SKF
SKF Shaft Alignment Tool TKSA 40
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Alignment

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6

Introduction

Alignment of drives and driven machinery is an important activity during initial installation and maintenance. Machine alignment is crucial in preventing premature bearing damage and subsequent damage to other components. The cost to align machines properly is small, relative to escalating maintenance costs, should a critical piece of equipment fail.

Alignment is required for:

- shafts
- offset drives, e.g. cardan shafts
- drive belts (pulleys)
- rolls and cylinders, e.g. in paper machines

The principal procedures employed for shaft, offset drive and belt alignments are presented in this chapter.

The benefits of accurate alignment include:

- extended bearing service life
- extended seal service life
- extended coupling service life
- extended maintenance intervals
- improved energy efficiency
- lower vibration and stress levels

For additional information about alignment of shafts, offset drives and belts, as well as information about roll and cylinder alignment, visit www.aptitudexchange.com or www.skf.com.

The SKF Reliability Maintenance Institute (RMI) offers a comprehensive range of training courses in alignment techniques (→ *Training*, starting on **page 326**). Contact your local SKF representative for additional information, or visit www.skf.com/services.

Shaft and belt alignment tools as well as machinery shims are available from SKF Maintenance Products (→ **Appendix K**, **page 419**). For additional information, visit www.mapro.skf.com.

SKF has experienced alignment services teams. For additional information, visit www.skf.com/services.

Machine installation and alignment

Proper alignment of drives and driven machinery depends largely on the quality of the machine installation. An optimal installation contributes to a quick and easy alignment process with precision results.

To achieve optimal installation, several aspects deserve consideration:

- foundation quality
- alignment targets
- soft foot
- shimming
- bolt tightening

Foundation quality

The key element when installing a machine is to provide a foundation that supports and maintains alignment between components under dynamic conditions. Whether it is a new machine installation or an existing machine being re-aligned, SKF recommends the following:

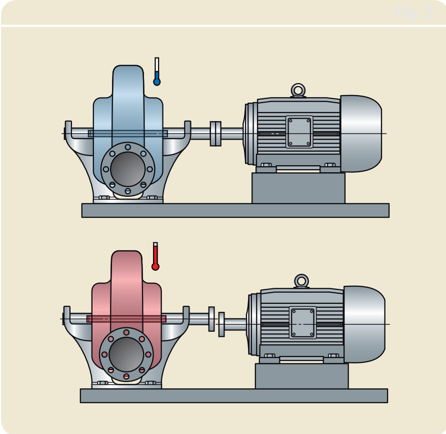
1 Inspect the foundation for cracks, deterioration and damaged bolt holes, and repair if necessary.
2 Remove existing shims and chocks. If they are not damaged, inspect them for rust and clean them, if necessary, before reuse.
3 Remove any rust, paint or oil from the foundation mounting surface.
4 Replace any existing attachment bolts if they are rusted or have thread damage.
5 Check the flatness of the foundation with a laser. The flatness should be within IT7 tolerance grade.

NOTE: All repair work should be completed before starting any alignment procedures!

Alignment targets

Machine components heat up and expand during operation (→ **fig. 1**). This is referred to as thermal expansion and depends on the material and temperature of the machine.

Generally, machine designers calculate thermal expansion and specify alignment parameters to compensate for it. These parameters are provided typically as coupling offset values or adjustment values at the machine feet.



In addition to any instructions given by the machine designers, SKF recommends aligning machines when they are stable in temperature relative to the foundation, casings and ambient temperature. Before starting with alignment, the temperature difference between the machine casings and their foundations should not exceed 10 to 15%. Also, make sure that the alignment targets take the real temperature into consideration (as they are often based on an assumed ambient temperature).

Soft foot

Soft foot (→ **fig. 2**) refers to a condition where a machine does not rest solidly on its foundation. Soft foot is typically caused by:

- damaged foundations, especially those that are cracked
- distorted or damaged machine base frames that rest on only part of their surface
- faulty shimming

Types of soft foot

There are two types of soft foot (→ **table 1**)

- parallel soft foot
- angular soft foot

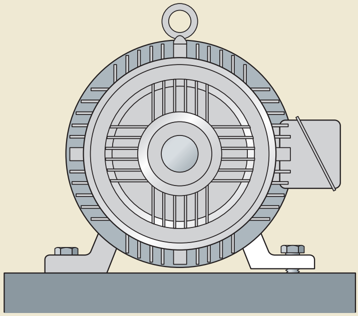
A soft foot condition makes vertical alignment impossible, since the machine can move during the precision alignment stage. Tightening the attachment bolts to compensate for soft foot can distort the machine housing, causing improper alignment that can result in premature bearing failure.

Both parallel and angular soft foot can be resolved using SKF Vibracon SM elements. For additional information, refer to the section *Shimming*, starting on **page 163**.

Checking for soft foot

Checking for soft foot is best achieved by using feeler gauges and registering four values per foot. With this method, the values and the type of soft foot can be determined with good precision.

