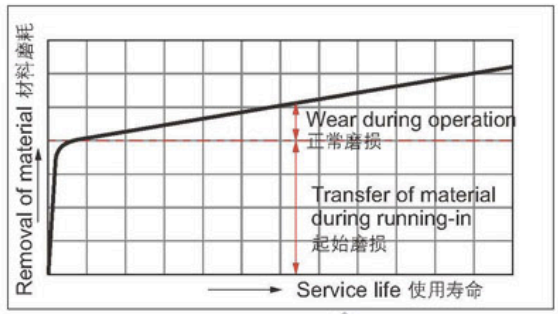
TECHNICAL REFERENCE 相关设计

Influences on the service life
影响轴承使用寿命的因素

Wear and service lif 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



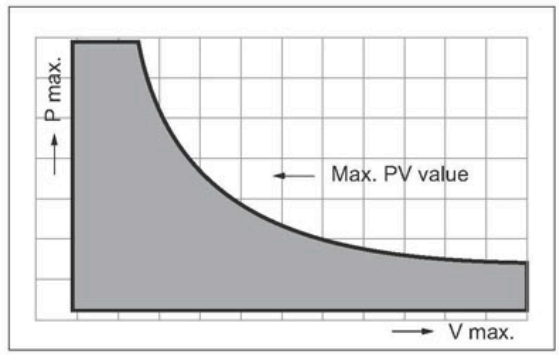
PV Value Calculation PV值的计算 $PV=P \times V(N/mm^2 \times m/s)$

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.

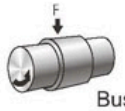
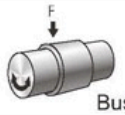
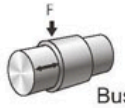
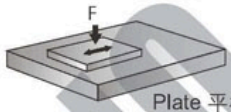
Also, the environmental temperature is necessary to consideration, the clearance can be changed caused by the dimensional change of the bearing and housing, the mating material hardness change from the environment temperature, the interference and so on.

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 N/mm² {kgf/cm²}	Velocity V 线速度 m/s {m/min}	PV Value PV值 N/mm²*m/s {kgf/cm²*m/min}
1. Rotating motion in single direction of radial journal 旋转运动	 Bushing 轴套	$\frac{F}{dL}$ $\left\{\frac{10^2F}{dL}\right\}$	$\frac{\pi dn}{10^3}$ $\left\{\frac{\pi dn}{10^3}\right\}$	$\frac{\pi Fn}{10^3L}$ $\left\{\frac{\pi Fn}{10L}\right\}$
2. Oscillating motion 摇摆运动	 Bushing 轴套	$\frac{F}{dL}$ $\left\{\frac{10^2F}{dL}\right\}$	$\frac{dc\theta}{10^3}$ $\left\{\frac{\pi dc\theta}{180\times10^3}\right\}$	$\frac{Fc\theta}{10^3L}$ $\left\{\frac{\pi Fc\theta}{180\times10^2L}\right\}$
3. Reciprocating motion 往复运动	 Bushing 轴套	$\frac{F}{dL}$ $\left\{\frac{10^2F}{dL}\right\}$	$\frac{2cS}{10^3}$ $\left\{\frac{2cS}{10^3}\right\}$	$\frac{2FcS}{10^3dL}$ $\left\{\frac{FcS}{5dL}\right\}$
4. Thrust motion 推力运动	 Rotation 旋转	$\frac{4F}{\pi(D^2-d^2)}$ $\left\{\frac{400F}{\pi(D^2-d^2)}\right\}$	$\frac{\pi Dn}{10^3}$ $\left\{\frac{\pi Dn}{10^3}\right\}$	$\frac{4FDn}{10^3(D^2-d^2)}$ $\left\{\frac{4FDn}{10(D^2-d^2)}\right\}$
	Oscillation 摇摆 Thrust washer 垫片	$\frac{4F}{\pi(D^2-d^2)}$ $\left\{\frac{400F}{\pi(D^2-d^2)}\right\}$	$\frac{Dc\theta}{10^3}$ $\left\{\frac{\pi Dc\theta}{180\times10^3}\right\}$	$\frac{4FDc\theta}{10^3\pi(D^2-d^2)}$ $\left\{\frac{4FDc\theta}{180\times10(D^2-d^2)}\right\}$
5. Plane reciprocating motion 平面滑动	 Plate 平板	$\frac{F}{BL}$ $\left\{\frac{10^2F}{WL}\right\}$	$\frac{2cS}{10^3}$ $\left\{\frac{2cS}{10^3}\right\}$	$\frac{2FcS}{10^3BL}$ $\left\{\frac{FcS}{5WL}\right\}$

