

FAG Angular Contact Ball Bearings

double row



FAG Angular Contact Ball Bearings

double row · Standards · Basic designs · Tolerances · Bearing clearance

The structure of the double row angular contact ball bearing corresponds to a pair of single row angular contact ball bearings in O arrangement. The bearing can accommodate high radial loads and thrust loads in both directions. It is particularly suitable for bearing arrangements requiring a rigid axial guidance. The self-aligning capability is very limited. The basic designs of double-row angular contact ball bearings differ by the contact angle and bearing ring design. Bearings of series 32B and 33B with seals or shields on both sides are maintenance-free and allow simple constructions to be made.

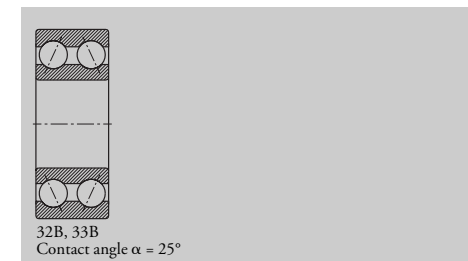
Standards

Double row angular contact ball bearings

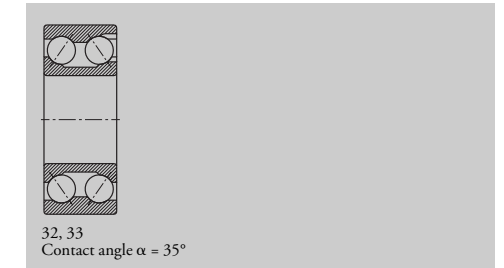
DIN 628, part 3

Basic designs

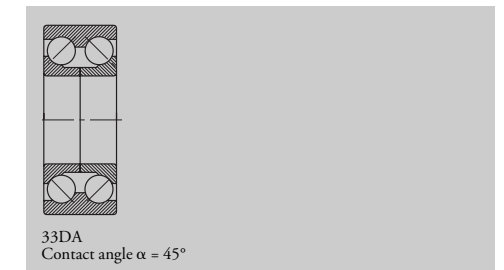
Double row angular contact ball bearings of series 32B and 33B have no filling slots and can therefore accommodate axial loads of same magnitude in both directions. The bearings are filled with grease. Angular contact ball bearings are available as open basic design and with seals (.2RSR) or shields (.2ZR) at both sides, see page 192. Bearings which are supplied as open basic designs may for manufacturing reasons have grooves in the outer ring for seals or shields.



Double row angular contact ball bearings 32 and 33 have filling slots on one side; they must be mounted in such a way that the main load is accommodated by the raceways which do not have filling slots.



Due to their contact angle of 45° , double row angular contact ball bearings 33DA with split inner ring are suitable for particularly high axial loads of reversing direction.



Tolerances

Basic double row angular contact ball bearings have normal tolerances.

For the tolerances see radial bearings, page 56.

Bearing clearance

Basic double row angular contact ball bearings have normal axial clearance. Bearings with larger than normal (C3) or smaller than normal (C2) axial clearance are supplied on request.

Bearings with split inner ring are provided for higher axial loads. They are usually mounted with a tighter fit than unsplit bearings. Their normal clearance corresponds to the clearance group C3 of unsplit bearings.

Axial clearance: double row angular contact ball bearings, page 77.

FAG Angular Contact Ball Bearings

double row · Cages · Speed suitability · Heat treatment · Sealed bearings

Cages

Double row angular contact ball bearings with pressed cages do not have a cage suffix. Bearings with ball riding machined brass cages are recognized by the suffix M. Suffix MA identifies machined brass cages with outer ring guidance.

Bearings with a cage of glass-fibre reinforced polyamide 66 (suffix TVH or TVP) can be used at steady-state temperatures of up to 120 °C. If the bearings are lubricated with oil, any additives contained in the oil may reduce the cage service life. Also, aged oil may reduce the cage life at higher temperatures; therefore, the oil change intervals have to be strictly observed (see also page 85).

▼ Standard cages of double row angular contact ball bearings

Series	Polyamide cage (TVH, TVP) Bore reference number	Machined brass cage (M, MA)	Pressed cage of steel sheet
32		19, 21, 22	17, 18, 20
33		17, 19, 20, 22	14 up to 16, 18
32B	up to 16		
33B	up to 13		
33DA	05	08, 10, 11	06, 07, 09, from 12 on

Other cage designs on request. The suitability for high speeds and high temperatures as well as the load ratings for such cages may deviate from the values indicated for bearings with standard cages.