Fig. 2

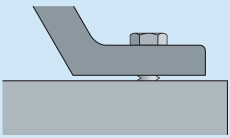


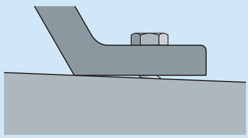
To determine if there is a gross soft foot problem, SKF recommends using laser methods.

For additional information, refer to the relevant section *Shaft alignment*, starting on **page 167** or *Belt alignment*, starting on **page 176**.

Table 1

Types of soft foot





Description	**Parallel soft foot** The machine foot is parallel to the machine base frame but does not rest on it. Also known as "short foot".	**Angular soft foot** Only part of the machine foot rests on the machine base frame. Also known as "angled foot".
Correction	Remove the gap by adding shims. Use SKF Vibracon SM elements to prepare the mounting surface for the machine (→ *SKF Vibracon SM elements*, **page 164**).	Adjust the angle or add a customized chock (wedge). Use SKF Vibracon SM elements to prepare the mounting surface for the machine (→ *SKF Vibracon SM elements*, **page 164**).

Shimming

Shimming is the method used to fill the gap between the support surface and the machine base frame. Shimming devices include:

- machinery shims
- adjustable steel levellers, e.g. SKF Vibracon SM elements (→ **fig. 3**)
- customized rigid steel chocks
- epoxy resin

The shimming process varies depending on the type of shim selected. Some shims are designed to establish the proper mounting plane for new installations or repair applications. Others are used to correct soft foot in preparation for the realignment of an existing machine.

Machinery shims

Machinery shims are thin alignment elements used to accurately adjust the overall height of a machine or to compensate for parallel soft foot. Shims are fitted between the machine feet and the support surface (→ **fig. 4**).

SKF recommends using shims made of stainless sheet steel with sufficient strength and the ability to withstand corrosion from several media. Shims made from inappropriate materials such as copper or brass are generally too soft and will plastically deform. This causes looseness and leads to possible alignment problems over time.

SKF supplies machinery shims in the TMAS series in five different sizes, each with ten different thicknesses (**tables 2a** and **2b, page 164**) for attachment bolts up to 52 mm in diameter. These pre-cut single slot shims are made of high-quality stainless sheet steel and are manufactured to close tolerances for accurate alignment. The shims are supplied in sets of ten, each marked individually with its thickness.

CAUTION: Where possible, use only one shim. Do not stack more than three shims. Doing so increases the number of mating surfaces, influencing the recommended bolt elongation. For more information about bolting, refer to the section *Bolt tightening* on **page 166**.

Fig. 3

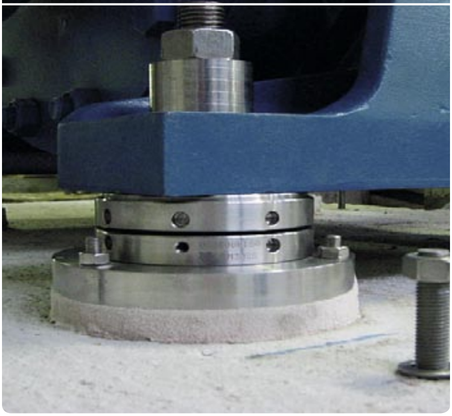


Fig. 4

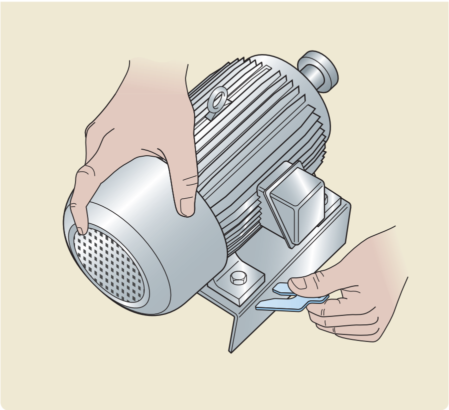


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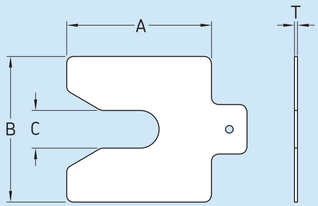
Table 2a

SKF Machinery shims TMAS series



Designation[1) 2)]	Dimensions A	B	C	T[2)]
–	mm			
TMAS 50-xxx	50	50	13	xxx
TMAS 75-xxx	75	75	21	xxx
TMAS 100-xxx	100	100	32	xxx
TMAS 125-xxx	125	125	45	xxx
TMAS 200-xxx	200	200	55	xxx

1) 10 shims per set
2) xxx refers to the shim thickness (→ **table 2b**)

Table 2b

Shim thickness

Designation	Dimension T	Tolerances
–	mm	
005	0,05	± 0,010
010	0,10	± 0,020
020	0,20	± 0,025
025	0,25	± 0,025
040	0,40	± 0,030
050	0,50	± 0,030
070	0,70	± 0,040
100	1,00	± 0,040
200	2,00	± 0,045
300	3,00	± 0,150

SKF Vibracon SM elements

SKF Vibracon SM elements are ready-to-mount, universal height adjustable steel units that provide a good mounting plane, especially in cases where soft foot may be a problem.

