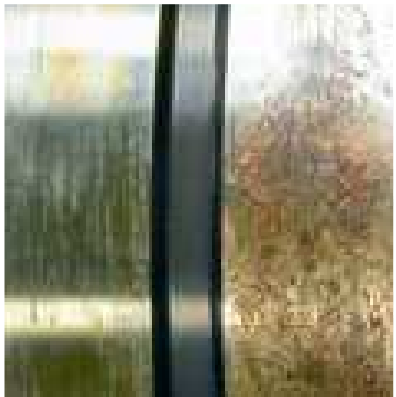
SKF troubleshooting guide for fan installations and fan bearings



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HOW TO READ THIS DOCUMENT:

This document is structured as follows:

Chapter: The basic observed problem or symptom, example,
2 Excessive noise and vibration

Section: A more targeted sub-category of the symptom, example,
2.3 Noise and vibration related to misalignment

Sub-item: Specific issue and what could have caused it, the implications, how to understand if this applies, example,
2.3.2 Coupling element damaged or distressed

- What corrective actions or checks to consider, example, Check metallic elements for wear and sufficient lubrication – Relevant SKF products, services and resources, Lubricate with SKF LMCG 1 coupling grease

1 Is your fan bearing running hot?

What is actually too hot? A bearing housing can be perceived as being hot at temperatures as low as 60-70 °C *(140 – 160 °F)*. This would certainly feel hot to the touch, however these temperatures are perfectly acceptable to a correctly lubricated bearing.

TIPS: If the temperature is increasing, check the actual bearing temperature periodically using an infrared thermometer without the need to remove guarding. It is sustained changes in temperature, or elevated temperatures beyond a certain level that are a concern. If for example a bearing housing temperature is 80 °C *(175 °F)* and over a period increases by 10% or more, there is likely an issue. If it is operating at 100 °C *(212 °F)* and there are no obvious application reasons why, then there is likely already a problem requiring investigation.

Here are some common reasons why bearings can run hot:

1.1 Hot running due to under- or overloading the bearing

While difficult to detect through inspection analysis, here are some potential causes:

1.1.1 Excessive axial load relative to radial load

It is often not feasible to identify the raceway contact zone patterns associated with excessive axial loading without at least dismounting the bearing.

If the fan impeller is properly balanced, the load zones will be 360° on the bearing inner ring raceway and 120° on the outer ring raceway, the latter due to the rolling elements only being in contact with the outer ring in the direction of the radial load. If the load is purely radial both load zones should be centred in the grooves (**Figure 1**).

If there is high axial loading, both the inner and outer ring raceways will have 360° load zones that are displaced towards opposite sides of the grooves (**Figure 2**).

- In these circumstances, verify the ratio between axial and radial load (Fa/Fr) and check if the bearing types and lubrication can cope with the running conditions
  - Contact SKF technical services for assistance with such a review and/or recommendations for improvements that could be made

1.1.2 High axial and/or radial loads

Excessive bearing loads, will cause damage to the raceway subjected to that overload (**Figure 3**). Increased fan unbalance can lead to high radial forces, outer ring rotation and housing seating wear, see **Figure 4** and **Figure 5**. Housing seating wear can cause the non-locating bearing to get stuck in the housing seating. This will lead to excessive axial loads that will cause damage to the raceway subjected to that axial overload (**Figure 3**). This is best identified by visual inspection.

- Correct the unbalance by cleaning or repair of the impeller
  - Balance the impeller using SKF maintenance tools or request balancing as a service from SKF
- Consider using a different housing, bearing combination
  - Seek advice from SKF about using a housing with a K7 fit in combination with SKF spherical roller and CARB bearings
- Check for the presence of fretting corrosion (**Figure 6**) on the outer surface of the outer ring
  - Use an anti-fretting paste like SKF LGAF 3
- For other potential remedial actions
  - Seek specialist SKF advice to eliminate the root cause, or suggest a redesign

