ANEXOS

Anexo A Especificaciones de las rótulas [Hephaist, 2014]

TECHNICAL SPECIFICATIONS

MODEL	BASIC LOAD RATINGS		RECOMMENDED PERMISSIVE LOADS				WEIGHT	MAXIMUM SWING ANGLE
	C (N)	Co (N)	Compressive (N)	Tensile (N)	Radial (N)	Moment (N-m)	(kg)	
SRJ004C	128	100	102	38.4	64	0.64	0.015	±15°
SRJ006C	320	280	256	96	160	1.84	0.036	±30°
SRJ008C	490	540	392	147	245	3.92	0.06	±30°
SRJ012C	720	770	576	216	360	7.20	0.18	±30°
SRJ016C	1170	1300	936	351	585	18.7	0.37	±30°
SRJ024C	2840	3920	2272	852	1420	59.6	0.93	±30°
SRJ032C	5800	8820	4640	1740	2900	174	2.30	±30°
SRJ048C	10600	16000	8480	3180	5300	413	6.73	±30°

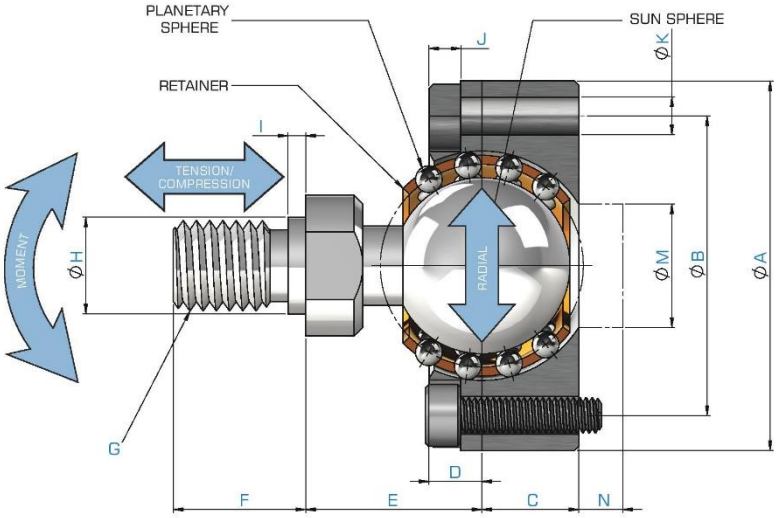
C(N) basic dynamic load rating Co(N) basic static load rating

• Standard product material is SUJ2 (high carbon, high chromium bearing steel) • Precision classification "SP" available for sizes SRJ008-SRJ-032 • Customization options include stainless steel product material, Raydent coating, and modifications to accommodate high vacuum and clean room environments • Additional customizations available upon request • The SR Joint is a patented product manufactured using Hephaist Seiko's unique spherical surface processing technology.

PART NUMBER BREAKDOWN

SRJ 012 C - P

- SRJ: SPHERICAL ROLLING JOINT
- 012: SPHERE SIZE (in 1/16th inch multiples)
- C - P: PRECISION CLASS
  - P: Precision (Run-out: ±2.5μm)
  - SP: Super-Precision (Run-out: ±1.0μm)



USAGE GUIDELINES

Designed for axial loading; do not apply load in any other direction with the shaft inclined for extended periods

Do not exceed 80% of the load rating for extended periods

Avoid rotating the shaft

Retainer may become misaligned gradually during use. If misaligned, release the load and set the retainer such that it is concentric with the shaft when oriented normal to the base. Continuous use of the joint while the retainer is misaligned could damage the retainer.

Please reference the **SRJ USAGE GUIDELINES** *document for additional information available for free download at* **srjoint.com**

DIMENSIONS

MODEL (units: mm)	A	B	C	D	E	F	G	H	I	J	K	M	N	WIDTH ACROSS FLATS
SRJ004C	19	15	3.8	2.5	10	6	M3x0.5	3.6	2	1.5	2	6	1.5	4
SRJ006C	25	20	5.5	3.8	11.5	8	M4x0.5	4.5	2	2.3	3	10	2	5
SRJ008C	30	24	7	4	16	12	M5x0.5	5.5	4	2	3.4	11	2	7
SRJ012C	42	34	11	6	20	15	M10x1.5	11	2	3.6	4.3	14	2	14
SRJ016C	56	45	12	7	32	18	M12x1.75	12.6	3	4.6	5.5	25	5	14
SRJ024C	74	62	17	11	42	23	M14x2	15	5	5.5	6.6	35	7	17
SRJ032C	100	84	22	16	60	30	M16x2	16.6	6	8.6	9	48	10	22
SRJ048C	136	114	38	22	78	38	M28x2	30	6	10.8	11	60	10	30

M and N indicate the required clearance for the retainer on the mounting surface

MYOSTAT MOTION CONTROL INC
Automation Components and Modern Mechatronic Solutions

