



NSK TL Bearings

Superior performance under high temperature conditions

Worldwide Sales Offices

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P.T. NSK Bearings Manufacturing Indonesia		Poland:		Franklin, Indiana	tel: 317-738-5038
Jakarta	tel: 021-898-0155	NSK Europe Ltd. Warsaw Liaison Office		San Jose, California	tel: 408-944-9400
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NSK Bearings (Malaysia) Sdn. Bhd.		Taiwan:		Franklin, Indiana	tel: 317-738-5038
Kuala Lumpur	tel: 03-7958-4396	Taiwan NSK Precision Co., Ltd.		San Jose, California	tel: 408-944-9400
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		Chonburi	tel: (038) 214-317-8	NSK Precision America, Inc.	
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		Chachoengsao	tel: (038) 522-343-350	San Jose, California	tel: 408-944-9400
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NSK TL Bearing

- Improvement of inner ring strength
- High hardness of raceway surface (long life)
- High temperature dimensional stability specification

NSK has based its reputation on solving the most challenging industrial problems in ways that exceed customers' expectations. Our innovative TL Series for the Dryer Section carries this tradition forward by providing outstanding performance under high temperature.

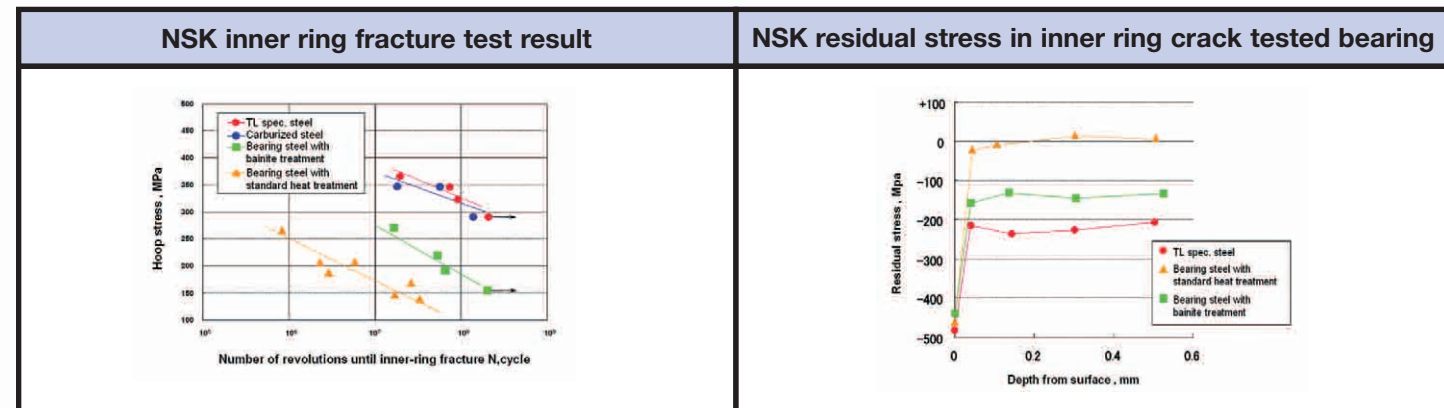
High temperature processing and manufacturing environments, such as those in the dryer section, are especially vulnerable to work stoppages due to inner ring fractures. TL will significantly reduce this risk with superior resistance to inner ring fractures while providing superior life and excellent dimensional stability.

TL Application – Dryer Roll

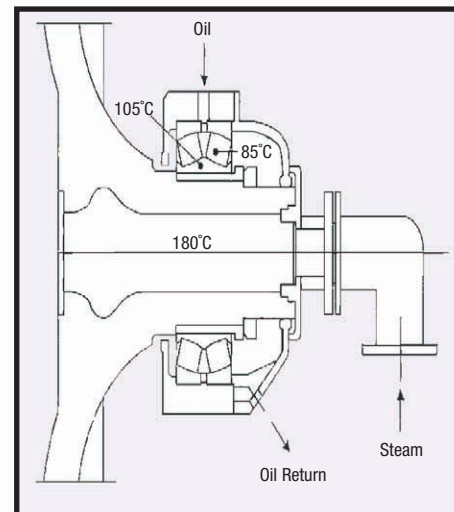
- Steam is passed through the roll to heat it
- The journal expands faster than the bearing, making the fit tighter
- Severe hoop stress on inner ring is repeated every time the machine is started
- Inner ring fracture is a common problem
- Tests show fracture resistance is higher than stress levels in other steels
 - Up to 50% higher than bainite steel
 - Up to 150% higher than through hardened steel
- Dimensional Stability
 - Equal to or better than normal heat stabilized (S11) bearings
- Fatigue Life
 - 2 times carburized steel (contaminated lube test)
 - 3.5 times bainite (contaminated lube test)

