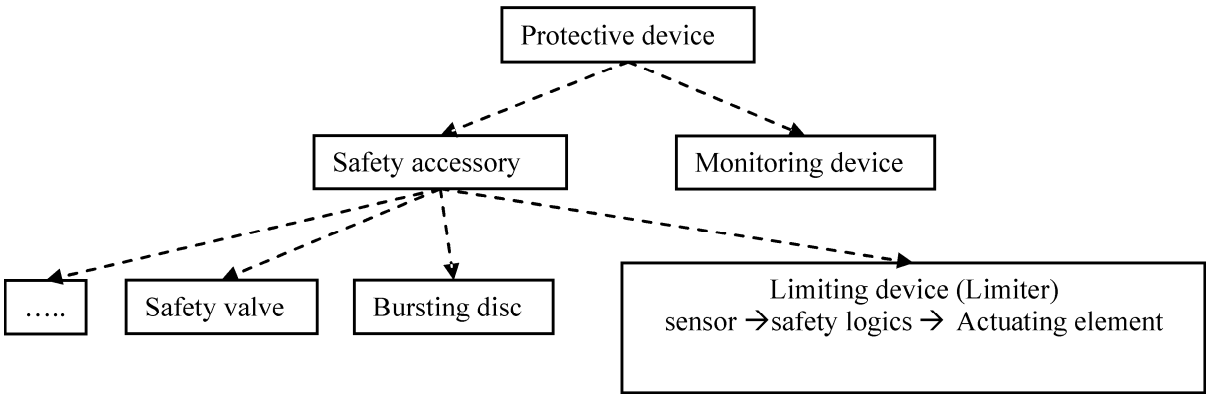

Figure 1 — Protective devices and safety accessories according to Directive 97/23/EC (PED)

3.2
actuating element
component which produces changes in other electrical circuits or volume flows (e.g. fuel, air) as a result of the effect of changes in signal

NOTE For example, a gas shut off valve is not an actuating element.

3.3
fail-safe
limiter is fail-safe if it possesses the capability of remaining in a safe condition or transferring immediately to another safe condition in the event of certain faults occurring

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3.4
self-monitoring
regular and automatic determination that all chosen components of a safety system are capable of functioning as required

3.5
redundancy
provision of more than one device or system which, in the event of a fault, will still be provided by the necessary facilities

3.6
diversity
provision of different means of performing the required function, e.g. other physical principles or other ways of solving the same problem

3.7
complex electronics
assemblies which use electronic components with more than one functional output

3.8
safety shut-down
process which is effected immediately following the detection of a fault within the limiter or caused by exceeding the threshold of the process value limit resulting in a defined state with deactivated terminals of the safety output(s)

3.9
lock-out
safety shut-down condition of the limiter, such that a restart can only be accomplished by a manual reset of the limiter or by a manual reset of the safety logic and by no other means

NOTE This will be achieved by a competent operator taking account of the physical situation

3.10
sensor
transducer which, on reaching a defined limit value, outputs a signal and/or cuts out and only reverses the output signal in the event of a specific change in the performance quantity (e.g. pressure, temperature, flow, level)

NOTE Sensors are used for signalling or for triggering control processes

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4 Requirements for limiter

4.1 General

4.1.1 The requirements set out below have been established to ensure uniform assessment of different devices.

A limiter shall be such that a single fault in any related part shall not lead to a loss of the safety function. This shall be achieved by fault avoidance techniques such as self-monitoring with redundancy, diversity or a combination of these methods. Fault assessment for the electrical components shall be in accordance with 4.4. The fault assessment chart, see Figure 2 shall also be applied for faults in hydraulic, pneumatic and mechanical components.

NOTE The various elements of limiters are given in Annex A.

4.1.2 Limiters shall function independently of each other and of controls unless their safety function cannot be affected by other such functions. Manual resetting can be realised as a part of the limiter or as a part of the safety logic. Instructions shall be delivered together with the limiter including necessary precautions for a safe installation of it.

4.2 Materials and design

4.2.1 The use of materials with significant differences in their electrochemical potential shall be avoided in order to prevent corrosion which could affect the function of the limiter.

4.2.2 Care shall be taken that if magnetic materials are chosen, they do not adversely affect the working of the limiter.

4.2.3 Parts of the limiter shall be designed to comply with the applicable European Standards.

4.2.4 Limiters shall be capable of withstanding the thermal, mechanical, chemical and electrical loads that can occur during operation.

4.2.5 Limiters shall be designed such that changes in critical circuit component values (such as those affecting timing) within the component manufacturer's declared worst case tolerances, including the long term stability, shall result in the system continuing to function in accordance with this standard. Compliance shall be checked by worst case analysis.

4.2.6 Limiters using complex electronics

For limiters using complex electronics the following requirements apply additionally:

- General

Systematic errors (built into the design) shall be avoided and random faults (component faults) shall be controlled by techniques such as self-monitoring with redundancy, diversity or a combination of these methods.

- Fault avoidance and fault tolerance

The design of the software and hardware shall be based on the functional analysis of the limiter resulting in a structured design explicitly incorporating the control flow, data flow and time related functions required by the application. In the case of custom-chips special attention is required with regard to measures taken to minimise systematic errors.

Software shall be designed using EN 61508-3 to a SIL level (Safety Integrity Level) as determined by analysis according to EN 50156-1.

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4.3 Electrical equipment

4.3.1 All wiring and electrical equipment in connection with the limiter shall be adequately protected against the ingress of moisture and the effect of temperature (see also [2], [3]).

4.3.2 The function of the limiter and the associated electrical circuit responsible for shutting down and locking out the heat supply system shall not be affected by other electrical circuits in their proximity. Screened cables shall be used where necessary (see also [2], [3]).

4.3.3 Electrical components within units directly attached to the boiler shall be capable of withstanding a temperature environment resulting from surrounding temperatures of up to 70 °C. Components within units not directly attached to the boiler shall be capable of withstanding an ambient temperature of up to 55 °C. Any equipment that is in contact with parts carrying steam or hot water shall be capable of withstanding the temperature of those parts.

4.3.4 Devices shall have, as a minimum, a protection rating to IP 54 in accordance with EN 60529. When units are installed inside an enclosure or control box, the IP rating required for the box shall be considered adequate.

4.3.5 All mechanical output contacts of the device shall be of the snap action type. Semi-conductor switches shall have similar characteristics.

4.3.6 The limiter shall tolerate electrical and electromagnetical influences as defined in Annex D.

4.4 Fault assessment

4.4.1 General

The limiter, excluding the stored programme section, shall be so constructed that the fault assessment analysis in accordance with Figure 2 results in termination. Power failure, breaks in connecting cables and short circuits shall also be considered and included in the fault assessment analysis.

4.4.2 Fault models and exclusions

4.4.2.1 General

With fault assessment in accordance with Figure 2, it shall be assumed that certain faults do not occur. Such assumptions are justified by describing the failure mechanism as well as by stating the conditions relating to design, construction, environment etc. for the conductors, components and equipment.

Faults which shall be taken into account are based in EN 298:2003, Annex A with consideration of the following faults which may be excluded without further justification:

4.4.2.2 Conductor-to-conductor short circuit fault

This fault may be excluded if:

a) cables and conductors as specified in EN 50156-1 are used;

b) components are encapsulated so that they are moisture resistant or, if they are hermetically sealed and they are capable of withstanding the test specified in EN 50156-1;

c) clearance between live parts shall be designed according to overvoltage category III and pollution degree 3 and the creepage distance shall be designed according to pollution degree 3 but at least for the nominal voltage of 63 V as specified in EN 60664-1;

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