Standard SKF Vibracon SM elements (→ **fig. 5**) are manufactured in two designs for attachment bolts from 12 to 65 mm diameter:

- SKF Vibracon original (**a**)
- SKF Vibracon low profile (**b**)

CAUTION: SKF Vibracon SM elements are not designed for lifting machinery! In these cases, SKF recommends using low height hydraulic cylinders or jacks.

Detailed instructions for installing SKF Vibracon SM elements are supplied with the elements.

Customized rigid steel chocks

Customized rigid steel chocks (slotted elements) should only be used in repair applications and under conditions where:

- the adjustment height is too low for SKF Vibracon SM elements
- the adjustment height is too high for machinery shims
- angular soft foot is present

The design and size of customized chocks (→ **fig. 6**) depends on the application conditions, e.g. machine weight and foundation type.

Epoxy resin

Epoxy resin is used mainly to align propulsion machinery. Epoxy resin is typically cast between the foundation and the machine base frame (→ **fig. 7**) and is suitable for height adjustments ranging from 15 to 100 mm.

Appropriate resins have a relatively short curing period, good compression resistance and good resistance to extrusion and thermal shocks. SKF recommends using Epocast 36, a two-part epoxy, as base material.

For additional information about epoxy resins, contact the SKF application engineering service.

Casting epoxy resin

Clean the support surface area of all paint and dirt. Score the support surface, creating undercuts. Drilling shallow holes at various angles in the support surface achieves the same result. This attaches the epoxy to the foundation.

Set the sleeve in position through the foot of the machine and into the foundation. Build a plywood or foam dam around the foot of the machine, using caulk to seal between the dam and the support surface. Apply parting agent to the sleeve, machine base frame and the dam. Fill the dam with resin until it is just above the bottom of the foot.

Fig. 5

a) SKF Vibracon original

b) SKF Vibracon low profile

Fig. 6

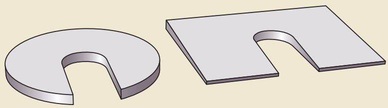
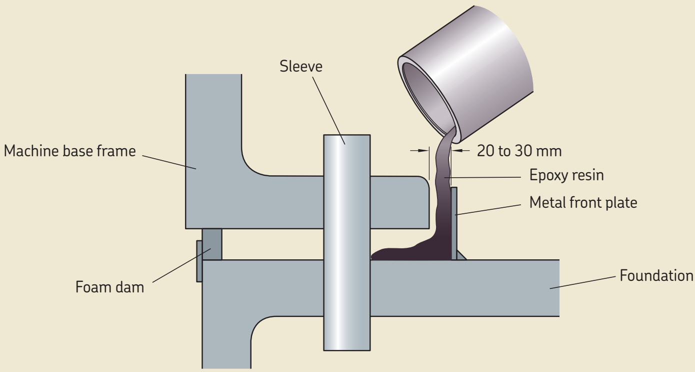


Fig. 7



Bolt tightening

Applying the correct torque value to a bolt during machine installation is extremely important. Improper torque values can lead to machinery movement during operation. This can cause misalignment of the shaft, which will eventually lead to premature damage to bearings and other components.

Generally, the machine designer does not determine the torque values. If these are not available from the machine owner, contact the SKF application engineering service.

Tightening torque and assembly preload

Attachment bolts should be tightened to a maximum bolt tension of 75% of the yield strength.

Tightening tools

All bolts and nuts should be tightened with an accurate torque wrench (in at least two stages) or a hydraulic bolt tensioner. For large bolts, SKF recommends using HYDROCAM hydraulic bolt tensioners (→ **fig. 8**), whenever possible. These tensioners enable bolts to be installed accurately without the need of a torque wrench. The tensioners also provide uniform assembly preload or uniform bolt elongation.

CAUTION: Tightening bolts with manual tools is inaccurate and does not provide reproducible results.

HYDROCAM hydraulic bolt tensioners

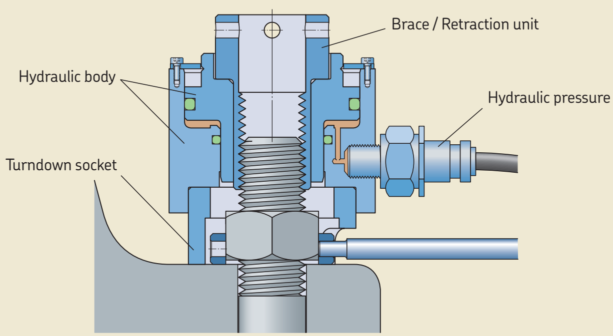
HYDROCAM hydraulic bolt tensioners are suitable for tightening bolts that have an end protruding above the tightening nut. Cold extension is applied to the bolt by means of an annular hydraulic body placed around it. The bolt is subjected to an axial traction load only.

