

Bearing Handbook for Electric Motors



The world's best machinery is

SKF Equipped

Improve your product's performance with SKF® engineering and application knowledge, design and testing expertise, and a wide range of solutions.

Your customers are continually raising their expectations of product performance and reliability—demanding equipment that consumes less energy, runs quieter, faster and longer, and requires less maintenance. Frequently, this also means lighter, more compact designs.

To meet these growing challenges and stay competitive, you need a trusted source of knowledge and application experience to provide you with solutions that work.

And for long-term results, you need a working partner that offers one source of responsibility from concept to completion. That source is SKF.

Knowledgeable solutions

From a position as the world's leading bearing manufacturer, SKF has evolved to being a provider of cost-effective and knowledgeable solutions. You can take advantage of SKF knowledge through our proprietary services and software to shorten the time required to develop and test your product.

SKF knowledge-engineering services, for example, include life calculation analysis, dynamic systems modelling, and 3-dimensional virtual test rigs to simulate and troubleshoot system vibration. SKF product solutions go beyond bearings, housings and seals, to include complete lubrication systems, industry-leading condition monitoring systems, advanced linear and rotary actuation systems, and unique solutions in mechatronics—combining mechanical and electronic elements in a single design.

Get SKF Equipped

When your product is “SKF Equipped”, it tells your customers that your resources include the best in state-of-the-art technology, and that your products contain some of the very best components available on the market.



Contents

Bearing Installation Tips	2, 3
Speed Ratings	4, 5
6200 and 6300 Series	6, 7
N, NJ, NU 200 EC and 300 EC Series	8, 9
Shaft and Housing Diameters	
6200 Series	10
6300 Series	11
N, NJ, NU 200 EC Series	12
N, NJ, NU 300 EC Series	13
Shaft Shoulder Dimensions	
6200 Series	14
6300 Series	15
Minimum Radial Load	
N, NJ, NU 200 EC Series	16
N, NJ, NU 300 EC Series	17
Grease Relube Recommendations	
6200 Series	18
6300 Series	19
N, NJ, NU 200 EC Series	20
N, NJ, NU 300 EC Series	21
Vibration Frequencies	
6200 Series	22
6300 Series	23
N, NJ, NU 200 EC Series	24
N, NJ, NU 300 EC Series	25
ABMA-SKF Product Comparison	26, 27

Installation tips for maximum bearing operation

- 1. Handle with care.** Never pound directly on a bearing or ring. If a bearing is dropped, it is best not to install it. Store bearings horizontally in a dry place in their original unopened package and never place bearings on a dirty surface; periodically turn over sealed and shielded bearings to prevent grease from settling to one side.
- 2. Inspect the shaft and housing.** Check for size and damage; remove nicks and burrs with emery paper, and wipe clean with a soft cloth. Replace or repair shafts and housings showing obvious signs of wear or damage. A shaft placed in a vise for mounting should be protected from vise jaws with a sheet of soft metal.
- 3. Avoid overheating.** During heat-mounting operations, never bring a flame in direct contact with the bearing and never heat beyond 230°F. Also, immediately hold a heat-mounted bearing in place against the shaft shoulder until it cools and locks in place. Otherwise, the bearing may creep away from the proper position.
- 4. Use identical replacement bearings.** Replacement bearings should be identical to the bearings they replace. Contact an SKF Authorized Distributor or SKF for interchange information.
- 5. Use the right tool for the job.** Induction heaters, oil injection kits, and hydraulic nuts are among the specialized tools available for mounting and dismounting bearings over 4 in. O.D. Their use lowers the possibility of damaging bearings and speeds the process.
- 6. Pay attention to the bearing's press fit.** Use a press for any bearing under 4 in. O.D. Pressure should be applied only to the bearing ring with the press fit, which is usually the ring that rotates after the bearing is installed. Pressure to the ring without the press fit will damage the raceways.

7. **Don't wash new bearings.** Bearing manufacturers take great care to package and ship bearings that are dirt-free and ready for lubrication. There's usually no need to wash them or remove the protective slushing compound.

8. **Proper lube is critical.** Bearing manufacturers evaluate several factors before determining the type of lubricant required for specific bearings. Be sure to follow their recommendations. Temperature and contamination conditions will influence the frequency of lubrication changes.

9. **Rotate idle bearings.** Bearings installed in equipment that is subject to vibration while the shafts are stationary may incur false brinelling damage, which also occurs when equipment is not properly protected during shipment. It can appear as bright, polished depressions on the inner and/or outer races, as well as on the rolling elements.

10. **Look for danger signs.** Keep alert for three sure signs of improper bearing operation: excessive noise and increases in vibration and temperature. Troubleshooting instruments like hand-held vibration pens, digital thermometers, and electronic stethoscopes help spot bearings in poor operating condition.

11. **Find the cause of bearing failures.** Bearings are built to last, so frequent failures may point to an installation or lubrication problem. SKF bearing analysis experts can identify the cause of bearing failure and help you prevent it in the future.

12. The contact between the bearing ring and a properly machined and dimensioned bearing seat should not require the use of bonding agents to prevent movement or turning.

Speed ratings

There is a speed limit to which rolling bearings can be operated. Generally, it is the operating temperature that can be permitted with respect to the lubricant being used or to the material of the bearing components that sets the limit. The speed at which this limiting bearing temperature is reached depends on the frictional heat generated in the bearing (including any externally applied heat) and the amount of heat that can be transported away from the bearing.

Bearing type and size, internal design, load, lubrication and cooling conditions as well as cage design, accuracy and internal clearance all play a part in determining speed capability. In the accompanying tables two speeds are listed: (Thermal) Reference Speed and (Kinematic) Limiting Speed.

Warning: The new Reference and Limiting Speeds are not to be used as a direct substitution for the previous Oil and Grease speed ratings. Consult SKF to determine the actual reference speed limit for your operating conditions.

Reference speeds

The reference speed for a given bearing represents the permissible operating speed of said bearing when subjected to the specific operating conditions of load, lubrication type and method as outlined in ISO 15312. This standard has been established for oil lubrication but is also valid for grease and uses the following reference conditions:

- A temperature increase of 90° F (50° C) above an ambient temperature of 68° F (20° C), (thus a bearing temperature of 158° F (70° C), measured on the bearing stationary outer ring or housing washer.
- Radial bearing: a constant radial load, being 5% of the basic static load rating C_0 .
- Thrust bearing: a constant axial load, being 2% of the basic static load rating C_0 .
- Open bearings with Normal clearance.

