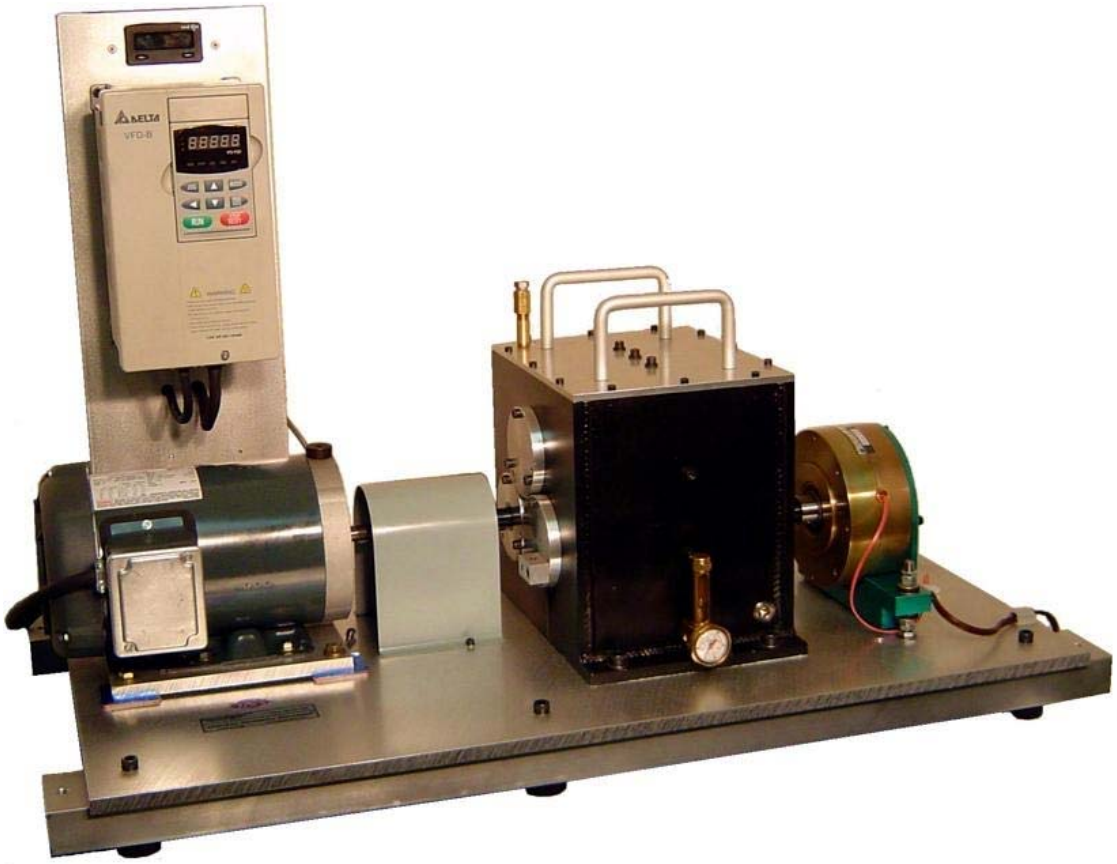
Gearbox Dynamics Simulator

GDS



The Perfect Tool for Gearbox Dynamics Studies

SpectraQuest, Inc.
8227 Hermitage Road, Richmond, VA 23228 U.S.A.
TEL +1-804-261-3300/FAX +1-804-261-3303
www.spectraquest.com

Gearbox Dynamics Simulator (GDS)