The stress-free nut is then turned down with very little effort and does not transmit any torque to the bolt. When the fluid pressure is released in the tensioner, the major part of the hydraulic load on the tensioner is transferred into the nut, and tightening is completed.

For optimum accuracy, SKF recommends performing traction of the bolt and turning-down of the nut twice.

For additional information about HYDROCAM hydraulic bolt tensioners, contact the SKF application engineering service.

Fig. 8



Shaft alignment

All shafts, straight or offset, rotate about an axis called the rotational centre. In any power transmission application, the most efficient energy transfer occurs when two connected shafts are collinear, i.e. when the rotational centres of the shafts form a single straight line under normal operating conditions. Any deviation from this collinear state is referred to as misalignment.

The benefits of properly aligned shafts include:

- minimized induced bearing loads that result in longest bearing service life
- reduced wear on belts, pulleys, couplings and seals that result in extended maintenance intervals
- reduced friction losses, noise and vibration levels that result in improved energy efficiency
- reduced shaft bending that results in lower vibration and stress levels

Types of misalignment

There are two main types of shaft misalignment (→ **fig. 9**):

- offset (parallel) misalignment (**a**)
- angular misalignment (**b**)

In practice, both types of misalignment often exist simultaneously.

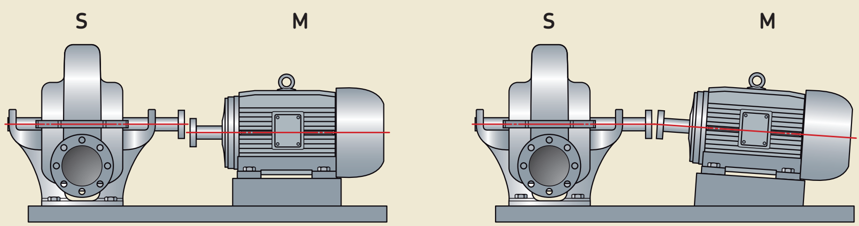
Measuring conventions

Stationary and movable machines

When aligning two machines, one is designated the stationary machine (S) and the other, the movable machine (M) (→ **fig. 9**). In most cases, the stationary machine is the driven unit. Adjustments are then made to the movable machine, typically a motor.

Sometimes, it is necessary to move both machines. For example, when the movable machine is either base- or bolt-bound, the stationary machine is moved slightly to enable precision adjustments of the movable machine.

Fig. 9



a) Offset misalignment
Offset misalignment is the deviation between two shaft rotational centres, measured at the plane of power transmission from the drive to the driven unit (measured in millimetres at the coupling). The direction of the offset should always be specified.

b) Angular misalignment
Angular misalignment is the difference between the slopes of the drive and driven unit shafts, usually represented by the offset per coupling diameter (mm/mm). An angular tolerance expressed in mm / 100 mm can be applied to all shafts, regardless of the coupling diameter.

Alignment parameters

Misalignment is measured in two planes (→ **fig. 10**):

- horizontal (side-to-side, along the x-axis)
- vertical (up and down, along the y-axis)

Each alignment plane has offset and angular components, so there are actually four alignment parameters to be measured and corrected:

- horizontal offset
- horizontal angularity
- vertical offset
- vertical angularity

Measuring positions

To define the various measuring positions during the alignment process, the analogy of a clock, as viewed facing the stationary machine (S) from behind the movable machine (M), is used (→ **fig. 11**). The position with the measuring units standing upright is defined as the 12 o'clock position, while 90° left and right are defined as the 9 and 3 o'clock positions respectively. The 6 o'clock position is opposite the 12 o'clock position (not shown).

As shown in **fig. 12**, measurements taken in the vertical plane, i.e. in the 12 or 6 o'clock position, are used to determine the vertical misalignment (**a**). Vertical misalignment is any misalignment when viewed from the side that is corrected by making height adjustments at the front and rear feet of the movable machine.

Fig. 10

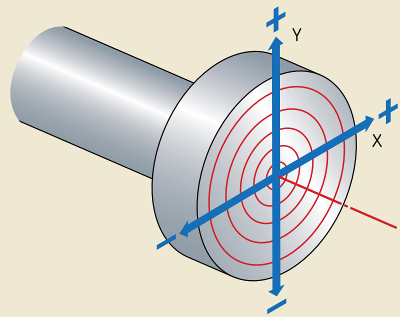


Fig. 11

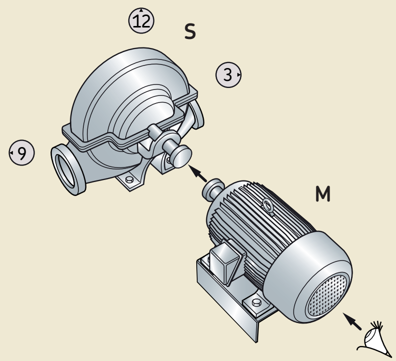
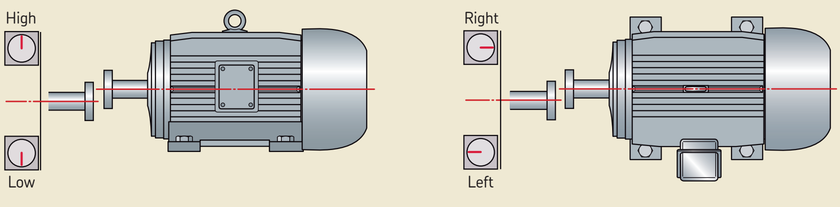