For oil lubricated bearings:

- Lubricant: mineral oil without EP-additives having a kinematic viscosity at 158° F (70° C) of: $\nu = 12 \text{ mm}^2/\text{s}$ (ISO VG32) for radial bearings, and $\nu = 24 \text{ mm}^2/\text{s}$ (ISO VG68) for thrust roller bearings
- Oil bath with the oil reaching up to the middle of the rolling element in the lowest position.

For grease lubricated bearings:

- Regular lithium soap grease with mineral base oil having a viscosity of 100 to 200 mm^2/s at 104° F (40° C) (e.g. ISO VG 150).
- Filling approximately 30% of the free space in the bearing.

The reference speed will be reached after 10 to 20 hours running time. Under these specific conditions the reference speed for oil and grease lubrication will be equal.

Speeds above the reference speed

It is possible to operate bearings at speeds above the reference speed if the bearing friction can be reduced, for example by lubrication systems with small, accurately measured quantities of lubricant or when heat can be removed from the bearing by circulating oil lubrication with cooling of the oil, by cooling ribs on the housing, or by directed cooling air streams.

Any increase in speed above the reference speed without taking any of these precautions would only cause bearing temperature to rise excessively. An increase of bearing temperature means that lubricant viscosity is lowered and film formation is made more difficult, leading to even higher friction and further temperature increases. If, at the same time, the operational clearance in the bearing is reduced because of increased inner ring temperature, the final consequence would be bearing seizure.

Limiting speeds

The speed limit is determined by criteria that include: the stability and or strength of the cage, lubrication of cage guiding surfaces, centrifugal and gyroscopic forces acting on the rolling elements, and other speed-limiting factors. Experience gained from laboratory tests and practical applications indicates that there are maximum speeds that should not be exceeded for technical reasons or because of the very high costs involved.

Limiting Speeds shown in the tables are based on the demands of high speed running applications and are valid only for the specific design and cage design shown in the tables. It is possible to run bearings faster than the limiting speeds, but several factors must be reviewed and improved such as the running accuracy, cage material, lubrication, heat dissipation and design of the bearing. It is therefore advisable to contact SKF Applications Engineering for advice. For enclosed and open bearings using grease lubrication, additional parameters have to be considered such as lubrication of cage guiding surfaces and the shear strength of the lubricant, which is determined by the base oil and thickener.

Open balls bearings with low friction typically have Reference Speeds greater than the Limiting Speed. In these cases the permissible speed must be calculated from the operating conditions and the lower value between the permissible and Limiting speed used.

Speed ratings (RPM)

Deep groove ball bearings
6200 & 6300 series

Bearing	double sealed limiting r/min	double shielded limiting r/min	open limiting r/min	reference speed r/min
6200	17,000	28,000	34,000	56,000
6201	15,000	26,000	32,000	50,000
6202	13,000	22,000	28,000	43,000
6203	12,000	19,000	24,000	38,000
6204	10,000	17,000	20,000	32,000
6205	8,500	14,000	18,000	28,000
6206	7,500	12,000	15,000	24,000
6207	6,300	10,000	13,000	20,000
6208	5,600	9,000	11,000	18,000
6209	5,000	8,500	11,000	17,000
6210	4,800	8,000	10,000	15,000
6211	4,300	7,000	9,000	14,000
6212	4,000	6,300	8,000	13,000
6213	3,600	6,000	7,500	12,000
6214	3,400	5,600	7,000	11,000
6215	3,200	5,300	6,700	10,000
6216	3,000	4,800	6,000	9,500
6217	2,800	4,500	5,600	9,000
6218	2,600	4,300	5,300	8,500
6219	2,400	4,000	5,000	8,000
6220	2,400	3,800	4,800	7,500
6221	2,200	3,600	4,500	7,000
6222	–	3,400	4,300	6,700
6224	–	3,200	4,000	6,300
6226	–	3,000	3,600	5,600
6228	–	–	3,400	5,300
6230	–	–	3,200	5,000
6232	–	–	3,000	4,500
6234	–	–	3,800	4,300
6236	–	–	3,600	4,000
6238	–	–	3,400	3,800
6240	–	–	3,200	3,600

Warning: The new reference and limiting speeds are not to be used as a direct substitution for the previous oil and grease speed ratings. See page 4/5 or contact SKF Applications Engineering.

Speed Ratings (RPM)

Deep groove ball bearings
6200 & 6300 series

Bearing	double sealed limiting r/min	double shielded limiting r/min	open limiting r/min	reference speed r/min
6300	15,000	26,000	32,000	50,000
6301	14,000	22,000	28,000	45,000
6302	12,000	19,000	24,000	38,000
6303	11,000	17,000	22,000	34,000
6304	9,500	15,000	19,000	30,000
6305	7,500	13,000	16,000	24,000
6306	6,300	11,000	13,000	20,000
6307	6,000	9,500	12,000	19,000
6308	5,000	8,500	11,000	17,000
6309	4,500	7,500	9,500	15,000
6310	4,300	6,700	8,500	13,000
6311	3,800	6,300	8,000	12,000
6312	3,400	5,600	7,000	11,000
6313	3,200	5,300	6,700	10,000
6314	3,000	5,000	6,300	9,500
6315	2,800	4,500	5,600	9,000
6316	2,600	4,300	5,300	8,500
6317	2,400	4,000	5,000	8,000
6318	2,400	3,800	4,800	7,500
6319	2,200	3,600	4,500	7,000
6320	–	3,400	4,300	6,700
6321	–	3,200	4,000	6,300
6322	–	3,000	3,800	6,000
6324	–	–	3,400	5,600
6326	–	–	3,200	5,000
6328	–	–	4,300	4,800
6330	–	–	4,000	4,300
6332	–	–	3,800	4,000
6334	–	–	3,400	3,800
6336	–	–	3,200	3,600
6338	–	–	3,000	3,400

Note: Low-friction seals (2RZ, 2RSL) and double shielded bearings use same speed ratings. Single enclosure (Z, RSL, RZ) and open bearings use the same speed ratings.

