



UNDGÅ UNØDIGE LEJESKADER

Ved: Carsten Harreby

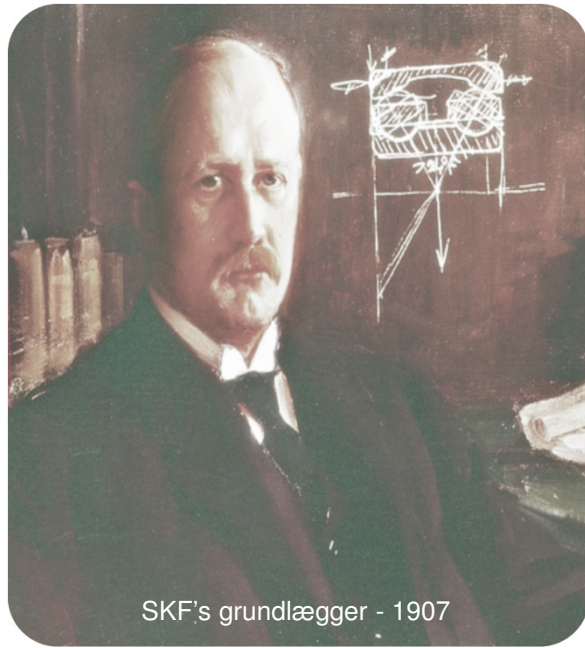


Kort om præsentationen

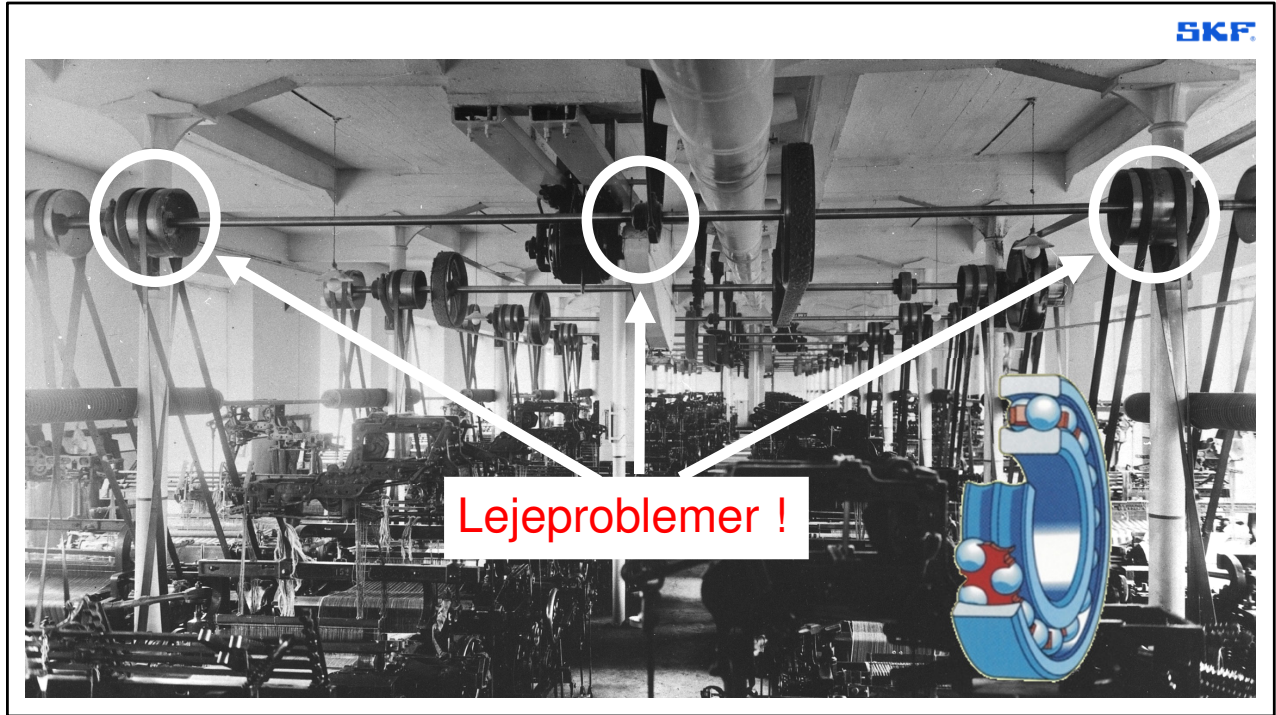
- Indledning
- Typiske årsager til lejeskader
- Klassifisering af lejeskader (ISO)
- Lejeundersøgelse og korrigerende handling



Hvem er jeg og SKF?



