



## 1. Design features and characteristics

The dimensional range of miniature and extra small bearings can be found in **Table 1**. Boundary dimensions for both metric and inch series are in accordance with the internationally specified ISO and ANSI/ABMA standards. The most widely used sealed and shielded type ball bearings generally have a 1 - 2 mm wider width dimension than open type bearings.

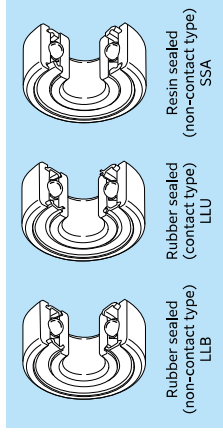
The main variations of these bearings are shown in **Table 2**. Miniature and extra small size ball bearings can also utilize snap rings, which simplify assembly within the housing. These bearings with snap rings can also be found in the dimensional tables in this catalog.

Among the most generally used sealed and shielded bearings are standard ZZ and ZZZ type which incorporate non-contact steel shield plates. **Fig. 1** also shows non-contact type rubber sealed LLB and resin sealed SSA type bearings, as well as the contact-type rubber sealed LLU bearing.

Section "1.1. Lubrication" provides additional information on grease filled within the sealed and shielded bearings.

**Table 1 Dimensional range**

Bearing	Dimensional range
Miniature ball bearings	Nominal outer diameter $D < 9\text{mm}$
Extra small ball bearings	Nominal bore diameter $d < 10\text{mm}$ Nominal outer diameter $D \geq 9\text{mm}$



**Fig. 1**

**Table 2 Main types and construction**

Type	Standard type code		Flange-attached type code	
	Construction	Metric series	Inch series	Inch series
Open type		6 BC	R	FLR
Shielded type		6 X X ZZ W6 X X ZZ WBC X X X ZZ	RA X X ZZ	FL6 X X ZZ FLW6 X X ZZ FLWBC X X ZZ

Note: 1. Representative codes are shown. For further details, please refer to dimension tables.  
2. May change to ZA or SA for shielded type bearings, according to the bearing number.

# Miniature and Small Size Ball Bearings



2. Standard cage type

Pressed steel cages are standard for miniature and small size bearings.



3. Dimensional and rotational accuracy

The accuracy of miniature and extra small ball bearings complies with JIS standards. Accuracy of these bearings is defined by Table A-54 in section "6. Bearing Accuracy." Flange accuracies are listed in Table 3.

Table 3 Tolerance and tolerance values for outer ring flange

Accuracy class	Outer diameter tolerance $\Delta_{D1/15}$ or $\Delta_{D25}$		Outer ring surface runout for rear surface $S_{D1}$ Max.	Back face axial runout $S_{Baf}$ Max.	Width deviation $\Delta_{G15}$ or $\Delta_{G25}$		Width unevenness $V_{G15}$ or $V_{G25}$
	Upper	Lower			Upper	Lower	
Class 0			—	—			Identical to same bearing's inner ring $V_{I15}$ .
Class 6			—	—			
Class 5	*		8	11	Identical to same bearing's inner ring $\Delta_{I15}$ .		5
Class 4			4	7			2.5
Class 2			1.5	3 <sup>1)</sup>			1.5
				4			

1) Applies to nominal outer diameter  $D$  of 18 mm or less.

Flange nominal outer diameter $D_1$ or $D_2$ mm	Incl.	Outer diameter dimensional tolerance $\Delta_{D1/15}$ or $\Delta_{D25}$	
		Upper	Lower
—	10	+220	-36
10	18	+270	-43
18	30	+330	-52
30	50	+390	-62

\* Unit:  $\mu\text{m}$

4. Radial internal clearance

Radial internal clearance is defined by Table A-88 in section "8. Internal Clearance and Preload."

The radial clearance values for high precision miniature and extra small bearings can be found in Table 4.

