



**SLOVENSKI STANDARD**  
**oSIST prEN 14917:2020**  
**01-april-2020**

---

**Kompenzatorji s kovinskimi mehovi v tlačnih cevovodih**

Metal bellows expansion joints for pressure applications

Kompensatoren mit metallischen Bälgen für Druckanwendungen

Compensateurs de dilatation à soufflets métalliques pour appareils à pression

**Ta slovenski standard je istoveten z: prEN 14917**

[oSIST prEN 14917:2020](https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020)

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

**ICS:**

23.040.99	Drugi sestavni deli za cevovode	Other pipeline components
-----------	---------------------------------	---------------------------

**oSIST prEN 14917:2020**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[oSIST prEN 14917:2020](#)

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**DRAFT**  
**prEN 14917**

February 2020

ICS 23.040.99

Will supersede EN 14917:2009+A1:2012

English Version

## Metal bellows expansion joints for pressure applications

Compensateurs de dilatation à soufflets métalliques  
pour appareils à pression

Kompensatoren mit metallischen Bälgen für  
Druckanwendungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 342.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

**Warning** : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

<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>13</b>
<b>4</b> <b>Classification</b> .....	<b>15</b>
<b>4.1</b> <b>Classification of expansion joints</b> .....	<b>15</b>
<b>4.1.1</b> <b>General</b> .....	<b>15</b>
<b>4.1.2</b> <b>Axial</b> .....	<b>15</b>
<b>4.1.3</b> <b>Angular</b> .....	<b>16</b>
<b>4.1.4</b> <b>Lateral</b> .....	<b>16</b>
<b>4.1.5</b> <b>Universal</b> .....	<b>16</b>
<b>4.1.6</b> <b>Pressure balanced designs (axial or universal)</b> .....	<b>16</b>
<b>4.2</b> <b>Classification of the parts of expansion joints</b> .....	<b>19</b>
<b>4.2.1</b> <b>Main pressure-bearing parts (A)</b> .....	<b>19</b>
<b>4.2.2</b> <b>Pressure parts other than main pressure-bearing parts (B)</b> .....	<b>19</b>
<b>4.2.3</b> <b>Attachments to main pressure-bearing parts and to pressure parts (C)</b> .....	<b>19</b>
<b>4.2.4</b> <b>Other parts (D)</b> .....	<b>19</b>
<b>5</b> <b>Materials</b> .....	<b>21</b>
<b>5.1</b> <b>General</b> .....	<b>21</b>
<b>5.1.1</b> <b>Materials for pressure-bearing parts</b> .....	<b>21</b>
<b>5.1.2</b> <b>Materials for parts attached to pressure-bearing parts</b> .....	<b>21</b>
<b>5.1.3</b> <b>Materials for non-pressure parts</b> .....	<b>21</b>
<b>5.1.4</b> <b>Documentation</b> .....	<b>21</b>
<b>5.2</b> <b>Pressure-bearing parts</b> .....	<b>21</b>
<b>5.2.1</b> <b>Bellows</b> .....	<b>21</b>
<b>5.2.2</b> <b>Other pressure-bearing parts</b> .....	<b>22</b>
<b>5.2.3</b> <b>Ductility</b> .....	<b>22</b>
<b>5.2.4</b> <b>Brittle fracture</b> .....	<b>22</b>
<b>5.3</b> <b>Material documentation</b> .....	<b>26</b>
<b>6</b> <b>Design</b> .....	<b>27</b>
<b>6.1</b> <b>General</b> .....	<b>27</b>
<b>6.1.1</b> <b>Symbols</b> .....	<b>27</b>
<b>6.1.2</b> <b>Basic design criteria</b> .....	<b>33</b>
<b>6.1.3</b> <b>Allowable stresses</b> .....	<b>34</b>
<b>6.1.4</b> <b>Additional loadings</b> .....	<b>36</b>
<b>6.2</b> <b>Bellows design</b> .....	<b>37</b>
<b>6.2.1</b> <b>Purpose</b> .....	<b>37</b>
<b>6.2.2</b> <b>Conditions of applicability</b> .....	<b>37</b>
<b>6.2.3</b> <b>Design of U-shaped unreinforced bellows</b> .....	<b>55</b>
<b>6.2.4</b> <b>Design of U-shaped reinforced bellows</b> .....	<b>70</b>
<b>6.2.5</b> <b>Design of toroidal bellows</b> .....	<b>73</b>
<b>6.2.6</b> <b>Fatigue</b> .....	<b>80</b>
<b>6.2.7</b> <b>Bellows under the influence of movements</b> .....	<b>84</b>
<b>6.2.8</b> <b>Equivalent axial displacement per corrugation</b> .....	<b>89</b>
<b>6.2.9</b> <b>Forces and moments on pressurized expansion joints</b> .....	<b>94</b>
<b>6.2.10</b> <b>Torsion acting on bellows (unreinforced or reinforced)</b> .....	<b>105</b>