Speed ratings (RPM)

Cylindrical roller bearings

N, NJ, NU 200 EC series

Bearing	reference speed r/min	limiting speed r/min
202 EC	22,000	26,000
203 EC	19,000	22,000
204 EC	16,000	19,000
205 EC	14,000	16,000
206 EC	13,000	14,000
207 EC	11,000	12,000
208 EC	9,500	11,000
209 EC	9,000	9,500
210 EC	8,500	9,000
211 EC	7,500	8,000
212 EC	6,700	7,500
213 EC	6,300	6,700
214 EC	6,000	6,300
215 EC	5,600	6,000
216 EC	5,300	5,600
217 EC	4,800	5,300
218 EC	4,500	5,000
219 EC	4,300	4,800
220 EC	4,000	4,500
221 EC	3,800	4,300
222 EC	3,600	4,000
224 EC	3,400	3,600
226 EC	3,200	3,400
228 EC	2,800	3,200
230 EC	2,600	2,800
232 EC	2,400	2,600
234 EC	2,400	2,400
236 ECMA	2,200	3,200
238 ECMA	2,000	3,000
240 ECMA	1,900	2,800

Warning: The new reference and limiting speeds are not to be used as a direct substitution for the previous oil and grease speed ratings. See page 4/5 or contact SKF Applications Engineering.

Speed ratings (RPM)

Cylindrical roller bearings

N, NJ, NU 300 EC series

Bearing	reference speed r/min	limiting speed r/min
303 EC	15,000	20,000
304 EC	15,000	18,000
305 EC	12,000	15,000
306 EC	11,000	12,000
307 EC	9,500	11,000
308 EC	8,000	9,500
309 EC	7,500	8,500
310 EC	6,700	8,000
311 EC	6,000	7,000
312 EC	5,600	6,700
313 EC	5,300	6,000
314 EC	4,800	5,600
315 EC	4,500	5,300
316 EC	4,300	5,000
317 EC	4,000	4,800
318 EC	3,800	4,500
319 EC	3,600	4,300
320 EC	3,200	3,800
321 EC	3,200	3,800
322 EC	3,000	3,400
324 EC	2,800	3,200
326 EC	2,400	3,000
328 EC	2,400	2,800
330 EC	2,200	3,400
332 EC	2,000	2,400
334 EC	1,700	2,200
336 EC	1,600	2,200
338 EC	1,500	2,000
340 ECMA	1,400	2,400

Shaft and housing diameters

Deep groove ball bearings

6200 series

Bearing	bearing bore diameter (mm)	shaft diameter (in.)		bearing outside diameter (mm)	housing diameter (in.)	
		max.	min.		max.	min.
6200	10	0.3939	0.3936	30	1.1816	1.1811
6201	12	0.4726	0.4723	32	1.2604	1.2598
6202	15	0.5908	0.5905	35	1.3786	1.3780
6203	17	0.6695	0.6692	40	1.5754	1.5748
6204	20	0.7878	0.7875	47	1.8510	1.8504
6205	25	0.9847	0.9844	52	2.0479	2.0472
6206	30	1.1815	1.1812	62	2.4416	2.4409
6207	35	1.3785	1.3781	72	2.8353	2.8346
6208	40	1.5753	1.5749	80	3.1503	3.1496
6209	45	1.7722	1.7718	85	3.3474	3.3465
6210	50	1.9690	1.9686	90	3.5442	3.5433
6211	55	2.1660	2.1655	100	3.9379	3.9370
6212	60	2.3628	2.3623	110	4.3316	4.3307
6213	65	2.5597	2.5592	120	4.7253	4.7244
6214	70	2.7565	2.7560	125	4.9223	4.9213
6215	75	2.9534	2.9529	130	5.1191	5.1181
6216	80	3.1502	3.1497	140	5.5128	5.5118
6217	85	3.3472	3.3466	150	5.9065	5.9055
6218	90	3.5440	3.5434	160	6.3002	6.2992
6219	95	3.7409	3.7403	170	6.6939	6.6929
6220	100	3.9377	3.9371	180	7.0876	7.0866
6221	105	4.1350	4.1344	190	7.4814	7.4803
6222	110	4.3318	4.3312	200	7.8751	7.8740
6224	120	4.7255	4.7249	215	8.4657	8.4646
6226	130	5.1194	5.1187	230	9.0562	9.0551
6228	140	5.5131	5.5124	250	9.8436	9.8425
6230	150	5.9071	5.9061	270	10.6312	10.6299
6232	160	6.3012	6.3003	290	11.4186	11.4173
6234	170	6.6949	6.6940	310	12.2060	12.2047
6236	180	7.0886	7.0877	320	12.5998	12.5984
6238	190	7.4827	7.4815	340	13.3872	13.3858
6240	200	7.8764	7.8752	360	14.1746	14.1732

Note: Diameters shown are based on normal loads, operating temperatures, and current industry fitting practices. See SKF Bearing Installation and Maintenance Guide (#140-710) for specific tolerance classes and corresponding fits.

Shaft and housing diameters

Deep groove ball bearings

6300 series

Bearing	bearing bore diameter (mm)	shaft diameter (in.)		bearing outside diameter (mm)	housing diameter (in.)	
		max.	min.		max.	min.
6300	10	0.3939	0.3936	35	1.3786	1.3780
6301	12	0.4726	0.4723	37	1.4573	1.4567
6302	15	0.5908	0.5905	42	1.6541	1.6535
6303	17	0.6695	0.6692	47	1.8510	1.8504
6304	20	0.7878	0.7875	52	2.0472	2.0479
6305	25	0.9847	0.9844	62	2.4416	2.4409
6306	30	1.1815	1.1812	72	2.8353	2.8346
6307	35	1.3785	1.3781	80	3.1503	3.1496
6308	40	1.5753	1.5749	90	3.5442	3.5433
6309	45	1.7722	1.7718	100	3.9379	3.9370
6310	50	1.9690	1.9686	110	4.3316	4.3307
6311	55	2.1660	2.1655	120	4.7253	4.7244
6312	60	2.3628	2.3623	130	5.1191	5.1181
6313	65	2.5597	2.5592	140	5.5128	5.5118
6314	70	2.7565	2.7560	150	5.9065	5.9055
6315	75	2.9534	2.9529	160	6.3002	6.2992
6316	80	3.1502	3.1497	170	6.6939	6.6929
6317	85	3.3472	3.3466	180	7.0876	7.0866
6318	90	3.5440	3.5434	190	7.4814	7.4803
6319	95	3.7409	3.7403	200	7.8751	7.8740
6320	100	3.9377	3.9371	215	8.4657	8.4646
6321	105	4.1350	4.1344	225	8.8594	8.8583
6322	110	4.3318	4.3312	240	9.4499	9.4488
6324	120	4.7255	4.7249	260	10.2375	10.2362
6326	130	5.1194	5.1187	360	11.0249	11.0236
6328	140	5.5131	5.5124	300	11.8123	11.8110
6330	150	5.9071	5.9061	320	12.5998	12.5984
6332	160	6.3012	6.3003	340	13.3872	13.3858
6334	170	6.6949	6.6940	360	14.1746	14.1732
6336	180	7.0886	7.0877	380	14.9620	14.9606
6338	190	7.4827	7.4815	400	15.7494	15.7480
6340	200	7.8764	7.8752	420	16.5370	16.5354

Note: Diameters shown are based on normal loads, operating temperatures, and current industry fitting practices. See SKF Bearing Installation and Maintenance Guide (#140-710) for specific tolerance classes and corresponding fits.