SKF's grundlægger - 1907





Fakta om SKF



Repræsenteret over hele verden.

Mere end 42.000 ansatte.

87 fabrikker & >17.000 forhandlere i mere end 130 lande.

Producerer ca. 230.000 lejer/time

Omsætning 2021 – 55.600 MDkk



Levetid for lejer

Beregnet levetid:

$$L_{nm} = a_1 a_{SKF} L_{10} = a_1 a_{SKF} \left(\frac{C}{P}\right)^p$$

You can use [SKF Bearing Select](#) to perform this calculation.

If the speed is constant, the life can be expressed in operating hours, using

$$L_{nmh} = \frac{10^6}{60 n} L_{nm}$$

where

L_{nm} SKF rating life (at 100 – n¹ % reliability) [millions of revolutions]

L_{nmh} SKF rating life (at 100 – n¹ % reliability) [operating hours]

L_{10} basic rating life (at 90% reliability) [millions of revolutions]

a_1 life adjustment factor for reliability (table 3, values in accordance with ISO 281)

a_{SKF} life modification factor

C basic dynamic load rating [kN]

P equivalent dynamic bearing load [kN]

n rotational speed [r/min]

p exponent of the life equation

= 3 for ball bearings

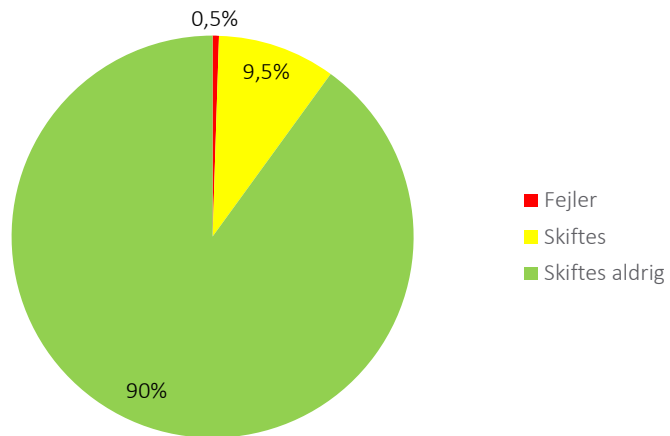
= 10/3 for roller bearings

Service levetid (faktisk levetid):



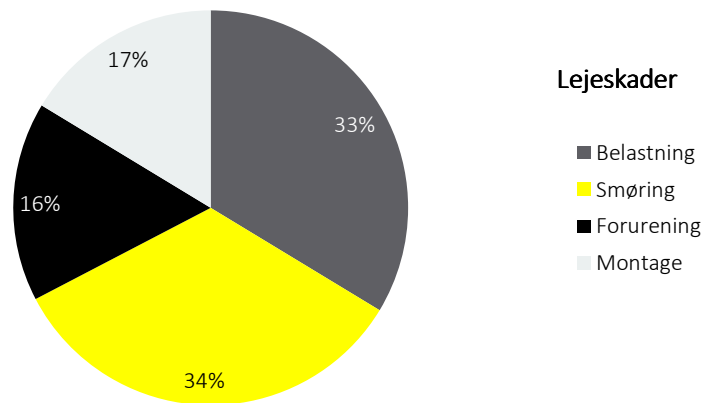


Lejelevetid





Hvorfor fejler 0,5% af alle monterede lejer?

