

Hard Drawn Steel

Chemical Composition

CHEMICAL COMPOSITION, MASS % EN 10270-1:2011

Designation	European Standard (EN)	Chemical composition %					
		C	Si	Mn	Max. P	Max. S	Max. Cu
SL	EN 10270-1	0.35 - 1.00	0.10 - 0.30	0.40 - 1.20	0.035	0.035	0.20
SM	EN 10270-1	0.35 - 1.00	0.10 - 0.30	0.40 - 1.20	0.035	0.035	0.20
SH	EN 10270-1	0.35 - 1.00	0.10 - 0.30	0.40 - 1.20	0.035	0.035	0.20
DM	EN 10270-1	0.45 - 1.00	0.10 - 0.30	0.40 - 1.20	0.020	0.025	0.12
DH	EN 10270-1	0.45 - 1.00	0.10 - 0.30	0.40 - 1.20	0.020	0.025	0.12
CLASS II	DIN 17223:1964-1	values not guaranteed			0.030	0.030	0.12

Note- For diameters $\geq 1.6\text{mm}$, the product can be supplied using patented or unpatented lead material.

Equivalents

APPROXIMATE EQUIVALENTS

DESIGNATION	EUROPEAN		AMERICAN	JAPANESE	CHINESE
	EN STANDARD	DIN	ASTM	G-3506 / G3522	GB / T 4357
SL	EN 10270-1	CLASS A	A 227	SWB	SL
SM	EN 10270-1	CLASS B	A 227	SWC	SM
SH	EN 10270-1	CLASS C	A 228	SWP-B	SH
DM	EN 10270-1	-	A 227	-	-
DH	EN 10270-1	CLASS D	A 228	SWP-B	DH
CLASS II	DIN 17223:1964-1	CLASS II	-	-	-

Mechanical properties

APPLICATION

TYPE	APPLICATION
SL	Tension, compression or torsion springs that are chiefly subjected to low static stress.
SM	Tension, compression or torsion springs that are subjected to medium-high static stresses or, rarely, dynamic stresses.
DM	Tension, compression or torsion springs that are subjected to medium-high dynamic stresses. Also for wire shapes that require severe bending.
SH	Tension, compression or torsion springs that are subjected to high static stresses or moderately dynamic stresses.
DH	Tension, compression and torsion springs that are mainly submitted to high static strains and to medium levels of dynamic strains.
CLASS II	Compression springs, extension springs, and torsion springs for high and dynamic stresses.

TYPES OF WIRES FOR SPRINGS. CLASSED ACCORDING TO EN 10270-1:

Tensile strength	Static conditions	Dynamic conditions
Low	SL	-
Medium	SM	DM
High	SH	DH

MECHANICAL PROPERTIES AND QUALITY REQUIREMENTS OF THE SL, SM, DM, SH AND DH STEEL WIRE TYPES EN 10270-1

Diameter of the wire <i>d</i>	Tensile strength Rm For steel wires of the type					CLASS II (approx.) ¹⁾	Minimum area reduction after Z
Nominal value mm	SL	SM	DM	SH	DH e		break for SL, SM, SH, DM and DH wire types
	MPa	MPa	MPa	MPa	MPa		%
d = 0.05	-	-	-	-	2800 - 3520	2700 - 3090	
0.05 < d ≤ 0.06	-	-	-	-	2800 - 3520		
0.06 < d ≤ 0.07	-	-	-	-	2800 - 3520		
0.07 < d ≤ 0.08	-	-	-	-	2800 - 3480		
0.08 < d ≤ 0.09	-	-	-	-	2800 - 3430		
0.09 < d ≤ 0.10	-	-	-	-	2800 - 3380		
0.10 < d ≤ 0.11	-	-	-	-	2800 - 3350		
0.11 < d ≤ 0.12	-	-	-	-	2800 - 3320		
0.12 < d ≤ 0.14	-	-	-	-	2800 - 3250		
0.14 < d ≤ 0.16	-	-	-	-	2800 - 3200		
0.16 < d ≤ 0.18	-	-	-	-	2800 - 3160		
0.18 < d ≤ 0.20	-	-	-	-	2800 - 3110		
0.20 < d ≤ 0.22	-	-	-	-	2770 - 3080		
0.22 < d ≤ 0.25	-	-	-	-	2770 - 3010		
0.25 < d ≤ 0.28	-	-	-	-	2680 - 2970		
0.28 < d ≤ 0.30	-	2370 - 2650	2370 - 2650	2660 - 2940	2660 - 2940	2650 - 3040	
0.30 < d ≤ 0.32	-	2350 - 2630	2350 - 2630	2640 - 2920	2640 - 2920		
0.32 < d ≤ 0.34	-	2330 - 2600	2330 - 2600	2610 - 2890	2610 - 2890		
0.34 < d ≤ 0.36	-	2310 - 2580	2310 - 2580	2590 - 2870	2590 - 2870		
0.36 < d ≤ 0.38	-	2290 - 2560	2290 - 2560	2570 - 2850	2570 - 2850		
0.38 < d ≤ 0.40	-	2270 - 2550	2270 - 2550	2560 - 2830	2560 - 2830		
0.40 < d ≤ 0.43	-	2250 - 2520	2250 - 2520	2530 - 2800	2530 - 2800		
0.43 < d ≤ 0.45	-	2240 - 2500	2240 - 2500	2510 - 2780	2510 - 2780	2650 - 2940	
0.45 < d ≤ 0.48	-	2220 - 2480	2220 - 2480	2490 - 2760	2490 - 2760		

