DYNOmite™ Dynamometer Systems

- Both steady state and inertial testing
- Integrates with your PC or laptop
- Customizeable to your requirements
- Affordable upgrades that protect your investment
- Easy to learn and simple to operate

www.land-and-sea.com

Land & Sea's DYNOmite Dynamometers are state-of-the-art engine dyno systems featuring sophisticated data acquisition electronics. Their unique design delivers a price/performance ratio formerly unheard of for professional, computerized dynamometers.

"Customizable upgrade path... meets today's budget while protecting your long term investment!"

DYNOmite Owner's Manual

1/9/2012

(See web support site at www.land-and-sea.com for revisions after this date.)

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Important! Please read this GENERAL INFORMATION section first, and then finish the entire manual before attempting to install the dynamometer equipment.

WARNING: THIS SYMBOL IS USED THROUGHOUT THE MANUAL FOR SAFETY STEPS TO AVOID DEATH OR SERIOUS INJURY!

CAUTION: This symbol is used throughout the manual for advice to avoid injury or damage to equipment!

TIP: *This symbol is used throughout the manual for helpful hints, examples, and additional explanations.*

Note: *This symbol is used throughout the manual for useful notes and specifications.*

As software, hardware, and procedures evolve, the information in this manual may become obsolete. Periodically contact Land & Sea and visit our web site often to find out what changes, improvements, bulletins, etc. are currently applicable to your system.

DYNOmite Dynamometers and Data Acquisition Systems are adaptable to a wide variety of engines, vehicles, and industrial uses. Since many owners eventually move one data acquisition system among multiple installations, this manual covers numerous applications. Most operators learn useful extra information by also reading those sections not directly pertaining to their current configuration.

Illustrations (where provided) may not depict the exact model dynamometer hardware or application you have! However, the subject matter should still apply. If you require further explanation or advice, please contact Land & Sea.

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If you require further technical assistance, we invite you to e-mail your Land & Sea support technician directly. If you do not know your support technician's personal e-mail address, you may e-mail "*support*" or phone one of the numbers below:

E-mail your question to "support@land-and-sea.com".

Phone (603) 226-DYNO (from outside the USA dial +1-603-226-3966).

Fax (603) 226-4FAX (from outside the USA dial +1-603-226-4329).

For after-hours support and tips, downloading documentation, product information, and peer-to-peer user community access:

Land & Sea Website at "www.land-and-sea.com" (click on support menu option).

DYNOmite Users Forum "forums.land-and-sea.com" (answers 24 hours a day).

Before calling for technical assistance, please be sure you have reviewed this manual, including the Q & A section below. If you are using DYNO-MAX, also consult its On-Line Help System and Multimedia CD Demo & Tutorial. Should you call, first make sure that your phone location has access to both the dynamometer and computer. It is best to e-mail (or fax) your questions (including test data) in advance of calling. This way both you and the technician have the same information on hand during discussions.

TIP: *An inexpensive 100' phone line extension is clearer and less expensive than using a cell phone!*

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Match your purchased components and review terminology in the following parts list(s). In addition to the basic parts listed, examine any listed (and unlisted) options you may have selected. You need this familiarization to understand the remaining instructions.
Note: These generic lists may describe some parts you have not purchased.

Basic Automotive/Marine Absorption Unit Parts

Qty.	Description	Fig.
1	13” diameter toroid water absorber absorption unit and torque arm assembly	none
1	load control valve assembly (with inlet pressure gauge)	none
1	inlet hose -16 diameter stainless braided assembly (load valve outlet to brake inlet)	none
1	drain hose -12 diameter stainless braided assembly (brake bottom drain)	none
1	vent hose -4 diameter stainless braided assembly (absorber vent fitting)	none
1	6" long stainless steel dowel (locking absorber rotor)	none
1	1"-15 splined drive bushing (for adapting absorber to a 1”-15 engine’s shaft)	none
3	stainless steel drive key pins (for locking drive bushing to absorber)	none
1	large flat washer (for holding absorber on splined output shaft)	none
1	extension arm (for hanging optional torque arm calibration weights)	none
2	assorted absorber drain orifices (to match its load characteristics to engine)	none
1	special ¾”-16 self-locking nut (to clamp absorber onto splined output shaft)	none
bag	other miscellaneous mounting hardware	none

Basic Snowmobile/PWC Absorption Unit Parts

Qty.	Description	Fig.
1	9” diameter toroid water absorber absorption unit and torque arm assembly	none
1	load control valve assembly (with inlet pressure gauge)	none
1	inlet hose -12 diameter stainless braided assembly (load valve outlet to brake inlet)	none
1	drain hose -10 diameter stainless braided assembly (brake bottom drain)	none
1	vent hose -4 diameter stainless braided assembly (for absorber vent fitting)	none
1	4" long stainless steel dowel (for locking absorber rotor)	none
2	assorted absorber drain orifices (to match its load characteristics to engine)	none
1	absorber to crankshaft mounting bolts and washers	none
bag	other miscellaneous mounting hardware	none

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Basic Kart Absorption Unit Parts

