INTERNATIONAL STANDARD

ISO 16528-1

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Boilers and pressure vessels —

Part 1: Performance requirements

Chaudières et récipients sous pression —

Partie 1: Exigences de performance

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16528-1 was prepared by Technical Committee ISO/TC 11, *Boilers and pressure vessels*.

This first edition of ISO 16528-1, together with the first edition of ISO 16528-2, cancels and replaces ISO/TS 16528:2002, which has been technically revised.

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ISO 16528 consists of the following parts, under the general title *Boilers and pressure vessels*:

— *Part 1: Performance requirements*

— *Part 2: Procedures for fulfilling the requirements of ISO 16528-1*

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Introduction

This part of ISO 16528 specifies performance requirements for boilers and pressure vessels, to ensure the integrity of the pressure boundary.

An important safety requirement is the suitable provision of technical requirements taking into account the various modes of failure that can occur in boilers and pressure vessels. Guidance is given on these modes together with the criteria for satisfying these.

There are significant differences among countries in regulating the supply and operation of boilers and pressure vessels. These differences include compliance with specific standard(s) limiting source or specification of materials, use of specific inspection bodies and discriminatory certification systems or import licenses. However, these standards have a proven history of supporting public safety and good commercial operating experience.

This part of ISO 16528, which is performance-based, enables these standards to co-exist, providing an approach that can accommodate technical innovations, existing regulatory frameworks and market needs. Compliance with the requirements of this part of ISO 16528 does not relieve parties from obligations under local, national or international laws or regulations.

ISO 16528-2 provides a procedure to identify existing prescriptive standards that fulfil the requirements of this part of ISO 16528.

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Boilers and pressure vessels —

Part 1:
Performance requirements

1 Scope

This part of ISO 16528 defines the performance requirements for the construction of boilers and pressure vessels.

It is not the intent of this part of ISO 16528 to address operation, maintenance and in-service inspection of boilers and pressure vessels.

In relation to the geometry of the pressure-containing parts for pressure vessels, the scope of this part of ISO 16528 includes the following:

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a) welding end connection for the first circumferential joint for welded connections;

b) first threaded joint for screwed connections;

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c) face of the first flange for bolted, flanged connections;

d) first sealing surface for proprietary connections or fittings;

e) safety accessories, where necessary.

In relation to the geometry of pressure-containing parts for boilers, the scope of this part of ISO 16528 covers the following:

f) feedwater inlet (including the inlet valve) to steam outlet (including the outlet valve), including all inter-connecting tubing that can be exposed to a risk of overheating and cannot be isolated from the main system;

g) associated safety accessories;

h) connections to the boilers involved in services, such as draining, venting, desuperheating, etc.

This part of ISO 16528 does not apply for nuclear components, railway and marine boilers, gas cylinders or piping systems or mechanical equipment, e.g. turbine and machinery casings.

2 Terms and definitions

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

2.1
boiler
assembly intended for generation of steam or hot water above atmospheric pressure

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2.2
pressure vessel
housing designed and built to contain gases or liquids under pressure

2.3
certification
procedure by which a third party or manufacturer gives written assurance that a product, process or service conforms to specified requirements

NOTE Adapted from ISO/IEC 17000:2004.

2.4
conformity
fulfilment of specified requirements

2.5
construction
processes that include design, material specification, manufacture, inspection, examination, testing and conformity assessment of boilers and pressure vessels

2.6
contracting party
individual or organization procuring boilers and pressure vessels for a user or for resale

2.7
designer
organization or individual that performs design of boilers and pressure vessels in compliance with a standard

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2.8
examination
activity carried out by qualified personnel using qualified procedures to assess that given products, processes or services are in conformance with specified acceptance criteria

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2.9
inspection
activity to check that the results of required testing or examinations comply with specified requirements

2.10
manufacturer
individual or legal entity who is responsible for the construction of boilers and pressure vessels in accordance with

— specifications provided by the contracting party, and

— requirements of the standard applicable to boilers and pressure vessels under consideration

NOTE The manufacturer may entrust subcontractors with all or part of the operations or works (including design or assembly), after informing (if applicable) the third party inspection body. The manufacturer remains fully responsible for the operations or works subcontracted.

2.11
maximum allowable pressure
maximum pressure for which boilers and pressure vessels are designed

2.12
owner
individual or organization having legal title to boilers and pressure vessels

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2.13
qualification
proof of suitability of an individual, process, procedure or service to fulfil specified requirements

2.14
regulation
rules promulgated by a government authority in accordance with legal statutes or directives

2.15
safety accessory
devices designed to protect boilers and pressure vessels against the allowable limits being exceeded

NOTE Such devices include

— devices for direct pressure limitation, such as safety valves, bursting disc safety devices, buckling rods, controlled safety pressure relief systems;

— limiting devices, which either activate the means for correction or provide for shutdown or lockout, such as pressure switches or temperature switches or fluid level switches;

— safety related measurement, control and regulation devices.

