HENDRIX PRECISION

PRECISION MAINTENANCE SKILLS 1

Reducing Common Assembly Errors to Exponentially
Extend the Life of Rotating Equipment

COURSE OUTLINE



Precision Maintenance Skills 1 | *What attendees will learn and how to perform*

- **Precision Maintenance**
  - ⇒ What is Precision Maintenance → Origin Story: NASA Rocketry Program
  - ⇒ How equipment fails → Failure Curves
  - ⇒ The Value and Opportunity of Precision Maintenance – "***Do It Once, Do It Right***"
    - Uptime/OEE Improvement, Energy Efficiency Gains, & Extended Asset Life

- **Vibration and The Impact on Bearing Life**
  - ⇒ 90% of Bearing Failures Occur Prematurely
  - ⇒ Overview of Vibration Fundamentals
  - ⇒ Proper Method for Vibration Data Collection
  - ⇒ Common Machinery Faults Associated with Respective Vibration Frequencies
- **Precision Measuring Tools**
  - ⇒ What is Precision, What and How to Measure
  - ⇒ What's 1/1000th of an Inch Amongst Friends?
  - ⇒ Micrometer vs. Digital Caliper
  - ⇒ Bearing Clearances
  - ⇒ Other Precision Measuring Tools – Proper Selection and Usage
- **Fits & Tolerances**
  - ⇒ Rule #1 – Measure, Measure, Measure
  - ⇒ Shafts, Bearings, & Housings
  - ⇒ Mic Your Shims
  - ⇒ Heating vs. Beating
- **Bearings, Overview**
  - ⇒ Not a Bearing Class, An Introduction
  - ⇒ L10 Bearing Life – Bearings should last 11-20 Years
    - Bearing life and essential factors: shaft speed, axial/radial loads, environment, duty cycle, and proper lubrication
  - ⇒ Bearing Failure Modes, Common Causes, and Correction/Avoidance

- **Rough Alignment & Common Assembly Errors**
  - ⇒ How to Perform a Rough Alignment including the Elimination of Common Assembly Errors
  - ⇒ Identify and correct various types of Soft Foot
  - ⇒ Coupling Gap – What is it, why is it important, and how to measure and set
  - ⇒ Pipe Strain – What it is, impact, and how to eliminate
  - ⇒ Fasteners, Shims, Washers, Pusher Bolts, Shaft Keys, and Tightening & Torquing

- **Alignment – Precision in No Time**
  - ⇒ Perform Precision Alignment using Correct Procedures and Principles
  - ⇒ Precision Maintenance Worksheet – Step-by-Step Instructions & Thermal Growth Calculator
  - ⇒ Dial Indicators & Graphing Alignment Process
  - ⇒ Customer Laser Alignment Tool if Desired

Balance

- ⇒ The meaning of *Balance* and *Unbalance* → Effect on Rotating Equipment
- ⇒ Balancing standards → How to specify to reduce vibration (G6.3, G2.5, G1.0)
- ⇒ How not to disrupt factory balance on installation, commissioning, and operation

- **Lubrication, Basic Mistakes to Avoid**
  - ⇒ Identify and Eliminate the Common Lubrication Mistakes that Kill Bearings and Cause Downtime & Waste
  - ⇒ Lubrication Best Practices – Oil & Grease
  - ⇒ Re-lubrication → Intervals, Lubrication Type, Calculating Correct Amounts, and Proper Lubrication Practices & Procedures
- **Couplings**
  - ⇒ Various types of Couplings
  - ⇒ Difference between long life vs. failure, smooth operation vs. downtime, and making vs. losing money
  - ⇒ 10-Step Grid Coupling Inspection Procedure
  - ⇒ 10-Step Gear Coupling Inspection Procedure
  - ⇒ Coupling Gap and Thermal Growth
- **Thermal Growth**
  - ⇒ What is Thermal Growth how to account for and compensate
    - How to calculate and apply “Average Temperature” for both Driver & Driven Equipment
    - Step-by-Step Instructions to determine Thermal Growth Alignment Adjustments
- **Belt Drives**
  - ⇒ Terminology: Belts, Sheaves, Pulleys, & Bushings
    - Proper installation & inspection standards and procedures for all components
  - ⇒ Various Types and Applications of Belts
    - Torque-Flex, Hy-T, Compass-V-Steel, Wedge, Torque Team, F.H.P. V-Belts, and More
  - ⇒ How to use supplied *Precision Maintenance Field Worksheet* for Belt Applications

- **Appendix: Supporting Documents & Reference Guides**
  - ⇒ Reverse Dial Indicator Data Sheet | Vertical & Horizontal
  - ⇒ Soft Foot Check Form
  - ⇒ Thermal Growth Calculator
  - ⇒ Precision Maintenance Filed Worksheet | Direct Drive & Belt Drive
  - ⇒ Goodyear Belt Tension Tables
  - ⇒ Gates Belt Tension Tables
  - ⇒ Metric to Imperial Conversion Charts
  - ⇒ Minimum Tools Required for Precision Maintenance
  - ⇒ Suggested Tools for Precision Maintenance