DIN EN 14917:2026-11 (E)

Metal bellows expansion joints for pressure applications

Contents

Page

European foreword ... 6

1 Scope ... 9

2 Normative references ... 9

3 Terms and definitions ... 13

4 Classification ... 16
4.1 Classification of expansion joints ... 16
4.1.1 General ... 16
4.1.2 Axial ... 16
4.1.3 Angular ... 16
4.1.4 Lateral ... 16
4.1.5 Universal ... 16
4.1.6 Pressure balanced designs (axial or universal) ... 16
4.2 Classification of the parts of expansion joints ... 19
4.2.1 Main pressure-bearing parts (A) ... 19
4.2.2 Pressure parts other than main pressure-bearing parts (B) ... 19
4.2.3 Attachments to main pressure-bearing parts and to pressure parts (C) ... 19
4.2.4 Other parts (D) ... 19

5 Materials ... 21
5.1 General ... 21
5.1.1 Materials for pressure-bearing parts ... 21
5.1.2 Materials for parts attached to pressure-bearing parts ... 21
5.1.3 Materials for non-pressure parts ... 21
5.2 Pressure-bearing parts ... 21
5.2.1 Bellows ... 21
5.2.2 Other pressure-bearing parts ... 21
5.2.3 Ductility ... 22
5.2.4 Brittle fracture ... 22
5.3 Material documentation ... 26

6 Design ... 27
6.1 General ... 27
6.1.1 Symbols ... 27
6.1.2 Basic design criteria ... 33
6.1.3 Allowable stresses ... 34
6.1.4 Additional loadings ... 36
6.2 Bellows design ... 37
6.2.1 Purpose ... 37
6.2.2 Conditions of applicability ... 37
6.2.3 Design of U-shaped unreinforced bellows ... 55
6.2.4 Design of U-shaped reinforced bellows ... 71
6.2.5 Design of toroidal bellows ... 75
6.2.6 Fatigue ... 82
6.2.7 Bellows under the influence of movements ... 87
6.2.8 Equivalent axial displacement per corrugation ... 92
6.2.9 Forces and moments on pressurized expansion joints ... 97

6.2.10 Torsion acting on bellows (unreinforced or reinforced) 108
6.3 Internal sleeve 109
6.3.1 Scope 109
6.3.2 Additional symbols 110
6.3.3 Flow velocity 110
6.3.4 Design conditions 112
6.4 Hardware 113
6.4.1 General 113
6.4.2 Design parameters 113
6.4.3 Hardware parts 115
6.4.4 Permanent joints 116

7 Manufacturing 118
7.1 General 118
7.2 Materials 118
7.2.1 General 118
7.2.2 Material traceability 119
7.3 Permanent joints 119
7.3.1 General 119
7.3.2 Process and personal 119
7.3.3 Repair and rework during manufacturing 120
7.4 Forming of the bellows 120
7.4.1 Forming processes 120
7.4.2 Heat treatment 121
7.5 Tolerances 122
7.5.1 General 122
7.5.2 Bellows 122
7.5.3 Expansion joint 123
7.6 Production tests 124

8 Testing, inspection and documentation 124
8.1 General 124
8.2 Abbreviations 124
8.3 Documents 124
8.4 In-process inspection and testing 125
8.4.1 General 125
8.4.2 Materials 125
8.4.3 Permanent joints 125
8.4.4 Non-destructive testing of welds 127
8.5 NDT methods 134
8.5.1 Quality level 134
8.5.2 Acceptance levels and testing techniques 134
8.5.3 Non-destructive testing Personnel qualifications and approval 135
8.5.4 Non-destructive testing documentation 135
8.6 Final assessment and documentation 137
8.6.1 General 137
8.6.2 Final inspection 138
8.7 Documentation 140
8.7.1 Final documentation package 140
8.7.2 Declaration/certification 140
8.7.3 Operating instructions 141

9 Marking and labelling 141

10 Handling and installation 141
10.1 General instructions 141
10.2 Packaging and storage 142
10.3 Installation 142
10.4 Unrestrained expansion joints 142

10.5 Restrained expansions joints **142**

Annex A (informative) **Categories of expansion joints** **143**
A.1 General **143**
A.2 Determination of expansion joints categories **143**
A.3 Fluid groups **143**
A.4 Technical requirements **144**
A.5 Expansion joint category **145**

Annex B (informative) **Specification for materials 1.4828, 1.4876, 2.4360 and 2.4858** **147**

Annex C (informative) **Incorporation of expansion joints into piping or pressure vessels** **154**
C.1 General **154**
C.2 Specific symbols and definitions **155**
C.3 Application criteria for expansion joints in piping **156**
C.4 Application criteria for expansion joints in pressure vessels **173**

Annex D (informative) **Calculation methods for systems of pipes containing expansion joints** **175**
D.1 General **175**
D.2 Approximate calculation of bellows movement **177**
D.3 Exact calculation of bellows movement **182**
D.4 Calculation of forces and moments **190**

Annex E (informative) **Explanatory notes on the design of expansion bellows** **191**
E.1 General **191**
E.2 Calculation design **191**
E.3 Types of bellows **192**
E.4 Fatigue life expectancy **192**
E.5 Instability **193**
E.6 Bellows spring rate **194**

Annex F (informative) **Procedure for setting-up a design fatigue curve** **196**
F.1 General **196**
F.2 Procedure for setting up a design fatigue curve for expansion bellows **196**
F.3 Tests **197**
F.4 Evaluation of the test results **199**
F.5 Linear regression **204**

Annex G (informative) **Polynomial approximations for coefficients C_p, C_f, C_d** **205**
G.1 Coefficient C_p **205**
G.2 Coefficient C_f **206**
G.3 Coefficient C_d **207**
G.4 Linear interpolation **208**

Annex H (informative) **Required design data and information** **210**
H.1 Required design conditions **210**
H.2 Additional information **210**

Annex I (informative) **Expansion joints risk analyses** **211**

Annex J (informative) **Additional material properties** **212**

Annex K (normative) **Hardware calculation** **216**
K.1 General **216**
K.2 Additional symbols **216**
K.3 Force due to pressure **220**
K.4 Tie bar **220**
K.5 Pin **222**

K.6 Lug with bore **224**
K.7 Gimbal, square and round **227**
K.8 Attachment plate **232**
K.9 Lug-plate connection (hinge/gimbal) **243**
K.10 Tie bar and lug attachment on flanges **248**
K.11 Gusset **255**
K.12 Gusset with reinforcing rings **255**

Annex L (informative) **Benchmarks for calculation** **261**

Annex ZA (informative) A1 **Relationship between this European Standard and the Essential Requirements of EU Directive 2014/68/EU** **275**

Bibliography **277**