HEPHAIST

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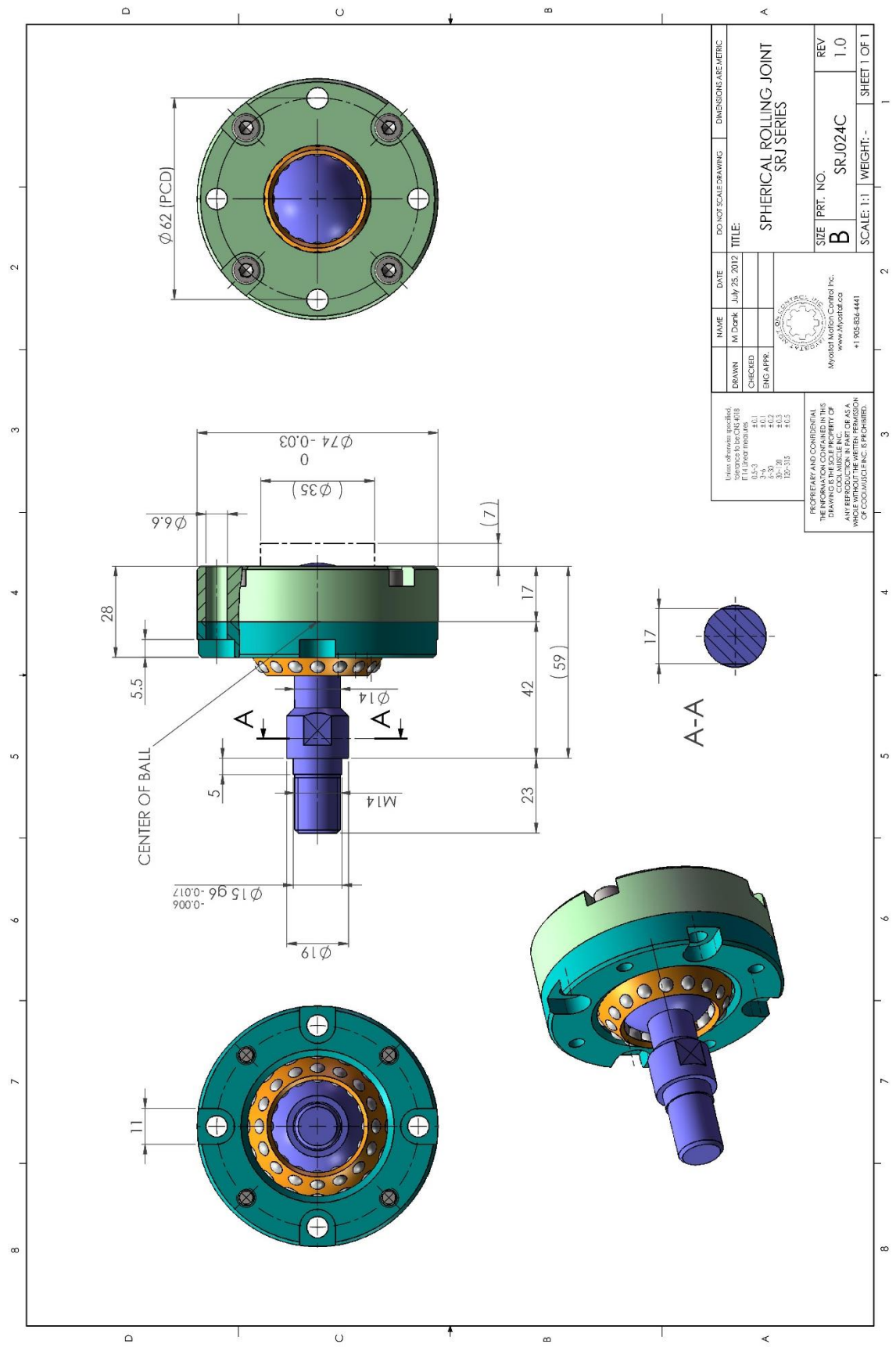
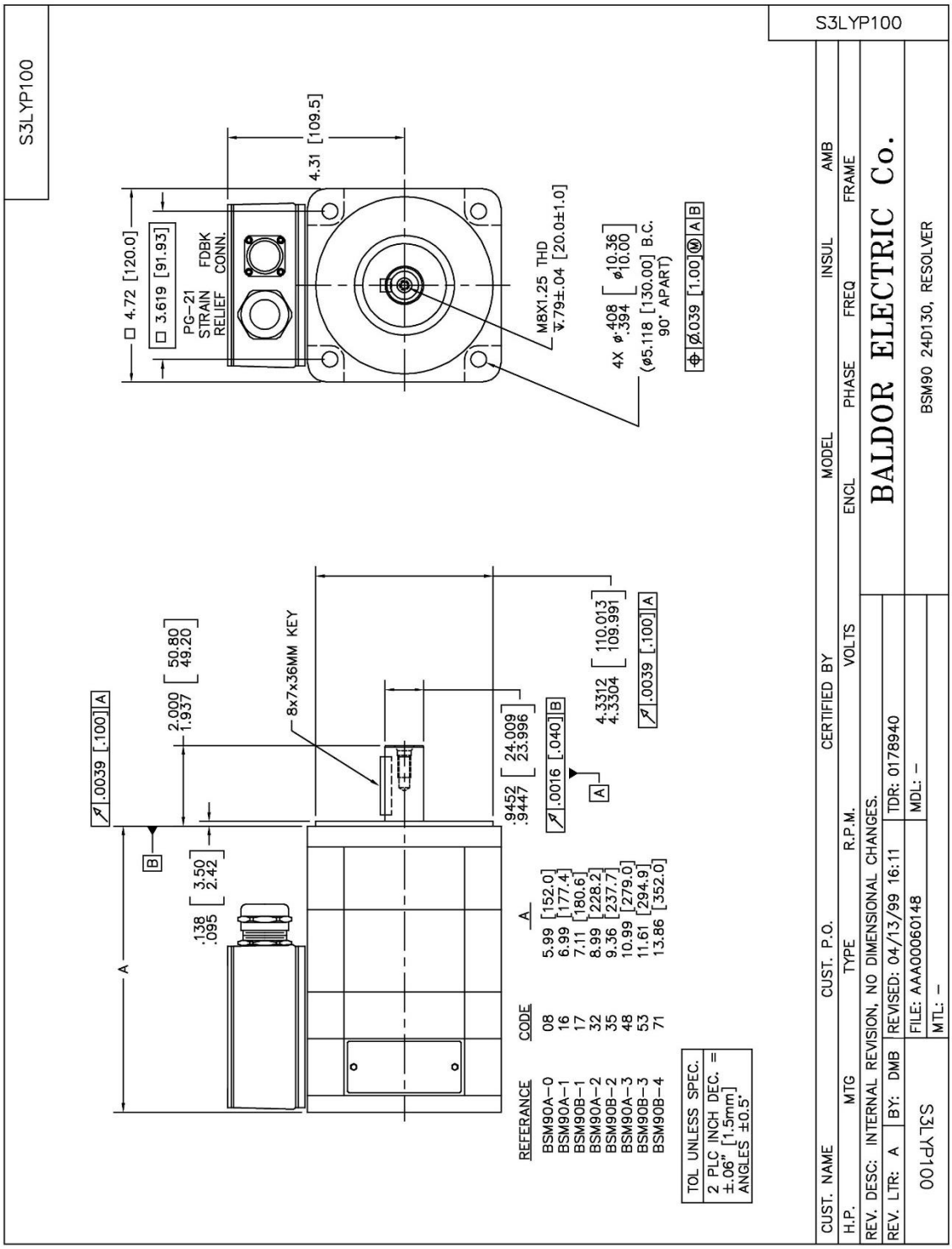