Speed suitability

General data on the suitability for high speeds are shown on page 87 et seq.

Under appropriate operating conditions, the reference speed may be exceeded up to the value for the limiting speed. Special operating conditions are taken into consideration by determining the thermally permissible operating speed.

If the reference speed in the tables exceeds the limiting speed, the higher value must not be used.

Restrictions for sealed bearings are described in the corresponding section.

Heat treatment

FAG double row angular contact ball bearings are heat-treated in such a way that they can be used at operating temperatures of up to 150 °C. If bearings with polyamide cage are used, the tempera-

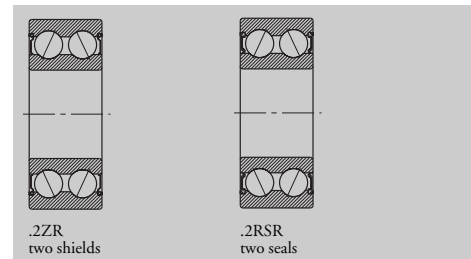
ture limits of application of the cage material have to be observed. With sealed bearings the valid limits of application must be observed.

Sealed bearings

In addition to open double-row angular contact ball bearings FAG supply as basic designs also angular contact ball bearings with ZR shields (non-rubbing seals) or RSR seals (rubbing seals) on both sides. These bearings are filled, at the manufacturer's plant, with a high-quality grease tested to FAG specifications. On request, we also supply bearings which are sealed on one side.

In bearings with rubbing seals (.2RSR) the speed is limited by the permissible sliding velocity of the sealing lips so that the tables list only the limiting speed.

The limiting speed of bearings with non-rubbing shields (suffix .2ZR) is lower than that of open bearings.



See page 86 for the behaviour of sealed bearings at high temperatures; lower temperature limit -30 °C.

FAG Angular Contact Ball Bearings

double row · Equivalent loads · Abutment dimensions · Suffixes

Equivalent dynamic load

The formulas for the equivalent load depend on the contact angle of the bearings.

Angular contact ball bearings, series 32B and 33B with a contact angle of $\alpha = 25^\circ$

$$P = F_r + 0.92 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} \leq 0.68$$

$$P = 0.67 \cdot F_r + 1.41 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} > 0.68$$

Angular contact ball bearings, series 32 and 33 with a contact angle of $\alpha = 35^\circ$

$$P = F_r + 0.66 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} \leq 0.95$$

$$P = 0.6 \cdot F_r + 1.07 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} > 0.95$$

Angular contact ball bearings, series 33DA with a contact angle of $\alpha = 45^\circ$

$$P = F_r + 0.47 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} \leq 1.33$$

$$P = 0.54 \cdot F_r + 0.81 \cdot F_a \quad [\text{kN}] \text{ for } \frac{F_a}{F_r} > 1.33$$

Equivalent static load

The radial factor is 1; the thrust factors depend on the contact angle.

Angular contact ball bearings, series 32B and 33B with a contact angle of $\alpha = 25^\circ$

$$P_0 = F_r + 0.76 \cdot F_a \quad [\text{kN}]$$

Angular contact ball bearings, series 32 and 33 with a contact angle of $\alpha = 35^\circ$

$$P_0 = F_r + 0.58 \cdot F_a \quad [\text{kN}]$$

Angular contact ball bearings, series 33DA with a contact angle of $\alpha = 45^\circ$

$$P_0 = F_r + 0.44 \cdot F_a \quad [\text{kN}]$$

Abutment dimensions

General data on the abutment dimensions are shown on page 123.

The bearing tables list the maximum fillet radius r_f and the diameters of the abutment shoulders.

