

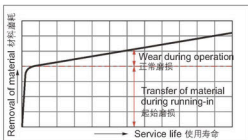
TECHNICAL REFERENCE 相关设计

Influences on the service life

影响轴承使用寿命的因素

Wear and service life of SinoBronze sliding bearings are dependent on the following:

- Specific bearing load
- Sliding speed
- PV value
- Roughness depth of the mating surface
- Mating surface material and Temperature etc.
- 轴承载荷和负载方式
- 线速度
- PV值
- 对磨件表面光洁度
- 对磨件热处理方式
- 环境温度等



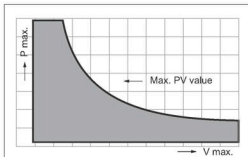
PV Value Calculation PV值的计算 $PV = P \times V (N/mm^2 \times m/s)$

The PV value has a considerable influence on the bearing service life. It is the product of the specific load P and the sliding speed V and the PV is one of the most important design data, it is recommended a PV value lower than the required specification will leads to a longer service life.

PV value listed in this catalogues is allowable PV value for radial journal rotational operation. In many cases, engineers need to take into account the actual bearing work situation, designing small PV values as far as possible so as to extend the service life of bearing, of course the suitable data will need a lot of experiments to verify.





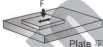
Also, the environmental temperature is necessary to consideration, the clearance can be changed caused by the dimensional change of the bearing and housing, the mating material hardness change from the environment temperature, the interference and so on.

PV是指轴承在一定的承载和线速度条件下的乘积之和。PV值与轴承的使用寿命成反比例关系；因此建议设计时尽量使用比较低的安全的PV值，以确保轴承会有更长的使用寿命；虽然样本中有明确了各类材料的PV值但是这些都是是在径向旋转条件下测得的，而事实上设计人员在设计轴承寿命时还需要考虑很多因素。另外环境温度是一个必须要考虑的参数，由于温度的上升会导致轴承与座孔间的配合间隙发生变化，轴与轴承内孔的配合公差也会发生变化。



TECHNICAL REFERENCE 相关设计

Direction of motion and PV value 运转方式和PV值的计算

		Load 负载 $P \text{ N/mm}^2$ { kgf/cm^2 }	Velocity V 线速度 m/s {(m/min)}	PV Value PV值 $\text{N/mm}^2 \cdot \text{m/s}$ { $\text{kgf/cm}^2 \cdot \text{m/min}$ }
1. Rotating motion in single direction of radial journal 旋转运动	 Bushing 轴套	$\frac{F}{dL}$ { $\frac{10^3 F}{dL}$ }	$\frac{\pi d n}{10^3}$ { $\frac{\pi d n}{10^3}$ }	$\frac{\pi F n}{10^3 L}$ { $\frac{\pi F n}{10 L}$ }
2. Oscillating motion 摇摆运动	 Bushing 轴套	$\frac{F}{dL}$ { $\frac{10^3 F}{dL}$ }	$\frac{dc \theta}{10^3}$ { $\frac{\pi dc \theta}{180 \times 10^3}$ }	$\frac{Fc \theta}{10^3 L}$ { $\frac{\pi Fc \theta}{180 \times 10^3 L}$ }
3. Reciprocating motion 往复运动	 Bushing 轴套	$\frac{F}{dL}$ { $\frac{10^3 F}{dL}$ }	$\frac{2cS}{10^3}$ { $\frac{2cS}{10^3}$ }	$\frac{2FcS}{10^3 dL}$ { $\frac{FcS}{5dL}$ }
4. Thrust motion 推力运动	 Rotation 旋转 Oscillation 摇摆 Thrust washer 垫片	$\frac{4F}{\pi (D^2 - d^2)}$ { $\frac{400F}{\pi (D^2 - d^2)}$ }	$\frac{\pi D n}{10^3}$ { $\frac{\pi D n}{10^3}$ }	$\frac{4FDn}{10^3 (D^2 - d^2)}$ { $\frac{4FDn}{10 (D^2 - d^2)}$ }
		$\frac{4F}{\pi (D^2 - d^2)}$ { $\frac{400F}{\pi (D^2 - d^2)}$ }	$\frac{Dc \theta}{10^3}$ { $\frac{\pi Dc \theta}{180 \times 10^3}$ }	$\frac{4FDc \theta}{10^3 \pi (D^2 - d^2)}$ { $\frac{4FDc \theta}{180 \times 10 (D^2 - d^2)}$ }
5. Plane reciprocating motion 平面滑动	 Plate 平板	$\frac{F}{BL}$ { $\frac{10^3 F}{WL}$ }	$\frac{2cS}{10^3}$ { $\frac{2cS}{10^3}$ }	$\frac{2FcS}{10^3 BL}$ { $\frac{FcS}{5WL}$ }

