



FLUKE®

Reliability

**Tips, technology, and
tools for next-
generation machinery
alignment**

David Metz

Accelix™

Webinar Series



David Metz

*Technical Sales Representative, PRUFTECHNIK
Fluke Reliability*

- Former machinist/millwright with more than 30 years of technical and craft experience with Exelon Energy
- Extensive background performing machinery alignment on rotating equipment from very small to the largest GE steam turbines and generators
- Proficient at vibration analysis, with category 2 certification from Mobius
- Represents PRUFTECHNIK for New York state in current sales role

About PRUFTECHNIK

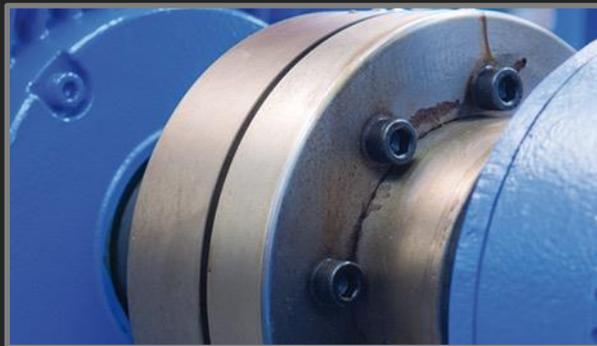
WE KEEP YOUR WORLD ROTATING

A division of Fluke Reliability, PRUFTECHNIK is a leading maintenance technology manufacturer and solution provider.

Founded in 1972, PRUFTECHNIK grew from a family-owned business to a worldwide operating company and is now part of Fluke Reliability. It is present in 80 countries, with 20 subsidiaries and a large network of authorized sales and service partners. In July 2019, PRUFTECHNIK was acquired by the Fluke Corporation, a company of the Fortive group.

Trusted worldwide for the condition-based maintenance of rotating equipment and plant reliability.

We offer a broad range of high-quality products, services and training tailored to the needs of maintenance professionals in the areas of:



Alignment Systems

Shaft alignment and vibration analysis



Condition Monitoring

Vibration analysis and fault diagnosis



Nondestructive Testing

Quality assurance and process control

POLL QUESTION No. 1

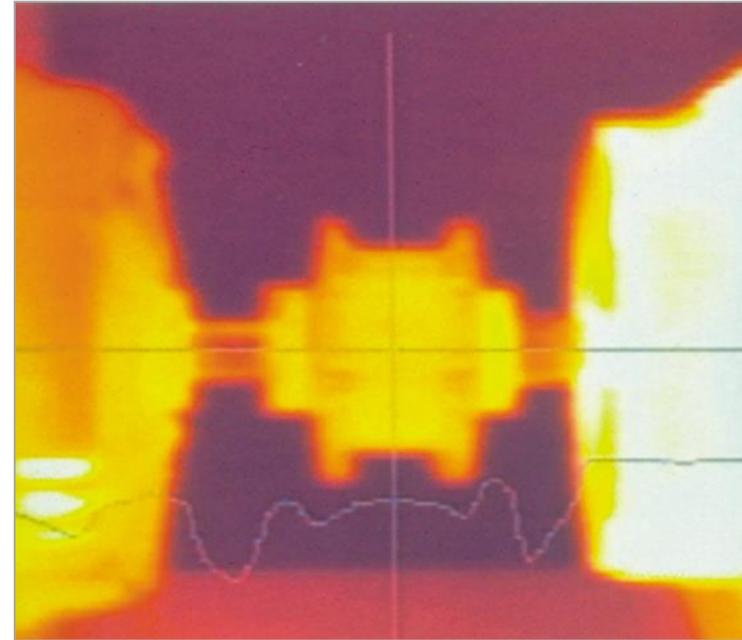
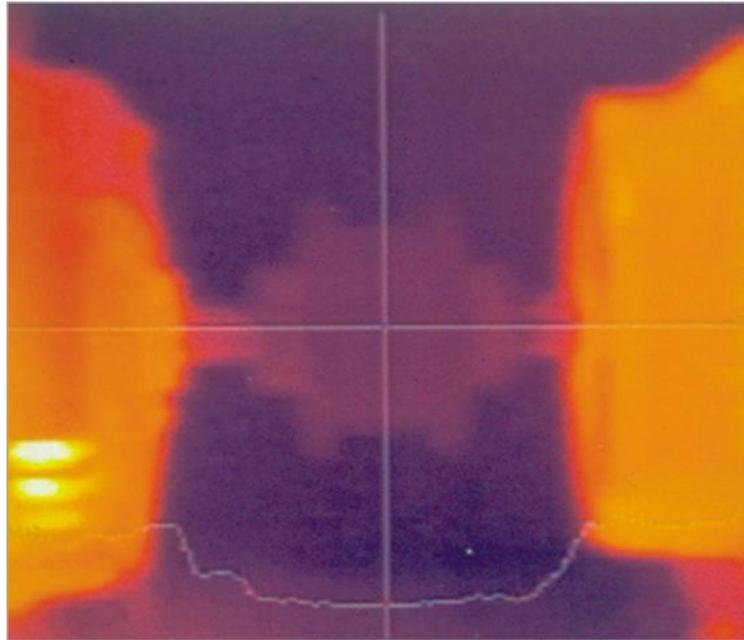


Are you currently using a laser shaft alignment system?

(Click only one answer)

- Yes, a current laser shaft alignment system
- An older laser shaft alignment system
- A dial indicator
- A straight edge or feeler gauge
- No system or tools for alignment

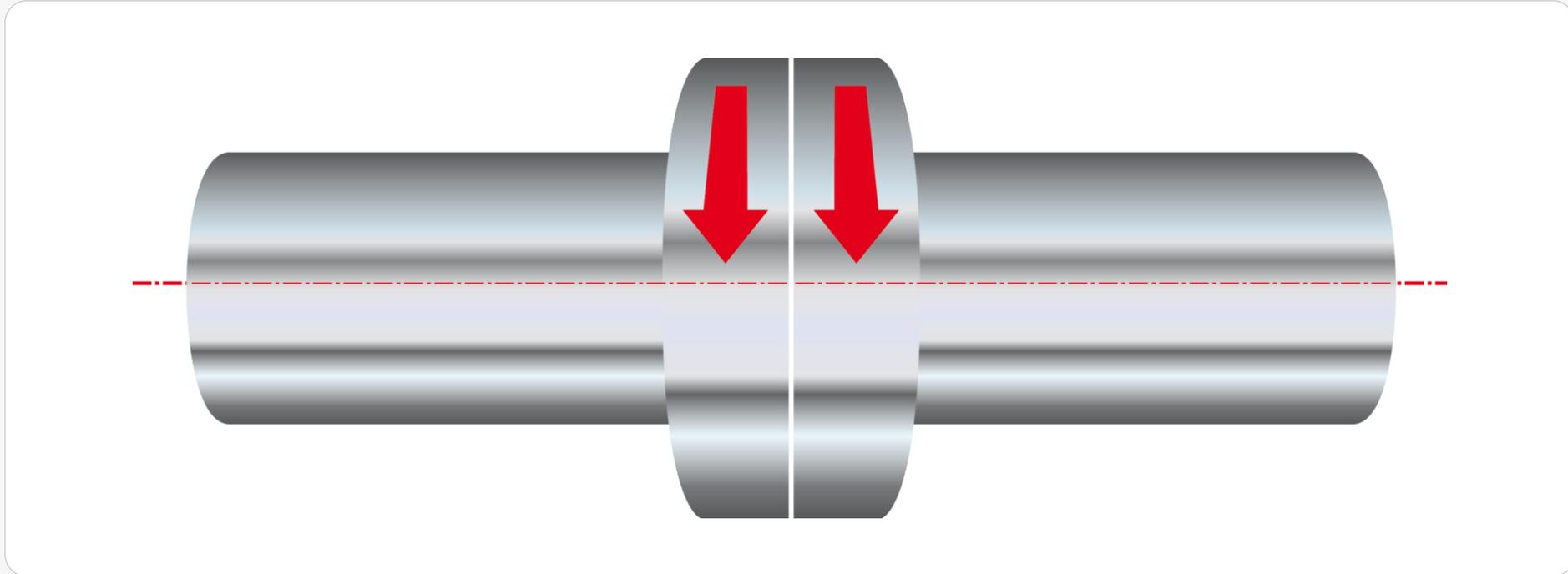
Coupling and shaft loading



- When misaligned the **loading of the shafts increases** due to the reaction forces created within the coupling
- The flexible coupling elements heats up and the machine develops elevated temperatures particularly around the bearing housings

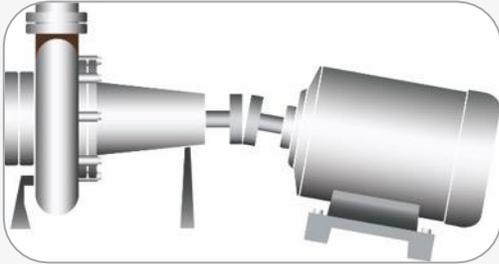
Definition of **shaft alignment**

What is shaft alignment ?