Figure 1

Pure radial load patterns on a deep groove ball bearing on a balanced fan

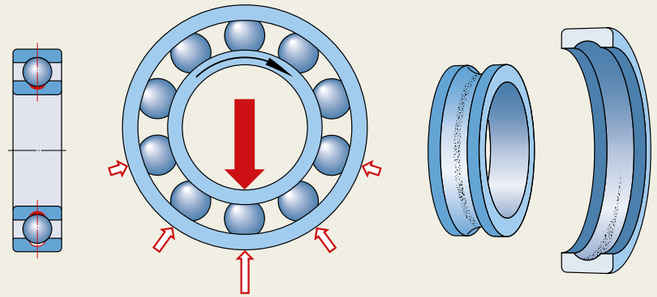


Figure 2

Axial and radial load patterns on a deep groove ball bearing on a balanced fan

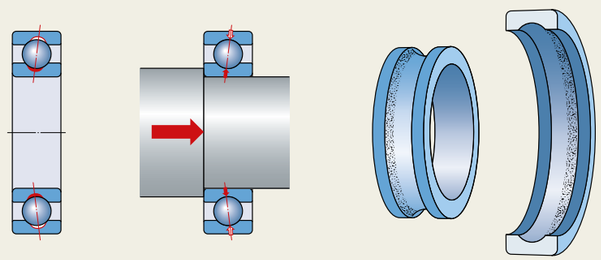


Figure 3. Excessive axial load on a spherical roller bearing, one raceway is damaged while the other is like new

Figure 4. Worn housing bore due to outer ring rotation

Figure 5. Closer view on a worn housing bore, the W33 lubrication groove pattern of the spherical roller bearing can be clearly seen

Figure 6. Fretting corrosion on the outer surface of a spherical roller bearing

1.1.3 High angular misalignment of shaft or housing

Vibration monitoring can be applied to identify if high misalignment is causing problems. This is generally identified by a high vibration amplitude corresponding at two times outer ring defect frequency.

Carry out a visual inspection:

- Seals should be checked first. For contact seals, these must touch the shaft in a uniform manner (no gap or flattened lip). For non-contact seals, verify that the gap between the seal and the shaft is uniform.
- Observe the running patterns in the bearing, these will look different depending on the bearing type. See example in **Figure 7**.

If there are indications of axial misalignment, the following corrective actions might be taken:

- Check the straightness of the fan support structure
  - Some soft foot conditions are detectable using SKF TKSA tools
- Check the straightness of the shaft
- Verify the belt tension
  - Use an SKF belt tensioner
- Align the shaft, housing and adjacent part
  - Using alignment tools, such as the SKF TKSA shaft alignment series
- Self-aligning bearing solutions might be needed
  - SKF self-aligning solutions (SKF Cooper bearings), see the SKF Rolling bearing catalogue

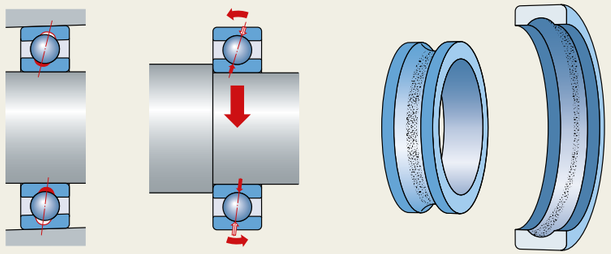
1.1.4 Too low bearing load (causing rolling elements to slide on raceways)

To run properly, bearings require a minimum load. If not, instead of rolling the elements may slide on the raceways leading to adhesive wear also known as smearing. See **Figure 8** and **Figure 9**.

- A different bearing type or arrangement might be needed, change of lubrication conditions, etc.
  - Contact SKF technical services for advice

Figure 7

Patterns caused by misalignment in a deep groove ball bearing (static load, rotating inner ring and fixed outer ring)



1.1.5 Belt transmission problem

If the belt tension is too high, bearings may run in conditions for which they were not selected, e.g. related to load and lubricant viscosity. On the other hand, if the belt tension is too low, the required minimum bearing load may not be achieved and the bearing's rolling elements may slide rather than roll, creating friction.

- See chapter 3

DON'TS IN CASE OF OVERHEATED HOUSING: common user practice is to cool the housing by using an external blower. This however can lead to housing shrinkage which can cause the bearing outer ring to get stuck in the housing, may preload the bearings and increase overheating.

- Do not excessively cool the housing, but cool the shaft instead, or find another solution to cool the system (using lubrication systems, cooling discs etc.)

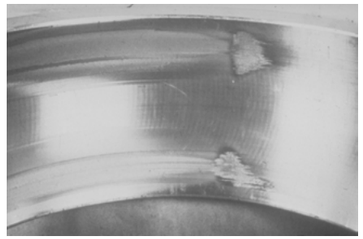


Figure 8. Smearing in beginning of loaded zone in spherical roller bearing

Figure 9. Excessive smearing in a tapered roller bearing (ring is fractured)

1.2 Hot running due to incorrect mounting, bearing or seal design issues

1.2.1 Inappropriate shaft or housing fits

Original shaft and housings fits can generally be found by referring to the fan drawings or by measuring the bearing seats with proper tools.