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Diameter of the wire <i>d</i>	Tensile strength Rm For steel wires of the type					CLASS II (approx.) ¹⁾	Minimum area reduction after Z break for SL, SM, SH, DM and DH wire types
Nominal value mm	SL	SM	DM	SH	DH e		%
	MPa	MPa	MPa	MPa	MPa		
0.48 < d ≤ 0.50	-	2200 - 2470	2200 - 2470	2480 - 2740	2480 - 2740	2550 - 2840	
0.50 < d ≤ 0.53	-	2180 - 2450	2180 - 2450	2460 - 2720	2460 - 2720		
0.53 < d ≤ 0.56	-	2170 - 2430	2170 - 2430	2440 - 2700	2440 - 2700		
0.56 < d ≤ 0.60	-	2140 - 2400	2140 - 2400	2410 - 2670	2410 - 2670		
0.60 < d ≤ 0.63	-	2130 - 2380	2130 - 2380	2390 - 2650	2390 - 2650		
0.63 < d ≤ 0.65	-	2120 - 2370	2120 - 2370	2380 - 2640	2380 - 2640		
0.65 < d ≤ 0.70	-	2090 - 2350	2090 - 2350	2360 - 2610	2360 - 2610		
0.70 < d ≤ 0.75	-	2070 - 2320	2070 - 2320	2330 - 2580	2330 - 2580	2500 - 2800	
0.75 < d ≤ 0.80	-	2050 - 2300	2050 - 2300	2310 - 2560	2310 - 2560		40
0.80 < d ≤ 0.85	-	2030 - 2280	2030 - 2280	2290 - 2530	2290 - 2530		40
0.85 < d ≤ 0.90	-	2010 - 2260	2010 - 2260	2270 - 2510	2270 - 2510	2450 - 2750	40
0.90 < d ≤ 0.95	-	2000 - 2240	2000 - 2240	2250 - 2490	2250 - 2490		40
0.95 < d ≤ 1.00	1720 - 1970	1980 - 2220	1980 - 2220	2230 - 2470	2230 - 2470		40
1.00 < d ≤ 1.05	1710 - 1950	1960 - 2200	1960 - 2200	2210 - 2450	2210 - 2450		40
1.05 < d ≤ 1.10	1690 - 1940	1950 - 2190	1950 - 2190	2200 - 2430	2200 - 2430		40
1.10 < d ≤ 1.20	1670 - 1910	1920 - 2160	1920 - 2160	2170 - 2400	2170 - 2400	2350 - 2650	40
1.20 < d ≤ 1.25	1660 - 1900	1910 - 2140	1910 - 2140	2150 - 2380	2150 - 2380		40
1.25 < d ≤ 1.30	1640 - 1890	1900 - 2130	1900 - 2130	2140 - 2370	2140 - 2370		40
1.30 < d ≤ 1.40	1620 - 1860	1870 - 2100	1870 - 2100	2110 - 2340	2110 - 2340		40
1.40 < d ≤ 1.50	1600 - 1840	1850 - 2080	1850 - 2080	2090 - 2310	2090 - 2310	2260 - 2500	40
1.50 < d ≤ 1.60	1590 - 1820	1830 - 2050	1830 - 2050	2060 - 2290	2060 - 2290		40
1.60 < d ≤ 1.70	1570 - 1800	1810 - 2030	1810 - 2030	2040 - 2260	2040 - 2260		40
1.70 < d ≤ 1.80	1550 - 1780	1790 - 2010	1790 - 2010	2020 - 2240	2020 - 2240	2210 - 2450	40
1.80 < d ≤ 1.90	1540 - 1760	1770 - 1990	1770 - 1990	2000 - 2220	2000 - 2220		40
1.90 < d ≤ 2.00	1520 - 1750	1760 - 1970	1760 - 1970	1980 - 2200	1980 - 2200		2110 - 2350
2.00 < d ≤ 2.10	1510 - 1730	1740 - 1960	1740 - 1960	1970 - 2180	1970 - 2180	40	

