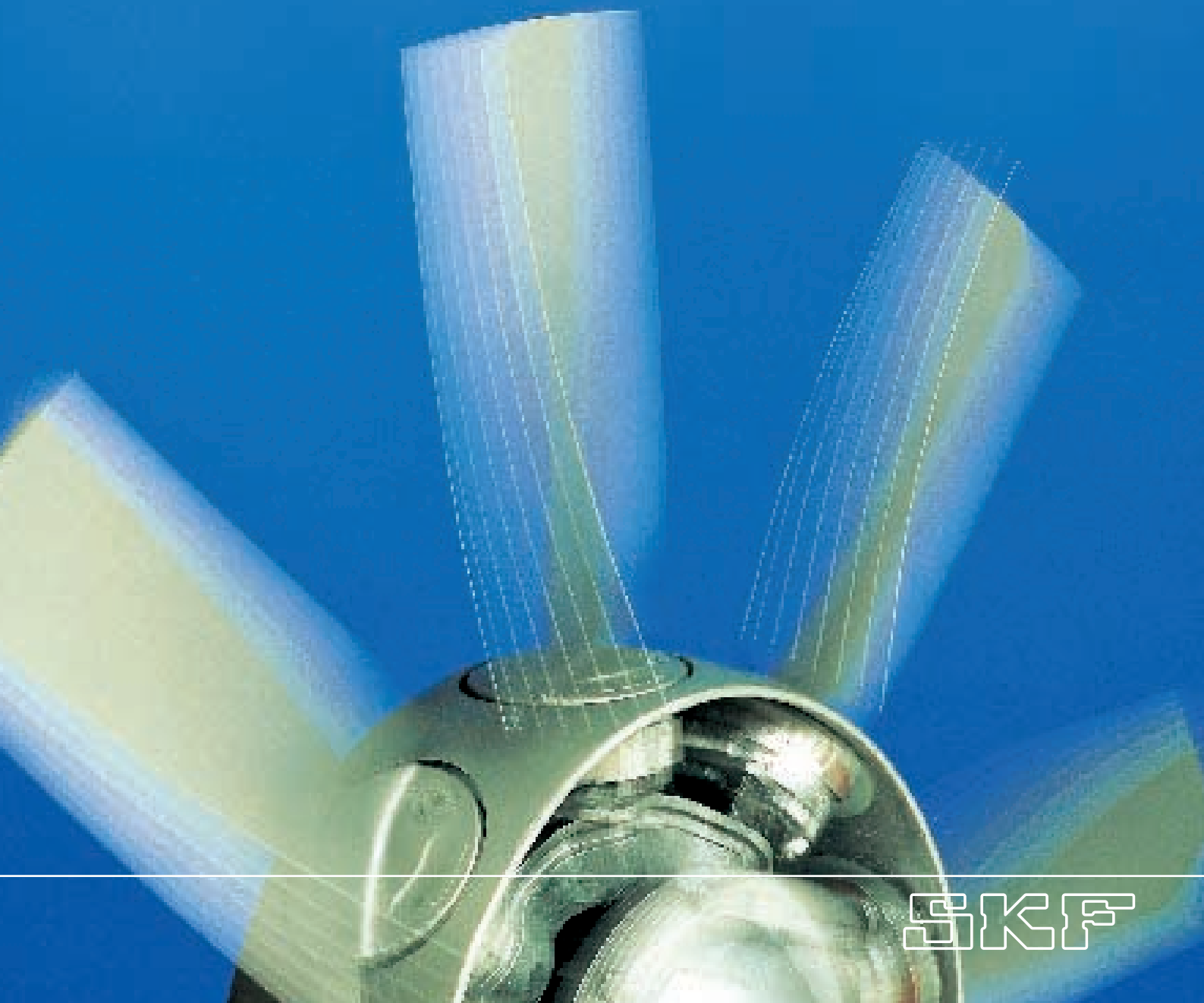
• Highest reliability • Optimum performance • Minimised maintenance costs •

The better bearing solution for industrial fans



SKF

Yesterday's solutions

The most common bearing solution for industrial fans, until now, has been to use two double-row self-aligning bearings in separate plummer block housings – either self-aligning ball bearings for light loads and high speeds, or spherical roller bearings for heavy loads and moderate speeds.