F : Vertical load ..... N {kgf}
N : Number of rotation ..... S^{-1} {rpm}
c : Cylic velocity of reciprocating or oscillating motion ..... S^{-1} {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^{-1} {rpm}
c : 往复或摇摆数 ..... S^{-1} {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 : 轴承高度 ..... mm {mm}
W : 轴承宽度 ..... mm {mm}

TECHNICAL REFERENCE 相关设计

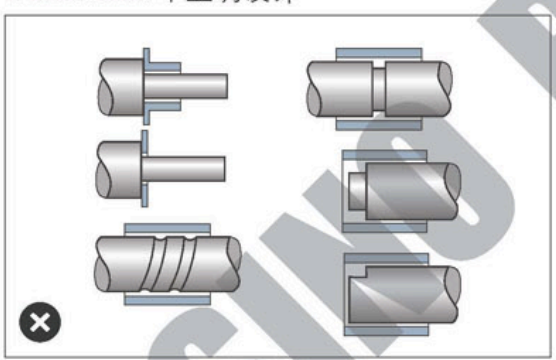
Mating Shaft 相配轴

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.

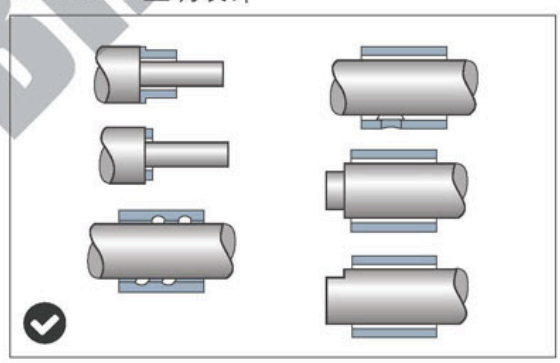
相配轴的材料、硬度、表面粗糙度和表面处理对轴承的使用有很大的影响，以下推荐材料可供参考；另外，在海水、药液等腐蚀场合下使用时建议使用不锈钢或表面镀铬处理。

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



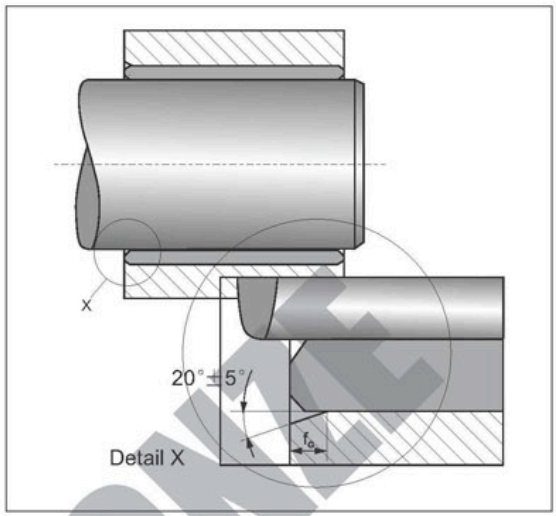
TECHNICAL REFERENCE 相关设计

Housing 轴承座孔

There should be chamfers on the housing bore during the assembly. A chamfer $F_G \times 20° \pm 5°$ 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°±5°的倒角。

Housing bore diameter d_G 座孔	Chamfer with f_G 倒角
$d_G \leqslant 30$	0.8±0.3
$30 < d_G \leqslant 80$	1.2±0.4
$80 < d_G \leqslant 180$	1.8±0.8
$180 < d_G$	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 Length/ID = 0.5~2.0, for high load, high speed and uneven contact is recommend: the Length/ID = 0.8~1.0.