Shaft and housing diameters

Cylindrical roller bearings

N, NJ, NU 200 EC series

Bearing	bearing bore diameter (mm)	shaft diameter (in.)		bearing outside diameter (mm)	housing diameter (in.)	
		max.	min.		max.	min.
202	15	0.5910	0.5906	35	1.3786	1.3780
203	17	0.6697	0.6693	40	1.5754	1.5748
204	20	0.7878	0.7875	47	1.8510	1.8504
205	25	0.9847	0.9844	52	2.0479	2.0472
206	30	1.1815	1.1812	55	2.4416	2.4409
207	35	1.3785	1.3781	72	2.8353	2.8346
208	40	1.5753	1.5749	80	3.1503	3.1496
209	47	1.7725	1.7721	85	3.3474	3.3465
210	50	1.9693	1.9689	90	3.5442	3.5433
211	55	2.1664	2.1659	100	3.9379	3.9370
212	60	2.3632	2.3627	110	4.3316	4.3307
213	65	2.5601	2.5596	120	4.7253	4.7244
214	70	2.7569	2.7564	125	4.9223	4.9213
215	75	2.9538	2.9533	130	5.1191	5.1181
216	80	3.1506	3.1501	140	5.5128	5.5118
217	85	3.3476	3.3470	150	5.9065	5.9055
218	90	3.5444	3.5438	160	6.3002	6.2992
219	95	3.7413	3.7407	170	6.6939	6.6929
220	100	3.9381	3.9375	180	7.0876	7.0866
221	105	4.1353	4.1344	190	7.4814	7.4803
222	110	4.3321	4.3312	200	7.8751	7.8740
224	120	4.7258	4.7249	215	8.4657	8.4646
226	130	5.1197	5.1187	230	9.0562	9.0551
228	140	5.5134	5.5124	250	9.8436	9.8425
230	150	5.9075	5.9066	270	10.6312	10.6299
232	160	6.3012	6.3003	290	11.4186	11.4173
234	170	6.6949	6.6940	310	12.2060	12.2047
236	180	7.0886	7.0877	320	12.5998	12.5984
238	190	7.4827	7.4815	340	13.3872	13.3858
240	200	7.8764	7.8752	360	14.1746	14.1732

Note: Diameters shown are based on normal loads, operating temperatures, and current industry fitting practices. See SKF Bearing Installation and Maintenance Guide (#140-710) for specific tolerance classes and corresponding fits.

Shaft and housing diameters

Cylindrical roller bearings

N, NJ, NU 300 EC series

Bearing	bearing bore diameter (mm)	shaft diameter (in.)		bearing outside diameter (mm)	housing diameter (in.)	
		max.	min.		max.	min.
302	15	0.5910	0.5906	42	1.6541	1.6535
303	17	0.6697	0.6693	47	1.8510	1.8504
304	20	0.7878	0.7875	52	2.0479	2.0472
305	25	0.9847	0.9844	62	2.4416	2.4409
306	30	1.1815	1.1812	72	2.8353	2.8346
307	35	1.3785	1.3781	80	3.1503	3.1496
308	40	1.5753	1.5749	90	3.5442	3.5433
309	45	1.7725	1.7721	100	3.9379	3.9370
310	50	1.9693	1.9689	110	4.3316	4.3307
311	55	2.1664	2.1659	120	4.7253	4.7244
312	60	2.3632	2.3627	130	5.1191	5.1181
313	65	2.5601	2.5596	140	5.5128	5.5118
314	70	2.7569	2.7564	150	5.9065	5.9055
315	75	2.9538	2.9533	160	6.3002	6.2992
316	80	3.1506	3.1501	170	6.6939	6.6929
317	85	3.3476	3.3470	180	7.0876	7.0866
318	90	3.5444	3.5438	190	7.4814	7.4803
319	95	3.7413	3.7407	200	7.8751	7.8740
320	100	3.9381	3.9375	215	8.4657	8.4646
321	105	4.1353	4.1344	225	8.8594	8.8583
322	110	4.3321	4.3312	240	9.4499	9.4488
324	120	4.7258	4.7249	260	10.2375	10.2362
326	130	5.1197	5.1187	280	11.0249	11.0236
328	140	5.5134	5.5124	300	11.8123	11.8110
330	150	5.9075	5.9066	320	12.5998	12.5984
332	160	6.3012	6.3003	340	13.3872	13.3858
334	170	6.6949	6.6940	360	14.1746	14.1732
336	180	7.0886	7.0877	380	14.9620	14.9606
338	190	7.4827	7.4815	400	15.7494	15.7480
340	200	7.8764	7.8752	420	16.5370	16.5354

Note: Diameters shown are based on normal loads, operating temperatures, and current industry fitting practices. See SKF Bearing Installation and Maintenance Guide (#140-710) for specific tolerance classes and corresponding fits.

