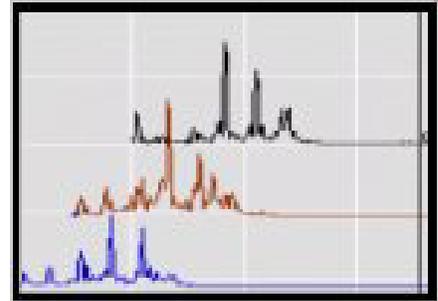




- Simple methods for introducing controlled, calibrated faults.
- Study the vibration spectra of common faults, learn fault signatures and validate rules provided in training courses.
- Bench top machine for hands-on training and sharpening skills.
- Learn machine condition monitoring and PdM.
- Manual with exercises for individually paced study.
- Modular, versatile, robust, and comprehensive.
- Simultaneous reciprocating and rotating mechanisms.
- Learn resonance, variable speed, gearbox, and belt drive diagnostics.
- Learn to determine vibration transmission path and perform root-cause analysis.
- Study correlation among vibration, motor current, and noise spectra.
- Model rotor dynamics and its effects on fault signatures.
- Validate balancing procedures above and below the first critical.

A VERSATILE TOOL FOR PROTECTING YOUR INVESTMENT IN PRODUCTION MACHINERY

Condition-based predictive maintenance (PdM) is a reliable, cost-effective technique for monitoring and diagnosing machinery faults before they irreversibly damage your machinery, and cause breakdowns that threaten to undermine product quality, delivery and overall customer service. The success of any PdM program ultimately depends on how easily and accurately you are able to analyze and understand vibration spectra, wave forms and phase relationships.



Spectra Quest's Machinery Fault Simulator is an innovative tool you can use to study the signatures of common machinery faults without compromising your production schedule or profits. The bench-top system has a spacious modular design featuring versatility, operational simplicity, and robustness. Each component is machined to high tolerances so it can be operated without conflicting vibration. Then, depending on the situation, you can introduce, various faults either individually or jointly in a totally controlled environment.

THE ULTIMATE TOOL FOR LEARNING MACHINERY DIAGNOSIS

To gain an in-depth understanding of different vibration signatures, you need to conduct controlled experiments on a device that emulates real world machinery. While you may need to analyze single faults one at a time, there are many occasions when you will need to study dynamic stiffness, resonance, and speed when components interact. A thorough analysis of vibration usually requires studies of several defects simultaneously to gain an understanding of real world vibration spectra.

With the Simulator, you can develop the expertise required to diagnose industrial machinery problems in well controlled experiments. When your plant is running at a high level of productivity, it is virtually impractical to gain an understanding of the kinetics and dynamics of machinery without adversely affecting production and profits. It is essential in environments where it is unacceptable to shut down production machinery for training and experimentation.

VERSATILITY IMPROVES PLANT EFFICIENCY

The most comprehensive device of its kind on the market, the Simulator meets the needs of a broad range of vibration analysts, from novice to experienced. It is an effective tool for introducing the concepts and methodologies of predictive maintenance and design considerations to engineering students. Companies can train their maintenance professionals on the Simulator, offering experienced technicians a way to upgrade their job skills and improve performance. Having trained vibration analysts on staff offers companies a high degree of confidence in their operating efficiency because someone on the plant floor is immediately available to ensure that machinery continues to run productively. It enables you not only to predict the condition of your machinery to maximize yields and efficiencies, but also to support planned, efficient shut downs with just-in-time parts delivery. Thereby maximizing the necessity and high cost of local spares inventory.

Applications

Using the Simulator offers you a wide range of benefits in developing your understanding of predictive maintenance and learning to recognize the signatures of various machine faults. Different types of studies can be done with application specific kits. Each kit is designed to fit on the basic simulator. Application notes and exercises provide a cost effective self-paced training program. The following list indicates some of the many ways the simulator can increase your knowledge of machinery diagnosis and vibration analysis.