An Ideal Simulator for Gearbox Reliability Studies

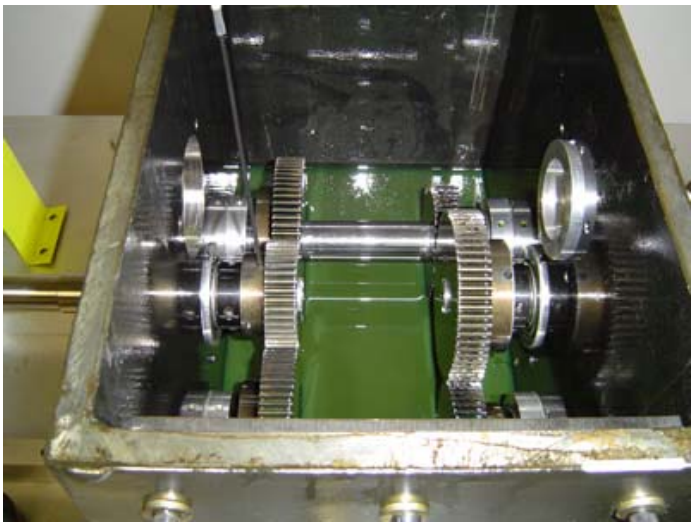
SpectraQuest's Gearbox Dynamics Simulator (GDS) has been specifically designed to simulate industrial gearbox for experimental and educational purposes. The gearbox consists of a 2 stage parallel shaft gearbox with rolling bearings and a magnetic brake. All elements of the GDS have been designed to investigate gearbox dynamics and acoustic behavior, health monitoring, vibration based diagnostic techniques, lubricant conditioning or wear particle analysis. It is robust enough to handle heady loads and spacious enough for easy gear placement, setup, and installation of monitoring devices. The two-stage parallel shaft gearbox can be configured as to reduce or increase the gear ratio.

Flexible Gearbox Fault Diagnostics

The effect faults like surface wear, crack tooth, chipped tooth and missing tooth can be demonstrated on either spur gears or helical gears. Rolling element bearing faults like inner race, outer race, and ball damage can also be incorporated. Adjustable clearance to study backlash is possible: increasing the amount of backlash is without major consequence (other than increased noise and rotational play), and reducing backlash can result in binding and/or excessive operating temperatures. Any of these faults can be added to the gearbox one at a time, or simultaneously to study fault interactions. Torsional can be applied via a 3 HP variable frequency AC drive with a programmable, user-defined speed profiles, to study damage signature or propagation in gears.

Easily Configurable

The GDS design enables changing gearbox and bearing components quickly and easily. The unit is adaptable to install either spur or helical gears. The modular design makes the introduction of faulted gears an easy task. Multiple mounting locations are provided for installation of transducers. The motor, gearboxes, brake are mounted on a half inch aluminum plate with stiffeners and vibration isolators to minimize environmental vibration.



Transducers and DAQ

The gearbox is designed to accommodate different types of sensors easily. Accelerometers can be installed on the gearboxes and on the bearing housing to measure the vibrations in all three directions. The input and output shafts can be fitted with encoder or tachometer to measure the transmission error or for time synchronize averaging. Other transducers can also be installed per customers' request. Data acquisition hardware and software are also available from Spectra Quest and ready to do time domain and frequency domain signal analysis.

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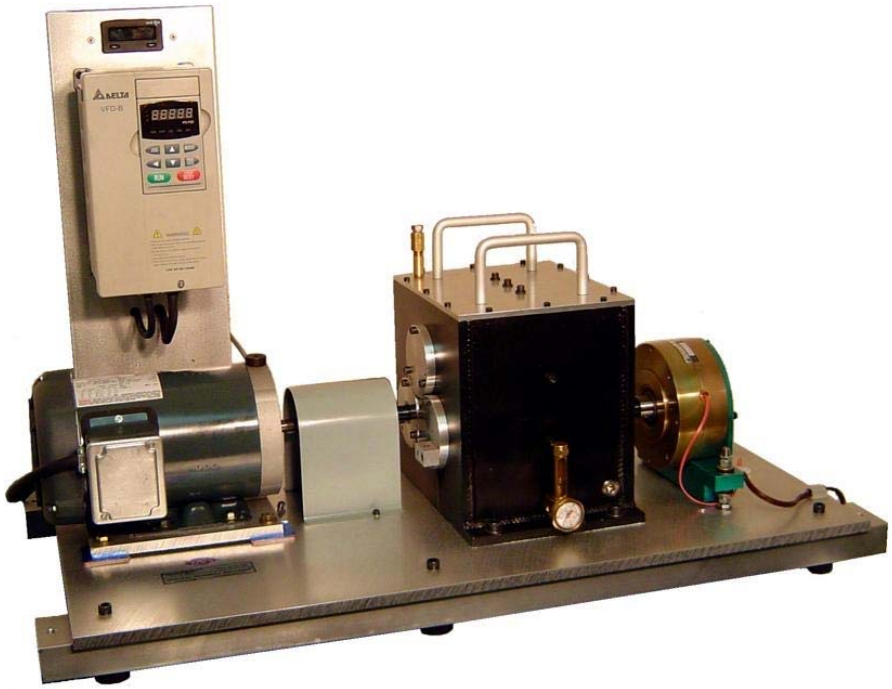

Features:

- Gears can slide along the shafts to alter system stiffness and make room for additional devices.
- Adaptable to spur or helical gears.
- Intentionally damaged or worn gearing can be fitted to study the effects on vibration signature.
- Alterable backlash by replacing bearing mounting hubs to provide the desired clearance.
- Modular design makes the introduction of faulted bearing and/or faulted gears an easy task.
- Multiple mounting locations provided for installation of various transducers.
- Develop diagnosis techniques and advanced signal processing methods.
- Torsional variable speed loading.
- Additional devices may be mounted instead of the brake.

