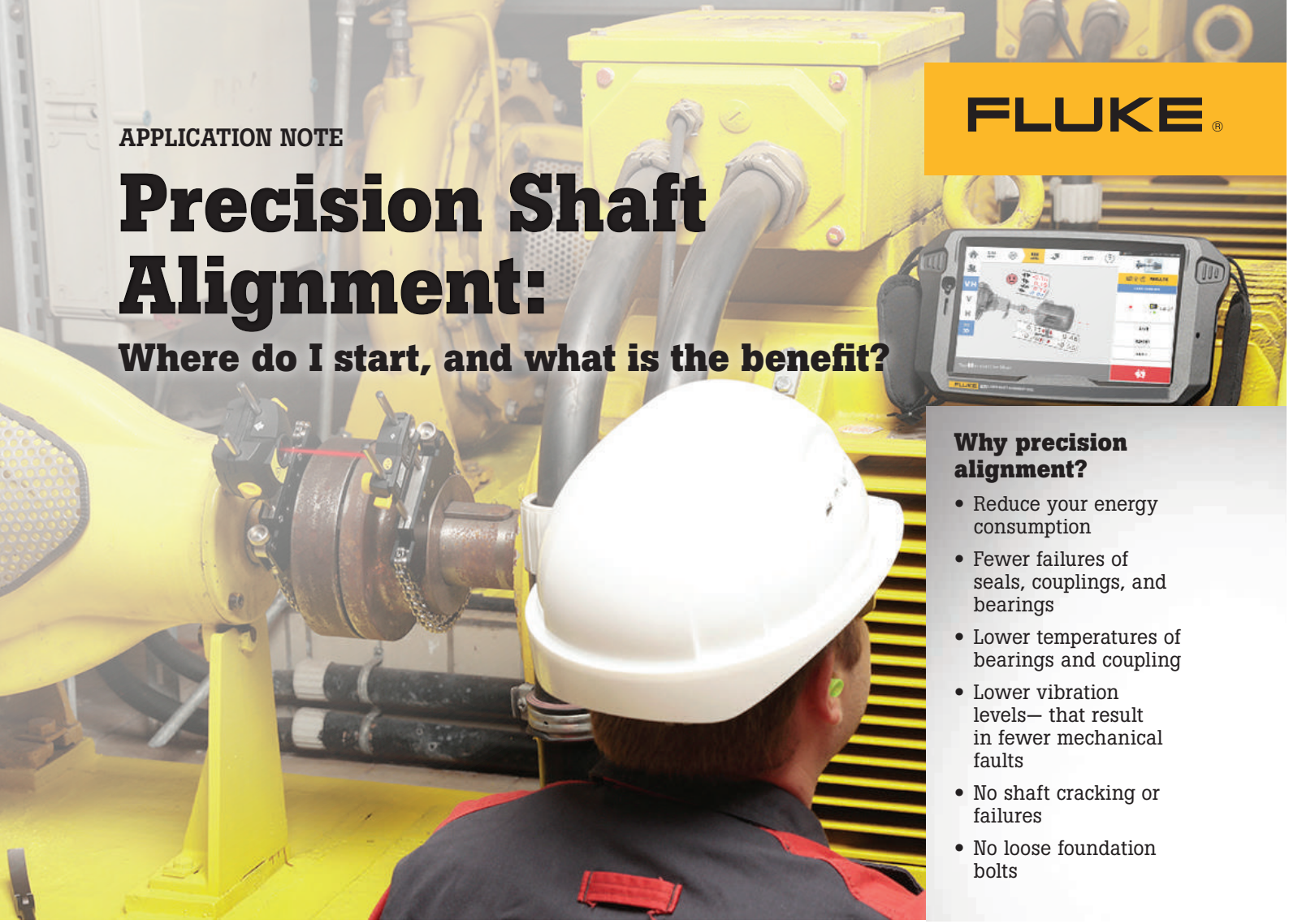
APPLICATION NOTE

Precision Shaft Alignment:

Where do I start, and what is the benefit?