- § Balance training
- § Shaft alignment training
- § Alignment system assessment
- § Coupling studies
- § Bearing faults and load effects
- § "Cocked" rotor
- § Eccentric rotor
- § Resonance studies
- § Sleeve bearing studies
- § Belt drive performance
- § Mechanical rub
- § Gearbox fault studies
- § Reciprocating mechanism studies
- § Foundation studies
- § Signal processing techniques
- § Variable speed/load effects
- § Motor current analysis
- § Rotor dynamics
- § Operating deflection shape and modal analysis
- § Optimize sensor mounting
- § Sensor types (accelerometer, proximity probes, etc.)
- § Vibration training
- § Analyst certification
- § Customized test bed for rotor dynamics studies and demonstrations

SHAFT ALIGNMENT EFFECTS

Misalignment between two mating shafts is the most common cause of machinery deterioration. A properly aligned machine can save a factory 20% to 30% in down time, replacement parts, inventory and energy consumption. The Simulator provides:

- § Calibrated dials to introduce known amounts of parallel and angular misalignment.
- § Easy ways to study misalignment effects and methods of correction.
- § Learn effects of speed, coupling and rotor stiffness on misalignment signatures.

BALANCING

Unbalanced rotors are a very common cause of machinery malfunction. An improperly balanced machine has many hidden costs in down time and parts due to accelerated wear and performance issues. The Simulator provides for controlled study of unbalance.



- § Eccentric and "cocked" rotor effects
- § Center and over hung
- § Critical speed effects
- § Single and multi-plane

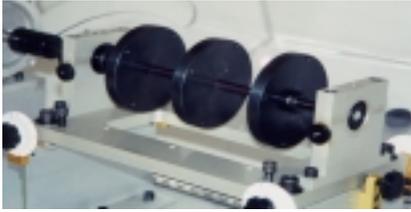
ROTOR ELEMENT BEARING FAULT SIGNATURE ANALYSIS

Most common machines are fitted with rolling element bearings. Many malfunctions damage bearings first. It is essential to learn bearing defect signatures in the presence of other complicating effects so that malfunctions are detected prior to catastrophic failure.

- § Deliberately faulted bearings fit the standard rotor shaft.
- § Waveform and spectral recognition of classic bearing defects.

RESONANCE AND CRITICAL SPEED STUDIES

A proper understanding of resonance phenomenon is fundamental for minimizing down time and maintaining the sound health of production machinery. The Simulator, along with the resonance kits, is an ideal tool for an in-depth study of resonance and lateral critical speed phenomena.



- § Critical speeds below 2000 RPM simulate real world operating conditions and improve safety.
- § Study effects of mass and stiffness on resonance frequencies and mode shapes.
- § Study damaging effects of resonance and develop control methods.
- § Study beating due to closely spaced vibration modes.
- § Study rotor stability and non-linear dynamics for chaos modeling.

SLEEVE BEARING EFFECTS

Many high speed machines are designed with sleeve bearings. Sleeve bearings are inherently quieter than the rolling element bearings, but they exhibit different rotor dynamics and problems. The modular design of the Simulator makes it easy to install grease lubricated sleeve bearings.

- § Waveform and spectral recognition of worn or loose fitted bearings.
- § Fits the standard rotor shaft with grease lubricated, babbitt lined, sleeve bearings.
- § Bearings split so that plastic shims may be used to open the clearance to simulate real world conditions.
- § Shaft orbital analysis.
- § Examine heat generation as a function of alignment and bearing clearance.



BELT DRIVE STUDIES



Belt tension can be controlled with an idler lever or by sliding the gearbox. The system can be operated with one or two belts, and the belts can be mismatched. Parallel and angular belt misalignment can be easily introduced to study the effects on vibration signatures.

GEARBOX STUDY

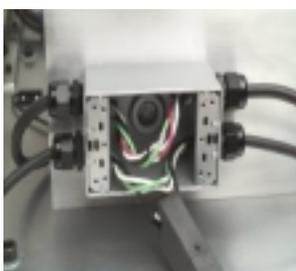
Gearbox vibration signatures are very complicated. The Simulator provides easy methods for introducing typical gearbox defects for study. Straight and spiral gearing problems can be studied with controlled backlash and loading. Missing tooth, chipped tooth and worn gears are available.



RECIPROCATING MECHANISM EFFECTS

The reciprocating mechanism introduces speed variation into the rotor dynamics, generating complex vibration signatures. The loading patterns are controlled so that torsional vibration and nonlinear dynamics can be studied effectively.

MOTOR CURRENT SIGNATURE ANALYSIS



Mechanical malfunctions can often be seen in electrical current signatures. The Simulator has easy access to all the electrical leads to facilitate motor current signature analysis.

FOUNDATION EFFECTS

Foundations have a profound effect on machinery vibrations and performance. The Simulator provides convenient ways to study the relationships among foundation mass and stiffness and the vibration spectra.