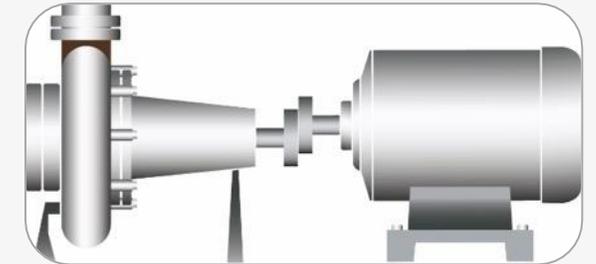


“... at the point of power transfer from one shaft to another, the axes of rotation of both shafts should be colinear when the machine is running under normal operating conditions ...”

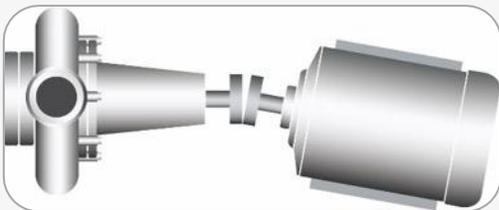
The 4 alignment parameters



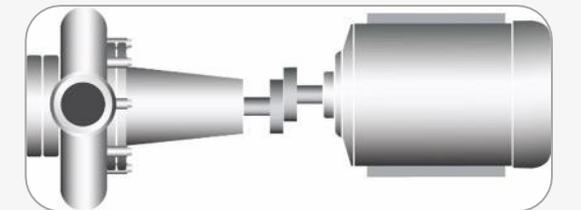
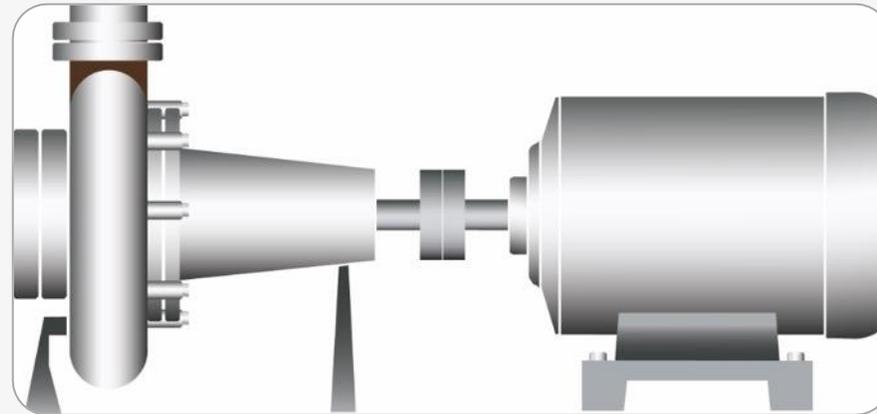
Vertical angularity



Vertical offset



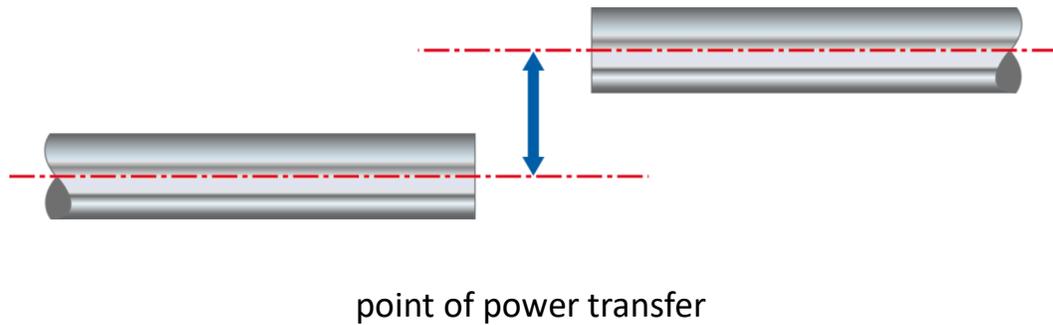
Horizontal angularity



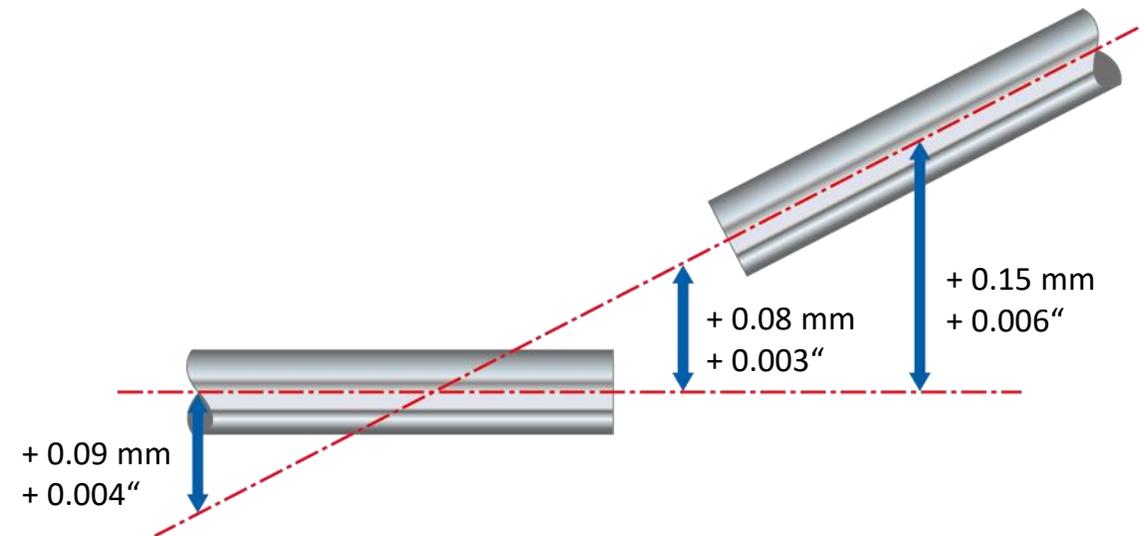
Horizontal offset

Offset

Offset means distance between rotation axes at a given point

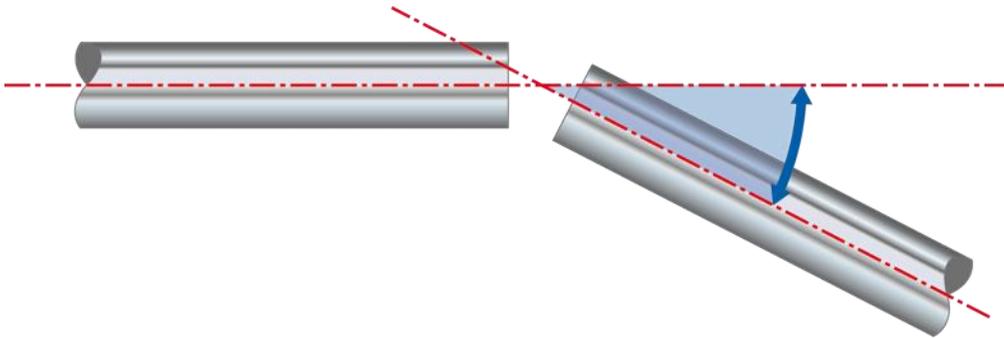


Offset value varies depending upon the location where the distance between two shaft rotation axes is measured

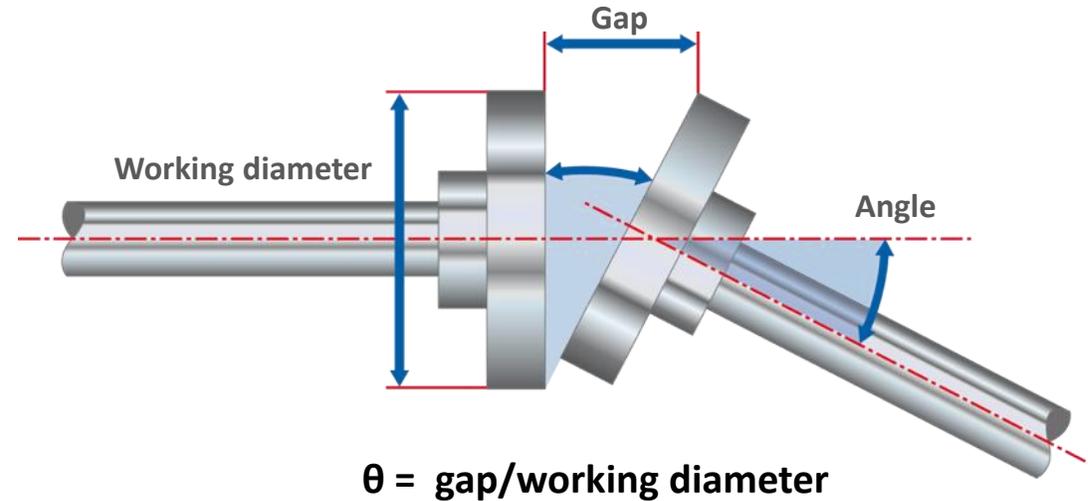


Angularity and gap (1)

Angularity means the angle between two rotation axes



The angle is usually given as a **gap per working diameter**.