Table 4 Radial internal clearance for high precision bearings

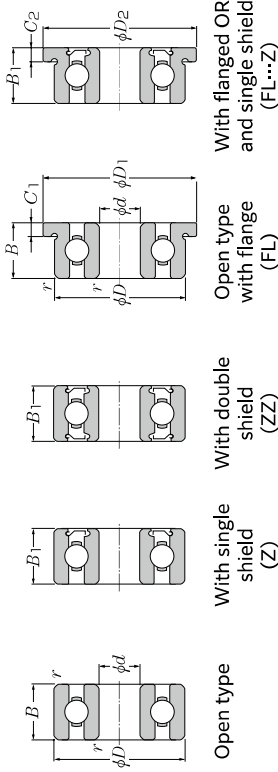
MIL Standard Code	Tight			Standard			Loose			Extra Loose				
	C2S	CNS	CNM	CNL	C3S	C3M	C3L	C3M	C3L	C3L	C3L			
Internal clearance	0	5	3	8	5	10	8	13	10	15	13	20	20	28

Note: 1. These standards are specified in accordance with MIL B23063. However, NTN codes are shown.  
2. Clearance values do not include compensation for measuring load.

# Miniature and Small Size Ball Bearings

NTN

Metric series



d 1.5 ~ 5mm

d	Boundary dimensions					Basic load rating			Fatigue load limit	Factor N	C <sub>10</sub>	f <sub>0</sub>	Allowable speed	
	D	B	B <sub>1</sub>	D <sub>2</sub>	G <sub>1</sub>	dynamic	static	C <sub>0r</sub>					Grease lubrication	Oil lubrication
1.5	4	1.2	2	5	0.4	0.6	0.15	113	29.0	0.775	13.6	88 000	100 000	
	5	2	2.6	6.5	0.6	0.8	0.15	189	51.0	1.35	13.3	79 000	93 000	
	6	2.5	3	7.5	0.6	0.8	0.15	305	86.0	2.28	12.3	71 000	84 000	
2	4	1.2	—	—	—	—	0.05	115	37.0	0.970	14.8	83 000	98 000	
	5	1.5	2.3	6.1	0.5	0.6	0.08	189	51.0	1.35	13.3	74 000	87 000	
	5	2	2.5	—	—	—	0.1	189	51.0	1.35	13.3	74 000	87 000	
	6	2.3	3	7.5	0.6	0.8	0.15	310	89.0	2.37	12.8	67 000	79 000	
	6	2.5	—	7.2	—	0.6	—	310	89.0	2.37	12.8	67 000	79 000	
	7	2.5	—	—	—	—	0.15	430	120	3.20	11.9	59 000	70 000	
	7	2.8	3.5	8.5	8.5	0.7	0.9	425	125	3.30	12.4	62 000	73 000	
2.5	5	1.5	2.3	—	—	—	0.08	169	59.0	1.56	15.0	70 000	82 000	
	6	1.8	2.6	7.1	7.1	0.5	0.8	231	73.0	1.92	14.2	65 000	76 000	
	7	—	3	—	8.2	—	0.6	315	96.0	2.53	13.7	59 000	70 000	
	7	2.5	3.5	8.5	8.5	0.7	0.9	315	96.0	2.53	13.7	59 000	70 000	
	8	2.5	2.8	9.2	—	0.6	—	475	152	4.05	13.2	56 000	66 000	
	8	2.8	4	9.5	9.5	0.7	0.9	610	174	7.05	11.5	56 000	66 000	
	6	2	2.5	7.2	7.2	0.6	0.6	268	94.0	2.47	14.7	60 000	71 000	
	7	2	3	8.1	8.1	0.5	0.8	430	130	3.45	12.9	58 000	68 000	
3	8	2.5	—	9.2	—	0.6	—	620	180	7.25	11.9	54 000	63 000	
	8	3	4	9.5	9.5	0.7	0.9	620	180	7.25	11.9	54 000	63 000	
	9	2.5	4	10.2	10.6	0.6	0.8	700	219	8.85	12.4	50 000	59 000	
	9	3	5	10.5	10.5	0.7	1	700	219	8.85	12.4	50 000	59 000	
10	4	4	11.5	11.5	1	1	710	224	9.05	12.7	50 000	58 000		
4	7	2	2.5	8.2	8.2	0.6	0.6	246	88.0	2.31	15.3	54 000	63 000	
	8	2	3	9.2	9.2	0.6	0.6	440	140	5.65	13.9	52 000	61 000	
	9	2.5	4	10.3	10.3	0.6	1	710	224	9.05	12.7	49 000	57 000	
	10	3	4	11.2	11.6	0.6	0.8	720	235	9.50	13.3	46 000	55 000	
	11	4	4	12.5	12.5	1	1	790	276	11.1	13.7	45 000	52 000	
	12	4	4	13.5	13.5	1	1	1 080	360	14.4	12.8	43 000	51 000	
	13	5	5	15	15	1	1	1 450	490	19.8	12.4	42 000	49 000	
	16	5	5	—	—	—	—	1 940	680	23.1	12.4	37 000	44 000	
	8	2	2.5	9.2	9.2	0.6	0.6	241	91.0	2.39	15.8	49 000	57 000	
	9	2.5	3	10.2	10.2	0.6	0.6	555	211	5.55	14.6	46 000	55 000	
10	3	4	11.2	11.6	0.6	0.8	790	276	11.1	13.7	45 000	52 000		

