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

National foreword

This British Standard is the UK implementation of EN 12953-9:2007.

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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Großwasserraumkessel - Teil 9: Anforderungen an Begrenzungseinrichtungen an Kessel und Zubehör

This European Standard was approved by CEN on 26 May 2007.

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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of an identical text or by endorsement, at the latest by January 2008 and conflicting national standards shall be withdrawn at the latest by January 2008.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.

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.

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

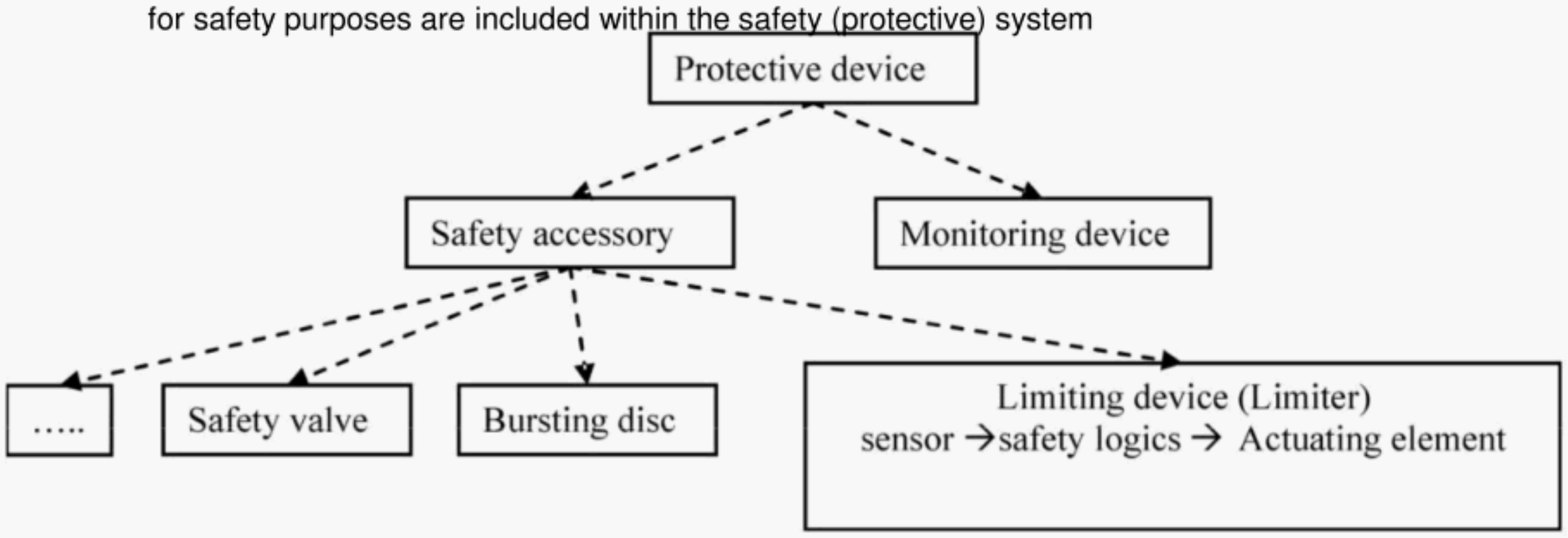

Figure 1 — Protective devices and safety accessories according to Directive 97/23/EC (PED)

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

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.

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;

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 is a single layer winding and shall be 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 is also 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 be 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. In deviation from EN 60742, for 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; 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.

The clearance and creepage distances of the optocoupler in its installed position shall fulfil the relevant conditions of EN 60664-1:2003, 3.1 and 3.2.

4.5 Marking

The limiters shall be marked with the following:

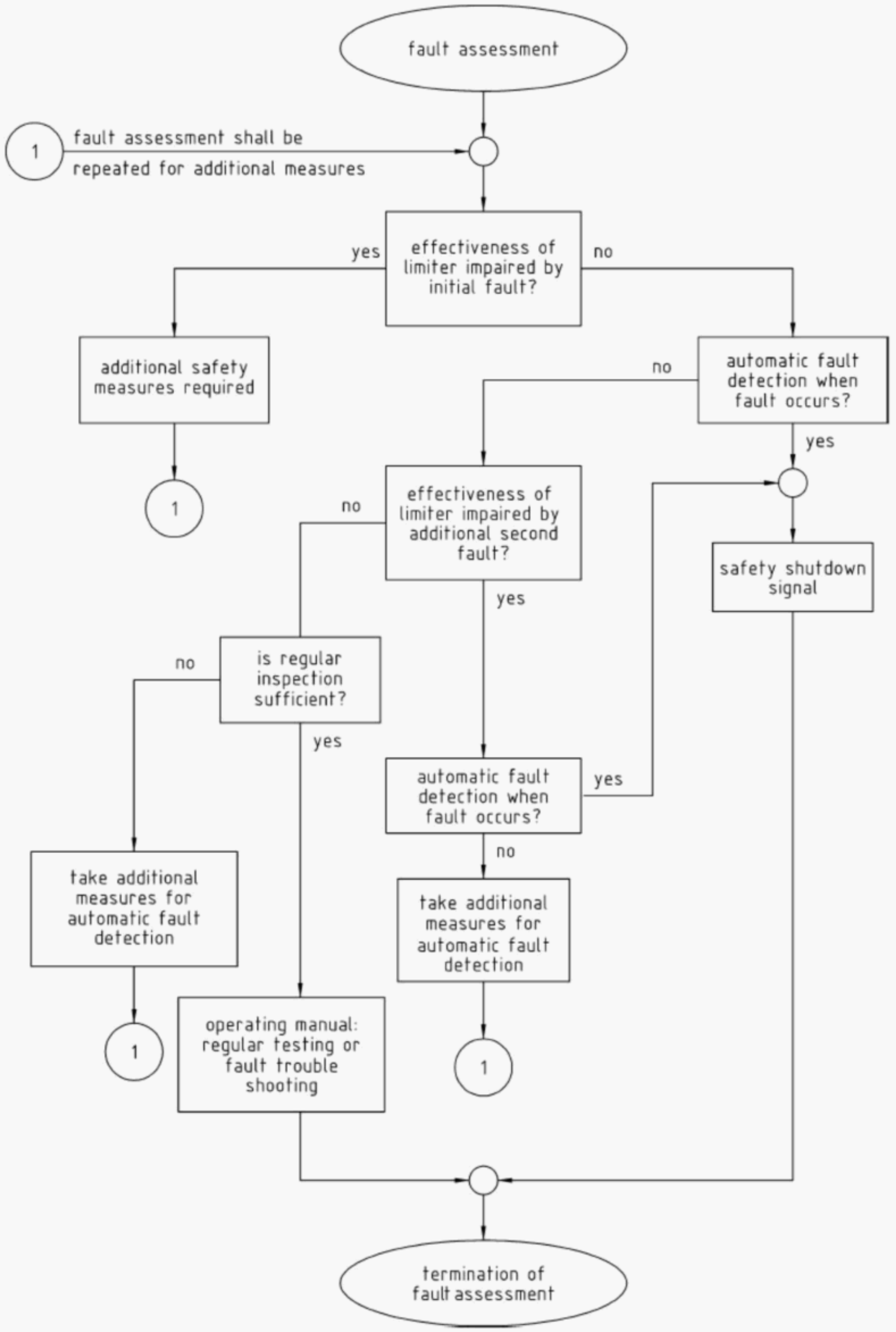
manufacturer´s name and/or trademark;

year of manufacture;

maximum/minimum allowable design limits;

unique type reference.