F : Vertical load N (kgf)
N : Number of rotation S^{*} (rpm)
c : Cyclic velocity of reciprocating or oscillating motion S^{*} (cpm)
S : Stroke distance m (mm)
θ : Oscillating angle rad
d : Bearing ID mm (mm)
D : Bearing OD mm (mm)
L : Bearing length mm (mm)
W : Bearing width mm (mm)

F : 承载 N (kgf)
N : 转数 S^{*} (rpm)
c : 往复或摇摆数 S^{*} (cpm)
S : 行程 m (mm)
θ : 摇摆角度 rad
d : 轴承内径 mm (mm)
D : 轴承外径 mm (mm)
L : 轴承长度 mm (mm)
W : 轴承宽度 mm (mm)

TECHNICAL REFERENCE 相关设计

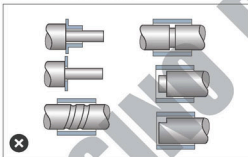
Mating Shaft 相配轴

Bearing performance is influenced by the material, hardness, surface roughness and surface treatment of the mating shaft. If used in a corrosive environment such as in the seawater, or in the chemical liquid, double or triple chrome plating should be consideration.

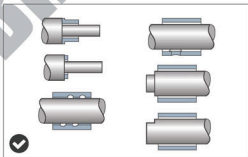
相配轴的材料、硬度、表面粗糙度和表面处理对轴承的使用有很大的影响。以下推荐材料可供参考；另外，在海水、药液等腐蚀场合下使用时建议使用不锈钢或表面镀铬处理。

Bearing material 轴承材料	Bearing load 面压	Shaft material recommend 推荐相配轴材料	Hardness 硬度	Roughness 表面粗糙度
Metallic Bearing 金属基 自润滑轴承	<25Mpa	Carbon steel, structure alloy steel (S45C, SNC415, SCM435), in corrosive environment, corrosion resistant steel (SUS304, SUS403, SUS420) 优质碳钢, 合金钢, 腐蚀条件下使用耐腐蚀钢	>HB150	<1.6a
	25~49Mpa	Surface hardening treatment such as induction hardening and carburizing should be implemented for the above materials. 表面硬化处理如渗碳处理、感应淬火等	>HB250	<1.6a
	49~98Mpa	In addition to surface hardening treatment as above, additional surface treatment such as nitride treatment and hard chrome plating for above material. 以上处理外同时作渗氮处理、镀铬硬铬等	>HRC50	<1.6a

Incorrect 不正确设计



Correct 正确设计



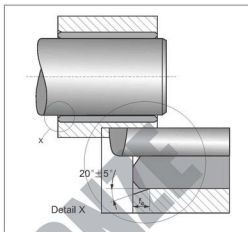
TECHNICAL REFERENCE 相关设计

Housing 轴承座孔

There should be chamfers on the housing bore during the assembly. A chamfer $F_0 \times 20^\circ \pm 5^\circ$ is important for the easier pressing of the bushing into the housing

SB 设计的标准轴承要求座孔必须加工到H7公差，最大表面粗糙度为Ra3.2，为了便于轴承的安装，轴承座孔应有 $20^\circ \pm 5^\circ$ 的倒角。

Housing bore diameter d_o 座孔	Chamfer with f_0 倒角
$d_o \leq 30$	0.8 ± 0.3
$30 < d_o \leq 80$	1.2 ± 0.4
$80 < d_o \leq 180$	1.8 ± 0.8
$180 < d_o$	2.5 ± 1.0



Wall thickness 壁厚设计

Wall thickness of the metallic bearings can be made thin to realize smaller mechanical design.

