

# DIN EN 12952-5:2022-02 (E)

## Water-tube boilers and auxiliary installations - Part 5: Workmanship and construction of pressure parts of the boiler

---

<b>Contents</b>		<b>Page</b>
European foreword .....		8
<b>1</b>	<b>Scope .....</b>	<b>10</b>
<b>2</b>	<b>Normative references .....</b>	<b>10</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>12</b>
<b>4</b>	<b>Symbols and abbreviations .....</b>	<b>12</b>
<b>5</b>	<b>General .....</b>	<b>12</b>
<b>6</b>	<b>Pressure part .....</b>	<b>13</b>
<b>6.1</b>	<b>Drums, headers and similar pressure parts .....</b>	<b>13</b>
<b>6.1.1</b>	<b>Principles for manufacturing .....</b>	<b>13</b>
<b>6.1.2</b>	<b>Manufacturing process for header ends .....</b>	<b>13</b>
<b>6.1.3</b>	<b>Material for header ends .....</b>	<b>13</b>
<b>6.2</b>	<b>Material identification .....</b>	<b>13</b>
<b>6.3</b>	<b>Material marking .....</b>	<b>13</b>
<b>6.3.1</b>	<b>General .....</b>	<b>13</b>
<b>6.3.2</b>	<b>Responsible personnel .....</b>	<b>13</b>
<b>6.3.3</b>	<b>Method of marking .....</b>	<b>14</b>
<b>6.3.4</b>	<b>Marking of non-pressure parts .....</b>	<b>14</b>
<b>6.3.5</b>	<b>Marking of bolts and nuts .....</b>	<b>14</b>
<b>6.4</b>	<b>Marking during manufacture .....</b>	<b>14</b>
<b>6.4.1</b>	<b>Temporary marking .....</b>	<b>14</b>
<b>6.4.2</b>	<b>Permanent marking .....</b>	<b>14</b>
<b>6.4.3</b>	<b>Tube bends .....</b>	<b>14</b>
<b>6.4.4</b>	<b>Location drawings .....</b>	<b>14</b>
<b>7</b>	<b>Cutting, forming and fabrication tolerances .....</b>	<b>15</b>
<b>7.1</b>	<b>Cutting material .....</b>	<b>15</b>
<b>7.1.1</b>	<b>Methods for cutting .....</b>	<b>15</b>
<b>7.1.2</b>	<b>Post-cutting measures .....</b>	<b>15</b>
<b>7.2</b>	<b>Forming of drums, headers and ends .....</b>	<b>15</b>
<b>7.2.1</b>	<b>General .....</b>	<b>15</b>
<b>7.2.2</b>	<b>Drum and header shells .....</b>	<b>15</b>
<b>7.2.3</b>	<b>Ends .....</b>	<b>16</b>
<b>7.2.4</b>	<b>Plates welded prior to hot or cold forming .....</b>	<b>16</b>
<b>7.2.5</b>	<b>Extruded openings in headers .....</b>	<b>16</b>
<b>7.3</b>	<b>Forming of tube bends .....</b>	<b>16</b>
<b>7.3.1</b>	<b>General .....</b>	<b>16</b>
<b>7.3.2</b>	<b>Tube bending procedure test .....</b>	<b>16</b>
<b>7.3.3</b>	<b>Requirements for dimensional testing .....</b>	<b>16</b>
<b>7.3.4</b>	<b>Thinning at the tube bend extrados for tubes of nominal outside diameter 142 mm and below .....</b>	<b>17</b>
<b>7.3.5</b>	<b>Thickening at the tube bend intrados for tubes of nominal outside diameter above 80 mm and including 142 mm .....</b>	<b>18</b>
<b>7.3.6</b>	<b>Thinning/thickening at the tube bend extrados/intrados for tubes of nominal outside diameter greater than 142 mm .....</b>	<b>18</b>
<b>7.3.7</b>	<b>Departure from circularity of the tube bends .....</b>	<b>18</b>