Fig. 12



a) Vertical misalignment

b) Horizontal misalignment

Measurements taken in the horizontal plane, i.e. in the 9 or 3 o'clock position, are used to determine the horizontal misalignment (**b**). Horizontal misalignment is any misalignment when viewed from the top that is corrected by sliding the movable machine sideways.

Shaft alignment tolerances

Shaft alignment tolerances are more commonly based on the rotational speed of the shaft than on the shaft diameter or specifications from the coupling manufacturer.

The machine designer is responsible for specifying the required alignment accuracy. However, if no specifications are available, the tolerances provided in **table 3** are commonly accepted. These tolerances are not related specifically to bearing type, machine size, driven speed or equipment type and should be used as a guideline only.

To compensate for thermal expansion, equipment manufacturers may publish thermal offset values that take the thermal growth during initial alignment into consideration. They will also take other factors into consideration for the alignment target. For example, for the horizontal alignment of a shaft in a gearbox, the gearbox arrangement and the various component functions can be used to determine whether the target is dependent on a specific component.

NOTE: Accurate shaft alignment generally becomes more critical as speeds increase.

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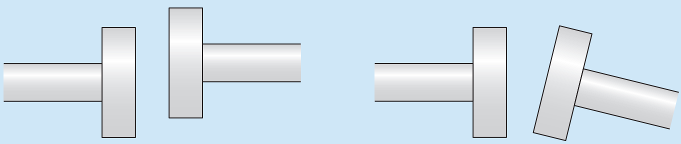
Table 3

Guidelines for shaft alignment tolerances



Rotational speed		**Tolerances**[1]			
		Offset misalignment		Angular misalignment	
over	incl.	Excellent	Acceptable	Excellent	Acceptable
r/min		mm		mm / 100 mm	
–	**1 000**	0,07	0,13	0,06	0,10
1 000	**2 000**	0,05	0,10	0,05	0,08
2 000	**3 000**	0,03	0,07	0,04	0,07
3 000	**4 000**	0,02	0,05	0,03	0,06
4 000	**6 000**	< 0,02	0,03	< 0,03	0,05

[1] Tolerances vary depending on the bearing type, machine size and other design factors.

Shaft alignment methods

There are various methods for aligning the shafts of two machines. Some of the principal shaft alignment methods are compared in **table 4** and described on **pages 170** to **173**.
SKF recommends using laser technology whenever possible.

NOTE: During alignment, measurements can be taken at the shaft end or at the half coupling rim. For the sake of simplicity, only the half coupling rim is mentioned in the following procedures. For information about alignment parameters and measuring positions, refer to the section *Measuring conventions*, starting on **page 167**.

Traditional shaft alignment methods

Traditional alignment methods are quick but often inaccurate. With these methods, mechanical tools such as straightedges, tape measures, wire, string, feeler gauges, spirit levels and calibrated cones are used.

Dial indicator methods

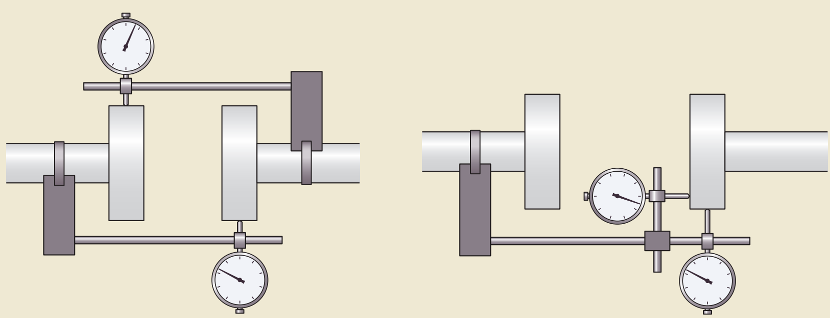
Dial indicators are used for two fundamental alignment methods (→ **fig. 13**):

- reverse rim method (**a**)
- rim-face method (**b**)

The reverse rim method is preferred because it is a "true" shaft alignment method. With this method, two dial indicators are used to take measurements on both half coupling rims to determine the shaft offset between the stationary and movable machines.
With the rim-face method, one set of measurements is taken on the rim of the half coupling to determine the the shaft offset. The other set of measurements is taken on the face of the half coupling to determine the shaft angularity.

