

## Delivery Conditions for case-hardened steel

### Open-die forged shafts of 18CrNiMo7-6 for rotors with peripheral speeds > 50 m/s

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**NOTE: In the event of deviating specifications regarding chemical analysis, mechanical properties or tolerances in the drawing, the latter shall take precedence!**

#### Changes

2023-04-06:  
The following changed in comparison to RN 1556-2:2010-10-13:

- a) transfer to new numbering system
- b) updated references
- c) editorially revised

Responsible division: PK	Editor M. Förste	Approval: see doc. workflow	Technical reference: C. Eschert	Page: 1 / 4
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## 1 Scope

This Factory Standard applies to	Material no.:	1.6587
	Material designation:	18CrNiMo7-6
	Delivery conditions:	open-die forged shaft hot formed; pre-turned
	Use case:	rotors with peripheral speeds > 50 m/s

## 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.

DIN 50602:1985-09	Metallographic examination; microscopic examination of special steels using standard diagrams to assess the content of non-metallic inclusions
EN 10204	Metallic products - Types of inspection documents
EN 10250-3	Open die steel forgings for general engineering purposes - Part 3: Alloy special steels
EN ISO 642	Steel - Hardenability test by end quenching (Jominy test)
EN ISO 643	Steels - Micrographic determination of the apparent grain size
EN ISO 683-3	Heat-treatable steels, alloy steels and free-cutting steels - Part 3: Case-hardening steels
EN ISO 6506-1	Metallic materials - Brinell hardness test - Part 1: Test method
EN ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
SEP 1923	Ultrasonic testing of steel forgings to stringent standards, in particular for components in turbine and generator systems
RN 72	Packaging and Preservation; Supply parts for production
RN 1550	Material samples
RN 1567	Remanent magnetism in components
RN 1936	Labelling; Raw material, parts and gearboxes

### 3 Chemical composition

**Table 1** Chemical composition in %

	C	Si	Mn	P	S	Cr	Mo	Ni	V	Cu
min	0,15	0,15	0,50		0,002	1,50	0,25	1,40		
max	0,19	0,40	0,60	0,015	0,005	1,70	0,35	1,70	0,10	0,30
	Sn	Al	N	Ti	Nb	Sb	O <sub>2</sub>	Ca	H <sub>2</sub>	Al / N
min		0,02	0,008							
max		0,04	0,012	0,006	0,05		15 ppm	0,0015	1,7 ppm	3,7

### 4 Physical characteristics

**Table 2** Mechanical properties

 (Test temperature: 20° C / degree of transformation:  $\phi \geq 6,0$ )

Rm	Rp <sub>0,2</sub>	A5 [%]		Z [%]		Av [J]	
[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	longit.	transv.	logit.	transv.	longit.	transv.
min.	min.	min.	min.	min.	min.	min.	min.
1080	785	10	8	40	25	35	25

## a) Structure, inclusions

- grain size, standard: EN ISO 643 Standard series: Table C.1;  $G \geq 6$
- purity degree, standard: DIN 50602 method: K;  $K3 \leq 20$

## b) Hardenability

- Standard: EN ISO 683-3 scatter band: +HH
- testing: EN ISO 642
- end distance [mm]:  $\underline{5}$   $\underline{11}$   $\underline{25}$   $\underline{40}$
- hardness [HRC]: 42-48 40-47 35-43 33-41

## c) Additional properties

- radioactivity:  $\leq 0,10$  Bq/g

### 5 Manufacturing

## a) Casting method: ingot casting

## b) Melting

- making process: E, LD, ESU (on special request)
- post-treatment: vacuum degassing (VD) for E or LD

## c) Heat treatment

- treatment condition: +QT
- treatment method: liquid quenching and tempering
- anneal to: 650 to 850 N/mm<sup>2</sup> tensile strength

## d) Surface condition

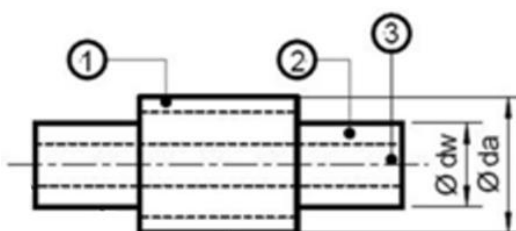
- defect depth:  $\leq$  machining allowance
- unmachined: rust-, crack- and scale-free prereturned: max. Rz 40
- repair by welding: not permitted

## e) Manufacturing tolerances see drawing details

## 6 Testing

- a) Ultrasonic testing
- standard: [SEP 1923](#)
  - scanning acc. to: [A3, A4, A7, A8, A9](#)
  - type of testing: [marginal and core zone testing](#)
  - probe specification: [4 MHz \(normal, TR and 45° angle probe\)](#)
  - sound attenuation: [≤ 6 dB/m](#)
  - examiner qualification: [EN ISO 9712, stage 2](#)
  - testing accuracy:

	<u>shaft</u>	<u>quality class</u>
Zone 1 (gearing):	0,8 × da bis da	<a href="#">1a</a>
Zone 2 (power transmission):	≥ 0,2 × dw	<a href="#">1a</a>
Zone 3 (remaining volume):	< 0,2 × dw	<a href="#">2a, 2b for EE+VE with extension</a>



da = bale diameter

dw = shaft diameter

**Figure 1 shaft**

- b) Material identification check: [to be carried out](#)

## 7 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) Sample material and collection
- [RN 1550](#)
- d) Remanent magnetism
- [RN 1567](#)
- e) Labelling
- [RN 1936](#)
- f) Documentation (must be digitally available upon delivery)
- acceptance test certificate EN 10204 - 3.1 per melt and furnace trip or per piece or production lot with specification of primary material and forging ratio
  - copy of the acceptance test certificate 3.1 from the steel manufacturer
  - evidence of radioactivity and remanent magnetism
  - forging schedule (on special request)