

Replaces:  
RN 1563-1:2018-06-12

## Delivery Conditions for nitriding steel

### Steel bars and forged shafts of 31CrMoV9 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 1563-1:2018-06-12:

- a) transfer to new numbering system
- b) updated references
- c) editorially completely 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.:	1.8519
	Material designation:	31CrMoV9
	Delivery conditions:	steel bar / shaft; forged / rolled hot formed; unmachined
	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 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 683-5	Heat treatable steels, alloy steels and free-cutting steels - Part 5: Nitriding 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.	0,27		0,40			2,30	0,15		0,10	
max.	0,34	0,40	0,70	0,02	0,025	2,70	0,25		0,20	0,30
	Sn	Al	N	Ti	Nb	Sb	O <sub>2</sub>	Ca	H <sub>2</sub>	Al / N
min.		0,01								
max.	0,05	0,04	0,012				25 ppm		2,0 ppm	3,7

### 4 Physical characteristics

**Table 2** Mechanical properties

(Test temperature: 20° C)

Diameter		Rm		Rp <sub>0,2</sub>	A5 [%]			Z [%]			Av [J]		
[mm]		[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	[N/mm <sup>2</sup> ]	longit.	tang.	transv.	longit.	tang.	transv.	longit.	tang.	transv.
over	up to	min.	max.	min.	min.	min.	min.	min.	min.	min.	min.	min.	min.
	40	1100	1300	900	9	7	-	35	25	-	25	15	-
40	100	1000	1200	800	10	8	6	35	25	15	30	20	15
100	160	900	1100	700	11	9	7	35	25	15	35	25	20
160	250	850	1050	650	12	10	8	35	25	15	40	27	22
250 <sup>1)</sup>	500	800	1000	600	12	10	8	40	30	20	35	25	20

<sup>1)</sup> values not contained in EN ISO 683-5

**a) Structure, inclusions**

- grain size, standard: EN ISO 643
- purity degree, standard: DIN 50602

 Standard series: Table C.1; G ≥ 5  
 method: K; K4 ≤ 20

**b) Hardenability**

- Standard: EN ISO 683-5
  - testing: EN ISO 642
- |                    |          |           |           |           |
|--------------------|----------|-----------|-----------|-----------|
| end distance [mm]: | <u>5</u> | <u>11</u> | <u>25</u> | <u>40</u> |
| hardness [HRC]:    | 47-56    | 46-56     | 39-53     | 36-50     |

**c) Additional properties**

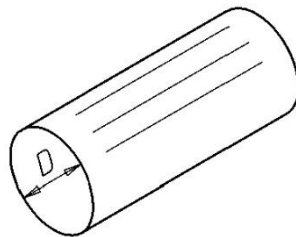
- radioactivity: ≤ 0,10 Bq/g

## 5 Manufacturing

a) Casting method and forging ratio			
• bar $\varnothing < 180$ mm:	continuous or ingot casting	bar $\varnothing \geq 180$ mm:	ingot casting
• bar $\varnothing < 250$ mm:	rolled / forged	bar $\varnothing \geq 250$ mm:	forged
b) Forging reduction ratio (VG)			
• forged:	VG $\geq 5,0$	rolled:	VG $\geq 4,0$
• ingot casting, forged:	VG $\geq 3,0$		
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) Surface condition			
• defect depth:	$\leq$ machining allowance		
• unmachined:	crack- and scale-free	returned (on request):	Ra 6,3 (max. Rz 63)
• repair by welding:	only after approval by REINTJES		
f) Manufacturing tolerances	EN 10060		

## 6 Testing

a) Ultrasonic testing			
• standard:	EN 10228-3		
• scanning acc. to:	Table 3, 1a, grid scanning		
• type of testing:	marginal and core zone testing		
• probe specification:	4 MHz (normal and TR probe)		
• sound attenuation:	$\leq 6$ dB/m		
• examiner qualification:	EN ISO 9712, stage 2		
• testing accuracy:			
○ steel bar, pre-turned / dipping bath	<u>diameter</u>	<u>quality class</u>	
zone 1 (gearing):	$D \geq 0,3 \times dw$	4	
zone 2 (power transmission):	$D < 0,3 \times dw$	4	
○ steel bar, unmachined			
entire diameter range:	$0 < D \leq dw$	3	



dw = bar diameter

Figure 1 Steel bar

b) Material identification check:	to be carried out
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## 7 Other requirements

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- 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:  $\leq 10$  t
- 
- c) Packaging and preservation
- [RN 72](#)
- 
- d) Sample material and collection
- [RN 1550](#)
- 
- e) Remanent magnetism
- [RN 1567](#)
- 
- f) Labelling
- [RN 1936](#)
- 
- 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)