Anexo B Especificaciones de los servomotores [BALDOR, 2014]



Section 2
Installation

Overview Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location The motor should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance. Be sure to allow clearance for ventilation and access for cleaning, repair, service and inspections. Ventilation is extremely important. Be sure the area for ventilation is not obstructed. Obstructions will limit the free passage of air. Motors get warm and the heat must be dissipated to prevent damage.

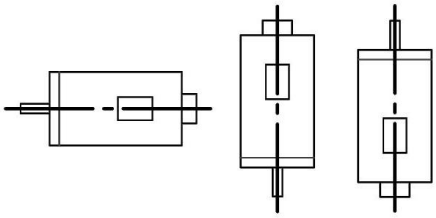
These motors are not designed for atmospheric conditions that require explosion proof operation. They must NOT be used in the presence of flammable or combustible vapors or dust.

Mounting The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage. For mounting dimensions, refer to http://www.baldor.com/products/servo_motors.asp and provide adequate clearance.

Alignment Accurate alignment of the motor with the driven equipment is extremely important.

1. **Direct Coupling**
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. **End-Play Adjustment**
   The axial position of the motor frame with respect to its load is also extremely important. The motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.

Figure 2-1 Mounting Orientation



These mounting orientations are allowed.

Receiving Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Storage If the motor is not put into service immediately, the motor must be stored in a clean, dry and warm location. If the parts are not put into service immediately, store them in a clean, dry and warm location. The motor must be protected from moisture and condensation. Storage area should be a dust free environment, maintained –25 degC to +85 degC and less than 90% relative humidity non–condensing.

Unpacking Each Baldor motor is packaged for ease of handling and to prevent entry of contaminants.

1. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
2. When the motor has reached room temperature, remove all protective wrapping material from the motor.

Handling Use proper care and procedures that are safe during handling, lifting, installing, operating and maintenance operations. Improper methods may cause muscle strain or other harm.

Repairs Baldor will not share any responsibility for damage caused by customer attempt to repair or modify a motor. Consult Baldor for any service.