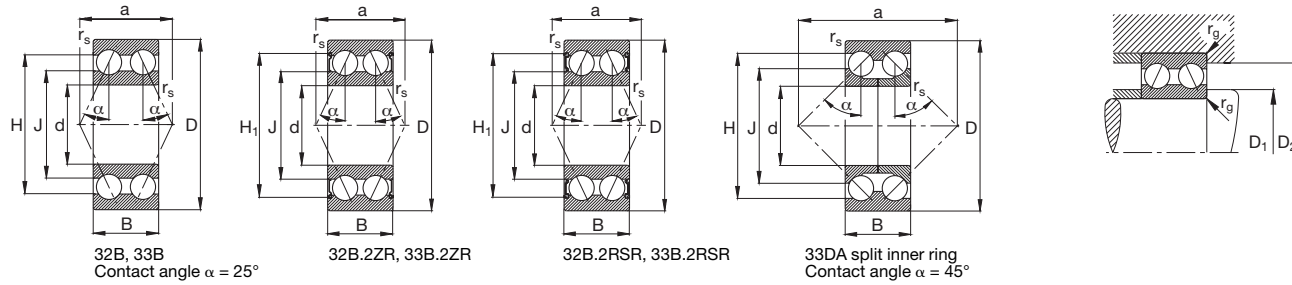
Suffixes

- B** changed internal design
- DA** split inner ring
- M** machined brass cage, ball riding
- MA** machined brass cage, outer ring guided
- .2RSR** two seals
- TVH** moulded snap-type cage of glass-fibre reinforced polyamide, ball riding
- TVP** moulded window-type cage of glass-fibre reinforced polyamide, ball riding
- .2ZR** two shields

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Rolling bearings can be fail-safe if $C_0/P_0 \geq 8$, see page 41.

