Replaces:
RN 68-1:2023-03-08

Welded constructions

Steel housings

Content

Page

Changes

2023-06-16:
The following changed in comparison to RN 68-1:2023-03-08:

a) updated references
b) editorially revised

1 Scope

This Factory standard comprises specifications for manufacturing, supplying and testing of welded constructions of structural steel, in particular for welded housings.

It does not apply to the welding of pipework and fixing elements such as consoles and fasteners.

2 References

The following documents, cited in part or in whole, shall apply for the use of this standard. In the case of dated references, only the referenced edition applies; in the case of undated references, the latest edition of the referenced document (including all amendments) applies. The applicable version of the standards listed below and the rules issued by the classification societies shall apply to all contents not covered by this factory standard.

DIN 17052-1	Heat treatment furnaces - Part 1: Requirements for temperature uniformity
EN 1011	Welding - Recommendations for welding of metallic materials Part 1: General guidance for arc welding Part 2: Arc welding of ferritic steels
EN 10021	General technical delivery conditions for steel products
EN 10025	Hot rolled products of structural steels Part 1: General technical delivery conditions Part 2: Technical delivery conditions for non-alloy structural steels Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10029	Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape
EN 10160	Ultrasonic testing of steel flat product of thickness equal to or greater than 6 mm (reflection method)
EN 10204	Metallic products - Types of inspection documents
EN ISO 2553	Welding and allied processes - Symbolic representation on drawings - Welded joints
EN ISO 3452-1	Non-destructive testing - Penetrant testing - Part 1: General principles
EN ISO 3834-2	Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements
EN ISO 5817	Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections
EN ISO 9001	Quality management systems - Requirements
EN ISO 9013	Thermal cutting - Classification of thermal cuts - Geometrical product specification and quality tolerances
EN ISO 9606-1	Qualification testing of welders - Fusion welding - Part 1: Steels
EN ISO 9692-1	Welding and allied processes - Types of joint preparation - Part 1: Manual metal-arc welding, gas-shielded metal-arc welding, gas welding, TIG welding and beam welding of steels
EN ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
EN ISO 11666	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels

EN ISO 14175	Welding consumables - Gases and gas mixtures for fusion welding and allied processes
EN ISO 14341	Welding consumables - Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels - Classification
EN ISO 14731	Welding coordination - Tasks and responsibilities
EN ISO 15607	Specification and qualification of welding procedures for metallic materials - General rules
EN ISO 17637	Non-destructive testing of welds - Visual testing of fusion-welded joints
EN ISO 17638	Non-destructive testing of welds - Magnetic particle testing
EN ISO 17640	Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment
EN ISO 23277	Non-destructive testing of welds - Penetrant testing - Acceptance levels
EN ISO 23278	Non-destructive testing of welds - Magnetic particle testing - Acceptance levels
RN 72	Packaging and preservation; Supply parts for production
RN 1908	General tolerances; Dimensions without tolerance specification
RN 1936	Labelling; Raw material, parts and gearboxes

3 Basic Requirements

3.1 Qualification

The manufacturer must

a) meet the comprehensive quality requirements applying to welding workshops in accordance with EN ISO 3834-2,

b) have a comprehensive quality assurance system,

c) meet the requirements of EN ISO 14731,

d) be certified to EN ISO 9001 ff. and

e) be approved by at least one of the member societies of the IACS.

In addition, the manufacturer must ensure that

f) production orders placed with subcontractors are executed in accordance with this factory standard,

g) REINTJES consented in writing about any placement of production orders at subcontractors; without such written consent, any subcontracting of production orders is prohibited.

All welding operations

h) must only be carried out by welders who successfully completed the required qualification tests according to EN ISO 9606-1 regarding materials, procedures and welding positions.

The applied welding procedures must

i) be qualified in accordance with EN ISO 15607 and

j) be approved by the classifications societies.

