

Bearing Facts

Improper lubrication and contamination are responsible for 70% of all early bearing failures.

Dirt is responsible for more than 90% of all bearing troubles.

Bearing life is reduced by approximately 20% with outer race rotation.

When a bearing is press fitted onto a steel shaft or press fitted into steel or cast iron housings, the **internal clearance is reduced by 80%** of fit interference.

Deep groove ball bearings (Conrad) are ideally designed to permit radial loading and thrust loading from either direction (the combined load should not exceed 100% of radial load rating).

Maximum type ball bearings (with precision ground filling slots) have a radial capacity of 10-15% more than the Conrad type. Thrust is limited to approximately 10% of radial capacity.

The angular contact design permits this bearing to carry high thrust in ONE DIRECTION ... Equal to 150% of its radial load capacity.

Double row ball bearings combine the features of two single row angular contact bearings mounted in duplex.

Always check bearing fit-up after assembly.

Recommended shaft finishes for Grade 1 bearings under 2" - max. 32 rms; over 2" - max. 64 rms; housing bores - 125 rms max.

High points of eccentricity of inner and outer races of high precision bearings are marked with a burnished spot on one face.

It is desirable to press needle bearings from the lettered end.

Do not check O.D. of a drawn cup needle bearing unmounted.

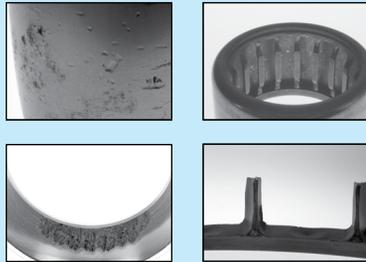
Bearings lubricated with petroleum greases have a shelf life of approximately seven years.

If you double the speed of a bearing, you cut its life in half. If you double the load on a ball bearing, you cut its life to 1/8 of its original life.

Coefficient of thermal expansion for steel is .000007 inch per °F and .000063 inch per °F for carbon steel.

Common Causes of Bearing Failures

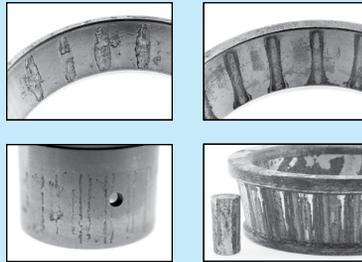
FOREIGN MATERIAL



Typical causes include improper cleaning methods, poor oil filtration, or seal wear.

- Hard particle contamination
- Contamination bruising
- Fine particle contamination
- Internal cage wear from fine particle contamination

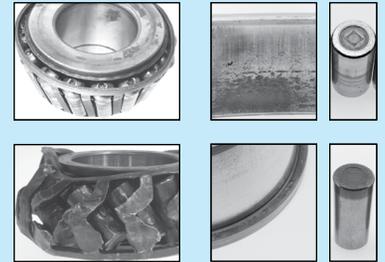
CORROSION/ETCHING



Typical causes include damaged packaging, improper storage, and worn or damaged seals.

- Roller-spaced spalling
- Corrosion on the outer ring race
- Etching and corrosion
- Advanced corrosion and spalling

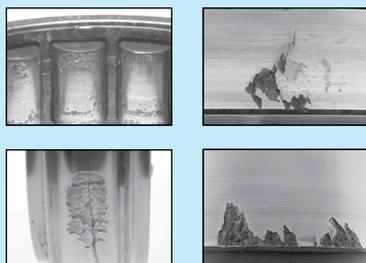
INADEQUATE LUBRICATION



Typical causes include improper grease or oil viscosity, low flow rate, and high operation temperatures.

- Race deformation from excessive heat generation
- Peeling/Scoring damage on roller end
- Complete bearing lockup
- Rib and roller end scoring

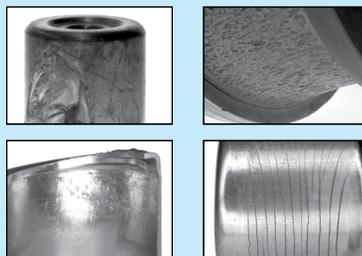
FATIGUE SPALLING



Typical causes include high load, misalignment, and stress concentration.

- Fatigue spalling on a cylindrical roller bearing
- Point Surface Origin (PSO) spalling
- Fatigue spalling on ball bearing inner ring
- Geometric Stress Concentration (GSC) spalling

EXCESSIVE PRELOAD, OVERLOAD AND ROLLOUT



Typical causes include excessive load, and/or misalignment, and improper mounting procedure.

- Roller fracture
- Peeling
- Rollout in bearing outer ring
- Outer ring subrace fracture

MISALIGNMENT



Typical causes include high load, shaft or housing deflection, inaccurate housing, or shaft machining.