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

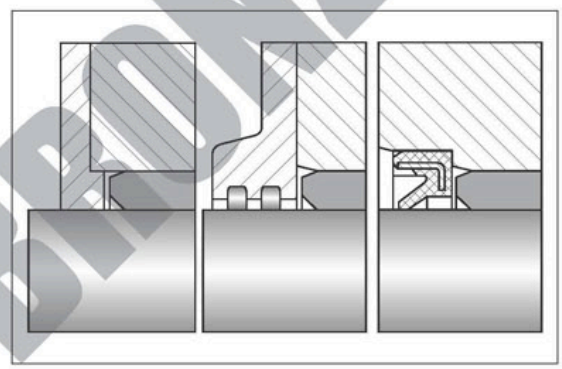
SB金属基自润滑轴承设计为自润滑免维护的轴承材料，但在润滑条件下更能表现出其优越的性能。

- 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
- 防止对磨件的生锈现象

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碾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。

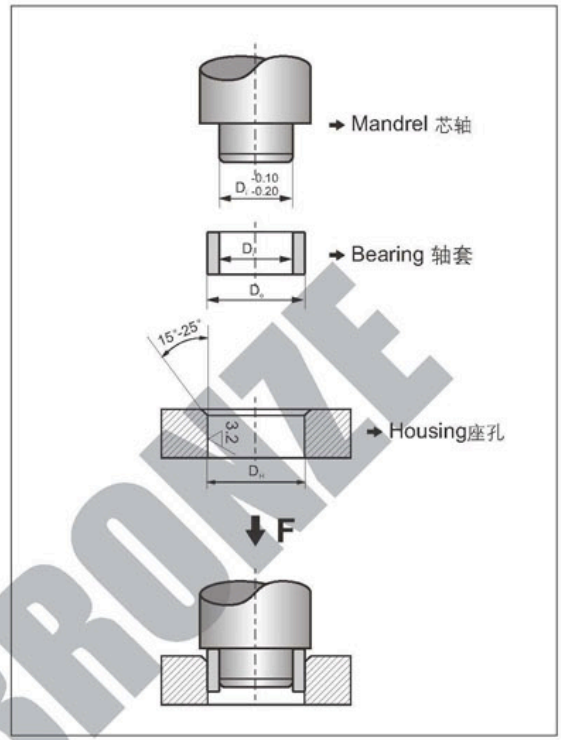


BEARING INSTALLATION 轴承的装配

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℃~-70℃ , 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℃~-70℃，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 ($1/10^5 k$)

ΔT: Temperature difference 温度差

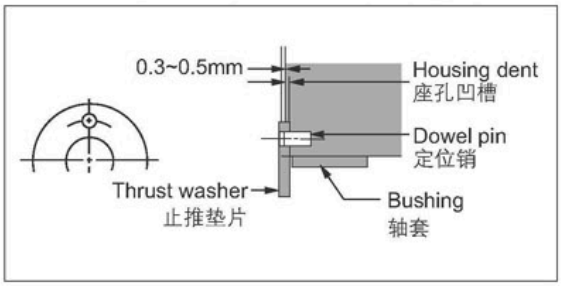
BEARING INSTALLATION 轴承的装配

Thrust washers and plate fit
止推垫片和滑板的安装

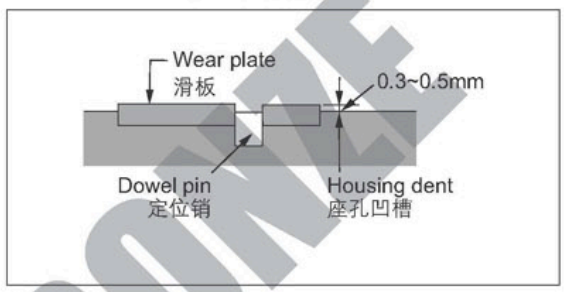
It is recommend to install the thrust washers and sliding plates with the hollow indented housings. To avoid the moving of such parts, a dowel pins is recommended to be installed.