1) Smallest allowable dimension for chamfer dimension r. B-48

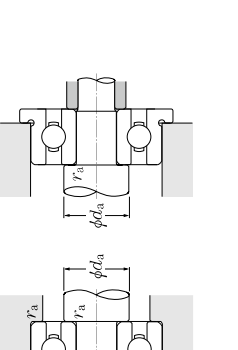
# Miniature and Small Size Ball Bearings

NTN

Dynamic equivalent radial load  $P_r = X F_r + Y F_a$

$f_0 \cdot F_a / C_{0r}$	$F_a / F_r \leq e$		$F_a / F_r > e$	
	X	Y	X	Y
0.172	0.19	—	—	2.30
0.345	0.22	—	—	1.99
0.689	0.26	—	—	1.71
1.03	0.28	—	—	1.55
1.38	0.30	1	0	1.45
2.07	0.34	—	—	1.31
3.45	0.38	—	—	1.15
5.17	0.42	—	—	1.04
6.89	0.44	—	—	1.00

Static equivalent radial load  $P_0 = 0.6 F_r + 0.5 F_a$



When  $P_0 < F_r$ , use  $P_0 = F_r$ .

Series	Installation-related dimensions			Mess (approx.)
	mm	mm	mm	
68/1.5	With single shield	With double shield	With flanged OR and double shield	Open type
	W68/1.5SA	W68/1.5SA	FLW68/1.5SA	SSA
	W68/1.5ZA	W68/1.5ZA	FLW68/1.5ZA	SSA
682	With single shield	With double shield	With flanged OR and double shield	Open type
	W682SA	W682SA	FLW682SA	SSA
	W682ZA	W682ZA	FLW682ZA	SSA
692	With single shield	With double shield	With flanged OR and double shield	Open type
	W692SA	W692SA	FLW692SA	SSA
	W692ZA	W692ZA	FLW692ZA	SSA
602	With single shield	With double shield	With flanged OR and double shield	Open type
	W602SA	W602SA	FLW602SA	SSA
	W602ZA	W602ZA	FLW602ZA	SSA
67/2.5	With single shield	With double shield	With flanged OR and double shield	Open type
	W67/2.5SA	W67/2.5SA	FLW67/2.5SA	SSA
	W67/2.5ZA	W67/2.5ZA	FLW67/2.5ZA	SSA
68/2.5	With single shield	With double shield	With flanged OR and double shield	Open type
	W68/2.5SA	W68/2.5SA	FLW68/2.5SA	SSA
	W68/2.5ZA	W68/2.5ZA	FLW68/2.5ZA	SSA
69/2.5	With single shield	With double shield	With flanged OR and double shield	Open type
	W69/2.5SA	W69/2.5SA	FLW69/2.5SA	SSA
	W69/2.5ZA	W69/2.5ZA	FLW69/2.5ZA	SSA
60/2.5	With single shield	With double shield	With flanged OR and double shield	Open type
	W60/2.5SA	W60/2.5SA	FLW60/2.5SA	SSA
	W60/2.5ZA	W60/2.5ZA	FLW60/2.5ZA	SSA
673	With single shield	With double shield	With flanged OR and double shield	Open type
	WA673SA	WA673SA	FLWA673SA	SSA
	W683Z	W683Z	FLW683Z	ZZ
683	With single shield	With double shield	With flanged OR and double shield	Open type
	W683SA	W683SA	FLW683SA	SSA
	W683ZA	W683ZA	FLW683ZA	SSA
693	With single shield	With double shield	With flanged OR and double shield	Open type
	W693SA	W693SA	FLW693SA	SSA
	W693ZA	W693ZA	FLW693ZA	SSA
603	With single shield	With double shield	With flanged OR and double shield	Open type
	WA603SA	WA603SA	FLWA603SA	SSA
	W603Z	W603Z	FLW603Z	ZZ
674	With single shield	With double shield	With flanged OR and double shield	Open type
	WA674SA	WA674SA	FLWA674SA	SSA
	W684Z	W684Z	FLW684Z	ZZ
684	With single shield	With double shield	With flanged OR and double shield	Open type
	WA684SA	WA684SA	FLWA684SA	SSA
	W684Z	W684Z	FLW684Z	ZZ
694	With single shield	With double shield	With flanged OR and double shield	Open type
	WA694SA	WA694SA	FLWA694SA	SSA
	W694Z	W694Z	FLW694Z	ZZ
604	With single shield	With double shield	With flanged OR and double shield	Open type
	WA604SA	WA604SA	FLWA604SA	SSA
	W604Z	W604Z	FLW604Z	ZZ
634	With single shield	With double shield	With flanged OR and double shield	Open type
	WA634SA	WA634SA	FLWA634SA	SSA
	W634Z	W634Z	FLW634Z	ZZ
675	With single shield	With double shield	With flanged OR and double shield	Open type
	WA675SA	WA675SA	FLWA675SA	SSA
	W685Z	W685Z	FLW685Z	ZZ
685	With single shield	With double shield	With flanged OR and double shield	Open type
	WA685SA	WA685SA	FLWA685SA	SSA
	W685Z	W685Z	FLW685Z	ZZ
695	With single shield	With double shield	With flanged OR and double shield	Open type
	WA695SA	WA695SA	FLWA695SA	SSA
	W695Z	W695Z	FLW695Z	ZZ
605	With single shield	With double shield	With flanged OR and double shield	Open type
	WA605SA	WA605SA	FLWA605SA	SSA
	W605Z	W605Z	FLW605Z	ZZ