NSK TL Inner Ring Tests

A special steel and heat treatment developed by NSK strengthens the inner ring against increasing hoop stress caused by rising shaft temperatures.

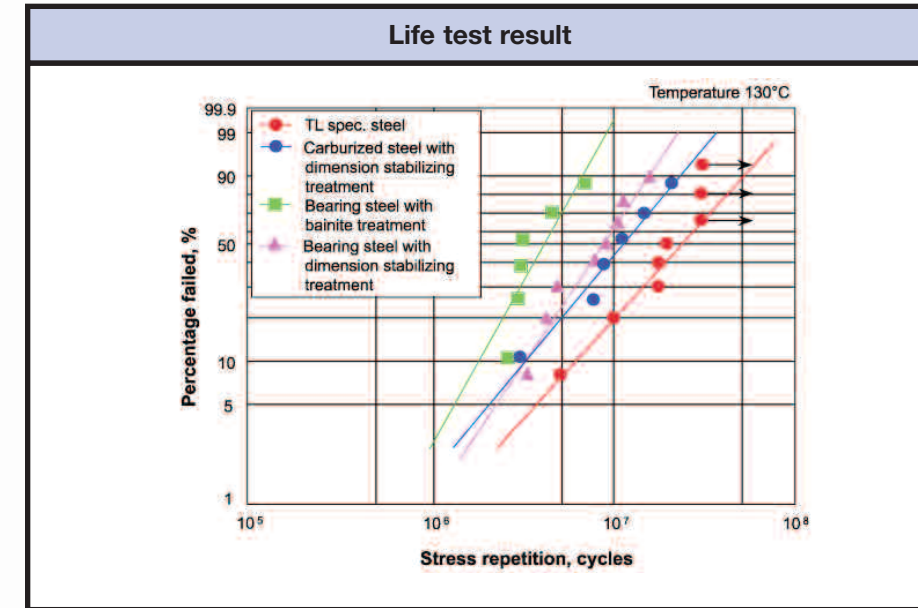


	Problem	Countermeasure
Inner ring crack	Temperature difference between shaft and inner ring ↓ interference increases ↓ hoop stress of inner ring enlarges ↓ inner ring crack	<ul style="list-style-type: none"> • Improved strength of inner ring • Selection of appropriate interference
Short bearing life	High temperature condition ↓ viscosity of lubricant oil lowers ↓ bearing life lowers	<ul style="list-style-type: none"> • Improved hardness of bearing raceway surface (long life) • Selecting high viscosity oil • Lowered temperature of bearing part (increased amount of circulating oil, adiabatic sleeve)
Creep	High temperature condition ↓ aging expansion of bearing ↓ creep	<ul style="list-style-type: none"> • High temperature dimensional stability specification



