

<b>Quality</b>	<b>C60E</b>	<b>Quenching and Tempering Steel</b>	<i>Technical card</i>
According to standards	<b>ISO 683-1: 2018</b>		<b>Lucefin Group</b>
Number	<b>1.1221</b>		rev. 2024

### Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Mo%	Ni%	Cu%	
			max	max	max	max	max	max	
0,57-0,65	0,10-0,40	0,60-0,90	0,025	0,035	0,40	0,10	0,40	0,30	Product deviations are allowed
± 0.03	± 0.03	± 0.04	+ 0.005	± 0.005	+0.05	+0.03	+0.03	+0.05	
Cr+Mo+Ni max 0.63%									
For C60R n° 1.1223, S% 0.020-0.040 product deviations ± 0.005									

### Temperature °C

Hot-forming	Normalizing +N	Quenching +Q	Quenching +Q	Tempering +T	Stress-relieving +SR		
1050-850	820-860 air	800 water	840 oil or polymer	550-660 air	50° under the temperature of tempering		
Soft annealing +A	Isothermal annealing +I	Natural state +U	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		600 furnace cooling	
				<b>Ac1</b>	<b>Ac3</b>	<b>Ms</b>	<b>Mf</b>
				730	760	290	70

### Mechanical properties

**C60E – C60R Hot-rolled** mechanical properties in **normalized** condition ISO 683-1: 2018

size d / t		Testing at room temperature (longitudinal)					
mm		<b>R</b>	<b>Re<sub>H</sub></b> <sup>a)</sup>	<b>A%</b>	<b>Z%</b>	<b>Kv<sub>2</sub></b>	<b>HB</b> for information
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

<sup>a)</sup> Re<sub>H</sub> upper yield strength or, if no yield phenomenon occurs, Rp<sub>0.2</sub> has to be considered  
d = diameter t = thickness

**Hot-rolled** mechanical properties in **quenched and tempered** condition ISO 683-1: 2018

size d / t		Testing at room temperature (longitudinal)					
mm		<b>R</b>	<b>Re<sub>H</sub></b> <sup>a)</sup>	<b>A%</b>	<b>Z%</b>	<b>Kv<sub>2</sub></b>	<b>HB</b>
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<sub>H</sub> 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 N/mm<sup>2</sup></b>			2420	2070	1700	1250	880		
<b>Tempering at °C</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>		
<b>Thermal Expansion</b>	10 <sup>-6</sup> • K <sup>-1</sup>	►	11.1	12.1		12.9	13.5	13.9	14.1
<b>Mod. of Elasticity long.</b>	GPa		210			197		178	
<b>Mod. of Elasticity tang.</b>	GPa		80			76		68	
<b>Specific Heat Capacity</b>	J/(Kg•K)		460	502	544				
<b>Thermal Conductivity</b>	W/(m•K)				46.8				
<b>Density</b>	Kg/dm <sup>3</sup>		7.85						
<b>Spec. Electric Resist.</b>	Ohm•mm <sup>2</sup> /m		0.13						
<b>Elec. Conductivity</b>	Siemens•m/mm <sup>2</sup>		7.69						
<b>°C</b>		<b>20</b>	<b>100</b>	<b>200</b>	<b>250</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>

The symbol ► indicates temperature between 20 °C and 100 °C, 20 °C and 200 °C ...

<b>Cold-drawn +C</b> <sup>c)</sup>						Hot-rolled and <b>Peeled +SH</b> <sup>d)</sup>			
size		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
mm		<b>R</b> <sup>a)</sup>	<b>Rp</b> <sup>0.2 a)</sup>	<b>A%</b>	<b>HBW</b>	<b>R</b>	<b>Rp</b> <sup>0.2</sup>	<b>A%</b>	<b>HBW</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 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+G  
<sup>d)</sup> values valid also for +SH+G

Hot-rolled, quenched and tempered, <b>cold-drawn +QT+SH</b> <sup>c)</sup>						<b>Cold-drawn + quenching and tempering +QT+C</b>			
size		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
mm		<b>R</b>	<b>Rp</b> <sup>0.2</sup>	<b>A%</b>	<b>Kv<sub>2</sub></b>	<b>R</b>	<b>Rp</b> <sup>0.2</sup>	<b>A%</b>	<b>Kv<sub>2</sub></b>
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J min	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	J min
5 <sup>b)</sup>	10	-	-	-	-	900-1100	630	6	-
10	16	-	-	-	-	880-1080	615	6	-
16	40	800-950	520	13	-	830-1030	580	7	-
40	63	750-900	450	14	-	780-980	545	8	-
63	100	750-900	450	14	-	750-950	525	8	-

<sup>b)</sup> for thickness < 5 mm, mechanical properties should be agreed before order placement  
<sup>c)</sup> values valid also for +C+QT

Work-hardening by <b>cold-drawing</b> (Hot-rolled +N+C)						
<b>R</b>	N/mm <sup>2</sup>	750	800	850	910	980
<b>Rp 0.2</b>	N/mm <sup>2</sup>	500	680	720	730	670
<b>A%</b>		18	10	9	8	7
<b>Reduction</b>	%	<b>0</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>

<b>C60E 1.1221 Forged</b> normalized UNI EN 10250-2: 2001								
size		Testing at room temperature (longitudinal)						
mm		<b>R</b>	<b>Re</b> <sup>c)</sup>	<b>A%</b>	<b>A%</b>	<b>Kv</b>	<b>Kv</b>	<b>HB</b>
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min (L)	min (T)	J min (L)	J min (T)	<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>C60E 1.1221 Forged</b> quenched and tempered UNI EN 10250-2: 2001								
size d / t		Testing at room temperature (longitudinal)						
mm		<b>R</b>	<b>Re</b> <sup>c)</sup>	<b>A%</b>	<b>A%</b>	<b>Kv</b>	<b>Kv</b>	<b>HB</b>
from	to	N/mm <sup>2</sup> min	N/mm <sup>2</sup> min	min (L)	min (T)	J min (L)	J min (T)	<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  
<sup>c)</sup> Re upper yield strength or, if no yield phenomenon occurs, Rp 0.2 has to be considered  
d = diameter t = thickness

ISO 683-1: 2018 <b>Jominy test HRC</b> grain size 5 min.																	
mm distance from quenched end																	
	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	

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