These bearing solutions allow a wide range of operating conditions, whilst accommodating the misalignment which inevitably occurs in such a machine due, for instance, to machining tolerances, assembly errors, or deflection under load. However, they have one shortfall: in order to allow axial expansion of the shaft due to changes in temperature etc., the outer ring of one bearing on each fan shaft (the "free" or "non-locating" bearing) must be able to slide axially inside the housing.

In order to achieve axial sliding, the housing bores are machined to give a loose fit for the bearing. This is a major compromise in the design, since with the typical light and imbalanced loads which often occur in fans, a tight fit would be preferred to prevent the bearing outer ring turning in the housing, and thus avoid extra vibration, temperature, and wear of the housing.

Even more importantly, a loose fit does not guarantee that the bearing will slide easily; due to friction between the bearing and housing as a result of radial load, some axial (thrust) force is generated within the bearing system. *This thrust force creates vibration and high temperatures, resulting in reduced bearing life.* This occurs to some extent even under ideal ("normal") operation.

If external factors such as corrosion, wear, deflection, distortion or machining/mounting errors on the support surface mean that the bearing outer ring is prevented from sliding, then the real friction will be much higher, and the effect on the bearing system much more severe (see fig 1).

Today's solutions

The disadvantages/compromises with the old bearing system solution can be avoided completely by replacing the non-locating bearing with CARB®, the toroidal roller bearing from SKF. The spherical roller bearing or self-aligning ball bearing at the locating position remains as before.

