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Preparation of Manufacturing Documents in Steel Construction

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Preparation of Manufacturing Documents in Steel Construction

Recommendations of the
Engineering Office Working Group

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Guideline on Preparation of Manufacturing Documents in Steel Construction

This guideline has been prepared by the Engineering Office Working Group.

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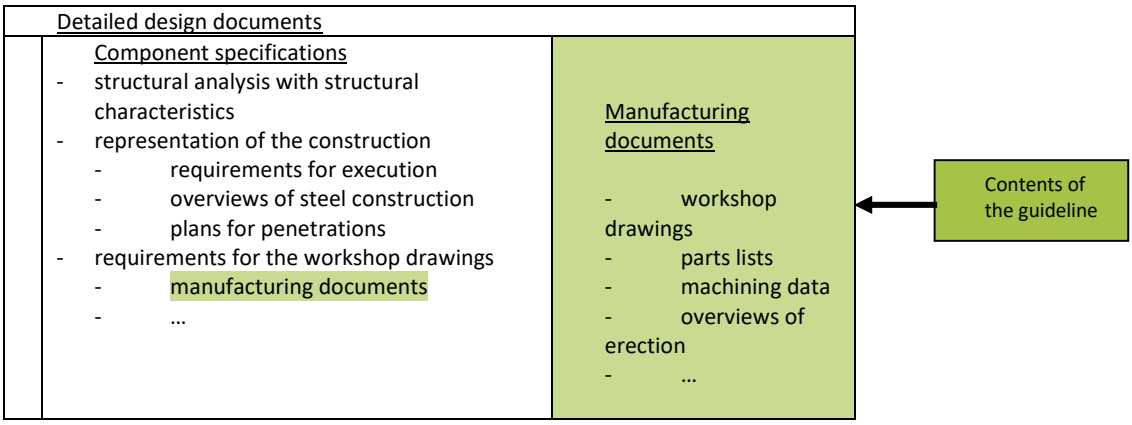
1 | Scope

This guideline has been prepared by the BFS Engineering Office Working Group.

The guideline governs the necessary content of manufacturing documents for steel construction.

All technical documents for the manufacturing of steel structures in the sense of EN 1090 are termed manufacturing documents. They include workshop drawings, parts lists, machining data (NC data) and erection overviews.

The manufacturing documents are part of the complete component specification as follows:



The manufacturing documents have to be written in such a way that those participating in the manufacturing are provided with the necessary information and technical requirements for the steel construction to be erected. In particular, the manufacturing documents must contain the data that form the basis for

- manufacturing and manufacturer's declaration of performance in accordance with EN 1090 [1]
- building authority inspection
- erection.

2 | Normative references

[1] EN 1090-1 Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components

[2] EN 1090-2 Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures

[3] EN ISO 1302 Geometrical Product Specifications (GPS) - Indication of surface texture in technical product documentation

[4] EN 1993-1-10 Eurocode 3: Design of steel structures - Parts 1-10: Selection of steel grade with respect to fracture toughness and properties in through-thickness direction,

[5] EN ISO 8501-1 Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

[6] EN ISO 8503-2 Part 2: Preparation grades of previously coated steel substrates after localized removal of previous coatings
[7] EN ISO 8501-3 Part 3: Preparation grades of welds, edges and other areas with surface imperfections
[8] EN 10160 Ultrasonic testing of steel flat product of thickness equal to or greater than 6 mm (reflection method)
[9] EN 10164 Steel products with improved deformation properties perpendicular to the surface of the product
[10] EN 10204 Metallic products - Types of inspection documents
[11] EN ISO 13920 Welding - General tolerances for welded constructions - Dimensions for lengths and angles; shape and position
[12] DASt Guideline 022 Feuerverzinken von tragenden Stahlbauteilen (Hot-dip galvanising of load-bearing steel structural elements)
[13] bauforumstahl Guideline BFS-RL 07-102; Dokumentation von Standsicherheitsnachweisen im Stahlbau (Documentation of verification of stability in steel construction)
[14] bauforumstahl Guideline BFS-RL 02-101; Presentation of Steel Structures in Workshop Drawings
[15] bauforumstahl Guideline BFS-RL 03-106, Interface Description of CAD Parts; Recommendations of the BFS Information Technology Working Group
[16] bauforumstahl Guideline BFS-RL 03-105, Standard Description of Steel Components for the NC Control; Recommendations of the Information Technology Working Group
[17] bauforumstahl Guideline BFS-RL 03-104, Product Identifiers for Data Exchange in Steel Construction, Recommendations of the Information Technology Working Group

3 | Terms

3.1 | Execution

‘All activities performed for the physical completion of the works, i.e. procurement, fabrication, welding, mechanical fastening, transportation, surface treatment and the inspection and documentation thereof.’ (EN 1090-2, 3.7 [2]).

3.2 | Manufacturing

‘All activities required to produce and deliver a component. As relevant, this comprises e.g. procurement, preparation and assembly, welding, mechanical fastening, transportation, surface treatment and the inspection and documentation thereof.’ (EN 1090-2, 3.6 [2]).

