

iLearnAlignment

Alignment Training Subjects

The following is a list of the subjects covered in the iLearnAlignment training system. The complete detail is shown.

Alignment Fundamentals - An Introduction

- 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

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

- 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

- Pre-alignment Checks
 - 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

- Detecting and Correcting Soft Foot
 - 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

- 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

- 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

- Laser alignment systems
 - 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

- 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

- 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

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