# 1. Extension of Bearing Life

## 1.1 Mechanism of Flaking

<table>
<thead>
<tr>
<th>Type</th>
<th>Long Life Bearings</th>
<th>Mechanism</th>
<th>Long Life Bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLAKING IN CONTAMINATED LUBRICANT</td>
<td></td>
<td>Abrasion caused by small hard particles</td>
<td>SH,KE,MF</td>
</tr>
<tr>
<td>FLAKING IN CLEAN LUBRICANT</td>
<td></td>
<td>Plastic deformation caused by outside force or caused by large hard particles</td>
<td>HRS,GTS,KUJ 7,CH 213</td>
</tr>
<tr>
<td>SURFACE STARTING FLAKING</td>
<td></td>
<td>Material defect of maximum shear stress</td>
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<td></td>
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</tr>
</tbody>
</table>

- **FLAKING IN CONTAMINATED LUBRICANT**: Abrasion caused by small hard particles.
- **FLAKING IN CLEAN LUBRICANT**: Plastic deformation caused by outside force or caused by large hard particles.
- **SURFACE STARTING FLAKING**: Material defect of maximum shear stress.
- **SURFACE FLAKING**
- **BRINELLING INITIATED FLAKING**
- **INSIDE STARTING FLAKING**

## 1.2 Koyo Long Life Bearing Series

- **LONG LIFE**
  - **IN CLEAN LUBRICANT**
    - **MATERIAL**
      - **HRS**: High Refining Steel Bearings
      - **GTS**: Greater Toughness Steel Bearings
      - **KUJ 7**: Medium Heat Resistant Steel Bearings
      - **CH 213**: Carburized Steel for Large Size Bearings
  - **HEAT TREATMENT**
    - **SH**: Special Heat Treated Bearings
    - **KE**: New HI-CAP Tapered Roller Bearings
  - **DESIGN**
    - **MF**: Sealed Bearings
2. Bearing Life Evaluation Results Against Flaking

**HRS**

- **In Clean lubricant**
  - Conventional bearing
  - ESR steel
  - VAR steel

- **Cumulative failure probability, %**
  - 50
  - 90
  - 10
  - 5
  - 2
  - 1

- **Life ratio (Actual / Calculation)**
  - 1
  - 2
  - 4
  - 6
  - 8
  - 10
  - 20
  - 40

**GTS**

- **In Clean lubricant**
  - SUJ 2
  - HRS
  - GTS

- **Cumulative failure probability, %**
  - 50
  - 90
  - 10

- **Life, h**
  - 30
  - 100
  - 1000
  - 5000

**KUJ 7**

- **Lubricant ASTO 500**
  - Test temp. 150
  - SUJ 2
  - KUJ 7

- **Cumulative failure probability, %**
  - 50
  - 90
  - 10

- **Life, h**
  - 1
  - 10
  - 100
  - 1000

**CH 213**

- **In Clean lubricant**
  - SNCM815
  - CH213

- **Cumulative failure probability, %**
  - 50
  - 90
  - 10

- **Life, h**
  - 10
  - 50
  - 100
  - 500
  - 1000

**SH and KE**

- **Life in contaminated lubricant**
  - SH bearing, KE bearing
  - :10 times or longer

- **Hardness**
  - 830HV
  - 700HV

- **Mean particle size**
  - 27
  - 125

- **Amount**
  - 0.55 g/ℓ
  - 0.55 g/ℓ

- **Life in clean lubricant**
  - SH bearing: 6 times or longer
  - KE bearing: 2 times or longer

- **Dent resistance**
  - SH bearing: 8 times or more
  - KE bearing: 10 times or more

- **Dent area ratio measured at 20 points of inner ring raceway center and analyzed by computer**

- **Test hour, h**
  - 0
  - 100
  - 200
  - 300
  - 400
# 3. Bearing Types and Performance

<table>
<thead>
<tr>
<th>LONG LIFE BEARINGS</th>
<th>MATERIAL</th>
<th>CHARACTERISTICS AND EFFECTS</th>
<th>PERFORMANCE (Compared with Conventional Bearings)</th>
<th>APPLICABLE BEARINGS</th>
<th>APPLICATIONS</th>
</tr>
</thead>
</table>
| HRS (High Refining Steel Bearings) | Through Hardened Steel (SUJ2) | • Equivalent to special remelting steel  
• Long life by minimizing inclusions  
• HRS with SH treatment is more better | 3 times or longer  
Life in clean lubricant  
Life in contaminated lubricant | Same | • For Automobile |
| GTS (Greater Toughness Steel Bearings) | Through Hardened Steel | • Significant toughness and matrix strength by controlling alloy element | 6 times or longer  
2 times or longer | 2 times or longer | • Extra long life under heavy load |
| KUJ 7 (Medium Heat Resistant Steel Bearings) | Through Hardened Steel | • High resistance against hardness reduction by tempering | 7 times or longer  
(4 times or longer  
(at 150 °C))  
2 times or longer | 2 times or longer | • For Continuously casting equipment  
• For Tarbocharger |
| CH 213 (Carburized Steel for Large Size Bearings) | Carburized Steel | • High resistance against hardness reduction by tempering  
• Controlled alloy element | 4 times or longer  
2 times or longer | 2 times or longer | • For Steel rolling mill |
| SH (Special Heat Treated Bearings) | Through Hardened Steel | • High surface hardness  
• Adequate resistance to wear | 6 times or longer  
10 times or longer | 10 times or longer | • In contaminated lubricant such as differential and transmission |
| KE (New Hi-CAP Tapered Roller Bearings) | Carburized Steel | • High surface hardness  
• Controlled retained austenite | 2 times or longer  
10 times or longer | | |

## Applications

- Continuously casting equipment
- Steel rolling mill
- Tarbocharger
- Transmission
4. Life Comparison

Notes:
1) Case carburized steel.
2) Only inner ring is SH
3) Inner ring, outer ring and rolling elements are SH

In contaminated lubricant

In clean lubricant

STD  HRS  GTS  KUJ7  CH213  SH2  ALL SH  KE  MF

Notes:
1) Case carburized steel.
2) Others are through hardened steel
3) Only inner ring is SH
4) Inner ring, outer ring and rolling elements are SH

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