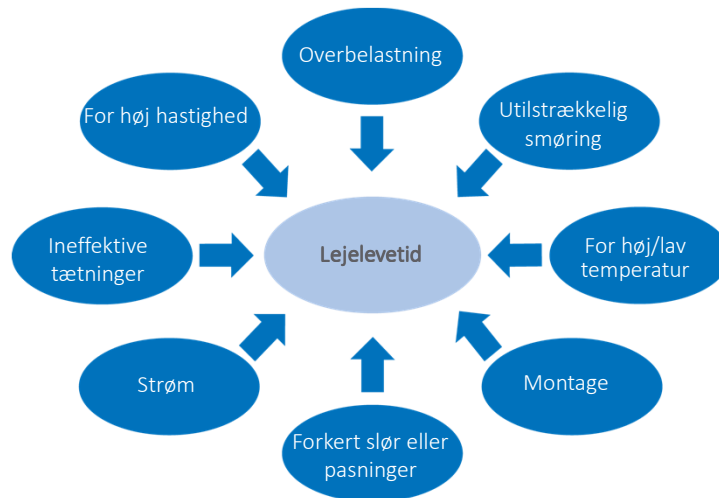




Forudsætninger for en lang lejelevetid

- Leje af en høj kvalitet
- Det rigtige leje
- En passende indbygning
- Korrekt opbevaring og montage
- Det rette smøremiddel i rette mængde og tidspunkt
- Effektive tætninger
- Driftsbetingelser tilpasset lejearrangementet
- Vedligehold

Typiske årsager til kort lejelevetid





Når lejeskader opstår under stilstand før eller efter montage

Montage:

- Overbelastning

Transport:

- False brinelling
- Korrosion

Opbevaring:

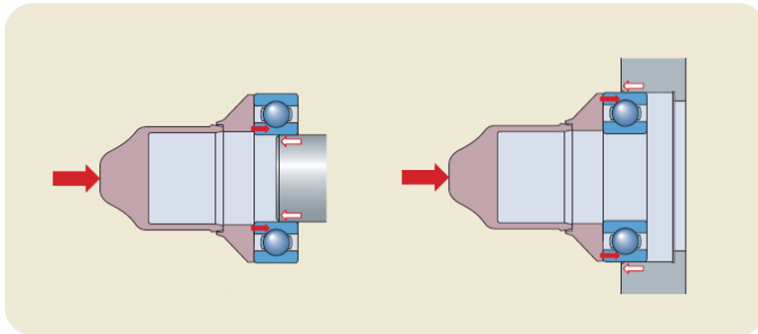
- False brinelling
- Korrosion

Stilstand efter idriftsætning:

- False brinelling
- Korrosion

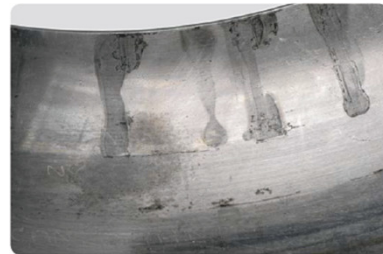
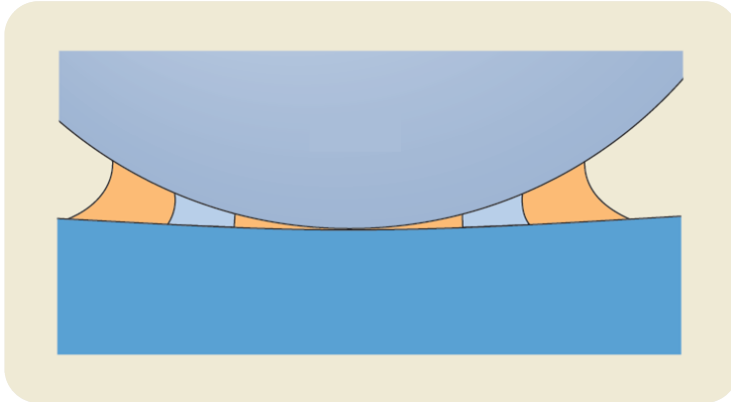
Eksempel på montageskade

Overbelastning

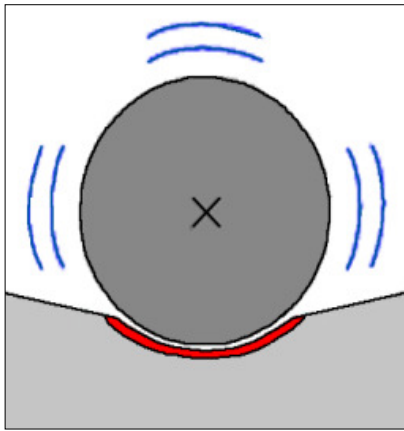


Eksempel på korrosionsskade

Tæring



False brinelling





Når lejeskader opstår under drift

Belastning:

- Udmattelse under overfladen

Smøring:

- Overfladeudmattelse
- Slibende og klæbende slid

Forurening:

- Indtrykninger
- Korrosion

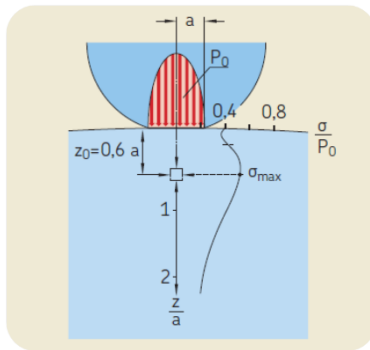
Strømgennemgang:

- Spændingsoverslag
- Strømlækage

Indbygning:

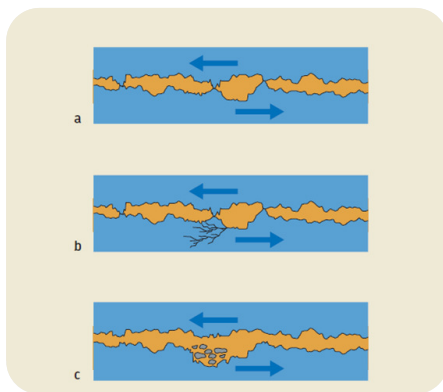
- Pasningsrust
- Slibende og klæbende slid
- Termisk revnedannelse
- Tvungen brud

Udmattelse under overfladen



Smøreproblemer

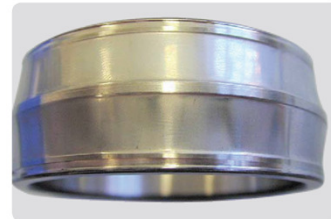
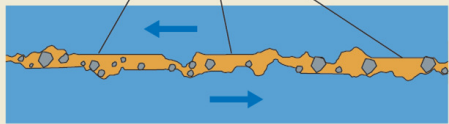
Overfladeudmattelse (utilstrækkelig smørefilm)



Smøreproblemer

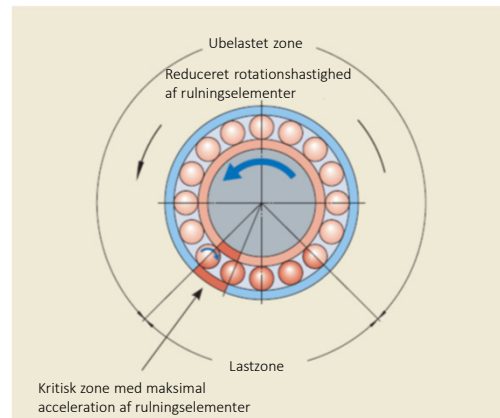
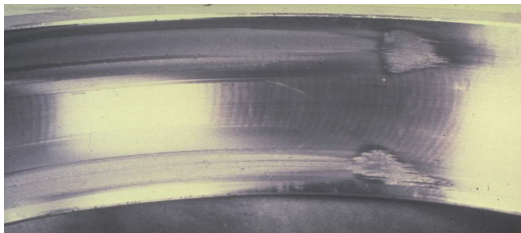
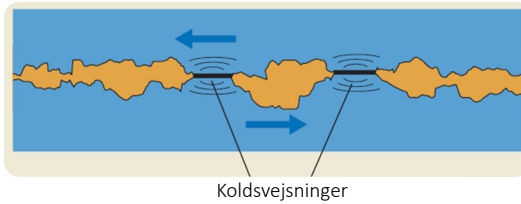
Slibende slid

