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The authoritative and approved version of this company standard is only available on the Broetje-Automation intranet. Hard copies and locally stored copies must be verified, as they are not subject to change management. The website of Broetje-Automation "www.broetje-automation.de" serves as an alternative source of company standards for external parties.

Application Area and Purpose

This specification describes the methods and specifications for producing welded parts. It is binding for all companies of the Broetje-Automation Group and their employees, as well as for all vendors who supply welded parts to a company of the Broetje-Automation Group.

The component specification for welded parts is constantly being extended and refined.

Contractors may view these documents at
<http://www.broetje-automation.de/en/downloads/>

Deviations from this standard require the approval of Broetje-Automation' Quality Assurance department and are documented separately.

1 Structural components pursuant to DIN 1090

1.1 Structural component classification

Classification pursuant to DIN EN 1090-2 Annex B.3 for steel structures

Classification pursuant to DIN EN 1999-1-1 Annex A.4 for aluminum structures

1.1.1 Steel components < Strength class S355:

Structural components pursuant to DIN EN 1090 EXC 1: For example railings, stairs
Components pursuant to DIN EN 1090 EXC 2: For example platforms, or other supporting structures with rigid top flange plate joints

1.1.2 Steel components \geq Strength class S355:

Structural components pursuant to DIN EN 1090 EXC 2: For example railings, stairs, platforms, etc.

1.1.3 Aluminum components

Structural components pursuant to DIN EN 1090 EXC 2: For example railings, stairs, platforms, etc.

1.2 Calculation

Calculation according to the corresponding part of the Eurocode, series of standards DIN EN ISO 1993.

1.3 Order

1.3.1 Placing an order with company authorized the appropriate certification level. Delivery of the product with the appropriate CE Declaration and Declaration of Performance pursuant to DIN EN 1090-1

1.3.2 Applicable quality documentation to be submitted

- Material test certificates pursuant to DIN EN 1090-2, Chap. 5.2, Table 1.
- Weld inspections pursuant to DIN EN 1090-2.
Documentation of the non-destructive testing, if these are specified pursuant to Chap. 12.4.2, DIN EN 1090-2.
- Personnel qualifications (Table 1) prescribed for the qualification level, welding instructions and procedural tests
- CE marking and Declaration of Performance pursuant to DIN EN 1090-1.

1.4 Assembly

1.4.1 The bolt sets determined in the design pursuant to DIN EN 15048-1 must be used on the construction site.

2 Structural components pursuant to DIN EN ISO 3834

2.1 Structural component categories

- Category 1: Weld seams with exclusively joining function or sealing function, for example covers
- Category 2: Standard welds, seams that have - at a minimum - a static force transmission function in the component
- Category 3: Heavily stressed weld seams. Seams which, in case of failure, lead to considerable damage to machinery or possibly causing injury to people.
Possible constructive measure: Safety factor 2

A component to be manufactured shall be classified in the highest category of the total welds that must be welded.

2.2 Operational requirements for component production

- Category 1: DIN EN ISO 3834-4 / 1090-2/-3 EXC1
/ no approval, but certified welders
- Category 2: DIN EN ISO 3834-3 / 1090-2/-3 EXC2
- Category 3: DIN EN ISO 3834-2 / 1090-2/-3 EXC3 u. EXC4

The classification of the entire component into a category corresponds to the weld with the highest category.

The component is subsequently to be classified by the designer according to its technical requirement.

Classification as follows:

- DIN EN ISO 3834-4: Basic quality requirements
DIN EN ISO 3834-3: Standard quality requirements
DIN EN ISO 3834-2: Comprehensive quality requirements

2.3 Structural component test

- Category 1: 100% VT (Visual Testing) with evaluation group D pursuant to DIN EN ISO 5817
- Category 2: 100% VT with quality level C pursuant to DIN EN ISO 5817
Test inspectors must be qualified pursuant to DIN EN 9712
- Category 3: 100% VT with quality level C pursuant to DIN EN ISO 5817
with additional non-destructive testing (NDT) that has to be defined in the symbol of the corresponding weld seam in the drawing:

- Fillet weld (FW):
 - Magnetic Particle Testing (MT) is used when seams are accessible (generally external sutures)

- MT pursuant to DIN EN ISO 17638. Admissibility limit 2. Areas must be repaired and the area must be checked again.
- Butt welds (BW):
 - MT testing when seams are accessible
 - Ultrasonic testing (UT) pursuant to DIN EN ISO 17640, test class B with admissibility limit B2 pursuant to DIN EN ISO 11666
 - Radiographic testing (RT) pursuant to DIN EN ISO 17636, film system class B with admissibility limit 1 pursuant to DIN EN ISO 10675-1/-2

Test inspectors must be qualified pursuant to DIN EN 9712.

