Design Characteristics of High Damping Rubber Bearing

Dimension and Performance Properties of H-RB

●HH-Series (Total Rabber Thickness 200mm)

Code

Designation	Compound	Shear Modulus (N/mm²)	Equivalent Damping Ratio
X6R	X0.6R	0.624	0.240

Characteristics			HH060X6R	HH065X6R	HH070X6R	HH075X6R	HH080X6R	HH085X6R	HH090X6R	HH095X6R	HH100X6R	HH110X6R	HH120X6R	HH130X6R	HH140X6R	HH150X6R	HH160X6R
Physical Dimensions	Outer Diameter (mm)		600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600
	Inner Diameter (mm)		15	15	15	15	20	20	20	20	25	55	55	55	65	65	80
	Effective Plan Area ($\times 10^2$mm^2)		2826	3317	3847	4416	5023	5671	6359	7085	7849	9480	11286	13249	15361	17638	20056
	Thickness of One Rubber Layer (mm)		4.0	4.4	4.7	5.0	5.4	5.7	6.0	6.4	6.7	7.4	8.0	8.7	9.5	10	10.4
	Number of Rubber Layers (–)		50	45	43	40	37	35	33	31	30	27	25	23	21	20	19
	Total Rubber Thickness (mm)		200	198	202	200	200	200	198	198	201	200	200	200	200	200	198
	First Shape Factor (–)		36.6	36.1	36.4	36.8	36.1	36.4	36.7	36.3	36.4	35.3	35.8	35.8	35.1	35,9	36,5
	Second Shape Factor (–)		3.00	3.28	3.46	3.75	4.00	4.26	4.55	4.79	4.98	5.51	6.00	6.50	7.02	7.50	8,10
	Diameter of Flange (mm)		900	950	1000	1100	1150	1200	1250	1300	1400	1500	1600	1700	1800	1900	2000
	Thickness of Flange (mm)		22/28	22/28	22/28	22/28	24/32	24/32	24/32	24/32	28/36	30/38	32/40	32/40	37/45	50/100	50/100
	Diameter of Bolt Center (mm)		775	825	875	950	1000	1050	1100	1150	1250	1350	1450	1550	1650	1700	1800
	Diameter (Number) of Fixing Bolts(mm)		33(12)	33(12)	33(12)	33(12)	33(12)	33(12)	33(12)	33(12)	39(12)	39(12)	39(12)	39(12)	42(12)	42(12)	45(12)
	Supposed Bolt (–)		M30	M30	M30	M30	M30	M30	M30	M30	M36	M36	M36	M36	M39	M39	M42
	Thickness of One Reinforcing Steel Plate (mm)		3.1	3.1	3.1	3.1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	5.8	5.8	5.8
	Height (mm)		407.9	390.4	388.3	376.9	422.2	413.1	402.8	394.4	400.6	390.2	385.6	376.9	405.5	510.2	522.0
	Total Weight (kN)		6.5	7.0	7.9	8.9	11.9	12.9	13.8	14.8	17.3	20.1	23.3	26.0	34.0	55.2	65.1
Compression Properties	Critical Stress (N/mm²)	$\gamma=0$ σ_{cr}	43	52	58	69	78	89	101	113	122	136	148	160	173	185	200
	Ultimate Compressive Stress (N/mm²)	(γ_0, σ_0)	(0,22)	(0,30)	(0,35)	(0,42)	(0,48)	(0,52)	(0,56)	(0,59)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)
		(γ_1, σ_1)	(1.5,22)	(1.4,30)	(1.4,35)	(1.5,42)	(1.5,48)	(1.8,52)	(2.1,56)	(2.3,59)	(2.5,60)	(3.1,60)	(3.6,60)	(3.8,60)	(3.8,60)	(3.9,60)	(3.9,60)
		(γ_2, σ_2)	(2.7,4)	(3.0,5)	(3.1,6)	(3.4,7)	(3.4,11)	(3.5,17)	(3.5,23)	(3.6,29)	(3.6,34)	(3.7,45)	(3.7,56)	–	–	–	–
	Compressive Stiffness($\times 10^3$kN/m)		1970	2340	2660	3090	3510	3970	4490	4980	5450	6590	7860	9220	10700	12300	14200
	Nominal Long Term Compressive Stress (N/mm²)		6.6	8.1	9.1	10.7	12.0	13.4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Nominal Long Term Column Load (kN)		1860	2690	3500	4710	6050	7620	9540	10630	11770	14220	16930	19870	23040	26460	30080
	Allowable Tensile Stress (γ=100%) (N/mm²)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Shear Properties (γ=100%)	Initial Stiffness ($\times 10^3$kN/m)		5.19	6.15	6.99	8.10	9.23	10.43	11.79	13.11	14.33	17.41	20.71	24.30	28.26	32.37	37.25
	Post-Yield Stiffness (γ=100%) ($\times 10^3$kN/m)		0.519	0.615	0.699	0.810	0.923	1.043	1.179	1.311	1.433	1.741	2.071	2.430	2.826	3.237	3.725
	Characteristic Strength (kN)		71.5	83.9	97.3	112	127	143	161	179	199	240	285	335	389	446	507
	Equivalent Shear Stiffness ($\times 10^3$kN/m)		0.88	1.04	1.18	1.37	1.56	1.76	1.99	2.21	2.42	2.94	3.50	4.11	4.77	5.47	6.29
	Equivalent Damping Ratio (–)		0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240