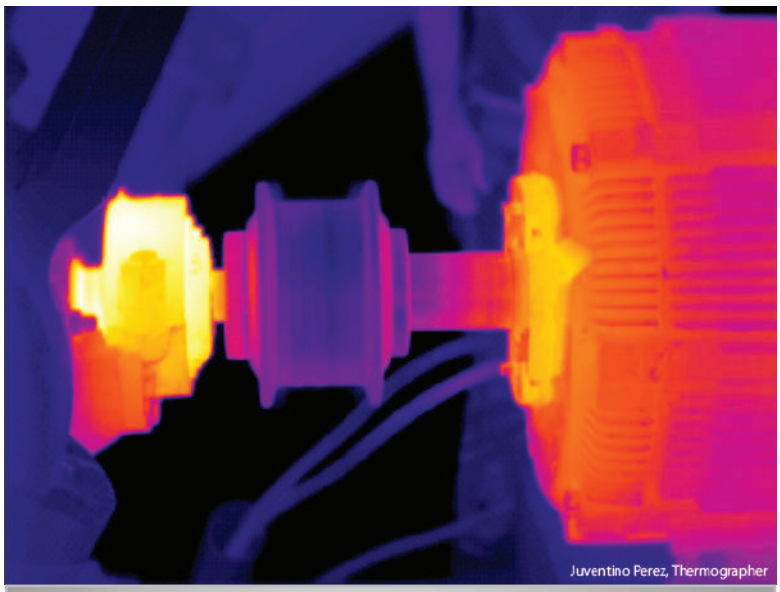
Why precision alignment?

- Reduce your energy consumption
- Fewer failures of seals, couplings, and bearings
- Lower temperatures of bearings and coupling
- Lower vibration levels— that result in fewer mechanical faults
- No shaft cracking or failures
- No loose foundation bolts

Asset uptime begins with precision shaft alignment

Misalignment in rotating machines can cause a number of problems, from production losses to unplanned downtime to increased maintenance and higher energy consumption costs. These can all be significantly reduced when machines are correctly aligned during installation and properly maintained over time. Laser shaft alignment increases machine life, protects asset availability, and can increase production quality and machine performance because vibration levels are at their lowest.

Misaligned machines cause higher reaction forces in the coupling which leads to heat and wear in couplings, seals, and bearings. Identifying this excess heat is often the first step in diagnosing misalignment. The effects of the heat due to misaligned shafts can be seen in the infrared thermography image on right.



1. When machines are misaligned the flexible couplings begin to heat up and the machine operates at higher temperature, especially around the bearings.

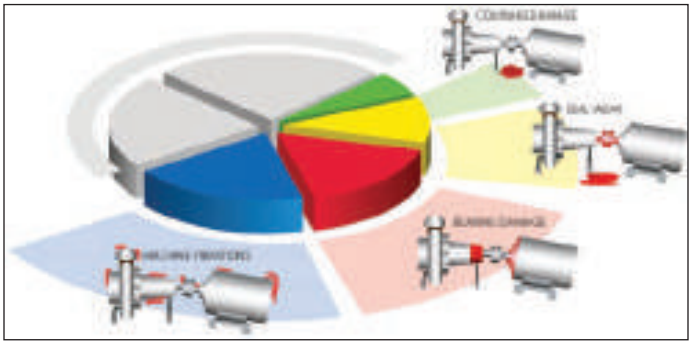
2. High reaction forces and faults that lead to asset failure and production losses are drastically reduced after performing a precision alignment.

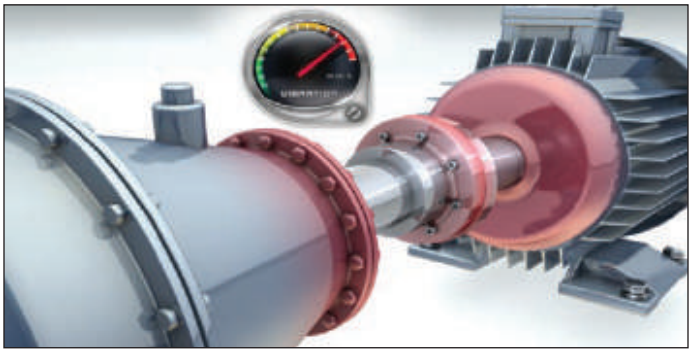
Why does precision shaft alignment matter?

Customers in any industry can benefit from precision shaft alignment and can expect:

- **Less energy consumption**—Alignment leads to significant power savings by eliminating reaction forces inside rotating machinery.
- **Increased reliability**—Precision aligned machines have fewer unexpected or catastrophic failures.
  By checking alignment you can anticipate problem areas before failure occurs and prioritize repair actions.
  - – Regular precision alignment reduces mechanical seal repairs by up to 65 %
  - – When precision alignment becomes an integral part of pump repair schedules, the rate of pump repairs is reduced by up to 30 %
- **Reduction in costs**—Reduce spare parts inventory costs and extend the life of existing equipment.
- **Increased maintenance intervals from longer machine life**—As misalignment is reduced, the expected bearing life increases which means the time between repairs can also increase.
- **Revenue**—Well-maintained machines have fewer unexpected and serious failures, helping to prevent production stoppages that cut into the bottom line.