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。

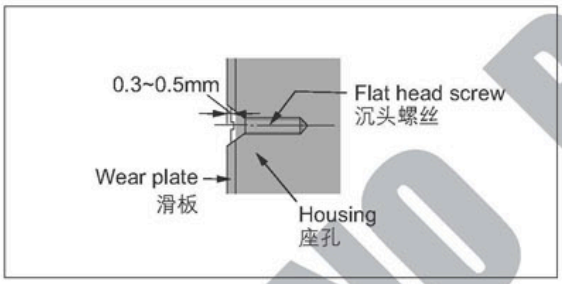
1. Dowel pin application(thrust washer) 定位销安装



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 DIN4763-60			SWITZERLAND 瑞士 VSM 10321-62		ITALY 意大利 UNI 13963-60	POLAND 波兰 PN 58/M 042-51			CZECH 捷克 CSNo 14450-61			JAPAN 日本 JIS B0601-70			
Ra (μ)	Rz Ry (μ)	Code	Ra (μ in)(μ)	Code	Ra (μ in)(μ)	Code	Ra (μ)	Rz (μ)	Code	Ra (μ)	Code	Ra (μ)	Ra (μ)	Rz (μ)	Code	Ra (μ)	Rz (μ)	Code	Ra (μ)	Rz (μ)	Rmax (μ)	Code
0.008	0.032												0.01	0.05	▽14							
0.01	0.04	0.012 0.008					0.01	0.04														
0.012	0.05												0.02	0.10	▽13	0.012	0.05		(0.0125a)		(0.05S)	
0.016	0.063						0.016	0.063														
0.02	0.08	0.025																				
0.025	0.10		1(0.025)		1(0.025)		0.025	0.10		0.025	N1	0.025	0.04	0.20	▽12	0.025	0.10			0.1Z	0.1S	
0.032	0.125																					
0.04	0.16	0.05					0.04	0.16														
0.05	0.20		2(0.05)		2(0.05)					0.05	N2	0.05	0.08	0.40	▽11	0.05	0.20		0.05a	0.2Z	0.2S	
0.063	0.25						0.063	0.25														
0.08	0.32	0.10			3(0.08)							0.08										
0.10	0.40		4(0.10)		4(0.10)		0.10	0.40		0.1	N3	0.1	0.16	0.80	▽10	0.10	0.40		0.1a	0.4Z	0.4S	
0.125	0.50				5(0.125)							0.12										
0.16	0.63	Rz0.3			6(0.16)		0.16	0.63				0.16										
0.20	0.80		8(0.2)		8(0.2)					0.2	N4	0.2				0.20	0.80		0.2a	0.8Z	0.8S	
0.25	1				10(0.25)		0.25	1				0.25	0.32	1.60	▽9							
0.32	1.25	Rz1.6		16	13(0.32)							0.3						6.3				
0.40	1.6		16(0.4)		16(0.4)		0.40	1.60		0.4	N5	0.4				0.40	1.60		0.4a	1.6Z	1.6S	
0.50	2				20(0.5)					0.5	N6	0.5	0.63	3.20	▽8							
0.63	2.5	0.80			25(0.63)		0.63	2.5				0.6										
0.8	3.2		32(0.8)		32(0.8)	16						0.8				0.80	3.2		0.8a	3.2Z	3.2S	
1	4				40(1)		1	4				1	1.25	6.30	▽7							
1.25	5	1.60			50(1.25)	16 8						1.2										
1.6	6.3		63(1.6)		63(1.6)		1.6	6.3		1.6	N7	1.6				1.6	6.3		1.6a	6.3Z	6.3S	
2	8				80(2)							2	2.5	10	▽6							
2.5	10	3.2			100(2.5)		2.5	10				2.5										
3.2	12.5		125(3.2)		125(3.2)					3.2	N8	3				3.2	12.5		3.2a	12.5Z	12.5S	
4	16				160(4)		4	16				4	5	20	▽5					(18Z)	(18S)	
5	20	6.3			200(5)							5										
6.3	25		250(6.3)		250(6.3)		6.3	25		6.3	N9	6				6.3	25		6.3a	25Z	25S	
8	32											8	10	40	▽4					35Z	35S	
10	40	Rz50					10	40				10										
12.5	50		500(12.5)		500(12.5)					12.5	N10	12				12.5	50		12.5a	50Z	50S	
16	63						16	63					20	80	▽3							
20	80	25			800(20)															(70Z)	(70S)	
25	100		1000(25)		1000(25)		25	100		25	N11	25				25	100		25a	100Z	100S	
32	125												40	160	▽2					140Z	140S	
40	160	Rz200					40	160														
125	200									50	N12					50	200		(50a)	200Z	200S	S
63	250						63	250					80	320	▽1					280Z	280S	
80	320	100																				
250	400						100	400								100	400		(100a)	400Z	400S	
							160	630	S											560Z	560S	
							250	1000														
								1600														
								2500														

