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Vodocevni kotli in pomožne napeljave - 11. del: Zahteve za omejevalne naprave kotla in opreme

Water-tube boilers and auxiliary installations - Part 11: Requirements for limiting devices of the boiler and accessories

Wasserrohrkessel und Anlagekomponenten - Teil 11: Anforderungen an Begrenzungseinrichtungen an Kessel und Zubehör

Chaudieres a tubes d'eau et installations auxiliaires - Partie 11: Exigences pour les dispositifs de limitation de la chaudiere et de ses accessoires

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Water-tube boilers and auxiliary installations - Part 11: Requirements for limiting devices of the boiler and accessories

Chaudières à tubes d'eau et installations auxiliaires - Partie 11: Exigences pour les dispositifs de limitation de la chaudière et de ses accessoires

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Foreword

This document (EN 12952-11:2007) 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of an identical text or by endorsement, at the latest by January 2008, and conflicting national standards shall be withdrawn at the latest by January 2008.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 12952 concerning water-tube boilers and auxiliary installations consists of the following Parts:

— *Part 1: General.*
— *Part 2: Materials for pressure parts of boilers and accessories.*
— *Part 3: Design and calculation for pressure parts.*
— *Part 4: In-service boiler life expectancy calculations.*
— *Part 5: Workmanship and construction of pressure parts of the boiler.*
— *Part 6: Inspection during construction, documentation and marking of pressure parts of the boiler.*
— *Part 7: Requirements for equipment for the boiler.*
— *Part 8: Requirements for firing systems for liquid and gaseous fuels for the boiler.*
— *Part 9: Requirements for firing systems for pulverized solid fuels for the boiler.*
— *Part 10: Requirements for safeguards against excessive pressure.*
— *Part 11: Requirements for limiting devices of the boiler and accessories.*
— *Part 12: Requirements for boiler feedwater and boiler water quality.*
— *Part 13: Requirements for flue gas cleaning systems.*
— *Part 14: Requirements for flue gas DENOX-systems using liquefied pressurized ammonia and ammonia water solution.*
— *Part 15: Acceptance tests.*
— *Part 16: Requirements for grate and fluidized bed firing systems for solid fuels for the boiler.*

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

Although these Parts can be obtained separately, it should be recognised that the Parts are inter-dependent. 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.

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.

Introduction

The types of limiters which shall be fitted to boilers are specified in EN 12952-7 and the design of the safety systems are specified in EN 50156-1.

A limiter (or limiting device) is one element of a water-tube 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.

1 Scope

This European Standard specifies requirements for limiters (or limiting devices) which are incorporated into safety systems for water-tube boilers as defined in EN 12952-1.

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 shall 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 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 4-5: Testing and measurement techniques — 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)*

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, as on its own or as part of safety (protective) system (e.g. sensors, limiters) (see also Figure 3.1). If this is achieved by multi channel systems, then all items or limiters for safety purposes are included within the safety (protective) system.

