

<b>Quality</b>	<b>C45E</b>
According to standards	<b>EN 10083-2: 2006</b>
Number	<b>1.1191</b>

Technical card  
Lucefin Group

### Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Mo%	Ni%	Product deviations are allowed
	max		max	max	max	max	max	
0,42-0,50	0,40	0,50-0,80	0,030	0,035	0,40	0,10	0,40	Product deviations are allowed
± 0.02	+ 0.03	± 0.04	+ 0.005	+ 0.005				

Cr+Mo+Ni max 0.63%

For C45R n° 1.1201, S% 0.020-0.040 product deviation ± 0.005

For C45 n° 1.0503, P% - S% max 0.045

On request, it may be supplied (Ca) treated

### Temperature °C

Hot-forming	Normalizing	Quenching	Quenching	Tempering	Stress-relieving
1100-850	870 air	840 water	860 oil or polymer	540-660 air	50° under the temperature of tempering
Soft annealing	Isothermal annealing	Natural state	End quench hardenability test	Pre-heating welding	Stress-relieving after welding
690 cooling 10 °C/h to 600, then air (HB max 207)	810 furnace cooling to 660, then air (HB 160-216)	Natural state (~ HB 169-245)	850 water	250	550 furnace cooling
				<b>Ac1</b> <b>Ac3</b> <b>Ms</b> <b>Mf</b>	
				735   780   350   120	

### Mechanical and physical properties

**C45E C45R Hot-rolled** mechanical properties in **normalized** condition EN 10083-2: 2006

size d / t		Testing at room temperature (longitudinal)					
mm	mm	R	Re <sup>a)</sup>	A%	C%	Kv	HB
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min.	min.	min.	J min.	min
	16/16	620	340	14			190
16/16	100/100	580	305	16			172
100/100	250/250	560	275	16			162

d = diameter t = thickness

**C45E C45R Hot-rolled** mechanical properties in **quenched an tempered** condition EN 10083-2: 2006

size d / t		Testing at room temperature (longitudinal)					
mm	mm	R	Re <sup>a)</sup>	A%	C%	Kv	HB
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min.	min.	J min	for information
	16/8	700-850	490	14	35		213-253
16/8	40/20	650-800	430	16	40	25	200-240
40/20	100/60	630-780	370	17	45	25	192-232

<sup>a)</sup> Re upper yield strength or, if no yield phenomenon occurs, Rp<sub>0.2</sub> has to be considered

d = diameter t = thickness

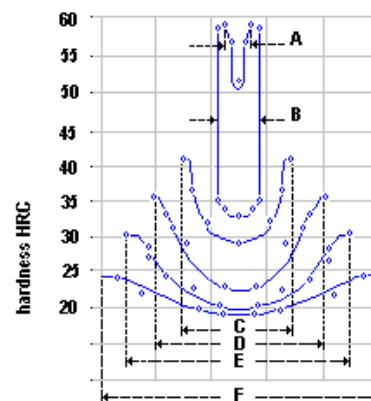
**Table of tempering** values obtained at room temperature on rounds of Ø 10 mm after quenching at 850 °C in water

°C	HB	HRC	R N/mm <sup>2</sup>
100	615	58	2330
200	597	57	2240
300	510	52	1880
400	401	43	1390
500	311	33	1030
600	242	23	810
°C	R	Rp <sub>0.2</sub>	A
	N/mm <sup>2</sup>	N/mm <sup>2</sup>	%
620	740	480	22
650	600	400	23
700	540	320	24

**Hardness condition**  
on bars quenched in water

- A = diameter 13 mm
- B = diameter 25 mm
- C = diameter 50 mm
- D = diameter 75 mm
- E = diameter 100 mm
- F = diameter 130 mm

• hardness check points



**C45E**

*Lucefin Group*

Temperature	Mod. of elasticity GPa Hot-rolled		Mod. of elasticity GPa Cold-drawn		Thermal expansion 10 <sup>-6</sup> • K <sup>-1</sup>
	E long.	G tang.	E long.	G tang.	
Testing at °C					
20	220	88	190	73	
100	205	78			11.1
200	195	74			12.1
300	185	71			12.9
400	175	67			13.5
500					13.9
600	155	59			14.1

Specific heat capacity J/(Kg•K)	Density Kg/dm <sup>3</sup>	Thermal conductivity W/(m•K)	Specific electric resist. Ohm•mm <sup>2</sup> /m	Electrical conductivity Siemens•m/mm <sup>2</sup>
460	7.85	50	0.12	8.33

Heat treatment	Temperature (+ ... °C) - min. values							Data under fatigue	
	20	200	300	350	400	450	500		600
+N Ø ≤ 60 mm		229	192	182	173				Yield stress <b>Rp</b> 0.2 N/mm <sup>2</sup> EN 10269: 01
+QT Ø ≤ 60 mm		229	192	182	173				Yield stress <b>Rp</b> 0.2 N/mm <sup>2</sup> EN 10269: 01
+QT Ø 60 – 150		220	186	167	147				Yield stress <b>Rp</b> 0.2 N/mm <sup>2</sup> EN 10269: 01
+N						100	70		Creep rupture, 10.000 h N/mm <sup>2</sup> 1)
+N						55	35		Creep rupture, 100.000 h N/mm <sup>2</sup> 1)
+U	591								Cyclic yield strength, <b>σ<sub>y</sub>'</b> N/mm <sup>2</sup>
+SR	336								low cycle number
+N	370								
+QT	462								
+U	0.23								Cyclic strength exponent, <b>n'</b> low cycle number
+SR	0.09								
+N	0.15								
+QT	0.13								
+U	2407								Cyclic strength coefficient, <b>K'</b> N/mm <sup>2</sup>
+SR	599								low cycle number
+N	952								
+QT	1078								
+U	774								Fatigue strength coefficient, <b>σ<sub>f</sub>'</b> N/mm <sup>2</sup>
+SR	519								low cycle number
+N	1267								
+QT	1405								
+U	- 0.06								Fatigue strength exponent, <b>b</b> low cycle number
+SR	- 0.04								
+N	- 0.14								
+QT	- 0.11								
+U	0.11								Fatigue ductility coefficient, <b>g<sub>f</sub>'</b> low cycle number
+SR	0.12								
+N	0.42								
+QT	0.61								
+U	- 0.37								Fatigue ductility exponent, <b>c</b> low cycle fatigue
+SR	- 0.42								
+N	- 0.53								
+QT	- 0.55								
+N	190								Fatigue limit, <b>σ<sub>L</sub>'</b> N/mm <sup>2</sup> high cycle fatigue
+QT	265								

