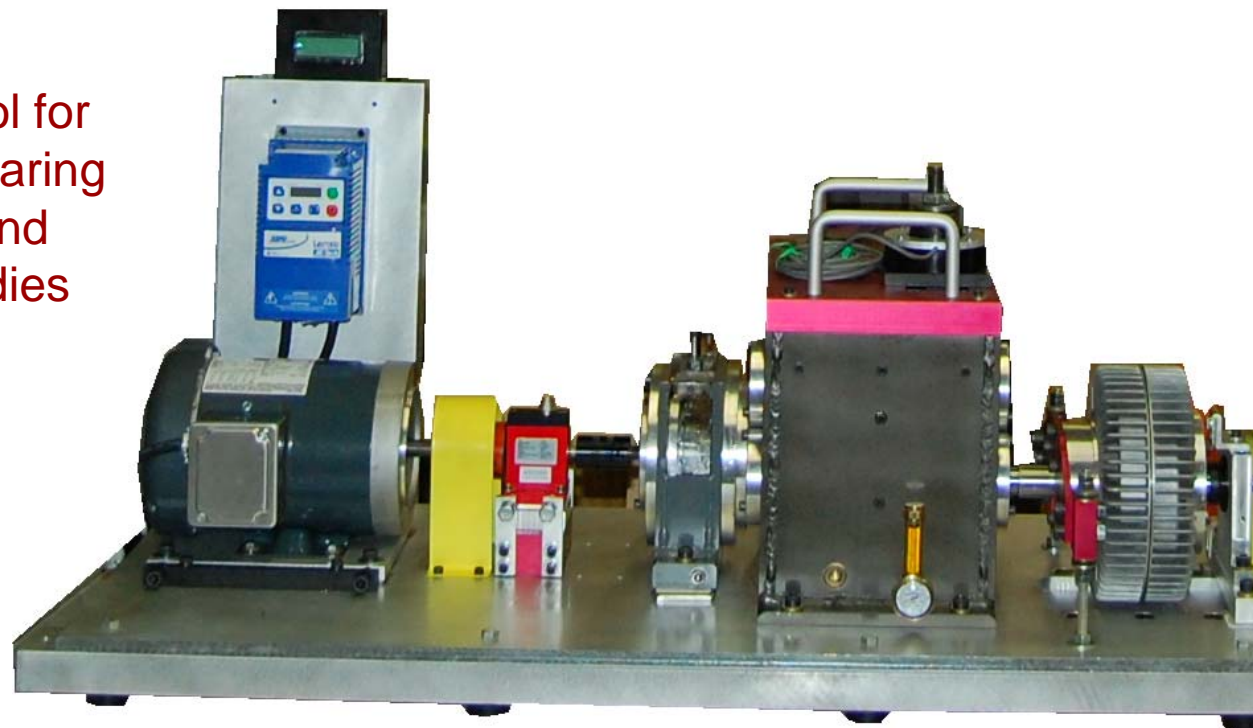


# *Drivetrain Diagnostics Simulator*

The Perfect Tool for  
Gearbox and Bearing  
Diagnostics and  
Dynamics Studies

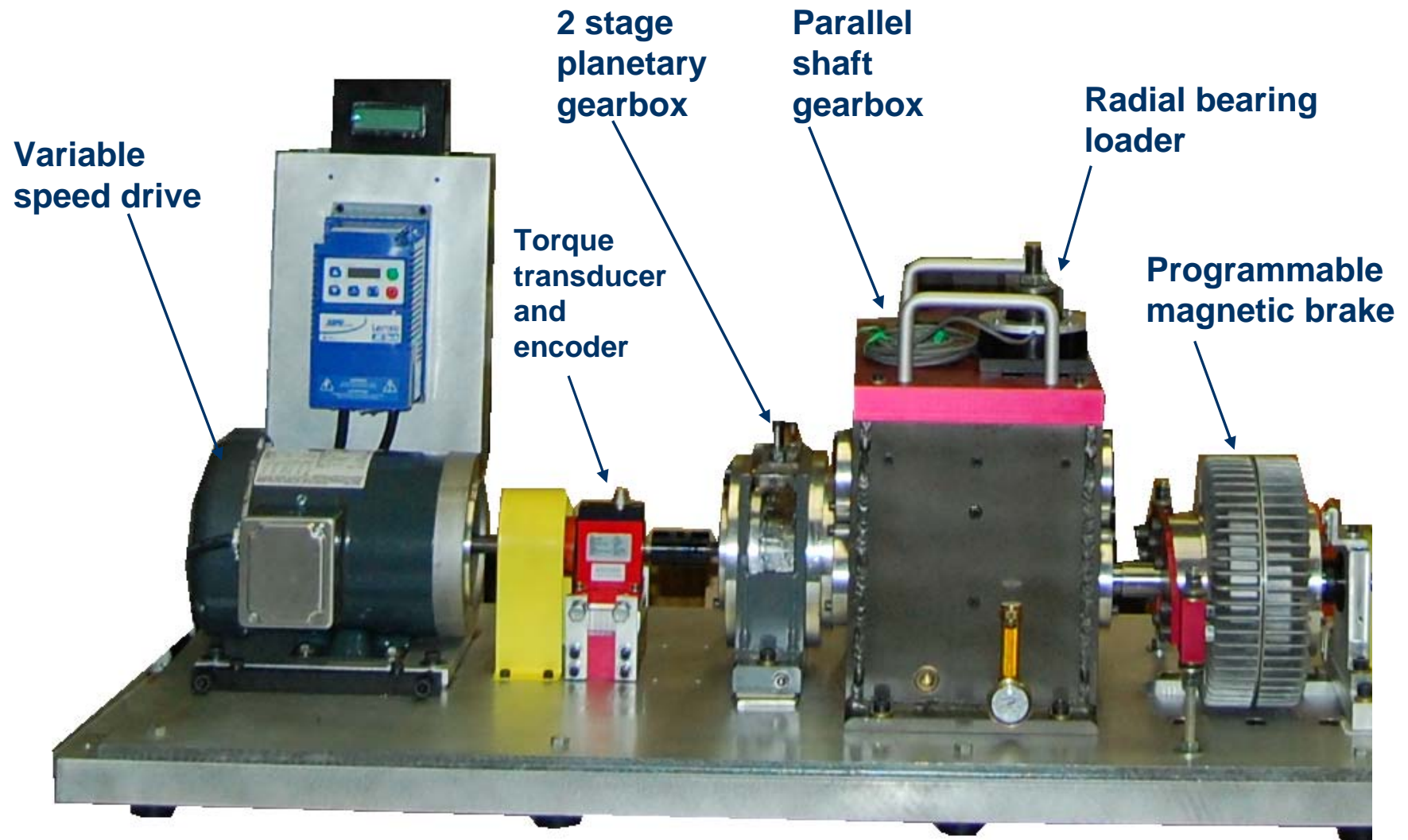


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# Drivetrain Diagnostics Simulator

- ❖ Designed to simulate industrial drivetrains for experimental and educational purposes
- ❖ Drivetrain consists of a 2 stage planetary gearbox, a 2 stage parallel shaft gearbox with rolling or sleeve bearings, a bearing loader, and a programmable magnetic brake.
- ❖ Designed to maximize the number of drivetrain configurations to investigate gearbox dynamics and acoustic behavior, health monitoring, vibration based diagnostic techniques, lubricant conditioning or wear particle analysis.
- ❖ Robust enough to handle heavy loads and spacious enough for easy gear placement, setup, and installation of monitoring devices.
- ❖ Can be configured to reduce or increase the gear ratio.
- ❖ Planetary gear train, sun, planet and ring gears, the carrier, and bearings are all easily accessible.