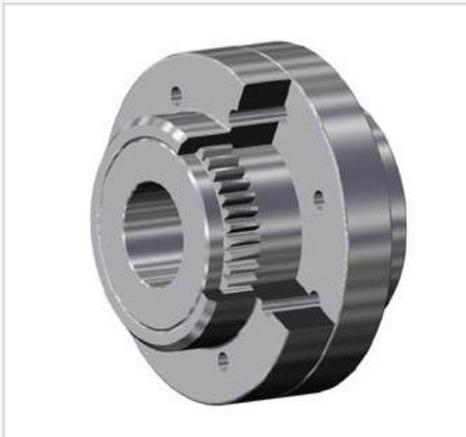


A 6" (152.4 mm) coupling open at the top by 0.005" (0.127 mm) gives an angle between shaft axes of 0.83 mrad:

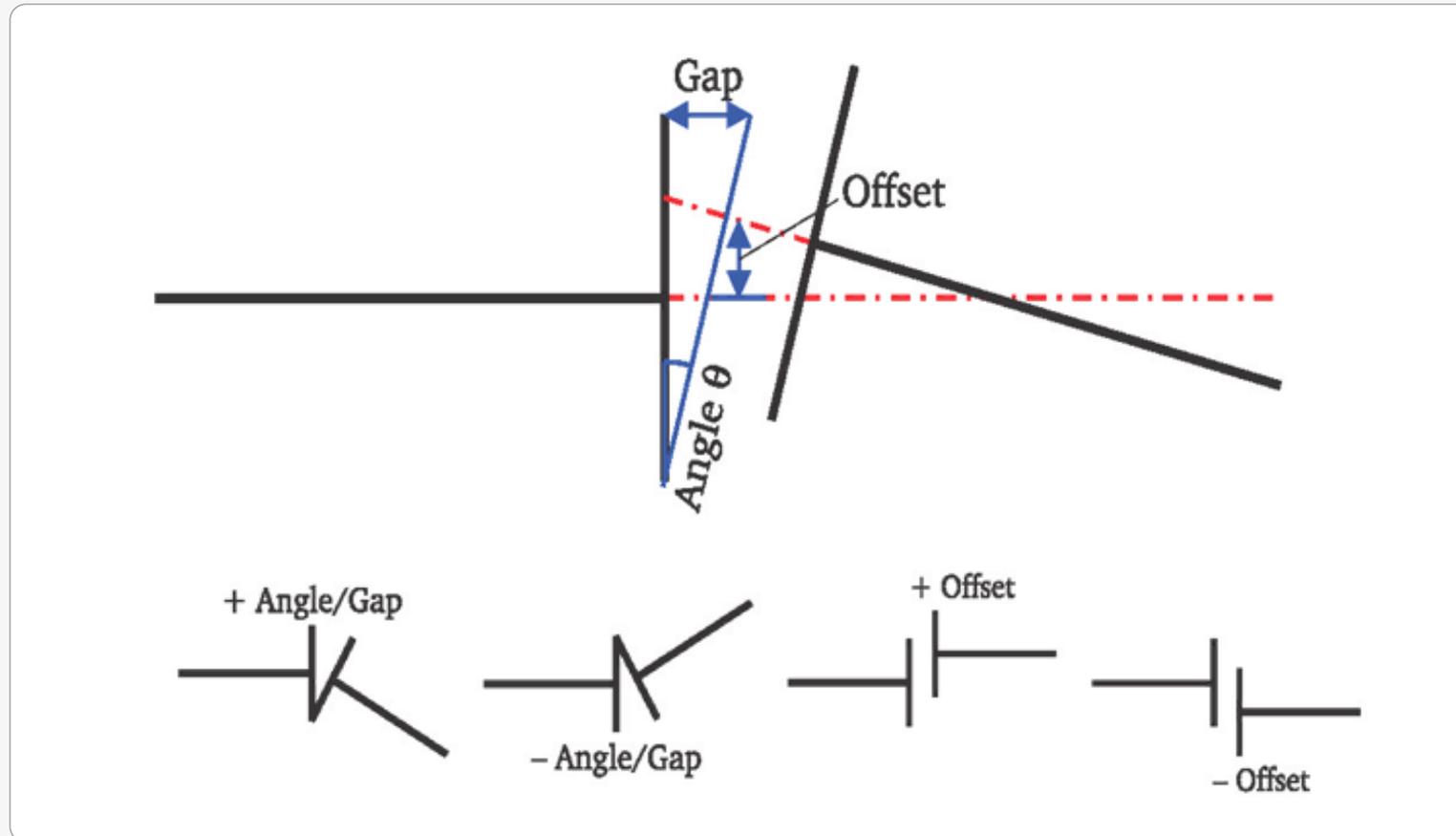
$$\theta = 0,127/152,4 = 8,33 \cdot 10^{-4} \text{ rad} = 0,83 \text{ mm/m}$$