3.2 Approvals and inspections

For classification approval the manufacturer must

a) prior to production, agree major production steps with the classification society independently and in good time

b) fix inspection appointments with the approval officer,

c) make sure that the complete and approved production documents are available to the approval officer when production starts,

d) on request, inform the approval officer about the welding procedures to be used by submitting the respective welding procedure specifications (WPS).

Production steps relevant for inspection:

- inspection of thermal cuts and weld preparation
- assembly condition (inspection of tack welds)
- condition after welding is completed (inspection of welded construction)
- condition after post-weld heat treatment (final acceptance)

3.3 Production documents

The production documents comprise:

- the raw part drawing,
- this Factory Standard,
- the standards listed in section 2 and
- the rules and standards issued by the classification societies.

Specifications on the raw part drawing:

a) The general tolerances according to RN 1908 shall apply to dimensions without tolerance specification.

b) As a system is involved, also drillings of the finished housing are indicated.

c) Drillings dimensioned on the raw part drawings must be produced by the welding shop.

Specifications for weld seams:

d) weld types must correspond to the specifications on the raw part drawing;
for missing items see section 5

e) quality, force-conducting welds (cf. section 5.2): quality level B to EN 5817
subordinate welds (cf. section 5.3): quality level C to EN 5817

3.4 Documentation

On delivery the following documents must be available to REINTJES:

- up-to-date certificates of the required qualifications (cf. section 3.1),
- inspection documents for all inspections carried out,
- heat treatment reports and
- certificates of semi-finished products.

The order will only be considered as supplied when all items forming part of the order including the documentation have been received.

Furthermore, the specifications of RN 72 regarding packaging and preservation must be observed.

4 Material requirements

4.1 Raw material

Material:	non-alloy steel according to EN 10025 as per drawing (alternatively to S235, S355J2 can also be used).
Tolerances:	tolerances on shape, dimension and position according to EN 10029 limit deviations for thickness: class A limited flatness tolerances: class S
Testing:	for metal sheets and pre-cut sheets: ultrasonic testing of flat steel product according to EN 10160, quality class S1/E1
Documentation:	Inspection document 3.1 according to EN 10204 with extended melt analysis

4.2 Welding consumables and auxiliary materials

Welding wires:	massive welding wires grade G4Si1 according to EN ISO 14341, use of grade G3Si1 requires prior approval from REINTJES
Shielding gases:	according to EN ISO 14175 (for metal active gas welding)

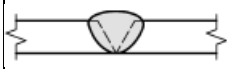
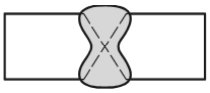
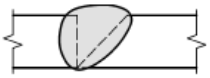
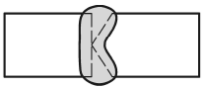
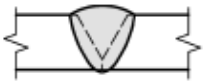
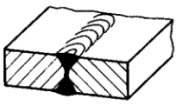
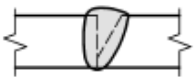
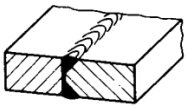
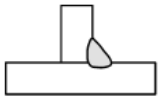
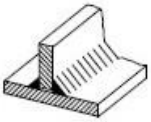
The manufacturer must ensure that all welding consumables and auxiliary materials used comply with the requirements set out by the classification societies.

Any use of consumables and auxiliary materials other than those specified herein requires prior approval from REINTJES.

5 Types of welds and joints

5.1 Selection

Table 1 Selection of preferred welds based on EN ISO 2553

no.	designation	illustration*	symbol	no.	designation	illustration*	symbol
1_2	single-V butt weld			2_1	double-V butt weld (X weld)		
1_4	single-bevel butt weld			2_2	double-bevel butt weld		
1_3	single-V butt weld with broad root face			x	double-V butt weld with broad root face		
1_5	single-bevel butt weld with broad root face			y	double-bevel butt weld with broad root face		
1_10	fillet weld			z	double fillet weld		

*Dotted lines indicate the seam preparation before welding

The grey lines in Table 1 are not part of the symbol. They indicate the position of the reference line.