●HL-Series (Total Rabber Thickness 160mm)

Code

Designation	Compound	Shear Modulus (N/mm²)	Equivalent Damping Ratio
X6R	X0.6R	0.624	0.240

Characteristics			HL060X6R	HL065X6R	HL070X6R	HL075X6R	HL080X6R	HL085X6R	HL090X6R	HL100X6R	HL110X6R	HL120X6R	HL130X6R
Physical Dimensions	Outer Diameter	(mm)	600	650	700	750	800	850	900	1000	1100	1200	1300
	Inner Diameter	(mm)	15	15	15	15	20	20	20	25	55	55	55
	Effective Plan Area	($\times 10^2$ mm^2)	2826	3317	3847	4416	5023	5671	6359	7849	9480	11286	13249
	Thickness of One Rubber Layer	(mm)	3.95	4.4	4.9	4.85	5.1	5.25	5.65	6.35	7.2	7.7	8.0
	Number of Rubber Layers	(–)	41	37	34	34	33	32	30	26	23	22	21
	Total Rubber Thickness	(mm)	162	163	167	165	168	168	170	165	166	169	168
	First Shape Factor	(–)	37.0	36.1	34.9	37.9	38.2	39.5	38.9	38.4	36.3	37.2	38.9
	Second Shape Factor	(–)	3.70	3.99	4.20	4.55	4.75	5.06	5.31	6.06	6.64	7.08	7.74
	Diameter of Flange	(mm)	900	950	1000	1100	1150	1200	1250	1400	1500	1600	1700
	Thickness of Flange	(mm)	22/28	22/28	22/28	22/28	24/32	24/32	24/32	28/36	30/38	32/40	32/40
	Diameter of Bolt Center	(mm)	775	825	875	950	1000	1050	1100	1250	1350	1450	1550
	Diameter (Number) of Fixing Bolts	(mm)	33(12)	33(12)	33(12)	33(12)	33(12)	33(12)	33(12)	39(12)	39(12)	39(12)	39(12)
	Supposed Bolt	(–)	M30	M30	M30	M30	M30	M30	M30	M36	M36	M36	M36
	Thickness of One Reinforcing Steel Plate	(mm)	3.1	3.1	3.1	3.1	4.4	4.4	4.4	4.4	4.4	4.4	5.8
	Height	(mm)	342.0	330.4	324.9	323.2	373.1	368.4	361.1	347.1	338.4	341.8	364.0
	Total Weight	(kN)	5.7	6.3	6.9	8.1	11.0	12.1	13.0	15.9	18.4	21.8	27.5
Compression Properties	Critical Stress (N/mm^2)	γ=0 σ_{cr}	67	78	86	102	111	125	131	149	164	175	191
	Ultimate Compressive Stress (N/mm^2)	(γ_0, σ_0)	(0,41)	(0,48)	(0,51)	(0,56)	(0,59)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)
		(γ_1, σ_1)	(1.4,41)	(1.5,48)	(1.7,51)	(2.1,56)	(2.2,59)	(2.6,60)	(2.9,60)	(3.6,60)	(3.8,60)	(3.8,60)	(3.9,60)
		(γ_2, σ_2)	(3.3,7)	(3.4,11)	(3.5,15)	(3.5,23)	(3.6,28)	(3.6,36)	(3.6,41)	(3.7,57)	–	–	–
	Compressive Stiffness	($\times 10^3$ kN/m)	2440	2840	3200	3760	4190	4760	5280	6680	7990	9330	11110
	Nominal Long Term Compressive Stress	(N/mm^2)	10.4	12.0	13.1	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Nominal Long Term Column Load	(kN)	2940	3970	5040	6620	7540	8510	9540	11770	14220	16930	19870
	Allowable Tensile Stress (γ=100%)	(N/mm^2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Shear Properties (γ=100%)	Initial Stiffness	($\times 10^3$ kN/m)	6.40	7.48	8.47	9.83	10.96	12.39	13.77	17.45	21.01	24.45	28.95
	Post-Yield Stiffness (γ=100%)	($\times 10^3$ kN/m)	0.640	0.748	0.847	0.983	1.096	1.239	1.377	1.745	2.101	2.445	2.895
	Characteristic Strength	(kN)	71.5	83.9	97.3	111.7	127.1	143.5	160.8	198.6	239.8	285.5	335.2
	Equivalent Shear Stiffness	($\times 10^3$ kN/m)	1.08	1.26	1.43	1.66	1.85	2.09	2.33	2.95	3.55	4.13	4.89
	Equivalent Damping Ratio	(–)	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240