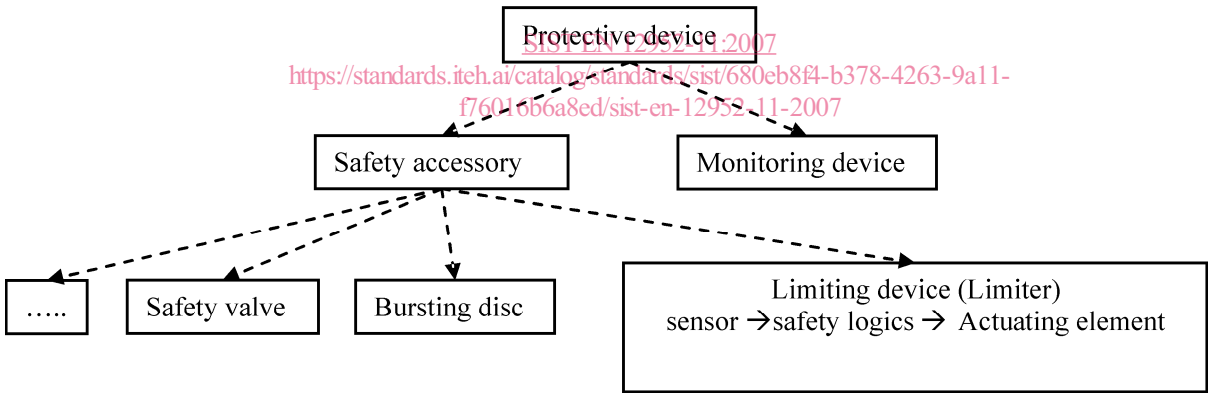

Figure 1 — Protective devices and safety accessories according to Directive 97/23/EC (PED)

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

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. 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.

4 Requirements for limiters

4.1 General

4.1.1 The requirements set out below shall be followed 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. An example of an examination plan is given in Annex B.

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.

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 [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 [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 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 on 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) the 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;

d) printed conductors (tracks) shall be varnished so that they are resistant to ageing by virtue of the distance between printed conductors being equivalent to at least the values specified in EN 60664-1:2003, Table 4 for pollution degree 1, and with a minimum nominal voltage of 32 V (minimum creepage distance of 0,14 mm).

4.4.2.3 Short circuit in wound film resistors

This fault may be excluded if the wound film resistors shall be used with a varnished or encapsulated resistive layer and axial terminations. The possibility of condensation shall be excluded during operation. The limits, e.g. voltage limit, power, shall not be exceeded even under worst case conditions.

4.4.2.4 Short circuit in wire-wound resistors

This fault may be excluded if the winding shall be a single layer winding and is secured by means of a glaze or embedded in a sealing compound.

4.4.2.5 Non-opening of contact elements due to permanent welding

This fault may be excluded if contactors, relays or auxiliary switches for example, shall be protected against the effects of short circuits by the appropriate overcurrent protective or current limiting devices. In rating the overcurrent protective device, the nominal current of the device as stated by the manufacturer, shall be multiplied by a safety factor of 0,6. Fault exclusion shall also be permissible if the prospective short circuit current is less than the nominal current for the contact element concerned. Where contact elements are connected in series, the contact element with the lowest overcurrent strength shall be the deciding factor.

Reed contacts shall not be used.

4.4.2.6 Mechanical failure of switching devices

This fault may be excluded if the switching devices are type tested to demonstrate they shall still be operative after at least 250 000 switching cycles under conditions similar to operating conditions. Contactors and relays shall, in addition, be capable of a mechanical endurance of 3 000 000 switching cycles, except for pressure limiters, see Table 2.

NOTE The term "conditions similar to operating conditions" covers chemical and climatic influences as well as electrical and mechanical stresses.

4.4.2.7 Faults in components for safe isolation

Faults in components which are provided for safe isolation of electrical circuits (e.g. power circuits and telecommunications circuits) in accordance with EN 61140 may be excluded. These include:

a) inter-winding short circuits in transformers (e.g. primary-secondary).

   Transformers shall comply with the electrical and mechanical requirements of EN 60742. Except that transformers with working voltages up to 200 V, insulation between windings and insulation against the core shall be designed for a test voltage of 2 kV rms. Transformers shall as a minimum be short-circuit proof. Displacement of windings, turns and connection lines shall be prevented, e.g. by vacuum impregnation or encapsulation;

b) transient voltage of switching devices like relays, contactors or auxiliary contacts between contacts and between coil and contacts.

   The insulation between contacts or between coil and contact shall be designed for nominal voltages U_b up to 200 V for a test voltage of 2 kV rms and at nominal voltages 200 V < U_b < 500 V for a test voltage of 3,75 kV rms. By special design features (e.g. caps, ribs, encapsulation, banding) at contacts and coils, safe isolation shall also be guaranteed against faults such as spring breakage;

c) short-circuiting of isolating distances in optocouplers.