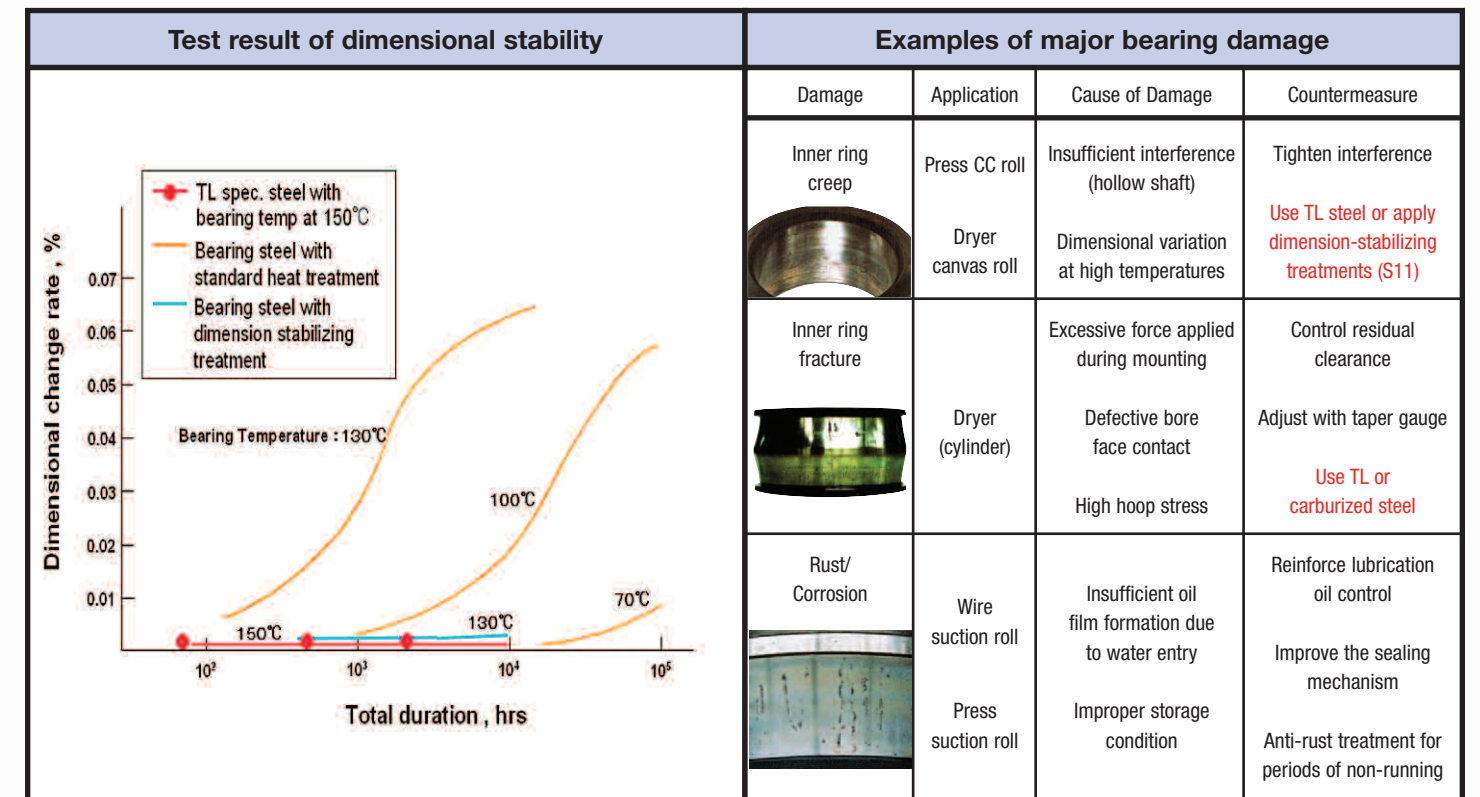
TL Long Life Test

Increased hardness of raceway surface provides longer life when foreign debris is present than that of other bearings.



TL Dimensional Stability Under High Temperatures

Dimensional stability under high temperatures is adopted as a standard specification. (max. 200°C)



TL Series Spherical Roller Bearings

Example: **TL 23152 CA g3 M K E4 C4 S11**

Spherical roller bearings (Bearing type)
Width series 3 (Bearing series symbols)
Diameter series 1 (Bearing series symbols)
Bearing bore 260 mm (Bore number)

Machined brass cage (Cage type symbol)

Max. operating temperature: less than 200°C
(Special specification symbol)

Radial clearance C4 (Internal clearance symbol)

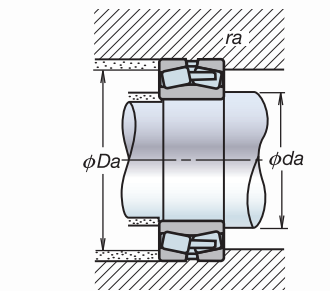
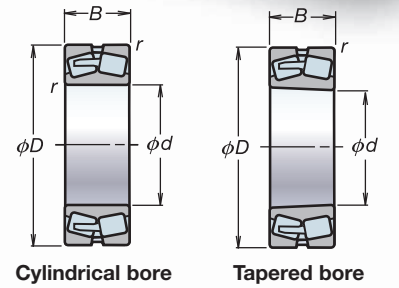
Outer ring with oil groove and oil holes (External features symbol)

