

DIN EN 15129:2010-06 (E)

Anti-seismic devices

Contents

	Page
Foreword	6
1 Scope	7
2 Normative references	7
3 Terms, definitions, symbols and abbreviations	8
3.1 Terms and definitions	8
3.2 Symbols	14
3.2.1 Latin upper case letters	14
3.2.2 Latin lower case letters	14
3.2.3 Greek letters	14
3.2.4 Subscripts	14
3.3 Abbreviations	15
3.4 List of devices	16
4 General design rules	18
4.1 Performance requirements and compliance criteria	18
4.1.1 Fundamental requirements	18
4.1.2 Increased reliability of structural system	18
4.1.3 Functional requirements	19
4.1.4 Structural and mechanical requirements	19
4.1.5 Compliance criteria	19
4.2 Action effects on devices	20
4.2.1 Seismic design situations and seismic combinations of actions	20
4.2.2 Effects of actions	20
4.3 Conceptual design of the devices	20
4.3.1 Reliability of the devices' behaviour	20
4.3.2 Capacity design	20
4.3.3 Maintenance	20
4.3.4 Modification and replacement of devices	21
4.3.5 Device documentation	21
4.4 General properties	21
4.4.1 Material properties	21
4.4.2 Device properties to be used in the analysis	21
4.4.3 Re-centring capability	22
4.5 Constitutive laws	23
4.6 Validation of anti-seismic devices	23
5 Rigid connection devices	24
5.1 Permanent Connection Devices	24
5.2 Fuse Restraints	24
5.2.1 Performance requirements	24
5.2.2 Material properties	24
5.2.3 Design requirements	25
5.2.4 Type Testing	25
5.2.5 Factory production control tests	26
5.3 Temporary (dynamic) connection devices	26
5.3.1 Functional requirements	26
5.3.2 Material properties	27
5.3.3 Design Requirements	27
5.3.4 Type Testing	28

5.3.5	Factory Production Control Tests	30
6	Displacement Dependent Devices	30
6.1	General	30
6.2	Performance Requirements	31
6.3	Materials	33
6.3.1	General	33
6.3.2	Elastomer	33
6.3.3	Steel	34
6.3.4	Other materials (special steel, stainless steel, SMA, visco-elastic polymeric materials)	34
6.4	Testing	34
6.4.1	General	34
6.4.2	Type tests of materials	34
6.4.3	Factory production control tests of materials	36
6.4.4	Type tests of devices	37
6.4.5	Factory production control testing of devices	38
7	Velocity Dependent Devices	38
7.1	Functional requirements	38
7.2	Material properties	38
7.2.1	General	38
7.2.2	Materials	39
7.2.3	Active Surfaces	39
7.2.4	Viscous Fluid	39
7.3	Design requirements	39
7.3.1	General	39
7.3.2	Over velocity	40
7.3.3	Buckling	40
7.4	Testing	41
7.4.1	General	41
7.4.2	Type Testing	41
7.4.3	Factory production control	44
8	Isolators	44
8.1	General Requirements	44
8.2	Elastomeric Isolators	46
8.2.1	Requirements	46
8.2.2	Materials	52
8.2.3	Design	59
8.2.4	Testing	63
8.2.5	Manufacturing Tolerances	72
8.2.6	Marking and Labelling	72
8.3	Curved Surface Sliders	73
8.3.1	Requirements	73
8.3.2	Materials	77
8.3.3	Design	78
8.3.4	Testing	80
8.3.5	Manufacturing, Assembly and Tolerances	87
8.4	Flat Surface Sliders	88
8.4.1	Requirements	88
8.4.2	Materials	88
8.4.3	Design	88
8.4.4	Testing	88
8.4.5	Manufacturing, Assembly and Tolerances	88
9	Combinations of Devices	89
9.1	Requirements	89
9.1.1	General	89
9.1.2	Particular requirements	89
9.2	Materials	89
9.3	Design	89
9.4	Testing	90