- Verify recommended shaft and housing seating fits
  - Recommended fits can be found in the SKF Rolling bearing catalogue
- For bearings with a tapered bore, a too high (or too low) drive-up might for example have caused preload in the bearing or inner ring rotation on the sleeve or shaft
  - Use feeler gauges, especially for SKF CARB bearings where the drive-up is controlled by measuring the radial clearance during mounting
  - Use the SKF Drive-up Method (software, hydraulic nuts). This is the preferred method as it has a higher accuracy

1.2.2 Does the bearing arrangement allow free shaft expansion?

In fan applications, there is generally a locating bearing or bearing pair which positions the shaft radially and axially. There is also a non-locating (floating) bearing which maintains the shaft's radial positioning but allows it to expand to avoid unexpected axial loads in the system, see **Figure 10** and **Figure 11**.

In case of applications with a hot running temperature, it is preferable to verify this non-locating (floating) function.

- Remove locating rings if any, from the non-locating bearing side
- Consider changing the bearing arrangement
  - Use SKF CARB bearings on the floating side so that locating rings or housings can be used similarly on both sides, see **Figure 12**

1.2.3 Detect a sealing system problem

Potential causes of seal problems can include an inappropriate material, design, lubricant compatibility or counter face. Observing that the seal lip counter face is rough is a good indication of a problem.

- A change of seal material or seal type (contact/non-contact) might be needed
  - Use the SKF Seal Selection Guide and the SKF Seal Finder online tool or seek engineering advice
- Consider improving seal lubrication: the seal may need grease during mounting or to be lubricated by oil during operation

NOTE: If problems persist, it might be that the bearing system or seals are not able to cope with the misalignment and thermal effects. Seek advice.

Figure 10

Example of arrangement with a locating bearing and a floating bearing (bearing on right can slide axially in its housing)

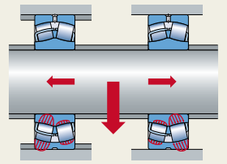


Figure 12

Bearing arrangement with a CARB

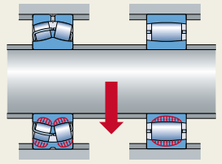
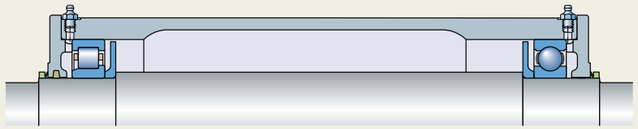


Figure 11

Non-locating function can be achieved by using specific bearings like cylindrical roller bearing or a CARB



1.3 Hot running due to bearing lubrication and cooling issues

1.3.1 Verify lubrication conditions

- Is the housing oil reservoir too shallow?
  - Check SKF recommendations for oil level
- If lubricant is leaking from the housing, refer chapter 4

Could the (re-)lubrication system be defective or blocked?

- Check pumps, piping and lubricant flow
- Check filling rate of lubrication tanks
  - Seek SKF engineering support to verify that the oil circulation system is properly designed
- Check if the oil pick-up ring is missing or damaged

Grease can be "pumped out" of a bearing due to a high pressure differential between the left and right sides of the bearing/housing.

- Avoid high air velocities near the bearing/housing, which may cause grease to be sucked out of the housing and bearings
- Use a balancing vent pipe from the labyrinth seal on one side of the split housing to the opposite side seal, to equalize pressures

1.3.2 Are re-lubrication practices and intervals appropriate?

- Verify your lubrication practices
  - Request a lubrication management assessment from SKF or an authorized distributor
- Tag grease nipples with the correct lubricant name
- Use a separate grease gun per grease type
  - See the SKF Maintenance and Lubrication Products catalogue for SKF's range of grease guns
- Adapt relubrication intervals to the level of external contamination (dust), moisture, high temperature and other conditions
  - Use the SKF Lubrication Planner application (downloadable from skf.com) to calculate relubrication intervals, see **Figure 13**