Shoulder dimensions for shafts and housings

Deep groove ball bearings

6200 series

Bearing	d mm	shaft shoulder		D mm	housing shoulder		shaft & housing corner max. in
		d _a min. in	d _a max. in		D _a max. in	D _a min in	
6200	10	0.551	0.571	30	1.024	0.984	0.024
6201	12	0.630	0.650	32	1.102	1.062	0.024
6202	15	0.748	0.768	35	1.220	1.180	0.024
6203	17	0.827	0.847	40	1.417	1.377	0.024
6204	20	0.984	1.004	47	1.654	1.614	0.039
6205	25	1.181	1.201	52	1.850	1.810	0.039
6206	30	1.378	1.398	62	2.244	2.204	0.039
6207	35	1.634	1.654	72	2.579	2.539	0.039
6208	40	1.831	1.851	80	2.894	2.854	0.039
6209	45	2.028	2.048	85	3.091	3.051	0.039
6210	50	2.224	2.244	90	3.287	3.247	0.039
6211	55	2.480	2.500	100	3.622	3.582	0.059
6212	60	2.677	2.697	110	4.016	3.976	0.059
6213	65	2.874	2.894	120	4.409	4.369	0.059
6214	70	3.071	3.091	125	4.606	4.566	0.059
6215	75	3.268	3.288	130	4.803	4.763	0.059
6216	80	3.504	3.524	140	5.157	5.117	0.079
6217	85	3.701	3.721	150	5.551	5.511	0.079
6218	90	3.898	3.918	160	5.945	5.905	0.079
6219	95	4.173	4.193	170	6.260	6.220	0.079
6220	100	4.370	4.410	180	6.654	6.574	0.079
6221	105	4.567	4.607	190	7.047	6.967	0.079
6222	110	4.764	4.804	200	7.441	7.361	0.079
6224	120	5.157	5.197	215	8.031	7.951	0.079
6226	130	5.630	5.670	230	8.543	8.463	0.098
6228	140	6.024	6.064	250	9.331	9.251	0.098
6230	150	6.417	6.457	270	10.118	10.038	0.098
6232	160	6.811	6.851	290	10.906	10.826	0.098
6234	170	7.323	7.363	310	11.575	11.695	0.118
6236	180	7.717	7.757	320	11.969	11.889	0.118
6238	190	8.110	8.150	340	12.756	12.676	0.118
6240	200	8.504	8.544	360	13.543	13.463	0.118

Shoulder dimensions for shafts and housings

Deep groove ball bearings

6300 series

Bearing	d mm	shaft shoulder		D mm	housing shoulder		shaft & housing corner
		d _a min. in	d _a max. in		D _a max. in	D _a min in	max. in
6300	10	0.551	0.571	35	1.220	1.180	0.024
6301	12	0.669	0.689	37	1.260	1.220	0.039
6302	15	0.787	0.807	42	1.457	1.417	0.039
6303	17	0.866	0.886	47	1.654	1.614	0.039
6304	20	1.043	1.063	52	1.791	1.751	0.039
6305	25	1.240	1.260	62	2.185	2.135	0.039
6306	30	1.437	1.457	72	2.579	2.539	0.039
6307	35	1.693	1.713	82	2.835	2.795	0.059
6308	40	1.890	1.910	90	3.228	3.188	0.059
6309	45	2.087	2.107	100	3.622	3.582	0.059
6310	50	2.323	2.343	110	3.976	3.936	0.079
6311	55	2.520	2.540	120	4.370	4.330	0.079
6312	60	2.795	2.815	130	4.685	4.645	0.079
6313	65	2.992	3.012	140	5.079	5.039	0.079
6314	70	3.189	3.209	150	5.472	5.432	0.079
6315	75	3.386	3.406	160	5.866	5.826	0.079
6316	80	3.583	3.603	170	6.260	6.220	0.079
6317	85	3.858	3.868	180	6.575	6.495	0.098
6318	90	4.055	4.075	190	6.969	6.889	0.098
6319	95	4.252	4.272	200	7.362	7.282	0.098
6320	100	4.449	4.489	215	7.953	7.873	0.098
6321	105	4.646	4.686	225	8.346	8.266	0.098
6322	110	4.843	4.883	240	8.937	8.857	0.098
6324	120	5.236	5.276	260	9.724	9.644	0.098
6326	130	5.748	5.788	280	10.394	10.314	0.118
6328	140	6.142	6.182	300	11.181	11.101	0.118
6330	150	6.535	6.575	320	11.969	11.889	0.118
6332	160	6.929	6.969	340	12.756	12.676	0.118
6334	170	7.323	7.363	360	13.543	13.463	0.118
6336	180	7.717	7.757	380	14.331	14.251	0.118
6338	190	8.268	8.308	400	14.961	14.881	0.157
6340	200	8.661	8.701	420	15.748	15.668	0.157

Minimum radial load requirements
Cylindrical roller bearings
200 EC series

Bearing	minimum radial load required @		
	900 rpm	1800 rpm	3600 rpm
204	24 lb.	25 lb.	27 lb.
205	32	33	36
206	45	48	52
207	62	65	72
208	76	83	93
209	92	99	112
210	108	116	131
211	132	143	164
212	160	174	202
213	183	211	248
214	204	235	280
215	225	261	310
216	261	307	368
217	299	355	429
218	339	405	494
219	383	463	568
220	429	522	648
221	514	588	735
222	572	658	
224	681	796	
226	797	938	
228	948	1126	
230	1117	1340	
232	1305	1585	
234	1485	1803	
236	1646	2025	
238	1872	2321	
240	2117	2646	

Note: Minimum radial loads are necessary for satisfactory rolling bearing operation. This is particularly true for roller bearings running at high speeds, where inertia forces and friction from the lubricant may cause damaging sliding—rather than rolling—movements between the rollers and raceways.

Minimum radial load requirements
Cylindrical roller bearings
300 EC series

Bearing	minimum radial load required @		
	900 rpm	1800 rpm	3600 rpm
304	28 lb.	29 lb.	31 lb.
305	41	43	46
306	56	59	65
307	72	76	84
308	79	84	95
309	115	124	141
310	143	156	182
311	197	216	254
312	216	239	285
313	240	266	320
314	280	314	382
315	322	364	448
316	367	417	517
317	415	475	593
318	467	537	678
319	524	606	
320	603	704	
321	670	788	
322	764	907	
324	914	1097	
326	1084	1316	
328	1248	1515	
330	1454	1790	
332	1688	2110	
334	1924	2426	
336	2117	2646	
338	2468		
340	2676		

Note: Minimum radial loads are necessary for satisfactory rolling bearing operation. This is particularly true for roller bearings running at high speeds, where inertia forces and friction from the lubricant may cause damaging sliding—rather than rolling—movements between the rollers and raceways.