The numbers beginning with „1_“ are part of table 1, the numbers beginning with „2_“ are part of table 2 of EN ISO 2553, examples with letters x, y and z are out of historic standards and only for symbolic representation.

For joining parts not specified in section 5.2 or section 5.3 a suitable weld type (preferably according to Table 1) may be chosen on manufacturer’s discretion taking into account the applicable standards (cf. section 2) and classification specifications.

If welds other than specified herein are better suited for the production procedure, they may be permitted in consultation with REINTJES.

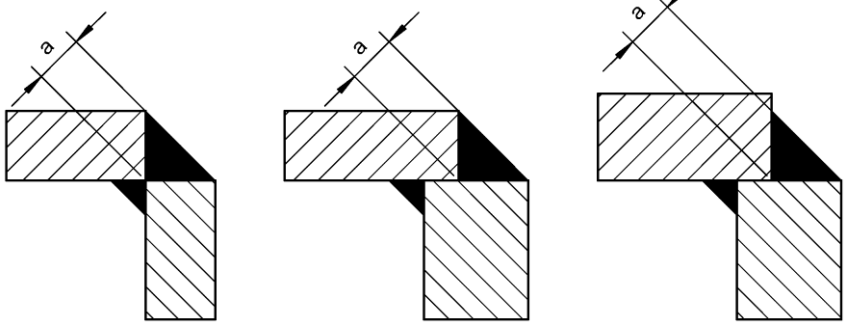


Figure 1
Execution of corner joints

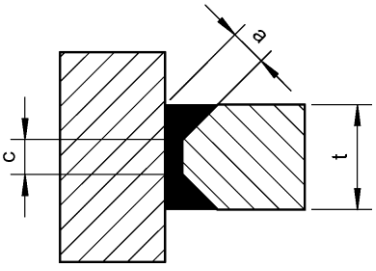


Figure 2
T-joint

5.2 Force-conducting welds

Table 2 Welded joints and weld types

no.	welded joints	weld type	no.[1)]	weld thickness[2)]
A.1	hubs - parting line	single-bevel butt weld, double-bevel butt weld	1_4, 2_2	fully penetrated
A.2	hubs - walls	t ≤ 40 mm: single-bevel butt weld, double-bevel butt weld, t > 40 mm: double-bevel butt weld with broad root face	1_4, 2_2 y	fully penetrated acc. to Table 3
A.3	split hubs (of thrust bearings)	double-V butt weld with broad root face, double-bevel butt weld with broad root face	x, y	fully penetrated
A.4	gearbox foundation - wall	t ≤ 40 mm: single-bevel butt weld, double-bevel butt weld t > 40 mm: double-bevel butt weld with broad root face	1_4, 2_2 y	fully penetrated acc. to Table 3
A.5	force-conducting ribs at thrust bearings and gearbox foundation			acc. to Table 4
A.6	cams or ribs with lifting holes for handling - wall			acc. to Table 4

Table 3 Width of root face c

plate thickness t [mm]	bar width c [mm][2)]
t ≤ 40	fully penetrated
40 < t ≤ 60	c = t - 40
60 < t	c = t / 3

[1)] according to Table 1 [2)] fully penetrated section according to EN ISO 9692-1

Table 4 Fillet weld thickness for force-conducting welds

sheet thickness t (thinner sheet)	corner joint		T-joint		minimum thickness of fillet weld a[2)]
[mm]	weld type	no.[1)]	weld type	no.[1)]	[mm]
t ≤ 10	fillet weld	1_10	double fillet weld	z	5
10 < t ≤ 18	fillet weld	1_10	double fillet weld	z	8
t > 18	single-V butt weld, single bevel butt weld	1_1, 1_4	double-bevel butt weld, double-bevel butt weld with broad root face	2_2, y	fully penetrated