- Irregular roller path caused by deflection
- Geometric Stress Concentration (GSC) spalling
- Irregular roller path (180 degree opposite of above)
- Geometric Stress Concentration (GSC) spalling on bearing outer ring

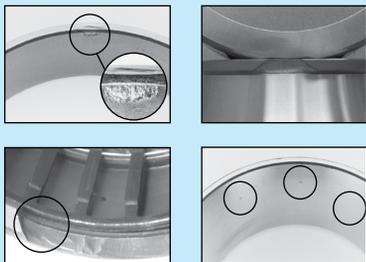
Photos courtesy of The Timken Company.

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Bearings

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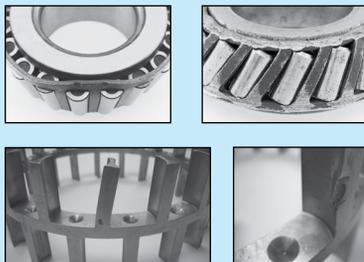
HANDLING DAMAGE



Typical causes include improper tool selection (hardened drivers), and poor handling practices.

- Outer ring denting
- Fractured inner ring rib
- Broken rib on outer race
- Roller spaced nicking

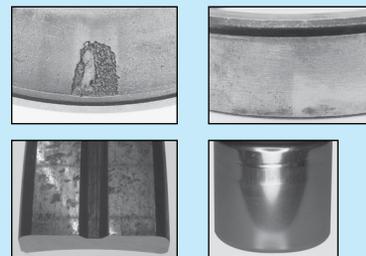
CAGE DAMAGE



Typical causes include improper handling, tools, and procedures.

- Cage deformation
- Roller binding and skewing
- Bent bridge
- Deep dent on cage

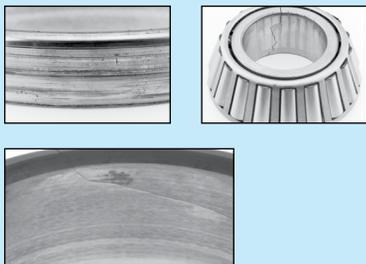
HIGH SPOTS AND FITTING PRACTICES



Typical causes include improper machining, grinding, or repair methods.

- Localized spalling
- Marks from high spot on the housing
- Metal tearing and wear
- Pinch point

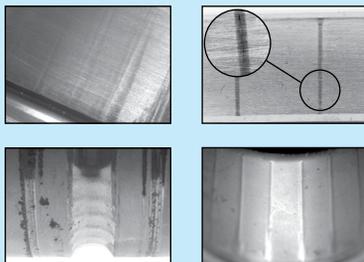
IMPROPER FIT IN HOUSING OR SHAFTS



Typical causes include wrong size and poor form, shaft or housing stress riser, and inaccurate machining.

- Loose outer ring fit in a wheel hub
- Fracture on inner ring
- Metal contaminant

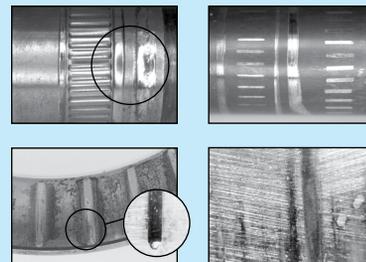
BRINELL AND IMPACT DAMAGE



Typical causes include rough handling, and shock loads exceeding the material's limits.

- Roller impact damage
- True metal deformation
- Shock loading
- True brinell on needle bearing drawn cup race

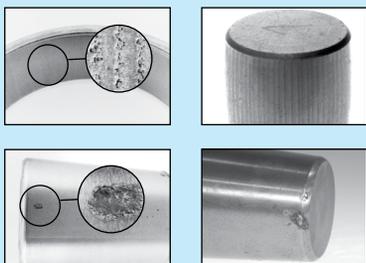
FALSE BRINELLING



Typical causes include excessive vibration during shipment, or when the shaft is stationary.

- Extreme vibration
- False brinell on a shaft where a cylindrical bearing was mounted
- Wear caused by vibration
- False brinell on outer race

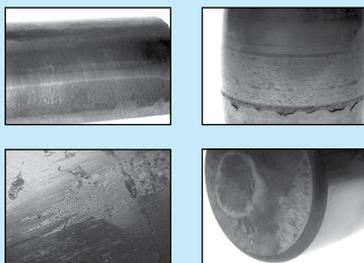
BURNS FROM ELECTRIC CURRENT



Typical causes include improper electrical grounding of equipment, welding damage, or static discharge.

