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INTERNATIONAL STANDARD

ISO 5730

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Stationary shell boilers of welded construction (other than water-tube boilers)

Chaudières à tubes de fumée de construction soudée (autres que chaudières aquatubulaires)

Reference number
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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.

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.

International Standard ISO 5730 was prepared by Technical Committee ISO/TC 11, *Boilers and pressure vessels*, Sub-Committee SC 5, *Shell boilers*.

Annexes A, B, C, D, E, F, G, H and J of this International Standard are for information only.

Stationary shell boilers of welded construction (other than water-tube boilers)

Section 1: General

1.1 Scope

1.1.1 This International Standard specifies requirements for both directly fired boilers and waste-heat boilers with a gas-side pressure not exceeding 0,05 N/mm^2 (0,5 bar)[1], of cylindrical horizontal designs, constructed from carbon or carbon manganese steels by fusion welding and, in the case of directly fired boilers, a design pressure not exceeding 3 N/mm^2. The boilers covered by this International Standard are intended for land use for providing steam or high-pressure hot water. (Typical examples are shown in figures 1 to 5.) This International Standard does not apply to water-tube boilers, to boilers for railway locomotives, or to marine boilers.

1.1.2 This International Standard applies to the boiler proper, from the feed-water inlet connection to the steam outlet connection and to all other connections, including those required for valves and steam and water fittings. If welded ends are used, the requirements specified herein begin or end at the weld where flanges, if used, would have been fitted.

1.1.3 This International Standard applies to boilers having a capacity of greater than 0,025 m^3, a pressure greater than 0,1 N/mm^2 and a water temperature in excess of 120 °C.

1.1.4 Air preheaters, mechanical stokers, gas- or oil-burning equipment, forced- or induced-draught equipment or other accessories which may be required by the purchaser are not considered as parts of a boiler for the purposes of this International Standard. Superheaters and economizers either integral with or separate from the boiler shall be constructed to the requirements of the future International Standard for water-tube boilers.

1.1.5 This International Standard does not cover brickwork setting, insulation or furnace fittings.

1.1.6 This International Standard does not cover rules of construction since they cannot be written in sufficient detail to ensure good workmanship and construction. Each manufacturer is responsible for taking every necessary step to make sure that the quality of workmanship and construction is such as to ensure compliance with good engineering practice.

1.1.7 Informative references are given in annex J.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

1) 1 N/mm^2 = 1 MN/m^2 = 1 MPa

1 bar = 10^5 N/m^2 = 10^5 Pa

ISO 148:1983, *Steel — Charpy impact test (V-notch).*

ISO 1027:1983, *Radiographic image quality indicators for non-destructive testing — Principles and identification.*

ISO 1106-1:1984, *Recommended practice for radiographic examination of fusion welded joints — Part 1: Fusion welded butt joints in steel plates up to 50 mm thick.*

ISO 1106-2:1985, *Recommended practice for radiographic examination of fusion welded joints — Part 2: Fusion welded butt joints in steel plates thicker than 50 mm and up to and including 200 mm in thickness.*

ISO 1106-3:1984, *Recommended practice for radiographic examination of fusion welded joints — Part 3: Fusion welded circumferential joints in steel pipes of up to 50 mm wall thickness.*

ISO 2504:1973, *Radiography of welds and viewing conditions for films — Utilization of recommended patterns of image quality indicators (I.Q.I.).*

ISO 2604-1:1975, *Steel products for pressure purposes — Quality requirements — Part 1: Forgings.*

ISO 2604-2:1975, *Steel products for pressure purposes — Quality requirements — Part 2: Wrought seamless tubes.*

ISO 2604-3:1975, *Steel products for pressure purposes — Quality requirements — Part 3: Electric resistance and induction-welded tubes.*

ISO 2605-1:1976, *Steel products for pressure purposes — Derivation and verification of elevated temperature properties — Part 1: Yield or proof stress of carbon and low alloy steel products.*

ISO 2605-3:1985, *Steel products for pressure purposes — Derivation and verification of elevated temperature properties — Part 3: An alternative procedure for deriving the elevated temperature yield or proof stress properties when data are limited.*

ISO 4126-1:1991, *Safety valves — Part 1: General requirements.*

ISO 5579:1985, *Non-destructive testing — Radiographic examination of metallic materials by X- and gamma rays — Basic rules.*

ISO 5580:1985, *Non-destructive testing — Industrial radiographic illuminators — Minimum requirements.*

ISO 6947:1990, *Welds — Working positions — Definitions of angles of slope and rotation.*

ISO 9328-1:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 1: General requirements.*

ISO 9328-2:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties.*

ISO 10474:1991, *Steel and steel products — Inspection documents.*

1.3 Definitions

For the purposes of this International Standard, the following definitions apply. Throughout this International Standard additional definitions have been included as necessitated by the specific text concerned.

