iLearnAlignment™

Training topics covered in the introduction and master versions

iLearnAlignment [Introduction]

If you need an introduction to shaft alignment in order to understand the benefits and the procedures, then all you need is iLearnAlignment [Intro]. The training comprises 190 narrated slides filled with 3D animations.

Introduction to Shaft Alignment

- Introduction
- Why is misalignment so important?
- Bearing damage
- Seal damage
- Coupling damage
- Vibration
- Energy consumption
- Product quality
- Downtime and production capacity
- Detecting misalignment

What is misalignment?

- What is misalignment?
- A closer look at misalignment
- Shaft fatigue
- Even bent shafts have rotational centerlines
- Offset and angular misalignment
- Alignment conventions
- Specifying misalignment
- Using feet corrections to specify misalignment
- Using Total Indicator Readings to specify the misalignment
- Using offset and angularity to specify alignment targets
- Angularity targets
- Visualizing tolerance
- Tolerances and speed
- Spacer couplings (jack shafts) conventions and tolerances
- Published tolerances
- Dynamic movement

Pre-Alignment checks and soft foot

- Pre-alignment tasks

Determining the alignment state

- Determining the alignment state
- Using a straightedge or feeler gauge
- Using dial indicators
- The Rim and Face method
- The Reverse Dial method
- Reverse dial method
- Dial indicator limitations

Laser alignment systems

- Laser alignment systems
- Moving the machine
- Moving the machine vertically - shimming
- Moving the machine laterally
- Summary

iLearnAlignment [Master]

If you will perform shaft alignment then you needs the complete iLearnAlignment [Master] package. It builds on the [Intro] package with the topics listed below.

Shaft Alignment Mathematics - A Primer

Offset, angularity and alignment mathematics

- Introduction
- Equal triangles
- Triangles and alignment
- A triangle from two offsets
- Dealing with negative numbers

Understanding Dial Indicators

- Introduction
- What can go wrong?
- Zero the dial
- Bar sag
- Total Indicator Readings (TIR)
- Hysteresis
- Clock positions
- Backlash
- Why do we rotate both shafts?

Using dial indicators for shaft alignment

- Using dial indicators for shaft alignment
- Rim measurements
- Face measurements

- Axial end-play and float
- Repeat all tests
- Validity rule

Pre-Alignment Checks and Corrections

- Introduction
- Plan and review maintenance history
- Why is the machine not aligned?
- Installing a new machine
- Decide on the required tolerance and coupling gap
- Pipe strain
- Mechanical looseness
- Bent shafts and coupling runout
- General preparations on site: Safety
- General preparations on site: Clean up
- General preparations on site: Shims
- General preparations on site: Jacking bolts

Soft Foot Checks and Corrections

- Introduction
- Different types of soft foot
- Rocking soft foot
- Short foot - parallel air gap
- Even foot
- High foot
- Bent foot
- Squishy foot
- Induced soft foot

Why is soft foot important?

- Why is soft foot important?
- Shaft fatigue
- Bearing distortion
- Impact on the alignment task

Testing for soft foot

- Testing for soft foot
- Taking soft foot measurements
- Recording results
- Using dial indicators to measure soft foot
- Correcting soft foot Correcting rocking soft foot
- Short cut number one: The Casanova method

- Short cut number two: The 80% Rule
- Using feeler gauges
- Using a "stair" of shims
- More complex shim patterns
- Detecting and correcting induced soft foot
- Mysterious soft foot
- Summary

The Rim-Face Dial Indicator method

- Introduction
- What if only one shaft can be rotated?
- Accuracy issues
- Setup problems
- Axial end-float
- Rim-Face Measurement Procedure
- Compensate for bar sag
- Alternative method
- Determine the alignment corrections
- Performing the calculations
- Computing the offset
- Computing the angularity
- Computing feet movements
- Shim calculations
- Move calculations
- Example calculations
- The graphical method
- Summary

The Reverse-Dial Method

- Introduction
- Reverse dial procedure
- Compensate for bar sag
- Performing the calculations
- Computing the offset
- Computing the angularity
- Computing feet movements
- Shim and move calculations
- An example
- Example:
- The graphical method
- Summary

- Alternative method

Laser Alignment

- Introduction
- The basic components in a laser alignment system
- Benefits of laser alignment systems over dial indicators
- How do laser alignment systems work?
- Using a Prism - Return Beam Method
- Beam Splitter - Single Beam Method
- Twin Emitter/Detector Pairs - Dual Beam Method
- Using a horizontal beam and a vertical detector

Using the laser alignment system

- Performing the laser alignment
- Pre-alignment
- Preparing the coupling
- Attaching the brackets
- Attach the brackets
- Check the optics
- Mount the laser heads
- Aim the heads
- Zeroing the beam
- Check for repeatability
- Rough alignment ("roughing-in")
- Correcting gross angularity
- Correcting gross parallel offset
- Dealing with gross misalignment
- Rough alignment with a laser system
- Dealing with distance and angularity
- Cones and circles and distance
- Enter the machine dimensions
- How accurate should the dimensions be?
- Entering the coupling diameter

Performing laser alignment measurements

- Performing the measurements
- The 3:00-12:00-9:00 method
- Swept measurements
- Getting the results
- Aligning spacer shafts or jackshafts
- What if you can't rotate one shaft?