Tapered bore (External features symbol)

TL spec. inner ring (Special spec, material symbol) g5: inner and outer ring



Boundary dimensions (mm)				Basic load ratings (N)		Limiting speeds (min ⁻¹)		Bearing numbers		Abutment and fillet dimensions (mm)					Constant	Axial load factors			Mass
d	D	B	r (min)	C _r	C _{or}	Grease	Oil	Cylindrical bore	Tapered bore (°)	(min) d _s	(max)	(max) D _s	(min)	r _s (max)	e	Y ₂	Y ₃	Y ₀	(kg) approx
65	140	48	2.1	375 000	380 000	3 200	4 000	TL22313EAE4	TL22313EAKE4	77	84	128	119	2	0.33	3.0	2.0	2.0	3.52
70	150	51	2.1	425 000	435 000	3 000	3 800	TL22314EAE4	TL22314EAKE4	82	91	138	129	2	0.33	3.0	2.0	2.0	4.28
90	190	64	3	665 000	705 000	2 400	3 000	TL22318EAE4	TL22318EAKE4	104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.56
100	215	73	3	860 000	930 000	2 000	2 600	TL22320EAE4	TL22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
110	170	45	2	293 000	465 000	2 000	2 400	TL23022CDE4	TL23022CDKE4	120	124	160	153	2	0.24	4.2	2.8	2.8	3.76
110	200	69.8	2.1	515 000	760 000	1 500	1 900	TL23222CE4	TL23222CKE4	122	130	188	170	2	0.34	3.0	2.0	1.9	9.54
110	240	80	3	825 000	1 120 000	1 700	2 200	TL22322EAE4	TL22322EAKE4	124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
120	260	86	3	955 000	1 320 000	1 600	2 000	TL22324EAE4	TL22324EAKE4	134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
130	280	93	4	995 000	1 350 000	1 300	1 600	TL22326CAE4	TL22326CAKE4	148	—	262	236	3	0.34	2.9	2.0	1.9	27.8
140	210	53	2	420 000	715 000	1 600	1 900	TL23028CDE4	TL23028CDKE4	150	157	200	190	2	0.22	4.5	3.0	2.9	6.49
140	250	68	3	645 000	930 000	1 400	1 700	TL22228CDE4	TL22228CDKE4	154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
140	250	88	3	835 000	1 300 000	1 100	1 500	TL23228CE4	TL23228CKE4	154	163	236	213	2.5	0.35	2.9	1.9	1.9	18.8
150	225	56	2.1	470 000	815 000	1 400	1 800	TL23030CDE4	TL23030CDKE4	162	168	213	203	2	0.22	4.6	3.1	3.0	7.90
150	250	80	2.1	725 000	1 180 000	1 100	1 400	TL23130CAE4	TL23130CAKE4	162	—	238	218	2	0.30	3.4	2.3	2.2	15.8
150	270	73	3	765 000	1 120 000	1 300	1 600	TL22230CDE4	TL22230CDKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
150	320	108	4	1 220 000	1 690 000	1 100	1 400	TL22330CAE4	TL22330CAKE4	168	—	302	270	3	0.35	2.9	1.9	1.9	41.5
160	240	60	2.1	540 000	955 000	1 300	1 700	TL23032CDE4	TL23032CDKE4	172	179	228	216	2	0.22	4.5	3.0	2.9	9.66
160	290	80	3	910 000	1 320 000	1 200	1 500	TL22232CDE4	TL22232CDKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
160	290	104	3	1 100 000	1 770 000	1 000	1 300	TL23232CE4	TL23232CKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
170	230	45	2	350 000	660 000	1 400	1 800	TL23934BCAE4	TL23934BCAKE4	180	—	220	213	2	0.17	5.8	3.9	3.8	5.38
170	260	67	2.1	640 000	1 090 000	1 200	1 600	TL23034CDE4	TL23034CDKE4	182	191	248	233	2	0.23	4.3	2.9	2.8	13.0
170	280	88	2.1	940 000	1 570 000	1 000	1 300	TL23134CAE4	TL23134CAKE4	182	—	268	245	2	0.29	3.5	2.3	2.3	21.0
170	360	120	4	1 580 000	2 110 000	1 000	1 200	TL22334CAE4	TL22334CAKE4	188	—	342	304	3	0.35	2.9	1.9	1.9	57.9
180	280	74	2.1	750 000	1 270 000	1 200	1 400	TL23036CDE4	TL23036CDKE4	192	202	268	249	2	0.24	4.2	2.8	2.8	17.1
180	320	112	4	1 300 000	2 110 000	850	1 100	TL23236CAE4	TL23236CAKE4	198	—	302	274	3	0.35	2.9	1.9	1.9	38.5
190	290	75	2.1	775 000	1 350 000	1 100	1 400	TL23038CAE4	TL23038CAKE4	202	—	278	261	2	0.24	4.2	2.8	2.8	17.6
190	320	104	3	1 190 000	2 020 000	850	1 100	TL23138CAE4	TL23138CAKE4	204	—	306	276	3.5	0.31	3.2	2.2	2.1	34.0