Grease relube recommendation
 Deep groove ball bearings
 6200 series

Bearing	quantity	interval @		
		900 rpm	1800 rpm	3600 rpm
6204	.10 oz.	20,000 hr	14,000 hr	12,200 hr
6205	.12 oz.	19,100	13,500	9,000
6206	.15 oz.	18,200	13,000	8,000
6207	.19 oz.	17,300	12,500	7,000
6208	.23 oz.	16,500	12,000	6,500
6209	.25 oz.	16,400	11,500	5,900
6210	.28 oz.	16,250	11,200	5,300
6211	.33 oz.	16,150	10,500	4,600
6212	.38 oz.	16,000	10,000	4,000
6213	.43 oz.	15,600	9,600	3,200
6214	.47 oz.	15,200	9,200	2,600
6215	.50 oz.	14,800	8,800	2,000
6216	.55 oz.	14,500	8,500	1,500
6217	.65 oz.	14,400	8,250	1,200
6218	.74 oz.	14,250	8,000	900
6219	.84 oz.	14,100	7,750	650
6220	.95 oz.	14,000	7,500	

Note: The relubrication intervals shown are based on a good quality lithium based grease at a maximum temperature of 160°F. Reduce the interval by half for each 27°F above 160°F, or for vertical applications. (High temperature greases, like polyurea, can operate for longer periods of time than those listed above.) Lubricate more often in applications where there is a risk of heavy solid and chemical contamination. Consult manufacturer or SKF application engineering for details.

LGHP 2 ball and roller bearing grease

LGHP 2 is a polyurea-based grease designed for use in electric motors. Unlike many polyurea-based greases, which are inherently noisy during operation, LGHP 2 meets strict SKF noise requirements. Each batch is blended and selected for consistency and adherence to quietness standards. The grease is also recommended for applications where long life is required.

With LGHP 2, users can often avoid compatibility problems when relubricating bearings. LGHP 2 is the factory fill grease used in SKF bearings under the designation GXN.

Grease relube recommendation
 Deep groove ball bearings
 6300 series

Bearing	quantity	interval @		
		900 rpm	1800 rpm	3600 rpm
6304	.12 oz.	20,000 hr	14,000 hr	12,200 hr
6305	.16 oz.	19,100	13,500	9,000
6306	.21 oz.	18,200	13,000	8,000
6307	.26 oz.	17,300	12,500	7,000
6308	.32 oz.	16,500	12,000	6,500
6309	.39 oz.	16,400	11,500	5,900
6310	.46 oz.	16,250	11,200	5,300
6311	.54 oz.	16,150	10,500	4,600
6312	.63 oz.	16,000	10,000	4,000
6313	.72 oz.	15,600	9,600	3,200
6314	.81 oz.	15,200	9,200	2,600
6315	.92 oz.	14,800	8,800	2,000
6316	1.03 oz.	14,500	8,500	1,500
6317	1.14 oz.	14,400	8,250	1,200
6318	1.26 oz.	14,250	8,000	
6319	1.40 oz.	14,100	7,750	
6320	1.57 oz.	14,000	7,500	

Note: The relubrication intervals shown are based on a good quality lithium based grease at a maximum temperature of 160°F. Reduce the interval by half for each 27°F above 160°F, or for vertical applications. (High temperature greases, like polyurea, can operate for longer periods of time than those listed above.) Lubricate more often in applications where there is a risk of heavy solid and chemical contamination. Consult manufacturer or SKF application engineering for details.

Grease relube recommendation

Cylindrical roller bearings

N, NJ, NU 200 EC series

Bearing	quantity	interval @		
		900 rpm	1800 rpm	3600 rpm
204	.10 oz.	15,000 hr	10,000 hr	5,000 hr
205	.12 oz.	14,500	9,500	4,500
206	.15 oz.	14,000	9,000	4,000
207	.19 oz.	13,500	8,500	3,500
208	.23 oz.	13,000	8,000	3,000
209	.25 oz.	12,500	7,500	2,700
210	.28 oz.	12,000	7,000	2,400
211	.33 oz.	11,500	6,500	2,100
212	.38 oz.	11,000	6,000	1,700
213	.43 oz.	10,750	5,500	1,400
214	.47 oz.	10,500	5,000	900
215	.50 oz.	10,250	4,500	800
216	.55 oz.	10,000	4,000	700
217	.65 oz.	9,500	3,500	500
218	.74 oz.	9,000	3,000	200
219	.84 oz.	8,500	2,500	
220	.95 oz.	8,000	2,100	

Note: The relubrication intervals shown are based on a good quality lithium based grease at a maximum temperature of 160°F. Reduce the interval by half for each 27°F above 160°F, or for vertical applications. (High temperature greases, can operate for longer periods of time than those listed above.) Lubricate more often in applications where there is a risk of heavy solid and chemical contamination. Consult manufacturer or SKF application engineering for details.

Grease relube recommendation

Cylindrical roller bearings

N, NJ, NU 300 EC series

Bearing	quantity	interval @		
		900 rpm	1800 rpm	3600 rpm
304	.12 oz.	15,000 hr	10,000 hr	5,000 hr
305	.16 oz.	14,500	9,500	4,500
306	.21 oz.	14,000	9,000	4,000
307	.26 oz.	13,500	8,500	3,500
308	.32 oz.	13,000	8,000	3,000
309	.39 oz.	12,500	7,500	2,700
310	.46 oz.	12,000	7,000	2,400
311	.54 oz.	11,500	6,500	2,100
312	.63 oz.	11,000	6,000	1,700
313	.72 oz.	10,750	5,500	1,400
314	.81 oz.	10,500	5,000	900
315	.92 oz.	10,250	4,500	
316	1.03 oz.	10,000	4,000	
317	1.14 oz.	9,500	3,500	
318	1.26 oz.	9,000	3,000	
319	1.40 oz.	8,500	2,500	
320	1.57 oz.	8,000	2,100	

Note: The relubrication intervals shown are based on a good quality lithium based grease at a maximum temperature of 160°F. Reduce the interval by half for each 27°F above 160°F, or for vertical applications. (High temperature greases, can operate for longer periods of time than those listed above.) Lubricate more often in applications where there is a risk of heavy solid and chemical contamination. Consult manufacturer or SKF application engineering for details.