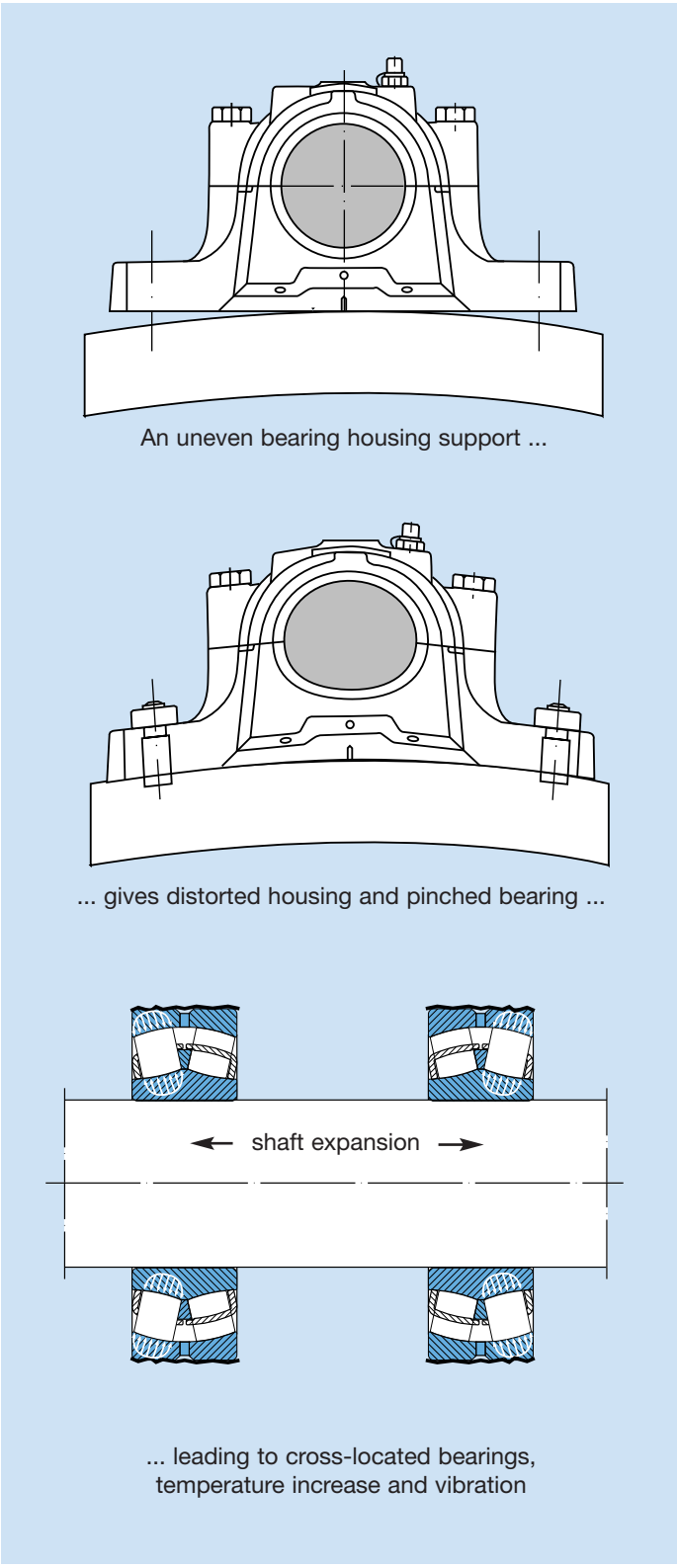


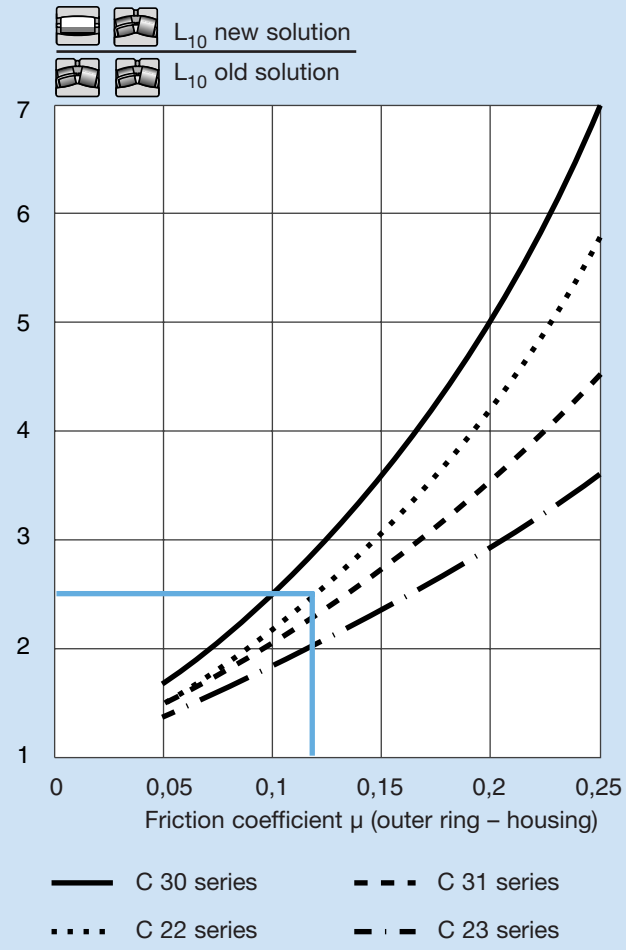
Fig 1 *An uneven housing support may cause problems when not using CARB bearings*

CARB is a purely radial bearing, and cannot carry any axial loads. It accommodates the axial expansion within the bearing itself, with negligible friction, at the same time as it allows misalignment. Therefore, the typical high vibration levels, elevated temperatures, and reduced bearing lives seen in fans, are avoided.

CARB toroidal roller bearings can be used with the same standard housings and accessories as other self-aligning bearings. An extra benefit is that tight fits may be used in the housings, eliminating wear and further reducing vibration levels. This is done with no adverse effects on the bearings.

SKF standard housings, such as SNL plummer blocks, can be supplied with non-standard bore tolerances on request to give the bearing outer ring a tight fit.

Fig 3 shows comparative calculated combined fatigue (L_{10}) lives of an optimised bearing arrangement using one spherical roller bearing and one CARB toroidal roller bearing, and a conventional bearing arrangement using two spherical roller bearings. The chart assumes no externally applied loads on the system and that the coefficient of friction between the "free" spherical roller bearing and housing remains constant. The actual coefficient of friction is very hard to determine; a normal assumption for an "ideal" bearing housing is that $\mu = 0{,}1 - 0{,}15$. It does however vary significantly. Higher values of μ are common and if the bearing becomes jammed in the housing, then μ will be greater than 1,0.



Example: A bearing arrangement using one CARB toroidal roller bearing (C 2220 K) and one spherical roller bearing (22220 EK) is compared with an arrangement using two spherical roller bearings (22220 EK). $\mu = 0{,}12$. Life increase is then 2,4 times (see diagram).