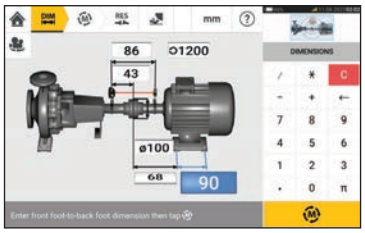
Consequences of misalignment





Fluke 831 redefines shaft alignment: Simple and effective

Many tools are simple, but they can take a lot of time to re-learn how to use them and to remember what the numbers mean—especially if it has been a long time since the last alignment was performed. You need a tool that walks you through the steps so that you can get back to running the plant. With the Fluke 831 Laser Shaft Alignment tool, evaluating alignment can be done in three simple steps:



1. Dimensions

Guided interface for inputting machine dimensions & machine specifications e.g., tolerances and thermal growth (machine profiles can also be saved for later use)

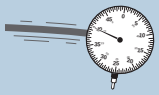
2. Measure

"Active Clock"—take readings from three or more sectors and watch them turn yellow on the screen indicating the correct data has been gathered

3. Results

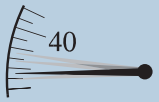
Actual coupling and feet result values with feet correction arrows are clearly displayed, and a tolerance indicator 'smiley' gives you at-a-glance measurement results condition: then use precision shims to save time and perform a precision alignment every time

How accurate are dial indicator readings?



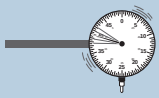
Sagging indicator brackets

Sag should always be measured before actual alignment readings are taken irrespective of how solid the bracket appears.



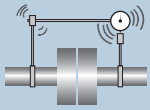
Low resolution

Up to 0.005 mm rounding error may occur with each reading—which easily results in an error of up to 0.04 mm in the calculated results.



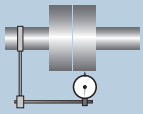
Sticking/jumping dial hands

Sometimes the indicator must be tapped in order for the needle to settle on its final value.



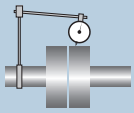
Play in mechanical linkages

Slight amounts of looseness may not be noticed, yet produce large errors in results.



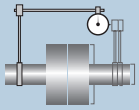
Reading errors

Human errors occur all too often when dials must be read under cramped, poorly-lit conditions and severe time constraints.



Tilted dial indicator

The indicator may not be mounted perpendicular to the measurement surface so that part of the displacement reading is lost.



Axial shaft play

This can affect face readings taken to measure angularity unless two axially mounted indicators are used.

Conventional shaft alignment methods

Modern machines require precision alignment to remain within a recommended tolerance range, and conventional alignment methods can fail to meet these standards, resulting in poor alignment. One common alignment method is to use a straightedge or feeler gauge, which only has the resolution of the human eye. For most machines, this resolution of 1/10 mm is inadequate for properly diagnosing misalignment.

Another common method for evaluating alignment is the dial indicator method—dial indicators provide a resolution of 1/100 mm but require complex math to determine whether misalignment is present. In addition, this method is susceptible to human error, which results from improperly reading measurements values and potential errors in the complex calculations that are required. Additionally, this method traditionally takes many hours to complete and requires a highly skilled user.

(see image on the left)

Alignment tolerances provide acceptable limits

If a machine is not aligned within the acceptable tolerance limits, undue stress can cause increased heat and wear in couplings, seals, and bearings. Suggested precision alignment tolerances can be determined in several ways.

Most often, acceptable machine tolerances are provided by the manufacturer of the machine, but general industry standards for alignment tolerances are also available. Industry standards for alignment tolerances should only be used if no other tolerances are prescribed by the machine manufacturer or if in-house standards do not exist. In the instance that a machine manufacturer requires an alignment tolerance tighter than that recommended by industry standards, the manufacturer's recommendation should be used. It should be noted that rigid couplings have no tolerance for misalignment and should be aligned as accurately as possible.

The Acoustical Society of America (ASA) developed shaft alignment tolerances for both short flex and spacer couplings on standard rotating machinery. These tolerances are an approved American National Standards Institute (ANSI) specification.

FLUKE®

What's the alternative to conventional methods?

A great alternative to traditional shaft alignment measurements is a laser shaft alignment tool. Laser shaft alignment systems reduce the potential for human error and can have resolutions as good as 1/1000 mm or 1 micron (0.00004 in). When choosing a precision laser shaft alignment system, you should consider:

Setup

- Quick and error free setup–pre-assembled brackets with zero sag
- Easy-to-use screens that are user intuitive
- Easy to follow guides that walk the user through the machine setup information

Measurement accuracy and flexibility

- High resolutions of 1/1000 mm or 1 micron (0.00004 in)
- Fast and accurate adjustment of laser sensor
- Measurement flexibility that allows you to take numerous readings from almost any desired position

Results/Correction

- Actionable recommendations in terms of specific coupling and feet values and correction arrows instead of complex calculations or guesswork
- Coupling and feet adjustment values in terms of both horizontal and vertical adjustments
- Robust machine tolerance tables that evaluate alignment compared to acceptable limits for specific machine speed
- Measurement results that are accurate, reliable, and extremely repeatable
- Reporting capabilities with both as found, and as left results to document the alignment correction per ISO 9001

Answers NOT just data:

Any tool can give numbers—dial indicators give numbers but require complex calculations that take time to perform. When asset uptime is on the line you need fast answers that can quickly help you precisely align the machine and get it up and running fast.

