

Delivery Conditions for quenched and tempered steel

Drop-forged parts of 42CrMo4 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 1560-6:2021-03-15:

- 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 / 5
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1 Scope

This Factory Standard applies to	Material no.:	1.7225
	Material designation:	42CrMo4
	Delivery conditions:	shaft / drop-forged hot formed; unmachined / 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 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 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 683-2	Heat-treatable steels, alloy steels and free-cutting steels - Part 2: Alloy steels for quenching and tempering
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.	0,38	0,10	0,60			0,90	0,15			
max.	0,45	0,40	0,90	0,025	0,010	1,20	0,30	0,60		0,30
	Sn	Al	N	Ti	Nb	Sb	O ₂	Ca	H ₂	Al / N
min.		0,02	0,008							
max.	0,05	0,05	0,015	0,006			25 ppm		2,0 ppm	4,0

4 Physical characteristics

Table 2 Mechanical properties

(Test temperature: 20° C)

Diameter		Rm		Rp _{0,2}	A5 [%]			Z [%]			Av [J]		
[mm]		[N/mm ²]	[N/mm ²]	[N/mm ²]	longit.	tang.	transv.	longit.	tang.	transv.	longit.	tang.	transv.
over	up to	min.	max. ¹⁾	min.	min.	min.	min.	min.	min.	min.	min.	min.	min.
	40	1000	1300	800	11	9	-	45	25	-	35	25	-
40	100	900	1200	700	12	10	8	50	25	15	35	27	-
100	160	850	1150	600	13	11	9	50	25	15	35	27	21
160	250	800	1100	550	14	12	10	55	35	25	35	27	21
250	500	750	1050	500	15	13	11	50	35	25	35	27	21
500	750	700	1000	450	16	14	12	45	30	20	35	27	18
750	1000	650	950	400	16	14	12	45	30	20	35	27	18

¹⁾ deviating from EN ISO 683-2

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 683-2 scatter band: +HH
- testing: EN ISO 642
- end distance [mm]: 5 11 25 40
- hardness [HRC]: 55-61 48-59 39-53 36-47

c) Additional properties

- radioactivity: ≤ 0,10 Bq/g

5 Manufacturing

- a) Proceedings
 - casting method: [continuous or ingot casting](#)
 - reshaping input material: [rolling / forging](#)

- b) Forging reduction ratio (VG)
 - input material: [VG ≥ 4,0](#) completed: [VG ≥ 5,0](#)

- c) Melting
 - making process: [E, LD, ESU \(on special request\)](#)
 - post-treatment: [vacuum degassing \(VD\) for E or LD](#)

- d) Heat treatment
 - treatment condition: [+QT](#)
 - treatment method: [liquid quenching and tempering](#)

- e) Tolerances
 - Standard: [EN 10243-1, Table 1 \(forging quality F\)](#)
 - repair by welding: [only after approval by REINTJES](#)

6 Testing

- a) Ultrasonic testing, input material
 - standard: [EN 10308](#)
 - scanning acc. to: [Table 1, entire testing](#)
 - type of testing: [marginal and core zone testing](#)
 - probe specification: [2 to 4 MHz \(vertical probe\)](#)
 - sound attenuation: [≤ 6 dB/m](#)
 - examiner qualification: [EN ISO 9712, stage 2](#)
 - testing accuracy:

<u>thickness</u>	<u>diameter</u>	<u>quality class</u>
○ t ≤ 160	entire diameter	4
○ 160 < t ≤ 180	outside (2/3 t resp. 2/3 D)	4
	core (1/3 t resp. 1/3 D)	3
○ t > 180		by agreement

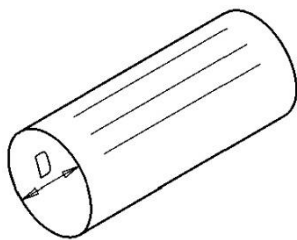
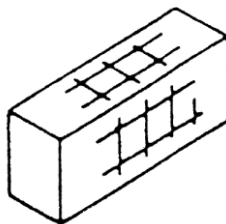
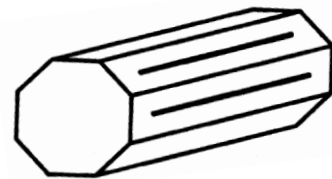


Figure 1 steel bar, Type 1a



Type 1b



Type 1c

- b) Ultrasonic testing, forging blank
 - Standard: [EN 10228-3](#)
 - scanning acc. to: [Table 3, 1a, grid scanning, for 10 % of lot size](#)
 - 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>
○ zone 1 (power transmission):	D ≥ 0,3 dw	4
○ zone 2 (core cross-section):	D < 0,3 dw	3

- c) 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) Packaging and preservation
- [RN 72](#)
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- c) Sample material and collection
- [RN 1550](#)
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- d) Remanent magnetism
- [RN 1567](#)
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- e) Labelling
- [RN 1936](#)
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- 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)