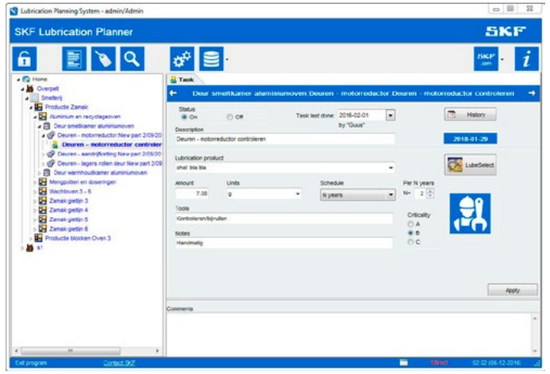


Figure 13. The SKF Lubrication Planner application

1.3.3 Incorrect lubricant choice (viscosity, consistency, especially in hot gas fans)

- If a lubricant is not mentioned in the OEM documentation, check that the lubricant being used has similar properties to the ones recommended for the application
- Check whether the actual running conditions (e.g. temperature) are the same as the design parameters
  - For an appropriate lubricant, check the online SKF lubricant selection guide
- If speed is too high, consider using bearings capable of higher speed operation and thin film lubrication
  - Use SKF Hybrid ceramic bearings

1.3.4 Insufficient heat removal from bearings

- Clean oil filters
- Install a cooling disc or other cooling device if needed
- If the problem persists, consider seeking advice regarding a change or upgrade of the lubrication system and housing, e.g. for a change from grease to oil lubrication

DON'TS OF LUBRICATION: a bearing "perceived" as running hot is often further lubricated which can make the issue worse, not better. Over greasing often results in elevated operating temperatures due to churning, seal damage and loss in sealing efficiencies.

1.4 Hot running due to general issues not directly related to bearings

1.4.1 Drive system issues

Having identified a fan bearing that is running hot, or exhibiting unusual noise or vibrations, there may be concern that the drive system will be unreliable and cause production stoppages.

- Stroboscopic examination, where the rotating equipment is illuminated by a strobe light flashing at the rotational speed of the component being examined, provides a means of visually inspecting that component for signs of wear, cracking, distortion, looseness, etc. during normal operation.
  - Use an SKF Stroboscope to check the condition and operation of belts, pulleys, coupling elements etc., see **Figure 14**

1.4.2 Hot gas leaking from impeller to shaft and bearings

- Improve the fan casing sealing solution
- Use a cooling disc

Figure 14. With SKF's range of portable TKRS stroboscopes, you can perform visual inspection of running components such as fan blades, couplings or belt drives

2 Excessive noise and vibration

A change in the “signature” of the machine (unexpected or changing noise and/or vibration, even smell) should prompt further investigation. There are a range of tools which can help in assessing machine condition, most of which are designed to be easy to use and intuitive in application. A vibration measurement tool can give as a minimum a traffic light indication of condition. Whether it is the bearing, the drive, or another component that is the source, there can be multiple causes for this.

TIPS: In general, after any troubleshooting or maintenance involving impeller cleaning or repair, belt replacement, bearing change, etc. a shaft alignment is recommended to ensure optimal performance. It is possible to use simple shaft alignment tools such as dial indicators or laser in low speed applications, if components can accept some misalignment, if this will not affect fan life or productivity or if the asset is not critical. Alignment tools like the SKF TKSA 51 are recommended. When the fan is running at high speed, if even slight misalignment is not permitted, if fan stop may affect production or cause losses, an advanced precision alignment by SKF or an SKF authorized distributor is recommended.

Do maintenance staff need training on condition monitoring and balancing? Contact SKF or an SKF authorized distributor.

2.1 Noise and vibration related to the impeller

While difficult to detect through visual inspection, here are some issues that could cause unexpected noise/vibration:

2.1.1 Dust and dirt buildup on the impeller

If buildup of particulate matter is evenly distributed over all surfaces, the resulting imbalance is minimal. However, if a piece of the built-up material detaches due to centrifugal force, then sudden and significant imbalance can occur.

- Clean the impeller and rebalance as needed:
  - Request a fan balancing service from SKF
  - Balance the rotating assembly with an advanced tool such as the SKF Microlog Analyzer
- Centre the impeller in the housing

2.1.2 Impeller getting loose on shaft or impeller blades becoming loose

- Check impeller attachment system
  - Use SKF PT hubs / shaft adapters for axial fans (hubs to be bolted or welded to fan hub and to be used with taper bushing system)

2.1.3 Worn, bent, cracked or broken vanes on the impeller

- Repair or renew the impeller then rebalance as appropriate
  - Refer 2.1.1 for SKF products and services for balancing

2.2 Noise and vibration originating from bearings

Impending bearing related issues can be detected with basic condition monitoring/vibration measurement.