5.3 Subordinate welds

Table 5 Subordinate welds

no.	welded joints	weld type	no.[1)]	weld thickness [mm][2)]
B.1	pierced cams, cover frames	fillet weld, both sides	1_10	5
B.2	weld-on cams, plates	fillet weld	1_10	5
B.3	fasteners to join peripheral elements	fillet weld, both sides	1_10	5
B.4	parting line - wall (T-joint)	double fillet weld	z	acc. to Table 6
B.5	wall - wall (corner joint, T-joint)	fillet welt, both sides	1_10	acc. to Table 6
B.6	rib - wall (T-joint) (to increase rigidity or reduce sound emissions)	double fillet weld	1_10	acc. to Table 6
B.7	rib to wall (accessible from one side)	single-bevel butt weld	1_4	fully penetrated

Table 6 Fillet weld thickness for subordinate welds

sheet thickness t (thinner sheet)	corner joint		T-joint		minimum thickness of fillet weld a[2)]
[mm]	weld type	no.[1)]	weld type	no.[1)]	[mm]
t ≤ 10	fillet weld	1_10	double fillet weld	z	5
10 < t ≤ 16	fillet weld	1_10	double fillet weld	z	8
16 < t ≤ 20	fillet weld	1_10	double fillet weld	z	12
20 < t ≤ 40	single-V butt weld, single bevel butt weld	1_2, 1_4	double-bevel butt weld, double-bevel butt weld with broad root face	2_2, y	fully penetrated

[1)] according to Table 1 [2)] fully penetrated section according to EN ISO 9692-1

5.4 Welds on housings

Examples of joined parts (numbers according to Table 2 and Table 5)

