

DIN EN 1090-2:2018-09 (E)

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

Contents	Page
European foreword	9
Introduction	11
1 Scope.....	12
2 Normative references.....	12
2.1 Constituent products	12
2.1.1 Steels.....	12
2.1.2 Steel castings	15
2.1.3 Welding consumables	15
2.1.4 Mechanical fasteners.....	16
2.1.5 High strength cables	16
2.1.6 Structural bearings	17
2.2 Preparation.....	17
2.3 Welding.....	17
2.4 Testing	19
2.5 Erection	19
2.6 Corrosion protection	19
2.7 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 Requirements for surface preparation for corrosion protection	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	26
5.3 Structural steel products	28
5.3.1 General.....	28
5.3.2 Thickness tolerances.....	29
5.3.3 Surface conditions	30
5.3.4 Additional properties.....	30
5.4 Steel castings	31
5.5 Welding consumables	31
5.6 Mechanical fasteners.....	33
5.6.1 General.....	33
5.6.2 Terminology	33
5.6.3 Structural bolting assemblies for non-preloaded applications	33
5.6.4 Structural bolting assemblies for preloading.....	34

5.6.5	Direct tension indicators	34
5.6.6	Weather resistant assemblies.....	34
5.6.7	Foundation bolts.....	34
5.6.8	Locking devices	35
5.6.9	Washers.....	35
5.6.10	Solid rivets for hot riveting.....	35
5.6.11	Special fasteners	35
5.6.12	Delivery and identification	35
5.7	Studs and shear connectors	36
5.8	Reinforcing steel welded to structural steel.....	36
5.9	Grouting materials	36
5.10	Expansion joints for bridges.....	36
5.11	High strength cables, rods and terminations	36
5.12	Structural bearings	37
6	Preparation and assembly	37
6.1	General	37
6.2	Identification.....	37
6.3	Handling and storage	37
6.4	Cutting.....	39
6.4.1	General	39
6.4.2	Shearing and nibbling.....	39
6.4.3	Thermal cutting.....	39
6.4.4	Hardness of free edge surfaces.....	40
6.5	Shaping.....	40
6.5.1	General	40
6.5.2	Hot forming.....	40
6.5.3	Flame straightening.....	41
6.5.4	Cold forming.....	42
6.6	Holing.....	44
6.6.1	Dimensions of holes.....	44
6.6.2	Tolerances on hole diameter for bolts and pins.....	45
6.6.3	Execution of holing.....	45
6.7	Cut outs.....	46
6.8	Full contact bearing surfaces	46
6.9	Assembly.....	46
6.10	Assembly check	47
7	Welding	47
7.1	General	47
7.2	Welding plan	47
7.2.1	Requirements for a welding plan.....	47
7.2.2	Content of a welding plan	48
7.3	Welding processes.....	48
7.4	Qualification of welding procedures and welding personnel	49
7.4.1	Qualification of welding procedures	49
7.4.2	Welders and welding operators.....	51
7.4.3	Welding coordination	52
7.5	Preparation and execution of welding.....	54
7.5.1	Joint preparation	54
7.5.2	Storage and handling of welding consumables	55
7.5.3	Weather protection.....	55
7.5.4	Assembly for welding.....	55
7.5.5	Preheating.....	56

7.5.6	Temporary attachments.....	56
7.5.7	Tack welds.....	56
7.5.8	Fillet welds.....	56
7.5.9	Butt welds.....	57
7.5.10	Welds on steels with improved atmospheric corrosion resistance.....	58
7.5.11	Branch connections.....	58
7.5.12	Stud welding.....	58
7.5.13	Slot and plug welds.....	58
7.5.14	Other weld types.....	59
7.5.15	Post-weld heat treatment.....	59
7.5.16	Execution of welding.....	59
7.5.17	Welding of orthotropic bridge decks.....	59
7.6	Acceptance criteria.....	59
7.6.1	Routine requirements.....	59
7.6.2	Fatigue requirements.....	60
7.6.3	Orthotropic bridge decks.....	60
7.7	Welding of stainless steels.....	60
8	Mechanical fastening.....	60
8.1	General.....	60
8.2	Use of bolting assemblies.....	61
8.2.1	General.....	61
8.2.2	Bolts.....	61
8.2.3	Nuts.....	62
8.2.4	Washers.....	62
8.3	Tightening of non-preloaded bolting assemblies.....	63
8.4	Preparation of contact surfaces in slip resistant connections.....	63
8.5	Tightening of preloaded bolting assemblies.....	65
8.5.1	General.....	65
8.5.2	Torque reference values.....	66
8.5.3	Torque method.....	67
8.5.4	Combined method.....	67
8.5.5	HRC method.....	68
8.5.6	Direct tension indicator method.....	69
8.6	Fit bolts.....	69
8.7	Hot riveting.....	69
8.7.1	Rivets.....	69
8.7.2	Installation of rivets.....	69
8.7.3	Acceptance criteria.....	70
8.8	Use of special fasteners and fastening methods.....	70
8.9	Galling and seizure of stainless steels.....	71
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.....	73
9.4	Survey.....	74
9.4.1	Reference system.....	74
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.....	75
9.5.4	Temporary supports	75
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	76
9.6.3	Handling and storage on site.....	76
9.6.4	Trial erection	77
9.6.5	Erection works.....	77
10	Surface treatment.....	79
10.1	General	79
10.2	Preparation of steel substrates for paints and related products.....	79
10.3	Weather resistant steels	80
10.4	Galvanic coupling.....	80
10.5	Hot dip galvanizing	80
10.6	Sealing of spaces	81
10.7	Surfaces in contact with concrete.....	81
10.8	Inaccessible surfaces.....	81
10.9	Repairs after cutting or welding	81
10.10	Cleaning of stainless steel components.....	82
11	Geometrical tolerances.....	82
11.1	Tolerance types.....	82
11.2	Essential tolerances.....	82
11.2.1	General	82
11.2.2	Manufacturing tolerances	82
11.2.3	Erection tolerances.....	83
11.3	Functional tolerances.....	84
11.3.1	General	84
11.3.2	Tabulated values.....	85
11.3.3	Alternative criteria	85
12	Inspection, testing and correction.....	85
12.1	General	85
12.2	Constituent products and components.....	85
12.2.1	Constituent products.....	85
12.2.2	Components.....	86
12.2.3	Non-conforming products	86
12.3	Manufacturing: geometrical dimensions of manufactured components	86
12.4	Welding	87
12.4.1	General	87
12.4.2	Inspection after welding	87
12.4.3	Inspection and testing of welded shear studs for composite steel and concrete structures	91
12.4.4	Production tests on welding.....	91
12.4.5	Inspection and testing of welding of reinforcing steel.....	92
12.5	Mechanical fastening.....	92
12.5.1	Inspection of non-preloaded bolted connections	92
12.5.2	Inspection and testing of preloaded bolted connections.....	92
12.5.3	Inspection and repairs of solid rivets for hot riveting.....	95
12.5.4	Special fasteners and fastening methods.....	96
12.6	Surface treatment and corrosion protection.....	96