SMART DESIGN MAKE THE SIMULATOR ROBUST AND EASY TO USE

The Simulator is designed so that it's both versatile and easy to operate. The instrument is constructed with special kinds of bearings, rotors with split collar ends, a split bracket bearing housing, a multiple belt tensioning and gearbox mounting mechanism, and reciprocating system, all of which make it easy to remove and replace various components for specific types of tests. Here are just a few of the design features that make the Machinery Fault Simulator easy to use without sacrificing the performance you need.

DESIGN AND CONSTRUCTION

- § Precision machined parts with high tolerances.
- § Modular design for easy upgrades and customization as a "Test Bed".
- § Rigid, slippage-free operation using typical components from manufacturing.

REMOVING AND REPLACING PARTS

- § Split bracket bearing housing for easy rotor assembly interchanges.
- § Specialized bearings and rotors with split collar ends for easy replacement and installation.
- § Main shaft slides without removing mounted components for easy changes.
- § Couplings, rotors, bearings, shaft, pulleys, and belt can be changed without removing bearing housings.

APPLYING THE SIMULATOR TO A BROAD RANGE OF SITUATIONS

- § Five pairs of jacking bolts included for studying misalignment.
- § Built-in high resolution circular dials for studying calibrated controlled misalignment.
- § Opposed jacking bolts included for easy realignment.
- § Vibration isolators and base stiffener for studying foundation design.
- § Multi-belt drive, tensioning mechanism and gearbox system.
- § Machine design allows various studies of rotor dynamics:
 - § 10 different rotor assembly span configurations.
 - § Different rotor span lengths.
 - § Easy to install additional bearing housings for stiffer rotor system.
 - § Resonance kit available.

Machinery Fault Simulator Lite



Gearbox Dynamics Simulator



Alignment/Balance Vibration Trainer



SpectraQuest **A VALUABLE RESOURCE FOR KEEPING COMPANIES PRODUCTIVE**

SpectraQuest offers a wide range of optional tool kits for productivity enhancement. We also continue to develop new applications for and improvements in the Simulator so that the investment you make in this important maintenance tool will continue to provide value for many years to come. To learn more about the Machinery Fault Simulator and how it can help you to keep your plant operating profitably, please call or contact us by e-mail. We are eager to explain how the Simulator can help you meet the special challenges you face as you concentrate on maintaining your company's competitive position in the market.

SPECIFICATIONS

Electrical:

Drive:

DC Drive Drive:

1/2 HP Variable Speed DC

AC Drive Drive:

1/2 HP 3 Phase Variable Speed AC
(with local and/or Remote Control)

RPM:

Maximum 4,000

to over 10,000

Range:

0 to 4,000 user selection

0 to 10,000 user selection

Voltage:

115/230 VAC, Single phase, 60/50 Hz

115/230 VAC, Single phase, 60/50 Hz

Both AC and DC drives can also be obtained at 1 HP rating. A panel box provides an easy and safe access to all cables for motor current signature analysis.

Mechanical:

Shaft Diameter:

5/8 in., Steel; 3/4 in. Steel optional

Bearings:

2, Sealed Ball bearings

Bearing Housings:
mount

2, Aluminum Horizontally split bracket for simple and easy changes, tapped to accept transducer

Bearing Housing Base:

Completely movable using Jack Bolts for easy misalignment in all three planes

Axial Loading:

Easy to introduce using Jack Bolts

Rotors:

2, Aluminum, 6" diameter with two rows of tapped holes at every 20½ *(with lip for introducing unbalance force)*

Sheaves:

Double V-Belt (finished bore and split tapered bushing)

Tensioners:

Positive adjusting lever and sliding base

Gearbox:

Three way straight tooth profile bevel gearbox with 1.5:1 ratio, accessible internals

Magnetic Brake:

Manually adjustable, .5 - 10 lb.-in; designed to introduce desired load on the gearbox

Reciprocating Mechanism:

Strokes:

1.0" (25.4mm), 1.5" (37.5mm), and 2.0" (50.8mm)

Resistance Force:

Preload adjustable using 3 coil springs

Mounting base and general structure: Precision Machined Aluminum

Foundation:

1/2 in. die cast aluminum base with removable stiffeners and 6 Rubber isolators

Safety Cover:

Clear, impact resistance hinged cover with safety cut-off interlock

Physical:

Operating weight:

Approximately 130 lb.

Size:

L = 37", W = 20", H = 18.5"

Local Representative:

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