3.3 | Detailed design documents

Detailed design documents have to provide all participants in the execution process with the necessary information. Detailed design documents contain all the necessary documents with the technical data and requirements as well as the load-carrying-capacity and manufacturing features needed for the manufacturing, transport and erection of all works.

3.4 | Component specification

‘Document or documents giving all necessary information and technical requirements for manufacturing the structural component." (EN 1090-1, 3.1.1 [1])

3.5 | Structural characteristics

‘Assessment of structural characteristics shall be based on a) the structural design, and b) the manufacturing characteristics of the component.’ (EN 1090-1, 5.6 [1])

‘Manufacturing characteristics are e.g. the execution classes, the welding quality, the geometrical accuracy (tolerances) or the surface properties, i.e. all properties that have influence on the structural behaviour.’ (EN 1090-1, 3.1.8 [1])

3.6 | Manufacturing documents

The manufacturing documents contain the manufacturing characteristics and are a constituent part of the detailed design documents.

In this guideline, all technical documents on manufacturing in the sense of EN 1090 are termed manufacturing documents. They include workshop drawings, parts lists, machining data (NC data) and erection overviews.

4 | Prerequisites

‘The necessary information and technical requirements for execution of each part of the works shall be agreed and complete before commencement of execution of that part of the works. There shall be procedures for making alterations to previously agreed execution specification.’ (EN 1090-2, 4.1.1 [2]).

The following stipulations and documents must be fulfilled or available in order to prepare the manufacturing documents:

- implementation planning for carrying out the construction authorised by the project planner, usually the principal, orderer or architect
- implementation planning for carrying out the construction authorised by the structural engineer with all necessary information for preparation of the workshop drawings
- complete and verified structural analysis according to the ‘Documentation of verification of stability in steel construction’ [13] that contains the necessary information (connection stress resultants, execution classes, deformations, cross-sections and materials, etc.) of all components in a clearly arranged form
- structural analysis of connections in accordance with [13] provided they are not covered by other technical regulations (typified connections, company standards, data reference books, approvals, etc.)
- additional quality requirements with regards materials and execution
- corrosion protection category and protection period

- tolerance data, tolerance classes (EN 1090-2, 4.1.4 [2] and EN ISO 13920 [11]),
- necessary information according to A.1 of EN 1090-2, Annex A [2],
- If necessary, options according to A.2 of EN 1090-2, Annex A [2].

5 | Requirements

5.1 | Workshop drawings

The components to be produced have to be shown on the workshop drawings in such a way that all users are provided with sufficient information.

Rules on presentation should be taken from the bauforumstahl Guideline BFS-RL 02-101; Presentation of Steel Structures in Workshop Drawings [14].

Workshop drawings, parts lists and NC data belong together. The necessary contents are lumped together randomly in the following.

5.1.1 | Designation and specification of individual parts

Complete designation compliant with standard of the construction materials used, their requirements (EN 1090-2, 5., Tables 2 to 4 [2]) and inspection documents in accordance with EN 10204 [10].
Example:

Positioning	Pos. 008
Designation	HEA300, BL30
Steel type / grade / + condition as-supplied	S355J2+N (EN 1993-1-10)
Additional requirements	Z25 (EN 1993-1-10; EN 10164 [9]) Ultrasonic testing S1 (EN 10160 [8]) Preheating or quality of flame-cut edges

5.1.2 | Geometry data

- relevant system dimensions, axis references, main axis designations
- component dimensions, oblique sections, hogs
- hole spacings
- eccentricities
- attachment dimensions as chain or difference dimensions, centre marks
- angles or slope triangles
- minus sizes or undersizes
- allowances and symbols for machining according to EN ISO 1302 [3]
- tolerances, e.g. tolerance classes C and G according to EN ISO 13920 [11]
- control dimensions.

5.1.3 | Positioning, sections, details and component environment

Main parts and attached components must be positioned clearly.

Main parts should be assigned to the drawings.

The necessary sections, views and details must be placed clearly and designated explicitly. If required, the component environment, such as adjacent components, outline of the solid construction, sealing joints, face, is shown.

5.1.4 | Threaded joints

Threaded joints are assigned to the main position that is connected.

- designations of bolts, washers or sets
- bolt length (clamping length if necessary)
- bolt grade (standard or approval),
- corrosion protection (e.g. hot-dip galvanised),
- diameters of drilled holes (e.g. details of countersunk holes)
- level of preloading (e.g.: hand-tightened, partially preloaded with 0,5 to 1,0 Fp,C* where Fp,C* = 0,7 fyb As (EN 1993-1-8/NA), preloaded (EN 1993-1-8)
- workshop bolts have to be designated separately
- special screw locking devices
- block representation in accordance with [17], e.g. for sets: ‘14399-4-M20X95MU2S-10.9-TZN’.

5.1.5 | Welded joints

- welded joint symbols and weld dimensions
- details of welded joint with seam preparation, e.g. dimensioning of the chamfers
- post-treatment, e.g. grind flat
- assessment group according to EN ISO 5817, provided different from EN 1090-2
- additional non-destructive testing over and above EN 1090-2, Table 24: e.g. penetrant testing (PT), magnetic particle inspection (MT), ultrasonic testing (UT) or radiographic testing (RT)
- mark field welded seams.

