Model 2500
Horsepower Computer System
User Manual

Manufacturered by:
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Description:

The function of the Model 2500 Horsepower Computer is to provide the operator with a continuous digital readout of the RPM, TORQUE, POWER (Horsepower or Kilowatts) and percentage of Torque Rise (% TORQUE RISE) when properly attached to a compatible dynamometer.

The RPM readout shows the operator the rotation speed (rotations per minute) of the power shaft of the dynamometer. The RPM is measured by a pickup and gear combination that is mounted on the dynamometer and coupled to the power shaft of the dynamometer.

The TORQUE readout shows the operator the torque (Foot-Pounds or Newton-Meters) being produced by the prime mover being tested. This is the same as the torque applied to the dynamometer by the power source (motor, engine, drive wheels, etc.). The torque is measured by a load cell that is mounted on the dynamometer.

The POWER readout shows the operator the amount of power being produced by the prime mover and applied to the dynamometer. This is the same as the power being absorbed by the dynamometer. It is computed by the Horsepower Computer using the RPM and Torque measurements using the formulae below:

HORSEPOWER = (RPM * TORQUE (foot-pounds)) / 5252

KILOWATTS = (RPM * TORQUE (Newton-Meters)) / 9549

The % Torque Rise (% Torque Load) meter shows the torque as a percentage compared to a reference torque value. It is used to measure the “lugging ability” of an engine.

The Horsepower Computer has a Universal Serial Bus (USB) interface which can be connected to an external computer system, which is referred to as the “host computer”.

The host computer provides control and display functions and can also be used to record measurement data and provide further analysis functions such as graphing and printing hard copy records of the measurement data

Installation:

The Model 2500 horsepower computer should be installed in a location where the unit is not exposed to wetness (including water, gasoline, diesel fuel or other oils, etc.), extremely high temperatures, prolonged direct sunlight, or other environmental factors that would shorten the life expectancy of the unit. The Model 2500 horsepower computer should not be installed in a location where it is subject to strong vibrations or other factors which might also adversely affect the life expectancy of the unit.

Power Supply:

The Model 2500 horsepower computer is normally operated from 110 to 125 VAC (60 Hz) using the outlet mounted power supply that is supplied with the unit. The power consumption of the computer is very low and the unit has a very high tolerance for power supply variations, so nearly any standard 115 VAC utility power outlet should power the unit adequately. See (below) information on a special (optional) "wide-range" power supply which will power the unit properly when the line voltage is either very low or very high.

The computer may also be operated from a source of 12 to 18 Volts DC such as a small DC power supply or 12 Volt storage battery. If a storage battery is used, be sure that it is properly charged. If the battery voltage is low, the host computer will indicate that the power supply voltage is inadequate to power the unit properly. **NOTE: WHEN OPERATING THE UNIT FROM A BATTERY OR POWER SUPPLY, THE POLARITY (+/- WIRING) MUST BE CORRECT OR THE UNIT WILL NOT OPERATE. WIRING A BATTERY OR POWER SUPPLY TO THE UNIT WITH IMPROPER POLARITY MAY RESULT IN DAMAGE TO THE UNIT.**

Operation of the unit from a 110 to 250 VAC 50 to 60 Hz power source

A special "universal input" power supply is available (as an option) which will allow the unit to be operated from a wide range of AC power sources – both domestic and international.

This power supply has a detachable power cable which may be easily replaced with a power cable which matches the local power system.

This power supply is also very useful when operating the unit from power sources which may be lower than standard and/or slightly erratic. This power supply will result in proper operation when the AC power source is a low as about 90 Volts AC.

Operation:

Measurement Rate:

The horsepower computer normally operates with a two second measurement cycle. It can optionally be factory programmed for a one second measurement cycle. During the measurement cycle, the RPM of the dynamometer shaft is measured along with the torque sensed by the dynamometer load cell. At the end of each measurement cycle, the RPM and TORQUE values (averaged over the measurement interval) are displayed and the POWER and % TORQUE RISE

values are computed and displayed. This process is repeated continuously while the unit is in operation.

