Steels for larger forged parts
Quality Instructions

STAHL-EISEN-WERKSTOFFBLATT 550 3rd Edition

The sections marked with a dot (•) contain information about the agreements to be made for an order or which can be made.

1. Scope

1.1 This material data sheet covers steels, which are used in a heat-treated or normalized condition for larger open die forged construction parts also at higher temperatures (please see also section 7.4). [1)]

1.1.1 For the scope regarding the used cross section to be taken into consideration this material data sheet is in relation to DIN 17 100 – heat-treatable steels.

For limiting the scope further the following data sheets must be stated:

SEW 555 (Stahl-Eisen-Werkstoffblatt) – steels for larger forged parts as construction parts of turbines and generator plants – (in future):

SEW 089 Part 6 (Stahl-Eisen-Werkstoffblatt) – forged parts of fine grain construction steels suitable for welding – (in preparation);

SEW 620 (Stahl-Eisen-Werkstoffblatt) – forged parts of heat-resistant steels suitable for welding – (new issue in preparation);

SEW 640 (Stahl-Eisen-Werkstoffblatt) – steels for parts in the primary circuit of nuclear power plants -;
SEW 640 (Stahl-Eisen-Werkstoffblatt Addendum 1 – steels for nuts and bolts for the use at slightly higher temperatures as construction parts in the primary circuit of nuclear power plants – (in preparation).

2. Denominations

Steels for larger forged parts are heat-treatable steels with cross sections taken into consideration and chemical compositions corresponding to the requirements.

3. Dimensions and allowable dimension deviations

• The dimensions and the admissible dimension deviations must be agreed upon when ordering.

4. Weight calculation and allowable weight deviations

4.1 For calculating the nominal weight of a forged part from steels according to this material data sheet a densitiy of 7.85 kg/dm³ is assumed.

4.2 • The admissible weight deviations can be agreed upon when ordering.

1) The preceding issue of the SEW 550 (Stahl-Eisen-Werkstoffblatt) (of 1957) covers a relatively large number of steel grades for forged parts of various types and for different applications; e.g. including those for the turbine and generator industry. It has proven to be recommendable, to cover the steel qualities required for these construction parts in a special date sheet (SEW 555). The existing issue of he SEW 550 therefore contains only those steel grades, which are used for more general applications such as for the machine tool industry and which are partly similar to the standard heat-treatable steels.

5. Grade classification and steel selection

5.1 This material data sheet covers the steel qualities as stated in table1. They are principally classified according to the chemical composition and are killed. These steels are special steels.

5.2 Selecting the steel quality is the responsibility of the buyer. It is recommended to ask the producer for assistance.

6. Denomination

The short names for the steel grades are in correspondence with section 2.1.2 of the explanatory comments to the standard book 3, the Werkstoff-Nos. are determined according to DIN 17 007 sheet 2.

7. Requirements

7.1 Method of Melting

- The producer decides on the method of melting and desoxidation as long as nothing else has been agreed upon when ordering.
The method of melting must be made known to the buyer on request.

7.2 Supply condition

7.2.1 Normally the forged parts are supplied in a condition finish heat-treated, machined according to the details as stated in the drawings

7.2.1.1. The type of heat-treatment to achieve the guaranteed properties is at the discretion of the producer; it must be stated on request of the buyer.

7.2.21. Normally the forged parts must be supplied separated according to heats.

7.3. Chemical composition

- For the chemical composition as per melt analysis table 1 applies. Deviations from the composition limits as stated in table 1 are allowed as long as the guaranteed properties are not influenced negatively. In special cases an agreement about the deviations must be reached with the buyer.

7.4. For the forged parts the values for the mechanical properties as stated in tables 2 – 4 are guaranteed.

7.4.1.1 The following cross section shapes and dimensions can e used as near equivalents to the governing diameters for the heat-treatment [2]) (see tables 2 – 4):

a) for cylindrical solid parts – the diameter;
b) for non-cylindrical solid parts – factor 1.5 of the smallest corner length
c) for open cylindrical hollow bodies:
   - 2 times of the wall thickness, if the interior diameter is smaller than 80 mm
   - 1.75 times of the wall thickness, if the interior diameter is between 80 and 200 mm
   - 1.5 times of the wall thickness, if the interior diameter is more than 200 mm

d) for closed cylindrical hollow bodies – 2.5 times of the wall thickness
e) for non-cylindrical hollow bodies the governing diameter for the heat-treatment must be judged analogously according to section c) or d).