5.1.6 | Durability / corrosion protection

- preparation grade, e.g. P1 according to EN ISO 8501-3 [7]
- information on corrosion protection, e.g. corrosivity categories and protection period
- alternatively: reference to corrosion protection specification or plan.

5.1.7 | Bought-in and standard parts

- distinct specification (type designation / standard / approval / manufacturer)
- reference to related documents such as standard drawings or data sheets.

5.1.8 | Title block

The title block serves the administration of the drawings and control of the drawing documents.

- meaningful designation / description of drawing contents with reference to position in the construction
- unique drawing number
- name field for originator with date
- name field for drawing approval and date checked
- index with index field containing information on changes made.

It is useful to include the following additional information above the title block:

- references to other drawings that need to be used
- relevant execution classes according to EN 1090-2, 4.1.2 and Annex B [2]
- recurring project-specific manufacturing characteristics
- overview with marking of the component illustrated.

5.1.9 | Despatch and transport

Data in special cases:

- despatch and transport information
- component dimensions and weights
- transport and installation eyelets
- centres of gravity or centroidal axes
- anchorage points, necessary spreader beams, special suspension lengths, etc.

5.1.10 | Installation instructions on workshop drawings

Data in special cases:

- installation instructions
- installation control dimensions.

5.2 | Parts lists and NC data

Files for parts lists and blanks (NC files to the DSTV standard) are usually transferred to a database in accordance with the provisions in [15] and [16]. The manufacturing facility can control various production steps from there. This presupposes that the files contain the complete specification, according to Section 5.1., including

- position and number
- item order numbers
- material specification, material testing (ultrasonic testing, through thickness strength, etc.)
- necessary material certificates and analyses
- transport or installation piece weights
- centre marks in the NC files, after consultation.

5.3 | Durability / corrosion protection

- data on corrosion protection, corrosivity categories and protection period
- hot-dip galvanising according to DASt 022 [12], corrosion or fire-protective coating
- preparation grade, e.g. P1 according to ISO 8501-3 [7]
- degree of surface roughness, e.g. SA 2 ½ according to EN ISO 8501-1 [5]
- degree of surface roughness, e.g. average according to EN ISO 8503-2 [6]
- corrosion protection system with coating material, layer thickness and information on colour shade, e.g. primer / intermediate coating / topcoat / possibly edge protection
- contact surfaces with different coating (e.g. for high strength friction grip (HSFG) connections)
- if necessary, prepare special corrosion protection plan.

5.4 | Outline plans of gratings

Outline plans contain the following information for preparing grating installation plans:

- designation of grating type, e.g. SP340-3
- direction of the supporting member
- fixing
- front edge
- skirting boards.

5.5 | Drawings registry

To control the drawing documents, a drawings registry should be created containing the following information:

- order designation and order number
- drawing number
- contents of the drawing
- date of preparation of the plan, revision status
- if necessary, circulation of the plan.

5.6 | Erection drawings

Positioned erection overviews are typically prepared in steel construction. They must contain the following:

- presentation of the main positions (erection positions) in association with ground plans, views and sections, and possibly isometric or exploded views
- unique designations of the positions of the component with information on the drawing number and the position numbers
- indication of all components to be installed (e.g. sections, turnbuckle, bearing, grouting mortar)
- information on the erection bolts and other fasteners at the respective joints
- dimensions between axes, attachment, grid, main and reference dimensions, elevations
- control dimensions for intermediate states in the construction process
- special connection and interface details (roof and wall details, base points, bearings, expansion joints, etc.), provided no separate drawings are prepared for this. Separate anchoring plans are often required.
- erection instructions, erection sequences
- laying plans, e.g. for grating, bulb plate, roof covering and wall cladding.

Further requirements with regards the erection drawings must be agreed between the contract partners; when refurbishing, for example, component environments, connection points, reference heights and installation holes with dimensioning have to be given.

5.7 | Additional documents

5.7.1 | Additional manufacturing, performance and quality documents

- quality control plan, e.g. on the basis of EN 1090-2
- boxplots and cut-out drawings, possibly with details of shrinkage and machining allowances
- templates or workshop gauges
- welding procedure with details of weld seams
- general welding procedure specifications (WPS)
- data on weld-seam preparation, welding process, welding position and filler metals
- welding seam test schedule
- control dimensions and measurement records
- coating specification
- corrosion protection plan with control, masked and contact surfaces.

5.7.2 | Additional assembly documents

- construction site setup plan
- crane setup drawings
- presentation of erected states
- erection aids and scaffolding
- bearing installation plan
- drawings of earthing.

5.7.3 | Invoicing documents

- invoicing parts lists, if necessary with correlation to positions of the schedule of services
- painted and invoiced areas
- dimensioned drawings.

6 | Documentation

The documentation has to contain the latest version of the manufacturing documents.
More extensive documentation requirements have to be agreed separately.