NOTE Other markings may be added by the limiter manufacturer or placed in the operating instructions, see Annex C.



Key

1 reassessment

Figure 2 — Fault assessment chart for limiters excluding the stored programme section

5 Special requirements for water level limiters

5.1 Components

This limiter shall consist of one or more units needed to provide the necessary safety function. The limiter shall comprise of the following elements where applicable: sensor, protection tube or external chamber (see NOTE), timing element, testing devices and other associated equipment up to the terminals of the switching output contacts as shown in Annex A.

NOTE Protection tubes and external chambers may be considered to be part of the boiler and in these cases it will be necessary for the limiter manufacturer and the boiler manufacturer to agree on the design and manufacturing requirements to ensure that the limiter system performs as intended. Examples of water level sensor are: float level switch, electrode probe, conductivity sensor.

5.2 Design

5.2.1 General

Chambers, connecting pipes and protection tubes shall be designed so that they:

allow free movement in the tube to equalise with the water level in the boiler;

can be cleaned and inspected;

prevent the build up of sludge in the tubes/chambers.

5.2.2 Internal protection tubes

5.2.2.1 Openings on the protection tube, which are necessary to ensure level equalisation, shall have a minimum diameter of 20 mm or equivalent area but not greater than one-third of the clear bore of the protection tube, except where specific type approval permits other dimensions.

5.2.2.2 The openings shall be positioned at the lowest point of the bottom and at the highest practicable point of the protection tube.

5.2.3 External chambers

5.2.3.1 The pipe connections to external chambers shall not be less than 20 mm clear bore. It shall be possible to blow down the chambers and connecting pipes to ensure that they do not become blocked.

Where applicable, blowdown systems should be fitted with a timing element which prevents the blow down period exceeding a predetermined maximum safe time and monitors the complete move next of the relevant valves and the function of the limiter output contact.

5.2.3.2 If isolating valves are fitted on the connecting pipes to external chambers, an interlock system shall be installed to shut off the heat supply when valves are not fully open.

5.2.3.3 The drain connection of the chamber shall be 15 mm minimum clear bore.

5.2.3.4 Chambers can be considered as being an integral part of the boiler and need not be blown down if:

a) the connecting pipes shall be 100 mm minimum clear bore on the water side and 40 mm minimum clear bore on the steam side and

b) the connection pipes shall be less than one metre long and

c) there shall be no isolating valves fitted on the connecting pipes.

Limiters fitted in such a chamber may be deemed to be inside the boiler.

5.3 Floating devices

5.3.1 The float shall be guided and shall be able to move freely.

5.3.2 As the actuating force is small, it shall be converted to a positive movement with a minimum of friction.

5.3.3 Mechanical transfer shall be performed in such a way that no sticking can occur.

5.3.4 The magnets shall be protected against the influence of the boiler water (e.g. suspended magnetic particles) by positioning them above the highest operational water level or by the use of an additional shield.

5.3.5 The magnetic materials shall be selected with regard to the temperature and operating conditions, such that the magnetic properties of the materials will not decrease by more than 3 % over a 10 year period. It shall be possible to prove by means of testing equipment integral with the water limiter system, that the magnetic interaction remains adequate to operate the switch.

5.3.6 Stray magnetic fields shall not adversely influence the magnetic transfer.

5.3.7 The test force for float devices at 15 °C shall be no greater than the total weight of the float and the parts attached to it.

5.4 Level electrode devices

5.4.1 The level electrodes shall be designed, positioned installed and protected in such a way that their proper functioning is not affected by:

a) foam and turbulence from the boiler water;

b) dirt build up;

c) mechanical influences during operation (e.g. vibration);

d) positional changes relative to the protection tube and or to other electrodes which could result in a short circuit.

5.4.2 Unless the manufacturers fault assessment shows that an equivalent degree of safety is maintained:

the minimum air distance between measuring electrodes to earth and to each other inside the pressure part shall be 14 mm;

level electrode devices shall be installed vertically or at inclinations of up to 45° from the vertical.

5.4.3 Devices that are used to support or restrict movement of the electrode shall be included in the examination of functional capability (5.5).

5.4.4 The maximum operating voltage of electrodes shall be 50 V a.c. rms without a d.c. component which could cause significant polarisation effects. If galvanic isolation from the mains supply is required, it shall be provided by a safety transformer in accordance with EN 60742, meeting the requirements of class of protection II (double insulation).

5.4.5 The earth return connection shall be as close as possible to the electrode.

5.4.6 The manufacturer of the limiter shall define the limits of application with respect to the water conductivity.

5.4.7 The insulation resistance of the electrode and the cable shall be monitored. In the case of low insulation resistance caused for example, by dirt build up on the insulator or internal leakage of the electrode, the system shall go into a safe state.

5.4.9 Only one low water limiter shall be permitted to be installed within the protection tube or an external chamber. It is acceptable, however, to install additional electrodes for control and other alarm functions.

5.5 Examination of functional capability

The examination of the functional capability of the limiter shall be in accordance with the procedures given in Table 1.

Table 1 — Examination of functional capability of water level limits

Pos.	Description	Verification	Acceptance criteria
A	FUNCTIONAL TESTS		
A.1	Environmental influences	Check operation of the water level limiter under the following conditions, either by certified test document review, simulation, on a test boiler or in any combination. — power supply variation test; — power supply interruption test; — frequency variation test; — EMC immunity test; — ambient temperature test; — IP rating.	Annex D EN 50156-1
A.2	Test of independent functioning	When common components are shared, a failure of the second limiter or the control circuit(s) shall be simulated.	The safety function of the limiter shall not be affected.
A.3	Thermal cycle test	The whole limiter assembly shall be subjected to at least 100 thermal cycles at full pressure by the manufacturer. During each cycle, the limiter shall be shown to operate to the manufacturer's specification at the lowest temperature and highest temperature, allowing sufficient soak time at both these conditions. In the case of electrode devices, immediately after completing the cyclic test, the insulation resistance of all insulated parts of the electrode shall be measured.	No steam leak shall be permitted. The resistance shall be more than 10 MΩ at test voltage of 500 V d.c. under room conditions.
A.4	Final performance test	This shall consist of a comprehensive series of measurements and observations of the characteristics and performance of the water level limiter to demonstrate that no unacceptable deterioration has occurred as a result of previous tests. Tests shall be done at ambient temperature at normal voltages and subsequently with the worst combination of supply voltages. In the case of electrode devices, the water level limiter shall be checked for correct operation within the maximum and minimum water conductivities as specified by the manufacturer.	The water level limiter shall initiate alarm signals when the level drops below the low water level at for each of the max and min. water conductivities.