Host Computer Check Mode Functions :

The horsepower computer has a user controllable self test mode ("CHECK MODE"). This can be used to test much of the horsepower computer's internal circuits for proper operation. In this check mode, internal test signals are fed to the RPM and TORQUE measuring circuits to simulate normal operation of the unit at about 37.5 % of full scale torque. The actual readings shown on the displays of the unit depend on internal factory set optional settings – principally the full scale torque value (which corresponds to the size of the load cell being used with the unit).

IMPORTANT NOTE : The dynamometer must be stopped when using Check Mode, so that the load cell (torque sensor) has no load applied to it. If this is not done, the torque reading will indicate the combined torque of the dyno torque plus the check mode test signal.

In check mode, the RPM display should read about 4800 RPM (+/- 1 or 2 counts) on all units. The Torque display should read about 2/3 (67.24%) of the load cell rating – but the torque display reading may vary a bit from the values in the table below, according to the properties and calibration of the individual load cell. Refer to the tables below for the proper readings of the Torque and Power displays for your unit. The Power reading should agree with the power you compute from the actual RPM and TORQUE readings (within +/- 1 or 2 counts) using the above formulae for the horsepower or kilowatts.

Load Cell Rating (Ft.-Lbs.)	Torque (Ft.-Lbs.)	Power (HP)
50	33.62	30.73
100	67.24	61.46
200	134.5	122.9
500	336.2	307.3
1,000	672.4	614.6
2,000	1345	1229
5,000	3362	3073
10,000	6724	6146

CHECK readings using Ft.-Lbs. & Horsepower

Load Cell Rating (Ft.-Lbs.)	Torque (N-M)	Power (KW)
50 (67.75 N-M)	25.42	10.65
100 (135.5 N-M)	50.84	21.30
200 (271 N-M)	101.6	42.60
500 (677.5 N-M)	254.2	106.5
1,000 (1355 N-M)	508.4	213.0
2,000 (2710 N-M)	1016	426.0
5,000 (6775 N-M)	2542	1065
10,000 (13550 N-M)	5084	2130

CHECK readings using Newton-Meters and Kilowatts

The CHECK MODE function provides a quick check to determine whether the horsepower computer is operating properly. Proper readings indicate that the major portion of the computer is working correctly.

With the dynamometer at rest, the host computer software in the "RUN" mode, and CHECK MODE turned OFF (un-checked) the speed and power displays should show zero ("0"). The torque display may show some small value --- typically less than +/- ½% of the full scale torque value. The % torque rise display reading depends on whether or not the reference torque has been set and if so, to what value – so the reading of this display should be ignored at this time. See also the section below.

System Power LED:

The system power LED (Light Emitting Diode) is located on the front panel of the unit, just above the power connector.

This green LED indicates that power is applied to the unit and the unit is turned "ON". It indicates (by a steady glow) that power is applied to the unit.

Torque Set Switch:

The reference torque "set switch" is a "button" that appears on the display screen when the host computer software is in "RUN" mode.

The torque set switch (button) is used to set the torque reference which is used to compute the % Torque Rise reading. To set the torque reference, proceed as follows:

Run the engine at it rated speed, loaded at rated power or torque output. This represents the 100% torque output condition for the engine.

With the engine running at its rated speed and load, press the Torque Set switch (button) momentarily. The reference torque value is now set to the rated engine 100% torque and the % Torque Rise display should now read 100.0 (100%). All future measurements will now display the torque on the % Torque Rise meter as the percentage of the reference torque value. For example, if the % torque rise meter reads 75.0, this means that the current actual torque is 75.0% of the reference (or rated) torque.