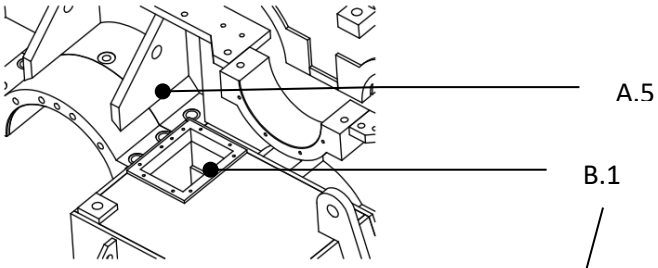


Figure 3 Detail thrust bearing

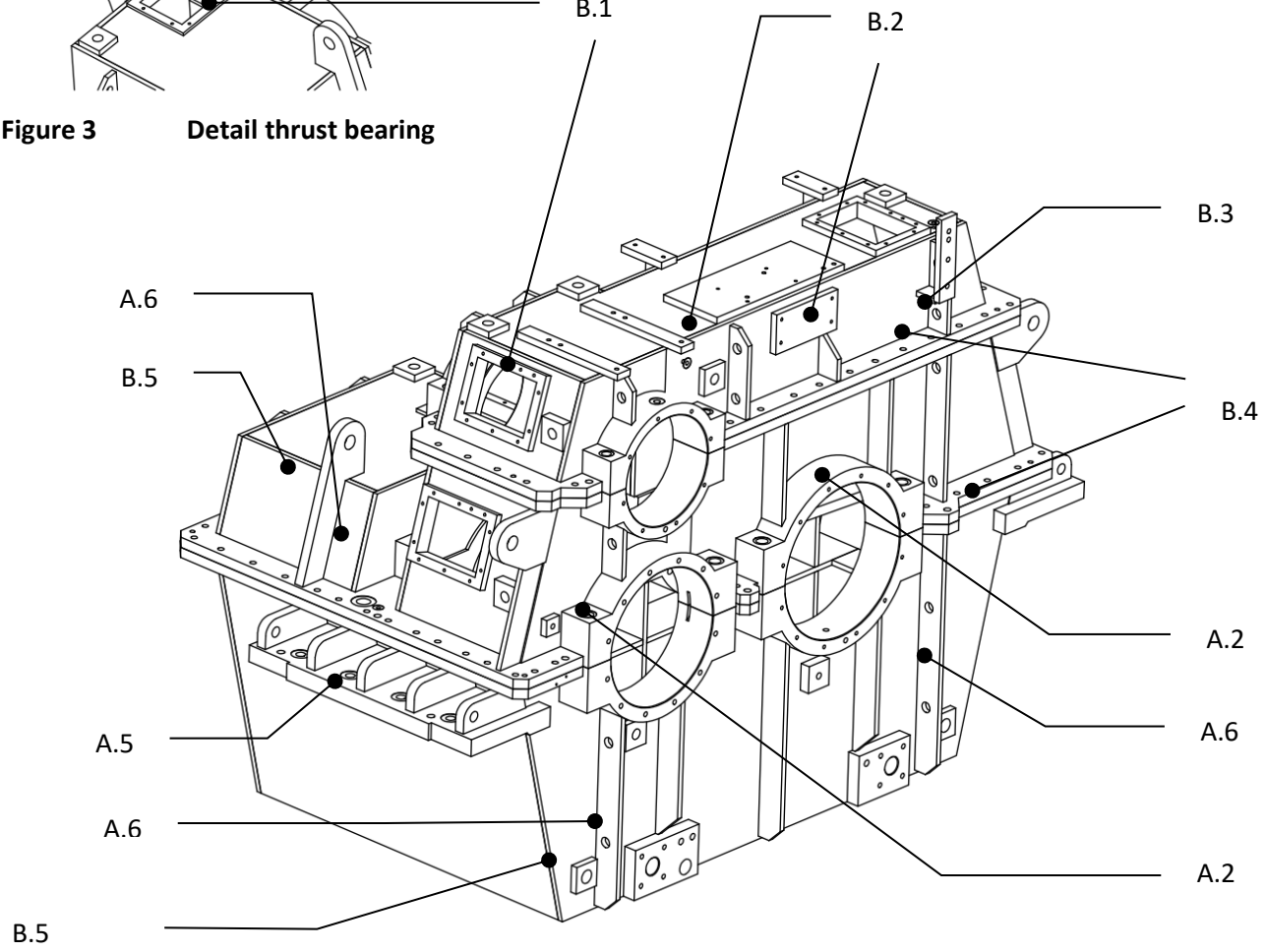


Figure 4 Housing, propeller side

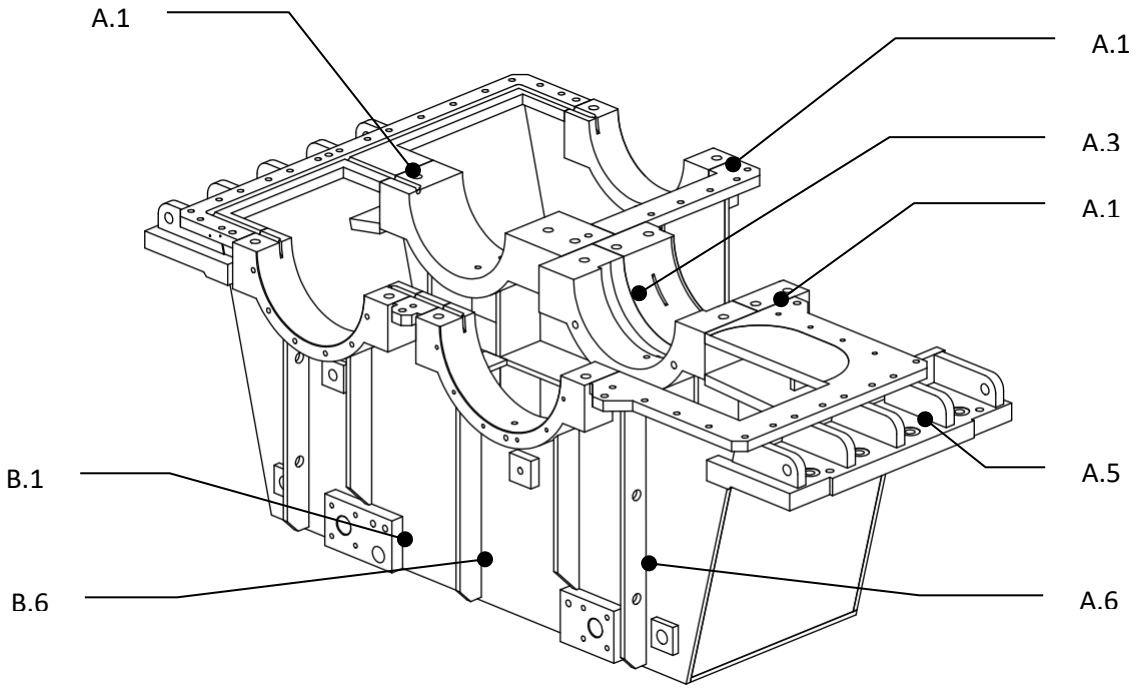


Figure 5 Housing, lower part

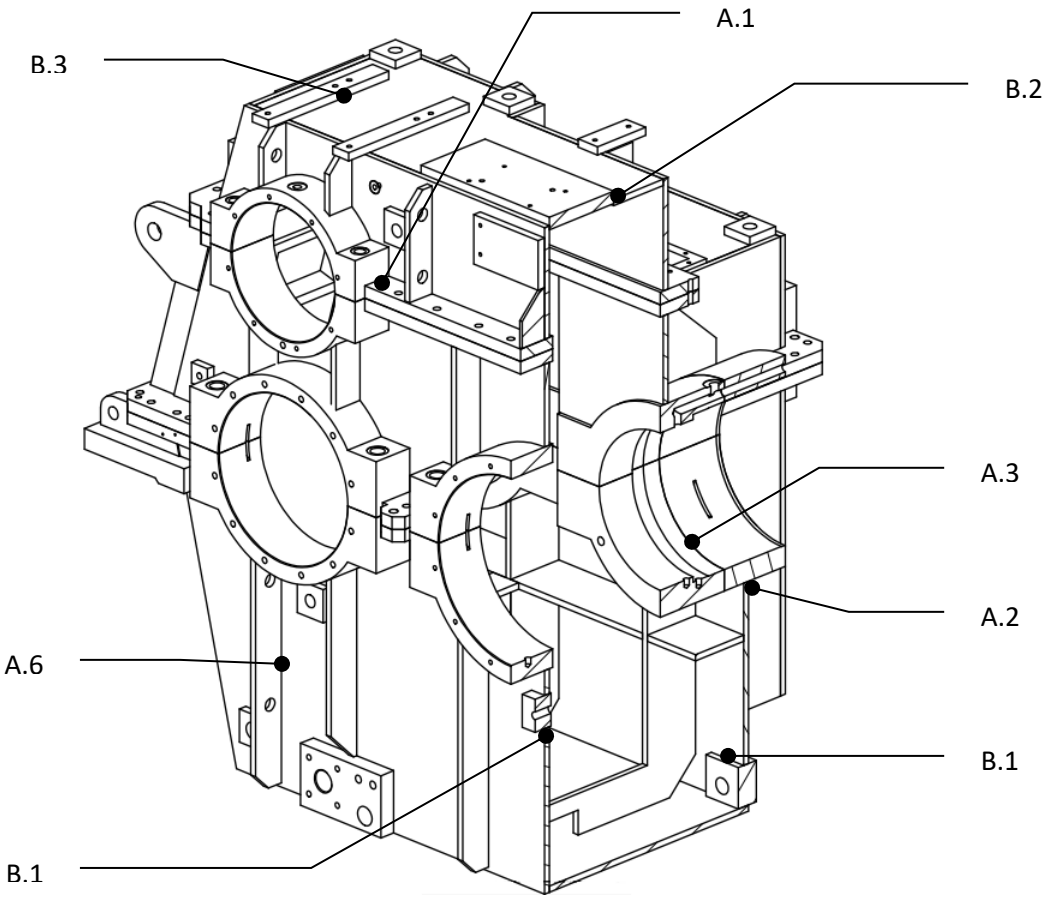


Figure 6 Housing, sectional view 1

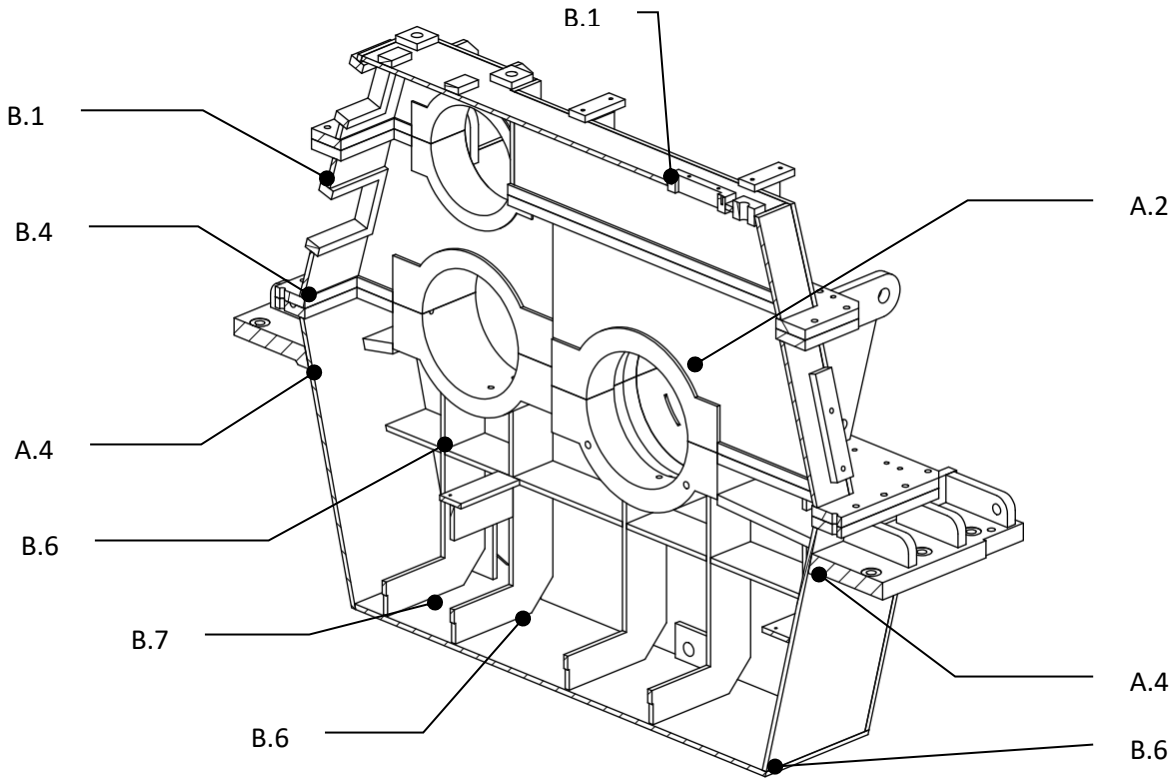


Figure 7 Housing, sectional view 2

6 Part preparation

Cutting sheets: Mechanical and thermal cutting processes are permitted for cutting sheets and preparing welds. Edge zones must be reworked mechanically in order to ensure good weldability.
Tolerances and roughness depth: acc. to EN ISO 9013 - 331.

Weld preparation: For all fully penetrated sections according to EN ISO 9692-1.

Cleaning: Welding joints and consumables must be dry and free from dirt and impurities when welding starts.

Thermal preparation:

- Welding operations, in particular gas-shielded arc welding, must be carried out free of any impact from draught and other weather conditions.
- Welding of steel whose temperature is below +5° C is not permitted.
- To avoid ruptures, plates with a thickness ≥ 20 mm shall be pre-heated in accordance with EN 1011-1 and 1011-2.