7.4.1.2 • The indication of certain limits for the governing diameter for the heat-treatment does not mean, that the corresponding forged parts can be through heat-treated down to the core. If such a condition of a forged part is demanded the producer must be informed and an understanding about the suitable steel quality must be reached between the buyer and the producer or – if necessary – a special agreement must be made.

7.4.2 An overview about the minimum values of the yield strength at room temperature in relation to areas of the governing diameter for the heat-treatment is given in table 5[3]) as an indication for the applicaton.

7.5. Technological Properties

Suitability for welding

The steels according to this data sheet can only be welded under consideration of the for the quality individually required measures. In case welding is done by the producer a consultation with the customer is recommended.

For welding of constructions the steel grades Ck 22, 20 Mn 5, 28 Mn 6, 20 MnMoNi 4 5, NiMoCr 4 7, 24 CrMo 5 are to be preferred.

7.6. Physical Properties

7.6.1. The (dynamic) modulus of elasticity of the steels changes with the temperature approximately as follows [4)5)]:

at	20°C	100°C	200°C	300°C	400°C	(500°C)	(600°C)
10^3 N/mm²	212	207	200	193	184	(175)	(164)

7.6.2 The medium linear coefficient of thermal expansion is approximately [4)5)]

between	20°C and	100°C	200°C	300°C	400°C	(500°C)	(600°C)
10^{-6} K^{-1}		12.5	13.2	13.7	14.2	(14.6)	(14.9)

2) for this and other technical expression of the heat treatment see DIN 17 014 sheet 1
3) table 5 see page 5
4) These are medium (average) values of values measured at steels according to this technical data sheet and other comparable steels after examinations in the near past; the values measured at various steels can be averaged because the property values in relation to the covered steel qualities fluctuate only insignificantly. See in this respect especially the following publications: Fink, K., F. Richter, U. Lotter u. K. Schrecke: Thyssen-Research. 2 (1970) S. 65/80: Richter, F: The most important physical properties of 52 iron qualities, Steel iron special report copy 8, Düsseldorf 1973.
5) With regard to the scope of this technical data sheet the values for 500°C and 600°C are stated in brackets.

7.7. Condition at the surface and within the interior

7.7.1. The forged parts must be free of any defects which might influence their application negatively more than normal.

7.7.2. The parts supplied in non-machined condition should have a smooth surface as well as the modern forging technology allows.

7.7.2.1. Within the machining allowance surface defects are allowed and can be removed as long as the application of the product is not influenced in a negative way.

7.7.3. Repairs of defects by welding required the approval of the buyer or his representative.

8. Tests

8.1 Delivery tests

- For orders of forgings from the steels acc. to this technical data sheet delivery tests can be agreed upon, which normally are carried out by experts of the supplying mill – but also - as per special agreement – by external representatives of the buyer.

8.2 Heat treatment condition at the test

8.2.1. The parts are normally tested in the heat treatment condition, for which the guaranteed mechanical properties are stated in tables 2 to 4.

8.2.2. • A test in other heat-treatment conditions, taking samples from the piece before the heat-treatment and their seperate and/or special heat-treatment must be especially agreed upon when ordering

8.3 Scope of testing

8.3.1 test units

8.3.1.1 The forged parts should be tested separated by heat numbers and heat-treatment lots.

8.3.1.2. Forged parts with similar dimensions and similar forging ratio from the same heat and the same heat-treatment lot are combined into one testing unit. In case the total weight of the pieces of such a testing unit is less than 10 tons one piece will be tested; in case of a larger total weight two pieces are tested.

8.3.1.2.1. • in all other cases the size of the testing units and the number of pieces of the testing units to be tested will be chosen by the producer accordingly as long as there are no other agreements when ordering.