Fig 3 *This bearing system life comparison shows that a toroidal roller bearing arrangement always has a higher basic rating life than an arrangement with only spherical roller bearings due to the absence of axial loads generated within the bearing system*

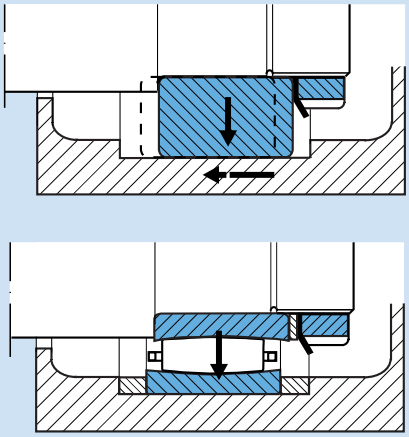


Fig 2 *Non-locating arrangement with and without CARB toroidal roller bearing. The toroidal roller bearing arrangement does not induce any axial loads*

SKF recommended bearing solution for industrial fans – the complete package

- Locating bearing: spherical roller bearing or self-aligning ball bearing
- Non-locating bearing: CARB toroidal roller bearing
- Standard housings (optional tight fits)
- Locating rings
- Adapter sleeves / lock nuts
- Seals
- Lubricants
- System 24 automatic lubricators
- Condition monitoring equipment

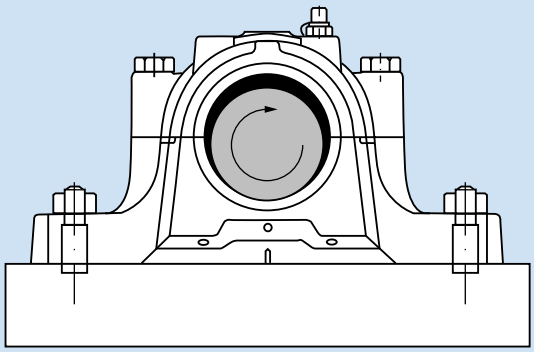


Fig 4 *When not using a CARB toroidal roller bearing, loose fits in housing are used to allow the "free" bearing to move axially. The disadvantages of this method are a risk of the outer ring turning in its seating, causing wear of housing and vibration*

Benefits of CARB toroidal roller bearing in industrial fans

- true free/held bearing arrangement
  The internal axial freedom of a toroidal roller bearing eliminates the risk of failure from outer rings sticking in the housing bore due to distortions from non-flat mounting surfaces. Outer rings are axially fixed and can have a light press fit in the housing bore, reducing the risk of creeping as a result of unbalanced loading.
- reduced vibration and noise
  Momentary axial load changes or changes in gas temperature will not lead to increased axial vibrations, due to the absence of inter-action between the locating and non-locating bearings.
- less sensitive to minimum load
  The design allows the bearing to function properly where the applied loads are typically lighter than those required by similar size spherical roller bearings.
- lower operating temperature
- longer service life
- improved grease life
- less sensitive to imbalance
  Imbalance loads in fans can produce wear of housings with loosely fitted bearings – CARB toroidal roller bearings can be mounted with a tight fit thereby eliminating housing wear
- uses the same standard housings as spherical roller and self-aligning ball bearings

Note: ***Both*** *the non-locating* and *locating bearings benefit from all these improvements*

Vibration comparison of axial flow fan rebuilt to use CARB toroidal roller bearing