2.16
standard
code
document established and approved by a standard issuing body that provides for common and repeated use, mandatory requirements, guidelines or characteristics for activities or their results

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NOTE The word “standard” used throughout this part of ISO 16528 shall be considered as the equivalent of “code” and vice versa.

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2.17
testing
activity carried out to determine, by specific procedures, that one or more characteristic of a product, process or service meet(s) one or more specified requirements

2.18
third-party inspection body
organization that performs inspections on boilers and pressure vessels as provided for by standards and is independent of the manufacturer, contracting party, owner or user

2.19
user
organization or individual using or operating boilers and pressure vessels

3 Units of measurements

Measurements shall be in SI Units. Product standards that are available only in other units may be used.

4 Classification of boilers and pressure vessels

Due to the broad application of boilers and pressure vessels, this part of ISO 16528 does not provide a use-based application scheme. This part of ISO 16528 addresses a minimum set of failure modes and technical requirements that aid users of this part of ISO 16528 in determining appropriate applications.

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5 Duties and responsibilities

5.1 General

It is essential that the duties, responsibilities and the interfaces between contracting parties, manufacturers and third-party inspection bodies are clearly established. The general duties and responsibilities are provided in 5.2 to 5.4.

5.2 Users and contracting parties

The user or the contracting party should establish the technical requirements for the boilers and pressure vessels, taking into consideration factors associated with all aspects of use. The following is a summary of the major design elements that shall be considered by the user in establishing these requirements:

a) construction standard;

b) installation site or application of boilers and pressure vessels built for stock;

c) vessel classification;

d) vessel configuration and controlling dimensions;

e) design conditions, e.g. loads and load cases and environmental requirements;

f) design life (fatigue, creep, corrosion);

g) materials of construction;

h) overpressure protection, e.g. safety accessories.

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NOTE Where the manufacturer is the only party involved in the construction of boilers or pressure vessels (e.g. built for stock, turnkey units, etc.), the manufacturer also has the responsibilities of the user.

5.3 Manufacturers

The manufacturer is responsible for assuring that boilers and pressure vessels comply with the user's requirements and with a standard fulfilling the requirements of this part of ISO 16528. Information documenting compliance with a standard fulfilling the requirements of this part of ISO 16528 and the user's requirements specification should be available in the manufacturer's documentation, including as a minimum the following:

a) detailed and general assembly drawings;

b) design calculations and analysis that establish the construction details;

c) documentation of design by experiment or testing, when employed;

d) documentation of material, fabrication, examination and testing processes and results, e.g. forming, welding, heat treatment and radiography, etc.;

e) documented statement signed by the manufacturer and, where appropriate, verified by a third-party inspection body, that the boilers and pressure vessels comply with the applicable standard;

f) any necessary operating or maintenance instructions.

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5.4 Third-party inspectors

It is the duty of inspectors to make all necessary inspections and verify that boilers and pressure vessels comply with all requirements of a standard fulfilling the requirements of this part of ISO 16528. The following is a summary of the major inspection categories:

a) confirming requirements for design, material, welding, heat treatment, examination and testing;

b) monitoring of the manufacturer's quality-control system when the manufacturer employs a quality system (see Clause 8);

c) verifying the maintenance of records.

The inspector may be either

— independent from the manufacturer's organization and reporting to a third-party organization,

— independent of production but within a manufacturer's approved quality-management system, or

— within an independent inspection division of the user.

6 Failure mode

6.1 General

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The design shall consider the following failure modes and specifically address those listed in 6.2. This requirement does not mandate detailed analysis of the failure modes listed in 6.2 if the design parameters for the boilers and pressure vessels do not require such an analysis, e.g. it is not necessary to analyse creep rupture for boilers and pressure vessels operating at essentially ambient temperatures. In such cases, the designer shall document the reason for not addressing one or more of the failure modes listed in 6.2.

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It is not the intent to describe in detail each potential failure mode. Annex A contains a brief description of some common failure modes for guidance.

6.2 Common failure modes

6.2.1 Classification

The possible ways in which boilers and pressure vessels can fail are classified into short-term, long-term and cyclic-type failures, or a combination of these.

6.2.2 Short term failure modes

Failure modes due to the application of non-cyclic loads that lead to immediate failure can be classified as follows:

— brittle fracture;

— ductile failures (crack formation, ductile tearing due to excessive local strains, gross plastic deformation and plastic instability (bursting);

— excessive deformations leading to leakage at joints or other loss of function;

— elastic or elastic-plastic instability (buckling).

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