8.3.1.2.2. If in other so far valid supply instructions more comprehensive testing units and/or smaller numbers of pieces to be tested per testing unit are stated compared with the ones stated in section 8.3.1.2. then these instructions should remain valid.

8.3.1.3. • It must be stated in the order if each piece should be tested individually.

8.3.2. **Tests to be executed and number of samples**

8.3.2.1. From parts for testing as per sections 8.3.1.2 to 8.3.1.3 normally one sample each must be taken for the tensile test and 3 samples for the notch impact-bending test.

8.3.2.2. • In case no testing of the tensile strength and no notch impact-bending test is considered or the taking of samples is impossible then a hardness test can be done. The hardness values to be observed in that case must be agreed upon.

8.3.2.3. • If the yield strength at increased temperature should be examined this must be be stated explicitly in the order sheet. The yield strength might be checked only at one sample and only at one temperature above room temperature (within the temperature range as per table 4). The testing temperature must be indicated in the order sheet.

8.3.2.4. • A non-destructive test (e.g. ultrasonic test or as per the electromagnetic method) must be agreed upon when ordering.

8.4. Sample taking

8.4.1. The samples in sufficient number of pieces must be taken either directly from the part or an additional allowance for the samples in sufficient lengths must be given.

- At the forged parts material for the samples for repeat tests and – in case this has been agreed upon when ordering – sample material for tests of the buyer must be given.

8.4.2. When taking samples for tensile tests and notched-bar tests a difference must be made between their geometric location in the part and their position in relation to the grain flow.

8.4.2.1. The acronyms L,T,Q used in tables 2 and 3 name the position of the samples in relation to the grain flow and must be understood within this technical data sheet as follows:

L: the longitudinal axle of the sample is parallel to the general stretch direction of a non-curved grain flow
T: the longitudinal axle of the sample cuts a curved grain flow as a type of chord (and thus takes a certain 'sloping position' to the grain flow)
Q: the longitudinal axle of the sample cuts a – curved or non-curved – grain flow vertically

Samples with their longitudinal axle in direction of an additional up-setting (vertically to it's width) of the grain flow (so called sample location in 'thickness direction') do not fall under the sample position marked as Q (see section 8.4.2.1.2)

8.4.2.1.1 • In case of doubt the sample taking with regard to their position to the grain flow and under consideration of these instructions must be agreed upon when ordering. If there are no agreements the position of the samples with regard to the grain fow will be determined by the producer.

8.4.2.1.2. • Taking samples of which the longitudinal goes through a spread grain flow vertically to the broadening (in thickness direction), must be agreed upon especially when ordering whereas the minimum values to be observed must be determined - especially of the toughness values.

8.4.2.2. • When ordering the position of the samples in relation to the geometry of the part which might be important for the mechanical load can be agreed upon. In this case it must be checked, though, whether and to what extent the guaranteed values of the mechanical properties stated in tables 2 and 3 – especially the minimum toughness values set with regard to the grain flow – correspond to those requirements. If necessary the values of the mechanical properties to be guaranteed must be agreed upon in such cases.

8.4.3. For the sample taking location within the cross section the following applies:

The samples must be taken from the cross section area between the surface and 1/6 of the diameter or the (wall) thickness and maybe in a corresponding distance from another, neighbouring surface.

- If another location for the taking of the samples in the cross section must be considered then this must be agreed upon in the order sheet; the values of the mechanical properties to be guaranteed must also be determined.

8.5. Test methods to be applied

8.5.1. • The chemical composition is to be determined according to the method set by the Committee of the Chemical Engineers of the Association of German Ironworks Experts [6]. Methods not set by the Committee must be especially agreed upon.

8.5.2. The tensile test must be executed according to DIN 50145. Normally a short proportional test bar (with the measuring length $L_o = 5\ d_o$) according to DIN 50 125 should be used; the result determined with this bar is decisive in arbitration cases.

8.5.2.1. If the yield point is cannot be clearly determined then the 0.2 % yield strength must be identified.

8.5.3. The hardness test must be executed according to DIN 50103 (hardness test acc. to Rockwell), DIN 50133 (hardness test acc. to Vickers) or DIN 50351 (hardness test acc. to Brinell).