7.3.8	Post bend heat treatment of tube bends .....	19
7.3.9	Post-bend heat treatment requirements .....	20
7.3.10	Ripples on the intrados of tube bends .....	21
7.3.11	The surface of tube bends .....	23
7.3.12	Gang bending of tube panels .....	23
7.3.13	Bending of composite materials tubing .....	23
7.3.14	Manufacturing of tube reducers .....	23
7.4	Drum and header fabrication tolerances .....	24
7.4.1	Assembly tolerances for shells and fabricated from plate and end to shells .....	24
7.4.2	Finished tolerances for shells .....	25
7.4.3	Finished tolerances for ends .....	26
8	Welding .....	26
8.1	Design and other requirements specific to welding .....	26
8.1.1	General .....	26
8.1.2	Material selection with regard to welding .....	27
8.1.3	Indication of the welded seams in the drawings .....	27
8.1.4	Pre-requisites for welding .....	27
8.1.5	Oxy-acetylene welding .....	27
8.1.6	Butt welds in tube bends .....	27
8.1.7	Minimum distances between adjacent seams .....	27
8.1.8	Longitudinal butt welds in drum strakes .....	28
8.1.9	Offset of longitudinal butt welds in the case of several strakes .....	28
8.1.10	Joints of dissimilar materials .....	28
8.1.11	Protection from the weather .....	28
8.1.12	Availability of the welding procedure specification .....	28
8.2	Welding consumables .....	29
8.3	Welding procedure qualification .....	29
8.3.1	General .....	29
8.3.2	Application of EN ISO 15614-1:2017, Level 2 .....	29
8.4	Qualification of welders and welding operators .....	31
8.5	General production requirements for welding .....	32
8.5.1	Surface condition before welding .....	32
8.5.2	Assembly of components for welding .....	32
8.5.3	Temporary attachments .....	32
8.5.4	Stray arcing .....	32
8.5.5	Traceability of welders .....	32
8.6	Repairs to welds .....	33
8.6.1	General .....	33
8.6.2	Repair of longitudinal and circumferential butt welds of drums and headers requiring test plates .....	33
8.6.3	Non-destructive examination .....	33
8.6.4	Records of weld repairs .....	33
8.7	Pre-heating .....	33
8.8	Post-weld heat treatment .....	33
8.9	Welding subsequent to final post-weld heat treatment .....	34
8.10	Welded joints, connections and production test plates .....	35
8.10.1	Longitudinal and circumferential butt welds and test plates in drums and headers 35	
8.10.2	Welded header end closures .....	37
8.10.3	Welded branches, nozzles, stubs and other attachments on drums and headers .....	37
8.10.4	Pads, reinforcing plates and manhole frames .....	38
8.11	Attachment of non-pressure parts to drums and headers by welding .....	38
8.12	Welding of tubes .....	39
8.12.1	General .....	39
8.12.2	Continuity of welding .....	39
8.12.3	Completion of welding .....	39
8.12.4	Proximity of butt welds in straight tubes .....	39
8.12.5	Alignment of tube bores .....	39
8.12.6	Angular alignment of butt welded tubes .....	40

8.12.7	Fabricated bends .....	40
8.12.8	Backing rings .....	40
8.12.9	Purging of welds .....	40
8.12.10	Welding of branches, nozzles and stubs to tubes .....	40
8.12.11	Attachment by welding of non-pressure parts to tubes .....	41
8.13	Flash butt welding of tubes .....	41
8.14	Welded tube water walls .....	41
8.15	Arc stud welding .....	41
<b>9</b>	<b>Mechanical connections .....</b>	<b>41</b>
9.1	General .....	41
9.2	Access openings .....	41
9.2.1	Types .....	41
9.2.2	Size .....	42
9.2.3	Internal doors .....	42
9.2.4	External doors .....	42
9.3	Branches and nozzles mechanically connected to the main pressure parts .....	43
9.3.1	Scope and restrictions .....	43
9.3.2	Screwed connections .....	43
9.3.3	Studded connections .....	43
9.4	Tube connections .....	43
9.4.1	Expanded connections .....	43
9.4.2	Tube to tube mechanical connections .....	46
9.4.3	Connection of non-pressure parts to pressure parts .....	46
<b>10</b>	<b>Thermal treatment .....</b>	<b>46</b>
10.1	General .....	46
10.2	Heating cycles and heat treatment(s) associated with plate forming operations .....	46
10.2.1	Heating cycles associated with hot forming .....	46
10.2.2	Heat treatment associated with forming .....	47
10.2.3	Shells and strakes .....	47
10.2.4	Ends .....	47
10.2.5	Production test requirements for formed components .....	48
10.3	Pre-heating for welding and thermal cutting .....	48
10.3.1	General .....	48
10.3.2	Pre-heating for welding .....	48
10.3.3	Pre-heating for thermal cutting .....	49
10.3.4	Measurement of pre-heat .....	49
10.4	Post weld heat treatment .....	50
10.4.1	General .....	50
10.4.2	Methods of post weld heat treatment .....	55
10.4.3	Post-weld heat treatment procedures .....	58
10.5	Heat treatment of production test plates .....	59
<b>Annex A (normative)</b>	<b>Tube bending procedure tests .....</b>	<b>60</b>
<b>A.1</b>	<b>General .....</b>	<b>60</b>
<b>A.2</b>	<b>Hot or cold formed bends in tubes with outside diameter 142 mm .....</b>	<b>60</b>
A.2.1	Types of bending processes .....	60
A.2.2	Post bending heat treatment (PBHT) .....	61
A.2.3	Validity range of tests .....	61
A.2.4	Qualification test requirements .....	62
A.2.4.1	General .....	62
A.2.4.2	Ripples on intrados of the bend .....	62
A.2.4.3	Surface defects .....	62
A.2.4.4	Bend geometry .....	63
A.2.4.5	Hardness test .....	63
A.2.4.6	Mechanical tests .....	63
A.2.4.7	Gang bending of tube panels .....	63
<b>A.3</b>	<b>Cold formed bends in tubes with outside diameter &gt; 142 mm .....</b>	<b>63</b>
A.3.1	Types of bending processes .....	63
A.3.2	Post bending heat treatment .....	63