- Measure vibration velocity, enveloped acceleration and temperature and trend the values
  - Use an SKF QuickCollect sensor (**Figure 15**)
- In case of recurring bearing issues
  - Request an SKF vibration analysis service to find the root cause
  - Make own checks to identify potential root causes by referring to the SKF handbook “Bearing damage and failure analysis“

A number of issues can be noticed by visual inspection and applying simple troubleshooting:

2.2.1 Are there signs of the bearing rotating on the shaft?

To identify signs of inner ring rotation on the shaft, it is necessary to inspect the inner ring faces and/or the inner bore. The presence of scoring is a clue, see **Figure 16**.

- Consult the shaft drawings and specifications (to confirm fits and geometric tolerances, hardness)
  - In case an eccentric locking collar is used: check if it was assembled correctly according to the direction of shaft rotation
- Improve the bearing locking system
  - Using for example SKF ConCentra or SKF PEER GRIP-IT concentric locking system for precise and economic locking
  - Use SKF adapter and withdrawal sleeves with SKF hydraulic nuts and drive-up method to ensure the correct interference fit
- Does maintenance staff need best practice guides and training?
  - Find appropriate methods in the SKF brochure “Bearing installation and maintenance guide”
  - Request through your distributor an SKF mounting and drive-up method training

Figure 15. Example of QuickCollect system on site

Figure 16. Circumferential scoring on inner bore

2.2.2 Is the bearing outer ring 'jamming' in the housing seating

This can cause constraint forces and vibration. An example is given in **Figure 17**.

- Check if the issue is caused by impeller imbalance and clean, repair or change the impeller as necessary, refer 2.1
- Check the extent of wear in the housing seating, see **Figure 4** and **Figure 5**
  - Select a housing with a different seating/fit tolerance. Read the guidance in the SKF Rolling bearing catalogue
  - Seek SKF engineering advice: if it might be appropriate to use a housing with a K7 fit in combination with spherical roller bearing and CARB bearings
- Check the housing geometry and the flatness of the housing support to avoid the bearing being pinched by the housing bore, **Figure 18**.
  - Refer to SKF recommendations in the SKF bearing housings catalogue.

2.2.3 Could shaft tolerances be inappropriate?

- Measure shaft dimensions and roughness, repair the shaft if needed
  - Request SKF engineering services to measure the shaft geometry
  - Use SKF Speedi-Sleeve for a quick and effective repair of a worn shaft instead of grinding the shaft

2.2.4 Has the housing moved, or are there any loose housing base bolts?

- Use the recommended torque to fix the housing to the base frame
  - Use a torque wrench or SKF HYDROCAM bolt tensioner
- Align bearing housings
  - Use SKF alignment tools, e.g. TLBA series
  - Request through your distributor an SKF mounting training

2.2.5 Is there damage or rust at the housing support structure?

- Consider thicker shims to limit both the quantity of shims used and the number of interfaces
  - Select appropriate shims from the SKF Maintenance and Lubrication Products catalogue

2.2.6 Mismatch of housing cap and base

- Ensure cap and base have matching marks

Figure 17

Illustration of unexpected axial loads due to bearings jamming in housings

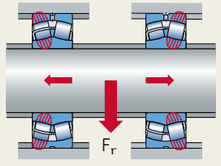
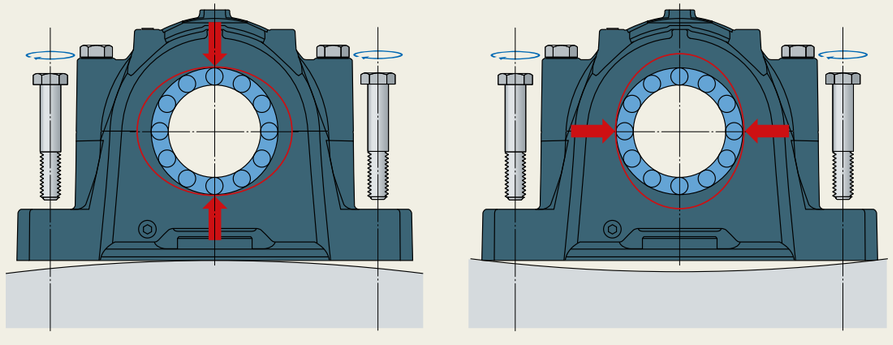