Basic GDS Configuration and Option Kits

The GDS provides a basic setup for performing gearbox experiments and for learning vibration signatures of gearbox and bearing malfunctions. However, a detailed investigation of particular and more advance vibration phenomena will require additional attachments and fixtures which are available through optional kits.

Gearbox Dynamics Simulator (GDS)

Basic Gearbox Dynamics Simulator (GDS) Description:

- 3 HP Variable frequency AC drive with multi-featured front panel programmable controller, 220 VAC 1 phase supply
- 3 Phase 3 HP motor, pre-wired self-aligning mounting system for easy installation/removal
- Three in-line parallel shafts configurable as single or two stage reduction/increaser
- Four Spur Gears to obtain two gear mesh frequencies and three shaft speeds
- Built-in Tachometer with LCD Display and analog output for DAQ purposes
- Six rolling element bearings
- Programmable Magnetic brake (220lb-in) with power supply for gearbox loading
- Precision machined bearing housings at both ends of the gearbox with mountings for direct measurements of bearing vibration
- Gearbox oil level gauge
- Vibration isolators mounts and base stiffener
- Comprehensive operations manual

Bearing Fault Kit (G-BFK-1)

- Learn waveform and spectra of classic bearing defects.
- Learn about signal processing issues such as averaging techniques, leakage, and spectral resolution on determining bearing faults.
- Perform experiments with increasing severity of defects.
- Determine why an ultra-high resolution spectrum is needed to diagnose a bearing fault when fault frequencies are located close to multiples rotational speed.
- Learn how a large signal can mask adjoining low amplitude signal due to spectra leakage.
- **The kit consists of one inner race defect, one outer race defect, one with ball defect, and one combination of defects.**

Defective spur gears (G-SDG)

- Study the effect of damaged tooth in gearboxes.
- Apply phase demodulation signal analysis to detect gear damage.
- Investigate backlash between mating gears.
- **The kit consists of one missing tooth gear, one chipped tooth gear, one root crack gear, and one surface wear gear**

Helical gears set (G-HG)

- Study the helical gears parallel shaft gearbox.
- Compare vibration signature between spur and helical gears.
- **The kit consists of four helical gears to replace standard spur gears in gearbox**

Defective helical gears (G-HDG)

- Study the effect of damaged helical gears.
- Apply phase demodulation signal analysis to detect gear damage.
- **The kit consists of one gear with chipped tooth, one gear with missing tooth and one gear with surface defect**
- Requires G-HG

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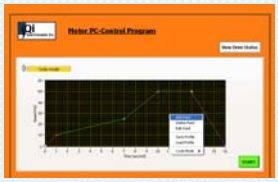
Eccentric Spur Gear (G-ESG)

- Study the effects of eccentric spur gear.
- Measure the vibration signature of eccentric gears.
- **The kit consists of one eccentric spur gear.**

Shaft encoder (G-ENC)

- Measure transmission error in the gearbox by comparing input and output rotation.
- **The kit consists of one 360 pulse per revolution encoder and once per revolution index**

PC Motor Control Kit (G-PCMK)



- Operate GDS from remote location.
- Pre-program speed acceleration, deceleration, and length of run to meet exact requirements.
- **The kit consists of PC software, one interface module to motor drive and cables.**

PC Load Control Kit (G-PCLK)

- Operate magnetic brake from remote location.
- Pre-program load profiles of run to meet exact requirements.
- **The kit consists of PC software, one interface module to magnetic brake and cables.**

1 HP AC Motor With Built-In Rotor Unbalance (G-UBM-1)

- Study the effects of unbalanced rotor on vibration and/or current signature.
- Study the effect of unbalance rotor on power quality and consumption.
- Study the effect of temperature rise on non-linear characteristics of induction motors.
- **The kit consists of one unbalanced 1 HP AC motor**

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1 HP AC Motor With Built-In Bowed Rotor (G-BRM-1)