Reference case

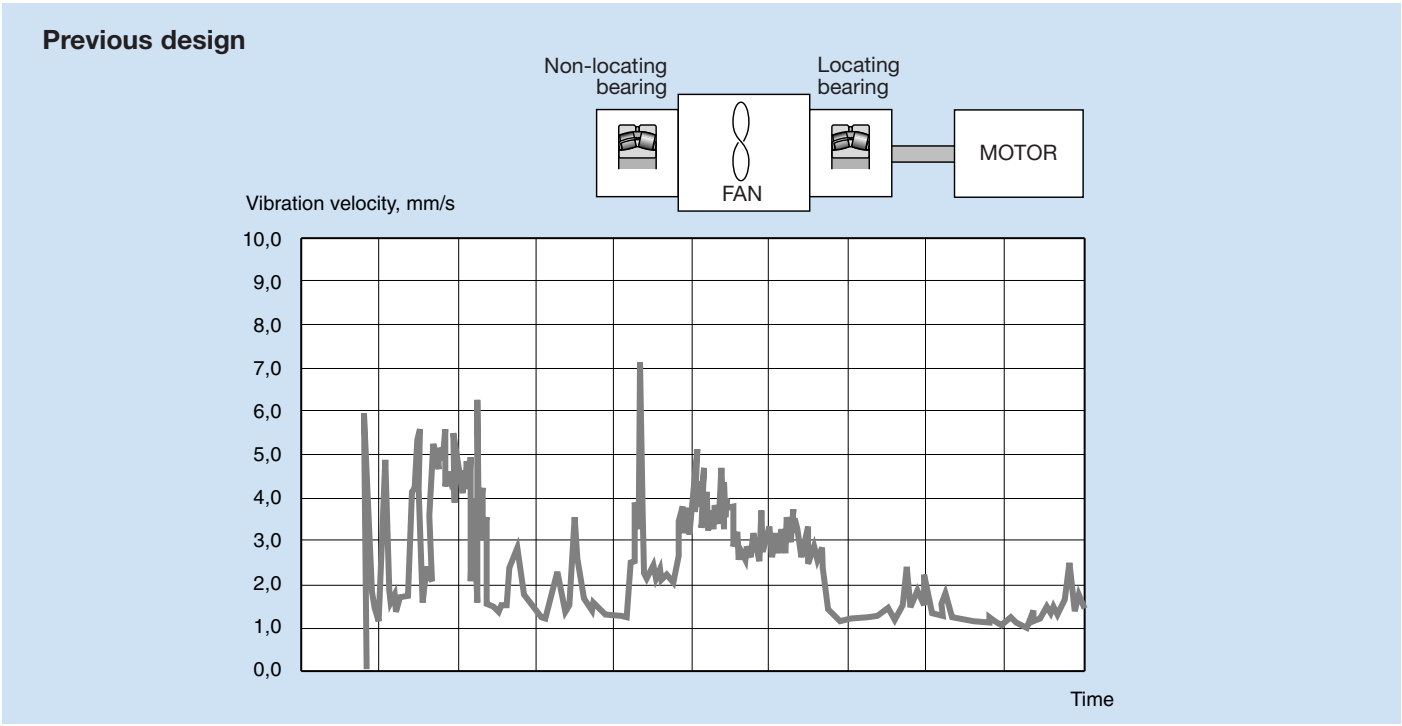


Fig 5 *Axial vibration, using two spherical roller bearings. Intermittent high peaks*

