

DIN EN 1090-2:2008-12 (E)

Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures

Contents		Page
Foreword		9
Introduction		10
1	Scope	11
2	Normative references	12
2.1	General	12
2.2	Constituent products	12
2.2.1	Steels	12
2.2.2	Steel castings	14
2.2.3	Welding consumables	14
2.2.4	Mechanical fasteners	15
2.2.5	High strength cables	16
2.2.6	Structural bearings	17
2.3	Preparation	17
2.4	Welding	18
2.5	Testing	19
2.6	Erection	19
2.7	Corrosion protection	20
2.8	Tolerances	20
2.9	Miscellaneous	20
3	Terms and definitions	21
4	Specifications and documentation	23
4.1	Execution Specification	23
4.1.1	General	23
4.1.2	Execution classes	23
4.1.3	Preparation grades	24
4.1.4	Geometrical tolerances	24
4.2	Constructor's documentation	24
4.2.1	Quality documentation	24
4.2.2	Quality plan	24
4.2.3	Safety of the erection works	25
4.2.4	Execution documentation	25
5	Constituent products	25
5.1	General	25
5.2	Identification, inspection documents and traceability	25
5.3	Structural steel products	26
5.3.1	General	26
5.3.2	Thickness tolerances	28
5.3.3	Surface conditions	28
5.3.4	Special properties	29
5.4	Steel castings	29
5.5	Welding consumables	29
5.6	Mechanical fasteners	31
5.6.1	General	31
5.6.2	Terminology	31
5.6.3	Structural bolting assemblies for non preloaded applications	31

5.6.4	Structural bolting assemblies for preloading	31
5.6.5	Direct tension indicators	32
5.6.6	Weather resistant assemblies	32
5.6.7	Foundation bolts	32
5.6.8	Locking devices	32
5.6.9	Taper washers	32
5.6.10	Hot rivets	32
5.6.11	Fasteners for thin gauge components	33
5.6.12	Special fasteners	33
5.6.13	Delivery and identification	33
5.7	Studs and shear connectors	33
5.8	Grouting materials	34
5.9	Expansion joints for bridges	34
5.10	High strength cables, rods and terminations	34
5.11	Structural bearings	34
6	Preparation and assembly	34
6.1	General	34
6.2	Identification	35
6.3	Handling and storage	35
6.4	Cutting	37
6.4.1	General	37
6.4.2	Shearing and nibbling	37
6.4.3	Thermal cutting	37
6.4.4	Hardness of free edge surfaces	38
6.5	Shaping	38
6.5.1	General	38
6.5.2	Hot forming	39
6.5.3	Flame straightening	39
6.5.4	Cold forming	39
6.6	Holing	41
6.6.1	Dimensions of holes	41
6.6.2	Tolerances on hole diameter for bolts and pins	42
6.6.3	Execution of holing	42
6.7	Cut outs	43
6.8	Full contact bearing surfaces	44
6.9	Assembly	44
6.10	Assembly check	45
7	Welding	45
7.1	General	45
7.2	Welding plan	45
7.2.1	Requirements for a welding plan	45
7.2.2	Content of a welding plan	45
7.3	Welding processes	46
7.4	Qualification of welding procedures and welding personnel	47
7.4.1	Qualification of welding procedures	47
7.4.2	Welders and welding operators	49
7.4.3	Welding coordination	49
7.5	Preparation and execution of welding	51
7.5.1	Joint preparation	51
7.5.2	Storage and handling of welding consumables	52
7.5.3	Weather protection	52
7.5.4	Assembly for welding	53
7.5.5	Preheating	53
7.5.6	Temporary attachments	53
7.5.7	Tack welds	53
7.5.8	Fillet welds	54
7.5.9	Butt welds	54
7.5.10	Welds on steels with improved atmospheric corrosion resistance	55
7.5.11	Branch connections	55
7.5.12	Stud welding	55