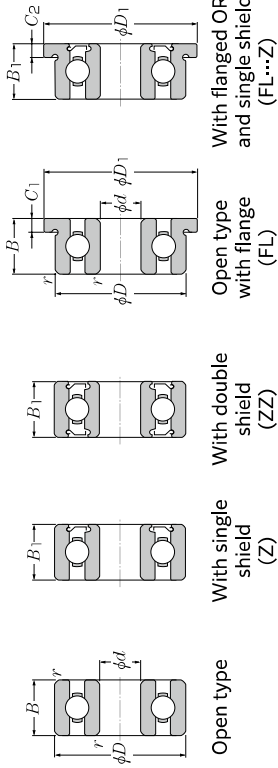
2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown. B-49



# Miniature and Small Size Ball Bearings

NTN

Inch series



d 1.984 ~ 9.525mm

d	Boundary dimensions					Basic load rating			Fatigue load limit	Factor N	Factor $f_0$	Allowable speed	
	D	B	B <sub>1</sub>	D <sub>1</sub>	C <sub>1</sub>	dynamic	static	C <sub>0r</sub>					C <sub>u</sub>
1.984	6.35	2.38	3.571	7.52	0.58	0.79	0.08	310	89.0	2.37	12.8	67 000	79 000
2.380	4.762	1.588	2.38	5.94	0.46	0.79	0.08	137	42.0	1.12	14.8	73 000	85 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.13	475	152	4.05	13.2	56 000	66 000
3.175	6.35	2.38	2.779	7.52	0.58	0.79	0.08	315	96.0	2.53	13.7	59 000	70 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.08	620	180	7.25	11.9	54 000	63 000
	9.525	2.779	3.571	10.72	0.58	0.79	0.13	710	224	9.05	12.7	49 000	58 000
	12.7	3.967	3.967	11.18	0.76	0.76	0.3	710	224	9.05	12.7	49 000	58 000
3.967	9.525	4.366	4.366	—	—	—	0.3	1 270	395	16.1	11.7	43 000	51 000
	12.7	4.978	4.978	14.35	1.07	1.07	0.3	1 450	490	19.8	12.4	41 000	48 000
4.762	9.525	3.175	3.175	9.12	0.58	0.91	0.08	370	133	3.50	14.8	51 000	60 000
	12.7	3.967	—	—	—	—	—	—	—	—	—	—	—
6.350	12.7	4.978	4.978	17.53	1.07	1.07	0.3	1 640	615	24.9	13.6	36 000	43 000
	19.05	—	—	—	—	—	—	—	—	—	—	—	—
9.525	12.7	4.978	4.978	17.53	1.07	1.07	0.3	1 640	615	24.9	13.6	36 000	43 000
	19.05	—	—	—	—	—	—	—	—	—	—	—	—

1) Smallest allowable dimension for chamfer dimension r.