6.3	Internal sleeve .....	106
6.3.1	Scope .....	106
6.3.2	Additional symbols .....	106
6.3.3	Flow velocity.....	107
6.3.4	Design conditions .....	109
6.4	Hardware.....	110
6.4.1	General .....	110
6.4.2	Design parameters .....	110
6.4.3	Hardware parts .....	112
6.4.4	Permanent joints .....	113
7	Manufacturing.....	116
7.1	General .....	116
7.2	Materials .....	116
7.2.1	General .....	116
7.2.2	Material traceability .....	116
7.3	Permanent joints .....	116
7.3.1	General .....	116
7.3.2	Process and personal .....	116
7.3.3	Repair and rework during manufacturing.....	117
7.4	Forming of the bellows .....	117
7.4.1	Forming processes .....	117
7.4.2	Heat treatment .....	119
7.5	Tolerances.....	119
7.5.1	General .....	119
7.5.2	Bellows .....	119
7.5.3	Expansion joint.....	120
7.6	Production tests .....	121
8	Testing, inspection and documentation .....	121
8.1	General .....	121
8.2	Abbreviations.....	121
8.3	Documents .....	122
8.4	In-process inspection and testing.....	122
8.4.1	General .....	122
8.4.2	Materials .....	122
8.4.3	Permanent joints .....	123
8.4.4	Non-destructive testing of welds .....	124
8.5	NDT methods.....	131
8.5.1	Quality level.....	131
8.5.2	Acceptance levels and testing techniques .....	131
8.5.3	Non-destructive testing Personnel qualifications and approval.....	131
8.5.4	Non-destructive testing documentation .....	132
8.6	Final assessment and documentation.....	134
8.6.1	General .....	134
8.6.2	Final inspection.....	134
8.7	Documentation .....	137
8.7.1	Final documentation package .....	137
8.7.2	Declaration/certification.....	137
8.7.3	Operating instructions.....	137
9	Marking and labelling .....	137
10	Handling and installation .....	138
10.1	General instructions.....	138

iTech STANDARD PREVIEW  
(standards.iteh.ai)

oSIST prEN 14917:2020  
<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pr-en-14917-2020>