1) Creep rupture strength

+U natural    +N normalized    +QT quenched and tempered    +SR stress-relieved

**Kv** values obtained on hot-rolled 130 mm round; **LUCEFIN** experience

+QT induction for R **743** N/mm<sup>2</sup> - Rp **421** N/mm<sup>2</sup> A% **26** C% **58**

J	50 – 57 - 60	36 – 33 - 40	32 – 41 - 28	14 – 24 - 24	16 – 26 - 14
°C	<b>+20</b>	<b>0</b>	<b>-20</b>	<b>-40</b>	<b>-60</b>

**C45E 1.1191 C45R 1.1201 EN 10277-5: 2008**
*Lucefin Group*

Cold-drawn +C <sup>c)</sup>						Hot-rolled + Peeled-Reeled +SH <sup>c)</sup>			
size mm		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
from	to	R <sup>a)</sup>	Rp 0.2 <sup>a)</sup>	A%	HB	R	Rp 0.2	A%	HB
		N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	for inform.	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	
5 <sup>b)</sup>	10	750-1050	565	5	225-319				
10	16	710-1030	500	6	218-311				
16	40	650-1000	410	7	200-298	580-820			172-242
40	63	630-900	360	8	192-271	580-820			172-242
63	100	580-850	310	8	172-253	580-820			172-242

<sup>a)</sup> for flats and special sections, yield point can be -10% and tensile strength can be ± 10%

<sup>b)</sup> for thickness < 5 mm, mechanical properties should be agreed before order placement

<sup>c)</sup> values valid also for +C+SL and +SH+SL

**C45E 1.1191 C45R 1.1201 EN 10277-5: 2008**

Hot-rolled, quenched and tempered, cold-drawn +QT +C <sup>c)</sup>						Cold-drawn + quenching and tempering +C +QT <sup>c)</sup>			
size mm		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
from	to	R	Rp 0.2	A%	HB	R	Rp 0.2	A%	HB
		N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	for inform.	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	for inform.
5 <sup>b)</sup>	10	850-1050	595	8	253-319				
10	16	810-1010	565	8	243-300				
16	40	750-950	525	9	225-286	650-800	430	16	200-240
40	63	650-850	455	10	200-253	630-780	370	17	192-232
63	100	650-850	455	11	200-253	630-780	370	17	192-232

<sup>b)</sup> for thickness < 5 mm, mechanical properties should be agreed before order placement

<sup>c)</sup> values valid also for +QT+C+SL and +C+QT+SL

 Testing at room temperature (longitudinal) **LUCEFIN** experience

Cold-drawn +QT					Cold-drawn + QT + Cold-drawn			
diameter mm	R	Rp 0.2	A%	Kv + 20 °C	R	Rp 0.2	A%	Kv + 20 °C
	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J
56	675	429	22,6	60-50-60	704	570	23,6	45-36-58

**C45E 1.1191 Forged** normalized EN 10250-2: 2001

size mm		Testing at room temperature							
from	to	R	Re <sup>c)</sup>	A%	A%	A%	Kv +20 °C	Kv +20 °C	HB
		N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min L	min T	min Q	J min L	J min T	min
	100	580	305	16					172
100	250	560	275	16	12		18	10	162
250	500	540	240	16	12		15	10	158
500	1000	530	230	15	11		12	10	156

**C45E 1.1191 Forged** quenched and tempered EN 10250-2: 2001

size d / t mm		Testing at room temperature							
from	to	R	Re <sup>c)</sup>	A%	A%	A%	Kv +20 °C	Kv +20 °C	HB
		N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min L	min T	min Q	J min L	J min T	min
	100/70	630	370	17			25		192
100/70	250/160	590	340	18	12		22	15	176
250/160	500/330	540	320	17	11		20	12	158

L = longitudinal T = tangential Q = radial

<sup>c)</sup> Re upper yield strength or, if no yield phenomenon occurs, Rp 0.2 has to be considered

d = diameter t = thickness

**C45E C45R EN 10083-2: 2006 Jominy test HRC** grain size 5 min.

mm distance from quenched extremity																	
	1	2	3	4	5	6	7	8	9	10	11	13	15	20	25	30	H
min	55	51	37	30	28	27	26	25	24	23	22	21	20				normal
max	62	61	61	60	57	51	44	37	34	33	32	31	30				

EUROPE EN	ITALY UNI	CHINA GB	GERMANY DIN	FRANCE AFNOR	U.K. B.S.	RUSSIA GOST	USA AISI/SAE
C45E	C45	45	Ck45	XC48	080M46	45	1045