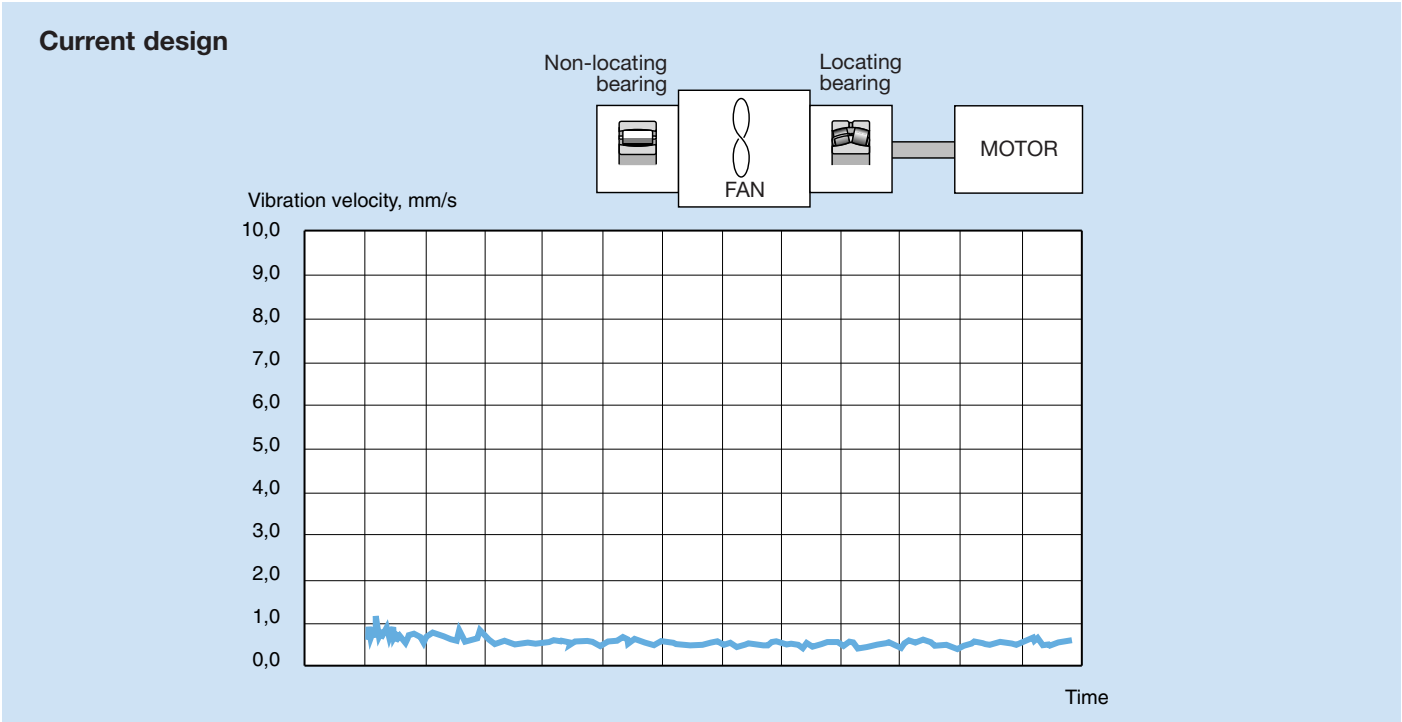


Fig 6 *Axial vibration, using one CARB toroidal roller bearing and one spherical roller bearing. Reduced overall level, no high peaks*