7.5.13	Slot and plug welds	55
7.5.14	Spot welds for thin gauge components	56
7.5.15	Other weld types	56
7.5.16	Post-weld heat treatment	56
7.5.17	Execution of welding	56
7.5.18	Welding of bridge decks	57
7.6	Acceptance criteria	57
7.7	Welding of stainless steels	58
7.7.1	Amendments to EN 1011-1 requirements	58
7.7.2	Amendments to EN 1011-3 requirements	59
7.7.3	Welding dissimilar steels	60
8	Mechanical fastening	60
8.1	General	60
8.2	Use of bolting assemblies	60
8.2.1	General	60
8.2.2	Bolts	61
8.2.3	Nuts	61
8.2.4	Washers	61
8.3	Tightening of non-preloaded bolts	62
8.4	Preparation of contact surfaces in slip resistant connections	62
8.5	Tightening of preloaded bolts	63
8.5.1	General	63
8.5.2	Torque reference values	65
8.5.3	Torque method	65
8.5.4	Combined method	65
8.5.5	HRC method	66
8.5.6	Direct tension indicator method	66
8.6	Fit bolts	67
8.7	Hot riveting	67
8.7.1	Rivets	67
8.7.2	Installation of rivets	67
8.7.3	Acceptance criteria	68
8.8	Fastening of thin gauge components	68
8.8.1	General	68
8.8.2	Use of self-tapping and self-drilling screws	69
8.8.3	Use of blind rivets	69
8.8.4	Fastening sidelaps	70
8.9	Use of special fasteners and fastening methods	70
8.10	Galling and seizure of stainless steels	70
9	Erection	71
9.1	General	71
9.2	Site conditions	71
9.3	Erection method	72
9.3.1	Design basis for the erection method	72
9.3.2	Constructor's erection method	72
9.4	Survey	73
9.4.1	Reference system	73
9.4.2	Position points	74
9.5	Supports, anchors and bearings	74
9.5.1	Inspection of supports	74
9.5.2	Setting out and suitability of supports	74
9.5.3	Maintaining suitability of supports	74
9.5.4	Temporary supports	74
9.5.5	Grouting and sealing	75
9.5.6	Anchoring	76
9.6	Erection and work at site	76
9.6.1	Erection drawings	76
9.6.2	Marking	77
9.6.3	Handling and storage on site	77
9.6.4	Trial erection	77

9.6.5	Erection methods	78
10	Surface treatment	79
10.1	General	79
10.2	Preparation of steel substrates	80
10.3	Weather resistant steels	81
10.4	Galvanic coupling	81
10.5	Galvanizing	81
10.6	Sealing of spaces	82
10.7	Surfaces in contact with concrete	82
10.8	Inaccessible surfaces	82
10.9	Repairs after cutting or welding	82
10.10	Cleaning after erection	83
10.10.1	Cleaning of thin gauge components	83
10.10.2	Cleaning of stainless steels components	83
11	Geometrical tolerances	83
11.1	Tolerance types	83
11.2	Essential tolerances	84
11.2.1	General	84
11.2.2	Manufacturing tolerances	84
11.2.3	Erection tolerances	84
11.3	Functional tolerances	86
11.3.1	General	86
11.3.2	Tabulated values	86
11.3.3	Alternative criteria	86
12	Inspection, testing and correction	87
12.1	General	87
12.2	Constituent products and components	87
12.2.1	Constituent products	87
12.2.2	Components	87
12.2.3	Non conforming products	87
12.3	Manufacturing: geometrical dimensions of manufactured components	88
12.4	Welding	88
12.4.1	Inspection before and during welding	88
12.4.2	Inspection after welding	89
12.4.3	Inspection and testing of welded shear studs for composite steel and concrete structures	92
12.4.4	Production tests on welding	92
12.5	Mechanical fastening	93
12.5.1	Inspection of non-preloaded bolted connections	93
12.5.2	Inspection and testing of preloaded bolted connections	93
12.5.3	Inspection, testing and repairs of hot rivets	96
12.5.4	Inspection of cold formed components and sheeting fastening	96
12.5.5	Special fasteners and fastening methods	97
12.6	Surface treatment and corrosion protection	97
12.7	Erection	98
12.7.1	Inspection of trial erection	98
12.7.2	Inspection of the erected structure	98
12.7.3	Survey of geometrical position of connection nodes	98
12.7.4	Other acceptance tests	99
Annex A (normative)	Additional information, list of options and requirements related to the execution classes	100
A.1	List of required additional information	100
A.2	List of options	103
A.3	Requirements related to the execution classes	107
Annex B (informative)	Guidance for the determination of execution classes	111