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Diameter of the wire d	Tensile strength Rm For steel wires of the type					CLASS II (approx.) ¹⁾	Minimum area reduction after Z
	SL	SM	DM	SH	DH e		break for SL, SM, SH, DM and DH wire types
	MPa	MPa	MPa	MPa	MPa		%
2.10 < d ≤ 2.25	1490 - 1710	1720 - 1930	1720 - 1930	1940 - 2150	1940 - 2150		40
2.25 < d ≤ 2.40	1470 - 1690	1700 - 1910	1700 - 1910	1920 - 2130	1920 - 2130	-	40
2.40 < d ≤ 2.50	1460 - 1680	1690 - 1890	1690 - 1890	1900 - 2110	1900 - 2110		40
2.50 < d ≤ 2.60	1450 - 1660	1670 - 1880	1670 - 1880	1890 - 2100	1890 - 2100		40
2.60 < d ≤ 2.80	1420 - 1640	1650 - 1850	1650 - 1850	1860 - 2070	1860 - 2070	-	40
2.80 < d ≤ 3.00	1410 - 1620	1630 - 1830	1630 - 1830	1840 - 2040	1840 - 2040	-	40
3.00 < d ≤ 3.20	1390 - 1600	1610 - 1810	1610 - 1810	1820 - 2020	1820 - 2020	-	40
3.20 < d ≤ 3.40	1370 - 1580	1590 - 1780	1590 - 1780	1790 - 1990	1790 - 1990	-	40
3.40 < d ≤ 3.60	1350 - 1560	1570 - 1760	1570 - 1760	1770 - 1970	1770 - 1970	-	40
3.60 < d ≤ 3.80	1340 - 1540	1550 - 1740	1550 - 1740	1750 - 1950	1750 - 1950	-	40
3.80 < d ≤ 4.00	1320 - 1520	1530 - 1730	1530 - 1730	1740 - 1930	1740 - 1930	-	35
4.00 < d ≤ 4.25	1310 - 1500	1510 - 1700	1510 - 1700	1710 - 1900	1710 - 1900	-	35
4.25 < d ≤ 4.50	1290 - 1490	1500 - 1680	1500 - 1680	1690 - 1880	1690 - 1880	-	35
4.50 < d ≤ 4.75	1270 - 1470	1480 - 1670	1480 - 1670	1680 - 1860	1680 - 1860	-	35
4.75 < d ≤ 5.00	1260 - 1450	1460 - 1650	1460 - 1650	1660 - 1840	1660 - 1840	-	35
5.00 < d ≤ 5.30	1240 - 1430	1440 - 1630	1440 - 1630	1640 - 1820	1640 - 1820	-	35
5.30 < d ≤ 5.60	1230 - 1420	1430 - 1610	1430 - 1610	1620 - 1800	1620 - 1800	-	35
5.60 < d ≤ 6.00	1210 - 1390	1400 - 1580	1400 - 1580	1590 - 1770	1590 - 1770	-	35
6.00 < d ≤ 6.30	1190 - 1380	1390 - 1560	1390 - 1560	1570 - 1750	1570 - 1750	-	35
6.30 < d ≤ 6.50	1180 - 1370	1380 - 1550	1380 - 1550	1560 - 1740	1560 - 1740	-	35
6.50 < d ≤ 7.00	1160 - 1340	1350 - 1530	1350 - 1530	1540 - 1710	1540 - 1710	-	35
7.00 < d ≤ 7.50	1140 - 1320	1330 - 1500	1330 - 1500	1510 - 1680	1510 - 1680	-	30
7.50 < d ≤ 8.00	1120 - 1300	1310 - 1480	1310 - 1480	1490 - 1660	1490 - 1660	-	30
8.00 < d ≤ 8.50	1110 - 1280	1290 - 1460	1290 - 1460	1470 - 1630	1470 - 1630	-	30
8.50 < d ≤ 9.00	1090 - 1260	1270 - 1440	1270 - 1440	1450 - 1610	1450 - 1610	-	30
9.00 < d ≤ 9.50	1070 - 1250	1260 - 1420	1260 - 1420	1430 - 1590	1430 - 1590	-	30
9.50 < d ≤ 10.00	1060 - 1230	1240 - 1400	1240 - 1400	1410 - 1570	1410 - 1570	-	30