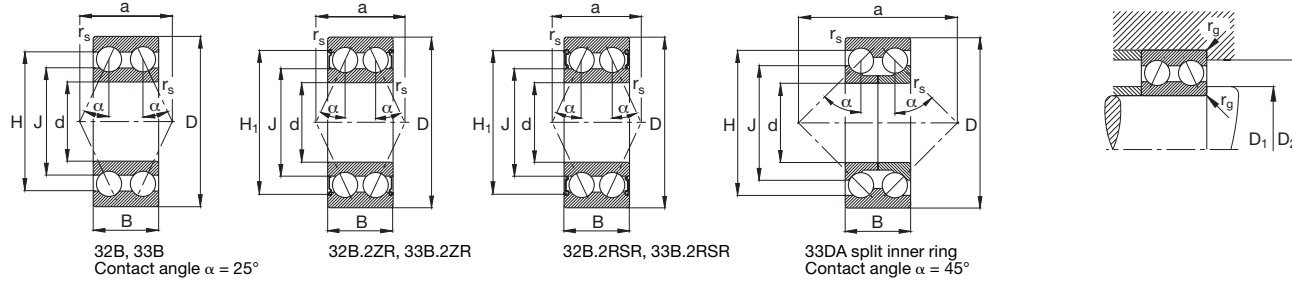


Shaft	Dimensions								Mass ≈ kg	Load rating		Limiting speed min ⁻¹	Reference speed	Code Bearing FAG	Abutment dimensions		
	d mm	D	B	r _s min	a ≈	H ≈	H ₁ ≈	J ≈		dyn. C kN	stat. C ₀				D ₁ min mm	D ₂ max	r _g max
10	10	30	14	0.6	15	23.9	26	17.9	0.05	7.8	4.55	22000	24000	3200B.TVH	14.2	25.8	0.6
	10	30	14	0.6	15	23.9	26	17.9	0.052	7.8	4.55	16000	24000	3200B.2ZR.TVH	14.2	25.8	0.6
12	12	32	15.9	0.6	17	25.7	28.1	18.3	0.051	10.6	5.85	20000	24000	3201B.TVH	16.2	27.8	0.6
	12	32	15.9	0.6	17	25.7	28.1	18.3	0.053	10.6	5.85	15000	24000	3201B.2ZR.TVH	16.2	27.8	0.6
15	15	35	15.9	0.6	18	28.8	31.6	21.1	0.065	11.8	7.1	19000	20000	3202B.TVH	19.2	30.8	0.6
	15	35	15.9	0.6	18	28.8	31.6	21.1	0.067	11.8	7.1	14000	20000	3202B.2ZR.TVH	19.2	30.8	0.6
	15	35	15.9	0.6	18	28.8	31.6	21.1	0.067	11.8	7.1	12000		3202B.2RSR.TVH	19.2	30.8	0.6
	15	42	19	1	21	34.5	36.6	25.6	0.124	16.3	10	16000	14000	3302B.TVH	20.6	36.4	1
17	17	40	17.5	0.6	20	33.1	35.1	24	0.093	14.6	9	17000	18000	3203B.TVH	21.2	35.8	0.6
	17	40	17.5	0.6	20	33.1	35.1	24	0.095	14.6	9	12000	18000	3203B.2ZR.TVH	21.2	35.8	0.6
	17	40	17.5	0.6	20	33.1	35.1	24	0.095	14.6	9	10000		3203B.2RSR.TVH	21.2	35.8	0.6
	17	47	22.2	1	24	37.7	40	26.2	0.177	20.8	12.5	15000	13000	3303B.TVH	22.6	41.4	1
20	20	47	20.6	1	24	38.7	41.1	28.9	0.154	19.6	12.5	15000	16000	3204B.TVH	25.6	41.4	1
	20	47	20.6	1	24	38.7	41.1	28.9	0.16	19.6	12.5	10000	16000	3204B.2ZR.TVH	25.6	41.4	1
	20	47	20.6	1	24	38.7	41.1	28.9	0.158	19.6	12.5	8500		3204B.2RSR.TVH	25.6	41.4	1
	20	52	22.2	1.1	26	42.7	45	31.2	0.217	23.2	15	13000	11000	3304B.TVH	27	45	1
	20	52	22.2	1.1	26	42.7	45	31.2	0.222	23.2	15	9000	11000	3304B.2ZR.TVH	27	45	1
	20	52	22.2	1.1	26	42.7	45	31.2	0.221	23.2	15	8000		3304B.2RSR.TVH	27	45	1
25	25	52	20.6	1	26	43.7	46.1	33.9	0.178	21.2	14.6	12000	14000	3205B.TVH	30.6	46.4	1
	25	52	20.6	1	26	43.7	46.1	33.9	0.182	21.2	14.6	8500	14000	3205B.2ZR.TVH	30.6	46.4	1
	25	52	20.6	1	26	43.7	46.1	33.9	0.182	21.2	14.6	7500		3205B.2RSR.TVH	30.6	46.4	1
	25	62	25.4	1.1	31	50	53.1	37.2	0.353	30	20	10000	10000	3305B.TVH	32	55	1
	25	62	25.4	1.1	31	50	53.1	37.2	0.359	30	20	7500	10000	3305B.2ZR.TVH	32	55	1
	25	62	25.4	1.1	31	50	53.1	37.2	0.359	30	20	6700		3305B.2RSR.TVH	32	55	1
	25	62	25.4	1.1	56	51.8		41	0.341	30	23.2	10000	10000	3305DA.TVP	32	55	1
	25	62	25.4	1.1	56	51.8		41	0.341	30	23.2	10000	10000	3305DA.TVP	32	55	1
30	30	62	23.8	1	31	52.1	55.7	40	0.289	30	21.2	9500	12000	3206B.TVH	35.6	56.4	1
	30	62	23.8	1	31	52.1	55.7	40	0.295	30	21.2	7000	12000	3206B.2ZR.TVH	35.6	56.4	1
	30	62	23.8	1	31	52.1	55.7	40	0.296	30	21.2	6300		3206B.2RSR.TVH	35.6	56.4	1
	30	72	30.2	1.1	36	58.9	62.5	44	0.548	41.5	28.5	8500	9000	3306B.TVH	37	65	1
	30	72	30.2	1.1	36	58.9	62.5	44	0.558	41.5	28.5	6300	9000	3306B.2ZR.TVH	37	65	1
	30	72	30.2	1.1	36	58.9	62.5	44	0.558	41.5	28.5	5600		3306B.2RSR.TVH	37	65	1
35	35	72	27	1.1	36	60.6	64.2	47.2	0.445	39	28.5	8500	11000	3207B.TVH	42	65	1
	35	72	27	1.1	36	60.6	64.2	47.2	0.454	39	28.5	6300	11000	3207B.2ZR.TVH	42	65	1
	35	72	27	1.1	36	60.6	64.2	47.2	0.454	39	28.5	5300		3207B.2RSR.TVH	42	65	1
	35	72	27	1.1	36	60.6	64.2	47.2	0.454	39	28.5	5300		3207B.2RSR.TVH	42	65	1

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Rolling bearings can be fail-safe if $C_0/P_0 \geq 8$, see page 41.