Note: 1 mrad = 1 thousandth of an inch per inch | 1 mrad = 1 mm / m

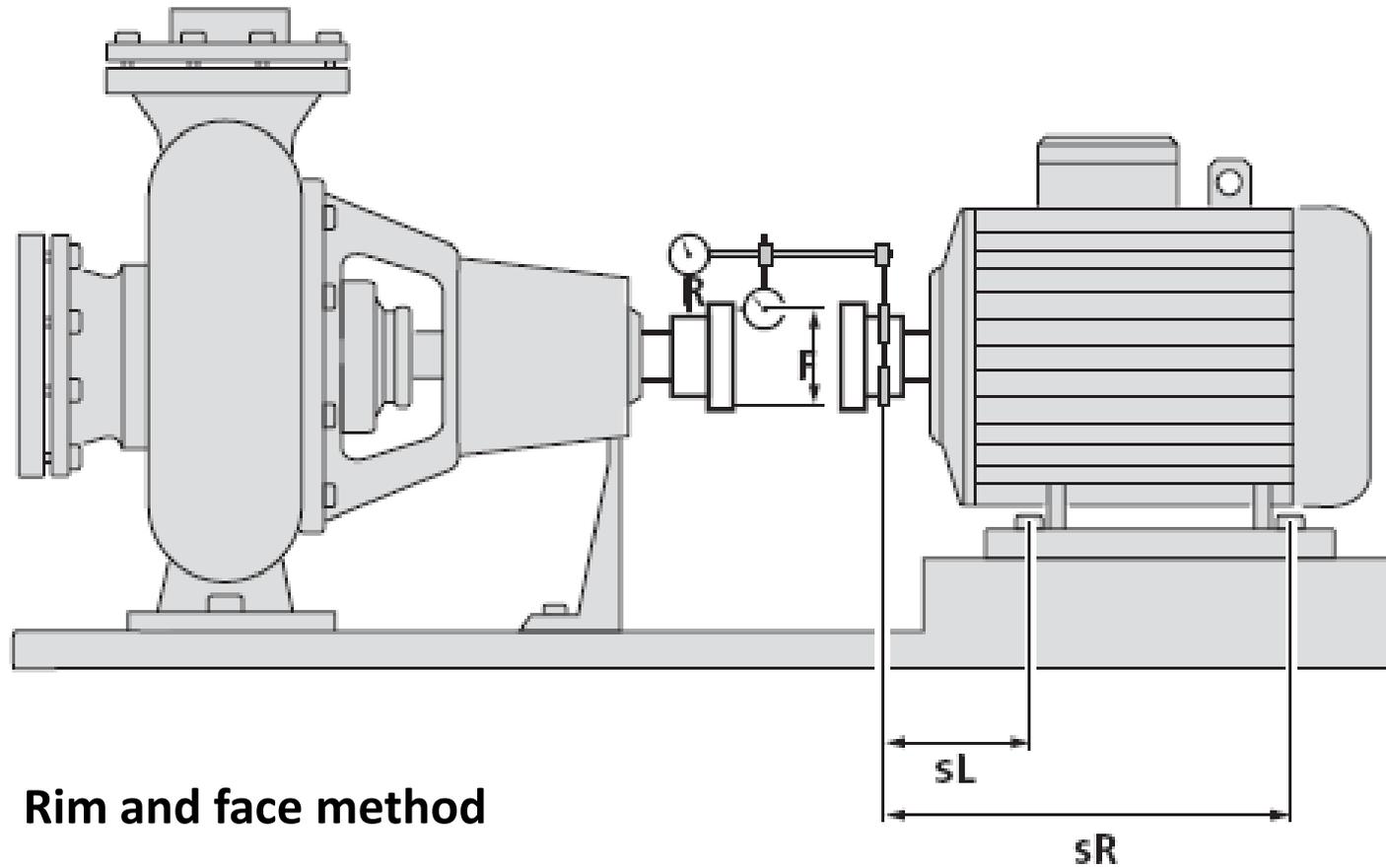
Some types of flexible couplings



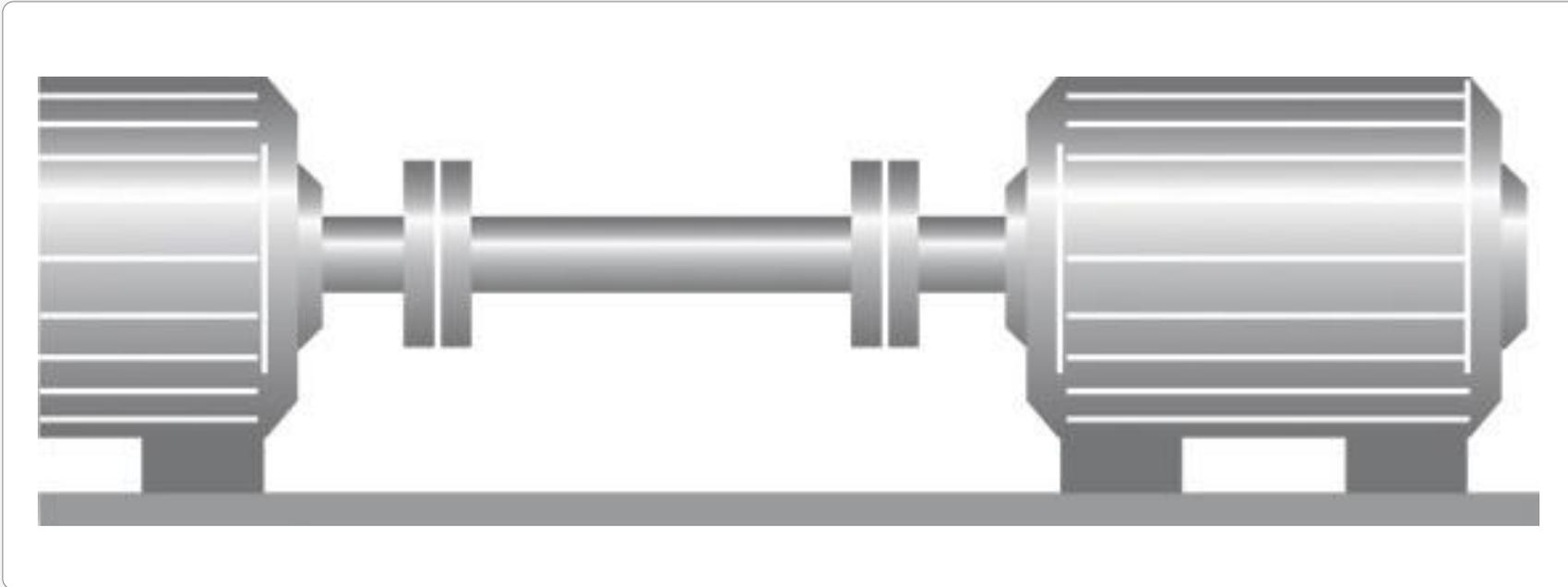
Short flexible couplings (3)



Shaft alignment methods: Dial indicators



Spacer coupling type (1)



Spacer coupling type (1)

COUPLING FORMAT

Offset B / Offset A

Gap A / Gap B

Angle α / Angle β

Gap / Offset at left

COUPLING TYPE

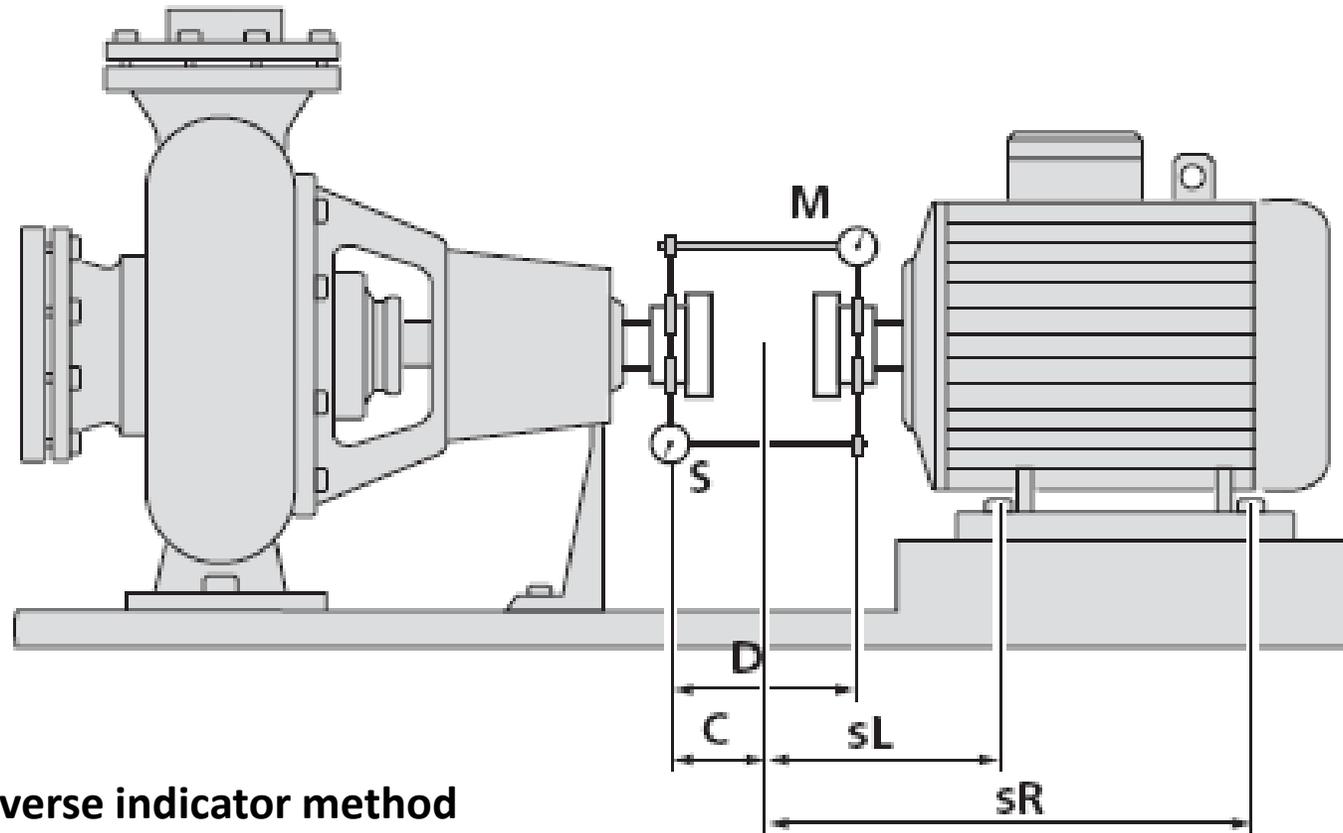
COUPLING FORMAT

TOLERANCES

TARGETS

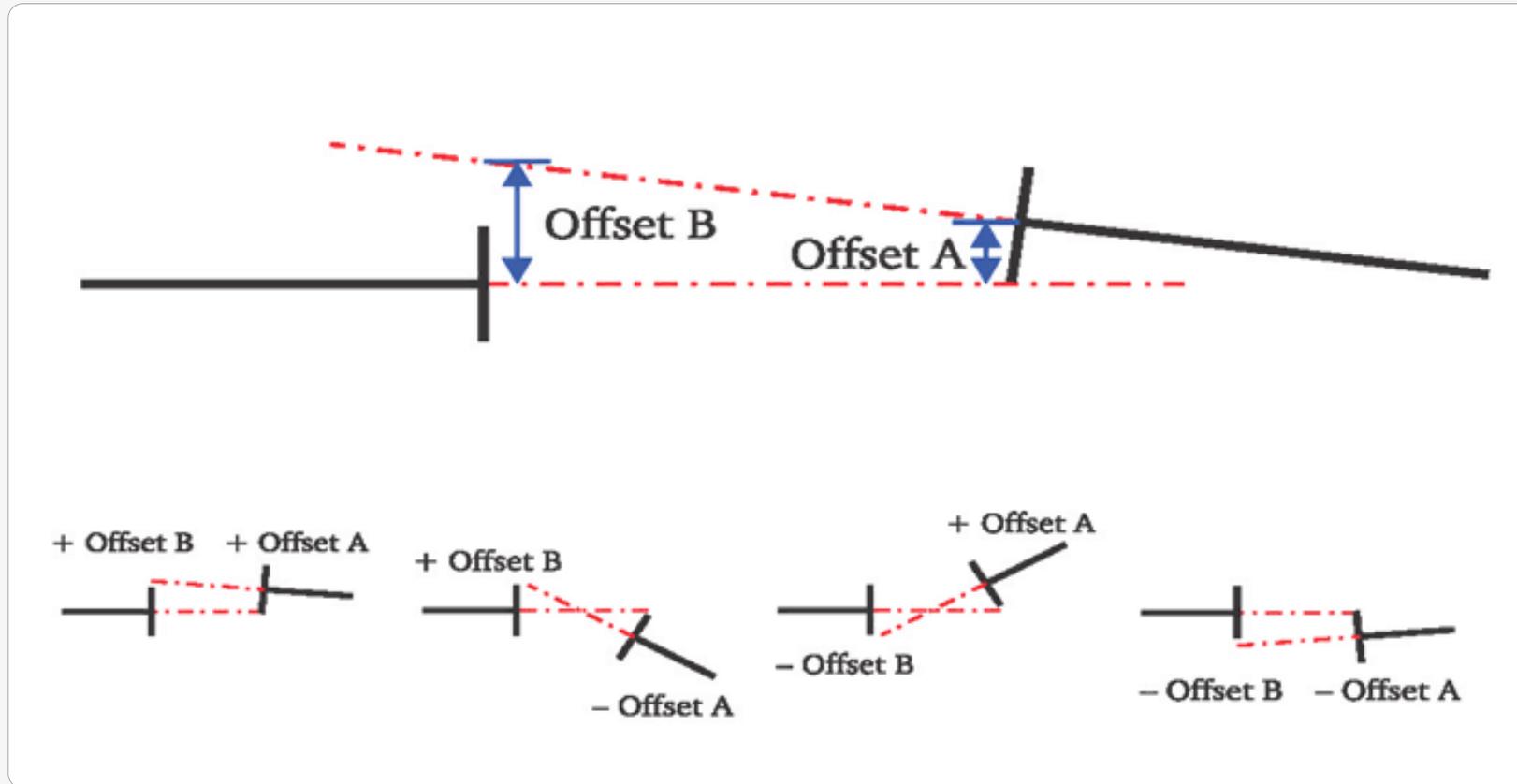
✓

Shaft alignment methods: Dial indicators



Reverse indicator method

Spacer couplings (4)