## prEN 14917:2020 (E)

10.2	Packaging and storage.....	138
10.3	Installation .....	138
10.4	Unrestrained expansion joints.....	139
10.5	Restrained expansions joints.....	139
Annex A (informative) Categories of expansion joints .....		140
A.1	General.....	140
A.2	Determination of expansion joints categories .....	140
A.3	Fluid groups .....	140
A.3.1	General.....	140
A.3.2	Group 1.....	140
A.3.3	Group 2.....	141
A.4	Technical requirements.....	141
A.4.1	Expansion joints for vessels .....	141
A.4.2	Expansion joints for piping.....	141
A.4.3	Sound engineering practice (SEP).....	142
Expansion joint category .....		142
Annex B (normative) Specification for materials 1.4828, 1.4876, 2.4360 and 2.4858.....		144
Annex C (informative) Incorporation of expansion joints into piping or pressure vessels .....		151
C.1	Introduction .....	151
C.2	Specific symbols and definitions .....	151
C.3	Application criteria for expansion joints in piping.....	153
C.3.1	General.....	153
C.3.2	Use of axial expansion joints.....	153
C.3.3	Use of restraint expansion joints.....	159
C.3.4	Use of universal expansion joints.....	165
C.3.5	Indeterminate configurations of expansion joints .....	167
C.4	Application criteria for expansion joints in pressure vessels .....	170
C.4.1	General.....	170
C.4.2	Axial expansion joint installed in the shell.....	170
C.4.3	Axial expansion joint installed at the floating head .....	171
Annex D (informative) Calculation methods for systems of pipes containing expansion joints..		172
D.1	General.....	172
D.1.1	Preliminary remarks .....	172
D.1.2	Determining movement values.....	172
D.1.3	Thermal expansion.....	172
D.2	Approximate calculation of bellows movement .....	174
D.2.1	General.....	174

D.2.2	Hinged systems.....	175
D.2.3	Definitions.....	175
D.3	Exact calculation of bellows movement .....	179
D.3.1	Two hinges in a plane system (Z-system) .....	179
D.3.2	Two gimbals in a three-dimensional system (Z-system) .....	180
D.3.3	Three hinges in a plane system (U-system) .....	181
D.3.4	Three hinges in a plane system (L-system).....	182
D.3.5	Three hinges in a three-dimensional system (Z-system).....	184
D.4	Calculation of forces and moments .....	186
Annex E	(informative) Explanatory notes on the design of expansion bellows.....	188
E.1	General .....	188
E.2	Calculation design .....	188
E.3	Types of bellows.....	189
E.3.1	Corrugation shape .....	189
E.3.2	Number of plies .....	189
E.4	Fatigue life expectancy .....	189
E.5	Instability .....	190
E.5.1	General .....	190
E.5.2	Column instability .....	190
E.5.3	In-plane instability .....	190
E.5.4	Buckling .....	190
E.6	Bellows spring rate .....	191
Annex F	(informative) Procedure for setting-up a design fatigue curve .....	193
F.1	General .....	193
F.2	Procedure for setting up a design fatigue curve for expansion bellows.....	193
F.2.1	General .....	193
F.2.2	Number of tests .....	193
F.2.3	Extrapolation range .....	193
F.2.4	Manufacturing methods .....	193
F.2.5	Bellows material .....	194
F.3	Tests .....	194
F.3.1	Movement.....	194
F.3.2	Test pressure.....	194
F.3.3	Other test conditions.....	194
F.3.4	Fatigue test equipment.....	195
F.4	Evaluation of the test results.....	196

ITeH STANDARD PREVIEW  
(standards.iteh.ai)

oSIST prEN 14917:2020

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

## prEN 14917:2020 (E)

F.5	Linear regression .....	201
Annex G (informative)	Polynomial approximations for coefficients $C_p$ , $C_f$ , $C_d$ .....	202
G.1	Coefficient $C_p$ .....	202
G.2	Coefficient $C_f$ .....	203
G.3	Coefficient $C_d$ .....	204
G.4	Linear interpolation.....	205
Annex H (informative)	Required design data and information.....	206
H.1	Required design conditions.....	206
H.2	Additional information .....	206
Annex I (informative)	Expansion joints risk analyses .....	207
Annex J (informative)	Additional material properties.....	208
Annex K (normative)	Hardware calculation .....	212
K.1	General.....	212
K.2	Additional symbols.....	212
K.3	Force due to pressure.....	215
K.4	Tie bar .....	215
K.4.1	General.....	215
K.4.2	Tie bar in tension .....	215
K.4.3	Tie bar in compression .....	216
K.5	Pin.....	217
K.6	Lug with bore .....	219
K.6.1	General.....	219
K.6.2	Forces due to pressure.....	219
K.6.3	Stresses due to reaction force.....	220
K.7	Gimbal, square and round.....	222
K.7.1	General.....	222
K.7.2	Stresses in bored section.....	222
K.7.3	Square type gimbal.....	223
K.7.4	Round type gimbal.....	226
K.8	Attachment plate .....	227
K.8.1	Attachment plate (closed/open) with 2 restraining parts.....	227
K.8.2	Circular attachment plate with 3 or more tie bars valid up to DN 800.....	234
K.9	Lug-plate connection (hinge/gimbal).....	237
K.9.1	General.....	237
K.9.2	Lug-plate for form-lock connection.....	238
K.9.3	Lug-plate for welded buttonhole connection.....	241