# Drivetrain Diagnosis Simulator

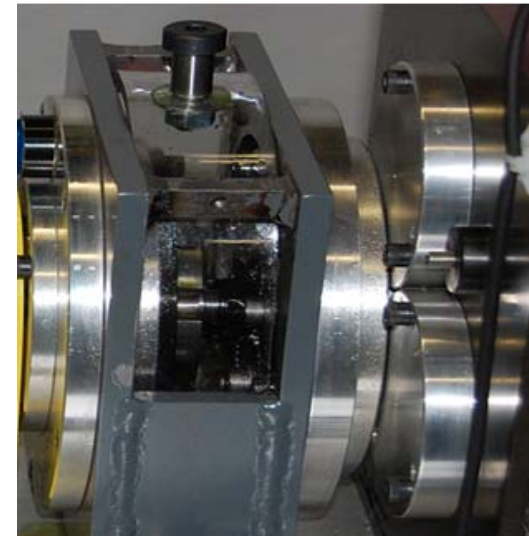
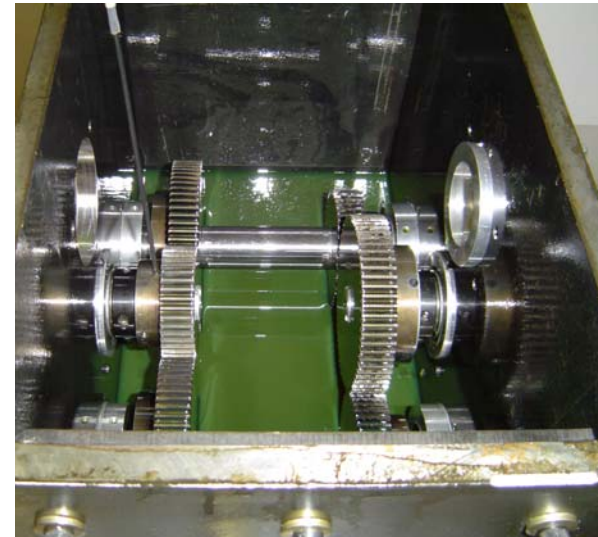


# DDS Benefits

- ❖ 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, 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.
- ❖ Misalignment can also be introduced intentionally
- ❖ Any of these faults can be added to the drivetrain one at a time, or simultaneously to study fault interactions.
- ❖ Both torsional and radial loadings can be applied to study damage signature or propagation in gears and/or bearings
  - ❖ Torsional load is applied via a 3 HP variable frequency AC drive with a programmable, user-defined speed profiles
  - ❖ Radial load is applied to a shaft in the parallel gearbox.

# DDS Features

- ❖ 2-stage planetary gearbox and 2-stage oil-lubricated parallel shaft gearbox
- ❖ 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.
- ❖ 2 stage, 27:1 gear ratio planetary gear with 4 planet stage 1 and 3 planet stage 2





# Versatility

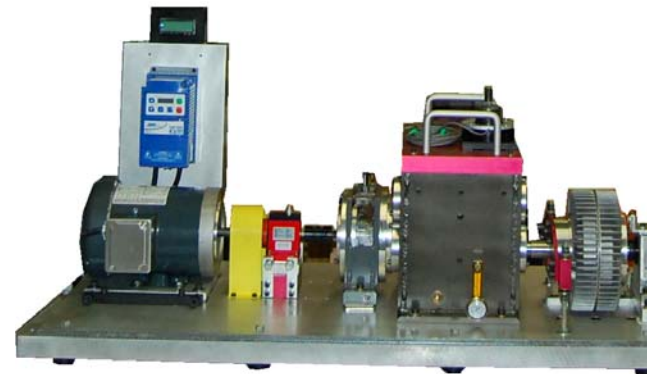
- ❖ Modular design makes the introduction of faulted bearing and/or faulted gears an easy task.
- ❖ Multiple mounting locations provided for installation of various transducers.
- ❖ Develop diagnosis techniques and advanced signal processing methods.
- ❖ Torsional and radial variable speed loading
- ❖ PC controlled magnetic brake connected directly to output shaft to provide loading

# Transducers and DAQ

- ❖ 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.
- ❖ Torque meter enables precise load measurement.
- ❖ 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 as per customer's request.
- ❖ Data acquisition hardware and software are also available from Spectra Quest and ready to do time domain and frequency domain signal analysis.