# Miniature and Small Size Ball Bearings

NTN

Dynamic equivalent radial load  $P_r = X F_r + Y F_a$

$f_0 F_a / C_{0r}$	e	$F_a / F_r \leq e$		$F_a / F_r > e$	
		X	Y	X	Y
0.172	0.19	—	—	2.30	—
0.345	0.22	—	—	1.99	—
0.689	0.26	—	—	1.71	—
1.03	0.28	—	—	1.55	—
1.38	0.30	1	0	1.45	—
2.07	0.34	—	—	1.31	—
3.45	0.38	—	—	1.15	—
5.17	0.42	—	—	1.04	—
6.89	0.44	—	—	1.00	—

Static equivalent radial load  $P_{0r} = 0.6 F_r + 0.5 F_a$

Installation-related dimensions		Mass (approx.)	
mm	g	Open type	Open type with flange
$d_a$ Min.	$r_{as}$ Max.	—	—
$d_a$ Max. <sup>2)</sup>	$r_{as}$ Max.	—	—

When  $P_{0r} < F_r$ , use  $P_{0r} = F_r$ .

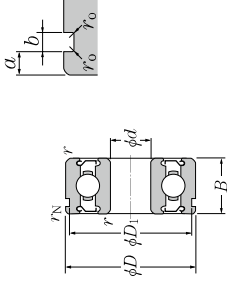
Series	With single shield		With double shield		With flanged OR and single shield		With flanged OR and double shield	
	Open type	With double shield	Open type with flange	With flanged OR and single shield	Open type with flange	With flanged OR and double shield	With flanged OR and double shield	With flanged OR and double shield
R1-4	RA1-4ZA	ZZA	FLR1-4	FLRA1-4ZA	ZZA	ZZA	ZZA	ZZA
R133	RA133ZA	ZZA	FLR133	FLRA133ZA	ZZA	ZZA	ZZA	ZZA
R1-5	RA1-5ZA	ZZA	FLR1-5	FLRA1-5ZA	ZZA	ZZA	ZZA	ZZA
R144	RA144ZA	ZZA	FLR144	FLRA144ZA	ZZA	ZZA	ZZA	ZZA
R2-5	RA2-5Z	ZZ	FLR2-5	FLRA2-5Z	ZZ	ZZ	ZZ	ZZ
RA2-6	RA2-6ZA	ZZA	FLR2-6	FLRA2-6ZA	ZZA	ZZA	ZZA	ZZA
R2	RA2ZA	ZZA	FLR2	FLRA2ZA	ZZA	ZZA	ZZA	ZZA
RA2	RA2Z	ZZ	—	—	—	—	—	—
RA155	RA155ZA	ZZA	FLR155	FLRA155ZA	ZZA	ZZA	ZZA	ZZA
R156	RA156Z	ZZ	FLR156	FLRA156Z	ZZ	ZZ	ZZ	ZZ
R166	RA166Z	ZZ	FLR166	FLRA166Z	ZZ	ZZ	ZZ	ZZ
R3	—	—	—	—	—	—	—	—
RA3	RA3Z	ZZ	FLRA3	FLRA3Z	ZZ	ZZ	ZZ	ZZ
R168A	R168AZ	AZZ	—	FLAR168AZ	ZZ	ZZ	ZZ	ZZ
R188	RA188ZA	ZZA	FLR188	FLRA188ZA	ZZA	ZZA	ZZA	ZZA
R4	RA4Z	ZZ	FLR4	FLRA4Z	ZZ	ZZ	ZZ	ZZ
—	RA4Z	ZZ	—	—	—	—	—	—
—	R6Z	ZZ	—	FLR6Z	ZZ	ZZ	ZZ	ZZ

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

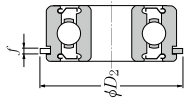
## Miniature and Small Size Ball Bearings

NTN

With snap ring groove  
With snap ring



Shielded type  
with snap ring groove  
(ZZ)



Shielded type  
with snap ring  
(ZZ)