iTech STANDARD PREVIEW  
(standards.itech.ai)

oSIST prEN 14917:2020

<https://standards.itech.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>



<b>K.10 Tie bar and lug attachment on flanges.....</b>	<b>242</b>
<b>K.10.1 Integral flange.....</b>	<b>242</b>
<b>K.10.2 Plate welded on flange.....</b>	<b>246</b>
<b>K.11 Gusset.....</b>	<b>249</b>
<b>K.12 Gusset with reinforcing rings.....</b>	<b>249</b>
<b>K.12.1 General.....</b>	<b>249</b>
<b>K.12.2 Basic definitions.....</b>	<b>251</b>
<b>K.12.3 Stresses in the gussets.....</b>	<b>252</b>
<b>K.12.4 Stresses in the ring and pipe.....</b>	<b>252</b>
<b>K.12.5 Stresses in welds <math>a_7</math>, <math>a_8</math> and <math>a_9</math>.....</b>	<b>253</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU.....</b>	<b>255</b>
<b>Bibliography.....</b>	<b>257</b>

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN 14917:2020](https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020)

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

**prEN 14917:2020 (E)**

**European foreword**

This document (prEN 14917:2020) has been prepared by Technical Committee CEN/TC 342 “Metal hoses, hose assemblies, bellows and expansion joints”, the secretariat of which is held by SNV.

This document is currently submitted to the CEN Enquiry.

This document supersedes EN 14917:2009+A1:2012.

This document has been prepared under a standardization request 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.

**iTeh STANDARD PREVIEW  
(standards.iteh.ai)**

[oSIST prEN 14917:2020](https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020)

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

## Introduction

Metal bellows expansion joints are used as components in piping or as parts of pressure vessels.

If an expansion joint is designed and manufactured according to this document, the risk analysis is already undertaken, see Annex I.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN 14917:2020](https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020)

<https://standards.iteh.ai/catalog/standards/sist/0a9ed34d-5e56-46f4-9448-4818c726ede2/osist-pren-14917-2020>

**prEN 14917:2020 (E)****1 Scope**

This document specifies the requirements for design, manufacture and installation of metal bellows expansion joints with circular cross section for pressure applications, i.e. maximum allowable pressure greater than 0,5 bar.

**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 764-4:2014, *Pressure equipment — Part 4: Establishment of technical delivery conditions for metallic materials*

EN 764-5:2014, *Pressure equipment — Part 5: Inspection documentation of metallic materials and compliance with the material specification*

EN 1092-1:2018, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 10028-1:2017, *Flat products made of steels for pressure purposes — Part 1: General requirements*

EN 10028-2:2017, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2017, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4:2017, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10028-7:2016, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10216-1:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties*

EN 10216-2:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Electric welded and submerged arc welded alloy fine grain steel tubes*

EN 10216-4:2013, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties*

EN 10217-1:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties*

EN 10217-2:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Electric welded and submerged arc welded alloy fine grain steel tubes with specified room, elevated and low temperature properties*

EN 10217-4:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Electric welded non-alloy steel tubes with specified low temperature properties*

EN 10217-5:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-6:2019, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties*

EN 10222-2:2017, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperatures properties*