CAUTION: Be careful not to miss a full revolution of the dial!

Fig. 13



a) Reverse rim method

b) Rim-face method

Table 4

Shaft alignment methods

Type	Method	Usage	Advantages	Disadvantages
Traditional	Straightedge	Rough alignment	Simple equipment Direct readings Relatively quick	Inaccurate Readings rely on naked eye approximation and the accuracy of the half coupling face Several repetitions are required
Dial indicator	Reverse rim	Precision alignment, when laser equipment is not available	Good accuracy Alignment is performed with all coupling elements in place Offset and angularity measurements can be taken at the same time	Requires specialized skills Time-consuming Adjustment calculations are required
	Rim-face	Checking shaft runout Precision alignment, when laser equipment is not available	Good accuracy Suitable for large couplings and where space is limited	Requires specialized skills Time-consuming Adjustment calculations are required
Laser	Single laser	Precision alignment	Accurate in angular measurement over short distances Values automatically calculated by the equipment	Method susceptible to backlash when moving the uncoupled machines Re-measuring is required after each move, as the reference is lost
	Twin laser, e.g. using SKF Shaft alignment tools	Precision alignment for large and small shafts and for measuring distances of up to 10 m	Excellent accuracy Specialist operators are not required Displays real time alignment values and updated corrections as the machine is adjusted Facilitates alignment over long distances	The closer the distance between the measuring units, the less accurate the angular alignment measurement becomes

Laser shaft alignment methods

Laser alignment equipment makes shaft alignment faster and more accurate than any other method.

There are two types of laser systems used for alignment:

- single laser system
- twin laser system

The single laser system has a single laser beam and electronic detector with a single or double target. The twin laser system features a laser emitter and detector unit, and is based on the reverse rim dial indicator method.

Equipment featuring the twin laser system, such as SKF Shaft alignment tools (→ **fig. 14**), is strongly recommended.

CAUTION: Do not allow welding activities near laser alignment equipment or on the machine where the laser is attached. This can damage the laser diodes and electronics.

Twin laser method using SKF Shaft alignment tools

Checking alignment using SKF Shaft alignment tools is very simple and easily done. The process typically consists of:

- securing the measuring units to the shaft
- connecting the display unit
- measuring distances A, B and C (→ **fig. 15**) and entering the values in the display unit
- setting the measuring units

Fig. 14

Fig. 15

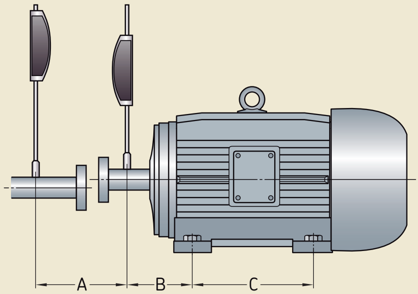
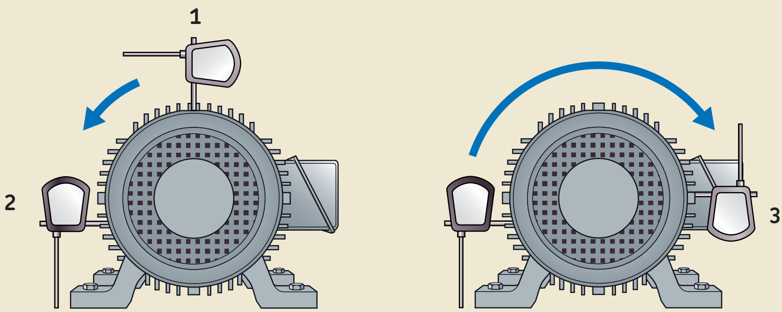


Fig. 16



- determining the machine feet adjustment by taking measurements with the laser beams in three different positions 1, 2 and 3 (→ **fig. 16**)
- using shims to make the necessary adjustments

Detailed instructions for use of SKF Shaft alignment tools are supplied with the equipment.

CAUTION: Readings from laser systems are affected by variables such as heat, light and vibration. To confirm the alignment, SKF recommends taking the measurements again, using the above steps.

The alignment process

The alignment process is very important. SKF recommends a multi-stage process (→ **fig. 17**) designed to secure the quality of the end result.

1. Preparation

Preparation is an important stage in the alignment process as it enables the alignment activities to be carried out smoothly. The problem definition, initial scope of work, conditional instructions, and task responsibilities should be clearly defined.

The result of the preparation stage is that all known information is stated clearly on a job card, and all tools and materials required for the inspection activities are available at the site.

2. Inspection

The goal of the inspection is to capture all data that describes the "as-is" condition of the machine. Examples of typical inspection activities include:

- Inspect the support surface and machine base frame.
- Measure soft foot.
- Measure the runout of both shafts.
- Establish which unit is stationary and which unit is movable.
- Select the alignment measurement method and prepare the measuring equipment.

For additional information about these activities, refer to the section *Machine installation and alignment*, starting on **page 161**.