Shaft alignment methods: Dial indicators

COUPLING FORMAT

Gap A / Gap B

Angle α / Angle β

Gap / Offset at left

Gap / Offset at right

COUPLING TYPE

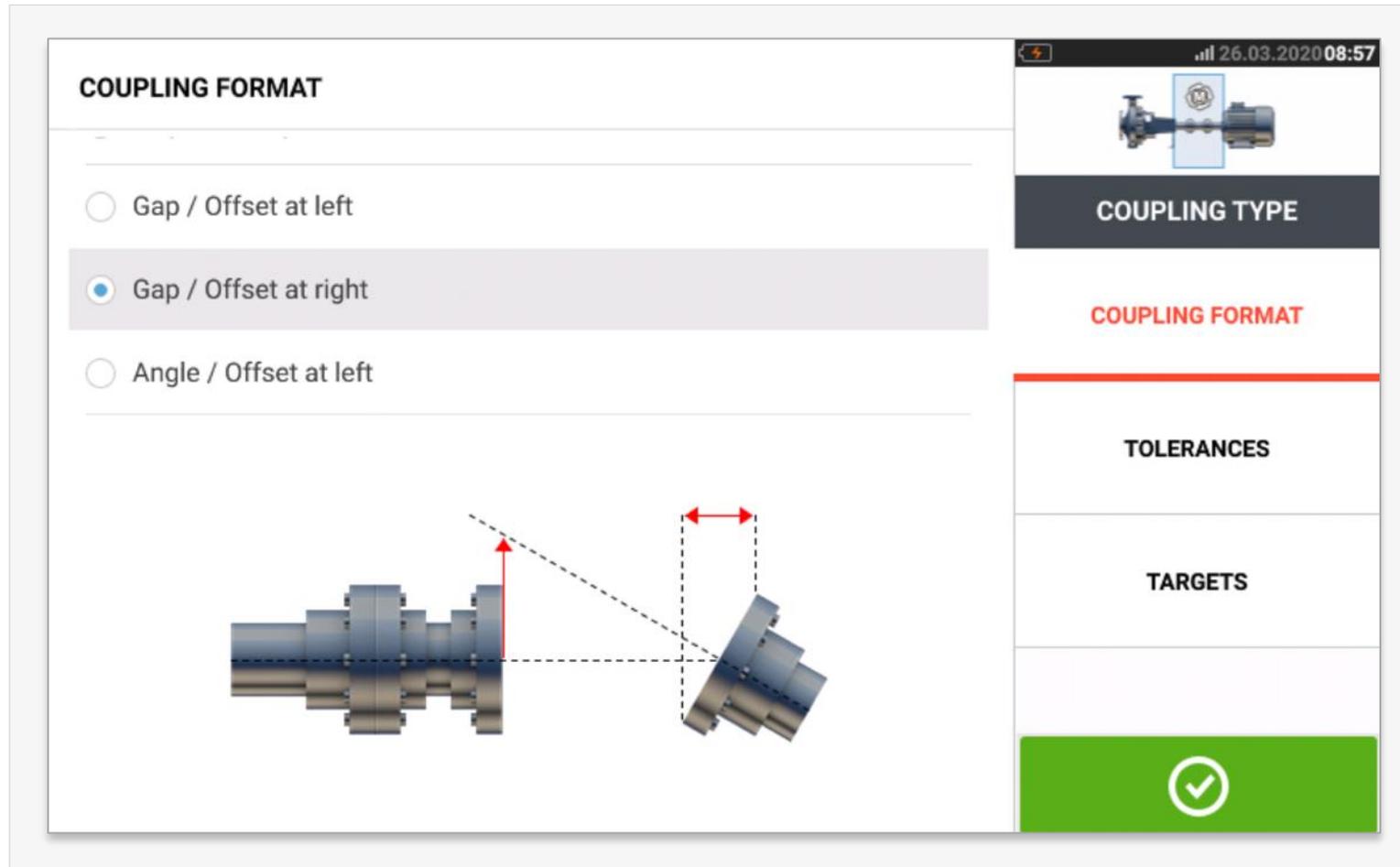
COUPLING FORMAT

TOLERANCES

TARGETS

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Spacer couplings (4)



POLL QUESTION No. 2



How would describe your current alignment challenges?

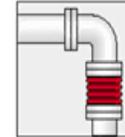
(Click only one answer)

- Basic
- Somewhat complicated
- Incredibly challenging and complicated
- Unpredictable at this point

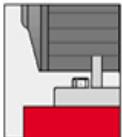
Pre-alignment checklist



Machine tagged out-
Padlock on switchgear



Pipe/bracket
strain eliminated?



Base OK?



Shafts OK?
Run out, bending bearing play?



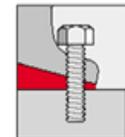
Shims OK?
(maximum 4 shims!)



Coupling OK?
Proper fit on shaft, looseness
eccentricity, flexible elements OK?



Bent bolts
Cupped washers?



Soft foot
eliminated?



Hold-down bolts,
Jacking bolts lubricated?



Targets, tolerances
established?

HAYES

SPECIAL FASTENER SPECIFICATIONS



FOR MISMATCHED HOLES



FOR HOLES TOO NEAR THE EDGE



FOR HOLES COUNTERSUNK TOO DEEP



FOR HOLES DRILLED CROOKED



CORRUGATED FOR VICE GRIP



FOR HOLES WITH COUNTERSINK ON WRONG SIDE



BINOCULAR BOLT FOR DOUBLE DRILLED HOLES



FOR HOLES NOT SQUARE



FOR TAPERED HOLES



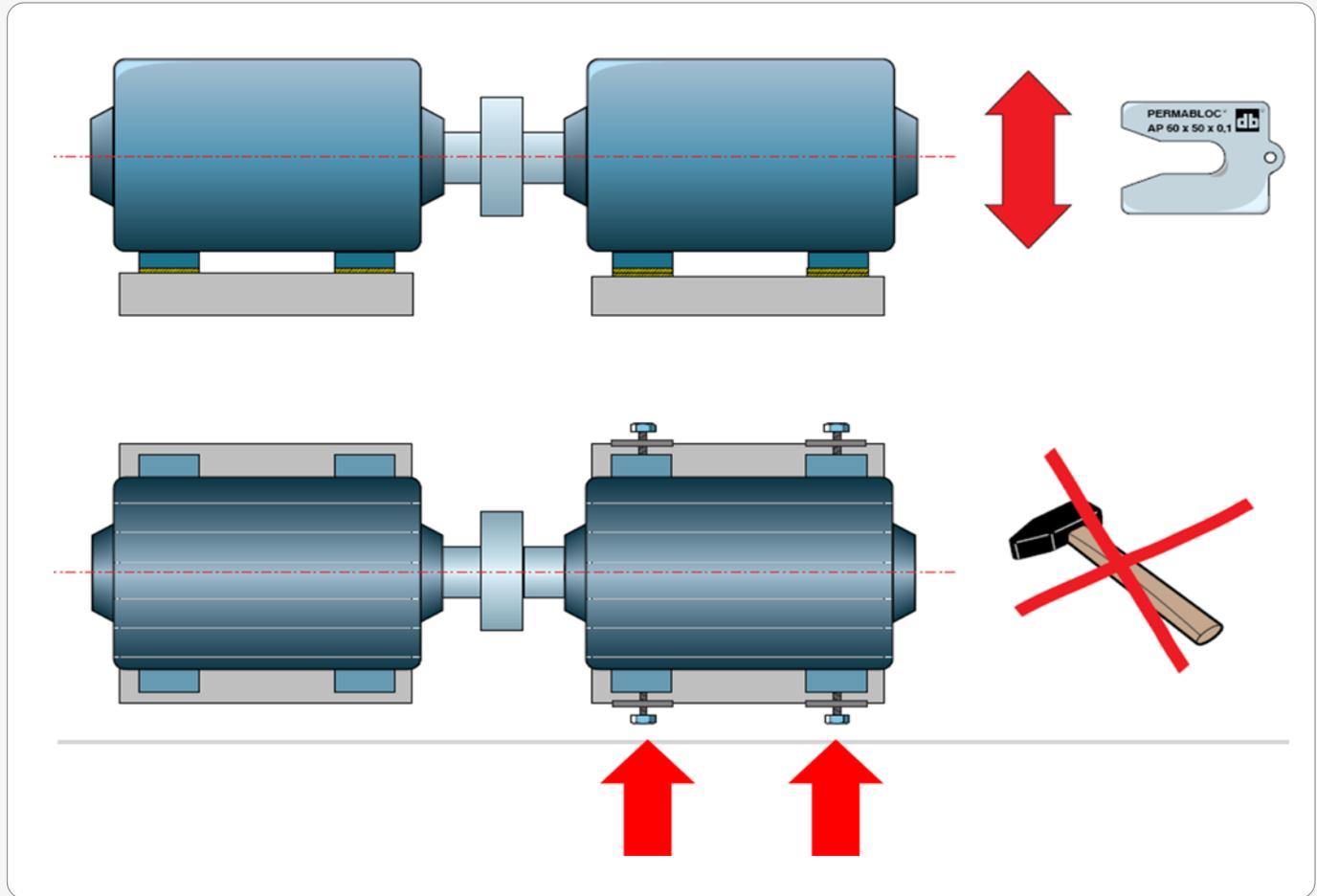
FOR RE-DRILLED HOLES THAT STILL DONT MATCH