Examples of SKF optimised fan bearing arrangements

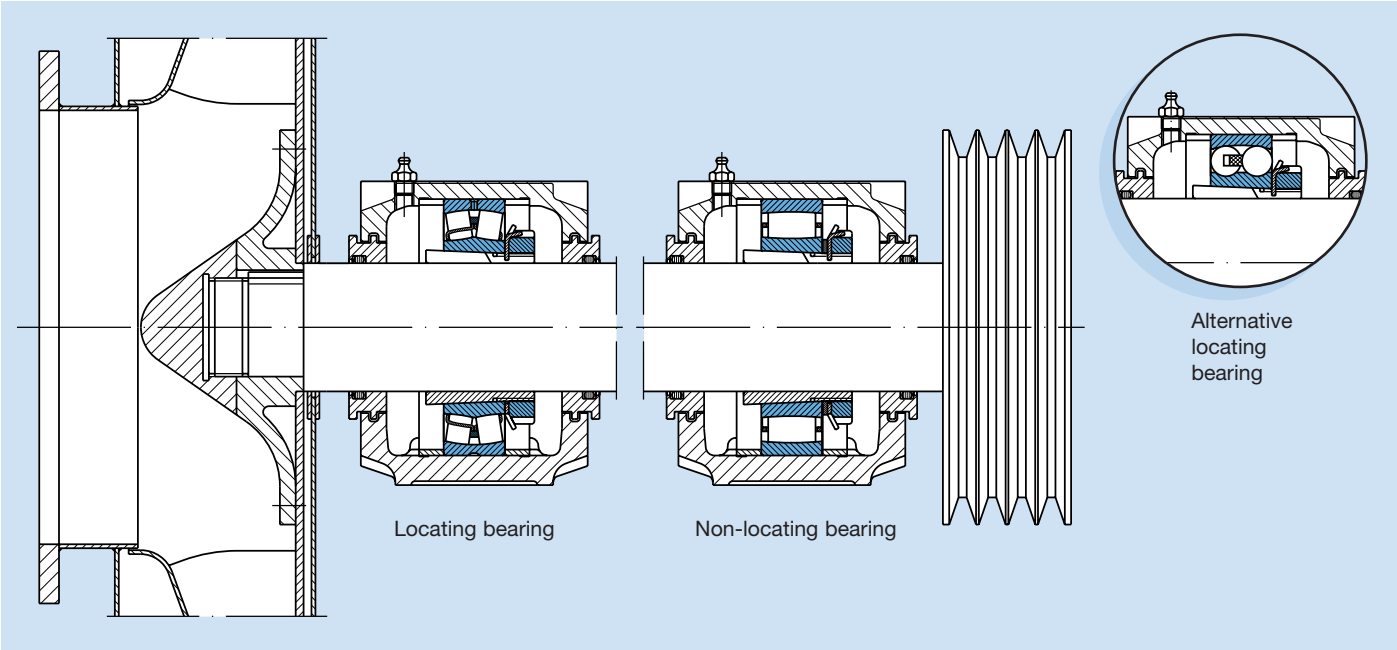


Fig 7 *Overhung centrifugal fan, pulley drive, plummer block housing*

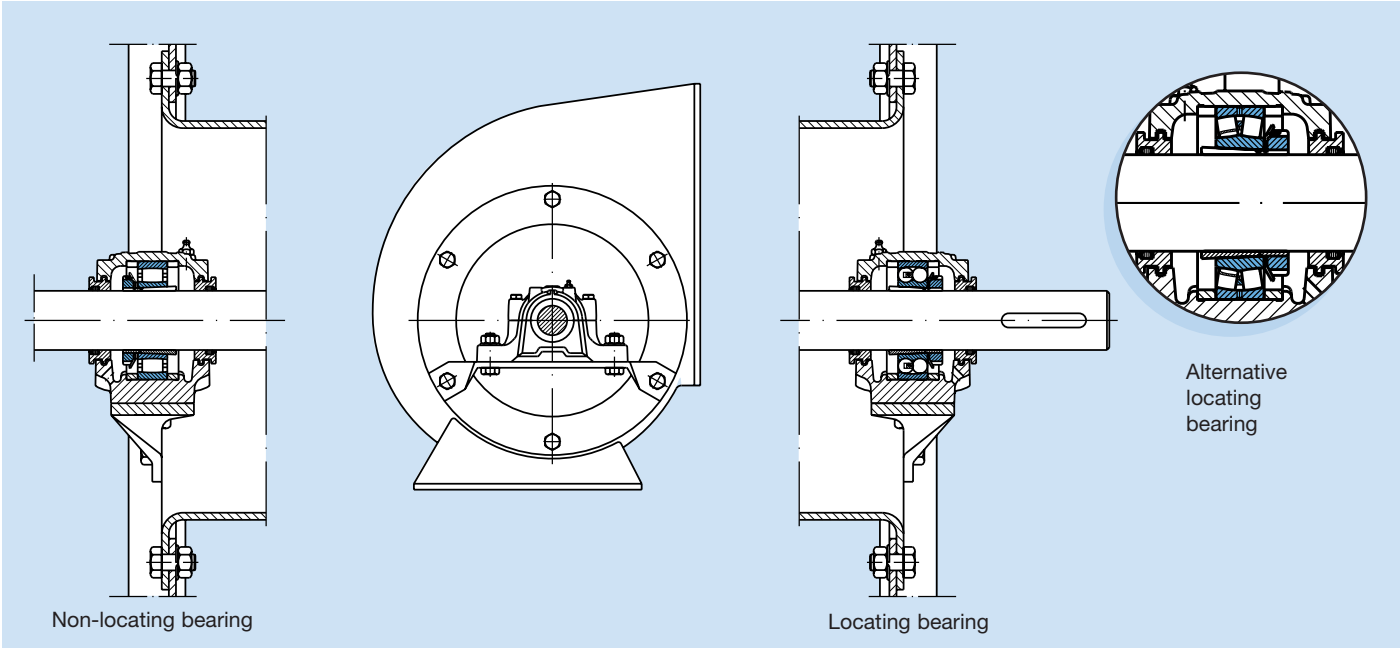


Fig 8 *Straddle-mounted centrifugal fan, plummer block housing*

List of components before and *after* a CARB redesign	Non-locating →	*Non-locating*	Locating →	*Locating*
Plummer block housings	• SNL/SD/SAF • Spherical roller bearing or self-aligning ball bearing • Sleeve • Seals	• *SNL/SD/SAF* • *CARB toroidal roller bearing* • *Sleeve* • *Seals* • *Locating rings*	• SNL/SD/SAF • Spherical roller bearing or self-aligning ball bearing • Sleeve • Seals • Locating rings	*as before*