Labelling: It must be ensured that the parts can be clearly identified at any time during the production process.
Pre-cut metal sheets must be marked in a way that they can be assigned to the steel plate they originate from.
Every housing part must bear the drawing and commission number on the outer edge of the parting line. The labelling requirements acc. to RN 1936 must also be observed.

7 Welding operations

7.1 Tacking

Tack welds must

a) be carried out as economically as possible by qualified welding personnel.

b) be completely removed before welding starts, if the quality does not meet the requirements or if complete fusion is not ensured (never produce overlay welds on defective tack welds).

c) have a length of 50 mm minimum.

7.2 Welding

a) The welds must be carried out according to Section 5 of this factory standard taking into account the relevant international welding standards (cf. Section 2).

b) During welding and annealing auxiliary struts must be used, on manufacturer's discretion, to prevent impermissible distortion of the housing parts.

c) Butt welds, provided they are accessible, must be fully welded across the whole cross section on both sides. For this purpose, the root must be produced and counter-welded. If accessibility is limited, one side must be carried out as a fillet weld.

d) Fillet welds, if accessible, must be welded on both sides. Interrupted fillet welds are not permitted.

e) If multi-layer welds are produced, the slag of the previous weld must be completely removed before applying another weld.

f) Build-up welds on functional surfaces, such as hub bores, parting lines and seating surfaces must be agreed with and expressly approved by REINTJES before being carried out.

g) Weld defects, ruptures or pores in welds and tack welds must not be over welded, but adequately worked out.

h) During welding and cooling of seams the welded parts must not be exposed to shock or vibration.

7.3 Post-weld heat treatment

a) When all welding operations are completed stress-relief heat treatment of the housing is mandatory in order to reduce internal stress.
After that, any welding is prohibited.

b) The annealing furnace must be sufficiently dimensioned, have temperature control and temperature measuring equipment allowing for steady temperature control according to DIN 17052-1, quality class C, or comparable standards.

c) The temperature must be measured using temperature sensors at the maximum and minimum sheet thickness of the housing in order to ensure that it is completely heated.

d) The temperature profile over the treatment time must be recorded and the respective document must be included in the shipment.

e) Unless agreed otherwise, the parameters indicated in Table 7 shall apply to stress-relief annealing. High temperature gradients must be avoided in order to prevent internal stress and distortion.

f) After the housing cooled down to 200° C in the furnace it can be removed from the furnace to finally cool down in quiet air.

g) After it has cooled down the auxiliary struts must be removed. Tack welds for struts must be completely removed by grinding.

Table 7 Parameters for stress-relief heat treatment

max. sheet thickness t [mm]	max. heating speed [K/h]	max. cool-down speed [K/h]	holding time [Min.]	annealing temperature [°C]
t ≤ 30	100	80	120	550 – 600
30 < t ≤ 40				
40 < t ≤ 50				
50 < t ≤ 60			180	
60 < t ≤ 70	90	70		
70 < t ≤ 80	80	60		
80 < t ≤ 90	70	50	240	
t > 90				

7.4 Final inspections and checks

After post-weld heat treatment is completed the manufacturer must carry out the following inspections and checks (weld seams must be cleaned before inspection):

a) Visual inspection in accordance with EN ISO 17637 for all welds over their entire length.

b) Check for surface-near defects by means of magnetic particle testing according to EN ISO 17638 for 20 % of all welds, in particular for force-conducting fillet welds according to Section 5.2. Acceptance level 2 according to EN ISO 23278 must be complied with.

c) Ultrasonic examination of welded joints according to EN ISO 17640, testing class B, for all fully joined butt welds. Recording limits and acceptance levels 2 according to EN ISO 11666, technique 2 shall apply.

d) Leak test using appropriate testing procedures to be chosen by the manufacturer.

e) Dimensional inspection of the welded construction according to drawing specifications.

All results must be documented in an inspection report.