12.7	Erection	96
12.7.1	Inspection of trial erection.....	96
12.7.2	Inspection of the erected structure.....	96
12.7.3	Survey of geometrical position of connection nodes.....	97
12.7.4	Other acceptance tests	98
Annex A (normative) Additional information, options and requirements related to the execution classes.....		99
A.1	Additional information.....	99
A.2	Options.....	102
A.3	Requirements related to the execution classes	107
Annex B (normative) Geometrical tolerances.....		111
B.1	General.....	111
B.2	Manufacturing tolerances.....	111
B.3	Erection tolerances	136
Annex C (informative) Check-list for the content of a quality plan.....		153
C.1	General.....	153
C.2	Content.....	153
C.2.1	Management	153
C.2.2	Specification review.....	153
C.2.3	Documentation	153
C.2.3.1	General.....	153
C.2.3.2	Documentation prior to execution	154
C.2.3.3	Execution records.....	154
C.2.3.4	Documentary records.....	154
C.2.4	Inspection and testing procedures.....	155
Annex D (informative) Procedure for checking capability of automated thermal cutting processes.....		156
D.1	General.....	156
D.2	Description of the procedure.....	156
D.2.1	General.....	156
D.2.2	Average surface roughness R_{Z5}	157
D.2.3	Perpendicularity and angularity tolerance.....	158
D.2.4	Hardness test.....	158
D.3	Range of qualification.....	159
D.3.1	Material groups	159
D.3.2	Material thickness	160
D.3.3	Pressures of gases.....	160
D.3.4	Cutting speed and height.....	160

D.3.5	Preheat temperature.....	160
D.4	Test report	160
Annex E (informative) Welded joints in hollow sections.....		164
E.1	General	164
E.2	Guidance for start and stop positions	164
E.3	Preparation of joint faces	164
E.4	Assembly for welding.....	165
E.5	Fillet welded joints.....	172
Annex F (normative) Corrosion protection.....		173
F.1	General	173
F.1.1	Field of application	173
F.1.2	Performance specification	173
F.1.3	Prescriptive requirements.....	173
F.1.4	Work method	174
F.2	Surface preparation of carbon steels	174
F.2.1	Surface preparation of carbon steels prior to painting or metal spraying.....	174
F.2.2	Surface preparation of carbon steels prior to hot dip galvanizing.....	175
F.3	Welds and surfaces for welding	175
F.4	Surfaces in preloaded connections	175
F.5	Preparation of fasteners	175
F.6	Coating methods	176
F.6.1	Painting.....	176
F.6.2	Metal spraying	176
F.6.3	Hot dip galvanizing	176
F.7	Inspection and checking	176
F.7.1	General	176
F.7.2	Routine checking	176
F.7.3	Reference areas.....	177
F.7.4	Hot dip galvanized components.....	177
Annex G (normative) Determination of slip factor.....		178
G.1	General	178
G.2	Significant variables	178
G.3	Test specimens	178
G.4	Slip test procedure and evaluation of results.....	181
G.5	Extended creep test procedure and evaluation.....	183
G.6	Test results.....	183

Annex H (normative) Calibration test for preloaded bolting assemblies under site conditions 185

H.1 General..... 185

H.2 Symbols and units..... 185

H.3 Principle of the test 186

H.4 Test apparatus 186

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..... 189

Annex I (informative) Determination of loss of preload for thick surface coatings..... 190

I.1 General..... 190

I.2 Test procedure..... 191

Annex J (informative) Resin injection bolts 193

J.1 General..... 193

J.2 Hole sizes 193

J.3 Bolts 193

J.4 Washers..... 194

J.5 Nuts 195

J.6 Resin 195

J.7 Tightening 195

J.8 Installation 195

Annex K (informative) Guide to flow diagram for development and use of a WPS..... 196

Annex L (informative) Guidance on the selection of weld inspection classes 197

L.1 General..... 197

L.2 Selection criteria 197

L.3 Extent of supplementary testing 198

Annex M (normative) Sequential method for fasteners inspection 200

M.1 General..... 200

M.2 Application 200

Bibliography 202