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Diameter of the wire d	Tensile strength Rm For steel wires of the type					CLASS II (approx.) ¹⁾	Minimum area reduction after Z break for SL, SM, SH, DM and DH wire types
Nominal value mm	SL	SM	DM	SH	DH e		%
	MPa	MPa	MPa	MPa	MPa		
10.00 < d ≤ 10.50	-	1220 - 1380	1220 - 1380	1390 - 1550	1390 - 1550	-	30
10.50 < d ≤ 11.00	-	1210 - 1370	1210 - 1370	1380 - 1530	1380 - 1530	-	30
11.00 < d ≤ 12.00	-	1180 - 1340	1180 - 1340	1350 - 1500	1350 - 1500	-	30
12.00 < d ≤ 12.50	-	1170 - 1320	1170 - 1320	1130 - 1480	1130 - 1480	-	28
12.50 < d ≤ 13.00	-	1160 - 1310	1160 - 1310	1320 - 1470	1320 - 1470	-	28
13.00 < d ≤ 14.00	-	1130 - 1280	1130 - 1280	1290 - 1440	1290 - 1440	-	28
14.00 < d ≤ 15.00	-	1160 - 1260	1160 - 1260	1270 - 1410	1270 - 1410	-	28
15.00 < d ≤ 16.00	-	1090 - 1230	1090 - 1230	1240 - 1390	1240 - 1390	-	28
16.00 < d ≤ 17.00	-	1070 - 1210	1070 - 1210	1220 - 1360	1220 - 1360	-	28
17.00 < d ≤ 18.00	-	1050 - 1190	1050 - 1190	1200 - 1340	1200 - 1340	-	28
18.00 < d ≤ 19.00	-	1030 - 1170	1030 - 1170	1180 - 1320	1180 - 1320	-	28
19.00 < d ≤ 20.00	-	1020 - 1150	1020 - 1150	1160 - 1300	1160 - 1300	-	28

1) The values listed in DIN 17223:1964 were given in kg/mm²; the conversion performed is for guidance purposes.

PERMISSIBLE TENSILE STRENGTH RANGE (MPA) IN A SINGLE PACKAGE EN 10270-1:2011

Nominal diameter d mm	SL, SM, SH	DM, DH
$d < 0.80$	150	150
$0.80 \leq d < 1.60$	120	100
$1.60 \leq d$	120	70

The requirements are applicable to unit packages in which the mass in kilogrammes is not greater than the value $250 \times d$ (d = wire diameter in mm) or a value of 1000 kg. In the case of coils with a higher mass, appropriate arrangements must be agreed.