金属自润滑轴承的壁厚可以尽可能的设计成薄壁结构已达到尺寸的最小化，建议壁厚设计如下：

ID 内径	10mm	20mm	50mm	100mm	300mm
Wall thickness 壁厚	3~4mm	3~5mm	7.5~10mm	10~15mm	20~30mm

Length 长度设计

In general, length of bearing is calculated by the ratio of the bearing length and inner side diameter, for normal application: the $\text{Length}/ID = 0.5 \sim 2.0$, for high load, high speed and uneven contact is recommend: the $\text{Length}/ID = 0.8 \sim 1.0$.

一般来说，轴承的长度是根据轴承的长度和内径比计算得到的，比如一般工况我们建议长度和内径比为0.5~2.0，而对于高速、高载和不平稳的接触面运用时建议长度和内径比为0.8~1.0。

TECHNICAL REFERENCE 相关设计

Periodic greasing 定期给油

SinoBronze metallic self-lubricating bearings designed for maintenance-free and dry operation, but periodic greasing or oiling will improve the bearing performance and extension the service life.

- Reduction of coefficient of friction and wear amount
- Smoothly running and Increase the limited PV value
- Cooling effect
- Greatly extension the bearing service life
- Protect the contamination reach the bearing section
- Prevent mating material rust

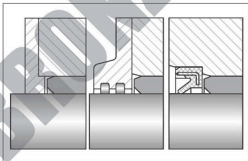
SB 金属基自润滑轴承设计为自润滑免维护的轴承材料，但在润滑条件下更能表现出其优越的性能。

- 降低摩擦系数，减少磨损量
- 运行更平稳，提高PV值
- 带走轴承运行过程中产生的热量
- 可以大大延长轴承的使用寿命
- 防止异物的侵入
- 防止对零件的生锈现象

Seals 密封件

if increased levels of contamination occur or the bearing is used in an aggressive environment, the bearing section should be protected from dust and containment. The normal solution is to re-design the surrounding structure so that the contamination can not reach the bearing section. if the contamination is critical, a collar of grease or a shaft seal is recommended.

金属基自润滑轴承允许一些不会损害轴承表面的异物进入，但当异物的侵入增加或高研磨型物质进入时应当安装合适的密封件以提高轴承的使用寿命。



BEARING INSTALLATION 轴承的装配

Pressure assembly 机械压装

In most applications, SinoBronze bearings can be fitted by press. For this procedure, a mandrel and a press machine are used, it is forbidden to hit the bearing in order to avoid deformation of bearings. The housing inner side should smooth without contamination.

通常情况下，轴承可以采用压力装配的方式进行安装，装配时应采用芯轴慢慢压入，禁止直接击打轴承以免产生变形，装配前应确保座孔内表面光洁无异物。

Cooling assembly 冷冻装配

The cooling fit uses liquid nitrogen or dry ice, compared to press fitting, cooling fit is efficient and achieves more accurate installation. The standard cooling temperature is $-40^{\circ}\text{C} \sim -70^{\circ}\text{C}$, cooling time should be more than one hour, details according to the bushing wall thickness and interference design.

通过液氮或干冰采用冷装配压装相比采用机械压装方式更为有效，此时标准的冷冻温度为 $-40^{\circ}\text{C} \sim -70^{\circ}\text{C}$ ，冷冻时间一般为1小时以上，具体需要根据零件的壁厚和配合公差。

Calculation of bearing shrinkage amount of outer diameter:

轴承的收缩量可以根据以下公式计算:

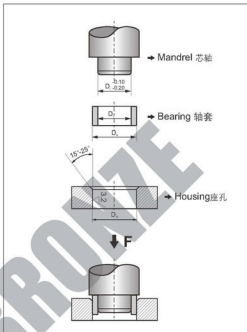
$$\Delta D = D \times \alpha \times \Delta T$$

