

<b>Quality</b>	<b>C60E</b>
According to standards	<b>EN 10083-2: 2006</b>
Number	<b>1.1221</b>

## Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Mo%	Ni%	Deviations allowed for analysis product
	max		max	max	max	max	max	
0,57-0,65	0,40	0,60-0,90	0,030	0,035	0,40	0,10	0,40	
± 0.03	+0.03	± 0.04	+ 0.005	+ 0.005				

Cr+Mo+Ni max 0.63%  
For C60R n° 1.1223, S% 0.020-0.040 product deviations ± 0.005  
For C60 n° 1.0601, P% - S% max 0.045

## Temperature °C

Hot-forming	Normalizing	Quenching	Quenching	Tempering	Stress-relieving	
1050-850	860 air	830 water	850 oil or polymer	550-650 air	50° under the temperature of tempering	
Soft annealing	Isothermal annealing	Natural state	End quench hardenability test	Pre-heating welding		Stress-relieving after welding
700 air (HB max 241)	780 furnace cooling to 670, then air (HB 200-244)	(HB max 280)	830 water	250 <b>Ac1</b> <b>Ac3</b> 730      760		600 furnace cooling <b>Ms</b> <b>Mf</b> 290      70

## Mechanical and physical properties

### Hot-rolled mechanical properties in normalized condition EN 10083-2: 2006

size d / t		Testing at room temperature (longitudinal)					
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		710	380	10			218
16/16	100/100	670	340	11			203
100/100	250/250	650	310	11			200

d = diameter t = thickness

### Hot-rolled mechanical properties in quenched and tempered condition EN 10083-2: 2006

size d / t		Testing at room temperature (longitudinal)					
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		850-1000	580	11	25		253-298
16/8	40/20	800-950	520	13	30		240-290
40/20	100/60	750-900	450	14	35		225-271

<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 830 °C in water

<b>HB</b>	697	688	634	560	468	371	264
<b>HRC</b>	62.5	62	59	55	49	40	27
<b>R</b> N/mm <sup>2</sup>			2420	2070	1700	1250	880
Tempering at °C	<b>50</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>

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<b>R</b> N/mm <sup>2</sup>			2420	2070	1700	1250	880
Tempering at °C	<b>50</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>

Temperature Testing at °C	Mod. of elasticity GPa		Thermal expansion	
	E long.	G tang.	10 <sup>-6</sup> · K <sup>-1</sup>	
<b>20</b>	210	80		
<b>100</b>			11.1	
<b>200</b>			12.1	
<b>250</b>	197	78		
<b>300</b>			12.9	
<b>400</b>			13.5	
<b>500</b>	178	68		
<b>600</b>			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	46	0.13	7.69

**C60E 1.1221 C60R 1.1223 EN 10277-5: 2008**

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> N/mm <sup>2</sup>	R <sub>p</sub> 0.2 <sup>a)</sup> N/mm <sup>2</sup> min	A% min	HB for inform.	R N/mm <sup>2</sup>	R <sub>p</sub> 0.2 N/mm <sup>2</sup> min	A% min	HB
5 <sup>b)</sup>	10	800-1150	630	5	240-347				
10	16	780-1130	550	5	232-339				
16	40	730-1100	480	6	224-331	670-940			198-278
40	63					670-940			198-278
63	100					670-940			198-278

<sup>a)</sup> for flats and special sections, yield point can be – 10% and tensile strenght 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

**C60E 1.1221 C60R 1.1223 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 N/mm <sup>2</sup>	R <sub>p</sub> 0.2 N/mm <sup>2</sup> min	A% min	HB for inform.	R N/mm <sup>2</sup>	R <sub>p</sub> 0.2 N/mm <sup>2</sup> min	A% min	HB for inform.
5 <sup>b)</sup>	10	900-1100	630	6	271-331				
10	16	880-1080	615	6	263-327				
16	40	830-1030	580	7	249-311	800-950	520	13	240-286
40	63	780-980	545	8	232-295	750-900	450	14	225-271
63	100	750-950	525	8	225-286	750-900	450	14	225-271

<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

**Work-hardening by cold-drawing**

<b>R</b> N/mm <sup>2</sup>	1090	1120	1200	1250	1300	1400	1450	1520	1650
<b>Reduction</b> %	<b>0</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>

## Forged normalized EN 10250-2: 2001

size		Testing at room temperature (longitudinal)							
mm		R	Re <sup>c)</sup>	A% L	A% T	A% Q	Kv L	Kv T	HB
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min	min	min	J min	J min	min
	100	670	340	11					203
100	250	650	310	11	8				200
250	500	630	275	11	8				192
500	1000	620	260	10	7				190

## Forged quenched and tempered EN 10250-2: 2001

size d / t		Testing at room temperature (longitudinal)							
mm		R	Re <sup>c)</sup>	A% L	A% T	Kv L	Kv T	Kv Q	HB
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min	min	J min	J min	J min	min
	100/70	750	450	14					225
100/70	250/160	690	390	15	10				210
250/160	500/330	670	350	14	9				203

L = longitudinal T = tangential Q = radial

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

d = diameter t = thickness

## 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	60	57	50	39	35	33	32	31	30	29	28	27	26	25	23	21	normal
max	67	66	65	63	62	59	54	47	39	37	36	35	34	33	31	30	

EUROPE EN	ITALY UNI	CHINA GB	GERMANY DIN	FRANCE AFNOR	U.K. B.S.	RUSSIA GOST	USA AISI/SAE
C60E	C60	60	Ck60		070M60	60	1060