Figure 18

Illustration of poor housing support flatness



2.3 Noise and vibration related to misalignment

2.3.1 Misaligned motor coupling or belt pulley to fan shaft

- Verify coupling and shaft alignment tolerances
  - Use shaft alignment tools, such as the SKF TKSA shaft alignment series
  - Use belt alignment tools, such as the SKF TKBA belt alignment series

2.3.2 Coupling element damaged or perished

- Check elastomeric elements for damage and signs of distress and replace as required
- Check metallic elements for wear and sufficient lubrication and change if damaged (**Figure 19**)
  - Lubricate with SKF LMCG 1 coupling grease
- Check if coupling type is appropriate for the conditions

2.3.3 Soft foot issues (distorted base frame) or inadequate damping of frame

- Verify if the issue is a "soft foot" (and not misalignment or looseness) by loosening each foot bolt at a time (while the others are kept tight) and check if the vibration problem goes away
- Correct the soft foot issue
  - Use SKF Vibracon (adjustable chocks)
  - Align the shaft, using SKF TKSA shaft alignment tools

2.3.4 Bolt torque too high or low

- Verify recommended bolt grade and tightening torque
  - Use a torque wrench or SKF HYDROCAM bolt tensioner

2.3.5 Bent/deformed shaft

- Verify straightness of the shaft and if necessary, replace the shaft

TIPS: Bearing or power transmission damage such as nicks, dents, or moisture corrosion can occur during transport or as a result of inappropriate storage. Request your distributor to conduct an awareness training to prevent such damage causing later issues in the application.

2.4 Resonant vibration at a certain speed during fan startup

This can be detected using condition monitoring (high amplitudes at shaft rotation frequency) or directly heard if close to the machine when the rotating speed reaches a natural frequency of the fan assembly.

- Analyze and reinforce the support structure
  - Have SKF conduct an ODS (Operational deflection shape analysis) to understand whether too low stiffness of the base frame or support structure is the cause
- Check bearing and system stiffness and natural frequencies
  - Request SKF engineering support to establish whether too low bearing housing support stiffness or too slim and/or overhung shaft is the cause

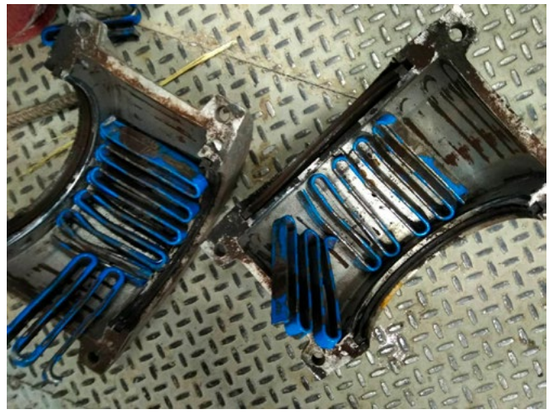


Figure 19. Wear of metallic elements in coupling, showing lack of lubrication

3 Belt transmission system issues

Once drive belts slip, they can quickly wear and consume more energy. A good indication of pulley wear is shiny “wear” in the “sheave” grooves.

There are further symptoms that can result in power transmission failures:

3.1 Belt is vibrating, wearing quickly, or overheating

3.1.1 Inappropriate belt selection

- Check if the belt type and number match the fan’s operation
  - Use the SKF tool “Belt Drive Design Calculations”
  - Find alternative options from the SKF power transmission products range

3.1.2 Belts are not properly tensioned, are worn out, or damaged

- Change belts if they are heavily worn
- Verify belt tension and correct
  - Use SKF belt tension testing tools (**Figure 20**)

3.1.3 Misalignment of belt to pulley

- Align pulleys with adequate tool
  - Use SKF belt alignment tools (TKBA series)

3.2 Worn sheaves and pulleys

- Check profile and wear of pulleys/sheaves
  - Use an SKF pulley gauge (**Figure 21**)
- Check and correct belt tension
  - Use an SKF belt tension meter

