

## Delivery conditions for Castings

### Copper alloys

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### Changes

2024-05-03

The following changed in comparison to RN 860-4:2023-07-27:

- a) Chapter 3, Table 1: Coupling carrier removed from part category C
- b) Chapter 5, d: Wording for required certificates clarified
- c) editorially revised

|                             |                      |                                |                                    |                |
|-----------------------------|----------------------|--------------------------------|------------------------------------|----------------|
| Responsible Division:<br>EK | Editor:<br>M. Förste | Approval:<br>see doc. workflow | Technical reference:<br>C. Eschert | Page:<br>1 / 4 |
|-----------------------------|----------------------|--------------------------------|------------------------------------|----------------|

## 1 Scope

This factory standard applies in addition to the standards for raw castings of copper alloys acc. to EN 1982, especially for components made from CuAl10Fe5Ni5, quoted in chapter 2 and has priority over the standards listed below. Components according to this standard are generally intended for underwater applications. The specifications regarding leakage and leak tests refer to this application.

## 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 shall apply to all contents not covered by this factory standard.

|               |  |
|---------------|--|
| EN 1559-1     | Founding – Technical conditions of delivery – Part 1: General  |
| EN 1593       | Non-destructive testing - Leak testing - Bubble emission techniques  |
| EN 1982       | Copper and copper alloys - Ingots and castings   |
| EN 10204      | Metallic products – Types of inspection documents  |
| EN ISO 2624   | Copper and copper alloys - Estimation of average grain size  |
| EN ISO 3452-1 | Non-destructive testing - Penetrant testing - Part 1: General principles   |
| EN ISO 6506-1 | Metallic materials - Brinell hardness test - Part 1: Test method   |
| EN ISO 6892-1 | Metallic materials - Tensile testing - Part 1: Method of test at room temperature  |
| EN ISO 8062-3 | Geometrical product specifications (GPS) – Dimensional and geometrical tolerances for moulded parts – Part 3: General dimensional and geometrical tolerances and machining allowances for castings |
| VDG P 378     | Casting of test specimens from copper casting alloys for tensile testing (sand casting and gravity die casting)  |
| RN 72         | Packaging and Preservation; Supply parts for production  |
| RN 1936       | Labelling; Raw material, parts and gearboxes   |
| 0-124-77303   | production specification radius design   |
| on request    | HB measuring points  |

## 3 Designations

Materials for parts of copper alloys are named acc. to EN 1982:

**Table 1 Materials and part categories**

| Part category  | EN 1982 designation |
|--|---------------------|
| A) Housings  | CuAl10Fe5Ni5        |
| B) Covers, bearing housing, shaft nuts and small parts |                     |

## 4 Part-specific requirements

### 4.1 Chemical composition

**Table 2** Mass fractions for CuAl10Fe5Ni5 acc. to EN 1982, Tab. 34

|      | Al   | Cu   | Fe  | Mn  | Ni  | Bi   | Cr   | Mg   | Pb   | Si  | Sn  | Zn  |
|------|------|------|-----|-----|-----|------|------|------|------|-----|-----|-----|
| min. | 8.5  | 76.0 | 4.0 | -   | 4.0 | -    | -    | -    | -    | -   | -   | -   |
| max. | 10.5 | 83.0 | 5.5 | 3.0 | 6.0 | 0.01 | 0.05 | 0.05 | 0.03 | 0.1 | 0.1 | 0.5 |