Printer / Computer Interface:

The Model 2500 horsepower computer is equipped with a RS-232-C compatible serial interface. This interface can be used to operate a small serial printer to make "hard copy" printouts of test results. Alternately, this interface can be used to connect the horsepower computer to a Windows type personal computer for calibration setup and so that test results can be saved, printed using the PC's printer, etc. The horsepower computer senses which type of device is connected to the serial interface (printer or computer) and operates the interface accordingly. It is NOT possible to connect a serial printer and a personal computer to the horsepower computer at the same time.

The manual print switch can be used at all settings of the report rate switch. It is NOT necessary to set the report rate switch to manual in order to use the manual print switch (or the optional remote print switch) to trigger a print report.

Software for the 2500 horsepower computer:

There are several software programs for the 2500 horsepower computer. These include:

Calibration Setup Software for the 2500:

HpcOptionsW32 is software for the 2500 horsepower computer which is used to prepare the 2500 for calibration. This is done so that the 2500 will "know" the details of the method you will use to check the torque calibration of the unit. This "factory setup" is normally performed on the 2500 by your dealer prior to delivery of the 2500 to you so won't have to.

If you change your calibration method or calibration tools, this program can be used to inform the 2500 of the changes so that subsequent torque calibrations will be accurate.

If you use a NIST traceable calibration method, this program must be used periodically (each time the load cell is returned to the factory to have its NIST traceable calibration checked) to inform the 2500 of any changes to the load cell calibration or the load cell's NIST traceable shunt resistor calibration.

HpcOptionsW32 is compatible with most Windows based computer systems including Win95, Win98, WinMe, Win2000, WinXP and Windows Vista.

Data Recording Software for the 2500 (Dyno2500):

The Dyno2500 software makes it easy to produce the 2500 horsepower displays on the screen of the personal computer for remote viewing, etc. There are also features for printing and recording (saving) your dyno measurements. Data printing and recording can be controlled from the 2500 horsepower computer and / or using the personal computer's keyboard or mouse.

Recorded data can be printed on the PC's printer and / or can be easily "imported" into Microsoft Excel (or other analysis programs) for further operations such as graphing, etc.

Dyno2500 is compatible with most Windows based computer systems including Win2000, WinXP, WinVista, Windows7, and Windows8.

Calibration:

The calibration of the Model 2500 horsepower computer should be checked at least once per year – or sooner if any doubts or questions arise as to whether the readings produced by the unit are within the accuracy specifications of the unit. The accuracy of the readings is improved by more frequent and more accurate calibrations.

The Model 2500 should also have its calibration checked if any of the following events occur:

1.) The instrument has been dropped or otherwise mistreated.
2.) The instrument has been moved (re-installed) from one dynamometer to another.
3.) The load cell of the dynamometer has been replaced, overloaded, dropped or otherwise mistreated.
4.) The power supply to the unit has been repaired or replaced.
5.) Prior to any measurements that require especially high accuracy.

6.) The instrument has been repaired, exchanged or replaced.

IMPORTANT NOTE:

The Model 2500 is a delicate instrument and should be treated accordingly. It should not be allowed to get wet, be exposed to excessive temperatures, dropped or subjected to excessive shock or vibration. It should only be used with an approved power supply.

It contains no user serviceable parts and no attempt should be made to repair or modify the unit.

If the unit is in need of repair, it should be returned to the dealer or directly to Ries Labs, Inc. for repair.

When it becomes necessary to check the calibration of the unit, follow the procedure below.

Calibration Procedure:

The Model 2500 horsepower computer uses quick and easy "push-button" calibration methods and can be calibrated using a variety of methods. Be sure to use the one that is correct for your dynamometer system and the calibration tools that are available to you.

Prior to attempting calibration, first verify that the 2500 is operating correctly using the CHECK MODE function of the host computer software (i.e. Dyno2500, etc.). If the 2500 does not pass these checks, there is a problem with the unit and it should be repaired before any attempt is made to calibrate the unit.