3 Order with component specification

Structural components are assigned to the relevant part of DIN EN ISO 3834 on the engineering drawing and assigned to a weld seam category (Table 1)

Structural component specification, welding				
		Certification level		
Serial no.	Designation	DIN EN ISO 3834-2 DIN EN 1090-2 EXC 3/4	DIN EN ISO 3834-3 DIN EN 1090-2 EXC 2	Without approval DIN EN ISO 3834-4 DIN EN 1090-2 EXC 1
a	Quality Management	pursuant to DIN EN ISO 3834-2	pursuant to DIN EN ISO 3834-3	pursuant to DIN EN ISO 3834-4
1	admissible qualification for welder & operator	DIN EN ISO 9606-1 DIN EN ISO 9606-2 DIN EN ISO 14732	DIN EN ISO 9606-1 DIN EN ISO 9606-2 DIN EN ISO 14732	DIN EN ISO 9606-1 DIN EN ISO 9606-2 DIN EN ISO 14732
2	Qualification of welding supervisors	SFI/IWE/SFM/IWS Tasks and responsibilities acc. to DIN EN ISO 14731	SFM/IWS Tasks and responsibilities acc. to DIN EN ISO 14731	_____
3	Personnel for non- destructive testing	VT/MT/UT/RT: Qualifications pursuant to DIN EN ISO 9712	VT/MT/UT/RT: Qualifications pursuant to DIN EN ISO 9712	_____
4	Welding instructions, arc welding	DIN EN ISO 15609-1	DIN EN ISO 15609-1	_____
5	Qualification for arc welding	DIN EN ISO 15614-1 DIN EN ISO 15614-2 DIN EN ISO 15613	DIN EN ISO 15614-1 DIN EN ISO 15614-2 DIN EN ISO 15613	DIN EN ISO 15610, approved welding consumables
6	Post heat treatment	ISO/TR 14745	ISO/TR 14745	_____

Table 1 Structural component specification for welding

4 Tolerances for welded constructions

Unless otherwise specified on the engineering drawing, the following general tolerances apply to welded constructions pursuant to DIN EN ISO 13920:

Dimensions for lengths:	Tolerance class B
Dimensions for angles:	Tolerance class B
Tolerances for straightness, flatness and parallelism	Tolerance class F

Unless otherwise specified on the engineering drawing, thermal cuts must be made pursuant to DIN EN ISO 9013-341.

5 Documentation

The following documentation must be enclosed with the delivery:

1. Material test certificates according to the requirement test plan
2. NDT test reports
3. Personnel qualifications required for the qualification level
4. Weld bead bend test (if required)
5. UT testing for duplication pursuant to EN 10160 (if required)
6. Annealing record with indication of warm-up, holding and cooling down time (if annealing is required)

6 Check before welding/weld seam preparation:

- The shape and dimensions of the weld preparation must comply with DIN EN ISO 9692-1. The manufacturing company shall proceed with the weld seam preparation (opening angle, web width, etc.) pursuant to the applicable standard.
- The surfaces in the weld area must be free of dust, grease and other contaminants (such as scale, slag, rust, paint, oil, galvanizing, moisture, etc.). The seam joints must be kept clean until they are welded. Weld flanks that are moist or re-coated with an oxide skin again, must be cleaned or dried immediately before the start of the welding process.
- The connecting parts must be tack-welded according to the instructions shown in the engineering drawing.
- Tack-welding points must always be completely melted and welded over. All cracks, lack of fusions and clusters of pores in the tack-welded areas must be removed before welding. Using tacked seams of sufficient length will ensure the formation of notches in the base metal will be prevented.