190	340	92	4	1 140 000	2 730 000	1 000	1 200	TL22238CAE4	TL22238CAKE4	208	—	322	296	3	0.26	3.8	2.6	2.5	35.5
190	340	120	4	1 440 000	2 350 000	800	1 100	TL23238CAE4	TL23238CAKE4	208	—	322	288	3	0.35	2.9	1.9	1.9	46.5
190	400	132	5	1 890 000	2 590 000	900	1 100	TL22338CAE4	TL22338CAKE4	212	—	378	338	4	0.34	2.9	2.0	1.9	77.6
200	310	82	2.1	940 000	1 700 000	1 000	1 300	TL23040CAE4	TL23040CAKE4	212	—	298	279	2	0.25	4.0	2.7	2.6	22.6
200	340	112	3	1 360 000	2 330 000	800	1 000	TL23140CAE4	TL23140CAKE4	214	—	326	293	2.5	0.32	3.2	2.1	2.1	41.5
200	360	98	4	1 300 000	2 010 000	950	1 200	TL22240CAE4	TL22240CAKE4	218	—	342	315	3	0.26	3.8	2.6	2.5	42.6
200	360	128	4	1 660 000	2 750 000	750	1 000	TL23240CAE4	TL23240CAKE4	218	—	342	307	3	0.35	2.9	1.9	1.9	57.0
220	340	90	3	1 090 000	1 980 000	950	1 200	TL23044CAE4	TL23044CAKE4	234	—	326	302	2.5	0.24	4.1	2.8	2.7	29.7
220	370	120	4	1 570 000	2 710 000	710	950	TL23144CAE4	TL23144CAKE4	238	—	352	320	3	0.31	3.2	2.2	2.1	52.0
220	400	108	4	1 570 000	2 430 000	850	1 000	TL22244CAE4	TL22244CAKE4	238	—	382	348	3	0.27	3.7	2.5	2.4	59.0
220	400	144	4	2 010 000	3 400 000	670	900	TL23244CAE4	TL23244CAKE4	238	—	382	337	3	0.36	2.8	1.9	1.8	79.5
220	460	145	5	2 350 000	3 400 000	750	950	TL22344CAE4	TL22344CAKE4	242	—	438	391	4	0.33	3.0	2.0	2.0	116
240	320	60	2.1	635 000	1 300 000	950	1 200	TL23948CAE4	TL23948CAKE4	252	—	308	298	2	0.17	6.0	4.0	3.9	13.3
240	360	92	3	1 160 000	2 140 000	850	1 100	TL23048CAE4	TL23048CAKE4	254	—	346	324	2.5	0.24	4.2	2.8	2.7	32.6
240	400	128	4	1 790 000	3 100 000	670	850	TL23148CAE4	TL23148CAKE4	258	—	382	347	3	0.31	3.3	2.2	2.2	64.5
240	500	155	5	2 600 000	3 800 000	670	850	TL22348CAE4	TL22348CAKE4	262	—	478	423	4	0.32	3.2	2.1	2.1	147
260	360	75	2.1	930 000	1 870 000	850	1 000	TL23952CAE4	TL23952CAKE4	272	—	348	333	2	0.19	5.4	3.6	3.5	23.0
260	400	104	4	1 430 000	2 580 000	800	950	TL23052CAE4	TL23052CAKE4	278	—	382	356	3	0.25	4.1	2.7	2.7	46.6
260	440	144	4	2 160 000	3 750 000	600	800	TL23152CAE4	TL23152CAKE4	278	—	422	380	3	0.32	3.2	2.1	2.1	88.2
280	380	75	2.1	925 000	1 950 000	800	950	TL23956CAE4	TL23956CAKE4	292	—	368	351	2	0.18	5.7	3.9	3.8	24.5
280	420	106	4	1 540 000	2 950 000	710	900	TL23056CAE4	TL23056CAKE4	298	—	402	377	3	0.24	4.2	2.8	2.7	50.5
280	460	146	5	2 230 000	4 000 000	560	750	TL23156CAE4	TL23156CAKE4	302	—	438	400	4	0.30	3.3	2.2	2.2	94.3
280	500	176	5	2 880 000	4 900 000	530	670	TL23256CAE4	TL23256CAKE4	302	—	478	425	4	0.35	2.9	1.9	1.9	147
300	420	90	3	1 230 000	2 490 000	710	900	TL23960CAE4	TL23960CAKE4	314	—	406	386	2.5	0.19	5.2	3.5	3.4	38.2
300	460	118	4	1 920 000	3 700 000	670	850	TL23060CAE4	TL23060CAKE4	318	—	442	413	3	0.24	4.2	2.8	2.7	70.5
300	500	160	5	2 670 000	4 800 000	500	670	TL23160CAE4	TL23160CAKE4	322	—	478	433	4	0.31	3.3	2.2	2.2	125
300	540	192	5	3 400 000	5 900 000	480	630	TL23260CAE4	TL23260CAKE4	322	—	518	458	4	0.35	2.9	1.9	1.9	189
320	540	176	5	3 050 000	5 500 000	480	600	TL23164CAE4	TL23164CAKE4	342	—	518	466	4	0.31	3.2	2.1	2.1	162
340	520	133	5	2 280 000	4 400 000	560	710	TL23068CAE4	TL23068CAKE4	362	—	498	465	4	0.24	4.2	2.8	2.8	101
340	580	190	5	3 600 000	6 600 000	430	560	TL23168CAE4	TL23168CAKE4	362	—	558	499	4	0.31	3.2	2.1	2.1	206
360	540	134	5	2 390 000	4 700 000	530	670	TL23072CAE4	TL23072CAKE4	382	—	518	485	4	0.24	4.2	2.8	2.8	106
380	520	106	4	1 870 000	4 100 000	530	670	TL23976CAE4	TL23976CAKE4	398	—	502	482	3	0.18	5.5	3.7	3.6	65.4