Finishes

COATINGS SUBJECT TO STANDARDS:

Coating		Description
Phosphated	ph	The wire is treated in a solution so that a layer of phosphated metal forms on its surface.
Galvanising	Z	The surface is coated in a layer of zinc.
Zinc - Aluminium	ZA	The surface is coated in a layer of Zn 95 / Al 5(%)
Reddish	rd	The surface is coated with a thin layer of copper, normally a conversion coating.
Coppery	Cu	The surface is coated in a thick (even) layer of copper

MINIMUM COATING DENSITY REQUIRED OF ZINC OR ZINC/ALUMINIUM EN 10270-1

Nominal diameter d mm	Minimum coating density ^{a) b)} g/m ²
$0.20 \leq d < 0.25$	20
$0.25 \leq d < 0.40$	25
$0.40 \leq d < 0.50$	30

Nominal diameter d mm	Minimum coating density ^{a) b)} g/m ²
$0.50 \leq d < 0.60$	35
$0.60 \leq d < 0.70$	40
$0.70 \leq d < 0.80$	45
$0.80 \leq d < 0.90$	50
$0.90 \leq d < 1.00$	55
$1.00 \leq d < 1.20$	60
$1.20 \leq d < 1.40$	65
$1.40 \leq d < 1.65$	70
$1.65 \leq d < 1.85$	75
$1.85 \leq d < 2.15$	80
$2.15 \leq d < 2.50$	85
$2.50 \leq d < 2.80$	95
$2.80 \leq d < 3.20$	100
$3.20 \leq d < 3.80$	105
$3.80 \leq d < 10.00$	110

a) The requirements regarding zinc coatings fall within class C in Standard EN 10244-2:2009.

b) If different coating weights are required, priority will be given to the reference coating weights established in Standard En 10244-2 (for example: class D of standard En 10244-2:2009).

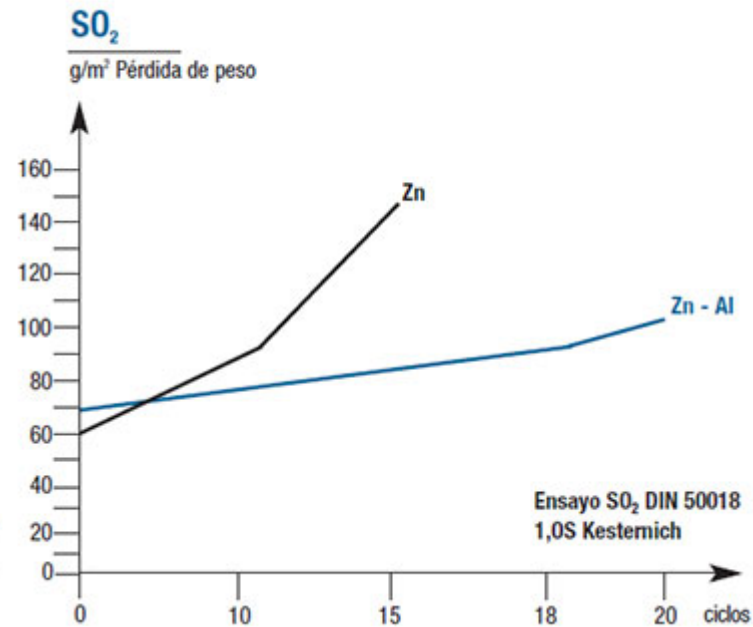
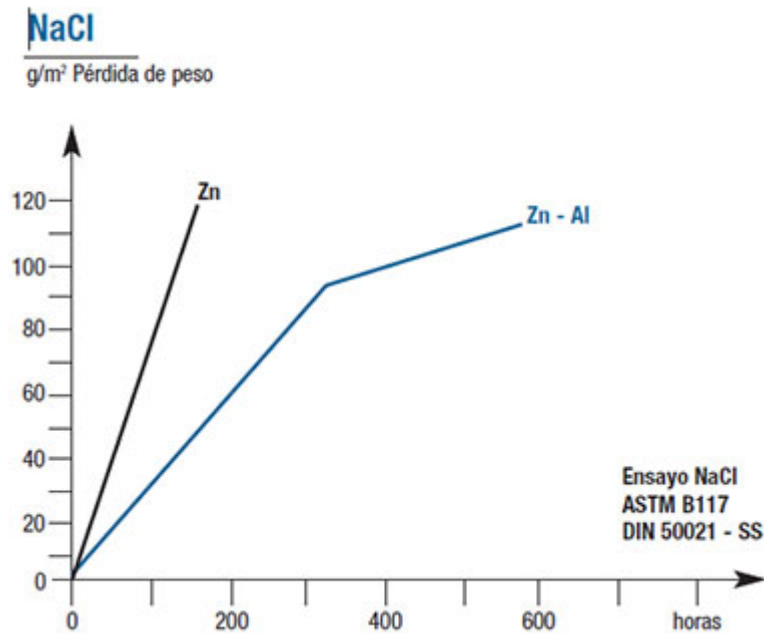
SALT SPRAY TEST