Table 1 — Examination of functional capability of water level limits (*concluded*)

Pos.	Description	Verification	Acceptance criteria
B	LEVEL ELECTRODE DEVICES		
B.1	Testing of internal faults	Failure of each critical component shall be simulated and a check shall be made to show that the water level limiter goes to a safe state in accordance with the relevant fault assessment charts. By way of examples "Internal Faults" are: a) short circuit or interruptions in components such as in resistors, capacitors, discrete and integrated semi-conductor elements etc.; b) faulty oscillations of electrical circuits; c) non-opening or non closing of electromagnetic components, such as contactors, relays etc.; d) short circuits or interruptions in control circuits, such as broken wires, earth fault and conductor-to-conductor short circuit etc.; e) software errors; f) systematic hardware faults in integrated circuit components.	Compliance with 4.4.
B.2	Insulation resistance test	A check shall be made of the resistance between all insulated parts of the limiter circuits, which includes contacts of switches, relays or contactors for isolation functions.	The resistance shall be more than 10 MΩ at test voltage of 500 V d.c. under room conditions.
B.3	Test for maximum operating voltage	Electrode shall be subjected to maximum voltage.	50 V a.c. rms maximum.
C	FLOATING DEVICES		
C.1	Durability test on electromechanical switches	Electromechanical switches shall be life tested to at least 100 000 operations at full rated temperature and full rated electrical load. At least one sample shall be with the maximum rated a.c. inductive load, and another with the maximum rated d.c. load.	The electromechanical switches shall still be functional at the end of the test cycle.
C.2	Test for free movement of the float	The difference in diameter between the outside of the float and the inside of the chamber or guide tube shall be checked.	The difference shall not be less than 10 mm.
C.3	Test for positive movement of the float	A check shall be made to ensure that the mechanical parts which are subjected to wear shall be shown to work for a minimum of 250 000 operations within the full range of the mechanical movement.	The limiter shall not malfunction during the test cycle.

5.6 Fault detection

5.6.1 The limiter shall be tested automatically and periodically during use to ensure that the safety is not impaired by at least one of the following methods:

a) incorporating a self testing device;

b) lowering the water level;

c) sinking the float device.

5.6.2 The safety shutdown signal shall be initiated if the test sequence fails.

5.6.3 Manual functional testing of the limiters shall be possible at any time under any operating conditions, e.g. by simulation where appropriate. The result of the test shall be clearly indicated to the boiler operator.

6 Special requirements for pressure limiters

6.1 Components

The limiter shall consist of one or more units needed to provide the necessary safety function. The limiter shall comprise the following units where applicable: connecting piping, body, sensor, external chamber, timing element, testing devices and other associated equipment up to the terminals of the switching output contacts as shown in Annex A.

6.2 Additional fault assessment requirements

In addition to the requirements in 4.4, it may be assumed that failure of the component shall not occur where a mechanical component of the pressure limiter has been designed for a dynamic load and has been successfully tested for 2 000 000 cycles over its full range of mechanical movement.

6.3 Design

6.3.1 The limiter shall be capable of withstanding an overload of at least 1,5 times its maximum adjustable pressure without detriment to its accuracy. The manufacturer may state a higher overload pressure.

6.3.2 The adjustment of the set pressure shall only be possible by means of a tool. Any adjustment shall be capable of being secured so that it does not alter due to any environmental influence, e.g. vibration. The set pressure shall be indicated on a scale.

6.3.3 It shall not be possible to adjust the set pressure to such an extent that the limiter loses its function (e.g. by the spring becoming coil-bound).

6.3.4 Connecting pipes for the limiter on steam boilers shall be connected to the steam space of the boiler. If necessary the limiter shall be protected from the steam temperature by a water seal. For fully flooded hot water generators the limiter shall be connected to the supply pipe before the first shut-off valve.

If isolating valves are fitted on the connecting pipes, an interlock system shall be installed to shut off the heat supply when valves are not fully open.

6.3.5 If there is the possibility of sludge build-up in the connecting pipe it shall be possible to purge the pipe. Such purging shall not remove the water seal or introduce dirt into the water seal.

6.3.6 The limiter body shall be installed vertically so that dirt does not enter the limiter.

6.3.7 Connecting pipes and the boiler connection for the limiter shall be designed so that they can be cleaned and inspected. The connecting pipe and its boiler connection shall have a clear bore of at least the following unless the manufacturers fault assessment shows that an equivalent degree of safety is maintained:

a) 8 mm where the pipe is less than 1 m long and the pipe supplies only the limiter or

b) 15 mm where the pipe is greater than 1 m long and the pipe supplies only the limiter or

c) 20 mm where the pipe supplies the limiter in addition to other devices.

6.4 Electrical equipment

Electrical equipment shall conform to the relevant clauses of EN 60730-1 (see Table 3).

6.5 Examination of functional capability

6.5.1 The deviation from the set pressure when type tested as specified in 6.5.2 to 6.5.6 shall not exceed the higher of:

± (2 % of the span + 1 % of the full scale) or

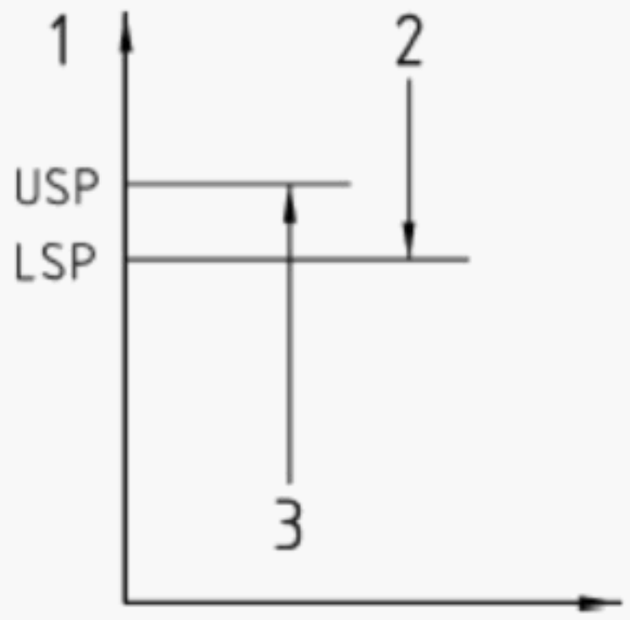
± 0,04 bar.