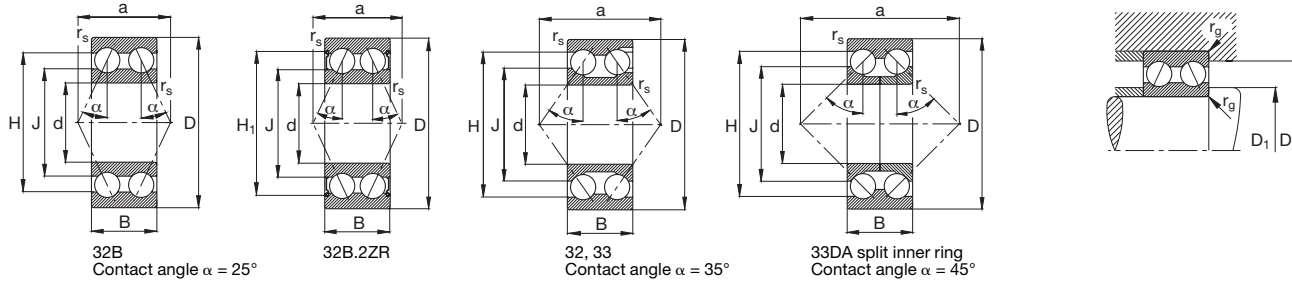


Shaft	Dimensions								Mass ≈ kg	Load rating		Limiting speed ≈ min ⁻¹	Reference speed	Code	Abutment dimensions		
	d	D	B	r _s min	a ≈	H ≈	H ₁ ≈	J ≈		dyn. C	stat. C ₀				Bearing FAG	D ₁ min mm	D ₂ max
35	35	80	34.9	1.5	41	65.5	68.5	49.3	0.657	51	34.5	7500	8500	3307B.TVH	44	71	1.5
	35	80	34.9	1.5	41	65.5	68.5	49.3	0.667	51	34.5	5600	8500	3307B.2ZR.TVH	44	71	1.5
	35	80	34.9	1.5	41	65.5	68.5	49.3	0.739	51	34.5	5000		3307B.2RSR.TVH	44	71	1.5
	35	80	34.9	1.5	75	69.6		55.2	0.889	50	41.5	7500	8500	3307DA	44	71	1.5
40	40	80	30.2	1.1	41	67.9	71.3	53	0.594	48	36.5	7500	10000	3208B.TVH	47	73	1
	40	80	30.2	1.1	41	67.9	71.3	53	0.604	48	36.5	5600	10000	3208B.2ZR.TVH	47	73	1
	40	80	30.2	1.1	41	67.9	71.3	53	0.605	48	36.5	4800		3208B.2RSR.TVH	47	73	1
	40	90	36.5	1.5	46	74.6	77.4	55.5	0.984	62	45	6700	7500	3308B.TVH	49	81	1.5
	40	90	36.5	1.5	46	74.6	77.4	55.5	0.998	62	45	5000	7500	3308B.2ZR.TVH	49	81	1.5
	40	90	36.5	1.5	46	74.6	77.4	55.5	0.998	62	45	4500		3308B.2RSR.TVH	49	81	1.5
	40	90	36.5	1.5	85	79.4		61.7	1.19	62	53	6300	7500	3308DA.MA	49	81	1.5
	45	85	30.2	1.1	43	72.9	75.5	57.2	0.627	48	37.5	6700	9000	3209B.TVH	52	78	1
45	85	30.2	1.1	43	72.9	75.5	57.2	0.64	48	37.5	5000	9000	3209B.2ZR.TVH	52	78	1	
45	85	30.2	1.1	43	72.9	75.5	57.2	0.64	48	37.5	4500		3209B.2RSR.TVH	52	78	1	
45	100	39.7	1.5	50	81.5	86.5	62.3	1.34	68	51	6000	7000	3309B.TVH	54	91	1.5	
45	100	39.7	1.5	50	81.5	86.5	62	1.36	68	51	4000		3309B.2RSR.TVH	54	91	1.5	
45	100	39.7	1.5	93	86.5		70	1.57	75	64	6000	6700	3309DA	54	91	1.5	
50	50	90	30.2	1.1	45	77.9	80.9	62	0.68	51	42.5	6300	8000	3210B.TVH	57	83	1
	50	90	30.2	1.1	45	77.9	80.9	62	0.692	51	42.5	4800	8000	3210B.2ZR.TVH	57	83	1
	50	90	30.2	1.1	45	77.9	80.9	62	0.693	51	42.5	4000		3210B.2RSR.TVH	57	83	1
	50	110	44.4	2	55	89.5		68.3	1.8	81.5	62	5300	6700	3310B.TVH	61	99	2
	50	110	44.4	2	104	96.9		77.3	2.24	90	85	5300	6300	3310DA.MA	61	99	2
	55	100	33.3	1.5	50	85.3	89.1	69	0.954	58.5	49	5600	7500	3211B.TVH	64	91	1.5
55	100	33.3	1.5	50	85.3	89.1	68.7	0.969	58.5	49	3800		3211B.2RSR.TVH	64	91	1.5	
55	120	49.2	2	61	98.4	105.2	75.2	2.32	102	78	5000	6000	3311B.TVH	66	109	2	
55	120	49.2	2	61	98.4	105.2	75.2	2.36	102	78	3800	6000	3311B.2ZR.TVH	66	109	2	
55	120	49.2	2	61	98.4	105.2	75.2	2.35	102	78	3400		3311B.2RSR.TVH	66	109	2	
55	120	49.2	2	111	105.3		81.6	2.85	110	100	5000	6000	3311DA.MA	66	109	2	
60	60	110	36.5	1.5	55	94.5		75.8	1.27	72	61	5000	7500	3212B.TVH	69	101	1.5
	60	110	36.5	1.5	55	94.5	98.6	75.8	1.29	72	61	3800	7500	3212B.2ZR.TVH	69	101	1.5
	60	110	36.5	1.5	55	94.5	98.6	75.8	1.29	72	61	3400		3212B.2RSR.TVH	69	101	1.5
	60	130	54	2.1	67	108.7		81.6	2.92	125	98	4500	5600	3312B.TVH	72	118	2.1
	60	130	54	2.1	122	115.8		91.9	3.39	127	118	4500	5600	3312DA	72	118	2.1
	65	120	38.1	1.5	60	103.5	107.2	84.9	1.64	80	73.5	4500	6700	3213B.TVH	74	111	1.5
65	120	38.1	1.5	60	103.5		84.5	1.66	80	73.5	3000		3213B.2RSR.TVH	74	111	1.5	
65	140	58.7	2.1	71	117.6		88.6	3.63	143	112	4300	5300	3313B.TVH	77	128	2.1	
65	140	58.7	2.1	131	124.3		98.4	4.38	143	137	4300	5000	3313DA	77	128	2.1	