# Basic DDS

- ❖ 3 HP variable frequency AC drive with multi-featured front panel programmable controller
- ❖ 3 Phase 3 HP motor, pre-wired self-aligning mounting system for easy installation/removal
- ❖ Built-in Tachometer with LCD Display and analog output for DAQ purposes
- ❖ Three in-line parallel shafts configurable as single or two stage reducer/increaser
- ❖ 2 stage planetary gearbox
- ❖ Four spur gears to obtain two gear mesh frequencies
- ❖ Six rolling element bearings
- ❖ Magnetic break for gearbox loading
- ❖ Precision machined bearing housings at both ends of the gearbox with mountings for direct measurements of bearing vibrations
- ❖ Gearbox oil level gauge
- ❖ Vibration isolators mounts and base stiffener





# Option Kits

- ❖ SpectraQuest offers a complete array of option kits enabling detailed investigations of particular and more advance vibration phenomena or machinery faults.

Parallel gearbox bearing fault kit	G-BFK-1
Planetary gearbox bearing fault kit	G-BFK-P
Parallel gearbox oil-impregnated sleeve bearing	G-SBH
Radial bearing loader	G-RBL
Defective spur gears	G-SDG
Eccentric Spur Gear	G-ESG
Helical gears set	G-HG
Defective helical gears	G-HDG
Defective planatary gears	G-PDG
PC motor control kit	G-PCK
PC controlled brake	G-PCB
Radial bearing loader force transducer (Requires W-RBL)	G-RBFT
Torque transducer with built encoder on input shaft	G-TOR
Shaft encoder	G-ENC

# Parallel Gearbox 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.



# Planetary Gearbox Bearing Fault Kit (G-BFK-P)

- ❖ Study bearing faults in planetary gearbox
- ❖ The kit consists of one inner race defect, one outer race defect, one with ball defect, and one combination of defects.

# Radial Bearing Loader (G-RBL)

- ❖ Investigate bearing radial loading effects.
  - ❖ Understand bearing failure signature as a function of load and rotational speed.
- 
- ❖ Compare vibration signature between loaded and unloaded bearings.
  - ❖ Study outer race bearing fault signature as a function of load location.
  - ❖ The kit consists of one mechanical bearing loader

# 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

# 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.



# 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)

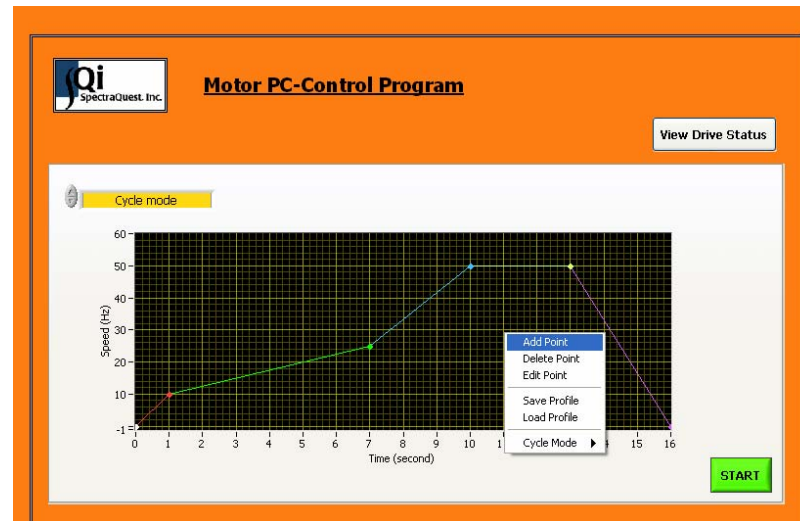
- ❖ Study the effect of damaged helical gears.
- ❖ Apply phase demodulation signal analysis to detect gear damage.
- ❖ The kit consists of one gear with chipped tooth and one gear with missing tooth

# Defective Planetary Gears (G-PDG)

- ❖ Study the effect of damaged planetary gears.
- ❖ Apply phase demodulation signal analysis to detect gear damage.
- ❖ The kit consists of one missing tooth gear, one chipped tooth gear, one root crack gear, and one surface wear gear