Prevent Electrical Noise

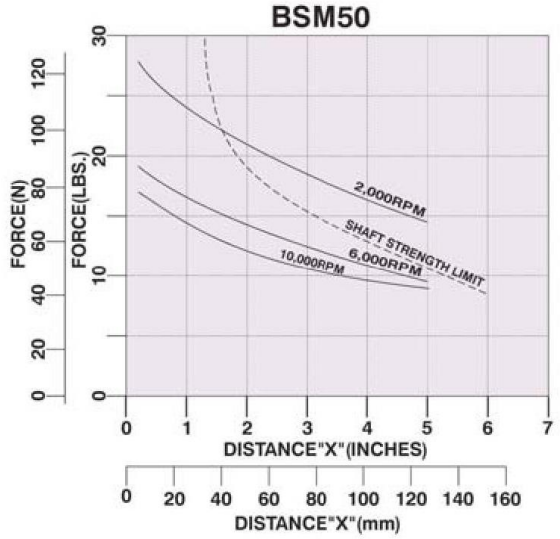
Electro–Magnetic–Interference (EMI), commonly called “electrical noise” may adversely affect motor performance by introducing stray signals. Effective techniques to reduce or prevent EMI include AC power filters, cable shielding, separating signal wires from power wires and good grounding techniques. Effective AC power filtering can be achieved by using properly installed “Isolated AC Power Transformers” or “AC Line Filters”. Other techniques are:

- Install motor cables and signal wires in separate conduits.
- Do not route motor cables and signal wires in parallel. Separate cables by at least 1 foot for every 30 feet of run.
- Cross signal and power wires at 90 degree angles to prevent inductive noise coupling.
- Do not route signal wires over the vent openings of the servo drives.
- Ground all equipment using a single point ground system.
- Keep wires as short as possible.
- Ground both ends of the encoder cable and use twisted pair wires.
- Use shielded motor cables to prevent EMI from other equipment.

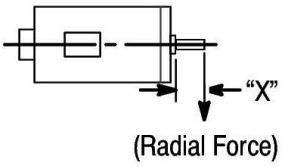
Shaft Loads The motors can be damaged by excessive shaft loads. This may shorten the motor's service life. The motor warranty is also voided for excessive shaft load related failures.

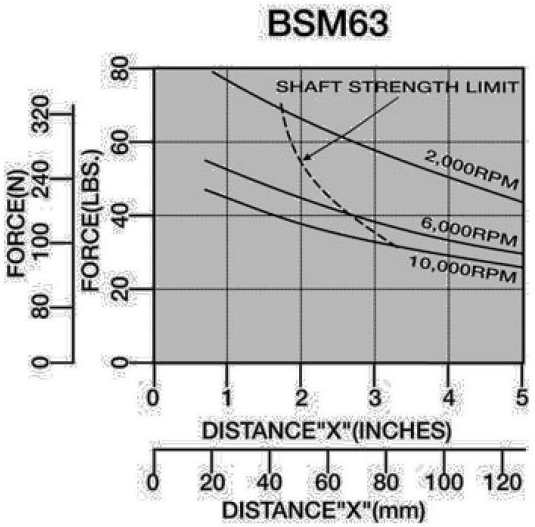
The maximum allowable radial force ($F_{radial\,max}$) depends on the shaft load. It is determined by (distance x force) and the output shaft design (plain shaft or shaft with keyway). When motor shaft has both a radial load and an axial load, axial load rating = 44% of radial load rating listed. Should questions arise contact Motion_Support@Baldor.com

Figure 2-2 Radial Load Capacity



Notes:
1) Solid lines are based on L_{10} = 20,000 hours.
2) Dashed line is based on 10^4 load peaks @ 110% of rated torque.





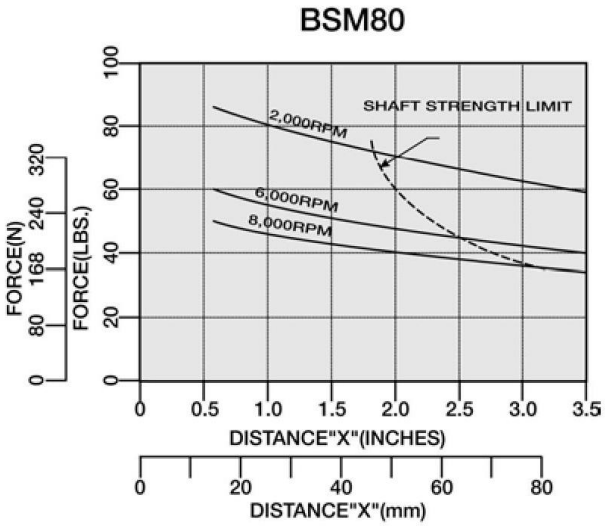
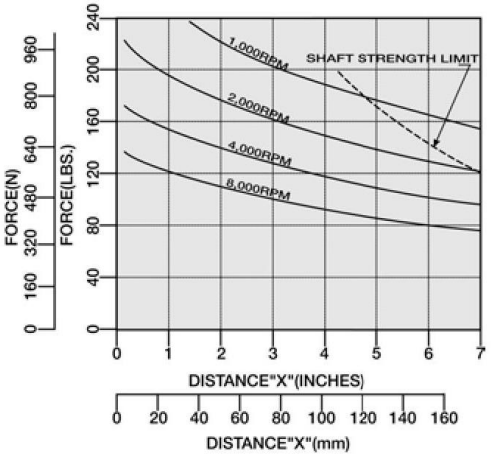
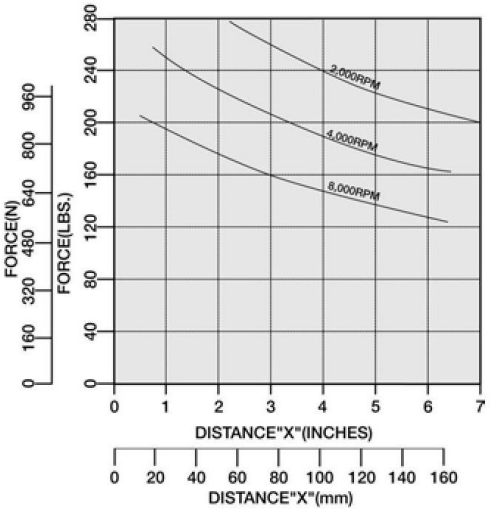