ΔD : Shrinkage of bearing OD 外径收缩量

D : Bearing OD 轴承外径

α : Coefficient of thermal expansion 线性膨胀系数 ($1/10^6\text{K}$)

ΔT : Temperature difference 温度差



BEARING INSTALLATION 轴承的装配

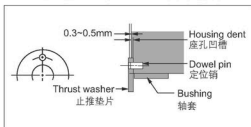
Thrust washers and plate fit

止推垫片和滑板的安装

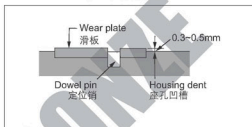
It is recommend to install the thrust washers and sliding plates with the hollow indented housings. To avoid the moving of such parts, a dowel pins is recommended to be installed.

止推垫片和滑板应当安装在座孔的凹槽内。为了避免零件的移动建议使用定位销或沉头螺丝加以固定。

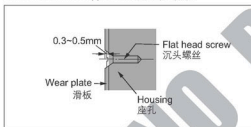
1. Dowel pin application(thrust washer) 定位销安装



2. Inlaid installation(plate) 镶嵌式安装



3. Flat head screw application 沉头螺丝安装



SURFACE ROUGHNESS TABLE 表面粗糙度对照表

CHINA 中国 GB 1031-83 ISO 468-83				UK 英国 BS 1134-61		USA 美国 ASAB 46.1-62		GERMANY 德国 DIN 4763-60		SWITZERLAND 瑞士 VSM 10321-62		ITALY 意大利 UNI 13963-60		POLAND 波兰 PN 58/M 042-51		CZECH 捷克 CSN 14450-61		JAPAN 日本 JIS B0601-70			
Ra (μ)	Rz (μ)	Ry (μ)	Code	Ra (μ in)(μ)	Code	Ra (μ in)(μ)	Code	Ra (μ)	Rz (μ)	ISO	Code	Ra (μ)	Rz (μ)	Code	Ra (μ)	Rz (μ)	Code	Ra (μ)	Rz (μ)	Rmax (μ)	Code
0.008	0.032	0.125												0.01	0.05	√14					
0.01	0.04	0.16						0.01	0.04								0.012	0.05		(0.0125a)	(0.055)
0.012	0.05	0.20						0.016	0.063					0.02	0.10	√13					
0.016	0.063	0.25						0.025	0.10	0.025	N1	0.025		0.04	0.20	√12			0.12	0.15	
0.02	0.08	0.32						0.04	0.16	0.05	N2	0.05		0.08	0.40	√11			0.05a	0.22	0.25
0.025	0.10	0.40	1(0.025)			1(0.025)		0.063	0.25	0.10	N3	0.10		0.10	0.40	√10			0.1a	0.42	0.45
0.032	0.125	0.50				2(0.05)		0.10	0.40	0.16	N4	0.16		0.16	0.80	√9			0.2a	0.82	0.85
0.04	0.16	0.63				3(0.08)		0.16	0.63	0.25	N5	0.25		0.25	1.60	√8			0.4a	1.62	1.65
0.05	0.20	0.80				4(0.10)		0.25	1	0.40	N6	0.40		0.4	3.20	√7			0.8a	3.22	3.25
0.063	0.25	1.0				5(0.125)		0.40	1.60	0.63	N7	0.63		0.6	6.30	√6			1.6a	6.32	6.35
0.08	0.32	1.25				6(0.16)		0.63	2.5	1.0	N8	1.0		1	12.5	√5			3.2a	12.52	12.55
0.10	0.40	1.6	4(0.10)			8(0.2)		1	4	1.6	N9	1.6		1.2	25	√4			(18Z)	(18S)	
0.125	0.50	2.0				10(0.25)		1.6	6.3	2.5	N10	2.5		2	50	√3			6.3a	25Z	25S
0.16	0.63	2.5				13(0.32)		2.5	10	4	N11	4		3	100	√2			35Z	35S	
0.20	0.80	3.2	8(0.2)			16(0.4)		4	16	6.3	N12	6.3		4	200	√1			50Z	50S	
0.25	1	4				20(0.5)		6.3	25	10		10		5	400				(70Z)	(70S)	
0.32	1.25	5				25(0.63)		10	40	16		16		6	800				100Z	100S	
0.40	1.6	6.3	16(0.4)			32(0.8)		16	63	25		25		8	1600				140Z	140S	
0.50	2	8				40(1)		25	100	40		40		10	2500				200Z	200S	
0.63	2.5	10	32(0.8)			50(1.25)		40	160	63		63		12	5000				280Z	280S	
0.8	3.2	15				63(1.6)		63	250	100		100		16	10000				560Z	560S	
1	4	20				80(2)		100	400	160		160		25	20000						
1.25	5	25				100(2.5)		160	630	250		250		40	40000						
1.6	6.3	32	63(1.6)			125(3.2)		250	1000	400		400		63	63000						
2	8	40				160(4)		400	1600	630		630		100	100000						
2.5	10	50				200(5)		630	2500	1000		1000		160	160000						
3.2	12.5	63	125(3.2)			250(6.3)		1000	4000	1600		1600		250	250000						
4	16	80				320(8)		1600	6300	2500		2500		400	400000						
5	20	100				400(10)		2500	10000	4000		4000		630	630000						
6.3	25	125	250(6.3)			500(12.5)		4000	16000	6300		6300		1000	1000000						
8	32	160				630(16)		6300	25000	10000		10000		1600	1600000						
10	40	200				800(20)		10000	40000	16000		16000		2500	2500000						
12.5	50	250	500(12.5)			1000(25)		16000	63000	25000		25000		4000	4000000						
16	63	320				1250(32)		25000	100000	40000		40000		6300	6300000						
20	80	400				1600(40)		40000	160000	63000		63000		10000	10000000						