Figure 20. SKF belt frequency meter

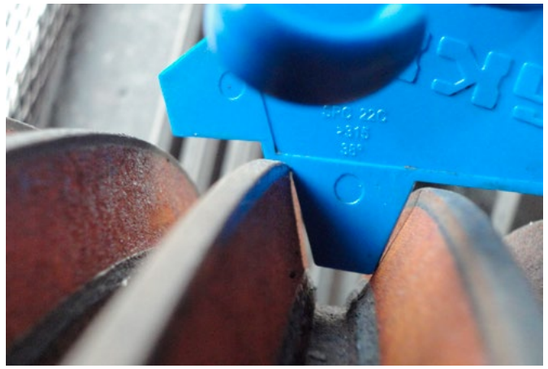


Figure 21. SKF pulley gauge

4 Leakage of lubricant

4.1 Lubricant leakage through seal

4.1.1 Seal is worn and needs replacement

- Replace seal, checking for options with better wear resistance under the operating conditions, including compatibility between lubricant and seal material
  - Use SKF Seal Select to identify options suitable for the operating conditions
- Protect the housing seal with an extra cover

4.1.2 Shaft is worn

- Change to an a different seal type or material
- Repair shaft; confirm shaft hardness recommendations
  - Use an SKF Speedi-Sleeve (**Figure 22**) to repair the seal lip seat without grinding the shaft

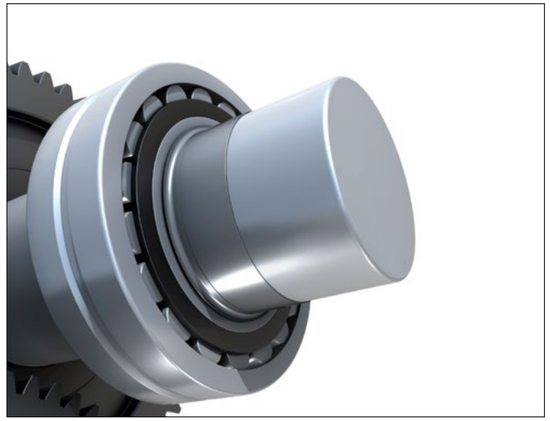


Figure 22. SKF Speedi-Sleeve

4.1.3 Excessive initial grease fill or re-greasing

This can cause excess lubricant to leak through the seal, in the long term this will reduce seal effectiveness.

- Use only the recommended lubricant quantity for the initial fill
- Improve greasing practices, filling precision, and intervals
  - Use a grease gun with a measuring device, such as SKF’s range of grease guns & grease pumps – see the SKF Maintenance and Lubrication Products catalogue
  - Verify relubrication quantities and intervals, using online tools such as SKF DialSet software

4.1.4 Excessive running temperature

This results in lubricant losing viscosity and consequential leakage.

- Address the root causes of elevated temperatures – Section 1

4.1.5 Inadequate seal for a vertical shaft arrangement

- Select a more appropriate seal
  - See the SKF catalogue “Industrial Sealing Solutions”

4.1.6 Impeller is “sucking” oil out of the housing due to improper sealing

Implement actions or mount protections to prevent this phenomenon.

- Reduce pressure differentials or use seals with a ventilation hole
- If there is a ventilation hole (“breather”) check that it is not blocked
- Select a better seal arrangement
  - See the SKF catalogue “Industrial Sealing Solutions”

4.2 Lubricant leaking from split/flanged surfaces of housing or end cover

4.2.1 Housing base and cap contacting surface not matching correctly

- Use sealant to prevent oil leakage or water ingress
- Clean housing split surfaces
- Avoid mix-up of cap and base by applying markings on components
  - For SKF housings, check that the numbers on the side of the housing base and cap are the same
- See also Section 2.2.4, “Has the housing moved...”

4.2.2 Poor mounting - wrong end cover adjustment or bolt tightening

- Check mounting instructions and practices

4.2.3 No drain hole for old grease or oil

- Drill evacuation holes if needed
  - SKF housings have marks for this purpose

4.2.4 Oil return pipe for oil circulation not working properly

- Verify pipe dimensions and inclinations
- Conduct a lubrication assessment to verify that the oil circulation is properly designed
  - Seek SKF engineering support

4.2.5 Wrong lubricant flow in housing

Wrong flow, viscosity, etc. can lead to poor draining of lubricant from the housing.

- Check the positioning of the lubricant feed and exit points.

4.2.6 Housing is not suitable for actual lubrication type

- Housing might be originally designed for grease or oil lubrication is used
  - Seek SKF engineering advice regarding appropriate housing and seal design for running and lubrication conditions

4.3 Rusty coloured fluid leaking from bearing or housing seating

4.3.1 Inadequate housing or shaft fit tolerances

This can cause fretting corrosion and give rise to the rusty colour. See also the patterns showing “rotation of bearing on shaft” and related troubleshooting – Section 2.2.1.

