

Quality	C60E
According to standards	EN 10083-2: 2006
Number	1.1221

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	Ac1 730	Ac3 760	Ms 290	Mf 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 ^{a)}	A%	C%	Kv	HB
from	to	N/mm ² min	N/mm ² 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 ^{a)}	A%	C%	Kv	HB
from	to	N/mm ²	N/mm ² 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

^{a)} Re upper yield strength or, if no yield phenomenon occurs, Rp_{0.2} 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							
HB	697	688	634	560	468	371	264
HRC	62.5	62	59	55	49	40	27
R N/mm ²			2420	2070	1700	1250	880
Tempering at °C	50	100	200	300	400	500	600

Temperature	Mod. of elasticity GPa		Thermal expansion
Testing at °C	E long.	G tang.	10 ⁻⁶ • K ⁻¹
20	210	80	
100			11.1
200			12.1
250	197	78	
300			12.9
400			13.5
500	178	68	13.9
600			14.1

Specific heat capacity J/(Kg.K)	Density Kg/dm ³	Thermal conductivity W/(m.K)	Specific electric resist. Ohm.mm ² /m	Electrical conductivity Siemens.m/mm ²
460	7.85	46	0.13	7.69

C60E 1.1221 C60R 1.1223 EN 10277-5: 2008

Cold-drawn +C ^{c)}						Hot-rolled + peeled-reeled +SH ^{c)}			
size mm		Testing at room temperature (longitudinal)				Testing at room temperature (longitudinal)			
from	to	R ^{a)}	Rp 0.2 ^{a)}	A%	HB	R	Rp 0.2	A%	HB
		N/mm ²	N/mm ² min	min	for inform.	N/mm ²	N/mm ² min	min	
5 ^{b)}	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

^{a)} for flats and special sections, yield point can be - 10% and tensile strenght can be ± 10%

^{b)} for thickness < 5 mm, mechanical properties should be agreed before order placement

^{c)} 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 ^{c)}						Cold-drawn + quenching and tempering +C +QT ^{c)}			
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 ²	N/mm ² min	min	for inform.	N/mm ²	N/mm ² min	min	for inform.
5 ^{b)}	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

^{b)} for thickness < 5 mm, mechanical properties should be agreed before order placement

^{c)} values valid also for +QT+C+SL and +C+QT+SL

Work-hardening by cold-drawing

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

Forged normalized EN 10250-2: 2001

size mm		Testing at room temperature (longitudinal)							
from	to	R	Re ^{c)}	A% L	A% T	A% Q	Kv L	Kv T	HB
		N/mm ² min	N/mm ² 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 mm		Testing at room temperature (longitudinal)							
from	to	R	Re ^{c)}	A% L	A% T	Kv L	Kv T	Kv Q	HB
		N/mm ² min	N/mm ² 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

^{c)} Re upper yield strength or, if no yield phenomenon occurs, Rp_{0.2} 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