- Study the effects of rotor bow on vibration and/or current signature.
- Study the effect of bowed rotor on power quality and consumption.
- **The kit consists of one 1 HP AC motor with centrally bent rotor**

1 HP AC Motor With Built-In Faulted Bearings (G-FBM-1)

- Study the effects of bearing faults on vibration and/or current signature.
- Study the effect of bearing faults on power quality and consumption.
- **The kit consists of one 1 HP AC motor fitted with one inner race faulted bearing and one with outer race faulted bearing. User can specify the types of bearing faults.**

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1 HP AC Motor With Built-In Rotor Misalignment System (G-MAM-1)

- Study the effect of variable air gap on vibration and/or current signature.
- Study the effect of amount/type of misalignment and rotor speed on vibration/current spectra.
- Determine the effect of misalignment on power quality and consumption.
- Study the effect of temperature rise on non-linear characteristics of induction motors.
- **The kit consists of one 1 HP AC motor with custom machined end bells, which allows for easy introduction of known misalignment at either end of the motor.**

1 HP AC Motor With Built-In Broken Rotor Bars (G-BRBM-1)

- Study the effect of broken rotor bars on motor vibration and/or current signature as a function of speed and load.
- Study the effect of broken rotor bars on power quality and consumption.
- Study the effect of temperature rise on non-linear characteristics of induction motors.
- **The kit consists of one 1 HP AC motor with broken rotor bars**

1 HP AC Motor With Stator Winding Faults (G-SSTM-1)

- Study the effects of turn-to-turn short in stator windings on vibration and/or current signature.
- Study the effect of turn-to-turn short in stator windings on power quality and consumption.
- Study the effect of temperature rise on non-linear characteristics of induction motors.
- **The kit consists of one 1 HP AC motor with shorted stator winding turns, and one control box to vary short conditions**

1 HP AC Motor With Voltage Unbalance & Single Phasing (G-VUSM-1)

- Study the effects of voltage unbalance and one phase loss on motor current/vibration signatures.
- Study the effect of voltage unbalance and one phase loss on power quality and consumption.
- Study the effect of temperature rise on non-linear characteristics of induction motors.
- **The kit consists of one 1 HP AC motor and one control box to vary voltage balance and to disconnect one phase.**

High Value Combination Packages

The GDS is available in two high value combination packages providing you with up to 6% savings**.**

Package No. 1: Basic GDS+ Kits for in-depth studies of gearing concepts
Package No. 2: Basic GDS + Kits in-depth studies of gearing concepts with instrumentation

Option kit		PKG 1	PKG 2
Bearing fault kit	G-BFK-1	x	x
Defective spur gears	G-SDG	x	x
Eccentric spur gear	G-HG	x	x
Helical gears set	G-HDG	x	x
Defective helical gears	G-ESG	x	x
PC motor control kit	G-PCMK	x	x
PC Load control Kit	G-PCLK	x	x

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1 HP AC motor with built-in rotor unbalance	G-UBM-1		x
1 HP AC motor with built-in rotor misalignment system	G-MAM-1		x
1 HP AC motor with built-in bowed rotor	G-BRM-1		x
1 HP AC motor with built-in faulted bearings	G-FBM-1		x
1 HP AC motor with built-in broken rotor bars	G-BRBM-1		x
1 HP AC motor with stator winding faults	G-SSTM-1		x
1 HP AC motor with voltage unbalance & single phasing	G-VUSM-1		x
Shaft encoder	G-ENC		

Specifications

Electrical	
Motor	3 Phase, 3 HP motor, pre-wired self-aligning mounting system for easy installation/removal
Drive	3 HP variable frequency AC drive with multi-featured front panel programmable controller
RPM range	0 to 5000 rpm variable speed
Tachometer	Built-in tachometer with LCD display and one pulse per revolution analog TTL output for DAQ purposes
Voltage	230 VAC, Single phase, 60/50 Hz
Mechanical	
Shaft Diameter	1” diameter; Turned, Ground, & Polished (TGP) steel
Parallel Shaft Gearbox	2 stage, 2.5 maximum ratio per stage, spur or helical gears
Bearing	Deep groove ball bearing
Magnetic Brake	4-220 lb.in capacity magnetic particle brake
Foundation	1/2” (12.7 mm) die cast aluminum base, base stiffener and eight rubber isolators
Physical	
Weight	Approximately 200 lb
Dimensions	L=39” (100cm), W=20” (50cm), H=24” (60cm)

Content of brochure is subject to change without any notice

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