- What if the shaft can't be rotated easily?
- What if you can't rotate either shaft?
- Limitations of laser systems
- Backlash
- Vibration
- Heat, steam, sunlight, water vapor
- General comment about commercial systems

Moving the Machine

- Introduction
- Perform the vertical move first
- Gross misalignment
- Using a laser alignment system
- Moving the machine vertically - shimming

Base bound and bolt bound

- Base bound
- Machine the feet
- Moving the machine horizontally
- Using a dial indicator to measure the horizontal move
- Using shims to measure horizontal machine moves
- Bolt bound
- Turn-down the bolts
- Open the bolt holes of the machine feet
- Moving the stationary machine
- Drill new holes

Dynamic and Thermal Movement

- Introduction
- Which machines will be affected?
- Thermal effects
- Manufacturer's supplied offsets
- Sources of heat
- Internal or system sources of heat
- External sources of heat
- Mechanical effects
- Pipe strain
- Oil wedges
- Jacking fluid
- Catenary sag
- Foundation changes

Dealing with dynamic movements

- Dealing with dynamic movements
- Temperature compensation
- Take 'hot' readings
- Monitoring the movement of the shaft or bearings
- Using laser heads to measure relative movement
- Issues to consider
- General issues to consider
- What do you do with the offset data?
- Manufacturer's offset data
- Determining targets graphically
- Summary

Machine Train Alignment

- Introduction
- Repeat your measurements
- Plan ahead
- Graphical method
- Optimizing the alignment
- Movement limitations
- Move in the vertical direction first
- Summary

DISTANCE LEARNING COURSES

Web-based, self-paced Category I, II, III & IV (Part 1) Mobius Institute Vibration Training Courses, ISO accredited certification through Mobius Institute Board of Certification (MIBoC). Machine Balancing and Alignment courses are also available.

PUBLIC COURSES & ON-SITE COURSES

Category I, II, III, IV (Part 2) Mobius Institute Vibration Training Courses, ISO accredited certification through Mobius Institute Board of Certification (MIBoC). Machine Balancing and Alignment courses are also available. Courses are available at training centers in more than 50 countries worldwide, or may be provided at your site.

PC-BASED e-LEARNING TRAINING PRODUCTS

- iLV – iLearnVibration™ – Vibration analysis training for beginner and intermediate vibration analysis.
- iLA – iLearnAlignment™ – Machine coupling alignment training for vibration analysts and machinists.
- iLB – iLearnBalancing™ – In-place machine dynamic balancing for vibration analysts and machinists.
- iLR – iLearnReliability™ - Plant Empowered Reliability Improvement (PERI) training for management, craftspeople and the plant floor. (* iLearnReliability includes iLV, iLA, and iLB listed above)

ABOUT US

MOBIUS INSTITUTE is a worldwide provider of Reliability Improvement, Condition Monitoring and Precision Maintenance education to industrial plant managers, reliability engineers and condition monitoring technicians, allowing plants to be successful in implementing Reliability Improvement programs through delivery of more easily understandable and comprehensive training of Reliability and Vibration Analysis via public, in-plant and online education programs. Mobius' key advantage is its extensive experience and success in teaching reliability management and technical skills development topics since 1999. Mobius Institute is unique to its competitors by offering superior training content that uses innovative 3D animations/simulations, and its technical advantage of delivering education and student success reporting through its cloud-based learning management system, allowing plant managers to monitor their employee's training and competency. Mobius Institute Board of Certification is ISO 9001 certified and is an ISO/IEC 17024 and ISO 18436-1 accredited certification body that provides globally recognized certification to Category I-IV vibration analysts in accordance with ISO 18436-1 and 18436-2. Mobius Institute has offices in Australia, Belgium, Costa Rica and the United States, and authorized training centers in more than 50 countries. For more information, call (615) 216-4811 (GMT -5), email us at learn@mobiusinstitute.com or visit www.mobiusinstitute.com.

EMPOWERING YOU TO CHANGE YOUR PLANT

280 Myers Road, Merricks North, Victoria, 3926, AUS
Tel: (+61)3-5989-7285

North America: Post Office Box 11216, Bainbridge Island, WA 98110, USA
Tel: (+1)615-216-4811

MOBIUS INSTITUTE

www.MobiusInstitute.com