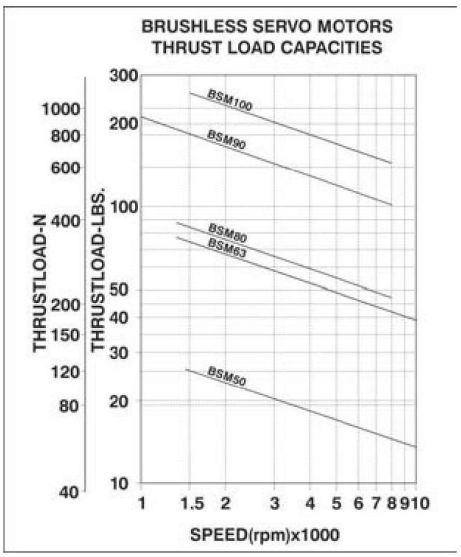
Figure 2-2 Radial Load Capacity Continued

BSM90



BSM100





Life Determination

How Life is Determined

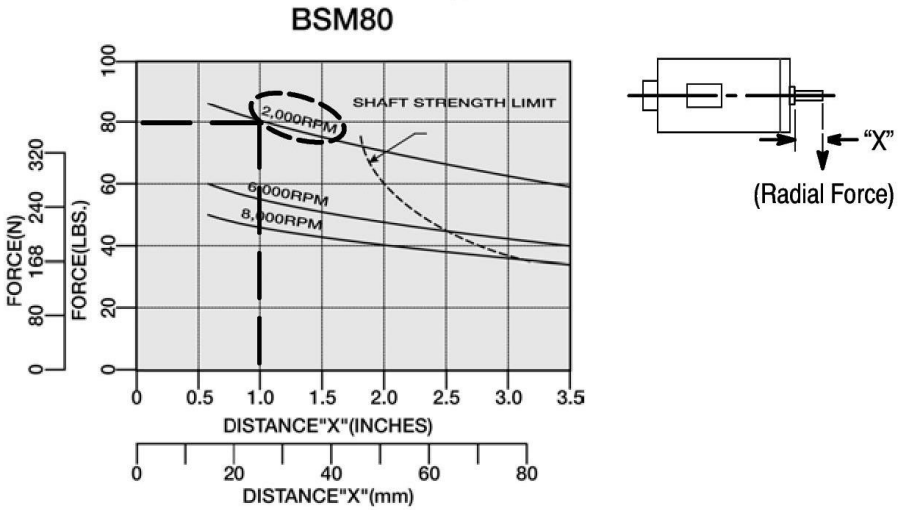
A life estimate is a calculated, statistical expectancy and is defined as the length of time, or the number of revolutions, until fatigue develops. This life depends on many different factors such as loading, speed, lubrication, operating temperature, contamination, plus other environmental factors. It's impossible to predict precisely.

Statistical calculation estimates are based upon L_{10} life. This is the life that 90 percent of a group, of apparently identical parts, will reach or exceed. Typical bearing radial load capacity curves presented in the literature are based upon bearing L_{10} life of 20,000 hours.

Using the Curves

First determine your load (or force), location (or distance) from the bearing the load will be applied, and speed (or RPM). Typical bearing radial load capacity curves presented in the literature are based upon bearing L_{10} life of 20,000 hours for a BSM80 Motor, (Figure 2-3). Second, plot these points on the curve. For example, a force of 80 lbs (352 N), applied 1 inch (25mm) from the bearing, with a motor speed of 2,000 RPM, would relate to a bearing L_{10} life estimate of 20,000 hours.

Figure 2-3



Operating 24 hours / day, which is 8500 hours, this would provide a L_{10} life estimate of: (20,000 hours) (8500 hours/yr)=2.35yrs.

If Plotted Point Does Not Match your RPM

Many times the point plotted (force and distance), is not specifically on your applications speed curve, so an estimate for life is calculated as follows:

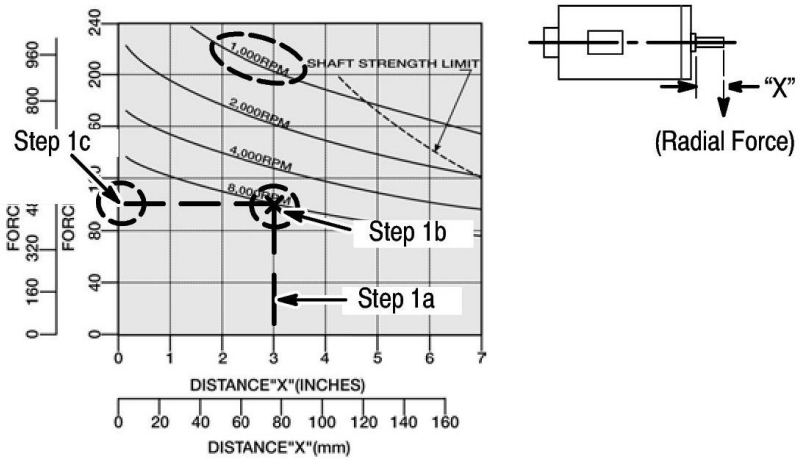
$$L_{10} = \left(\frac{16667}{S}\right) x \left(\frac{C}{F}\right)^3$$

Where: L_{10} = 20,000 hours
S = RPM
C = capacity of system
F = Force or Load (lb)

Example:. Provide an estimate L_{10} life for a BSM90 motor with a radial load or force of 130 lbs (570 N) located 3" (76mm) from the bearing. Operating speed is 1000 RPM.

1. Determine the systems capacity – at the distance for our application. To do this, refer to Figure 2-4 and read information from the curve:
   a. Locate our distance (3") on the X axis.
   b. Pick a speed (8,000 RPM) and locate the intersect with the 3".
   c. Read the force (100 lbs) on the Y axis.

Figure 2-4 BSM90 Load Capacity Curves



   d. Next, insert these numbers into equation (1) above and solve for capacity "C" (round off for clarity):

$$L_{10} = \left(\frac{16667}{S}\right)x\left(\frac{C}{F}\right)^3 = \left(\frac{16 \times 10^3}{8 \times 10^3}\right)x\left(\frac{C}{100}\right)^3$$

$$20,000 = \left(\frac{16667}{8000}\right)x\left(\frac{C}{100}\right)^3$$

$$C = 2125$$

2. Now that capacity is known, it is possible to estimate L_{10} with the applications load of 130 lbs (570 N) and 1000 RPM.

$$L_{10} = \left(\frac{16667}{S}\right)x\left(\frac{C}{F}\right)^3 = \left(\frac{16 \times 10^3}{1 \times 10^3}\right)x\left(\frac{2125}{130}\right)^3 = 72,795 \text{ hours}$$

This relates to 72,795 hours / 8500 hours/yr = 8.56 years.

Conclusion

Life is a statistical calculation based upon 90 percent of identical parts reaching or exceeding an estimate. It depends on many different factors and is impossible to predict precisely, however calculations provide a guideline.

Motor Poles

BSM50/63/80 Series motors are 4 pole (2 pole pair)
BSM90/100 Series motors are 8 pole (4 pole pair)

Speed and Torque

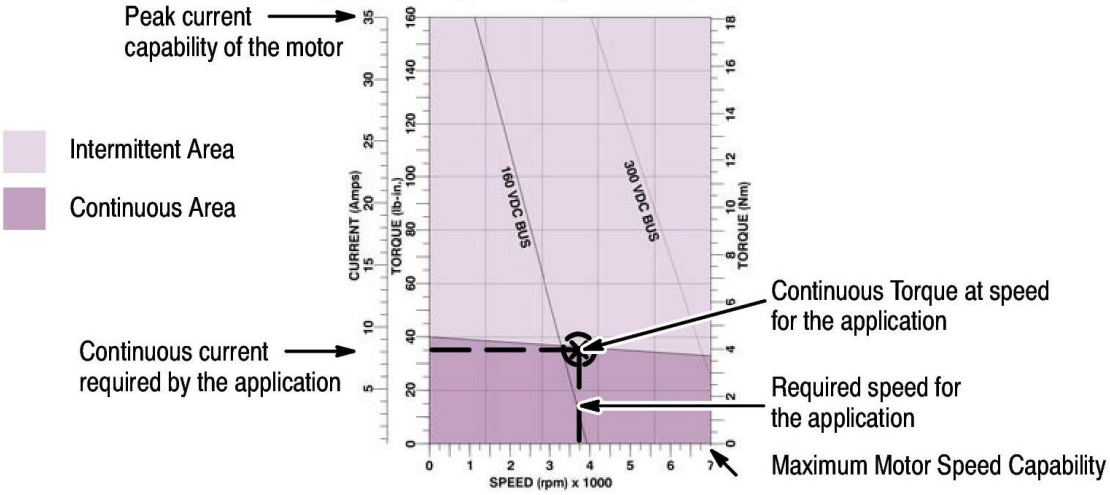
The speed–torque curves for a motor show the safe operating area, speed limit area and intermittent operating area. These curves are used to determine the maximum useable speeds with known torque requirements.

If operating within the continuous area, the motor's thermal limit will not be exceeded. If operated within the intermittent area (extended operation in this area will cause the motor to overheat), the operating time in this area must be limited to prevent overheating.

Brushless servo motors are rated at an ambient of 25 degrees C and a temperature rise of 130 degrees C. For operation at 40 degrees C derate by 6%.

WARNING: Severe burn is possible. The motor winding can reach 155 degrees C during operation. Do not touch motor without protective clothing or allow sufficient time for motor to cool to avoid burns.