Calibration of the Model 2500 is a simple, two step process:

1.) Set the ZERO calibration: The dynamometer should not be running and should be disconnected from the engine, tractor, motor, etc. The RPM reading should be exactly zero and the TORQUE reading should be fairly close to zero – especially if the unit has previously been calibrated to the load cell. If necessary, disconnect the load cell from the torque arm of the dynamometer to insure that there is no force being applied to the load cell (which would result in an inaccurate zero calibration).
2.) Set the TORQUE SPAN calibration: Apply the CALIBRATION TORQUE (see calibration torque notes below)
3.) Resume normal operation once calibration has been completed.

Calibration Procedure Notes:

1. ZERO CALIBRATION cannot proceed. This problem occurs when the ZERO OFFSET is excessive – too large for the zero offset correction facility of the 2500 to correct. A large zero offset in the load cell (more than about 2 percent of the full scale rating of the load cell) indicates that a serious problem exists somewhere in the system which must be corrected before calibration can proceed. Check the following:
   1.1 Make sure that the load cell is properly connected to the 2500 horsepower computer. Inspect the cable for damage, especially at the load cell end and the connector end. Make sure the connector is securely fastened to the 2500 torque sensor connector.
   1.2 Make sure that the load has been completely removed from the load cell. "Rock" the drive shaft of the dynamometer CW and CCW slightly (applying a small positive and negative torque to the unit) and verify that the torque reading returns closely to the same value. A failure here indicates a likely problem (excessive friction) with the dynamometer. Have the dynamometer checked by your dealer or dyno service person.
   1.3 Make sure that the shunt resistor switch is set to the OFF position. Check that the CHECK FUNCTION (on the "Calibrate Menu" is turned OFF (un-checked) and also check the load cell's shunt resistor switch (for load cells that include a shunt resistor calibration box) to be sure it is turned OFF.
   1.4 Make sure that the load has been completely removed from the load cell. Disconnect the load cell from the torque arm of the dynamometer by removing the coupling fastener. If this does not correct the excessive zero offset, a likely defective or damaged load cell – or a defective or damaged horsepower computer -- is indicated. You should have the load cell and the horsepower computer checked by your dealer or dyno service person.

2. TORQUE SPAN CALIBRATION cannot proceed. This problem occurs when the torque reading is not sufficiently close to that expected from the CALIBRATION TORQUE value. The CALIBRATION TORQUE value is the torque applied to the system by your calibration method (torque test bar plus weights or shunt resistor load cell). This is the total torque produced by the torque test bar and its calibration weights, or the torque produced by the shunt resistor box of the load cell – when a shunt resistor load cell is the calibration source. Check the following:
   2.1. Check to be sure that the CALIBRATION TORQUE is the value expected by the 2500 horsepower computer. The expected calibration torque value is normally programmed into the 2500 by your dealer to match the calibration value and method you will be using to check and adjust the calibration of your unit. The **calibration torque** is displayed on the **percent torque rise display** whenstarting a torque zero or torque gain calibration. The CALIBRATION TORQUE **must match** the torque applied during the torque span calibration. You can check this by canceling the current calibration while leaving the CALIBRATION TORQUE applied to the unit. The TORQUE display should now read (approximately) the torque you have applied. If this value is within about +/- 10% of the

CALIBRATION TORQUE that you have applied, then it is likely that the value programmed into the 2500 for the CALIBRATION TORQUE is different (i.e. does not match) than the value you are using. Check the programmed calibration torque value (see the percent torque display during the third start up screen or during calibration) and if it does not match you need to have the calibration torque re-programmed into the 2500.

2.2. If the TORQUE display does not read (within +/- about 10%) the torque that you have applied to the load cell, a possible defective or damaged load cell is indicated – or the horsepower computer may be damaged or defective. Have your dealer or dyno service person assist you.

2.3. Note that the maximum allowable deviation percentages mentioned above are for an "un-calibrated" unit and cannot be depended upon when a unit is being re-calibrated. For example: suppose a deviation of +8 percent has already been "calibrated out" during prior calibrations, and is +3 percent during the current calibration. The total (uncalibrated) deviation is then +11 percent and might be excessive (more than can be corrected by calibration). If the POWER display reads "EEEE" during calibration, this means that the torque reading is too far out of tolerance to be corrected by calibration and that some problem exists which must be corrected before calibration can proceed.