Dynamic equivalent load
 $P_0 = F_r + Y_0 F_a$

$F_a/F_r \leq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.67	Y_2

Static equivalent load
 $P_0 = F_r + Y_0 F_a$

Common Dryer Can Bearings, Sleeves, Threads & Hydraulic Nuts: Part Number

Bearing Number	Bearing Bore (mm)	Sleeve Number	Sleeve Thread used to dismount			Journal Thread used to mount			Mount Hydraulic Nut	Dismount Hydraulic Nut*
			Major Dia.	Pitch Dia.	Threads per inch	Major Dia.	Pitch Dia.	Threads per inch	NSK p/n	NSK p/n
TLI-112618	250	I-79804 x 9 1/4	10.600	10.492	6	9.125	9.055	8	HMV231Z-1	269Z
TL23152	260	AHA3152 x 9 5/8	11.000	10.892	6	9.125	9.055	8	HMV231Z-1	279Z
TL23152	260	none	n/a	n/a	n/a	10.192	10.0837	6	HMV258Z-1	n/a
TL23160	300	AHA3160 x 11 1/4	12.938	12.83	6	11.004	10.8957	6	HMV279Z-1	328Z
TL23038	190	none	n/a	n/a	n/a	7.472	7.3908	8	HMV189Z-1	n/a
TL22238	190	none	n/a	n/a	n/a	7.472	7.3908	8	HMV189Z-1	n/a
TL23238	190	none	n/a	n/a	n/a	7.472	7.3908	8	HMV189Z-1	n/a
TL22244	220	none	n/a	n/a	n/a	8.628	8.5468	8	HMV219Z-1	n/a
TL22244	220	SK 44 x 7 7/8	9.442	9.3245	6	7.847	7.7658	8	HMV199Z-1	239Z
TL22244	220	H31348 x 220mm	8.628	8.5468	8	7.847	7.7658	8	HMV199Z-1	219Z
TL23148	240	none	n/a	n/a	n/a	9.442	9.3337	6	HMV239Z-1	n/a
TL23148	240	AHA3148 x 7 15/16	n/a	n/a	n/a	220mm	220mm	n/a	HMV220-1	n/a
TL23156	280	none	n/a	n/a	n/a	11.004	10.8957	6	HMV279Z-1	n/a
TL22230	150	none	n/a	n/a	n/a	5.888	5.8339	12	HMV149Z-1	n/a

