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COURSE BROCHURE

Advanced Vibration Spectrum, Phase and Envelope Diagnostics Training Course

21 March – 1 April 2027
Online

Advanced Vibration Spectrum, Phase and Envelope Diagnostics Training Course

Ref: 887_33524 **Date:** 21 March – 1 April 2027 **Location:** Online **Fees:** 5200 GBP

Vibration Spectrum, Phase and Envelope Diagnostics is a 2-week advanced training course for vibration analysts and condition monitoring engineers who must name and grade faults; each participant builds a Fault Signature Casebook for their own machine fleet. Missed bearing and gear defects still drive unplanned outages, so confident signal interpretation protects output and spares budgets. Jupiter Prime Training delivers this course.

Why Vibration Spectrum, Phase and Envelope Diagnostics Matters Now

Wireless sensors and online monitoring systems now stream far more waveforms than analysts can read by hand, and leaner crews mean fewer specialists sign off each alarm. Operations leaders want fault calls they can trust before committing a crane, a crew and a production window. A plant that reads its spectra well catches looseness and bearing wear early and plans the repair; one that reads them badly either chases false alarms or runs machines to failure. The course anchors fault records in the vocabulary of EN 13306 maintenance terminology and links diagnosis to the asset decisions described in ISO 55001 asset management systems.

Who Gains Most from Vibration Spectrum, Phase and Envelope Diagnostics

- Analysts responsible for collecting routes, reviewing spectra and issuing fault severity reports
- Engineers who own online monitoring systems on critical compressors, turbines and pumps
- Rotating equipment specialists who decide repair scope after a confirmed fault call
- Reliability engineers who set alarm limits and measurement intervals for machine classes
- Service technicians who perform field balancing and alignment corrections after diagnosis

A condition monitoring group that sends analysts and the rotating equipment engineer together gains most, because both sides then share one way of reading and acting on a waveform.

Vibration Spectrum, Phase and Envelope Diagnostics Capabilities

Participants move from recognising peaks to proving a fault with phase, time waveform, orbit and demodulated evidence.

- Specify FFT resolution, window and averaging for each machine type — data collection strategy
- Calculate bearing and gear defect frequencies from machine geometry — fault confirmation
- Apply cross-machine phase comparison to separate unbalance, misalignment and looseness — corrective action choice
- Test for resonance with impact and coast-down measurements — redesign or speed change decisions
- Assess fault severity against trend and alarm bands — repair timing and production planners
- Communicate diagnoses with annotated plots and confidence levels — maintenance managers

Key Vibration Spectrum, Phase and Envelope Diagnostics Terms

- FFT spectrum — A plot of vibration amplitude against frequency, computed from a sampled time waveform, used to locate fault frequencies.
- Phase — The timing of a vibration peak relative to a reference mark or another sensor, used to tell one fault type from another.
- Envelope demodulation — A signal method that filters high-frequency impacts and extracts their repetition rate, revealing early rolling-element bearing damage.
- Shaft orbit — The path traced by a shaft centre, built from two proximity probes at right angles, showing preload, rub or instability.
- Natural frequency — A frequency at which a structure or rotor responds strongly when excited, creating resonance if running speed matches it.
- Sidebands — Peaks spaced evenly around a carrier frequency, often gear mesh, that indicate modulation from a damaged tooth or eccentric gear.

Vibration Spectrum, Phase and Envelope Diagnostics Day by Day

Day 1: Signals Behind Machine Faults

- Displacement, Velocity and Acceleration Units — Choosing the Measure for Each Speed Range
- Sensor Selection and Mounting Methods — Trusting High-Frequency Readings
- Time Waveform Reading Basics — Spotting Impacts Before the Spectrum
- Machine Criticality Ranking — Allocating Analyst Effort Across the Fleet
- Fault Report Language from EN 13306 — Consistent Failure Mode Records

Day 2: Spectrum Set-Up and Resolution

- FFT Lines, Fmax and Window Choice — Resolving Closely Spaced Peaks
- Averaging and Overlap Settings — Balancing Noise Against Collection Time
- Order Normalisation for Variable Speed — Tracking Running Speed Harmonics
- Log and Linear Amplitude Scales — Seeing Small Defect Peaks
- Route Database Configuration — Repeatable Measurement Points and Alarms

Day 3: Unbalance, Misalignment and Looseness

- One-Times Running Speed Patterns — Distinguishing Unbalance from Eccentricity
- Axial and Two-Times Harmonics — Confirming Angular and Parallel Misalignment
- Half-Order and Harmonic Families — Detecting Structural and Rotating Looseness
- Bent Shaft and Cocked Bearing Signatures — Avoiding Wrong Alignment Jobs
- Soft Foot Checks — Removing Hidden Frame Distortion