A.3.3	The validity range of the test .....	64
A.3.4	Qualification test requirements .....	64
A.3.4.1	General .....	64
A.3.4.2	Ripples on intrados of the bend .....	64
A.3.4.3	Surface imperfections .....	64
A.3.4.4	Bend geometry .....	64
A.3.4.5	Hardness test .....	64
A.3.4.6	Mechanical testing .....	65
A.4	Hot formed bends in tubes with outside diameter > 142 mm .....	65
A.4.1	Types of bending processes .....	65
A.4.2	Post bending heat treatment .....	65
A.4.3	The validity range of the test .....	65
A.4.4	Qualification test requirements .....	65
A.4.4.1	General .....	65
A.4.4.2	Ripples on intrados of the bend .....	66
A.4.4.3	Surface imperfections .....	66
A.4.4.4	Bend geometry .....	66
A.4.4.5	Mechanical testing .....	66
A.4.4.5.1	General .....	66
A.4.4.5.2	Metallographic examination .....	66
A.4.4.5.3	Definitive and comparative tests .....	66
A.4.4.5.4	Tensile test in accordance with EN ISO 6892-1:2019 .....	67
<b>Annex B (informative) Welded pressure connections and non-pressure containing attachments .....</b>		<b>69</b>
<b>Annex C (normative) Manufacture of welded tubewalls .....</b>		<b>70</b>
C.1	General .....	70
C.2	Methods of manufacture .....	70
C.2.1	General .....	70
C.2.2	Tubes finned by welding .....	70
C.2.3	Integrally finned tubes .....	70
C.2.4	Other methods .....	70
C.3	Allowable materials .....	70
C.3.1	Tubes .....	70
C.3.2	Fins .....	70
C.3.3	Filler materials .....	71
C.4	Manufacturing processes and controls .....	71
C.4.1	Welding process .....	71
C.4.2	Specific requirements for manufacturers .....	71
C.4.2.1	Surface cleanliness .....	71
C.4.2.2	Fin to tube attachment welds .....	71
C.4.2.3	Welding imperfections in fin to tube welds .....	72
C.4.2.4	Site welding .....	72
C.4.3	Heat treatment .....	72
C.4.3.1	Pre-heating .....	72
C.4.3.2	Post-weld heat treatment .....	72
C.5	Welding procedure approvals .....	72
C.6	Production tests .....	72
C.7	Non-destructive examination (NDE) .....	73
<b>Annex D (normative) Coiled boilers and coiled superheaters .....</b>		<b>77</b>
D.1	General .....	77
D.2	Special requirements .....	77
<b>Annex E (normative) Special requirements for chemical recovery boilers .....</b>		<b>78</b>
E.1	General .....	78
E.2	Special requirements for forming of composite tube bends .....	78
E.2.1	General .....	78
E.2.2	Application of forming rules to composite tubing .....	78

E.2.2.1	Range of tube bending procedure test approval .....	78
E.2.2.2	Additional tests required for composite tubes .....	78
E.2.2.2.1	Ultrasonic testing of a composite tube bend concerning the metallurgical bonding .....	78
E.2.2.2.2	Hardness test .....	78
E.3	Special requirements for manufacture of welded tubewalls from composite tubes .....	78
E.3.1	General .....	78
E.3.2	Fins .....	79
E.3.3	Fin-to-tube attachment welds on composite tubes .....	79
E.4	Material marking .....	79
E.5	Flash butt welding .....	79
E.6	Special requirements of qualification of welding procedures for fusion welding .....	79
E.6.1	General .....	79
E.6.2	Application of EN ISO 15614-1:2017, Level 2 to composite tubes .....	79
E.6.2.1	Range of qualification .....	79
E.6.2.2	Additional tests required .....	79
E.6.2.2.1	Depth of penetration of clad weld .....	79
E.6.2.2.2	Hardness test .....	80
E.6.2.2.3	Bend test .....	80
E.6.2.2.4	Transverse tensile test .....	80
E.6.2.2.5	Microscopic examination .....	80
E.7	Special requirements for welder's qualification for fusion welding of composite tubes .....	80
E.7.1	General .....	80
E.7.2	Application of EN ISO 9606-1:2017 to composite tubes .....	80
E.7.2.1	Range of qualification .....	80
E.7.2.2	Additional tests required - Macroscopic examination .....	81
<b>Annex F (informative) Guidelines for the determination of the competency of boiler manufacturers</b> .....		<b>82</b>
F.1	General .....	82
F.2	Responsibility of the purchaser .....	82
F.3	Responsibility of the manufacturer .....	82
F.4	Requirements concerning the manufacturer's competency .....	82
F.5	Manufacturer's competency declaration .....	83
<b>Annex G (informative) Significant technical changes between this document and the previous edition</b> .....		<b>94</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU aimed to be covered</b> .....		<b>95</b>
<b>Bibliography</b> .....		<b>96</b>