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Metal bellows expansion joints for pressure applications

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Metal bellows expansion joints for pressure applications

Compensateurs de dilatation à soufflets métalliques pour tuyauteurs et appareils a pression

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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (prEN 14917:2004) has been prepared by Technical Committee CEN/TC TC 342, "Metal hoses, hose assemblies, bellows and expansion joints", the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

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.

Metal bellows expansion joints for pressure applications designed and constructed in accordance with this standard satisfy the essential requirements of the Pressure Equipment Directive (97/23/EC) [1].

1 Scope

This *draft* European Standard describes the requirements for metal bellows expansion joints for pressure applications, i.e. maximum allowable pressure greater than 0,5 bar.

Metal bellows expansion joints are used as components in piping or as parts of pressure vessels. They shall be assessed according to the conformity assessment procedure for the equipment into which they are incorporated. The hazard analyses and the identification of the category have to be made by the piping or pressure vessel manufacturer.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 287, *Approval testing of welders — Fusion welding of steel.*

EN 288-2, *Specification and approval of welding procedures for metallic materials — Part 2: welding procedure specification for arc welding.*

EN 288-3, *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for the arc welding of steels.*

EN 288-5, *Specification and approval of welding procedures for metallic materials — Part 5: Approval by using approved welding consumables for arc welding.*

EN 473, *Non destructive testing — Qualification and certification of NDT personnel — General principles.*

EN 571-1, *Non destructive testing — Penetrant testing — Part 1: General principles.*

EN 970, *Non-destructive examination of fusion welds — Visual examination.*

EN 1289, *Non-destructive examination of welds — Penetrant testing of welds — Acceptance levels.*

EN 1290, *Non-destructive examination of welds — Magnetic particle examination of welds.*

EN 1291, *Non-destructive examination of welds — Magnetic particle testing of welds — Acceptance levels.*

EN 1418, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

EN 1435, *Non-destructive examination of welds — Radiographic examination of welded joints.*

EN 1593, *Non-destructive testing — Leak testing — Bubble emission techniques.*

EN 1712, *Non destructive examination of welds — Ultrasonic examination of welded joints — Acceptance levels.*

EN 1713, *Non-destructive examination of welds — Ultrasonic examination — Characterization of indications in welds.*

EN 1714, *Non destructive examination of welds — Ultrasonic examination of welded joints.*

EN 1779, *Non-destructive testing — Leak testing — Criteria for method and technique selection.*

EN 9606, *Nickel welding.*

prEN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels.*

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

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

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

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

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method.*

EN 10095, *Heat resisting steels and nickel alloys.*

EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties / Note: To be amended by EN 10216-1/prA1 (2003-07).*

EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties / Note: To be amended by EN 10216-2/prA1 (2003-07).*

EN 10216-3, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes / Note: To be amended by EN 10216-3/prA1 (2003-07).*

EN 10216-4, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties / Note: To be amended by EN 10216-4/prA1 (2003-07).*

EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties.*

EN 10217-2, *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, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes.*

EN 10217-4, *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, *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, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.*

EN 10204, *Metallic products — types of inspection documents.*

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

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

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

prEN 10253-2, *Butt welding pipe fittings — Part 2: Wrought carbon and ferritic alloy steel with specific inspection requirements.*

EN 10258, *Cold-rolled stainless steel and narrow strips in cut lengths — Tolerances on dimension and shape.*

EN 10259, *Cold-rolled stainless steel wide strips and plate/sheet — Tolerances on dimension, shape and mass.*

EN 12517, *Non-destructive examination of welds — Radiographic examination of welded joints — Acceptance levels.*

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

EN 13185, *Non-destructive testing — Leak testing — Tracer gas method.*

EN 13445-2:2002, *Unfired pressure vessels — Part 2: Materials.*

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

EN 13480-2:2002, *Metallic industrial piping — Part 2: Materials.*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation.*

EN 13480-4, *Metallic industrial piping — Part 4: Fabrication and installation.*

EN 25817, *Arc-welded joints in steel; guidance on quality levels for imperfections (ISO 5817:1992).*

EN ISO 6520-1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding (ISO 6520-1:1998).*

ISO 6208, *Nickel and nickel alloy plate, sheet and strip.*

ISO 15348:2002, *Pipework — Metal bellows expansion joints — General.*

CR ISO 15608:2000, *Welding — Guidelines for a metallic material grouping system.*

97/23/EC, *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.*

3 Terms and definitions

For the purposes of this European Standard, the basic definitions given in ISO 15348 shall apply. Additional terms and definitions are as follows.

3.1
classification
expansion joints are classified according to the type of movement which they are capable of absorbing. Details are given in clause 4

3.2
maximum allowable pressure, PS
maximum pressure for which the equipment is designed, as specified by the equipment manufacturer

3.3
maximum allowable temperature, TS
maximum temperature for which the equipment is designed, as specified by the equipment manufacturer

3.4
nominal pressure PN
PN is a dimensionless alphanumeric designation commonly used for reference purposes for piping components and stock parts. For this standard PN represents the maximum allowable pressure at 20 °C.