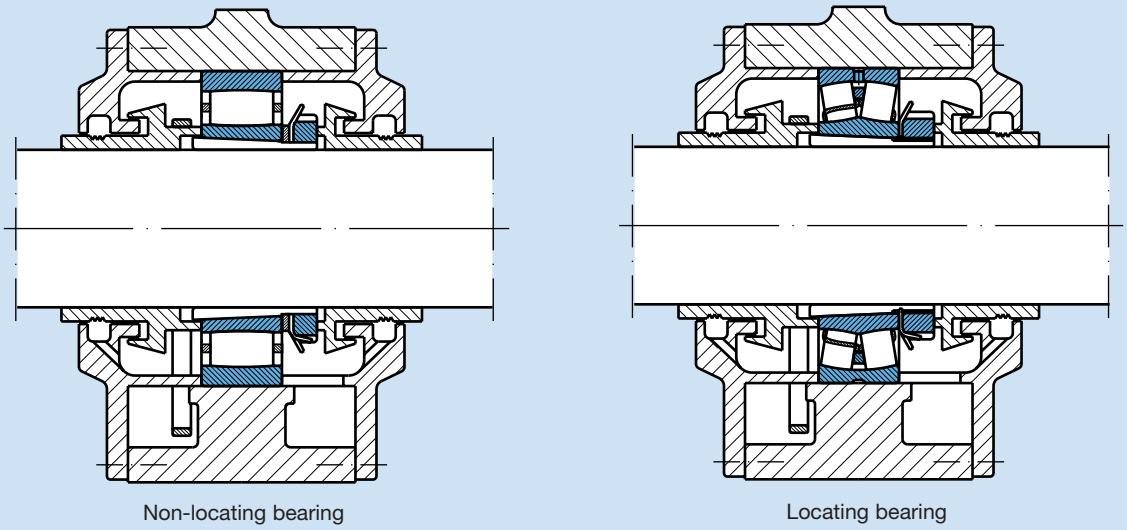


Fig 9 *Overhung centrifugal fan, coupling drive, SOFN housing*

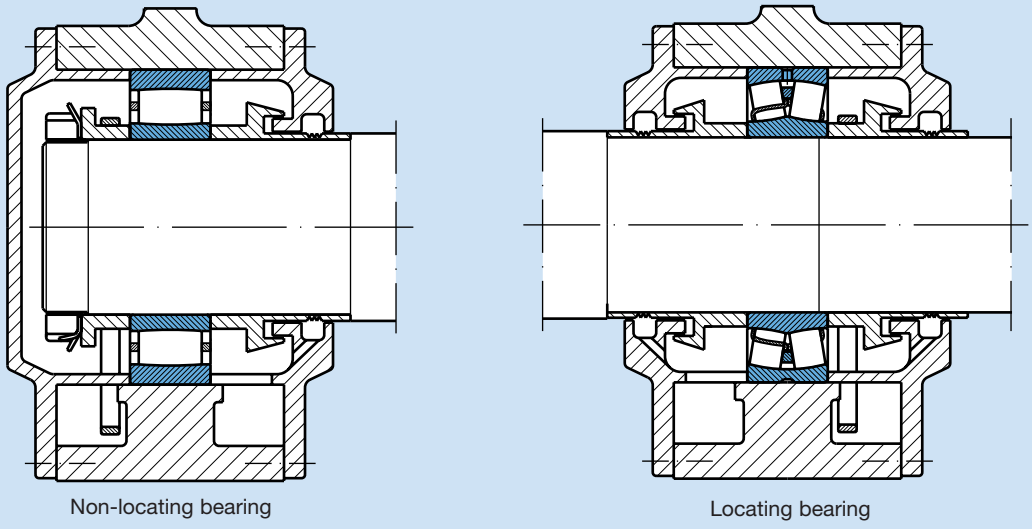


Fig 10 *Straddle-mounted centrifugal fan, SOFN housing*

List of components before and *after* a CARB redesign **SOFN and one-piece housings**	**Non-locating** →	***Non-locating*** • *SOFN "F"* or • *SOFN "L"* • *CARB toroidal roller bearing* • *CARB toroidal roller bearing* • *Sleeve* • *Sleeve* • *Spacer*	**Locating** →	***Locating*** *as before*
	• SOFN "L" • Spherical roller bearing • Sleeve		• SOFN "F" • Spherical roller bearing • Sleeve	

For more information and advice, please refer to the following SKF publications, or contact your local SKF office or distributor.

TI 1046	*CARB® roller bearings*
4691	*Mounting, dismounting and grease lubrication of CARB® bearings*
4727	*The optimum bearing system in SKF standard housings*
4667	*Ref. case: CARB® in sugar mill hot gas fan*
4688	*Ref. case: CARB® in a recirculating hot gas fan*
4689	*Ref. case: CARB® in paper mill hot gas fan*
4791	*Ref. case: No more wear and vibration problems in fan after upgrading to CARB®*
4792	*Ref. case: CARB® increases service life for vertical fan*
4403	*SNL plummer block housings solve the housing problems*
MP323	*SKF System 24 Lubricator*

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