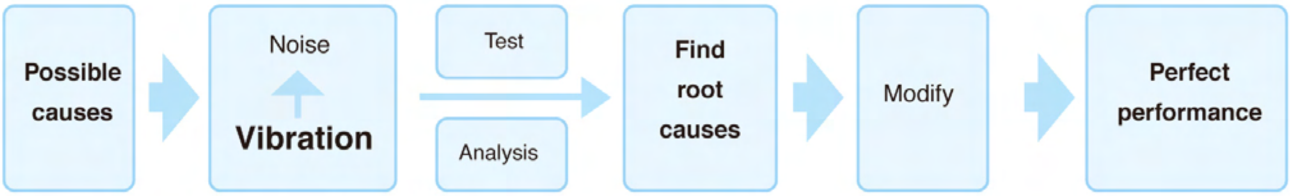
NOISE AND VIBRATION

In addition to the basic requirements on a bearing like load capacity, speed limit and life time; low noise and vibration is becoming more and more important in most applicatons. Vibrations in bearings are caused by time varying forces in bearings. The contact forces move around the bearing, giving rise to perfect bearing vibrations in the outer ring. It is well-known that excecssive vibrations can cause premature failure and costly maintenance, often including unplanned down-time and loss of production. High vibration levels also increase energy consumption. High noise levels, in turn, result in a poorer life environment for personnel and family. Therefore, to find out the roof causes of noise & vibration and prevent potential from the beginning is critical to perfect performance of the bearings.



Vibration Rising and Countermeasures

HCH is making 100% such noise and vibration testing before every single bearing leaves the factory. Also, HCH has recently significantly improved design of deep groove ball bearings, to further reduce noise and vibration levels.

Customers need to pay attention when coming across the following conditions.

Types	Description	Causes	Countermeasures
Self-Generated Vibration	Vibration generated from the bearing itself when it is in the rotating condition.	Variations of circular form in the bearing balls and raceway.	Can not be avoided, but could reduce the vibration level by selecting the proper clearance due to the application.
Vibration Arising from Exposure to External	Disturbed noises occur with the performance degrades of bearings in modes known as wear oxidation or fretting corrosion.	The contaminated surrounding environment affects bearing. Loaded bearings operate without sufficient lubrication.	These conditions can be relieved by properly designed isolation supports and adequate lubrication.
Vibration from Misalignment	Not well-aligned bearings make noise when they are rotating.	Bearings are not well aligned on the shafts or houses during installation. The shafts and houses are not accurate.	Good alignment methods and special alignment tools to reduce vibration. Applying high accuracy shafts and houses.
Local Damage Vibration	The small damaged sections on the raceways and rolling elements generate a specific vibration frequency.	Mishandling or incorrect mounting.	Applying correct mounting methods and mechanical tools such as fitting tools. Applying induction heaters with time control and pre-set temperature mode.

Noise & vibration testing

The vibration and noise of bearings are classified as four classes measured by BVT-1 and classified as V_1, V_2, V_3 and V_4.

Data for vibration of single deep groove ball bearing

Tolerance in µm/s.

d	V			V_1			V_2			V_3			V_4		
mm	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band
3,4	80	44	44	60	35	32	48	26	22	31	16	15	28	10	10
5,6	110	72	60	74	48	40	58	36	30	35	21	18	32	11	11
7,8,9	130	96	80	92	66	54	72	48	40	44	28	24	38	12	12
10,12	160	120	100	120	80	70	90	60	50	55	35	30	45	14	15
15	210	150	120	150	100	85	110	78	60	65	46	35	52	18	18
17	210	150	120	150	100	85	110	78	60	65	46	35	52	25	25
20	260	190	150	180	125	100	130	100	75	80	60	45	60	25	25
22,25	260	190	150	180	125	100	130	100	75	80	60	45	60	30	32
28	260	190	150	180	125	100	130	100	75	80	60	45	60	35	40
30,32	300	240	190	200	150	130	150	120	100	90	75	60	70	35	40
35	300	240	190	200	150	130	150	120	100	90	75	60	70	42	45
40	360	300	260	240	180	160	180	150	130	110	90	80	82	50	50
45	360	300	260	240	180	160	180	150	130	110	90	80	82	60	60
50	420	320	320	280	200	200	210	160	160	125	100	100	95	70	70
55	420	360	360	280	220	200	210	180	180	125	110	110	95	70	70
60	480	360	440	320	220	240	240	180	200	145	110	130	100	80	80