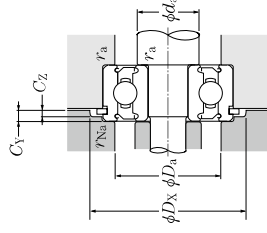
d 5 ~ 10mm

d	D	Boundary dimensions		Basic load rating	Fatigue load limit	Factor	Allowable speed	Bearing numbers <sup>2)</sup>		
		mm	mm					Shielded type with snap ring groove	Shielded type with snap ring	
		$r_{Na}$	$r_{s, min.}^{1)}$	dinamic	static	$f_0$	Grease lubrication	Oil lubrication		
		Min.	Min.	$C_2$	$C_{1r}$					
5	13	4	0.2	1 190	430	17.3	40 000	47 000	<b>SC559ZZN</b>	<b>ZZNR</b>
	14	5	0.2	1 470	505	20.5	39 000	46 000	<b>SC571ZZN</b>	<b>ZZNR</b>
6	12	4	0.15	640	365	—	40 000	47 000	<b>*F-SC6A06ZZ1N</b>	<b>ZZ1NR</b>
	13	5	0.15	1 200	440	17.5	39 000	46 000	<b>SC6A04ZZN</b>	<b>ZZNR</b>
	15	5	0.2	1 490	530	21.3	37 000	44 000	<b>SC6A17ZZN</b>	<b>ZZNR</b>
	19	6	0.3	2 590	885	64.5	34 000	40 000	<b>SC669ZZN</b>	<b>ZZNR</b>
8	16	5	0.2	1 390	585	23.6	35 000	41 000	<b>SC890ZZN</b>	<b>ZZNR</b>
	22	7	0.3	3 700	1 400	97.0	32 000	37 000	<b>SC850ZZN</b>	<b>ZZNR</b>
10	26	8	0.3	5 050	1 960	138	29 000	34 000	<b>SC0039ZZN</b>	<b>ZZNR</b>

1) Smallest allowable dimension for chamfer dimension r.  
2) "\*" mark indicates that stainless steel is used.

## Miniature and Small Size Ball Bearings

NTN



Dynamic equivalent radial load  
 $F_r = \sqrt{X F_r + Y F_a}$

$f_0 \cdot F_a / C_{1r}$	e	$F_a / F_r \leq e$		$F_a / F_r > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$$P_{br} = 0.6F_r + 0.5F_a$$

When  $P_{br} < F_r$ , use  $P_{br} = F_r$ .

Snap ring groove dimensions		Snap ring dimensions		Installation-related dimensions				Mass							
D <sub>1</sub> Max.	a Max.	b Min.	r <sub>o</sub> Max.	D <sub>2</sub> Max.	D <sub>2</sub> Min.	f Max.	D <sub>a</sub> Max.	D <sub>x</sub> Max.	C <sub>Y</sub> Max.	C <sub>Z</sub> Max.	r <sub>as</sub> Max.	r <sub>Nas</sub> Max.	r <sub>ring</sub> Max.	r <sub>ring</sub> (approx.)	kg
12.15	0.88	0.55	0.2	15.2	0.55	0.55	6.6	6.9	11.4	15.9	1.2	0.6	0.2	0.1	0.002
13.03	1.28	0.65	0.06	16.13	0.54	0.54	6.6	7.4	12.4	16.9	1.6	0.6	0.2	0.2	0.004
11.15	0.78	0.60	0.02	14.2	0.55	0.55	7.2	7.9	10.8	14.9	1.1	0.6	0.15	0.1	0.001
12.15	1.08	0.55	0.2	15.2	0.55	0.55	7	7.2	11.8	15.9	1.4	0.6	0.15	0.1	0.002
14.03	1.03	0.65	0.06	17.2	0.6	0.6	7.6	7.8	13.4	17.9	1.4	0.7	0.2	0.2	0.004
17.9	0.93	0.80	0.2	22	0.7	0.7	8	9.5	17	22.8	1.4	0.7	0.3	0.3	0.008
14.95	0.53	0.65	0.05	18.2	0.54	0.54	9.6	10	14.4	18.9	0.9	0.6	0.2	0.1	0.003
20.8	2.35	0.80	0.2	24.8	0.7	0.7	10	12.7	20	25.5	2.8	0.7	0.3	0.4	0.013
24.5	2.20	0.90	0.3	28.8	0.85	0.85	12	13.5	24	29.5	2.8	0.9	0.3	0.3	0.02