The span is the difference between the lowest and the highest set pressure indicated on the scale. Full scale means the highest set pressure indicated on the scale.

6.5.2 The test required for the test procedure shall be in accordance with Table 2 and Figure 3.

Table 2 — Test procedure

Clause reference	Adjustment	Number of cycles	Pressure	Temperature	Upper Switching Point (USP) high pressure limiter	Lower Switching Point (LSP) low pressure limiter	Requirements in accordance with 6.5.1
6.5.4	Lowest value	Minimum 1	Switching pressure	20 °C	USP 1	LSP 1	Compare USP 1/USP 2 or LSP 1/LSP 2
				70 °C	USP 2	LSP 2	
6.5.5	Highest value	Minimum 1	Switching pressure	20 °C	USP 3	LSP 3	Compare USP 3/USP 4 or LSP 3/LSP 4
				70 °C	USP 4	LSP 4	
6.5.6	Lowest value	Minimum 1	Switching pressure	20 °C	USP 5	LSP 5	Compare USP 5/USP 6 or LSP 5/LSP 6
		100	Maximum overload	20 °C	USP 6	LSP 6	
6.2	Mid point of the span	2×10^6	To give full mechanical movement	20 °C	—	—	No mechanical damage



Key

1 pressure
2 falling pressure
3 rising pressure

USP is the Upper Switching Point
(relevant for high pressure limiter)

LSP is the Lower Switching Point
(relevant for low pressure limiter)

Figure 3 — Switching point for pressure limiter

6.5.3 The repeatability shall be within the limits stated in 6.5.1 when the tests detailed in 6.5.4, 6.5.5 and 6.5.6 are carried out using air as the test medium. The pressure shall not be changed at a rate faster than the span of the limiter in one minute.

6.5.4 The set pressure shall be adjusted to the lower end of the set pressure scale and the switching pressure measured at an ambient temperature of 20 °C. The ambient temperature shall be raised to 70 °C and the switching pressure measured.

6.5.5 The test in 6.5.4 shall be repeated with the set pressure at the upper end of the set pressure scale.

6.5.6 The set pressure shall be adjusted to the lower end of the set pressure scale and the switching pressure measured at an ambient temperature of 20 °C. The pressure shall be changed 100 times from zero to the maximum overload pressure specified in 6.3.1. Where the limiter incorporates a lockout function it shall be reset after each cycle. After the 100 cycles the switching pressure at 20 °C shall be measured.

6.5.7 Further tests shall be in accordance with Table 3.

Table 3 — Examination of functional capability of pressure limiters

Pos.	Description	Verification	Acceptance criteria where it differs from EN 60730-1
A	Protection against electric shock	EN 60730-1:2000, Clause 8	
B	Provision for protective earthing	EN 60730-1:2000, Clause 9	
C	Terminals and terminations	EN 60730-1:2000, Clause 10	
D	Constructional requirements	EN 60730-1:2000, Clause 11	
E	Insulation resistance	EN 60730-1:2000, 13.1	The resistance shall be more than 10 MΩ
F	Electric strength	EN 60730-1:2000, 13.2	
G	Creeping distances, clearances and distances through insulation	EN 60730-1:2000, Clause 20	Compliance shall be with the values specified for dirty situation
H	Resistance to tracking	EN 60730-1:2000, 21.2.7	
I	Transformers	EN 60730-1:2000, 24.1	
J	Environmental stress	EN 60730-1:2000, Clause 16	
K	Endurance	EN 60730-1:2000, 17.7and 17.8	
L	Mechanical strength	EN 60730-1:2000, 18.1.1 Visual examination	If necessary tests shall be carried out in accordance with 18.2 to 18.8 inclusive
M	Threaded parts and connections	EN 60730-1:2000, 19.1.1and 19.2.2 Visual examination	If necessary tests shall be carried out in accordance with 19.1 to 19.2 inclusive
N	EMC	Relevant standards	Compliance with Annex D
O	Abnormal operation	EN 60730-1:2000, Clause 27	Where power consumption is less than 15 W, Clause 27 shall not be applied

6.6 Fault detection

Provision shall be made for functional testing of the limiter. The result of the test shall be clearly indicated to the boiler operator.

7 Special requirements for temperature limiters

7.1 Components

The limiter shall consist of one or more units needed to provide the necessary safety function. The limiter comprises the following units where applicable: thermowell, body, sensor, timing element, testing devices and other associated equipment up to the terminals of the switching output contacts as shown in Annex A.

7.2 Design

7.2.1 Temperature limiters shall be devices with characteristics given in Table 4.

Table 4 — Characteristics of temperature limiters

Device code	Description of code	Requirements
Type 2	automatic control for which the manufacturing deviation and the drift of its operating value, operating time or operating sequence have been declared and tested under this European Standard	x
A	full disconnection on operation	w
B	micro disconnection on operation	x
H	a trip free mechanism in which the contacts cannot be prevented from opening and which may automatically be reset to the "closed" position after normal operation conditions have been restored if the reset means is held in the "reset" position	x
J	a trip free mechanism in which the contacts cannot be prevented from opening and the control is not permitted to function as an automatic reset device if the reset means is held in the "reset" or "on" position	w
K	for sensing actions, no increase in the operating value as the result of a breakage in the sensing element, or in parts connecting the sensing element to the switch head	x
N	for sensing actions, no increase in the operating value as a result of any leakage from the sensing element, or from parts connecting the sensing element to the switch head	w
P	an action which operates after a 50 000 thermal cycle test (50 % to 90 %) (In general, thermal cut outs for specific applications, such as pressurised water heating systems, may be classified as having Type 2.P action.)	x
L	an action that does not require any external auxiliary energy source of electrical supply for its intended operation	x

x = mandatory
w = optional

7.2.2 A type 2 K action can also be achieved by two independent systems, the contacts of which shall be connected in series.

7.2.3 Adjustment of the set temperature shall only be possible by means of a tool. Any adjustment shall be capable of being secured so that it does not alter. The set temperature shall be indicated on a scale.

7.2.4 It shall not be possible to adjust the set temperature to such an extent that the limiter loses its function (e.g. by the spring becoming coil-bound).

7.2.5 The time constant shall not exceed 45 s for operation in water and 120 s for operation in steam.

7.2.6 During fluctuations of the electrical auxiliary energy in the range U_N –15 % to U_N + 10 %, or of the pneumatic or hydraulic auxiliary energy in the range ± 10 %, referred to the rated supply pressure, temperature limiters shall have no displacement of the operating values which could result in an unsafe state.