B.1	Introduction	111
B.2	Governing factors for choice of execution class	111
B.2.1	Consequence classes	111
B.2.2	Hazards connected with execution and use of the structure	111
B.3	Determination of execution classes	112
Annex C (informative) Check-list for the content of a quality plan		114
C.1	Introduction	114
C.2	Content	114
C.2.1	Management	114
C.2.2	Specification review	114
C.2.3	Documentation	114
C.2.4	Inspection and testing procedures	115
Annex D (normative) Geometrical tolerances		116
D.1	Essential tolerances	116
D.1.1	Essential manufacturing tolerances - Welded profiles	117
D.1.2	Essential manufacturing tolerances - Press braked cold formed profiles	118
D.1.3	D.1.4 Essential manufacturing tolerances - Flanges of welded box sections	120
D.1.5	Essential manufacturing tolerances - Web stiffeners of profiles or box sections	121
D.1.6	Essential manufacturing tolerances - Stiffened plating	123
D.1.7	Essential manufacturing tolerances - Cold formed profiled sheets	124
D.1.8	Essential manufacturing tolerances - Fastener holes, notches and cut edges	125
D.1.9	Essential manufacturing tolerances - Cylindrical and conical shells	126
D.1.10	Essential manufacturing tolerances - Lattice components	127
D.1.11	Essential erection tolerances - Single storey columns	128
D.1.12	Essential erection tolerances - Multi-storey columns	129
D.1.13	Essential erection tolerances - Full contact end bearing	130
D.1.14	Essential erection tolerances - Towers and masts	130
D.1.15	Essential erection tolerances - Beams subject to bending and components subject to compression	131
D.2	Functional tolerances	132
D.2.1	Functional manufacturing tolerances - Welded profiles	133
D.2.2	Functional manufacturing tolerances - Press braked cold formed profiles	134
D.2.3	Functional manufacturing tolerances - Flanges of welded profiles	136
D.2.4	Functional manufacturing tolerances - Welded box sections	137
D.2.5	Functional manufacturing tolerances - Webs of welded profiles or box sections	138
D.2.6	Functional manufacturing tolerances - Web stiffeners of welded profiles or box sections	139
D.2.7	Functional manufacturing tolerances - Components	141
D.2.8	Functional manufacturing tolerances - Fastener holes, notches and cut edges	142
D.2.9	Functional manufacturing tolerances - Column splices and baseplates	143
D.2.10	Functional manufacturing tolerances - Lattice components	144
D.2.11	Functional manufacturing tolerances - Stiffened plating	145
D.2.12	Functional manufacturing tolerances - Towers and masts	147
D.2.13	Functional manufacturing tolerances - Cold formed profiled sheets	148
D.2.14	Functional manufacturing tolerances - Bridge decks	148
D.2.15	Functional erection tolerances - Bridges	150
D.2.16	Functional erection tolerances - Bridge decks (sheet 1/3)	151
D.2.17	Functional erection tolerances - Bridge decks(sheet 2/3)	152
D.2.18	Functional erection tolerances - Bridges decks (sheet 3/3)	154
D.2.19	Functional manufacturing and erection tolerances - Crane beams and rails	155
D.2.20	Functional tolerances - Concrete foundations and supports	156
D.2.21	Functional erection tolerances - Crane runways	158
D.2.22	Functional erection tolerances - Positions of columns	159
D.2.23	Functional erection tolerances - Single storey columns	160
D.2.24	Functional erection tolerances - Multi-storey columns	161
D.2.25	Functional erection tolerances - Buildings	162
D.2.26	Functional erection tolerances - Beams in buildings	163
D.2.27	Functional erection tolerances - Roof sheeting designed as a stressed-skin	164
D.2.28	Functional erection tolerances - Profiled steel sheeting	164

Annex E (informative) Welded joints in hollow sections	165
E.1 General	165
Essential manufacturing tolerances - Flanges of welded profiles	119
E.2 Guidance for start and stop positions	165
E.3 Preparation of joint faces	165
E.4 Assembly for welding	166
E.5 Fillet welded joints	173
Annex F (normative) Corrosion protection	174
F.1 General	174
F.1.1 Field of application	174
F.1.2 Performance specification	174
F.1.3 Prescriptive requirements	174
F.1.4 Work method	175
F.2 Surface preparation of carbon steels	175
F.2.1 Surface preparation of carbon steels prior to painting and metal spraying	175
F.2.2 Surface preparation of carbon steels prior to galvanizing	176
F.3 Welds and surfaces for welding	176
F.4 Surfaces in preloaded connections	176
F.5 Preparation of fasteners	176
F.6 Coating methods	177
F.6.1 Painting	177
F.6.2 Metal spraying	177
F.6.3 Galvanizing	177
F.7 Inspection and checking	178
F.7.1 General	178
F.7.2 Routine checking	178
F.7.3 Reference areas	178
F.7.4 Galvanized components	178
Annex G (normative) Test to determine slip factor	180
G.1 General	180
G.2 Significant variables	180
G.3 Test specimens	180
G.4 Slip test procedure and evaluation of results	182
G.5 Extended creep test procedure and evaluation	182
G.6 Test results	183
Annex H (normative) Test to determine torque values for preloaded bolts under site conditions ...	185
H.1 Scope	185
H.2 Symbols and units	185
H.3 Principle of the test	185
H.4 Test apparatus	185
H.5 Test assemblies	186
H.6 Test set up	186
H.7 Test procedure	187
H.8 Evaluation of test results	187
H.9 Test report	188
Annex J (normative) Use of compressible washer-type direct tension indicators	189
J.1 General	189
J.2 Fitting	189
J.3 Checking	190
Annex K (informative) Hexagon injection bolts	192

K.1	General	192
K.2	Hole sizes	192
K.3	Bolts	193
K.4	Washers	193
K.5	Nuts	194
K.6	Resin	194
K.7	Tightening	194
K.8	Installation	195
Annex L (informative) Guide to flow diagram for development and use of a WPS		196
Annex M (normative) Sequential method for fasteners inspection		197
M.1	General	197
M.2	Application	198
Bibliography		200