Figure 2-5 Typical Speed–Torque Curve



Holding Brake

Holding brakes are offered as options for servo motors. These brakes are designed to hold the motor shaft at 0 RPM (to rated brake holding torque). The purpose of the holding brake is to hold the servo axis when power to the machine is turned off. The holding brake uses the "electric release" principle. Apply 24VDC to the brake causes the brake to release and let the motor shaft rotate. Loss of power causes the brake to hold the motor shaft.

The machine controller controls the holding brake. This ensures correct On and Off switching sequence.

WARNING: The holding brake alone does not guarantee personnel safety. Use structural measures such as protective fences or a second brake to secure personnel safety.

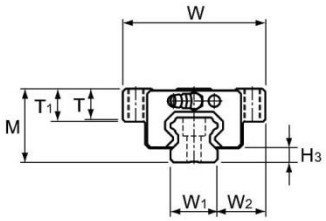
Caution: Do not use the holding brake to stop motion. This will cause premature brake wear and failure. The brakes are not designed to stop a rotating load. The servo drive inputs should always be used to stop motor shaft rotation.

Table 2-1 Brake Specifications

Motor Code	Brake Holding Torque (lb-in / N-m)	Watts	Brake Voltage VDC	Brake Current AMPS	Brake Times (msec)	
					Pull-in	Pull-out (with Diode)
BSM50N-1	13/1.4	10.1	24	0.5	18.6	55
BSM50N-2	13/1.4	10.1	24	0.5	18.6	55
BSM50N-3	13/1.4	10.1	24	0.5	18.6	55
BSM63N-1	18/2	11.9	24	0.6	33.5	33.8
BSM63N-2	18/2	11.9	24	0.6	33.5	33.8
BSM63N-3	18/2	11.9	24	0.6	33.5	33.8
BSM80N-1	40/4.5	19.7	24	0.7	34.5	79.3
BSM80N-2	40/4.5	19.7	24	0.7	34.5	79.3
BSM80N-3	40/4.5	19.7	24	0.7	34.5	79.3
BSM90N-1	77/8.7	22.5	24	0.9	64.1	73.6
BSM90N-2	140/15.8	22.5	24	0.9	64.1	73.6
BSM90N-3	140/15.8	22.5	24	0.9	64.1	73.6
BSM100N-1	200/22.5	31.4	24	1.3	83.9	188
BSM100N-2	200/22.5	31.4	24	1.3	83.9	188
BSM100N-3	350/39.5	33.7	24	1.4	157.3	220
BSM100N-4	350/39.5	33.7	24	1.4	157.3	220
BSM80C-1	30/3.3	19.7	24	0.8	34.5	79.3
BSM80C-2	30/3.3	19.7	24	0.8	34.5	79.3
BSM80C-3	30/3.3	19.7	24	0.8	34.5	79.3
BSM90C-1	77/8.7	22.5	24	0.9	64.1	73.6
BSM90C-2	77/8.7	22.5	24	0.9	64.1	73.6
BSM90C-3	77/8.7	22.5	24	0.9	64.1	73.6
BSM100C-1	200/22.5	31.4	24	1.3	83.9	188
BSM100C-2	200/22.5	31.4	24	1.3	83.9	188
BSM100C-3	200/22.5	31.4	24	1.3	83.9	188
BSM100C-4	200/22.5	31.4	24	1.3	83.9	188
BSM100C-5	350/39.5	33.7	24	1.4	157.3	220
BSM100C-6	350/39.5	33.7	24	1.4	157.3	220

Anexo C Especificaciones de los rieles circulares [THK, 2014]

R Guide Model HCR



Model No.	Outer dimensions			LM block dimensions									H_3
	Height M	Width W	Length L	B	C	S	L_1	T	T_1	N	E	Grease nipple	
HCR 12A+60/100R	18	39	44.6	32	18	M4	30.5	4.5	5	3.4	3.5	PB107	3.1
HCR 15A+60/150R	24	47	54.5	38	24	M5	38.8	10.3	11	4.5	5.5	PB1021B	4.8
HCR 15A+60/300R			55.5		28								
HCR 15A+60/400R			55.8		28								
HCR 25A+60/500R	36	70	81.6	57	45	M8	59.5	14.9	16	6	12	B-M6F	7
HCR 25A+60/750R			82.3										
HCR 25A+60/1000R			82.5										
HCR 35A+60/600R	48	100	107.2	82	58	M10	80.4	19.9	21	8	12	B-M6F	8.5
HCR 35A+60/800R			107.5										
HCR 35A+60/1000R			108.2										
HCR 35A+60/1300R			108.5										
HCR 45A+60/800R	60	120	136.7	100	70	M12	98	23.9	25	10	16	B-PT1/8	11.5
HCR 45A+60/1000R			137.3										
HCR 45A+60/1200R			137.3										
HCR 45A+60/1600R			138										
HCR 65A+60/1000R	90	170	193.8	142	106	M16	147	34.9	37	19	16	B-PT1/8	15
HCR 65A+60/1500R			195.4										
HCR 65A+45/2000R			195.9										
HCR 65A+45/2500R			196.5										
HCR 65A+30/3000R			196.5										