7.2.7 The manufacturing deviation shall be a maximum of 0 to – 10 % or 0 to – 4 K, whichever is the greater value. The % value refers to the highest temperature that can be set by adjustment.

7.2.8 The drift shall be a maximum of ± 5 % or ± 2 K, whichever is the greater value, referred to the highest temperature that can be set by adjustment. The maximum allowable temperature shall not be exceeded.

7.2.9 Manufacturing deviation and drift shall refer to the switch-off point.

7.2.10 At an ambient temperature of 20 °C up to the maximum permissible ambient temperature declared by the manufacturer, the switching point of temperature limiting devices shall not produce an alteration to higher tempe-

ratures. If the factory-set switching point is set for an ambient temperature exceeding 20 °C, the switching point may increase by a maximum of 5 K if the ambient temperature drops from that level to 20 °C.

7.2.11 The effect of the ambient temperature on capillaries and the switch head, respectively, shall be declared by the manufacturer.

7.2.12 Sensing elements of temperature limiters shall be capable of withstanding for one hour temperatures lying 15 % or 25 K above the maximum setting temperature, whichever is the highest value. As a result, no alteration of the switching point to an unsafe state shall occur.

7.3 Electrical equipment

Electrical equipment shall comply with the relevant clauses of EN 60730-1, in accordance with Table 5.

7.4 Examination of functional capability

The examination of the functional capability of the limiter shall be in accordance with the procedures shown in Table 5.

Table 5 — Examination of functional capability of temperature limiters

Pos.	Description	Verification	Acceptance criteria where it differs from EN 60730-1
A	Protection against electric shock	EN 60730-1:2000, Clause 8	
B	Provision for protective earthing	EN 60730-1:2000, Clause 9	
C	Terminals and terminations	EN 60730-1:2000, Clause 10	
D	Constructional requirements	EN 60730-1:2000, Clause 11	
E	Insulation resistance	EN 60730-1:2000, 13.1	The resistance shall be more than 10 MΩ
F	Electric strength	EN 60730-1:2000, 13.2	
G	Creeping distances, clearances and distances through insulation	EN 60730-1:2000, Clause 20	Compliance with the values specified for dirty situation
H	Resistance to tracking	EN 60730-1:2000, 21.2.7	
I	Transformers	EN 60730-1:2000, 24.1	
J	Environmental stress	EN 60730-1:2000, Clause 16	
K	Endurance	EN 60730-1:2000, 17.7and 17.8	Tests shall be carried out with cut off (300 cycles) and without cut off (30 000 cycles). The limiter shall still meet the requirements for the drift and the time constant. Visual faults shall not appear
L	Mechanical strength	EN 60730-1:2000, 18.1.1 Visual examination	If necessary tests shall be carried out in accordance with 18.2 to 18.8 inclusive
M	Threaded parts and connections	EN 60730-1:2000, 19.1.1and 19.2.2 Visual examination	If necessary tests shall be carried out in accordance with 19.1 to 19.2 inclusive
N	EMC	Relevant standards	Compliance with Annex D
O	Abnormal operation	EN 60730-1:2000, Clause 27	Where power consumption is less than 15 W, Clause 27 shall not apply
P	Fluctuations of the electrical auxiliary energy	EN 60730-1:2000, 3.2.13	It shall be checked whether these requirements are met both as supplied and after the test in accordance with position K

Table 5 — Examination of functional capability of temperature limiters (*concluded*)

Pos.	Description	Verification	Acceptance criteria where it differs from EN 60730-1
Q	Ambient temperature	EN 60730-1:2000, 3.2.14	The effect of the ambient temperature shall be checked, together with the determination of the switching values
R	Heating	EN 60730-1:2000, 3.2.5	

8 Special requirements for flow limiters

8.1 Components

This limiter shall consist of one or more units needed to provide the necessary safety function. The limiter comprises the following elements where applicable: body, sensor, testing devices and other associated equipment up to the terminals of the switching output contacts as shown in Annex A.

8.2 Design

Flow limiters shall not be of the impeller or flag type.

8.3 Electrical equipment

Electrical equipment shall comply with the relevant clauses of EN 60730-1.

8.4 Examination of functional capability

The examination of the functional capability of the limiter shall be in accordance with the procedures shown in Table 5, where applicable.

NOTE The integration of the device is covered by EN 12953-6.

Annex A

(informative)

Limiting device

The limiter (or limiting device) comprises various elements up to the terminals of the switching output contacts as shown in Figure A.1.

