

Delivery Conditions for case-hardening steel

Steel bars 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 1558-3:2022-07-20:

- a) transfer to new numbering system
- b) updated references
- c) Para. 1: adjusted delivery conditions
- d) Para. 5 f: adjusted manufacturing tolerances
- e) editorially revised

Responsible division: PK	Editor: M. Förste	Approval: see doc. workflow	Technical reference: C. Eschert	Page: 1 / 5
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1 Scope

This standard applies to	Material-No.:	1.6587
	Material designation:	18CrNiMo7-6
	Delivery conditions:	Steel bar forged / rolled / peeled (+SH)
	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 50125	Testing of metallic materials - Tensile test pieces
DIN 50602:1985-09	Metallographic examination; microscopic examination of special steels using standard diagrams to assess the content of non-metallic inclusions
EN 10021	General technical delivery conditions for steel products
EN 10060	Hot rolled round steel bars - Dimensions and tolerances on shape and dimensions
EN 10204	Metallic products - Types of inspection documents
EN 10228-3	Non-destructive testing of steel forgings - Part 3: Ultrasonic testing of ferritic or martensitic steel forgings
EN 10277	Bright steel products - Technical delivery conditions
EN 10278	Dimensions and tolerances of bright steel products
EN 10308	Non-destructive testing - Ultrasonic testing of steel bars
EN ISO 148-1	Metallic materials - Charpy pendulum impact test - Part 1: Test method
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 9443	Surface quality classes for hot-rolled bars and wire rod
EN ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
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		0,50			1,50	0,25	1,40		
max	0,21	0,40	0,90	0,025	0,010	1,80	0,35	1,70		0,30
	Sn	Al	N	Ti	Nb	Sb	O ₂	Ca	H ₂	Al / N
min		0,02	0,008							
max		0,05	0,015	0,006			25 ppm	0,0015	2,0 ppm	4,0

4 Physical characteristics

Table 2 Mechanical properties

(Test temperature: 20 °C)

Rm	Rp _{0,2}	A5 [%]			Z [%]			Av [J]		
[N/mm ²]	[N/mm ²]	longit.	tang.	cross	longit.	tang.	cross	longit.	tang.	cross
min	min	min	min	min	min	min	min	min	min	min
1080	785	12	10	8	45	35	25	45	35	25

Note: The final mechanical properties can only be achieved after heat treatment (case hardening or quenching and tempering), which is usually carried out at REINTJES. When delivered, the material has lower strengths (see para. 5 d).

a) Structure, inclusions

- grain size, standard: EN ISO 643 standard series: Table C.1; G ≥ 5
- purity degree, standard: DIN 50602 method: K; K4 ≤ 20

b) Hardenability

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

c) Additional properties

- radioactivity: ≤ 0,10 Bq/g

5 Manufacturing

a) Casting method

- bar Ø d_N < 180 mm: continuous or ingot casting bar Ø d_N ≥ 180 mm: ingot casting
- bar Ø d_N ≥ 250 mm: forged

b) Forging reduction ratio (VG)

- forged: VG ≥ 5,0
- Ingot casting, forged: VG ≥ 3,0 hot rolled: VG ≥ 4,0

c) Melting

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

d) Heat treatment

- treatment condition: +FP / +QT
- treatment method: liquid quenching and tempering
- anneal to: 600 up to 850 N/mm² tensile strength

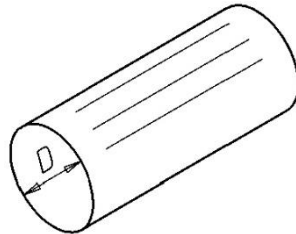
- e) Surface condition
- unmachined
 - $d_N \leq 160$: surface finish EN ISO 9443 - Class A
 - peeled (+SH) permissible defect depth
 - $160 < d_N \leq 200$: ≤ 1 mm
 - $200 < d_N \leq 350$: ≤ 2 mm
 - $350 < d_N$: ≤ 3 mm
 - repair by welding: only after approval by REINTJES

- f) Manufacturing tolerances
- $d_N \leq 160$: EN 10060, Table 1, regular
 - $d_N > 160$: $d_N + 2$ mm / 0 mm

6 Testing

- a) Ultrasonic testing
- standard: EN 10228-3 (forged and machined)
EN 10308 (unmachined)
 - scanning according to: table 3, 1a, grid scanning
 - type of testing: marginal and core zone testing
 - probe specification: 4 MHz (normal and TR probe)
 - sound attenuation: ≤ 6 dB/m
 - examiner qualification: EN ISO 9712, stage 2
 - testing accuracy:

	<u>diameter</u>	<u>quality class</u>
○ steel bar, peeled / dipping bath		
zone 1 (gearing):	$D \geq 0,3 \times d_N$	4
zone 2 (power transmission):	$D < 0,3 \times d_N$	4
○ steel bar, unmachined		
entire diameter:	$0 < D \leq d_N$	3



d_N = nominal size, bar diameter

Figure 1 Steel bar

- 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
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- b) Delivery condition
- bar length: $\leq 6,3$ m end faces: [mechanically separated](#)
 - bar weight: ≤ 10 t peeled bars (+SH): [EN 10277, Tol. h10](#)
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- c) Packaging and preservation
- [RN 72](#)
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- d) Sample material and collection
- [RN 1550](#)
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- e) Remanent magnetism
- [RN 1567](#)
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- f) Labelling
- [RN 1936](#)
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- g) 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)