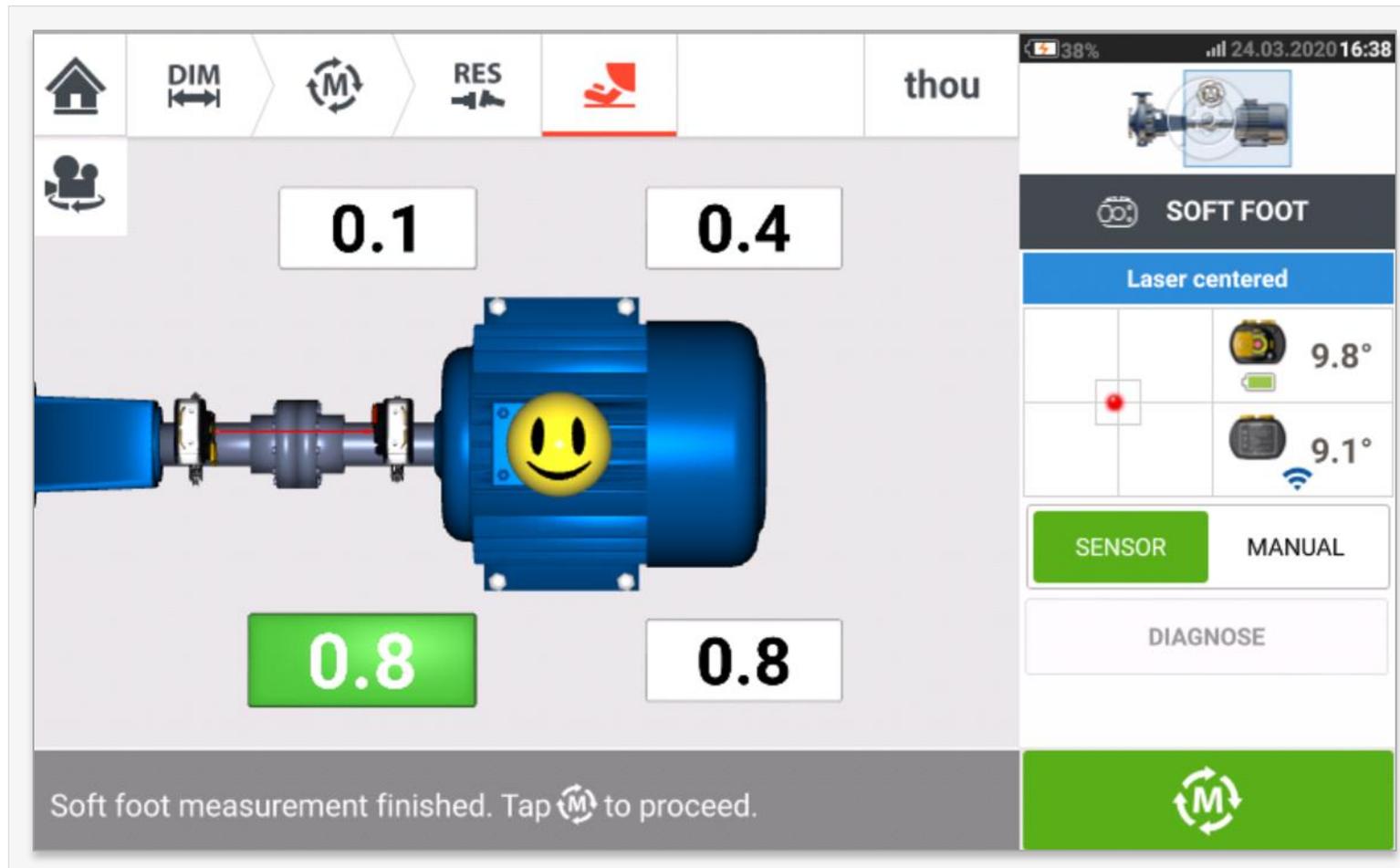
FOR DOUBLE COUNTERSUNK HOLES

Machine corrections / Machine mobility

- Use pre-cut shims; maximum 4 shims (avoid spring effect!)
- Use jack bolts or machine puller. No hammer!



Soft foot

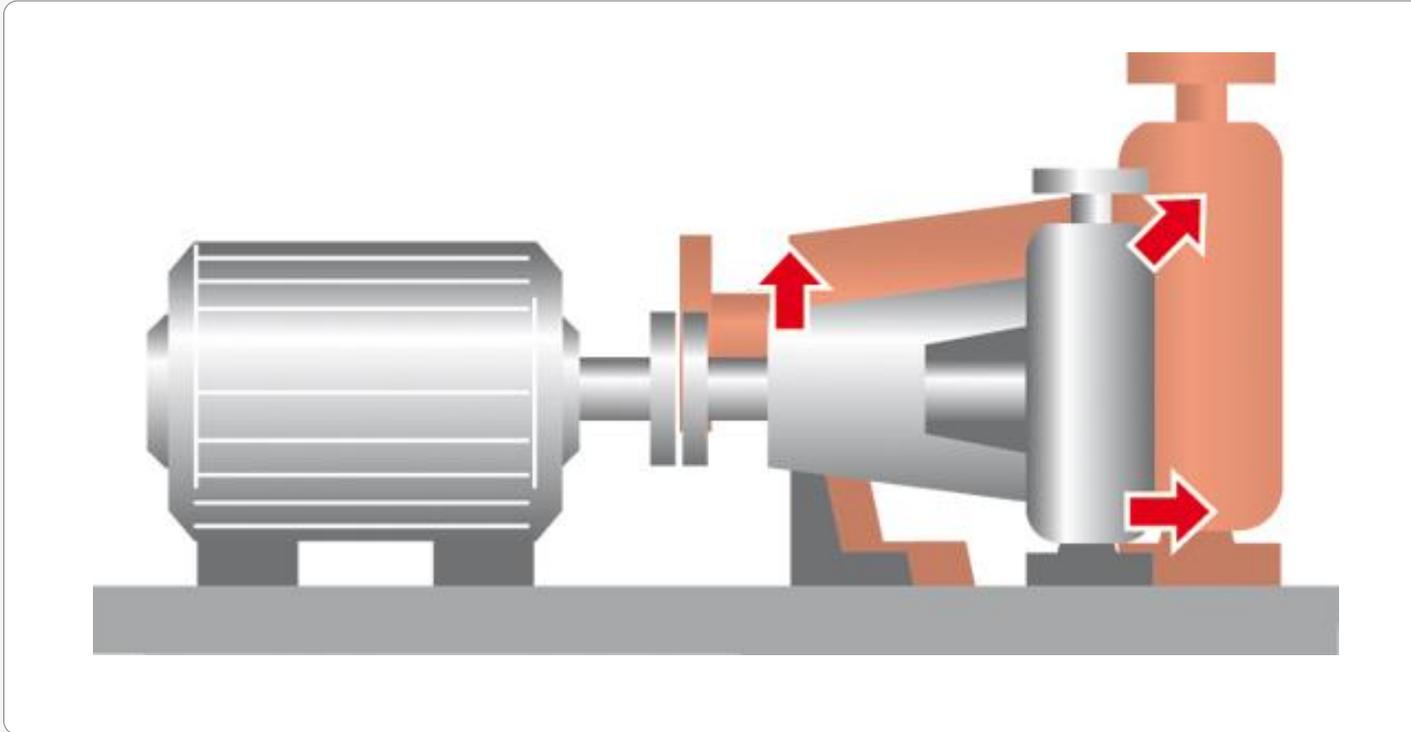








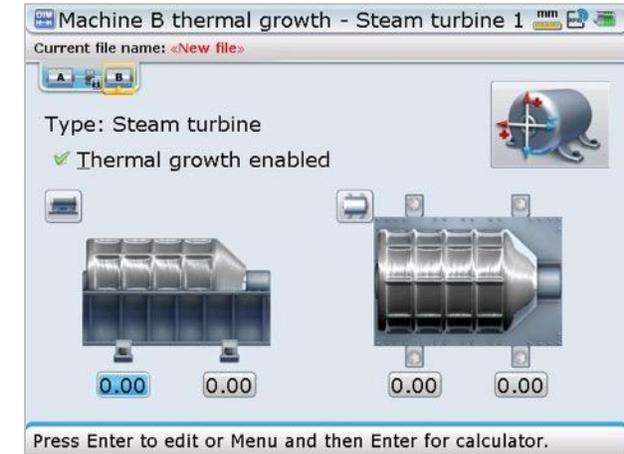
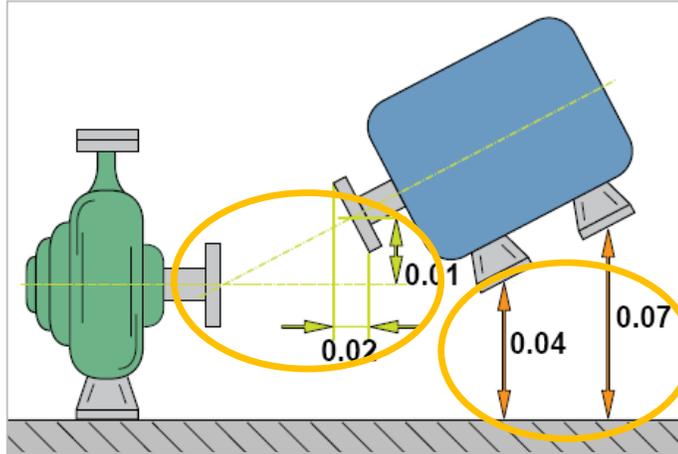
Thermal growth and target specifications