Day 4: Phase as Diagnostic Evidence

- Tachometer and Strobe Reference Methods — Repeatable Phase Readings
- Cross-Coupling Phase Comparison — Separating Misalignment from Unbalance
- Operating Deflection Shape Surveys — Locating Weak Frames and Bases
- Bode and Polar Plots — Reading Phase Shift Through Resonance
- Phase Data Sheets — Recording Evidence for Peer Review

Day 5: Rolling-Element Bearing Defects

- Bearing Defect Frequency Calculation — Matching Peaks to Race and Cage Faults
- Envelope Demodulation and Filter Bands — Exposing Early Spall Impacts
- Shock Pulse and Spike Energy Indicators — Screening Large Route Populations
- Four-Stage Bearing Wear Progression — Setting Replacement Windows
- Lubrication-Related High-Frequency Noise — Greasing Versus Bearing Change

Day 6: Gearbox Mesh and Modulation

- Gear Mesh and Hunting Tooth Frequencies — Identifying the Faulty Gear Pair
- Sideband Spacing Analysis — Locating Eccentric or Cracked Gears
- Synchronous Time Averaging — Isolating a Single Shaft Waveform
- Cepstrum Analysis — Revealing Sideband Families Hidden in Dense Spectra
- Planetary Gearbox Signatures — Fault Calls on Wind and Mill Drives

Day 7: Journal Bearings and Shaft Orbits

- Proximity Probe Gap and Runout — Valid Shaft Displacement Data
- Orbit and Shaft Centreline Plots — Detecting Preload and Rub
- Oil Whirl and Oil Whip Patterns — Bearing Clearance and Load Decisions
- Full Spectrum Forward and Reverse Components — Diagnosing Rotor Precession
- Startup Waterfall Plots — Reviewing Behaviour Across the Speed Range

Day 8: Resonance and Transient Testing

- Impact Hammer Bump Tests — Finding Structural Natural Frequencies
- Coast-Down and Run-Up Recording — Confirming Critical Speed Margins
- Cross-Channel Coherence — Trusting Measured Frequency Response
- Stiffening, Detuning and Damping Options — Resonance Remedy Selection
- Electrical Versus Mechanical Fault Separation — Motor Line Frequency Checks

Day 9: Field Balancing and Severity Decisions

- Single-Plane Influence Coefficient Balancing — In-Situ Correction Weights
- Two-Plane Balancing Trial Runs — Overhung and Long Rotor Corrections
- Alarm Bands and Statistical Baselines — Severity Grading by Machine Class
- Trend Rate Assessment — Deciding Run, Watch or Stop
- Repair Verification Readings — Proving the Fault Has Gone

Day 10: Practising the Fault Signature Casebook

- Combined Spectrum and Phase Case — Applying Days 3 and 4 Evidence
- Bearing and Gear Envelope Case — Applying Day 5 and Day 6 Methods
- Orbit and Resonance Case — Applying Day 7 and Day 8 Tests
- Peer Challenge of Fault Calls — Defending Confidence Levels to Engineers
- Fault Signature Casebook Assembly — Fleet Reference for Future Diagnoses

Applying Vibration Spectrum, Phase and Envelope Diagnostics After the Course

- Rebuild the envelope filter bands and defect frequency sets on the ten most critical bearing positions in the route database.
- Lead a cross-machine phase survey on one repeat misalignment offender and present the corrective plan to the rotating equipment owner.

Vibration Spectrum, Phase and Envelope Diagnostics Questions FAQ

What is vibration spectrum, phase and envelope diagnostics and why does it matter now?

It is the practice of proving machine faults from frequency, timing and demodulated signals. With far more monitoring data and fewer specialists, every fault call must be quick and defensible, so analysts need methods that separate look-alike faults before parts and crews are committed.

Which roles gain most from vibration spectrum, phase and envelope diagnostics?

Vibration analysts and condition monitoring engineers gain most. Rotating equipment and reliability engineers who act on fault reports also benefit, because they learn what evidence supports a call. Service technicians who balance and align machines gain clear targets for their corrections.

How does vibration spectrum, phase and envelope diagnostics differ from a rotor dynamics course?

It focuses on reading measured signals to name and grade faults. A rotor dynamics course centres on modelling critical speeds and bearing stability during design. Here you work from route data, phase readings and envelope spectra toward repair decisions on running machines.

What do you bring back from vibration spectrum, phase and envelope diagnostics?

You bring back a fault reference built from your own machine fleet. It holds annotated spectra, phase sheets, envelope settings and severity rules, giving your team one consistent way to diagnose, report and verify repairs across compressors, pumps, fans and gearboxes.

Vibration Spectrum, Phase and Envelope Diagnostics: The Way Forward

The Fault Signature Casebook first informs which open alarms deserve a repair window and which can be watched. Analysts use it to standardise calls, while planners and rotating equipment engineers use it to schedule work. After its first use, revisit the alarm bands and envelope filter choices, because repair verification readings show where the original thresholds were too loose or too tight.