Tolerance in µm/s.

d	V			V_1			V_2			V_3			V_4		
mm	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band
65	300	260	420	180	160	240	130	100	150	105	80	105	50	50	75
70	360	310	460	200	180	280	150	120	200	110	90	135	58	58	88
75	360	310	460	200	180	280	150	120	200	110	90	135	58	58	88
80	420	360	540	240	210	320	180	120	240	130	110	160	65	65	100
85	420	360	540	240	210	320	180	120	240	130	110	160	65	65	100
90	480	420	600	290	250	370	210	180	270	145	125	180	75	75	115
95	480	420	600	290	250	370	210	180	270	145	125	180	75	75	115
100	560	490	670	340	300	420	250	215	310	170	145	200	88	88	135
105	560	490	670	340	300	420	250	215	310	170	145	200	88	88	135
110	640	570	750	400	350	480	290	260	350	190	175	225	100	100	160
115	640	570	750	400	350	480	290	260	350	190	175	225	100	100	160

Data for vibration of single tapered roller bearing

Tolerance in µm/s.

d	V			V_1			V_2			V_3		
mm	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band	Low Band	Medium Band	High Band
15	310	500	500	220	360	360	150	220	220	100	100	100
17	330	550	550	240	400	400	170	240	240	110	110	110
20	330	550	550	240	400	400	170	240	240	110	110	110
25	360	590	600	280	440	450	210	280	280	120	140	130
30	360	590	600	280	440	450	210	280	280	120	140	130
35	400	640	670	320	480	500	250	320	300	150	180	160
40	440	690	740	360	530	560	280	350	320	170	210	190
45	440	690	740	360	530	560	280	350	320	170	210	190
50	480	750	810	400	600	620	320	400	360	220	260	240
55	480	750	810	400	600	680	320	400	360	220	260	240
60	530	850	1000	450	680	760	370	460	420	300	330	300

dB noise testing

The noise of bearings by dB is classified as four classes as Z1, Z2, Z3 and Z4. It is measured by the instrument of S0910-1.

Maximum vibration acceleration of single bearing

Tolerance in dB

d	Diameter Series (0)					Diameter Series (2)					Diameter Series (3)				
mm	Z	Z_1	Z_2	Z_3	Z_4	Z	Z_1	Z_2	Z_3	Z_4	Z	Z_1	Z_2	Z_3	Z_4
3	35	34	32	28	24	36	35	32	30	26	37	36	33	31	27
4	35	34	32	28	24	36	35	32	30	26	37	36	33	31	27
5	37	36	34	30	26	38	37	34	32	28	39	37	35	33	29
6	37	36	34	30	26	38	37	34	32	28	39	37	35	33	29
7	39	38	35	31	27	40	38	36	34	29	41	39	37	35	30
8	39	38	35	31	27	40	38	36	34	29	41	39	37	35	30
9	41	40	36	32	28	42	40	37	35	30	43	41	39	37	32
10	43	42	38	33	28	44	42	39	35	30	46	44	40	37	32
12	44	43	39	34	29	45	43	39	35	30	47	45	40	37	32
15	45	44	40	35	30	46	44	41	36	31	48	46	42	38	33
17	46	44	40	35	30	47	45	41	36	31	49	47	42	38	33
20	47	45	41	36	31	48	46	42	38	33	50	48	43	39	34
22	47	45	41	36	31	48	46	42	38	33	50	48	43	39	34
25	48	46	42	38	34	49	47	43	40	36	51	49	44	41	37
28	49	47	43	39	35	50	48	44	41	37	52	50	45	42	38
30	49	47	43	39	35	50	48	44	41	37	52	50	45	42	38
32	50	48	44	40	36	51	49	45	42	38	53	51	46	43	39
35	51	49	45	41	37	52	50	46	43	39	54	52	47	44	40
40	53	51	46	42	38	54	52	47	44	40	56	54	49	45	41
45	55	53	48	45	42	56	54	49	46	43	58	56	51	47	44
50	57	54	50	47	44	58	55	51	48	45	60	57	53	49	46
55	59	56	52	49	46	60	57	53	50	47	62	59	54	51	48
60	61	58	54	51	48	62	59	54	51	48	64	61	56	53	50