●HT-Series (Total Rabber Thickness 250mm)

Code

Designation	Compound	Shear Modulus (N/mm²)	Equivalent Damping Ratio
X6R	X0.6R	0.624	0.240

Characteristics			HT090X6R	HT100X6R	HT110X6R	HT120X6R	HT130X6R	HT140X6R	HT150X6R	HT160X6R
Physical Dimensions	Outer Diameter	(mm)	900	1000	1100	1200	1300	1400	1500	1600
	Inner Diameter	(mm)	20	25	55	55	55	65	65	80
	Effective Plan Area	($\times 10^2 mm^2$)	6359	7849	9480	11286	13249	15361	17638	20056
	Thickness of One Rubber Layer	(mm)	6	6.7	7.4	8	8.7	9.5	10	10.4
	Number of Rubber Layers	(–)	42	37	34	31	29	26	25	24
	Total Rubber Thickness	(mm)	252	248	252	248	252	247	250	250
	First Shape Factor	(–)	36.7	36.4	36.3	35.8	35.8	35.1	35.9	36.5
	Second Shape Factor	(–)	3.6	4.0	4.4	4.8	5.2	5.7	6.0	6.4
	Diameter of Flange	(mm)	1250	1400	1500	1600	1700	1800	1900	2000
	Thickness of Flange	(mm)	24/32	28/36	30/38	32/40	32/40	37/45	50/100	50/110
	Diameter of Bolt Center	(mm)	1100	1250	1350	1450	1550	1650	1700	1800
	Diameter (Number) of Fixing Bolts	(mm)	33(12)	39(12)	39(12)	39(12)	39(12)	42(12)	42(12)	45(12)
	Supposed Bolt	(–)	M30	M36	M36	M36	M36	M39	M39	M42
	Thickness of One Reinforcing Steel Plate	(mm)	4.4	4.4	4.4	4.4	4.4	5.8	5.8	5.8
	Height	(mm)	496.4	478.3	472.8	460.0	455.5	482.0	589.2	603.0
	Total Weight	(kN)	16.2	19.6	23.0	26.3	29.5	38.3	60.7	70.8
Compression Properties	Critical Stress (N/mm^2)	$\gamma=0\ \sigma_{cr}$	62	80	94	115	127	140	148	158
	Ultimate Compressive Stress (N/mm^2)	(γ_0, σ_0)	(0,38)	(0,48)	(0,53)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)
		(γ_1, σ_1)	(1.4,38)	(1.6,48)	(1.9,53)	(2.3,60)	(2.7,60)	(3.2,60)	(3.6,60)	(3.8,60)
		(γ_2, σ_2)	(3.2,6)	(3.4,12)	(3.5,19)	(3.6,30)	(3.6,38)	(3.7,49)	(3.7,56)	–
	Compressive Stiffness	($\times 10^3 kN/m$)	3,530	4,420	5,270	6,370	7,340	8,690	9,860	11,200
	Nominal Long Term Compressive Stiffness	(N/mm^2)	9.7	12.2	14.0	15.0	15.0	15.0	15.0	15.0
	Nominal Long Term Column Load	(kN)	6170	9580	13270	16930	19870	23040	26460	30080
	Allowable Tensile Stress (γ=100%)	(N/mm^2)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
※ Shear Properties (γ=100%)	Initial Stiffness	($\times 10^3 kN/m$)	9.26	11.62	13.83	16.70	19.28	22.83	25.90	29.49
	Post-Yield Stiffness (γ=100%)	($\times 10^3 kN/m$)	0.926	1.162	1.383	1.670	1.928	2.283	2.590	2.949
	Characteristic Strength	(kN)	161	199	240	285	335	389	446	507
	Equivalent Shear Stiffness	($\times 10^3 kN/m$)	1.56	1.96	2.34	2.82	3.26	3.86	4.37	4.98
	Equivalent Damping Ratio	(–)	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240