25	100	500	1000(25)			2000(50)		63000	250000	100000		100000		16000	16000000						
32	125	630				2500(63)		100000	400000	160000		160000		25000	25000000						
40	160	800				3200(80)		160000	630000	250000		250000		40000	40000000						
50	200	1000				4000(100)		250000	1000000	400000		400000		63000	63000000						
63	250	1250				5000(125)		400000	1600000	630000		630000		100000	100000000						
80	320	1600				6300(160)		630000	2500000	1000000		1000000		160000	160000000						
100	400	2000				8000(200)		1000000	4000000	1600000		1600000		250000	250000000						
125	500	2500				10000(250)		1600000	6300000	2500000		2500000		400000	400000000						
160	630	3200				12500(320)		2500000	10000000	4000000		4000000		630000	630000000						
200	800	4000				16000(400)		4000000	16000000	6300000		6300000		1000000	1000000000						
250	1000	5000				20000(500)		6300000	25000000	10000000		10000000		1600000	1600000000						
320	1250	6300				25000(630)		10000000	40000000	16000000		16000000		2500000	2500000000						
400	1600	8000				32000(800)		16000000	63000000	25000000		25000000		4000000	4000000000						
500	2000	10000				40000(1000)		25000000	100000000	40000000		40000000		6300000	6300000000						
630	2500	12500				50000(1250)		40000000	160000000	63000000		63000000		10000000	10000000000						
800	3200	16000				63000(1600)		63000000	250000000	100000000		100000000		16000000	16000000000						
1000	4000	20000				80000(2000)		100000000	400000000	160000000		160000000		25000000	25000000000						
1250	5000	25000				100000(2500)		160000000	630000000	250000000		250000000		40000000	40000000000						
1600	6300	32000				125000(3200)		250000000	1000000000	400000000		400000000		63000000	63000000000						
2000	8000	40000				160000(4000)		400000000	1600000000	630000000		630000000		100000000	100000000000						
2500	10000	50000				200000(5000)		630000000	2500000000	1000000000		1000000000		160000000	160000000000						
3200	12500	63000				250000(6300)		1000000000	4000000000	1600000000		1600000000		250000000	250000000000						
4000	16000	80000				320000(8000)		1600000000	6300000000	2500000000		2500000000		400000000	400000000000						
5000	20000	100000				400000(10000)		2500000000	10000000000	4000000000		4000000000		630000000	630000000000						
6300	25000	125000				500000(12500)		4000000000	16000000000	6300000000		6300000000		1000000000	1000000000000						
8000	32000	160000				630000(16000)		6300000000	25000000000	10000000000		10000000000		1600000000	1600000000000						
10000	40000	200000				800000(20000)		10000000000	40000000000	16000000000		16000000000		2500000000	2500000000000						
12500	50000	250000				1000000(25000)		16000000000	63000000000	25000000000		25000000000		4000000000	4000000000000						
16000	63000	320000				1250000(32000)		25000000000	100000000000	40000000000		40000000000		6300000000	6300000000000						
20000	80000	400000				1600000(40000)		40000000000	160000000000	63000000000		63000000000		10000000000	10000000000000						
25000	100000	500000				2000000(50000)		63000000000	250000000000	100000000000		100000000000		16000000000	16000000000000						
32000	125000	630000				2500000(63000)		100000000000	400000000000	160000000000		160000000000		25000000000	25000000000000						
40000	160000	800000				3200000(80000)		160000000000	630000000000	250000000000		250000000000		40000000000	40000000000000						
50000	200000	1000000				4000000(100000)		250000000000	1000000000000	400000000000		400000000000		63000000000	6						