8.5.4. The notched bar test must be executed acc. to DIN 50115 at DVM-samples.

8.5.4.1. The impact value is to be determined as average from 3 tests at samples, which are positioned always side by side in the same distances from the surface or – in case this is impossible or does not make sense – directly one after the other in the same part.

8.5.5. • For non-destructive tests the method to be used must be agreed upon when ordering.

8.6. Repeat tests

8.6.1. If the insufficient result of a test is obviously due to defects in the testing technology or a closely limited defect spot of a sample then the wrong result must not be considered for the decision about meeting the requirements and the corresponding test must be repeated.

8.6.2. If the results of a correct test are insufficient for the requirements set a repeat test can be done which normally means two more tests at the same sample for each insufficient test result.

The part is to be considered to meet the conditions if both repeat tests are satisfactory. It can be rejected if one of the two repeat tests are insufficient.

8.6.3. If the reason for an insufficient test can be removed by a corresponding heat-treatment then the part can be heat-treated again after which the test must be repeated.

8.7. Test certificates

- The delivery test is certified by a certificate according to DIN 50 049. The type of the certificate is to be agreed upon when ordering.

9. Claims [7]

9.1 External and interior defects can only be claimed if they considerably influence the steel quality and the type of the forged part and its application negatively.

9.2. The buyer must allow the supplying mill within a reasonable time limit to convince themselves that the claim is justified; as much as possible by providing the claimed part and reference samples of the quality supplied.

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[6] Manual for the Iron Works Laboratory, volume 2; The examination of metallurgical material; volume 4: arbitration analysis, volume 5: additional volume; Düsseldorf, Verlag Stahleisen mbH, always the latest valid issue.

[7] Explanations regarding this claim clause in quality standards for iron and steel see DIN-publication 40 (1961) page 111/122

table 5. chart for the minimum values of the yield strength in heat-treated condition.
The yield limit valid for one steel quality or possibly several steel grades is marked with a thick stroke directly under the short denomination.
The foot notes 1 to 5 state the total stated diameter range of the individual minimum value of the yield limit of the individual steel grade as per tables 3 and 4