Udglatning fra polering/slibning og
plastisk deformation af overfladeruheder



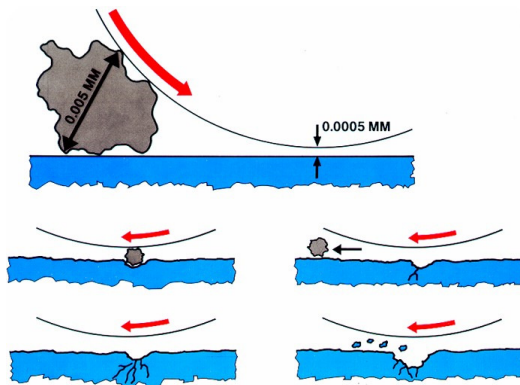
Smøreproblemer

Klæbende slid

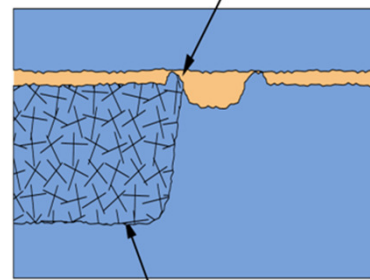


Forurening

Indtrykning fra partikler



Spændingskoncentration bag indtrykning



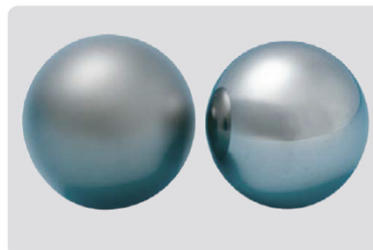
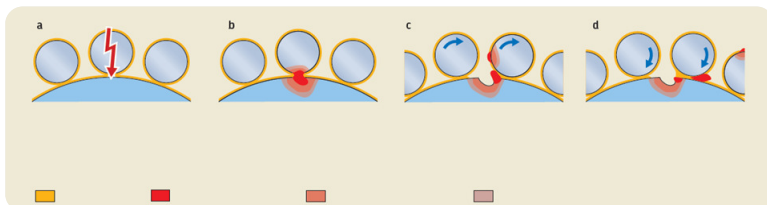
Afskaldning starter som revne under overfladen (udmattelse)