Torque Calibration Notes:

There are several methods which can be used to apply a calibration torque value to the 2500 horsepower computer.

1.) Dead Weight Test Fixture: This method uses a **Torque Test Bar** (dead weight test fixture) and one or more **calibration weights**. The torque test bar is attached to the torque arm of the dynamometer, being careful to align the position of the mark on the torque test bar with corresponding mark on the torque arm of the dynamometer. Then connect the test weight(s) onto the torque test bar at the indicated position, usually the 4 foot (1.210 meter) position. The torque produced by the torque test bar must be accurately known, the total weight of the test weights must be accurately known, and the horizontal distance from the center line of the dyno to the indicated position must be accurately known. If any of these three factors is not accurate, then the resulting calibration will not be accurate –and the result is inaccurate torque and power readings from the dynamometer. The calibration torque produced is equal to the sum of the torque produced by the Torque Test Bar itself plus the torque produced by the test weight(s) – which is equal to the total weight of the test weight(s) times the horizontal distance from the center line of the dyno to the position of the test weights. For example, assume the torque of the torque test bar itself is 17 Ft.-Lbs., the total weight is 100 Lbs. and the horizontal distance is 4.00 Ft. The calibration torque value produced by this setup is equal to 417 Ft.-Lbs. (= 4.00 Ft. * 100 Lbs. + 17 Ft.-Lbs.)

2.) Shunt Resistor: The 2500 horsepower computer has an internal shunt resistor which can be used to check the torque span calibration. The internal shunt resistor can also be used to re-calibrate the Model 2500 horsepower computer once the internal shunt resistor has itself been calibrated. The 2500 can (optionally) be equipped with a precision shunt resistor which can be used to perform a NIST (National Institute of Standards and Time) traceable torque calibration. Usually, this precision shunt resistor has been built into the load cell's interface cable – so that the precision shunt resistor and the load cell have been combined into a single unit. The "torque" introduced by the shunt resistor depends on the resistance value of the shunt resistor as well as the properties of the load cell. For the NIST traceable torque calibration to be accurate, the shunt resistor value and the load cell (as a pair) must have an NIST traceable calibration which should be checked periodically.

3.) A 2500 horsepower computer is itself supplied with an internal precision shunt resistor (43.2 K Ohm 1%). This internal shunt resistor can be used in a number of ways to facilitate the torque sensor calibration. For example, after performing a calibration of the unit using the dead weight test fixture calibration method, remove the dead weight test fixture and set the Shunt Resistor Switch to ON using the "Calibration", Check Mode" menu item.. The shunt resistor will produce a torque reading that is (roughly) 2/3 of the full scale torque of the unit (i.e. about 3300 Ft.-Lbs. on a 5000 Ft.-Lbs. full scale 2500). More precise values are shown in the table below. The reading should be within +/- 2 or 3 % of the appropriate value from the table below. The tolerance derives from the +/- 1% tolerance of the 43.2 K Ohm shunt resistor plus the tolerance of the load cell (likely +/- 1 or 2 %). If the reading is not this close, you should double check the calibration and your procedure as a possible problem is indicated. If the reading is within (or close to) the above limits, record its value. It can be used later for a quick check on your unit's calibration as it should be stable over time and temperature to within +/- 0.25% or better.

Full scale Torque (Ft.-Lbs.)	43.2 K Ohm Shunt Resistor Torque (Ft.Lbs)
50	33.62
100	67.24
200	134.5
500	336.2
1,000	672.4
2,000	1345
5,000	3362
10,000	6724

Typical readings produced by the **INTERNAL** shunt resistor of the 2500 horsepower computer.

In Case of Difficulty:

The following is a troubleshooting guide that will help you to resolve any problems that may arise.