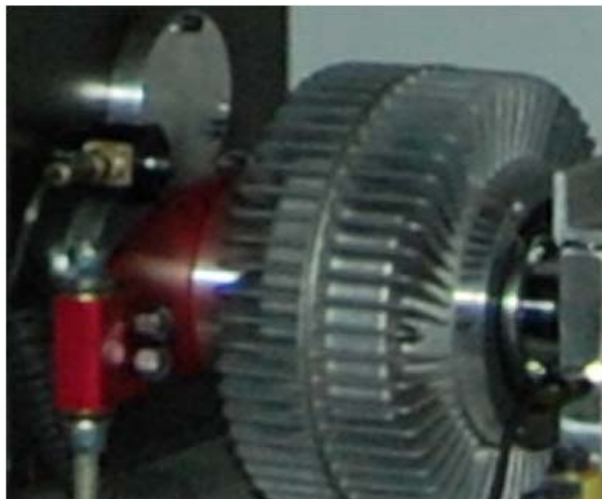
# PC Motor Control Kit (G-PCK)

- ❖ Operate DDS 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 Controlled Brake (G-PCB)

- ❖ 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.



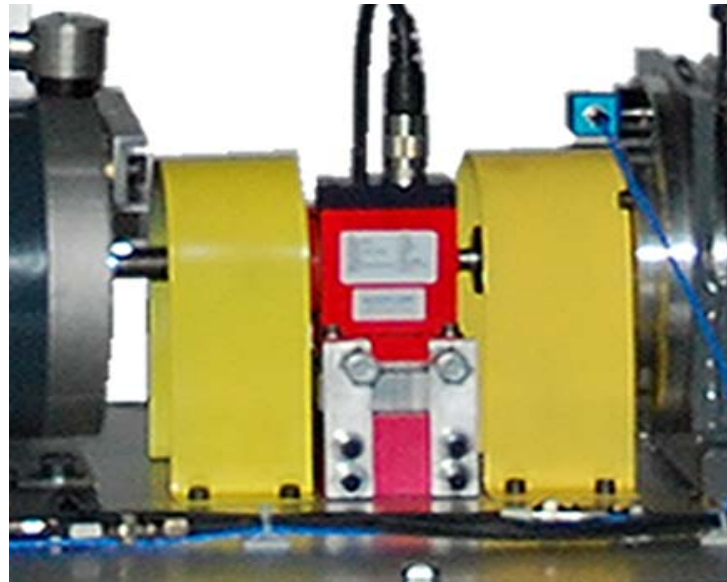
# Radial Bearing Loader Force Transducer (G-RBFT)

- ❖ Measure the radial load applied by the mechanically operated bearing loader.
- ❖ The kit consists of one transducer measuring radial force and one matching signal conditioner.



# Torque Transducer with Built Encoder on Input Shaft (G-TOR)

- ❖ Measure the torque on the input shaft.
- ❖ Study torque variation through full rotation cycle.
- ❖ Track shaft position in signal analysis.
- ❖ The kit consists of one 20 N.m torque meter with built-in 360 pulse encoder



# 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

# Value Packages

- ❖ The DDS is also available in high value combination packages

	Diagnostcs	Instrumentation
PKG 1	X	
PKG 2	X	X

	G-BFK-1	W-BFK-P	G-SBH	G-RBL	G-SDG	G-ESG	G-HG	G-HDG	G-PDG	G-PCK	G-PCB	G-BPC	G-RBFT	G-TOR	G-ENC
PKG 1	X	X	X	X	X	X	X	X	X						
PKG 2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

# Specifications

<b>Electrical</b>	
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
<b>Mechanical</b>	
Shaft Diameter	1" diameter; Turned, Ground, & Polished (TGP) steel
Planetary Gearbox	2 stage, 27:1 gear ratio planetary gear with 4 planet stage1 and 3 planet stage 2
Parallel Shaft Gearbox	2 stage, 2.5 maximum ratio per stage, spur or helical gears
Bearing	Deep groove ball bearing or oil-impregnated bronze sleeve bearing
Torque meter	Up to 20N.m with built-in 360 pulse encoder
Bearing Loader	3000lb capacity with available force transducer
Magnetic Brake	1.5 to 32 lb.ft capacity heavy duty magnetic particle brake
Foundation	1/2" (12.7 mm) die cast aluminum base, base stiffener and eight rubber isolators
<b>Physical</b>	
Weight	Approximately 250 lb
Dimensions	L=56" (142cm), W=76" (190cm), H=96" (220cm)