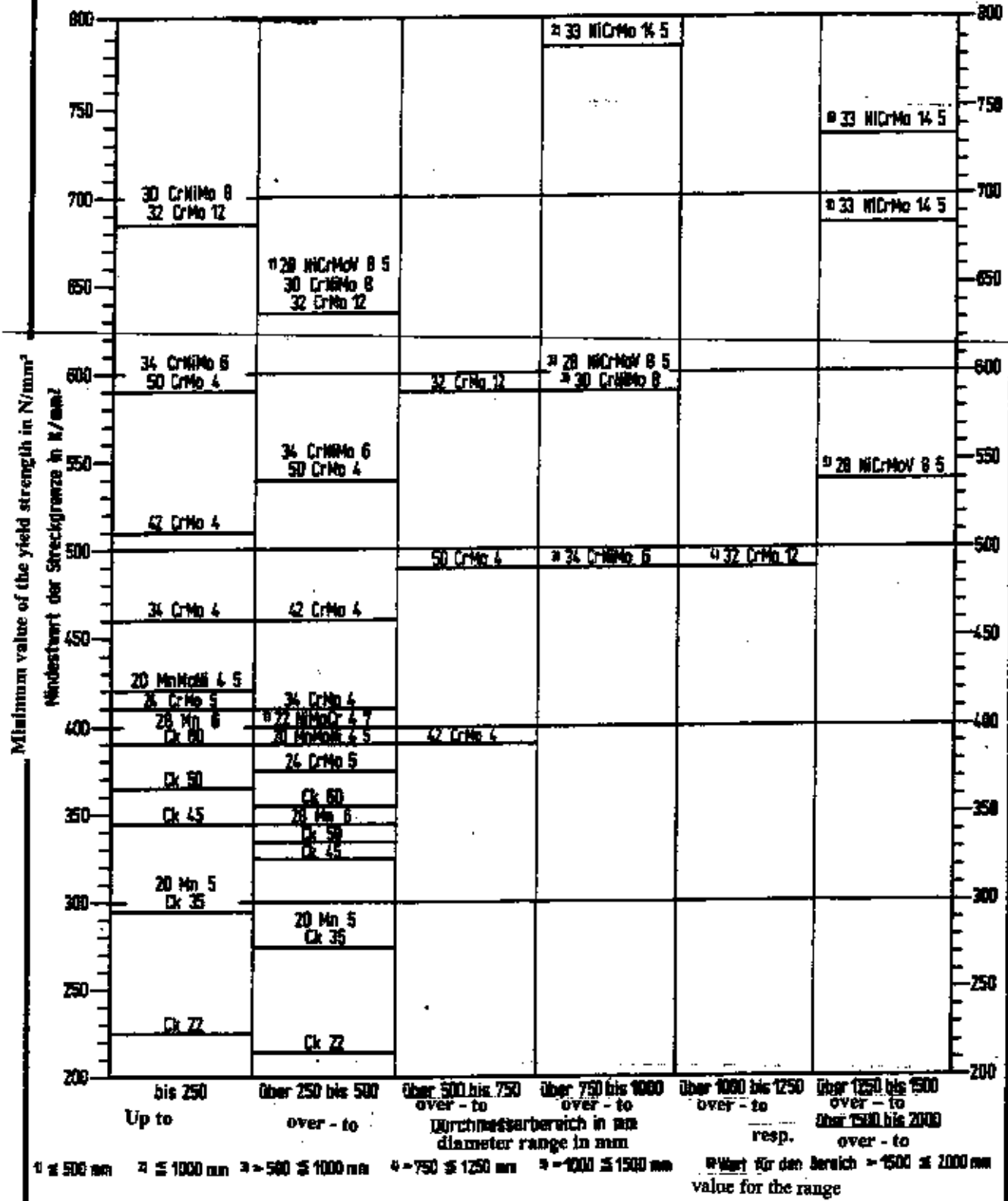

Table 1. Chemical composition of the steel grades for larger forged parts

Tafel 1. Chemische Zusammensetzung der Stähle für größere Schmiedestücke

steel grade		Chemical composition								
short name	DIN-Wno.	% C	% Si	% Mn	% P maximum	% S maximum	% Cr	% Mo	% Ni	% V
Ck 22 Ck 35 Ck 45 Ck 50 Ck 60	1.1151 1.1181 1.1191 1.1209 1.1221	0,18/0,25 0,32/0,39 0,42/0,50 0,47/0,55 0,57/0,65	≤ 0,35 ≤ 0,35 ≤ 0,35 ≤ 0,35 ≤ 0,35	0,30/0,60 0,50/0,80 0,50/0,80 0,60/0,90 0,60/0,90	0,035 0,035 0,035 0,035 0,035	0,035 0,035 0,035 0,035 0,035				
20 Mn 5 26 Mn 5	1.1133 1.1170	0,17/0,23 0,25/0,32	0,30/0,60 ≤ 0,40	1,00/1,30 1,30/1,65	0,035 0,035	0,035 0,035				
20 MnMoNi 4 5 22 NiMoCr 4 7	1.6311 1.6755	0,17/0,23 0,17/0,27	≤ 0,40 ≤ 0,40	1,00/1,50 0,80/1,00	0,035 0,035	0,035 0,035	≤ 0,80 0,30/0,50	0,45/0,60 0,50/0,80	0,40/0,80 1) 0,80/1,20 2)	
24 CrMo 5 34 CrMo 4 42 CrMo 4 50 CrMo 4 32 CrMo 12	1.7258 1.7220 1.7225 1.7228 1.7361	0,20/0,28 0,30/0,37 0,38/0,45 0,46/0,54 0,28/0,35	≤ 0,40 ≤ 0,40 ≤ 0,40 ≤ 0,40 ≤ 0,40	0,50/0,80 0,50/0,80 0,50/0,80 0,50/0,80 0,40/0,70	0,035 0,035 0,035 0,035 0,035	0,035 0,035 0,035 0,035 0,035	0,90/1,20 0,90/1,20 0,90/1,20 0,90/1,20 2,80/3,30	0,20/0,35 0,15/0,30 0,15/0,30 0,15/0,30 0,30/0,50	≤ 0,80 ≤ 0,80 ≤ 0,80 ≤ 0,80	
34 CrNiMo 6 30 CrNiMo 8	1.6582 1.6580	0,30/0,38 0,26/0,33	≤ 0,40 ≤ 0,40	0,40/0,70 0,30/0,60	0,035 0,035	0,035 0,035	1,40/1,70 1,80/2,20	0,15/0,30 0,30/0,50	1,40/1,70 1,80/2,20	
28 NiCrMoV 8 5 33 NiCrMo 14 5	1.6932 1.6956	0,24/0,32 0,28/0,36	≤ 0,40 ≤ 0,40	0,20/0,60 0,20/0,50	0,035 0,035	0,035 0,035	1,00/1,50 1,00/1,70	0,35/0,55 0,30/0,60	1,80/2,10 3,20/4,00	≤ 0,15 ≤ 0,15