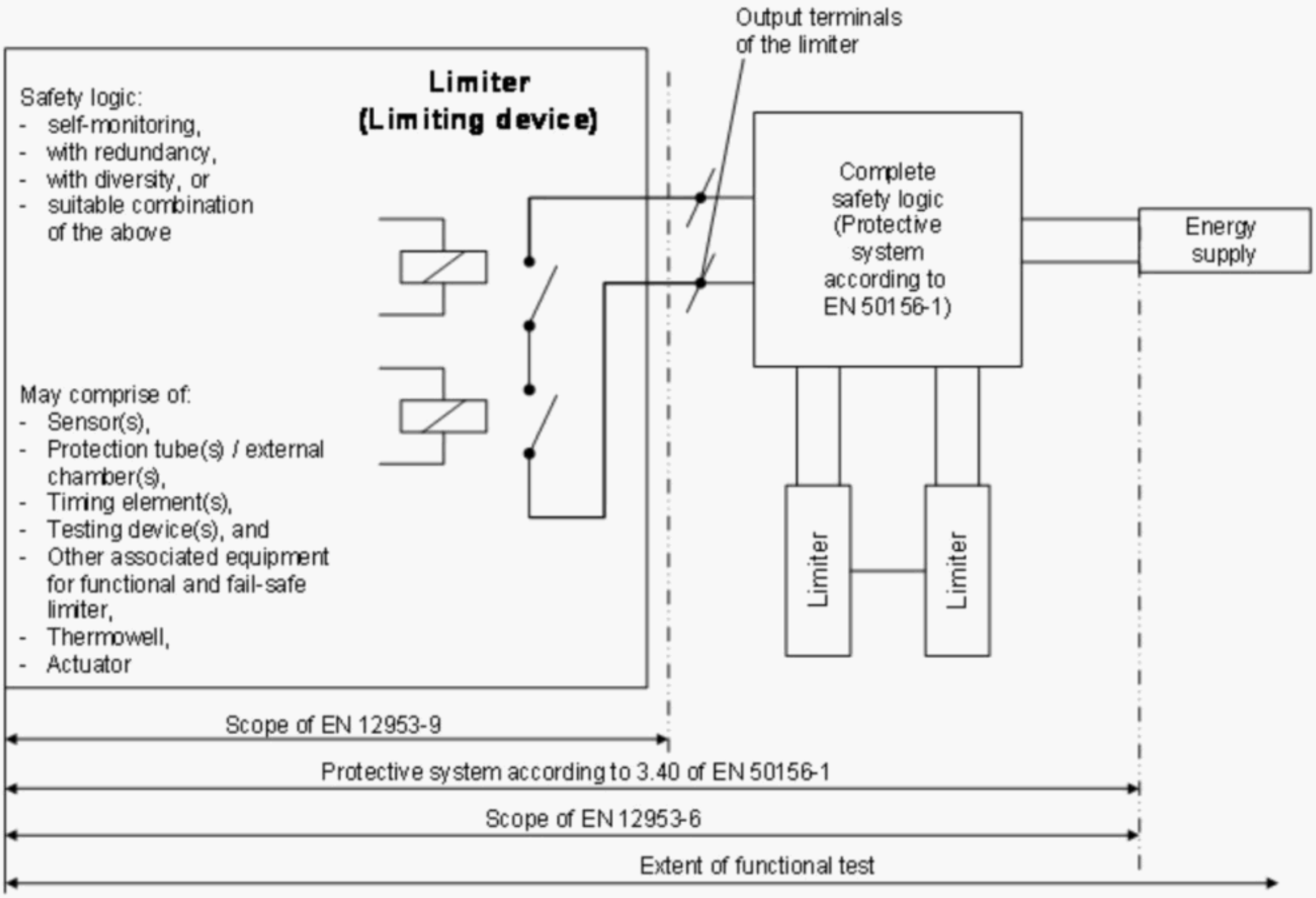


Figure A.1 — Limiting device

Annex B

(informative)

Example of an examination plan

An example of an examination plan is described in Table B.1.

Table B.1 — Example of an examination plan for limiting devices

Pos.	Description	Verification
A	**Design documents:** Submission of design documents, to include for example, the following:	The review of documents and evaluation of design. Further documents/records should be requested, if necessary.
A 1	General arrangement drawing of the limiter (true to scale with dimensions).	The completeness of documents should be checked.
A 2	Drawing of all functional components with information on materials and method of production.	The completeness of documents should be checked.
A 3	Sectional drawings complete with position numbers and parts list.	The completeness of documents should be checked.
A 4	Description of the limiter complete with information on: — design, use, application; — measuring procedures and principles; — basic design; — functional concepts; — technical data; — installation, operation and maintenance instructions.	The completeness of documents should be checked. The technical design should be examined. The compliance with applicable standards should be checked. (If necessary the evaluation of the design should include site tests on an operational boiler over a satisfactory proof run period. The test site should be chosen, with respect to the typical frequency of operation of the limiter, load conditions, and temperature conditions.)
A 5	Circuit diagrams, to include: — assembly plan; — PCB layout; — parts list.	The completeness of documents should be checked. The technical design should be examined. The compliance with applicable standards should be checked.
A 6	Calculations/computation of pressure bearing parts.	The completeness of documents should be checked. The compliance with applicable standards should be checked.
A 7	Manufacturer's declaration, to include: — QA management system; — Production quality control plan; — design of mains transformer; — evidence of protection classes; — data sheet on insulators used; — Declaration of conformity.	The completeness of documents should be checked. The technical design should be examined. The suitability of material used for their intended purpose should be checked. The compliance with applicable EU Directives and applicable standards should be checked.
B	**Test sample(s)** Submission of test samples.	Visual examination of samples to check conformity with design documents.
C	**Testing of sample(s)**	The test shall be to the following:

Water level limiters:	5.5
Pressure limiters:	6.5
Temperature limiters:	7.4

Table B.1 — Example of an examination plan for limiting devices (*concluded*)

Pos.	Description	Verification
D	**Test reports**	The test report should contain all the relevant data and test results. The contents should consist of the following where applicable: a) Place and data of the test, the names of those present, the names of the personnel carrying out the tests. b) Type references and serial numbers of the products tested. c) Description of the specimens and of the selection method used. d) Test specifications. e) Description of the test procedures, list of the test apparatus and measuring instruments used, with type references and serial numbers. f) Environmental conditions during the tests. g) Factual and reproducible test results. h) Explanatory notes on any faults which may have occurred, and the remedial measures taken. This test report is a relevant part of the technical documentation.
E	**Final approval**	Completion of all satisfactory design review and tests.

Annex C
(informative)

Marking of limiters

C.1 The following markings or information, where applicable, shall be provided with temperature limiters and pressure limiters in addition to those required by the other parts in accordance with Table C.1.

Table C.1 — Markings or information on temperature limiters and pressure limiters, where applicable

No.	Markings or information	Method
1	Rated voltage or rated voltage range in volts (V)	C
2	Nature of supply, unless the control is for both a.c. and d.c. or unless the rating is the same for a.c. and d.c.	C
3	Frequency, if other than for 50 Hz to 60 Hz inclusive	C
4	Purpose of control	D
5	Construction of control and whether the control is electronic	D
6	Type of load and rated current in each circuit	C
7	Degree of protection provided by enclosure	C
8	Which of the terminals are suitable for the connection of external conductors, and if they are suitable for line or neutral conductors, or both	C
9	The range of conductor sizes the terminals for external conductors are suitable for	D
10	For screwless terminals, the method of connection and disconnection	D
11	Details of any special conductors which are intended to be connected to the terminals for internal conductors	D
12	Maximum temperature of terminals or internal conductors, if above 85 °C	D
13	Temperature limits of the switch head, if T_{min} is lower than 0 °C, or T_{max} is above 60 °C	D
14	Temperature limits of mounting surfaces (T_s), if more than 20 K above T_{max}	D
15	Classification of control according to protection against electric shock	X
16	For Class II controls, the symbol for Class II protection	C
17	Type of disconnection or interruption provided for each circuit	X
18	CTI for materials used for insulation	X
19	Method of mounting the control	D
20	Method of providing earthing at the control	D
21	Intended transportation conditions of control (method of packing not required)	X
22	Details of any limitation of operating time	D
23	Fault response time (4.4.2.1 a))	D
24	Period of electric stress across insulating parts	X
25	Limits of activating quantity for any sensing element over which micro-disconnection or electronic disconnection is secured	X
26	Minimum and/or maximum rates of change of activating quantity, or minimum and/or maximum cycling rates for a sensing control	X
27	Type 2 action	D
28	Additional features of Type 2 actions	D

Table C.1 — Markings or information on temperature limiters and pressure limiters, where applicable (*concluded*)