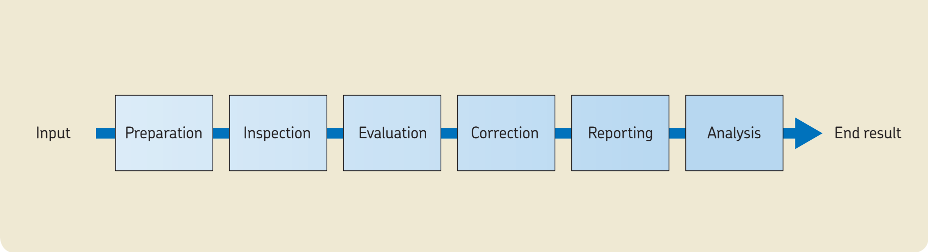
3. Evaluation

Compare the "as-is" condition with the "desired" condition of the machine and have the responsible persons decide on the appropriate actions on the measured deviations.

NOTE: Some deviations will not be corrected immediately after the evaluation stage. It is important to retain the information for these findings so that it can be used to initiate corrective action in the future. An additional risk assessment can be done to justify any delay in the corrective action.

The result of the evaluation stage is a clear decision on each finding, authorized by the responsible persons, about what corrective actions should be taken and the reason behind each decision. Each task is defined, and all tools and materials required for the alignment are available at the site.

Fig. 17



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> **WARNING**
> To minimize the chance of serious injuries, prior to making any corrections, perform required lockout/tagout procedures.

4. Correction

Make initial corrections to minimize misalignment and improve the accuracy of the precision alignment measurements.

During rough alignment, the objective is to get the machines' shaft centrelines aligned sufficiently to enable a precision alignment measurement. There are no rules for how accurate the rough alignment measurement should be. In general, about 1 mm vertical and horizontal offset and about 0,1 mm / 100 mm vertical and horizontal angularity are considered "rough". To meet these requirements, one of the traditional alignment methods can be used (→ *Traditional shaft alignment methods*, **page 170**).

To achieve the required precision for shaft alignment, SKF recommends using a laser alignment system (→ *Laser shaft alignment methods*, starting on **page 172**). Where laser equipment is not available, dial indicators can be used.

NOTE: Test running the machine is an important part of alignment correction. A final measurement should be taken after the test run to make sure that no further corrections are necessary. A conformance check is strongly recommended.

SKF recommends checking the shaft alignment of newly installed equipment after three to six months of operation. This is due to "settling" of the support surface(s), and/or chocks/shims. In general, shaft alignment should be checked annually.

5. Reporting

Information gathered during the correction stage is usually not in a useable format. Therefore, a reporting stage is necessary.

The purpose of the reporting stage is to develop a clear, unambiguous document containing all the relevant data (in a suitable format) necessary to make further analyses. The time it took to complete the alignment and the resources used, as well as any deviations from standard procedures should be included.

6. Analysis

In the final stage of the alignment process, the comparison between the "as-is" condition and the "desired" condition of the machine is analyzed. The machine history (former reports and specifications) as well as the machine benchmarks (or other comparable data) can be used to draw conclusions about the root cause of any deviations.

The analysis is an opportunity to identify additional improvements and perform a cost benefit analysis for the future.

Offset drive alignment

In an offset drive, power is transferred from the drive to the driven unit by an offset, intermediate shaft. Often referred to as a cardan shaft, an offset drive typically has a universal joint at each end of the shaft.

The most common cardan shaft arrangement is the Z-configuration (→ **fig. 18**), typically used in the paper industry.

Why offset drives need to be aligned precisely

It is a common misconception that offset drives can tolerate a large alignment error and therefore do not need to be precision aligned. On the contrary, poorly aligned offset drives can lead to increased vibration levels, energy loss, premature wear and even complete failure through shearing.

To compensate for these undesirable results, offset drives require equal deflection angles in the joints and precision alignment of the drive and driven shafts.

Fig. 18

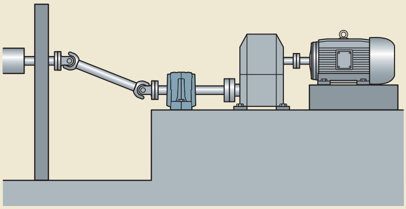
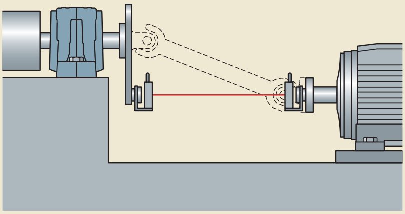


Fig. 19



Offset drive alignment tolerances

The accuracy of a laser offset drive alignment procedure is dependent on the half coupling face of the stationary machine, i.e. the rectangularity between the face and the rotational centre. Typically, an angular misalignment within 0,50 mm / 1 000 mm is acceptable. This is achievable in most circumstances provided there are no base- or bolt-bound conditions.

Offset drive alignment methods

In offset drive alignment, correction of the angular misalignment is important, while offset misalignment is irrelevant.