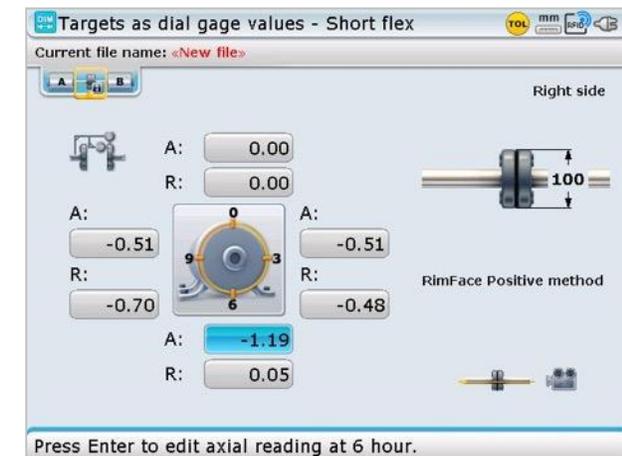
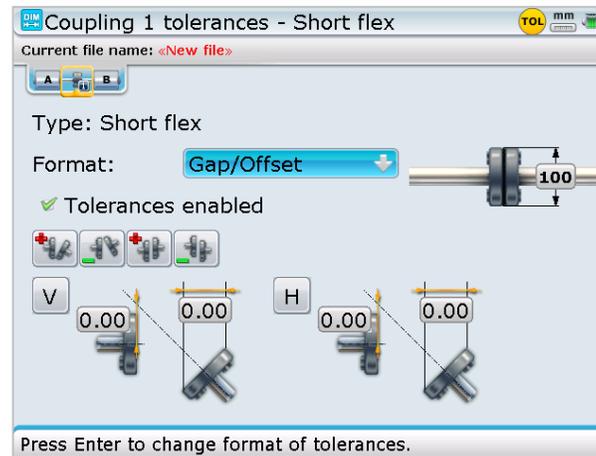
The specifications can be input to take into account the expected positional change of the machine during operation.

Thermal growth and target specifications

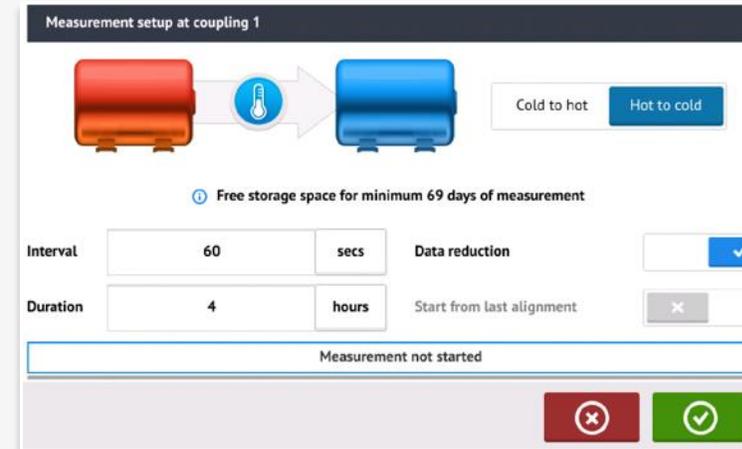
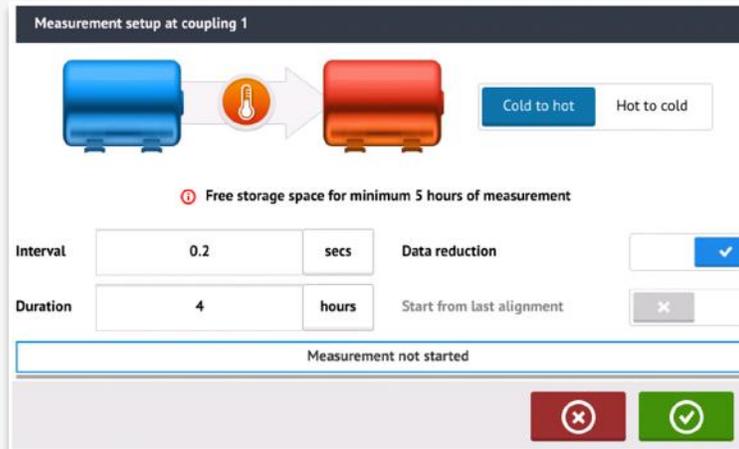
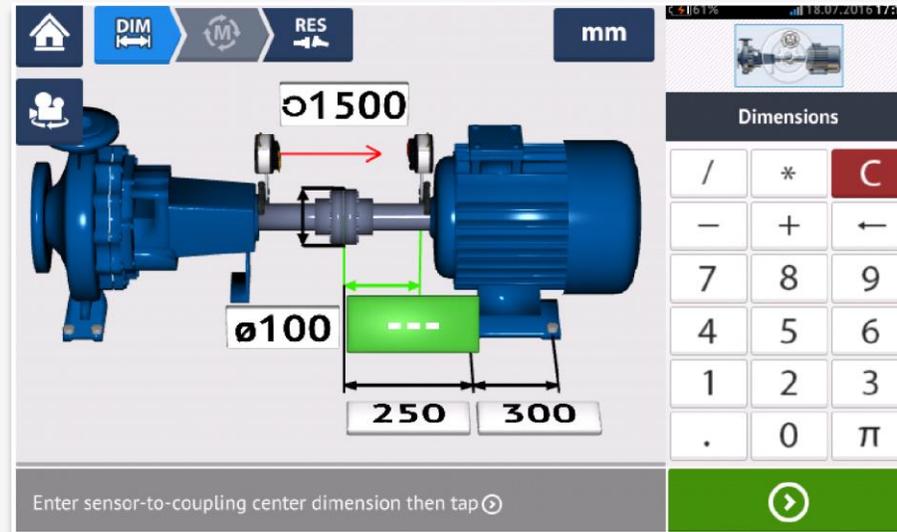
Thermal growth parameters – at machine feet



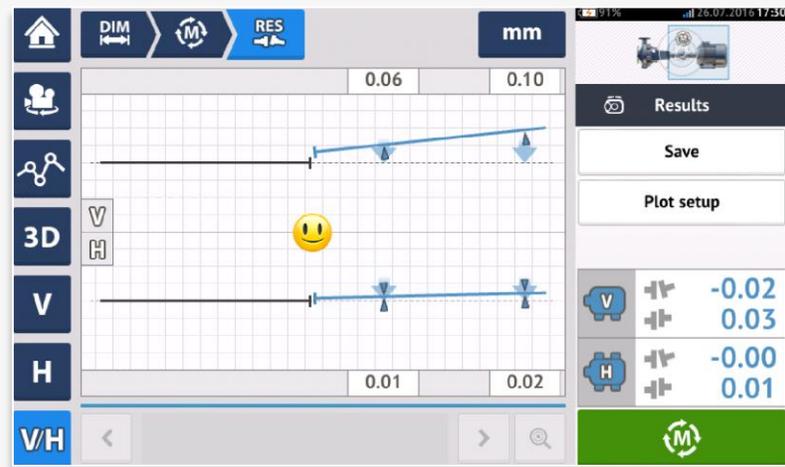
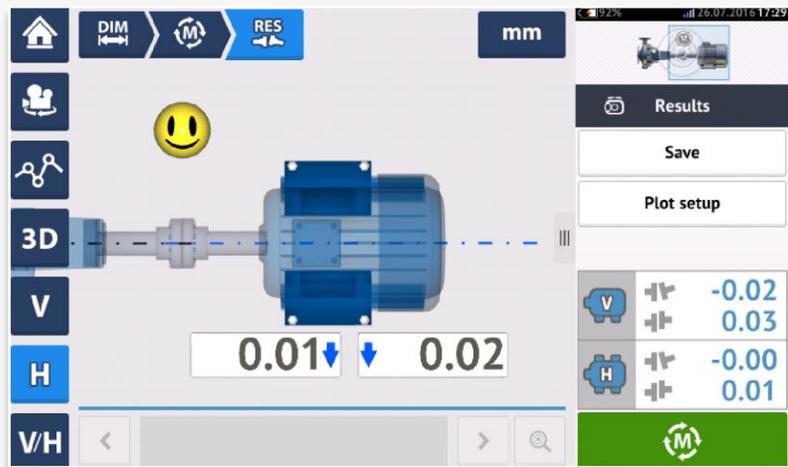
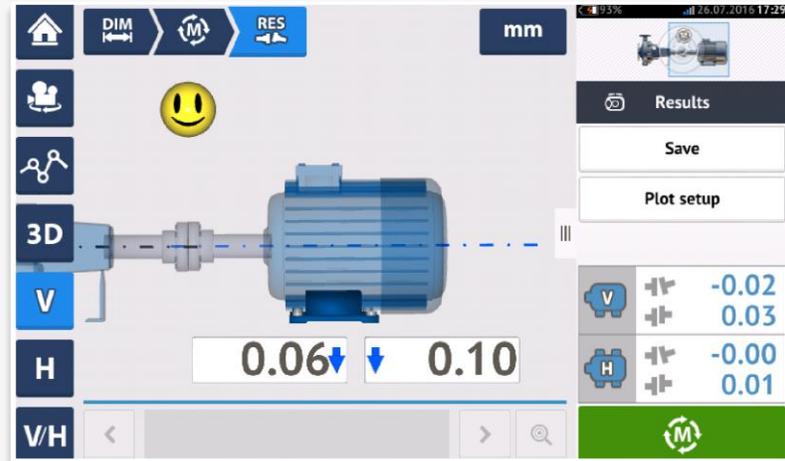
Target values – at coupling (as gap/offset or dial indicator readings)