μ=0.000001m=0.001mm
μin=0.000001 in=0.0254μ

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 +12	+23 +15	+27 +19
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 +15	+28 +19	+32 +23
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 +18	+34 +23	+39 +28
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																			
30	40	-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
40	50	-130 -192																		
50	65	-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
65	80	-150 -224																	+62 +43	+78 +59
80	100	-170 -257	-120 -174	-72 -107	-72 -126	-36 -71	-12 -34	0 -15	0 -22	0 -35	0 -54	±11	±17	+25 +3	+35 +13	+45 +23	+59 +37	+72 +37	+73 +51	+93 +71
100	120	-180 -267																	+76 +54	+101 +79
120	140	-200 -300	-145 -208	-85 -125	-85 -148	-43 -83	-14 -39	0 -18	0 -25	0 -40	0 -63	±12.5	±20	+28 +3	+40 +15	+52 +27	+68 +43	+83 +43	+88 +63	+117 +92
140	160	-210 -310																	+90 +65	+125 +100
160	180	-230 -330																	+93 +68	+133 +108
180	200	-240 -355	-170 -242	-100 -146	-100 -172	-50 -96	-15 -44	0 -20	0 -29	0 -46	0 -72	±14.5	±23	+33 +14	+46 +17	+60 +31	+79 +50	+96 +50	+106 +77	+151 +122
200	225	-260 -375																	+109 +80	+159 +130
225	250	-280 -395																	+113 +84	+169 +140
250	280	-300 -430	-190 -271	-110 -162	-110 -191	-56 -108	-17 -49	0 -23	0 -32	0 -52	0 -81	±16	±26	+36 +4	+52 +20	+66 +34	+88 +56	+108 +56	+126 +94	+190 +158
280	315	-330 -460																	+130 +98	+202 +170
315	355	-360 -500	-210 -299	-125 -182	-125 -214	-62 -119	-18 -54	0 -25	0 -36	0 -57	0 -89	±18	±28	+40 +4	+57 +21	+73 +37	+98 +62	+119 +62	+114 +108	+226 +190
355	400	-400 -540																	+150 +114	+244 +208
400	450	-440 -595	-230 -327	-135 -198	-135 -232	-68 -131	-20 -60	0 -27	0 -40	0 -63	0 -97	±20	±31	+45 +5	+63 +23	+80 +40	+108 +68	+131 +68	+166 +126	+272 +232
450	500	-480 -635																	+172 +132	+292 +252