SHAFT TOLERANCE TABLE (ISO STANDARD) 轴径公差

Unit(单位): mm

>	≤	c9	d8	e7	e8	f7	g6	h5	h6	h7	h8	js6	js7	k6	m6	n6	p6	p7	r6	s6
—	3	-60 -85	-20 -34	-14 -24	-14 -28	-6 -16	-2 -8	0 -4	0 -6	0 -10	0 -14	±3	±5	+6 0	+8 +2	+10 +4	+12 +6	+16 +6	+16 +10	+20 +14
3	6	-70 -100	-30 -48	-20 -32	-20 -38	-10 -22	-4 -12	0 -5	0 -8	0 -12	0 -18	±4	±6	+9 +1	+12 +4	+16 +8	+20 +12	+24 +15	+23 +19	+27 +21
6	10	-80 -116	-40 -62	-25 -40	-25 -47	-13 -28	-5 -14	0 -6	0 -9	0 -15	0 -22	±4.5	±7	+10 +1	+15 +6	+19 +10	+24 +15	+30 +19	+28 +23	+32 +26
10	18	-95 -138	-50 -77	-32 -50	-32 -59	-16 -34	-6 -17	0 -8	0 -11	0 -18	0 -27	±5.5	±9	+12 +1	+18 +7	+23 +12	+29 +18	+36 +23	+34 +28	+39 +32
18	24	-110 -162	-65 -98	-40 -61	-40 -73	-20 -41	-7 -20	0 -9	0 -13	0 -21	0 -33	±6.5	±10	+15 +2	+21 +8	+28 +15	+35 +22	+43 +22	+41 +28	+48 +35
24	30	-120 -182	-80 -119	-50 -75	-50 -89	-25 -50	-9 -25	0 -11	0 -16	0 -25	0 -39	±8	±12	+18 +2	+25 +9	+33 +17	+42 +26	+51 +26	+50 +34	+59 +43
30	40	-140 -214	-100 -146	-60 -90	-60 -106	-30 -60	-10 -29	0 -13	0 -19	0 -30	0 -46	±9.5	±15	+21 +2	+30 +11	+39 +20	+51 +32	+62 +32	+60 +41	+72 +53
40	50	-150 -224	-110 -162	-70 -107	-70 -126	-40 -71	-12 -34	0 -15	0 -22	0 -35	0 -54	±11	±17	+25 +3	+35 +13	+45 +23	+59 +37	+72 +37	+71 +51	+83 +63
50	65	-170 -257	-120 -174	-80 -126	-80 -148	-50 -83	-14 -39	0 -18	0 -25	0 -40	0 -63	±12.5	±20	+28 +3	+40 +15	+52 +27	+68 +43	+83 +43	+90 +65	+100 +70
65	80	-180 -267	-130 -192	-90 -138	-90 -162	-60 -98	-17 -44	0 -20	0 -29	0 -46	0 -72	±14.5	±23	+33 +14	+46 +17	+60 +31	+79 +50	+96 +50	+109 +80	+125 +100
80	100	-200 -300	-145 -208	-100 -146	-100 -172	-70 -119	-20 -54	0 -25	0 -32	0 -52	0 -81	±16	±26	+36 +4	+52 +20	+66 +34	+88 +56	+108 +56	+125 +88	+150 +114
100	120	-210 -310	-155 -224	-110 -162	-110 -192	-80 -126	-23 -63	0 -30	0 -39	0 -57	0 -89	±18	±28	+40 +4	+57 +21	+73 +37	+98 +62	+119 +62	+130 +88	+150 +114