1.3.1 purchaser: Individual or organization who buys the completed boiler from the manufacturer.

1.3.2 designer: Individual or organization who assumes the sole responsibility for the design of the boiler. He/it determines the shape, dimensions and thickness of the boiler, selects the materials and details the methods of construction and testing.

1.3.3 manufacturer: Individual or organization who fabricates or assumes responsibility for the fabrication of the boiler or any component thereof.

1.3.4 material supplier: Individual or organization not being a material producer, who supplies material or prefabricated standardized parts to be used in the construction of the boiler or any component thereof.

1.3.5 producer of the supplied construction material; material producer: Individual or organization who produces materials for the fabrication of the boiler, components or prefabricated standardized parts.

1.3.6 regulating authority: Authority in the country of installation which is legally charged with the enforcement of that country's requirements of the law and regulations relating to boilers.

1.3.7 inspecting authority: That independent body or association, acting on behalf of

a) the purchaser or owner and/or

b) the regulating authority,

which performs the check that the design, materials and construction requirements comply with this International Standard.

1.3.8 inspector: Person employed and trained by an inspecting authority to carry out the functions of that inspecting authority as indicated in 1.3.7 (see also 6.1).

1.3.9 national standard: Specific standard which has proved to be satisfactory in use, which is acceptable to the regulating authority, which is a specification or rule prepared by a national standards body or similar authority, and which includes rules prescribed by government authorities and having the force of law.

1.4 Symbols

For the purposes of this International Standard, the general terminology and symbols indicated below shall apply. Throughout this International Standard, additional terminology and symbols have been included where necessary to meet the requirements of the specific text concerned. It should also be noted that in some clauses of section 3 (Design of the parts under pressure) the same additional symbol is used in different formulae to represent different terms. However, in all such cases, the special meaning of each symbol is indicated for each formula.

a	Dimensions indicated in figures 14, 16 to 18, 43 and 47.	mm
a_i	Inner major axis of compensating plate.	mm
a_o	Outer major axis of compensating plate.	mm
A	Effective radiant heating surface (see figures 1 to 5).	m^2
A_f	Cross-sectional area effective as compensation without consideration of allowances.	mm^2
A_{fb}	Cross-sectional area of branch effective as compensation.	mm^2
A_{fp}	Cross-sectional area of reinforcing pad effective as compensation.	mm^2
A_{fs}	Cross-sectional area of main body effective as compensation.	mm^2
A_p	Pressure-loaded area without consideration of allowances.	mm^2
A_{pb}	Pressure-loaded area relative to branch.	mm^2
A_{ps}	Pressure-loaded area relative to main body.	mm^2
b	Dimensions indicated in figures 14, 16 to 19, 34, 35, 43, 47 and B.1.	mm
b_1	Minor axis of manhole.	mm
b_i	Inner minor axis of compensating plate.	mm
b_o	Outer minor axis of compensating plate.	mm
B_1	Distance from end plate of shell to centre of saddle.	mm
B_2	Width of saddle top plate.	mm
c	Corrosion allowance.	mm
C	Shape factor (figure 7).	
C_1	Constant depending on method of support as given in 3.14.2.4.	
C_2	Effective length of nozzle as given in 3.10.2 and figure 10.	mm
C_3	Factor for the calculation of stress at saddle support.	
d	Diameter of tube hole.	mm
d_i	Internal diameter.	mm
d_{ib}	Internal diameter of branch.	mm
d_{ip}	Diameter of inner periphery of circular pad or compensating plate.	mm
d_{is}	Internal diameter of main body (cylindrical shell, spherical shell or dished head).	mm
d_g	Depth of welded-on girder stay.	mm
d_m	Mean diameter.	mm
d_o	Outside diameter.	mm
d_{ob}	Outside diameter of branch.	mm
d_{op}	Diameter of outer periphery of circular pad or compensating plate.	mm
d_{os}	Outside diameter of main body.	mm