1) For larger cross sections a Ni-content of up to 1.00 % is allowed – 2) for larger cross sections a Ni- content of up to 1.50 % is allowed

Table 2. Guaranteed values of the mechanical properties at 20° C for forged parts from non-alloyed steel grades in normalized condition

steel grade		governing diameter for the heat-treatment[1]	yield point or 0.2% yield strength[2]	tensile strength	elongation ($L_o = 5\ d_o$) sample location in relation to the grain flow[3]			impact test (DVM-samples) sample location in relation to the grain flow[3]		
short name	DIN-Wno.	mm	N/mm² min.	N/mm²	L	T	Q	L	T	Q
					% min.			J, min.		
Ck 22	1.1151	≤ 250	226	410 bis 620	26	22	19	48	41	34
		> 250 ≤ 500	216	410 bis 620	25	21	17	41	34	27
		> 500 ≤ 1000	206	410 bis 620	24	20	16	38	31	24
Ck 35	1.1181	≤ 250	275	490 bis 610	22	18	15	38	31	24
		> 250 ≤ 500	255	490 bis 610	21	17	14	34	27	21
		> 500 ≤ 1000	245	490 bis 610	20	16	12	31	24	17
Ck 45	1.1191	≤ 250	305	590 bis 720	18	14	12	31	24	17
		> 250 ≤ 500	305	590 bis 720	18	13	11	27	21	14
		> 500 ≤ 1000	295	590 bis 720	15	12	10	24	17	14
Ck 60	1.1206	≤ 250	345	620 bis 770	16	13	11	-	-	-
		> 250 ≤ 500	325	620 bis 770	15	12	10	-	-	-
		> 500 ≤ 1000	315	620 bis 770	14	11	9	-	-	-
Ck 50	1.1221	≤ 250	275	630 bis 830	14	12	10	-	-	-
		> 250 ≤ 500	265	630 bis 830	13	11	9	-	-	-
		> 500 ≤ 1000	245	630 bis 830	12	10	8	-	-	-

1) see sections 7.4.1.1 and 7.4.1.2
2) the 0.2% yield strength is only important in case of an unclear yield point
3) see sections 8.4.2 to 8.4.2.2

Table 3. Guaranteed values of the mechanical properties at 20°C for heat-treated forged parts