- Electric arc fluting
- Fluting caused by electric current
- Electric arc pitting
- Roller with electric arc burns

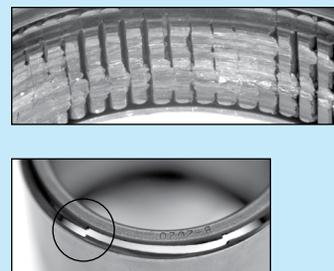
ADHESIVE WEAR



Typical causes include improper oil film, excess cage friction, and gross roller sliding.

- Roller flats and adhesive wear
- Spherical roller bearing with adhesive wear
- Skidding, raceway surface
- Cylindrical roller end with adhesive wear

NEEDLE BEARING INSTALLATION DAMAGE



Typical causes include improper tool design, tool positioning, poor roller alignment, and excessive force.

- Roller lock-up
- Bearing stamping lip fracture

WARNING

- Never spin a bearing with compressed air. The rollers may be forcefully expelled, creating a risk of serious bodily harm.
- Proper maintenance and handling practices are critical. Failure to follow installation instructions and to maintain proper lubrication can result in equipment failure, creating a risk of serious bodily harm.

Photos courtesy of The Timken Company.

SHAFT FITS									
Standard Bearings									
Types	Basic Number	BEARING BORE		SHAFT ROTATING			SHAFT STATIONARY		
		Max	Min	SHAFT DIAMETER		MEAN FIT TIGHT	SHAFT DIAMETER		MEAN FIT LOOSE
				Max	Min		Max	Min	
Single Row	00	0.3937	0.3934	0.3939	0.3936	0.00020	0.3935	0.3931	0.00025
Extra Light	01	0.4724	0.4721	0.4726	0.4723	0.00020	0.4722	0.4717	0.00030
200 Light	02	0.5906	0.5903	0.5908	0.5905	0.00020	0.5904	0.5899	0.00030
300 Medium	03	0.6693	0.6690	0.6695	0.6692	0.00020	0.6691	0.6686	0.00030
400 Heavy	04	0.7874	0.7870	0.7878	0.7875	0.00045	0.7871	0.7866	0.00035
	05	0.9843	0.9839	0.9847	0.9844	0.00045	0.9840	0.9835	0.00035
	06	1.1811	1.1807	1.1815	1.1812	0.00045	1.1808	1.1803	0.00035
	07	1.3780	1.3775	1.3785	1.3781	0.00055	1.3776	1.3770	0.00045
	08	1.5748	1.5743	1.5753	1.5749	0.00055	1.5744	1.5738	0.00045
	09	1.7717	1.7712	1.7722	1.7718	0.00055	1.7713	1.7707	0.00045
Radial-Thrust	10	1.9685	1.9680	1.9690	1.9686	0.00055	1.9681	1.9675	0.00045
7200 Light	11	2.1654	2.1648	2.1660	2.1655	0.00065	2.1650	2.1643	0.00045
7300 Medium	12	2.3622	2.3616	2.3628	2.3623	0.00065	2.3618	2.3611	0.00045
7400 Heavy	13	2.5591	2.5585	2.5597	2.5592	0.00065	2.5587	2.5580	0.00045
	14	2.7559	2.7553	2.7565	2.7560	0.00065	2.7555	2.7548	0.00045
	15	2.9528	2.9522	2.9534	2.9529	0.00065	2.9524	2.9517	0.00045
	16	3.1496	3.1490	3.1502	3.1497	0.00065	3.1492	3.1485	0.00045
	17	3.3465	3.3457	3.3472	3.3466	0.00080	3.3460	3.3452	0.00050
	18	3.5433	3.5425	3.5440	3.5434	0.00080	3.5428	3.5420	0.00050
Double Row	19	3.7402	3.7394	3.7409	3.7403	0.00080	3.7397	3.7389	0.00050
5200 Light	20	3.9370	3.9362	3.9377	3.9371	0.00080	3.9365	3.9357	0.00050
5300 Medium	21	4.1339	4.1331	4.1346	4.1340	0.00080	4.1334	4.1326	0.00050
5400 Heavy	22	4.3307	4.3299	4.3314	4.3308	0.00080	4.3302	4.3294	0.00050

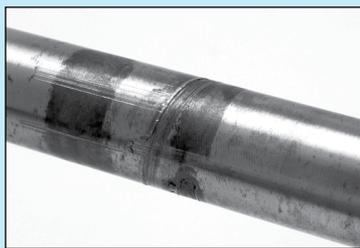


Photo courtesy of The Timken Company.

Fretting corrosion on a shaft caused by improper housing and shaft fits. Fretting corrosion will look the same on ID/OD of bearing.