SKF vibration data @ 1000 rpm inner ring rotation
 Deep groove ball bearings
 6200 series

Bearing	inner ring defect freq.(Hz)	outer ring defect freq.(Hz)	cage train freq.(Hz)	ball defect freq.(Hz)
6200	82.540	50.793	6.349	66.030
6201	74.242	42.424	6.061	56.566
6202	82.502	50.831	6.354	66.208
6203	82.449	50.884	6.361	66.456
6204	82.464	50.870	6.359	66.388
6205	90.250	59.750	6.639	78.580
6206	90.530	59.470	6.608	77.039
MRC 6206*	81.429	51.904	6.488	71.575
6207	90.578	59.422	6.602	76.782
MRC 6207*	81.503	51.831	6.479	71.183
6208	90.379	59.621	6.625	77.863
6209	99.106	67.560	6.756	84.900
MRC 6209*	90.633	59.367	6.596	76.488
6210	98.452	68.214	6.821	88.840
6211	98.697	67.970	6.797	87.330
6212	98.119	68.548	6.855	90.980
6213	107.348	75.986	6.908	94.577
MRC 6213*	98.733	67.934	6.793	87.111
6214	107.338	75.995	6.909	94.637
MRC 6214*	98.259	68.408	6.841	90.069
6215	107.284	76.049	6.914	94.986
MRC 6215*	98.334	68.333	6.833	89.590
6216	115.633	84.367	7.031	104.007
MRC 6216	98.367	68.300	6.830	89.381
6217	107.082	76.251	6.932	96.304
MRC 6217	97.970	68.696	6.870	91.962
6218	107.345	75.988	6.908	94.594
6219	98.309	68.357	6.836	89.745
6220	98.452	68.214	6.821	88.840
6221	98.581	68.086	6.809	88.040
6222	98.696	67.970	6.797	87.333
6224	88.505	61.495	6.833	89.555
6226	88.229	61.771	6.863	91.548
6228	96.902	69.765	6.976	99.649
6230	105.526	77.808	7.073	107.716
6232	114.111	85.889	7.157	115.758

*Old design; no longer produced

SKF vibration data @ 1000 rpm inner ring rotation
 Deep groove ball bearings
 6300 series

Bearing	inner ring defect freq.(Hz)	outer ring defect freq.(Hz)	cage train freq.(Hz)	ball defect freq.(Hz)
6300	66.081	33.919	5.653	46.460
6301	66.204	33.796	5.633	46.026
6302	74.472	42.195	6.028	55.633
6303	74.247	42.419	6.060	56.545
6304	73.767	42.899	6.128	58.582
6305	73.755	42.912	6.130	58.637
6306	82.440	50.894	6.362	66.500
6307	82.307	51.026	6.378	67.130
MRC 6307*	73.632	43.035	6.148	59.179
6308	82.134	51.199	6.400	67.967
6309	82.722	50.611	6.326	65.192
MRC 6309*	73.025	43.641	6.234	61.976
6310	82.542	50.792	6.349	66.023
6311	82.391	50.942	6.368	66.731
6312	82.267	51.067	6.383	67.325
6313	82.153	51.180	6.389	67.877
6314	82.061	51.273	6.409	68.330
6315	81.980	51.353	6.419	68.729
6316	81.909	51.424	6.428	69.084
6317	81.842	51.492	6.436	69.427
6318	81.786	51.548	6.443	69.711
6319	81.736	51.598	6.450	69.968
6320	82.121	51.213	6.402	68.035
6321	82.061	51.273	6.409	68.330
6322	82.392	50.941	6.368	66.724
6324	81.151	52.182	6.523	73.091
6326	81.122	52.211	6.526	73.252
6328	81.100	52.233	6.529	73.374
6330	90.201	59.799	6.644	78.853

*Old design; no longer produced

SKF vibration data @ 1000 rpm inner ring rotation
 Cylindrical roller bearings
N, NJ, NU 200 EC series

Bearing	inner ring defect freq.(Hz)	outer ring defect freq.(Hz)	cage train freq.(Hz)	roller defect freq.(Hz)
202	111.996	71.337	6.485	71.455
203	112.500	70.833	6.439	69.545
204	111.887	71.446	6.495	71.879
205	129.167	87.500	6.731	83.462
206	129.301	87.366	6.720	82.885
207	138.272	95.062	6.790	86.914
208	137.879	95.455	6.818	88.636
209	145.992	104.008	6.934	96.443
210	154.137	112.530	7.033	104.218
211	163.462	119.872	7.051	105.769
212	155.039	111.628	6.977	99.668
213	154.724	111.943	6.996	101.215
214	163.240	120.093	7.064	106.906
215	171.739	128.261	7.126	112.585
216	171.563	128.437	7.135	113.542
217	163.186	120.148	7.068	107.191
218	163.029	120.304	7.077	108.013
219	163.951	119.382	7.022	103.331
220	163.771	119.563	7.033	104.218
222	163.392	119.941	7.055	106.125
224	163.397	119.936	7.055	106.097
226	163.522	119.812	7.048	105.465
228	180.838	135.829	7.149	114.893
230	180.739	136.928	7.154	115.419
232	180.653	136.013	7.159	115.880

SKF vibration data @ 1000 rpm inner ring rotation

Cylindrical roller bearings

N, NJ, NU 300 EC series

Bearing	inner ring defect freq.(Hz)	outer ring defect freq.(Hz)	cage train freq.(Hz)	roller defect freq.(Hz)
302	94.737	55.263	6.140	58.947
303	104.037	62.629	6.263	62.943
304	103.881	62.785	6.279	63.483
305	112.500	70.833	6.439	69.545
306	121.359	78.641	6.553	74.470
307	120.619	79.381	6.615	77.397
308	121.212	78.788	6.566	75.036
309	130.442	86.224	6.633	78.265
310	129.733	86.934	6.687	81.083
311	130.367	86.299	6.638	78.555
312	129.774	86.892	6.684	80.912
313	130.314	86.353	6.643	78.761
314	129.805	86.862	6.682	80.788
315	130.182	86.485	6.653	79.278
316	129.828	86.839	6.680	80.693
317	139.303	94.030	6.716	82.664
318	129.770	86.896	6.684	80.928
319	138.517	94.816	6.773	85.867
320	130.068	86.599	6.661	79.729
322	139.077	94.256	6.733	83.563
324	129.774	86.892	6.684	80.912
326	139.211	94.122	6.723	83.029
328	138.739	94.595	6.757	84.942
330	138.725	94.608	6.758	84.997
332	138.889	94.444	6.746	84.325