120	140	-220 -330	-165 -239	-120 -174	-120 -208	-90 -148	-26 -77	0 -33	0 -42	0 -63	0 -97	±20	±31	+45 +5	+63 +23	+80 +40	+108 +68	+131 +88	+156 +114	+172 +132
140	160	-230 -340	-175 -254	-130 -192	-130 -224	-100 -162	-29 -83	0 -36	0 -45	0 -69	0 -107	±22	±34	+48 +6	+66 +26	+84 +42	+114 +72	+136 +94	+156 +116	+176 +136
160	180	-240 -355	-185 -269	-140 -208	-140 -239	-110 -174	-32 -91	0 -39	0 -48	0 -72	0 -111	±24	±37	+50 +7	+68 +28	+86 +44	+116 +74	+138 +96	+158 +118	+178 +138
180	200	-250 -365	-195 -279	-150 -218	-150 -254	-120 -183	-35 -101	0 -42	0 -51	0 -76	0 -119	±26	±40	+52 +8	+70 +30	+88 +46	+118 +76	+140 +98	+160 +120	+180 +140
200	225	-260 -375	-205 -289	-160 -228	-160 -269	-130 -197	-38 -111	0 -45	0 -54	0 -81	0 -127	±28	±43	+54 +9	+72 +32	+90 +48	+120 +78	+142 +100	+162 +122	+182 +142
225	250	-270 -385	-215 -299	-170 -238	-170 -279	-140 -208	-41 -121	0 -48	0 -57	0 -84	0 -135	±30	±46	+56 +10	+74 +34	+92 +50	+122 +80	+144 +102	+164 +124	+184 +144
250	280	-280 -400	-225 -310	-180 -248	-180 -299	-150 -218	-44 -131	0 -51	0 -60	0 -87	0 -141	±32	±49	+58 +11	+76 +36	+94 +52	+124 +82	+146 +104	+166 +126	+186 +146
280	315	-290 -420	-235 -330	-190 -258	-190 -309	-160 -228	-47 -141	0 -54	0 -63	0 -90	0 -147	±34	±52	+60 +12	+78 +38	+96 +54	+126 +84	+148 +106	+168 +128	+188 +148
315	355	-300 -450	-245 -340	-200 -268	-200 -319	-170 -238	-50 -151	0 -57	0 -66	0 -93	0 -151	±36	±55	+62 +13	+80 +40	+98 +56	+128 +86	+150 +108	+170 +130	+190 +150
355	400	-310 -460	-255 -350	-210 -278	-210 -329	-180 -248	-53 -161	0 -60	0 -69	0 -96	0 -159	±38	±58	+64 +14	+82 +42	+100 +58	+130 +88	+152 +110	+172 +132	+192 +152
400	450	-320 -480	-265 -360	-220 -288	-220 -339	-190 -258	-56 -171	0 -63	0 -72	0 -99	0 -167	±40	±61	+66 +15	+84 +44	+102 +60	+132 +90	+154 +112	+174 +134	+194 +154
450	500	-330 -500	-275 -370	-230 -298	-230 -349	-200 -268	-59 -181	0 -66	0 -75	0 -102	0 -175	±42	±64	+68 +16	+86 +46	+104 +62	+134 +92	+156 +114	+176 +136	+196 +156