steel grade		governing diameter for the heat-treatment[1]	yield point or 0.2% yield strength[2]	tensile strength	elongation ($L_o = 5\ d_o$) sample location in relation to the grain flow[3]			impact test (DVM-samples) sample location in relation to the grain flow[3]		
short name	DIN-Wno.	mm	N/mm² min.	N/mm²	L	T	Q	L	T	Q
					% min.			J, min.		
Ck 22	1.1151	≤ 250	225	410 bis 540	26	23	19	51	48	34
		> 250 ≤ 500	215	410 bis 540	25	21	17	41	34	27
Ck 35	1.1181	≤ 250	295	490 bis 640	22	19	15	41	34	27
		> 250 ≤ 500	275	490 bis 640	21	18	14	38	31	24
Ck 45	1.1191	≤ 250	345	590 bis 740	19	16	12	31	24	17
		> 250 ≤ 500	325	590 bis 740	17	14	11	27	21	14
Ck 50	1.1206	≤ 250	365	630 bis 780	17	14	11	–	–	–
		> 250 ≤ 500	335	630 bis 780	16	13	10	–	–	–
Ck 60	1.1221	≤ 250	380	690 bis 840	15	13	10	–	–	–
		> 250 ≤ 500	366	690 bis 840	14	12	9	–	–	–
20 Mn 5	1.1133	≤ 250	295	490 bis 640	22	19	15	48	34	24
		> 250 ≤ 500	275	490 bis 640	21	18	14	48	34	24
28 Mn 6	1.1170	≤ 250	360	590 bis 740	18	15	12	41	27	21
		> 250 ≤ 500	345	540 bis 690	19	18	13	41	27	21
20 MnMoNi 4 5	1.6311	≤ 250	420	590 bis 750	17	16	14	41	34	24
		> 250 ≤ 500	390	550 bis 700	17	15	14	41	34	24
22 NiMoCr 4 7	1.6765	≤ 500	400	560 bis 710	19	17	15	41	34	24
24 CrMo 5	1.7258	≤ 250	410	640 bis 790	17	16	13	48	34	27
		> 250 ≤ 500	375	590 bis 740	18	16	14	48	34	27
34 CrMo 4	1.7220	≤ 250	460	690 bis 840	15	13	11	41	31	24
		> 250 ≤ 500	410	640 bis 790	16	14	12	41	31	24

42 CrMo 4	1.7225	≤ 250	610	740 bis 890	14	12	10	38	27	21
		> 250 ≤ 500	480	690 bis 840	15	13	11	38	27	21
		> 500 ≤ 750	390	590 bis 740	15	14	12	38	27	21
50 CrMo 4	1.7228	≤ 250	690	780 bis 930	13	11	9	31	24	14
		> 250 ≤ 500	540	740 bis 890	14	12	10	31	24	14
		> 500 ≤ 750	490	690 bis 840	15	13	11	31	24	14
32 CrMo 12	1.7361	≤ 250	885	880 bis 1080	12	10	8	41	31	24
		> 250 ≤ 500	835	830 bis 980	13	11	9	41	31	24
		> 500 ≤ 750	590	780 bis 930	14	12	10	34	24	17
		> 750 ≤ 1250	490	690 bis 840	15	13	11	34	24	17
34 CrNiMo 6	1.6582	≤ 250	590	780 bis 930	13	11	9	41	31	21
		> 250 ≤ 500	540	740 bis 890	14	12	10	41	31	21
		> 500 ≤ 1000	490	690 bis 840	15	13	11	41	31	21
30 CrNiMo 8	1.6580	≤ 250	685	880 bis 1080	12	10	8	45	34	24
		> 250 ≤ 500	635	830 bis 980	12	10	8	45	34	24
		> 500 ≤ 1000	590	780 bis 980	12	10	8	45	34	24
26 NiCrMoV 8 6	1.6932	≤ 500	835	780 bis 980	14	12	10	41	34	24
		> 500 ≤ 1000	590	740 bis 890	15	13	11	41	34	24
		> 1000 ≤ 1500	540	690 bis 840	16	14	12	41	34	24
39 NiCrMo 14 6	1.6956	≤ 1000	785	930 bis 1130	12	10	8	34	27	24
		> 1000 ≤ 1500	735	880 bis 1080	13	11	9	34	27	24
		> 1500 ≤ 2000	685	830 bis 980	14	12	10	34	27	24

1) • In case the stated mechanical values for a range of larger heat-treatment diameters should be guaranteed for a dimension from a smaller heat-treatment diameters then this must be agreed upon when ordering.