No.	Markings or information	Method
29	Manufacturing deviation and condition of test appropriate for deviation	X
30	Reset characteristics for cut-out action	D
31	Operating sequence for controls with more than one circuit, if significant	D
32	Size of any sensing element	D
33	Control pollution condition	D
34	Control intended to be delivered exclusively to the equipment manufacturer	X
35	Heat and fire resistance category	X
36	Type of output waveform if other than sinusoidal	X
37	Relevant parameters of electronic devices or other circuit components considered unlikely to fail	X
38	Type of output waveform(s) produced after failure of an electronic device or other circuit component	X
39	Effect on controlled output(s) after electronic circuit component failure if relevant	X
40	For integrated and incorporated electronic controls if any protection against mains born perturbations, magnetic and electromagnetic disturbances is claimed, which of the test of Annex D shall be performed and the effect on controlled output(s) and function after a failure to operate as a result of each test	X
41	For other than integrated and incorporated electronic controls, the effect on controlled output(s) and function after a failure to operate as a result of the tests according to Annex D	X
42	Category (surge immunity)	X
43	According to the use of a thermistor	X
44	Resistance/temperature characteristics	X
45	Resistance/temperature characteristics drift	X
46	Number of cycles	X
47	Method of resistance/temperature measurement	X
48	Max. temperature for the sensing element	D
49	Time constant	D
50	Switching differential	D
51	Drawing specifying the main dimensions and identifying the parts	X
52	Protection pockets or accessories to be tested with the control	X
53	Installation of overcurrent protection devices, e.g. miniature fuses	D
54	Rated pressure range of protection pockets or immersion pockets, if applicable	D
55	Controlled medium	D
56	Ambient temperature, if other than 20 °C, at which the switching point was set	X
57	Temperature setting range switching point	C

C.2 Information shall be provided using one or more of the following methods. The information required for limiters and the appropriate method for providing this information shall be as indicated in Table C.1.

By marking (C) – this information shall be provided by marking on the limiter itself, except that, in the case of an integrated limiter, such marking can be on an adjacent part of the equipment, provided that it is clear that it refers to the limiter.

NOTE 1 Information provided by marking (C) may also be included in documentation (D).

By documentation (D) — this information shall be provided for the user or installer of the limiter, and shall consist of legible instructions. Each limiter shall be accompanied by such instructions. Instruction sheets and other texts required by this European Standard shall be written in the official language(s) of the country in which the control is to be sold. For limiters intended to be exclusively delivered to the equipment manufacturer, the instruction sheet may be replaced by a leaflet, letter or drawing etc. It is not necessary for each limiter to be accompanied by such a document.

By declaration (X) – this information shall be provided for the testing authority for purposes of test and in a manner agreed between testing authority and manufacturer. It may, for example, be provided by a marking on the limiter, by a leaflet, letter or drawing or, in the case of a limiter submitted in, on or with equipment, by measurement or inspection of the submitted equipment.

NOTE 2 Information which is indicated as being required by declaration (X) should also be provided to the equipment manufacturer, as appropriate.

C.3 Information which is indicated as being required by marking (C) or by documentation (D) shall also be provided for the testing authority in an agreed manner if so requested by the testing authority.

C.4 For controls submitted in, on or with equipment, the requirement for documentation (D) is replaced by declaration (X).

C.5 For an integrated limiter forming part of a more complex control, the marking relating to the integrated limiter may be included in the marking of the more complex control.

C.6 The requirement for documentation (D) is considered to be met if such information has been provided by marking (C).

C.7 The requirement for declaration (X) is considered to be met if such information has been provided by either documentation (D) or by marking (C).

C.8 For limiters that are neither integrated nor incorporated, where lack of space prevents legible marking as specified in Table C.1, these markings shall be included in documentation (D).

C.9 Additional marking or information is allowed, provided that it does not give rise to misunderstanding.

Annex D

(normative)

Immunity against electrical and electromagnetic influences — Requirements and testing

D.1 General

Limiters shall be designed so that they withstand the environmental influences listed in D.2 to D.10. They shall be subjected to the tests described there.

Class 3 in accordance with EN 61000-6-2 shall be applied as test level.

Unless specified otherwise, the limiter is operated with nominal voltage and nominal frequency during testing.

The tests shall be carried out in the defined functional conditions (e.g. standby, operating condition, shut-down condition, lock-out condition etc.).

Unless specified otherwise, the following performance criteria shall be applied:

Performance criteria A:

During testing the limiter shall continue to operate fully in accordance with the functional requirements. It shall not show any deviation from the intended functional sequence or from the associated times, where relevant.

Performance criteria B:

During testing the limiter shall continue to operate fully in accordance with the functional requirements or it may show a functional deviation to the safe direction (e.g. by shut-down or lock-out). It shall mot leave a condition defined as being safe (e.g. release from the lock-out condition or leave the shut-down condition).

Components intended specifically for protection against EMC interferences shall not fail or become destroyed during testing.

D.2 Immunity against mains voltage variations

The functional safety of the limiter shall be within the range of 85 % of the lowest to 110 % of the highest alternating current (AC) nominal voltage indicated by the manufacturer and 80 % of the lowest to 120 % of the highest direct current (DC) nominal voltage indicated by the manufacturer, respectively.

In the case of mains voltage variations within the range mentioned above the limiter shall meet the performance criteria A according to D.1.

For voltages below the smallest voltage indicated the limiter shall meet the performance criteria B according to D.1. Thereby, the safety-related time periods for reaching shut-down or lock-out shall not be prolonged by more than 100 %.

D.3 Immunity against short-time voltage interruptions and reductions

The test shall be carried out in accordance with EN 61000-4-11.

There shall be short-time mains voltage interruptions during time periods of 10, 20, 50, 500, 1 000 and 5 000 ms as well as short-time mains voltage reductions to 50 % of the nominal value during time periods of 50, 500, 1 000 and 5 000 ms.

Thereby, the limiter shall meet the following requirements:

a) for mains voltage interruptions up to 20 ms the limiter shall meet the performance criteria A according to D.1;

b) for mains voltage interruptions and mains voltage reductions to 50 % of more than 20 ms the limiter shall meet the performance criteria B according to D.1.

D.4 Immunity against mains frequency changes

If the limiter contains timing circuits, which are dependent of mains frequency, it shall be submitted to the following tests:

Testing shall be carried out at frequencies that correspond to the supply frequency (usually 50 Hz and 60 Hz).

a) For changes of mains frequency up to 2 % of the nominal frequency the limiter shall meet the performance criteria A according to D.1. Deviations of programming times shall not exceed the percentage of the applied frequency change.

b) For changes of mains frequency of more than 2 % up to 5 % of the nominal frequency the limiter shall meet the performance criteria B according to D.1. If the limiter continues to operate in accordance with the functional requirements, deviations of programming times shall not exceed the percentage of the applied frequency change.