*only applies if withdraw sleeve used

Common Dryer Can Bearings & Clearance: Axial Displacement

Bearing Number	Bearing Bore (mm)	Sleeve Number	Reduction in Radial Clearance (inch)		Radial Internal Clearance (inch)				1:12 Axial Displacement (inch)	
			min	max	C3		C4		min	max
					min	max	min	max		
TLI-112618	250	I-79804 x 9 1/4	0.0045	0.0060	0.0106	0.0140	0.0140	0.0178	0.072	0.094
TL23152	260	AHA3152 x 9 5/8	0.0050	0.0070	0.0118	0.0156	0.0156	0.0195	0.080	0.106
TL23152	260	none	0.0050	0.0070	0.0118	0.0156	0.0156	0.0195	0.080	0.106
TL23160	300	AHA3160 x 11 1/4	0.0050	0.0070	0.0130	0.0169	0.0169	0.0213	0.080	0.118
TL23038	190	none	0.0035	0.0050	0.0088	0.0114	0.0114	0.0146	0.056	0.082
TL22238	190	none	0.0035	0.0050	0.0088	0.0114	0.0114	0.0146	0.056	0.082
TL23238	190	none	0.0035	0.0050	0.0088	0.0114	0.0114	0.0146	0.056	0.082
TL22244	220	none	0.0040	0.0055	0.0099	0.0126	0.0126	0.0162	0.064	0.088
TL22244	220	SK 44 x 7 7/8	0.0040	0.0055	0.0099	0.0126	0.0126	0.0162	0.064	0.088
TL22244	220	H31348 x 220mm	0.0040	0.0055	0.0099	0.0126	0.0126	0.0162	0.064	0.088
TL23148	240	none	0.0045	0.0060	0.0106	0.0140	0.0140	0.0178	0.072	0.094
TL23148	240	AHA3148 x 7 15/16	0.0045	0.0060	0.0106	0.0140	0.0140	0.0178	0.072	0.094
TL23156	280	none	0.0050	0.0070	0.0118	0.0156	0.0156	0.0195	0.080	0.106
TL22230	150	none	0.0030	0.0040	0.0071	0.0091	0.0091	0.0118	0.048	0.062

NSK TL Success Stories

TL Offering Lasting Upgrades

Bearing failures on the drive side of the dryer roll had a paper mill urgently looking for an upgrade. After contact with a distributor, NSK came in for inspection. Upon inspection, NSK discovered that the use of a competitor's standard through hardened bearing, used in a high heat application, caused cracking on the inner race.

NSK's Solution: TL

TL bearings increase inner-ring toughness using a special surface-hardening heat treatment. From a metallurgical standpoint, the raceways are harder than conventional bearing steel but the core remains soft, giving the bearings the shock resistance needed to prevent fracturing. The bearings were installed on the drive side and proved to be a long-lasting solution.

The success was so well received that even the bearings on the tending side were changed over to TL. Now during each scheduled shutdown, 6-8 bearings are being replaced in both PM8 and PM9 with NSK TL. Another benefit – cost. TL is an upgraded product without an upgraded price.

TL Out-Rolls the Competition Once Again!

A Wisconsin paper mill was having problems with their chilled iron roll bearings on their super calendar. Their application is very similar to a dryer can, but turns at higher rpms. The competitor's bearings were failing on the rolls roughly every 3-4 months, costing the mill time and money.

When the competitor could not solve the problem, the mill called NSK. Through an in-depth analysis, NSK determined that the bearings were experiencing thrust loading, causing inner ring cracking. NSK recommended a few modifications to the housing and with the addition of our proprietary TL technology, TL outlasted the competition with 18 months on the first roll. The mill's problems were solved thanks to NSK's exceptional product and experience in proper procedure.