Live Trend



Live Trend



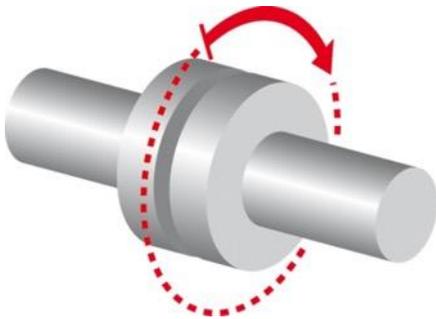
PRÜFTECHNIK laser shaft alignment modes

High-precision, adaptive alignment through unique and patented measurement modes



intelliSWEEP mode

- Continuous and automatic data collection
- Huge numbers of readings over the rotation
- Live Measurement Quality
- Spurious points are automatically considered inactive

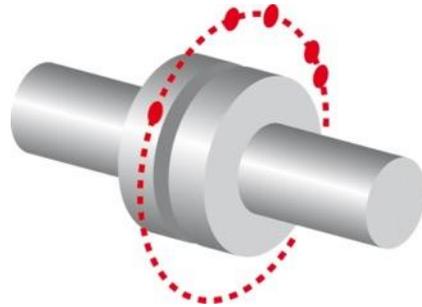


SWEEP mode

- Continuous and automatic data collection
- Huge numbers of readings over the rotation
- Starts at any position
- Rotation in any direction
- 60° SWEEP only to overcome rotation limitation

PRÜFTECHNIK laser shaft alignment modes

High-precision, adaptive alignment through unique and patented measurement modes



Multi-Point mode

- Measurement at any position
- Unlimited number of points
- Suitable for sleeve/journal bearing



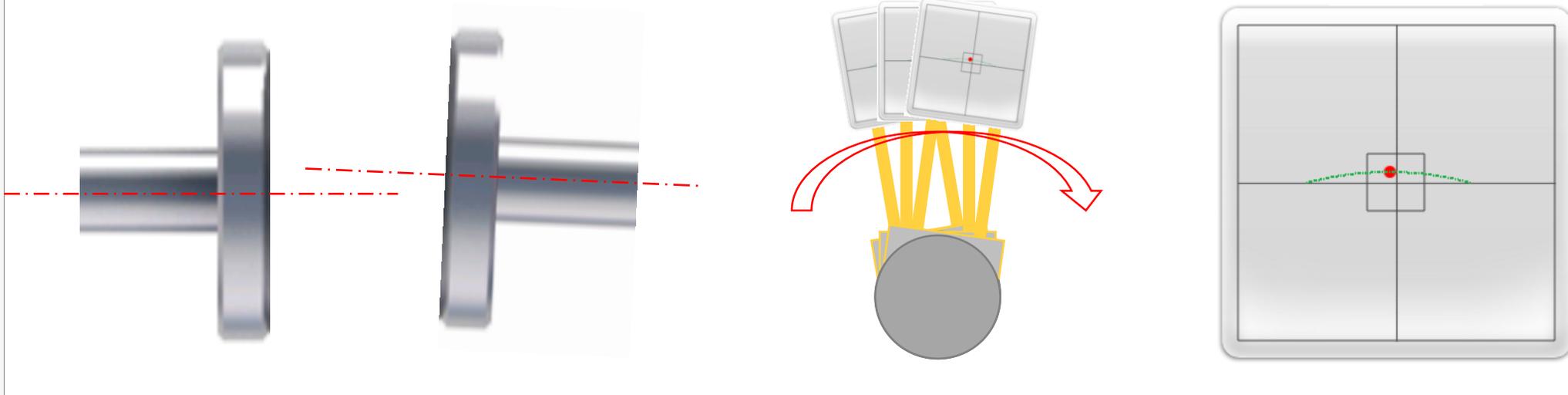
Pass Mode

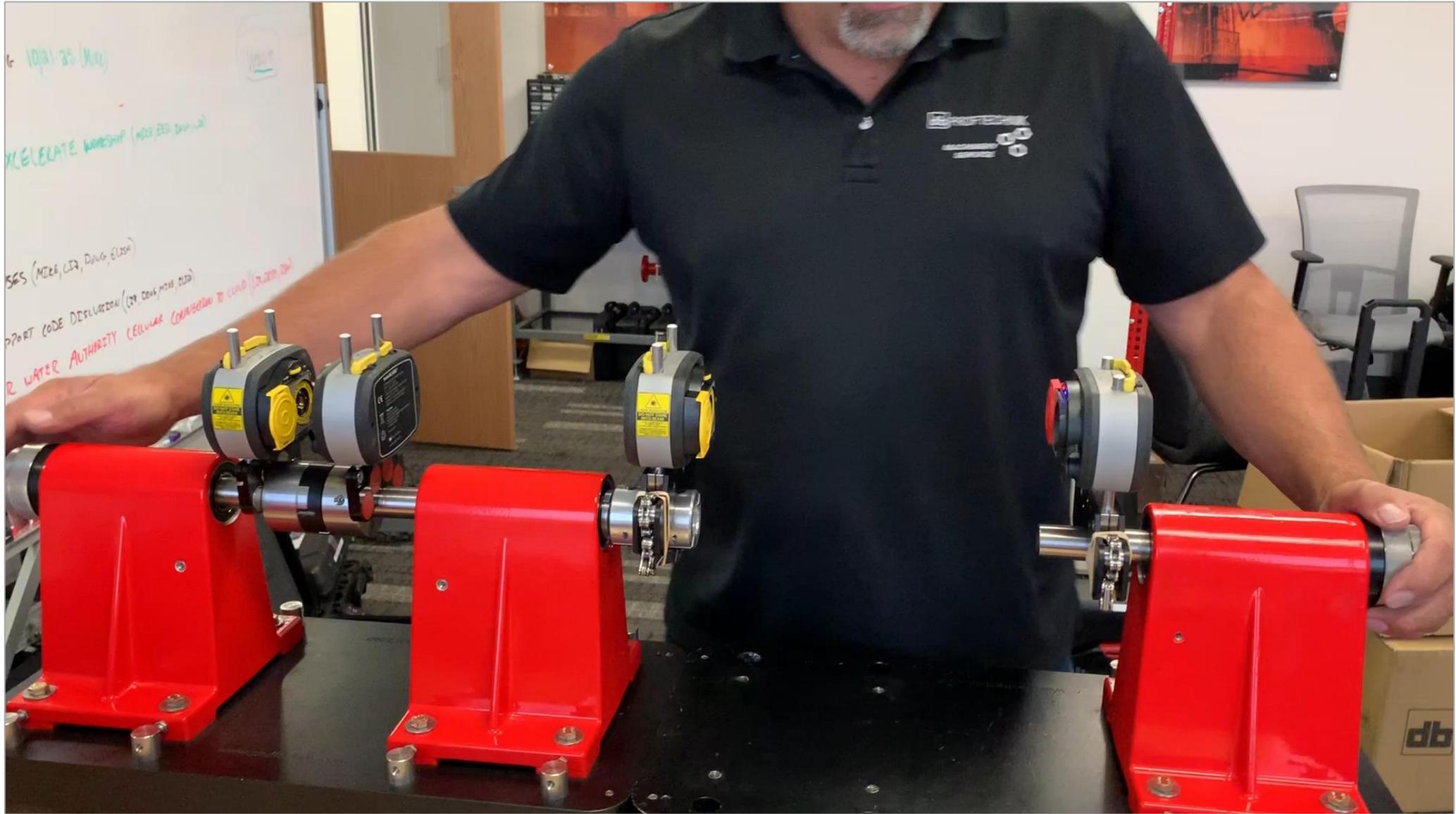
- The laser emitter is rotated past the receiver
- Ideal for uncoupled shafts

Uncoupled mode: intelliPOINT and intelliPASS

Uncoupled shafts or coupling play...

- Where to stop the shaft?
- Where to take the reading?





DIM M RES inch

ø1800 ø10.000 2.000 ø600 ø10.000 2.000 4.000 4.500 4.000 4.000 5.000

DIMENSIONS

/	*	C
-	+	←
7	8	9
4	5	6
1	2	3
.	0	π

Enter sensor-to-coupling center dimension then tap > or M

QUESTIONS?



Thank you!

David Metz

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Technical Sales Representative
PRUFTECHNIK, Fluke Reliability

Learn more about Adaptive Alignment

BEST PRACTICE WEBINAR

Wednesday, June 3, 11 a.m. ET

Adaptive alignment: the next generation in laser shaft alignment systems

What if laser alignment systems could automatically adapt to different assets, simple-to-complex alignment challenges, and any user's skills and experience?

In this webinar, Jonathan Gough, Fluke Reliability Product Manager for PRUFTECHNIK, explains what adaptive alignment means, how it can address the problems occurring with today's machines, and how it can work for your organization.



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DEMO

Visit [Accelix.com](https://www.accelix.com) for a free demo of our Connected Reliability Framework.



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