Korrosion



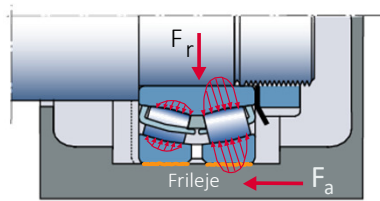
Strømgennemgang

Strømlækage og spændingsoverslag

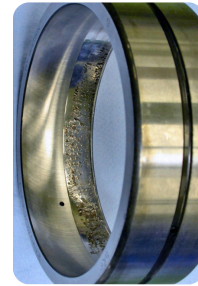


Indbygning

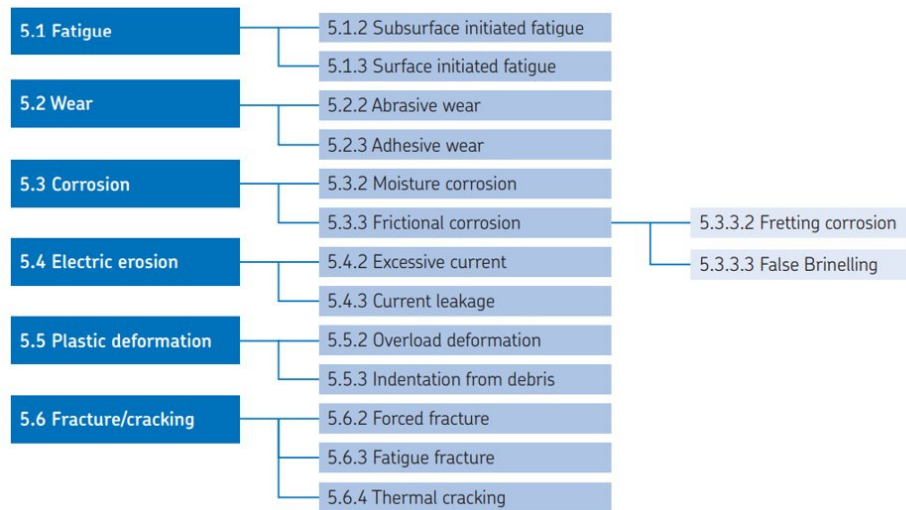
Pasningsrust



$$F_a = F_r \times \mu$$



Klassificering af lejeskader i.h.t. ISO 15243:2017



Lejeundersøgelse og korrigerende handling

Vedligeholdstrategier

Driftstimer



Havaribaseret vedligehold



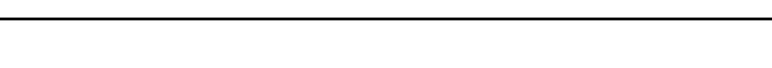
Tidsbaseret vedligehold



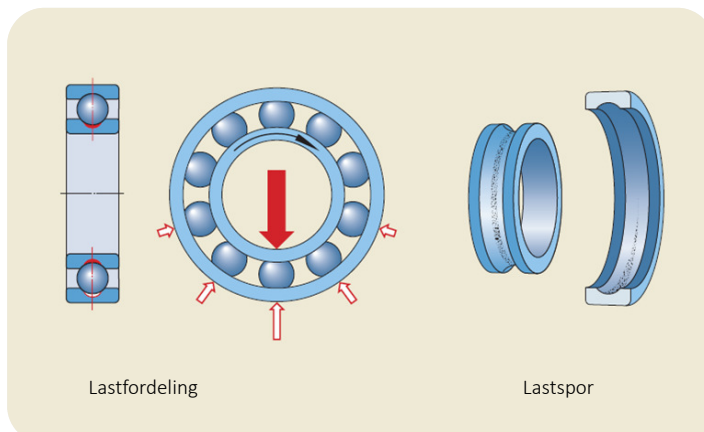
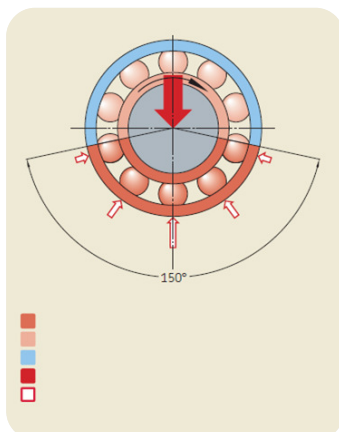
Tilstandsbaseret vedligehold

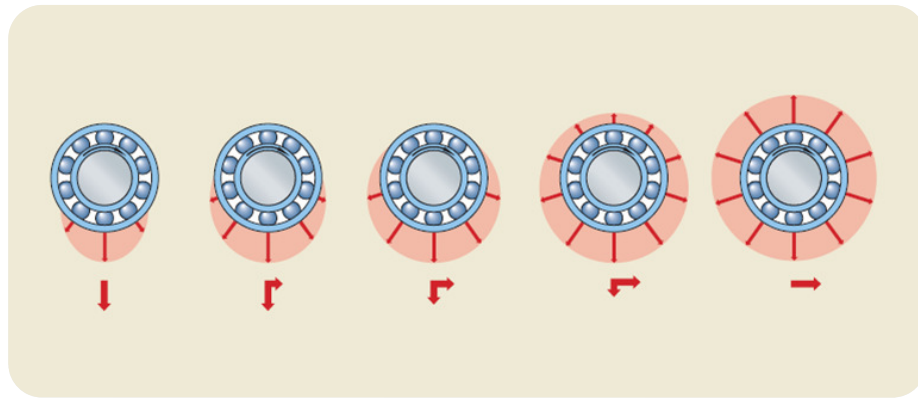


Pro-aktivt vedligehold



Lastspor og deres betydning





Visuel lejeundersøgelse

- Klassificering af lejeskader i.h.t. ISO 15243:2017
- Angivelse af mulige årsager
- Anbefaling til videre tiltag
- Sikring af spor!!





Renovering af lejer

- Large Size Bearings Remanufacturing (inner diameter above 200 mm)
- Backing Bearings Remanufacturing
- Caster Bearings Remanufacturing (open and sealed SRB & CARB)
- Slewing Bearings Remanufacturing (up to 3 m diameter in Steyr, above 3 m in France)



Large-size bearings



Backing bearings



Caster bearings



Slewing bearings



-90%
REDUCED
CARBON
FOOTPRINT