ABMA→SKF

Product number comparison

90	BC	03	J	PP	N	3	0	X	
1	2	3	4	5	6	7	8	9	10

6	3	18	2Z	N			C3		G/JN
2	3	1	5	6	4	8	7	10	9

symbols		
ABMA	SKF	description
1. Bore diameter		
90	XX18	ABMA/5 = SKF exc. 17 = XX03 15 = XX02 12 = XX01 10 = XX00
2. Bearing type		
BC BL BN BA BT	6XXX XXX 7XXX CD 7XXX CC 7XXX ACD 7XXX B	Conrad maximum capacity angular contact (15°) angular contact (12°) angular contact (25°) angular contact (40°)
3. Dimension series		
00 02 03 04	X0XX X2XX X3XX X4XX	extra light light medium heavy
4. Cage type		
X J Y, K M	- J Y M	any type pressed steel pressed brass machined brass
5. Seals/shields or duplex mounting		
X P E RR UU TT	- Z RS,RS1,RSH DB DF DT	<i>character separator</i> (PP ' 2Z, two shields) (EE ' 2RS, two seals) duplex back-to-back duplex face-to-face duplex tandem

ABMA→SKF

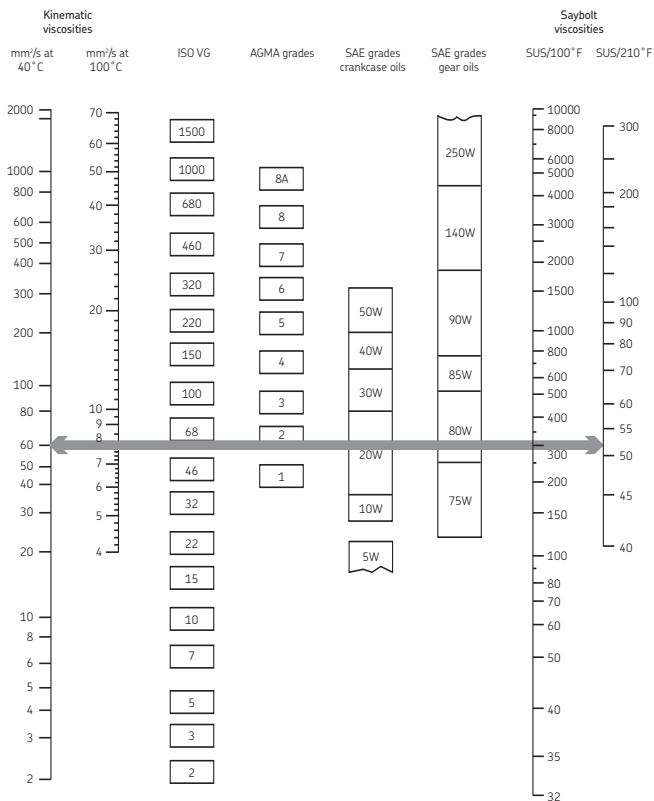
Product number comparison

90	BC	03	J	PP	N	3	0	X		
1	2	3	4	5	6	7	8	9	10	

6	3	18	2Z	N				C3		GJN
2	3	1	5	6	4	8	7	10	9	

symbols		
ABMA	SKF	description
6. Snap ring and groove		
N	N	groove without ring
A	NB	groove without ring on same side as seal/shield
G	NR	groove with ring
C	NBR	groove with ring on same side as seal/shield
7. Radial clearance/preload		
0	-	normal clearance
1	C1	tighter than C2
2	C2	tighter than normal
3	C3	looser than normal
4	C4	looser than C3
5	C5	looser than C4
7	GA	light preload
8	GB	medium preload
9	GC	heavy preload
8. Tolerance class		
0	-	normal, ABEC1, ISO P7
6	P6	ABEC 3, ISO P6
5	P5	ABEC 5, ISO P5
4	P4	ABEC 7, ISO P4
2	P9A	ABEC 9
9 Lubricant		
X	-	any slush or grease
A	-	refer to manufacturer
10. Special features		
X26		(consult SKF Engineering)
X27	S0	heat stabilized to 150° C
X28	S1	heat stabilized to 200° C

Comparative Viscosity Classifications



Viscosities based on 95 VI single-grade oils.
 ISO grades are specified at 40 °C.
 AGMA grades are specified at 100 °F.
 SAE 75W, 80W, 85W, and 5 and 10W
 specified at low temperature (below -17 °F = 0 °C).
 Equivalent viscosities for 100 °F and 210 °F are shown.
 SAE 90 to 250 and 20 to 50 specified at 210 °F (100 °C).

Comparison of various viscosity classification methods

NOTE: ISO mineral lubricants are recommended over SAE and AGMA lubricants for centrifugal pump applications.



Prolong your life

**The life of your electric motors—
with INSOCOAT® bearings from SKF®.**



Conventional motor bearings get “fried” by the electrical current passing through them. The result is premature failure and high maintenance costs. The SKF® solution is INSOCOAT® inverter-duty bearings that require no rework prior to mounting.

These drop-in replacement bearings feature a coating of aluminum oxide on the inner or outer ring, providing an insulating barrier which prevents electrical current from causing microscopic “melting” of the bearing. In addition, INSOCOAT bearings are treated with a sealant that resists humid environments, heat and chemicals.

INSOCOAT bearings are 100% performance tested to 1,000 V DC with a minimum ohmic resistance of 50 M Ω and available for shaft diameters up to 155 mm.

To get a copy of the 116-page, hard-cover, Electric Motor Handbook schedule a meeting with SKF by completing and returning this postage paid card.

Name: _____

Title: _____

Company: _____

Address: _____

Phone: _____ Fax: _____

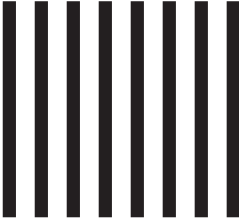
E-mail: _____

Complete and return this postage-paid card to schedule a meeting with SKF and to receive a copy of the 116-page hard-cover Electric Motor Handbook.





NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 13 KULPSVILLE, PA

POSTAGE WILL BE PAID BY ADDRESSEE

SKF USA INC.
PO BOX 332
KULPSVILLE, PA 19443



Complete and return this postage-paid card to schedule a meeting with SKF and to receive a copy of the 116-page hard-cover Electric Motor Handbook.



© SKF and INSOCOAT are registered trademarks of SKF USA Inc.

The contents of this publication are the copyright of the publisher and may not be reproduced (even extracts) unless prior written permission is granted.

Every care has been taken to ensure the accuracy of the information contained in this publication but no liability can be accepted for any loss or damage whether direct, indirect or consequential arising out of use of the information contained herein.

© 2000 SKF USA Inc. (7.5M/AN 12/2005) Printed in U.S.A.

Publication 140-430

Version 11/2005