- See “Poor fixture of housings to base frame” – Sections 2.2.4 and 2.2.5
- Fretting corrosion can also be caused by “impeller” unbalance and “inadequate” housing “base” stiffness. See “Hot running due to bearing overload or underload” – Section 1.1

4.3.2 Axial movement of outer ring in housing due to shaft thermal expansion

- See Section 1.1

4.3.3 Wrong geometry of housing inner bore surface

- To avoid distortion, ensure the housing is supported over the entire mounting surface, i.e. not just by shims at bolt locations
  - Select appropriate shims from the SKF Maintenance and Lubrication Products catalogue
- Verify that the flatness and roughness are according to SKF recommendations
  - Refer to the SKF bearing housings catalogue

5 Highly contaminated lubricant

5.1 Highly contaminated grease (by particles or moisture)

5.1.1 Poor sealing

- Use sealed bearings if possible
  - Use SKF sealed and pre-greased bearings such as sealed spherical roller bearings
- See “Hot running due to incorrect mounting, bearing or seal design issues” – Section 1.2

5.1.2 Grease nipples or lubricant feeds are dirty

- Clean grease nipples prior to relubrication
- Install plastic caps on grease nipples

5.1.3 Contamination during maintenance, installation and tool storage

- Check cleanliness of grease guns and other maintenance tools
- Organize and store tools in a clean room (Think 5S - workplace organisation method using , “sort”, “set in order”, “shine”, “standardize” and “sustain”)
- Improve practices and knowledge of personnel
  - Perform a lubrication practices audit with SKF
  - Use SKF’s maintenance tools to reduce bearing & grease exposure to contaminants and minimise maintenance time (see the Maintenance and Lubrication Products catalogue referenced in the Appendix)

5.2 Highly contaminated oil

5.2.1 Oil filters not effective

- Change oil filters

5.2.2 Contaminated piping or oil reservoir

- Remove contamination, increase pipe dimensions, or improve oil filtering

TIPS: If a certain level of contamination cannot be avoided and bearing life is too short, consider using hybrid ceramic bearings from SKF.

6 Other (general fan system issues)

6.1 Poor airflow

6.1.1 Fan impeller related issues

- Check impeller orientation and direction of rotation
- If rotation is in the wrong direction, check the supply connections to the electric motor
- Fan impeller not centred in its housing, bearing housings are not aligned, wrong shaft centring
- Incorrect vane design, missing cut-off

6.2 Fan ducting and fan performance curve issues

6.2.1 Ducting too large

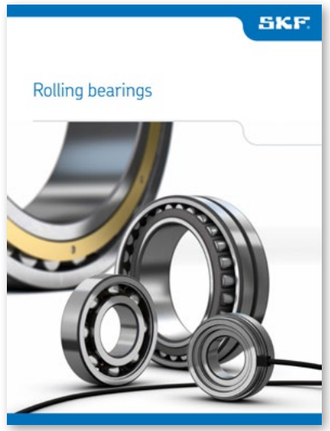
- Check if there are pulsations of the air column in the duct work

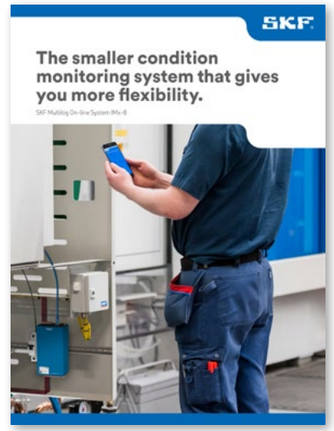
6.2.2 Obstructed air flow in the piping system

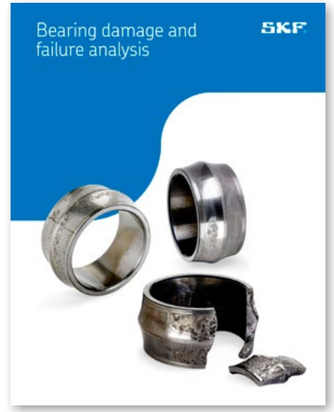
6.2.3 Running too far away from the BEP (best efficiency point)

6.2.4 Resonant pulsations (standing waves) due to blade/vane pass frequency

7 Key references and brochures







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