3.5
squirm
column or in-plane instability of the bellows under the effect of internal pressure

3.6
category
hazard grouping according to the Pressure Equipment Directive (97/23/EC), see Annex A

3.7
equipment manufacturer
person responsible for the values of the parameters PS and TS. This may be the manufacturer or planner of the piping or the pressure vessel for which the expansion joint is designed or the expansion joint manufacturer himself if he is free to set these values

4 Classification

4.1 Classification of expansion joints

There are four types of expansion joints which are designed according to the type of movements absorbed, see tables 4.1.

4.1.1 Axial

Absorbs mainly axial movement. When non-pressure balanced, it does not restrain pressure thrust. When pressure balanced, it restrains thrust. It can be internally or externally pressurized.

4.1.2 Angular

Absorbs angular movement. When fitted with hinges, it allows movement in a single plane. When fitted with gimbal rings, it allows movement in any plane. It restrains pressure thrust.

4.1.3 Lateral

Absorbs lateral movement. An angular movement is also permissible when fitted with two spherical tie bars, the movement being perpendicular to the plane containing the tie bars, or with double hinge or with double gimbal. It restrains pressure thrust.

4.1.4 Universal

4.1.4.1 Non-pressure balanced

Absorbs several movements. It does not restrain pressure thrust.

4.1.4.2 Pressure balanced

A pressure balanced expansion joint is one designed to accommodate axial and lateral movements and to counteract the bellows pressure thrust. An additional bellows is incorporated into the unit and is subject to the line pressure to generate a force equal and opposite to that on the main bellows. Tying these bellows neutralises the pressure load on the unit. These joints are often installed at changes of direction in piping but in-line designs are available.

Table 4.1 — Types of expansion joints

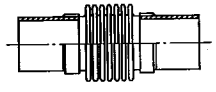
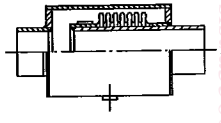
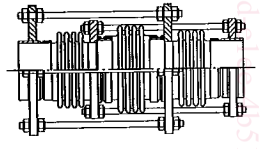
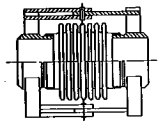
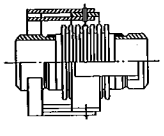
Type	Design		Pressure trust restraint	Movement				
				Axial	Angular		Lateral	
					Single plane	Multi-plane	Single plane	Multi-plane
Axial	Unrestrained Internally pressurized		No	X	(X)	(X)	(X)	(X)
	Unrestrained externally pressurized		No	X	(X)	(X)	(X)	(X)
	In-line pressure balanced			X				
Angular	Hinge		Yes		X			
	Gimbal		Yes		X	X		

Table 4.1 (*continued*)

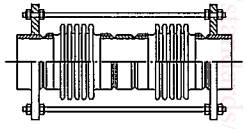
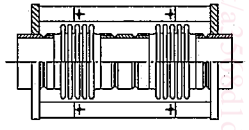
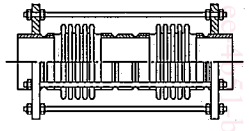
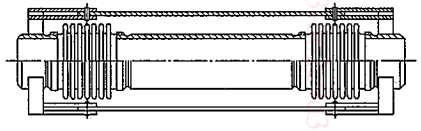
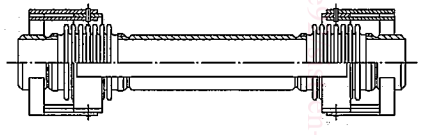
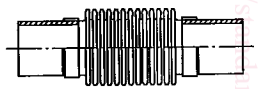
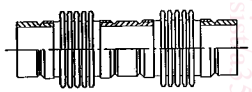
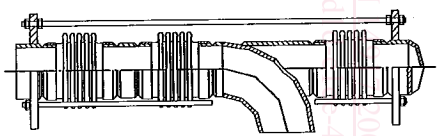
Type	Design		Pressure trust restraint	Movement				
				Axial	Angular		Lateral	
					Single plane	Multi-plane	Single plane	Multi-plane
Lateral	Two tie-bars spherical		Yes		X		X	X
	Two tie-bars Pinned(plane)		Yes				X	
	Three or more tie-bars		Yes				X	X
	Double hinge		Yes		X		X	
	Double gimbal		Yes		X	X	X	X

Table 4.1 (*continued*)

Type	Design		Pressure trust restraint	Movement				
				Axial	Angular		Lateral	
					Single plane	Multi-plane	Single plane	Multi-plane
Universal	Unrestrained One or two bellows		No	X	X	X	X	X
								
	Pressure balanced		Yes	X	X With two tie-bars only		X	X

NOTE 1 X — Applicable

NOTE 2 (X) — Limited use

4.2 Classification of the parts of expansion joints

4.2.1 Main pressure bearing parts (A)

Parts and assemblies that envelope the medium under pressure and which according to their design and their stress level are essential for the pressure-bearing integrity of the equipment, i.e. its failure may result in a sudden discharge of pressure energy, see figure 4.2.

4.2.2 Pressure parts other than main pressure-bearing parts (B)

Parts that are charged by the pressure indirectly and have no direct contact to the medium and parts that are in contact with the medium but that according to their design are not essential for the pressure-bearing integrity of the equipment, see figure 4.2.

4.2.3 Attachments to main pressure-bearing parts and to pressure parts (C)

Parts that are directly welded to A or B parts.

4.2.4 Other parts (D)

Parts that are not A, B or C parts.