

<b>Quality</b>	<b>C60E</b>	<i>Technical card</i> <i>Lucefin Group</i>
According to standards	<b>EN 10083-2: 2006</b>	
Number	<b>1.1221</b>	

### Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Mo%	Ni%	Product deviations are allowed
	max		max	max	max	max	max	
0,57-0,65 ± 0.03	0,40 +0.03	0,60-0,90 ± 0.04	0,030 + 0.005	0,035 + 0.005	0,40	0,10	0,40	

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> 730	<b>Ac3</b> 760	<b>Ms</b> 290	<b>Mf</b> 70

### Mechanical and physical properties

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

size d / t mm		Testing at room temperature (longitudinal)					
from	to	R N/mm <sup>2</sup> min	Re <sup>a)</sup> N/mm <sup>2</sup> min.	A% min.	C% min.	Kv J min.	HB 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 mm		Testing at room temperature (longitudinal)					
from	to	R N/mm <sup>2</sup>	Re <sup>a)</sup> N/mm <sup>2</sup> min	A% min.	C% min.	Kv J min	HB 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

a) 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>

Temperature	Mod. of elasticity GPa		Thermal expansion	
Testing at °C	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

<b>C60E 1.1221 C60R 1.1223 EN 10277-5: 2008</b>						<i>Lucefina Group</i>			
<b>Cold-drawn +C</b> <sup>c)</sup>						<b>Hot-rolled + peeled-reeled +SH</b> <sup>c)</sup>			
size		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
mm		<b>R</b> <sup>a)</sup>	<b>Rp</b> 0.2 <sup>a)</sup>	<b>A%</b>	<b>HB</b>	<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>HB</b>
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	<i>for inform.</i>	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	
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

<b>C60E 1.1221 C60R 1.1223 EN 10277-5: 2008</b>									
<b>Hot-rolled, quenched and tempered, cold-drawn +QT +C</b> <sup>c)</sup>						<b>Cold-drawn + quenching and tempering +C +QT</b> <sup>c)</sup>			
size		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
mm		<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>HB</b>	<b>R</b>	<b>Rp</b> 0.2	<b>A%</b>	<b>HB</b>
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	<i>for inform.</i>	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	<i>for inform.</i>
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

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

<b>Forged normalized EN 10250-2: 2001</b>										
size		Testing at room temperature (longitudinal)								
mm		<b>R</b>	<b>Re</b> <sup>c)</sup>	<b>A% L</b>	<b>A% T</b>	<b>A% Q</b>	<b>Kv L</b>	<b>Kv T</b>	<b>HB</b>	
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min	min	min	J min	J min	<i>min</i>	
	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	

<b>Forged quenched and tempered EN 10250-2: 2001</b>										
size d / t		Testing at room temperature (longitudinal)								
mm		<b>R</b>	<b>Re</b> <sup>c)</sup>	<b>A% L</b>	<b>A% T</b>	<b>Kv L</b>	<b>Kv T</b>	<b>Kv Q</b>	<b>HB</b>	
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min	min	J min	J min	J min	<i>min</i>	
	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 0.2 has to be considered

d = diameter t = thickness

<b>EN 10083-2: 2006 Jominy test HRC grain size 5 min.</b>																	
mm distance from quenched extremity																	
	1	2	3	4	5	6	7	8	9	10	11	13	15	20	25	30	H
<b>min</b>	60	57	50	39	35	33	32	31	30	29	28	27	26	25	23	21	normal
<b>max</b>	67	66	65	63	62	59	54	47	39	37	36	35	34	33	31	30	

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