D.5 Immunity against electrostatic discharge (ESD)

Testing shall be carried out in accordance with EN 61000-4-2.

The direct contact discharges and air discharges are applied onto all tangible conductive or insulating surfaces of the limiter, the indirect contact discharges and air discharges are applied to the horizontal and vertical coupling plates, respectively:

contact discharge: 4 kV;

air discharge: 8 kV.

The limiter shall meet the performance criteria B according to D.1.

D.6 Immunity against fast transient disturbance variables (burst)

Testing shall be carried out in accordance with EN 61000-4-4.

The disturbances mentioned hereafter:

duration of burst 15 ms;

period of burst 300 ms;

pulse form 5/50 ns;

repetition frequency 5 kHz

are coupled onto the power supply lines (including PE) and the signal lines (input/output interfaces of communication, data and control lines). Testing of the signal lines may be neglected, if the manufacturer explicitly specifies a permissible length of maximum 3 m for these lines.

The duration of the test shall be at least 30 s in each functional condition (e.g. operating condition, lock-out condition).

Table D.1 — Burst

	Power supply lines	Signal lines
Coupling	direct by means of coupling network	capacitively by means of coupling clamp
	amplitude / repetition frequency	amplitude / repetition frequency
	± 2,0 kV / 5 kHz	± 1 kV / 5 kHz

The limiter shall meet the performance criteria B according to D.1.

D.7 Immunity against surges

Testing shall be carried out in accordance with EN 61000-4-5.

The disturbances are coupled onto the power supply lines (including PE) and onto the signal and control lines.

Testing of the signal and control lines may be neglected, if the manufacturer explicitly specifies a permissible length of maximum 10 m for these lines.

For each functional condition (e.g. operating condition, lock-out condition) two surges each shall be carried out with each of the polarities (+,-) and with each phase angle.

Table D.2 — Surge

Power lines (AC)		Power lines, direct current inputs and outputs *(DC)*		Connections for signal and control lines	
line to line	line to earth	line to line	line to earth	line to line	line to earth
1,0 kV	2,0 kV	1,0 kV	2,0 kV	—	1,0 kV

The limiter shall meet the performance criteria B according to D.1.

D.8 Immunity against high-frequency electromagnetic fields

Testing shall be carried out in accordance with EN 61000-4-3.

The limiter is subjected to the electromagnetic disturbances, using a shielded measuring chamber.

Frequency range:	80 MHz to 1 000 MHz;
Modulation:	AM, 1 kHz, sine wave, degree of modulation 80 %;
Field strength:	10 V/m;
of the ISM/CB bands[1)]:	20 V/m;
Polarization:	horizontal / vertical;
Sweep rate:	max. 1,5 × 10^{-3} decades/s;

1) ISM/CB bands: 6,78 / 13,56 / 27,125 / 40,68 / 433,92 MHz.

or step size: ⩽ 1 %;
duration of influence: ⩾ 3 s[1)];

Frequency: (900 ± 5) MHz, (1 890 ± 10) MHz;
Modulation: PM, pulse-duty factor 50 %, 200 Hz;
Field strength: 10 V/m; Polarization: horizontal / vertical;
Degree of influence: ⩾ 3 s.

The limiter shall meet the performance criteria A according to D.1.

D.9 Immunity against conducted disturbances induced by high frequency fields

Testing shall be carried out in accordance with EN 61000-4-6.

The disturbances defined hereafter are coupled capacitively on the power supply lines and the signal and control lines by means of a coupling network. Testing of the signal and control lines may be neglected, if the manufacturer explicitly specifies a permissible length of maximum 1 m for these lines.

Frequency range: 150 kHz to 80 MHz;
Voltage level (recommended): 10 V;
of the ISM/CB bands[2)]: 20 V;
Modulation: AM, 1 kHz, sine wave, degree of modulation 80 %;
Sweep rate: max. 1,5 × 10^{-3} decades/s;
or step size: ⩽ 1 %;
duration of influence: ⩾ 3 s[3)].

The limiter shall meet the performance criteria A according to D.1.

D.10 Immunity against power frequency magnetic fields

The tests described in this clause shall be carried out only where the limiter contains components which are sensitive to magnetic fields.

Testing shall be carried out in accordance with EN 61000-4-8.

Testing shall be carried out at frequencies which correspond to the supply frequency (usually 50 Hz and 60 Hz). Limiters intended solely for supply with one of these frequencies need only be tested at this frequency.

Frequency range: 50 Hz / 60 Hz;
Field strength of test: 30 A/m.

The limiter shall meet the performance criteria A according to D.1.

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1) If required, adapt the dwell time at each frequency such as being not lower than the time needed for the test item to carry out its operational function and to react accordingly. Critical frequencies – e.g. pulse frequencies – need to be separately analysed.

2) ISM/CB bands: 6,78 / 13,56 / 27,125 / 40,68 / 433,92 MHz.

3) If required, adapt the dwell time at each frequency such as being not lower than the time needed for the test item to carry out its operational function and to react accordingly. Critical frequencies – e.g. pulse frequencies – need to be separately analysed.

Annex ZA

(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 97/23/EC

Clause(s)/subclause(s) of this EN 12953-9	Essential Requirements (ESRs) of Directive 97/23/EC	Qualifying remarks/Notes
4.1, 4.2, 4.3, 4.4	2.11.1	Safety accessories — design Reliability
4.5	3.3 a	Marking
5	2.11.1	Water level limiter
6	2.11.1	Pressure limiter
7	2.11.1	Temperature limiter
8	2.11.1	Flow limiter

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

Bibliography

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

[2] Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits [Low-voltage equipment directive]; OJEC, L 77

[3] Council directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility [EMC]; OJEC, L 139

[4] EN 12953-1, *Shell boilers — Part 1: General*

[5] EN 12953-6:2002, *Shell boilers — Part 6: Requirements for equipment for the boiler*

[6] EN 13445 (all parts), *Unfired pressure vessels*

[7] EN 60617 (all parts), *Graphical symbols for diagrams*

[8] EN 61082 (all parts), *Preparation of documents used in electrotechnology*

[9] EN 61558-2-6:1997, *Safety of power transformers, power supply units and similar — Part 2-6: Particular requirements for safety isolating transformers for general use (IEC 61558-2-6:1997)*

[10] EN 61558-2-17:1997, *Safety of power transformers, power supply units and similar — Part 2-17: Particular requirements for transformers for switch mode power supplies (IEC 61558-2-17:1997)*

[11] EN 61140:2001, *Protection against electric shock — Common aspects for installation and equipment (IEC 61140:2001)*

[12] EN 60742:1995, *Isolating transformers and safety isolating transformers — Requirements (IEC 60742:1983 + A1:1992, modified)*

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