- When closing cavities, vent holes \varnothing 8 mm (\varnothing 6 mm for aluminum) must be provided.
- Especially when using aluminum, do not use plastic-bonded grinding wheels. This increases the risk of the formation of pores. Ceramic bonded grinding wheels must be used.

7 Heat treatment

Structural steel components (S235 to S355) must be pre-heated in the weld preparation area as follows:

Work pieces with a thickness starting at 25 mm: $T_p \geq 150 \text{ }^\circ\text{C}$
Temperature of intermediate layers: $T_i \geq 150 \text{ }^\circ\text{C}$
or the Welding Procedure Specification WPS applicable to the sheet metal thickness

When using structural components made of aluminum, the maximum pre-heating temperature for hardenable alloys is 180 – 200°C. The exposure time to this temperature shall not exceed 10 minutes.

Temperature measurement:

In order to measure the temperature, a contact thermometer pursuant to DIN EN ISO 13916: 2018-03 shall be used:

1. For structural components ≤ 50 mm, the required preheat temperature must, if possible, be 50 mm away from the seam preparation area.
2. For structural components > 50 mm, the required preheat temperature must be measurable at 75 mm in all directions away from the seam preparation area of the base metal, if possible.
3. The temperature of intermediate layers T_i must be measured on the weld metal before welding the next bead and must be documented

Cooling:

The cooling must be done from the heat of the welding in still air. The direct ambient temperature must not drop below 15 °C. If this is not possible, heat blankets must be used to cover the component and cooling of the component must be awaited. Draft is generally to be avoided.

8 Welding:

- Only qualified personnel with a valid certification pursuant to DIN EN ISO 9606-1/2 shall be permitted to proceed with the welding process.
- The welding must be carried out in accordance with a valid and existing WPS available in the respective company.
- Especially the root of the weld must be cleaned of slags or other impurities before applying any further layers of weld.
- Irregularities such as cracks, cavities, scorch or the like must not be present in the intermediate layers.
- The weld root must be visually inspected.
- Unless otherwise specified on the engineering drawing, filler metal for aluminum pursuant to DIN EN ISO 18273 must be adjusted to the base material. Inert gas pursuant to DIN EN ISO 14175 adapted to welding filler.
- Unless otherwise specified on the engineering drawing, the information provided in the following table applies to all unspecified welds:

Weld thickness without dimensioning	
Fillet welds	
Sheet metal thickness t [mm]	Fillet weld thickness a [mm]
Up to 6	3
> 6 - 12	4
> 12 - 15	5
> 15 - 20	6 (several layers)
> 20 - 30	7
> 30 - 40	8
> 40	10
Butt welds	
Generally, butt welds are made as full penetration welds	

- If butt joints that are not indicated in the engineering drawing, a written approval must be obtained, requesting special drawing release in the production planning of Broetje-Automation.
- Butt joints that are not indicated in the engineering drawing are added with quality level B pursuant to DIN EN ISO 5817.
- Broetje-Automation reserves the right to inspect work samples of the material thicknesses to be welded and to view the corresponding WPS at the manufacturer's facility

- Temporary welds for eyebolts, braces, fixtures etc. must be completely removed. The surfaces of the relevant areas must be ground smooth, leaving no notches. In doing so, the required wall thickness must not be reduced below the minimum thickness. Using tacked seams of sufficient length will ensure the formation of notches in the base metal will be prevented.

9 Testing the finished weld

- All slag or other weld irregularities must be removed.
- The visual weld inspection must be carried based on the following standards:
 - DIN EN ISO 17637
 - DIN EN ISO 1090-2
 - DIN EN ISO 5817
 - DIN EN ISO 10042
- The non-destructive testing shall be carried out and documented in accordance with Chapter 12.4.2, Inspection after welding of EN 1090-2. (cf. Chapter 1.3.2)
For structural components according to DIN EN ISO 3834, the corresponding seam specification must be taken into account. (cf. Chapter 2.3)
- For non-destructive testing of components, written test reports must be prepared. Here, all necessary requirements listed in the engineering drawing and indicated in the order must be taken into account.