9.4.1	General	90
9.4.2	Type Testing	90
9.4.3	Factory Production Control testing	90
10	Evaluation of conformity	90
10.1	General	90
10.2	Type testing	91
10.2.1	Initial Type Testing	91
10.2.2	Further type-testing	95
10.3	Factory Production Control (FPC)	96
10.3.1	General	96
10.3.2	Raw materials and constituents	98
10.3.3	Equipment	101
10.3.4	Sampling	101
11	Installation	101
12	In-service inspection	102
12.1	General requirements	102
12.2	Regular inspection	102
12.3	Principal inspection	102
Annex A (informative) Commentary to Clause 1: Scope		103
Annex B (informative) Commentary to Clause 4: General design rules		104
B.1	Service life of a device	104
B.2	Basic requirements	104
B.3	Reliability differentiation	104
B.4	Increased reliability	104
B.5	Requirements at the ULS	105
B.6	Requirements at the SLS	105
B.7	Structural analysis	105
B.8	Material properties	105
B.9	Re-centring capability	106
Annex C (informative) Commentary to Clause 5: Rigid connection devices		107
C.1	Functional requirements	107
C.2	Material properties	107
C.3	Design Requirements	108
C.4	Testing	108
C.4.1	General	108
C.4.2	Low velocity test	109
C.4.3	Seal Wear Test	110
C.4.4	Impulsive Load Test	110
C.4.5	Overload Test	111
C.4.6	Cyclic Load Test	111
Annex D (informative) Commentary to Clause 6: Displacement Dependent Devices		112
D.1	Categories of Non Linear Devices (NLD)	112
D.2	Examples of linear devices -- Elastomeric shear-strained devices	114
D.3	Examples of non linear devices	114
D.3.1	Buffer	114
D.3.2	Steel hysteretic energy dissipating devices	114
D.3.3	Buckling Restrained Braces	114
D.3.4	SMA Re-centring Devices	115
Annex E (informative) Commentary to Clause 7: Velocity Dependent Devices		116
E.1	Functional requirements	116

E.2	Design Requirements	118
E.3	Testing	120
E.3.1	General	120
E.3.2	Low velocity test for Fluid Viscous Dampers	120
E.3.3	Low velocity test for Fluid Spring Dampers	121
E.3.4	Constitutive law test for Fluid Viscous Dampers	122
E.3.5	Constitutive law test for Fluid Spring Dampers	122
E.3.6	Damping efficiency test	123
Annex F (informative) Commentary to Clause 8: Isolators		125
F.1	Ageing conditions for elastomeric isolators	125
F.2	Low temperature crystallisation	125
F.3	Commentary on Basis of design	126
F.3.1	Shape Factor	126
F.3.2	Design shear strain due to compression by vertical loads	127
F.3.3	Isolator stiffnesses	127
F.4	Determination of the restoring stiffness by tests for curved and flat surface sliders	128
Annex G (normative) Equipment for combined compression and shear		130
G.1	General requirements	130
G.2	Data Acquisition	130
G.3	Combined compression and shear equipment	130
G.4	Load Platens	131
G.5	Data analysis	131
Annex H (informative) Design of Connections for Devices		133
H.1	Elastomeric Isolators	133
H.2	Sliders	133
Annex I (informative) Method for calculating pressure distributions on spherical surfaces		135
I.1	General	135
I.2	Modelling assumptions	135
I.3	Effects of vertical loads	135
I.4	Effects of horizontal loads	137
I.5	Combined loads	137
Annex J (informative) -FACTORS FOR COMMON ISOLATOR TYPES		139
J.1	max- values for elastomeric isolators	139
J.2	max- values for sliding isolator units	140
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive		142
Z.A.1	Scope and relevant characteristics	142
Z.A.2	Procedure(s) for attestation of conformity of anti-seismic devices	149
Z.A.2.1	System(s) of attestation of conformity	149
Z.A.2.2	EC Certificate and Declaration of conformity	151
Z.A.3	CE marking and labelling	153
Z.A.3.1	Declaration of product properties	154
Z.A.3.2	Declaration of compliance with given design specification	155
Bibliography		159