Minimum coating density in order to achieve a certain number of hours. *(Data provided for information purposes only)*

GALVANISED COATING		Zn - Al COATING	
Exposure time (hours)	Density of Zn (g/m ²)	Exposure time (hours)	Density of Zn - Al (g/m ²)
36	80	-	-
48	90	120	>40
72	105	240	>60
96	125	264	>75

GALVANISED COATING		Zn - Al COATING	
Exposure time (hours)	Density of Zn (g/m ²)	Exposure time (hours)	Density of Zn - Al (g/m ²)
120	165	288	>85
144	195	312	>100
168	220	360	>110
192	240	408	>125

The Zn - Al coating offers corrosion resistance that is 2 to 3 times higher than zinc in a salt spray test (NaCl) and in a SO₂ atmosphere.



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Tolerances

DIAMETER TOLERANCES. PERMISSIBLE DEVIATIONS ACCORDING TO EN 10270-1

Diameter of the wire d	
Nominal value mm	Permissible deviations mm
0.05 < d ≤ 0.09	± 0.003
0.09 < d ≤ 0.16	± 0.004
0.16 < d ≤ 0.25	± 0.005
0.25 < d ≤ 0.63	± 0.008
0.63 < d ≤ 0.75	± 0.010
0.75 < d ≤ 1.00	± 0.015
1.00 < d ≤ 1.20	± 0.020
1.20 < d ≤ 1.70	± 0.020
1.70 < d ≤ 2.60	± 0.025
2.60 < d ≤ 4.00	± 0.030
4.00 < d ≤ 5.30	± 0.035
5.30 < d ≤ 7.00	± 0.040
7.00 < d ≤ 9.00	± 0.045
9.00 < d ≤ 10.00	± 0.050
10.00 < d ≤ 11.00	± 0.070
11.00 < d ≤ 14.00	± 0.080
14.00 < d ≤ 18.00	± 0.090
18.00 < d ≤ 20.00	± 0.100

OVALITY

The difference between the maximum diameter and the minimum diameter of the wire in the same cross section must be no greater than 50% of the total permissible deviation specified on the mechanical properties table

WHEN SUPPLIED IN RODS. STRAIGHTENED WIRE:

Nominal diameter d mm	Diameter tolerance ^{a)} mm		Supply capacity ^{b)} mm.	
	Lower tolerance	Higher tolerance	Minimum length	Maximum length
0.65 ≤ d < 0.80	-0.010	+0.022	50	2000
0.80 ≤ d < 1.01	-0.015	+0,030	30	2000
1.01 ≤ d < 1.35	-0.020	+0,040		
1.35 ≤ d < 1.78	-0.020	+0,045		
1.78 ≤ d < 2.01	-0.025	+0,055	30	4000
2.01 ≤ d < 2.35	-0.025	+0,060		
2.35 ≤ d < 2.78	-0.025	+0,065		
2.78 ≤ d < 3.01	-0.030	+0,075	30	4000
3.01 ≤ d < 3.35	-0.030	+0,080		
3.35 ≤ d < 4.01	-0.030	+0,090		
4.01 ≤ d < 4.35	-0.035	+0,100	30	4350
4.35 ≤ d < 5.01	-0.035	+0,110		
5.01 ≤ d < 5.45	-0.035	+0,120		
5.45 ≤ d < 6.01	-0.040	+0,130	250	4350
6.01 ≤ d < 7.12	-0.040	+0,150		
7.12 ≤ d < 7.67	-0.045	+0,160		
7.67 ≤ d < 9.01	-0.045	+0,180		
9.01 ≤ d < 10.01	-0.050	+0,200		
10.01 ≤ d < 10.50	-0.070	+0,240		

a) Diameter tolerances of straightened and cut lengths according to EN 10270-1

b) Approximate data for information purposes.

STANDARD LENGTH TOLERANCES

NOMINAL LENGTH	TOLERANCE
L < = 1000 mm.	+/- 1 mm.
1000 < L < = 4000	- 0mm. / +3 mm.