2) See sections 7.4.1.1. and 7.4.1.2. – 3) the 0.2% yield strength is only important in case of an unclear yield point

4) see sections 8.4.2. to 8.4.2.2

Table 4. Guaranteed values for the high-temperature yield point of the steel grades in heat-treated condition in correspondence to table 3[1)]

steel grade		governing diameter for the heat-treatment[1)]	yield point or 0.2% yield strength[2)]							
short name	DIN-Wno.	mm	20°C	100°C	200°C	250°C	300°C	350°C	400°C	450°C
			N/mm², minimum							
Ck 22	1.1151	≤ 250[3)]	225	211	196	177	147	118	(98)	
		> 250 ≤ 500[3)]	215	201	186	167	137	108	(88)	
		> 500 ≤ 1000[3)]	205	186	172	152	123	98	(78)	
Ck 35	1.1181	≤ 250	295	265	235	216	196	177		
		> 250 ≤ 500	275	245	216	206	186	167		
Ck 45	1.1191	≤ 250	345	314	284	255	235	206		
		> 250 ≤ 500	325	294	265	245	226	196		
Ck 50	1.1206	≤ 250	365	335	304	284	255	226		
		> 250 ≤ 500	335	304	275	255	235	206		
Ck 60	1.1221	≤ 250	390	358	324	304	284	255		
		> 250 ≤ 500	355	324	294	275	255	231		
20 Mn 5	1.1133	≤ 250	295	280	255	235	226	206		
		> 250 ≤ 500	275	260	245	226	216	196		
26 Mn 5	1.1170	≤ 250	390	369	333	314	284	255		
		> 250 ≤ 500	345	324	304	275	255	235		
20 MnMoNi 4 5	1.6311	≤ 250	420	407	392	371	353	339	309	(280)
		> 250 ≤ 500	390	387	343	333	314	294	274	(255)
22 NiMoCr 4 7	1.6755	≤ 500	400	372	363	363	363	343	324	(294)
24 CrMo 5	1.7258	≤ 250	410	397	382	371	343	324	294	(265)
		> 250 ≤ 500	375	358	333	314	294	275	255	(216)

34 CrMo 4	1.7220		≤ 250	460	441	422	392	383	333	304	(276)
		> 250	≤ 500	410	392	371	343	314	294	265	(238)
42 CrMo 4	1.7225		≤ 250	510	486	461	441	422	392	363	
		> 250	≤ 500	460	431	412	402	382	353	324	
		> 500	≤ 700	390	363	333	324	304	275	245	
50 CrMo 4	1.7228		≤ 250	590	554	520	490	461	412	371	
		> 250	≤ 500	540	510	481	461	431	382	353	
		> 500	≤ 700	490	461	431	402	371	333	294	
32 CrMo 12	1.7361		≤ 250	665	657	628	608	579	539	500	
		> 250	≤ 500	636	608	579	559	539	500	461	
		> 500	≤ 700	590	569	550	510	490	461	412	
		> 700	≤ 1250	490	471	451	441	422	392	353	
34 CrNiMo 6	1.6582		≤ 250	590	549	510	481	441	412	371	
		> 250	≤ 500	540	506	471	451	412	382	353	
		> 500	≤ 1000	490	466	441	422	382	363	343	
30 CrNiMo 8	1.6580		≤ 250	685	657	628	598	559	520	481	
		> 250	≤ 500	636	609	579	549	510	471	431	
		> 500	≤ 1000	590	569	530	500	471	431	392	
26 NiCrMoV 8 6	1.6932		≤ 500	636	608	579	549	510	471	431	
		> 500	≤ 1000	590	559	530	500	471	431	392	
		> 1000	≤ 1500	540	515	490	461	431	402	363	
33 NiCrMo 14 6	1.6956		≤ 1000	786	745	706	677	647	598	559	
		> 1000	≤ 1500	735	696	657	628	598	559	520	
		> 1500	≤ 2000	686	647	608	579	549	510	471	

1) • In case the stated mechanical values for a range of larger heat-treatment diameters should be guaranteed for a dimension from a smaller heat-treatment diameters then this must be agreed upon when ordering. 2) See sections 7.4.1.1. and 7.4.1.2. – 3) the 0.2% yield strength is only important in case of an unclear yield point – 4) A value in brackets mean, that this steel grade is not provided for this application (and a test) at this temperature. - 5) The values in this line are valid also for the normalized condition (see table 2) -) The values in this line are valid only for the normalized condition (compare with table 2).