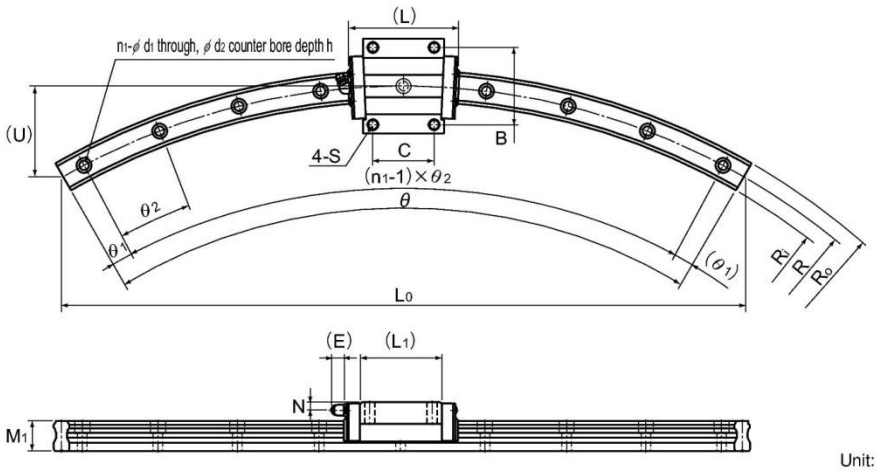
Model number coding

HCR25A 2 UU C1 +60 / 1000R H 6 T

- HCR25A: Model number
- 2: No. of LM blocks used on the same rail
- UU: Contamination protection accessory symbol (*1)
- C1: Radial clearance symbol (*2) — Normal (No symbol), Light preload (C1)
- +60: R-Guide center angle
- 1000R: LM rail radius (in mm)
- H: Accuracy symbol (*3) — Normal grade (No Symbol), High accuracy grade (H)
- 6: Number of LM rail joints used on one axis (*4)
- T: Symbol for LM rail jointed use

(*1) See **A1-510** (contamination protection accessories). (*2) See **A1-72**. (*3) See **A1-79**.
(*4) Number of LM rails used on one arc. For details, contact THK.

To download a desired data, search for the corresponding model number in the Technical site. https://tech.thk.com



Unit: mm

	LM rail dimensions													Basic load rating		Static permissible moment kN-m*					Mass	
						Width		Height						C	C_0	M_A		M_B		M_C	LM block	LM rail
	R	R_0	R_1	L_0	U	W_1	W_2	M_1	$d_1 \times d_2 \times h$	n_1	θ°	θ_1°	θ_2°	kN	kN	1 block	Double blocks	1 block	Double blocks	1 block	kg	kg/m
	100	106	94	100	13.4	12	13.5	11	3.5×6×5	3	60	7	23	4.7	8.53	0.0409	0.228	0.0409	0.228	0.0445	0.08	0.83
	150	157.5	142.5	150	20.1					3		7	23	6.66	10.8							
	300	307.5	292.5	300	40	15	16	15	4.5×7.5×5.3	5	60	6	12	8.33	13.5	0.0805	0.457	0.0805	0.457	0.0844	0.2	1.5
	400	407.5	392.5	400	54					7		3	9	8.33	13.5							
	500	511.5	488.5	500	67					9		2	7									
	750	761.5	738.5	750	100	23	23.5	22	7×11×9	12	60	2.5	5	19.9	34.4	0.307	1.71	0.307	1.71	0.344	0.59	3.3
	1000	1011.5	988.5	1000	134					15		2	4									
	600	617	583	600	80					7		3	9									
	800	817	783	800	107	34	33	29	9×14×12	11	60	2.5	5.5	37.3	61.1	0.782	3.93	0.782	3.93	0.905	1.6	6.6
	1000	1017	983	1000	134					12		2.5	5									
	1300	1317	1283	1300	174					17		2	3.5									
	800	822.5	777.5	800	107					8		2	8									
	1000	1022.5	977.5	1000	134	45	37.5	38	14×20×17	10	60	3	6	60	95.6	1.42	7.92	1.42	7.92	1.83	2.8	11.0
	1200	1222.5	1177.5	1200	161					12		2.5	5									
	1600	1622.5	1577.5	1600	214					15		2	4									
	1000	1031.5	968.5	1000	134					8	60	2	8									
	1500	1531.5	1468.5	1500	201					10	60	3	6									
	2000	2031.5	1968.5	1531	152	63	53.5	53	18×26×22	12	45	0.5	4	141	215	4.8	23.5	4.8	23.5	5.82	8.5	22.5
	2500	2531.5	2468.5	1913	190					13	45	1.5	3.5									
	3000	3031.5	2968.5	1553	102					10	30	1.5	3									

Note) LM rail radiuses other than the radiuses in the above table are also available. Contact THK for details.
The R-Guide center angles in the table are maximum manufacturing angles. To obtain angles greater than them, rails must be additionally connected. Contact THK for details.
Static permissible moment*: 1 block: static permissible moment value with 1 LM block
Double blocks: static permissible moment value with 2 blocks closely contacting with each other

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