Shaft and Housing Fits

HOUSING FITS Standard Bearings													
Types	Basic Number				BEARING O.D.		HOUSING STATIONARY			HOUSING ROTATING			
	EXTRA LIGHT	LIGHT	MEDIUM	HEAVY	Max	Min	HOUSING BORE		MEAN FIT LOOSE	HOUSING BORE		MEAN FIT TIGHT	
							Min	Max		Min	Max		
Single Row	00				1.0236	1.0232	1.0236	1.0241	0.00055	1.0228	1.0236	0.0002	
	01				1.1024	1.1020	1.1024	1.1029	0.00055	1.1016	1.1024	0.0002	
		200			1.1811	1.1807	1.1811	1.1816	0.00055	1.1803	1.1811	0.0002	
	02	201			1.2598	1.2593	1.2598	1.2604	0.00055	1.2588	1.2598	0.00025	
	03	202	300		1.3780	1.3775	1.3780	1.3786	0.00055	1.3770	1.3780	0.00025	
			301		1.4567	1.4562	1.4567	1.4573	0.00055	1.4557	1.4567	0.00025	
	Extra Light		203		1.5748	1.5743	1.5748	1.5754	0.00055	1.5738	1.5748	0.00025	
	200 Light	04		302	1.6535	1.6530	1.6535	1.6541	0.00055	1.6525	1.6535	0.00025	
	300 Medium	05	204	303	1.8504	1.8499	1.8504	1.8510	0.00055	1.8494	1.8504	0.00025	
	400 Heavy		205	304	2.0472	2.0467	2.0472	2.0479	0.00060	2.0460	2.0472	0.00035	
		06				2.1654	2.1649	2.1654	2.1661	0.00060	2.1642	2.1654	0.00035
	Radial-Thrust	07	206	305	403	2.4409	2.4404	2.4409	2.4416	0.00060	2.4397	2.4409	0.00035
08					2.6772	2.6767	2.6772	2.6779	0.00060	2.6760	2.6772	0.00035	
		207	306	404	2.8346	2.8341	2.8346	2.8353	0.00060	2.8334	2.8346	0.00035	
09					2.9528	2.9523	2.9528	2.9535	0.00060	2.9516	2.9528	0.00035	
10		208	307	405	3.1496	3.1491	3.1496	3.1503	0.00060	3.1484	3.1496	0.00035	
			209			3.3465	3.3459	3.3465	3.3474	0.00075	3.3451	3.3465	0.0004
7200 Light		11	210	308	406	3.5433	3.5427	3.5433	3.5442	0.00075	3.5419	3.5433	0.0004
7300 Medium		12				3.7402	3.7396	3.7402	3.7411	0.00075	3.7388	3.7402	0.0004
7400 Heavy		13	211	309	407	3.9370	3.9364	3.9370	3.9379	0.00075	3.9356	3.9370	0.0004
		14	212	310	408	4.3307	4.3301	4.3307	4.3316	0.00075	4.3293	4.3307	0.0004
			213	311	409	4.7244	4.7238	4.7244	4.7253	0.00075	4.7230	4.7244	0.0004
			214			4.9213	4.9205	4.9213	4.9223	0.00090	4.9197	4.9213	0.0004
Double Row	17	215	312	410	5.1181	5.1173	5.1181	5.1191	0.00090	5.1165	5.1181	0.0004	
	18	216	313	411	5.5118	5.5110	5.5118	5.5128	0.00090	5.5102	5.5118	0.0004	
	20	217	314	412	5.9055	5.9047	5.9055	5.9065	0.00090	5.9039	5.9055	0.0004	
			218	315		6.2992	6.2982	6.2992	6.3002	0.00100	6.2976	6.2992	0.0003
	5200 Light	21			413	6.2992	6.2982	6.2992	6.3002	0.00100	6.2976	6.2992	0.0003
	5300 Medium	22	219	316		6.6929	6.6919	6.6929	6.6939	0.00100	6.6913	6.6929	0.0003
	5300 Heavy	24	220	317	414	7.0866	7.0856	7.0866	7.0876	0.00100	7.0850	7.0866	0.0003
			221	318	415	7.4803	7.4791	7.4803	7.4814	0.00115	7.4785	7.4803	0.0003
		26	222	319	416	7.8740	7.8728	7.8740	7.8751	0.00115	7.8722	7.8740	0.0003
					417	8.2677	8.2665	8.2677	8.2688	0.00115	8.2659	8.2677	0.0003
			224	320		8.4646	8.4634	8.4646	8.4657	0.00115	8.4628	8.4646	0.0003
					418	8.8583	8.8571	8.8583	8.8594	0.00115	8.8565	8.8583	0.0003
		226			9.0551	9.0539	9.0551	9.0562	0.00115	9.0533	9.0551	0.0003	
				322	9.4488	9.4476	9.4488	9.4499	0.00115	9.4470	9.4488	0.0003	

* Dimensions to which shafts and housings should be machined to produce a satisfactory operating assembly of the bearings with these units. Standards were arrived by the Bearings Engineer Committee.