Many facilities don't have the time and resources to develop a reliability team, yet they struggle with mechanical breakdowns.

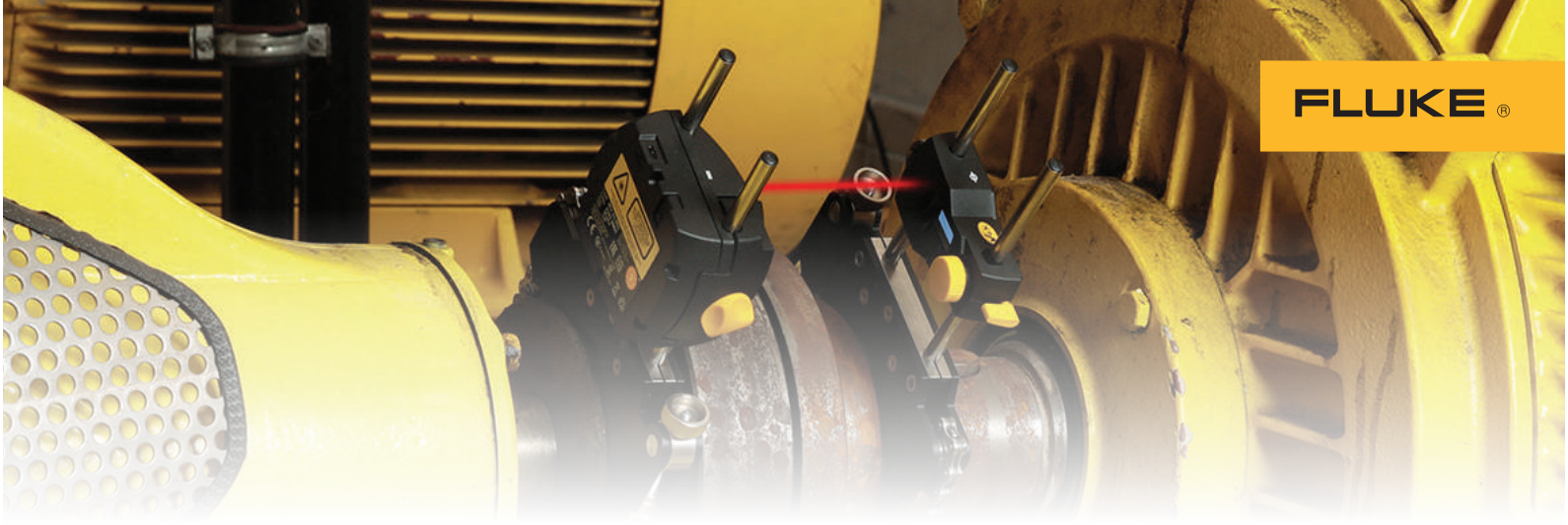
With this revolutionary way of precision shaft alignment, even small organizations can afford and enjoy big benefits:

1. Easy answers from result screen shows both coupling and feet results with feet correction arrows (vertical and horizontal).

2. "Live" mode gives you immediate and dynamic feedback of the alignment status while you are adjusting the feet. No additional steps are required to retake readings and evaluate results.

3. Tolerance tables (input machine speed) help you complete adjustments quickly letting you know precisely when the machine is within acceptable alignment.

4. Result confidence—Perform final alignment checks and print reports with 'as found' and 'as left' measurement results to document the procedure.



Fluke tools work together to solve your problems

Start your condition monitoring journey with Fluke's interconnected solutions.

Find potential problems with a thermal imager or vibration meter then use your vibration tester to diagnose the fault. Correct the fault using a belt alignment tool or laser shaft alignment tool such as the Fluke 831, and finally confirm, the effectiveness of your repair via a vibration meter.

Ensure the longevity, accuracy and safety of your tools and if needed, send then for repair or calibration to one of our various service centers all over the globe.

SCREEN	DIAGNOSE	CORRECT	VERIFY AND REPORT
5 fully automated tools for common faults on standard machines by techs with no advanced training			

Fluke. *Keeping your world up and running.®*