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Rolling bearings can be fail-safe if $C_0/P_0 \geq 8$, see page 41.



Shaft	Dimensions								Mass ≈ kg	Load rating		Limiting speed ≈ min ⁻¹	Reference speed	Code	Abutment dimensions		
	d	D	B	r _s min	a ≈	H ≈	H ₁ ≈	J ≈		dyn. C	stat. C ₀				Bearing FAG	D ₁ min mm	D ₂ max
70	70	125	39.7	1.5	62	106.3		87	1.8	83	76.5	4500	6300	3214B.TVH	79	116	1.5
	70	150	63.5	2.1	109	131.9		98.5	5.03	143	166	4000	4800	3314	82	138	2.1
	70	150	63.5	2.1	141	132.4		103.4	5.36	163	156	4000	4800	3314DA	82	138	2.1
75	75	130	41.3	1.5	65	112.6		92.4	1.91	91.5	85	4300	6000	3215B.TVH	89.3	116.6	1.5
	75	160	68.3	2.1	117	141.2		105.5	6.4	163	193	3800	4300	3315	87	148	2.1
80	80	140	44.4	2	69	120.3		98.5	2.45	98	93	4000	5600	3216B.TVH	91	129	2
	80	140	44.4	2	69	120.3	125.4	98.5	2.48	98	93	3000	5600	3216B.2ZR.TVH	91	129	2
	80	170	68.3	2.1	123	149.7		111.8	7.26	176	212	3600	4000	3316	92	158	2.1
85	85	150	49.2	2	106	135.1		108.5	3.44	112	150	3800	5000	3217	96	139	2
	85	180	73	3	131	160		119.6	8.78	190	228	3400	3800	3317M	99	166	2.5
90	90	160	52.4	2	113	143.7		115.6	4.22	125	170	3600	4800	3218	104	146	2
	90	190	73	3	136	168.2		126.1	9.23	216	275	3200	3400	3318	104	176	2.5
95	95	170	55.6	2.1	120	152.8		122.2	5.31	140	186	3400	4500	3219M	107	158	2.1
	95	200	77.8	3	143	177		133	11.2	220	285	3200	3200	3319M	109	186	2.5
100	100	180	60.3	2.1	127	163.7		131	6.19	160	224	3200	4300	3220	112	168	2.1
	100	215	82.6	3	153	188.7		142.5	14.6	236	320	3000	3000	3320M	114	201	2.5
105	105	190	65.1	2.1	135	172.9		138	7.78	180	245	3200	4000	3221M	117	178	2.1
110	110	200	69.8	2.1	144	179		142.7	9.1	190	260	3000	3800	3222M	122	188	2.1
	110	240	92.1	3	171	210.4		158.3	20.3	280	400	2600	2600	3322M	124	226	2.5