The Model 2500 Horsepower Computer contains no user serviceable parts. If it needs to be repaired you may return the unit to your dealer (who can also assist you with other repair problems such as problem diagnosis, replacement of the load cell, RPM pickup, other dynamometer repairs, etc.) or directly to Ries Labs, Inc.:

RIES LABS, INC.
2275 RAVEN ROAD
FARINA, ILLINOIS 62838
PHONE: (618) 238-1400
E-MAIL: ADMIN@RIESLABS.COM

Be sure to include a written description of the problems you are having with the unit, the name and phone number of a person to call if we need to discuss your problem with you, and return shipping instructions. If the unit is out of warranty, please also include a repair order and information about how you want the repaired unit returned to you. Ries Labs, Inc. does not open commercial accounts (charge accounts) for repair work. Ries Labs, Inc. accepts electronic payments (credit card or otherwise) using PayPal. You can sign up for your PalPal account by visiting http://www.paypal.com/ Sending your payment via PalPal is FREE, EASY, QUICK and SAFE.

Ries Labs, Inc. does not offer repair services for the other components of your dynamometer – only 2000S, 2400S and 2500 horsepower computers, their power supply, and other items manufactured by Ries Labs, Inc. To obtain repair services for the dynamometer contact your dealer.

The following table is useful for you to determine that cause of any problems that you might be able to fix yourself.

Problem	Possible causes and remedies
Power LED is not lit.	There is likely no power to the unit. Check the power supply to be sure it is plugged in.
Power LED comes ON and OFF erratically	Check to be sure the power supply is plugged in securely. Try another outlet. Make sure the power connector is fastened tightly to the front of the unit.
RPM display reads zero all the time, or is erratic	Check the RPM pickup on the dynamometer. Be sure that it is not loose. Check the wiring from the RPM pickup to the horsepower computer. Make sure the RPM sensor connector

	is tight. Have the horsepower computer checked.
Torque display reads – EEE or some other value all the time (or is erratic)	Check the load cell on the dynamometer. Be sure that it is not loose. Check the cable between the load cell and the horsepower computer. Make sure the Torque Sensor connector is tight. The load cell may be bad and need to be replaced. Have the horsepower computer checked.
Horsepower or Kilowatt readings are low or not correct	Check the torque calibration. If Chassis dyno, the tires may be slipping on the dynamometer rolls – increase chain tension to obtain more "over center" action between tires and rolls. Excess speed often causes power losses. If farm tractor, the PTO clutch may be slipping (refer to the tractor repair manual). Engine may not be performing properly. Have the horsepower computer checked.
RPM readings are inaccurate	Operate the unit in the CHECK MODE function. If the reading is not 4800 RPM, have the horsepower computer repaired. If the CHECK MODE reading is 4800 RPM, check the RPM pickup and the RPM sensor gear. Make sure that they are not loose and that the runout of the RPM gear is not excessive. Check the RPM sensor connector to be sure that it is tight. Check the cable from the RPM pickup to the horsepower computer. Check the power supply to the horsepower computer. Have the horsepower computer checked.
Torque readings are inaccurate	Operate the unit using the CHECK MODE function. If the readings do not agree with the tables above, unit needs to be repaired. Check the load cell mounting to be sure that it is not loose. Check the dynamometer to be sure that it is not in a bind. Check the torque calibration of the horsepower computer. Check the power supply to the horsepower computer. Have the horsepower computer checked.
Residual Torque readings are high when the dynamometer is stopped.	Pressure or force on the dynamometer absorption unit cradle may be causing the residual readings. Remove the load cell from the torque arm of the dyno to see if this removes the excessive residual torque reading. Manually rock the torque arm of the dyno. It should move freely and easily a minimum of 0.5 inches (12.7 mm) up and down. The load cell must be in a free floating position when not under load. Re-adjust the torque cable and connectors if necessary. Check the calibration zero of the horsepower computer. The load cell may be damaged and need to be replaced. Have the horsepower computer checked.