d_s	Diameter of stay.	mm
D_b	Gasket mean diameter.	mm
D_L	Bolt circle diameter.	mm
e	Minimum wall thickness.	mm
e_{cb}	Calculated wall thickness of branch or standpipe.	mm
e_{cf}	Calculated wall thickness of furnace.	mm
e_{cp}	Calculated wall thickness of end plate.	mm
e_{cs}	Calculated wall thickness of main body (cylindrical or spherical shell or dished head).	mm
e_{ct}	Calculated wall thickness of tube.	mm
e_g	Thickness of gusset stay.	mm
e_{rb}	Actual wall thickness of branch or standpipe minus allowances for corrosion and minus tolerances.	mm
e_{rep}	Actual wall thickness of flat end plate.	mm
e_{rf}	Actual wall thickness of furnace.	mm
e_{rp}	Effective wall thickness of reinforcing pad.	mm
e_{rs}	Actual wall thickness of main body (cylindrical or spherical shell or dished head) minus allowances for corrosion and minus tolerances.	mm
e_t	Ordered tube thickness.	mm
E	Young's modulus of elasticity at design temperature.	N/mm^2
f	Nominal design stress.	N/mm^2
f_a	Existing mean stress.	N/mm^2
$f_{a\varphi}$	Existing mean stress between the centres of two openings.	N/mm^2
f_b	Allowable stress for the branch material.	N/mm^2
f_c	Combined stress at supports.	N/mm^2
f_p	Allowable stress for the reinforcing plate material.	N/mm^2
f_s	Allowable stress for the material of the main body.	N/mm^2
F	Calculation heat flux.	W/m^2
g, g_1	Clear height as shown in figure 13.	mm
G	Gas mass flow rate in first pass tubes.	$kg/(m^2 \cdot s)$
h	Minimum width of gusset stay.	mm
h_c	Depth of curvature of dished head.	mm
h_f	Height of manhole frame.	mm
h_s	Length of skirt of dished head.	mm
H	Net heat input (burner heat release rate based on the net calorific value of the fuel plus any preheat).	W
I_1	Second moment of area of one complete furnace corrugation about its neutral axis excluding corrosion allowance.	mm^4
I_2	Second moment of area of stiffeners.	mm^4
K	Thermal conductivity.	$(W \cdot mm)/(m^2 \cdot K)$
l_{rb}	Effective length of branch contributing to reinforcement.	mm
l_{rbi}	Effective length of inward projection of set-through branch contributing to reinforcement.	mm
l_{rp}	Effective width of reinforcing pad.	mm
l_{rs}	Effective length of main body contributing to reinforcement.	mm
L	Distance between two effective points of furnace support.	mm

L_1	Shortest distance from the edge of the access opening to the centre-line of the stay furthest away from the access opening, or, where there is no access opening, half the maximum distance between the centre-lines of the stays.	mm
L_2	Distance between the rear plate of the reversal chamber and the boiler back end plate.	mm
L_b	Length of boiler between end plates.	mm
L_i	Length of leg of fillet weld around inner periphery of pad or compensating plate.	mm
L_g	Length of welded-on girders.	mm
L_h	Heated length of furnace.	mm
L_o	Length of leg of fillet weld around outer periphery of pad or compensating plate.	mm
L_s	Length of shell between end plates.	mm
L_t	Mean pitch of adjacent tubes.	mm
p	Calculation pressure.	N/mm²
p_b	Centre-to-centre distance of adjacent openings, referred to wall centre, without allowances.	mm
$p_{b\varphi}$	Centre-to-centre distance of adjacent openings, offset by angle φ, referred to wall centre without allowances.	mm
p_c	Pitch of corrugations.	mm
p_t	Hydrostatic test pressure.	N/mm²
Q	Force on saddle.	N
r_{ik}	Inside radius of knuckle of dished head.	mm
r_{is}	Inside radius of curvature of dished head or spherical shell.	mm
r_{ms}	Mean radius of shell.	mm
r_{ok}	Outside radius of knuckle of dished head.	mm
r_{os}	Outside radius of curvature of dished head or spherical shell.	mm
R_m	Minimum tensile strength for the grade of material concerned at room temperature.	N/mm²
$R_{p0,2}$	Minimum value of yield point (0,2 % proof stress) for the grade of material concerned at temperature t.	N/mm²
S	Pitch of welded-on girders.	mm
S_1	Factor of safety.	
S_2	Factor of safety.	
S_o	Original cross-sectional area of test piece subjected to a tensile test.	mm²
t	Calculation temperature.	°C
t_m	Maximum metal temperature.	°C
t_s	Saturation temperature corresponding to design pressure.	°C
u	Out-of-roundness, or ovality.	%
v	Weld factor.	
w	Depth of corrugations.	mm
W	Force exerted by the pressure on the end plate in the zone assumed to be supported by the gusset.	N
x	Stress reduction factor.	
X_2	Cross-sectional area of longitudinal section of furnace wall of length equal to one pitch and thickness $e_{rf} - c$.	mm²
y	Factor determined from figure 18 using the ratio b/a.	
φ	Angle of connecting lines between the centres of two openings relative to the axis of the main body.	degree