There are various methods for measuring offset drive alignment. Traditional alignment methods, such as straightedges, cannot provide the desired level of accuracy. SKF recommends using laser technology, whenever possible.

Laser offset drive alignment methods

The trick to aligning offset drives is to cancel the offset by creating a virtual or "dummy" rotational centre, parallel to the driven shaft (→ **fig. 19**).

Rough alignment is achieved using a cardan fixture kit and a suitable twin laser shaft alignment tool.

Detailed instructions for use for laser alignment equipment are supplied with the equipment.

Belt alignment

Belt alignment or, more precisely, pulley alignment, is a principal maintenance activity. When pulleys are not aligned properly, additional loads are induced. The aim of belt alignment is to align the grooves of the drive and driven pulleys so that the belts run with minimal wear.

The benefits of properly aligned belts include:

- extended service life of belts and bearings
- reduced vibration and noise levels
- energy savings

Types of belt misalignment

If the grooves of the pulleys are not in line with each other, the belts are misaligned. There are three types of belt misalignment (→ **table 5**). In practice, more than one type of belt misalignment can exist at the same time.

CAUTION: Unless belt misalignment is corrected, a new belt will last no longer than the one it replaced!

Belt alignment tolerances

Belt manufacturers typically recommend a maximum horizontal angle misalignment from 1,0 to 0,25°. This accuracy can only be achieved with precision alignment tools such as laser equipment.

Belt alignment methods

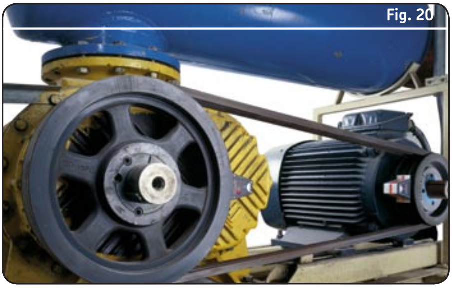
There are two ways to align pulleys: Traditional and laser. The principal belt alignment methods are compared in **table 6** and described below.

SKF recommends using laser technology, whenever possible.

Traditional belt alignment methods

Traditional alignment methods are quick but often inaccurate. With these methods, mechanical tools such as straightedges, tape measures, wire, string, feeler gauges, spirit levels and calibrated cones are used.

Fig. 20



Laser belt alignment methods

In contrast with traditional belt alignment tools, laser equipment enables measurements and adjustments to be made with incredible precision.

Laser belt alignment tools are grouped according to the parts of the pulleys that are aligned:

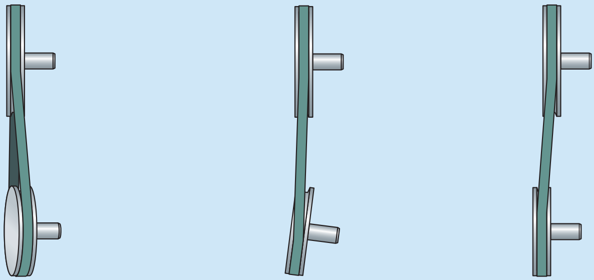
- the pulley grooves
- the pulley faces

Laser systems that align the pulley grooves, such as the SKF Belt alignment tool (→ **fig. 20**), provide superior accuracy to those that align the pulley faces. Aligning the pulley grooves is also preferred because pulleys of different thickness, brand, type or face quality can still be aligned accurately.

Detailed instructions for use of the SKF Belt alignment tool are supplied with the equipment.

Table 5

Types of belt misalignment



	Vertical angle (twisted) misalignment	Horizontal angle misalignment	Parallel misalignment
Description	The shafts of the drive and driven pulleys are parallel but one of the pulleys is twisted in the vertical plane	The shafts of the drive and driven pulleys are not parallel	The shafts of the drive and driven pulleys are parallel but one of the pulleys is too far forward (or backward)
Cause	The movable machine is incorrectly positioned in the vertical plane	The movable machine is incorrectly positioned in the horizontal plane	The movable machine is incorrectly positioned One of the pulleys is incorrectly adjusted on its shaft
Correction	Adjust the height of the front or rear feet of the movable machine	Slide the front or rear of the movable machine sideways	Move the movable machine forwards or backwards Move one of the pulleys forwards or backwards along the shaft

Table 6

Belt alignment methods

Type	Method	Usage	Advantages	Disadvantages
Traditional	Straightedge Length of string/ wire	Rough alignment	Simple equipment Direct readings Relatively quick	Inaccurate Readings rely on naked eye approximation and the accuracy of the pulley face Several repetitions are required
Laser	Face alignment	Rough alignment Precision alignment	Good accuracy Also used for timing belts Specialized skills are not required	Accuracy depends on the quality of the pulley face The faces are aligned and not the grooves
	Groove alignment, e.g. using the SKF Belt alignment tool	Precision alignment	High accuracy Specialized skills are not required All three misalignment conditions are monitored simultaneously Corrections are followed real time	None