EN 10222-3:2017, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties*

EN 10222-4:2017, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10253-2:2007, *Butt-welding pipe fittings — Part 2: Non alloy and ferritic alloy steels with specific inspection requirements*

EN 10269:2013, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 10272:2016, *Stainless steel bars for pressure purposes*

EN 10273:2016, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties*

EN 13184:2001, *Non-destructive testing — Leak testing — Pressure change method*

EN 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2014, *Unfired pressure vessels — Part 3: Design*

EN 13480-2:2017, *Metallic industrial piping — Part 2: Materials*

EN 13480-2:2017/A1:2018, *Metallic industrial piping — Part 2: Materials*

EN 13480-2:2017/A2:2018, *Metallic industrial piping — Part 2: Materials*

EN 13480-2:2017/A3:2018, *Metallic industrial piping — Part 2: Materials*

EN 13480-3:2017, *Metallic industrial piping — Part 3: Design and calculation*

EN ISO 148-1:2016, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2016)*

**prEN 14917:2020 (E)**

EN ISO 643:2012, *Steels — Micrographic determination of the apparent grain size (ISO 643:2012)*

EN ISO 3651-2:1998, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid (ISO 3651-2:1998)*

EN ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2014)*

EN ISO 6506-1:2014, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2014)*

EN ISO 6520-1:2007, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding (ISO 6520-1:2007)*

EN ISO 6892-1:2016, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2016)*

EN ISO 6892-2:2018, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature (ISO 6892-2:2018)*

EN ISO 9445-1:2010, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths (ISO 9445-1:2009)*

EN ISO 9445-2:2010, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet (ISO 9445-2:2009)*

EN ISO 9606-4:1999, *Approval testing of welders — Fusion welding — Part 4: Nickel and nickel alloys (ISO 9606-4:1999)*

EN ISO 9712:2012, *Non-destructive testing — Qualification and Certification of NDT personnel (ISO 9712:2012)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15610:2019, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables (ISO 15610:2003)*

EN ISO 15613:2004, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613:2004)*

EN ISO 15614-1:2017, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2017, Corrected version 2017-10-01)*

EN ISO 17635:2016, *Non-destructive testing of welds — General rules for metallic materials (ISO 17635:2016)*

EN ISO 17636-1:2013, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film (ISO 17636-1:2013)*

EN ISO 17637:2016, *Non-destructive testing of welds — Visual testing of fusion-welded joints (ISO 17637:2016)*

EN ISO 17638:2016, *Non-destructive testing of welds — Magnetic particle testing (ISO 17638:2016)*

EN ISO 17640:2018, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment (ISO 17640:2018)*

EN ISO 20485:2018, *Non-destructive testing — Leak testing — Tracer gas method (ISO 20485:2017)*

EN ISO 23277:2015, *Non-destructive testing of welds — Penetrant testing — Acceptance levels (ISO 23277:2015)*

EN ISO 23278:2015, *Non-destructive testing of welds — Magnetic particle testing — Acceptance levels (ISO 23278:2015)*

EN ISO 23279:2017, *Non-destructive testing of welds — Ultrasonic testing — Characterization of discontinuities in welds (ISO 23279:2017)*

### 3 Terms and definitions

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

#### 3.1

##### **expansion joint**

metal equipment consisting of one or more bellows used to absorb movements such as caused by thermal or mechanical effects in piping or pressure vessels

Note 1 to entry: See also Clause 4 Classification.

#### 3.2

##### **bellows**

flexible element consisting of one or more corrugations and the end tangents

#### 3.3

##### **corrugation (convolution)**

flexible unit of a bellows with a leakproof wall consisting of one or more plies

#### 3.4

##### **ply**

element of the bellows' wall usually made from sheet or strip material

#### 3.5

##### **end tangent**

straight un-corrugated portion at the ends of a bellows

#### 3.6

##### **reinforcing collar**

reinforcing sleeve or ring attached to the end tangent for reinforcement

#### 3.7

##### **assisting collar**

ring placed around the end tangents to facilitate welding