Maximum vibration acceleration of single bearing

Tolerance in dB

d	Diameter Series (0)				Diameter Series (2)				Diameter Series (3)			
mm	Z	Z_1	Z_2	Z_3	Z	Z_1	Z_2	Z_3	Z	Z_1	Z_2	Z_3
65	49	48	46	41	50	49	47	42	51	50	48	43
70	50	49	47	42	51	50	48	43	52	51	49	44
75	51	50	48	43	52	51	49	44	53	52	50	45
80	52	51	49	44	53	52	50	45	54	53	51	46
85	53	52	50	45	54	53	51	46	56	55	52	47
90	54	53	52	47	56	55	53	48	58	57	54	49
95	56	55	54	49	58	57	55	50	60	59	56	51
100	58	57	56	51	60	59	57	52	62	51	58	53
105	60	59	58	53	62	61	59	54	64	63	60	55
110	62	61	60	55	64	63	61	56	66	65	62	57
120	64	63	62	57	66	65	63	58	68	67	64	59

d	30200, 32200 Series			30300, 32300 Series		
mm	$Z^{1)}$	Z_1	Z_2	Z	Z_1	Z_2
15	-	-	-	56	54	50
17	56	54	50	58	56	52
20	57	55	51	61	58	53
25	58	56	52	64	61	56
30	59	56	52	67	64	59
35	61	58	53	68	65	60
40	63	60	55	69	66	61
45	65	62	57	69	66	61
50	67	64	59	71	68	63
55	69	66	61	74	71	66
60	71	68	63	77	74	69

Discord sound testing

dB noise testing is a traditional noise measurement which can only give a general idea of bearing quality by their noise level. Vibration measurements are of great importance for high-quality bearing production which is applied widespread over the world famous bearing manufacturers. HCH's bearings are 100% tested by noise and vibration measurements.

However, besides waviness, roundness and non-adequate lubrication etc., a noise application can lead the unreliable bearing performance which can also be caused by local defects, dirt particles and cage problems. In addition, HCH is also implementing 100% discord sound testing of bearings, which can test and detect all of these bearing quality issues. Following table lists common types of discord sound, their causes as well as countermeasures.

Causes of discord sound and countermeasures

Familiar discord sound	Cause	Countermeasure
Squeak	This is a dense and strident squeak just like noise when steel is sawed by saw blade and the wave crest occurs rhythmically. It will be specific reflected by BVT-1 equipment via high band: the pointer will rise and fluctuate. The amplitude is changing according to the intensity of noise. This kind of noise is the most deleterious. It is mainly caused by surface bumping (knocking) between the ball and raceway.	1. Choose the ball with surface strengthened. 2. Strictly control the quality of ball's surface (flaw, stripe, black spot and surface scuffing). 3. Strictly control the bumping (knocking) hurt of inner and outer raceway.
Chatter	This kind of noise is arrhythmic noise when grease or impurity is rolled. Sometimes it occurs and sometime it's gone. When this noise appears, the high band's pointer of BVT-1 equipment rises suddenly. The amplitude is changing according to the intensity of noise. It is closely related to the cleanliness of bearings, anti-rust oil and impurity of grease.	1. Do the inspection and control of bearing cleanliness. 2. Choose the anti-rust oil and grease with low impurity(namely high cleanliness anti-rust oil and grease).
Hum	When hum appears, normally the read of the low band of BVT-1 equipment is high. Louder the noise is, higher the read will be. This sound is closely related to the noise rising of the machine. It is related to the roundness and accuracy of bearing's inner and outer raceway.	Strictly control roundness of raceway.
Ripple	A kind of high-frequent noise which is symmetrical, ringing and continuous. The read of high band of BVT-1 equipment is a little bit higher which will increase the noise of the finished products. It is related to the raceway's chatter mark. reflecting the defect of the raceway waviness.	Strict control inner and outer race's undulation variation (monitor by Roundness & Waviness meter).
Grease stirring	Sounds like the clop.	Check the characteristic of grease. If the grease used is with high viscocity, it is normal agitating sound. But if the grease used is with low viscocity, please check the quality of the grease.