### 4.2 Further requirements

|   |   |
|---|---|
| mechanical properties:                    | <ul style="list-style-type: none"> <li>▪ min. values for <b>CuAl10Fe5Ni5</b> acc. to EN 1982<br/>                     casting method: sand casting (-GS)<br/>                     tensile strength Rm: 600 N/mm<sup>2</sup><br/>                     0.2 %-yield strength Rp<sub>0.2</sub>: 250 N/mm<sup>2</sup><br/>                     elongation at break A: 13 %</li> <li>▪ Brinell hardness: 140 HBW</li> </ul>   |
| heat treatment:                           | <ul style="list-style-type: none"> <li>▪ residual stresses in the casting must be minimised (controlled cooling in the mould is preferable to stress relief annealing)</li> <li>▪ casting stress-relieved on delivery</li> </ul>  |
| samples:                                  | <ul style="list-style-type: none"> <li>▪ separately cast test samples acc. to VDG P 378 for test certificate acc. to chapter 5 d)</li> </ul>  |
| external and internal condition:          | <ul style="list-style-type: none"> <li>▪ smooth, clean surface without disturbing unevenness, free of cracks, pores, burrs, adhering sand, ceramic residues, oxide skins and streaks</li> <li>▪ machined on the outside acc. to the reference sample</li> </ul>   |
| leakage:                                  | <ul style="list-style-type: none"> <li>▪ general: housings must be water- and oil-tight under operating conditions, i.e. leakage rate &lt; 10<sup>-4</sup>Pa*m<sup>3</sup>/s</li> <li>▪ at the manufacturer: VT for conspicuous porosities and cracks                             <ul style="list-style-type: none"> <li>○ production step: after surface treatment</li> <li>○ scope: each casting, entire surface</li> <li>○ description: visually locate conspicuous porosities and cracks and leakage testing acc. to chapter 4.3</li> </ul> </li> <li>▪ at REINTJES: bubble test acc. to EN 1593 (acc. to test instructions)</li> </ul> |
| hardness measurement                      | <ul style="list-style-type: none"> <li>▪ only on special request</li> </ul>   |
| general tolerances, machining allowances: | <ul style="list-style-type: none"> <li>▪ see drawing</li> </ul>   |
| Radius design: (only part category A)     | <ul style="list-style-type: none"> <li>▪ acc. to production specification 0-124-77303 (unless specified otherwise in drawing or order)</li> </ul>   |

### 4.3 Leakage testing (PT)

|             |   |
|-------------|---|
| type        | <ul style="list-style-type: none"> <li>▪ modified dye penetrant testing acc. to EN ISO 3452-1 (red-white test)</li> </ul> |
| preparation | <ul style="list-style-type: none"> <li>▪ prepared and cleaned acc. to chapter 4.2 and EN ISO 3452-1</li> </ul>            |

- processing
  - apply a suitable penetrant from the inside and developer from the outside (spray, brush) on conspicuous areas
  - visual testing at the earliest 30 minutes after application of the penetrant, developer must be dry
  - no indications: passed test
  - existing indications: failed test, treatment of bad spots acc. to chapter 4.4
- post-treatment
  - remove penetrant and developer as far as possible
- documentation
  - logging and test report acc. to EN ISO 3452-1
  - in case of failed test additional documentation acc. to chapter 4.4

**4.4 Treatment of bad spots by manufacturer**

- Repair:
  - repair leaks and larger porosities with production welds by qualified welders after approval by REINTJES
  - do not fill bad spots, but grind them properly (no visible impurities, shrink holes etc., minimized notch effect)
- Documentation:
  - measure bad spots, write dimensions clearly and legibly on the casting (indicate length, width, depth, residual wall thickness and position)
  - photograph model number for identification ( housings only)
  - photograph casting so that bad spot(s) can be localized
  - make close-ups so that dimensions of bad spot(s) are clearly visible
- Information, Approval:
  - Photographs of casting and/or bad spot(s) and
  - short description of bad spot(s) (type, position, dimensions etc.)

must be sent to the purchasing and quality assurance departments of REINTJES for an assessment and the decision for further action

**5 Other requirements**

- 
- a) Steel and forging plant
    - certified acc. to: [DIN EN ISO 9001 ff.](#)
    - approved by at least two member societies of IACS
- 
- b) Packaging and Preservation
    - [RN 72](#)
- 
- c) Labelling
    - [RN 1936](#)
- 
- d) Documentation (must be digitally available upon delivery)
    - inspection certificate 3.1 in accordance with EN 10204 indicating chemical composition, Brinell hardness and tensile strength (for part category A and coupling carriers)
    - test certificate 2.2 in accordance with EN 10204 for part category B
    - REINTJES quality control plan (geometric dimensions)
    - initial sample acceptance drawing (only if requested in the order)
    - evidence of radioactivity