Qty.	Description	Fig.
1	7” diameter toroid water absorber absorption unit and torque arm assembly	none
1	load control valve assembly (with inlet pressure gauge)	none
1	inlet hose -12 diameter stainless braided assembly (load valve outlet to brake inlet)	none
1	drain hose -10 diameter stainless braided assembly (brake bottom drain)	none
1	vent hose -4 diameter stainless braided assembly (absorber vent fitting)	none
1	4" long stainless steel dowel (for locking absorber rotor)	none
2	assorted absorber drain orifices (to match its load characteristics to engine)	none
1	absorber to crankshaft mounting bolts and washers	none
bag	other miscellaneous mounting hardware	none

Basic On-Board Transducer Parts

Qty.	Description	Fig.
1	rotary strain gauge transducer (yoke assembly)	none
1	rotary interface module	none
1	transducer pickup coil	none
1	5’ interface coaxial cable	none
1	12-volt DC power supply cable (cigarette lighter adapter with 3-amp slow-blow fuse)	none
1	stainless band clamp (for mounting pickup coil)	none

Basic Data Acquisition Parts

Qty.	Description	Fig.
1	DYNOmite Data Acquisition Computer module	none
	load cell transducer (for dyno conversion kits only)	none
1	data acquisition wiring harness (engine to data acquisition module)	none
1	battery charger (for hand-held data acquisition units only)	none
1	¼ amp spare fuse (for DYNOmite tachometer input lead - DO NOT OVERSIZE)	none
1	tachometer input lead resistors (for reducing excess voltages into DYNOmite tach)	none
bag	other miscellaneous terminals	none
1	demonstration tutorial for optional DYNO-MAX "Pro" software (on multi-media CD-ROM)	none

Automotive Engine Test Stand & Options

Qty.	Description	Fig.
1	engine stand (mobile heavy duty steel frame)	none
1	bell housing adapter (bearing plate with 1-1/8" splined clutch input shaft)	none
1	control console (either "Pro" or wall & stand mount type)	none
1	"Pro" Test Stand Upgrade Kit (with fuel tank, pump, filter, solenoid, and drip tray)	none
1	stand to console wiring harness ("Pro" Test Stand Upgrade Kit only)	none
1	cooling tower option (thermostatically controlled - stand mounted)	none
1	integral data acquisition and control relay subsystem ("Pro" up-grade only)	none

Optional Sensors and Controls (partial list)

Qty.	Description	Fig.
1	air-flow turbines (requires DYNO-MAX "Pro" software option)	*
1	DYNO-MAX "Pro" software (for interfacing a PC with the DYNOmite)	*
1	serial port cable (for hooking the DYNOmite to a PC with DYNO-MAX)	*
1	EGT Kit (exhaust gas temperature thermocouples)	*
1	pressure transducers (oil, fuel, manifold, etc.)	*
1	ignition and control relay boards (for adding control functions to DYNO-MAX)	*
1	Electronic Auto-Load Servo Kit (upgrade from manual load control valve)	*
1	Electronic Throttle Controller Kit (upgrade from manual throttle control)	*
1	servo extension harness (longer cable for remote console mounting)	*
1	Weather Station (for capturing air temperature, humidity, and pressure)	*
1	fuel-flow turbine kit (with universal plumbing)	*

Miscellaneous Options

Qty.	Description	Fig.
1	chassis roller assembly	none
1	calibration weight kits (precision weights with hanging hardware)	*
1	fuel hydrometer kit (for checking specific gravity of gasoline and alcohol)	*
1	portable gasoline powered water pump (for water supply during remote testing)	*
1	sling psychrometer (for measuring humidity)	*
1	Portable Thermal Printer (battery powered for getting DYNOmite reports anywhere)	*

*See DYNOmite Dynamometer Accessories Catalog (or "Accessories - Hardware and Software" section 14.1) for photos.

CAUTION: You must properly inspect, mount and operate the dynamometer to prevent hardware failure or engine over-revving!

Land & Sea, Inc. warrants its stationary DYNOmite Engine or Chassis Dynamometer Absorber, Torque-Arm, Dynamometer Engine Stand or Chassis Frame, and DYNOmite Data Acquisition Computer (hardware only) under the terms described within our:

DYNOmite™ DYNAMOMETER LIMITED WARRANTY

A copy of this warranty may be found on the Land & Sea, Inc. web site. At the time of this manual's creation, the address was:
http://www.land-and-sea.com/corporate/warranty_dynomite.htm

You may also reach this page by navigating through the site's menu system. That tree path to it is: "*Terms of Sale – Warranty-Dyno – Limited Warranty - DYNOmite Dynamometers*."

That General Limited Warranty supersedes all prior warranty statements. Inquiries concerning that warranty should be directed to:

Land & Sea, Inc.
Warranty Department
25 Henniker Street
Concord, NH 03301
USA

Land & Sea, Inc. warrants its DYNOmite™ "On-Board" Rotary Torque Transducers, custom built dynamometer systems and miscellaneous dynamometer hardware ("Products") under the terms described within our:

DYNOmite™ "ON-BOARD" AND MISCELLANEOUS HARDWARE LIMITED WARRANTY

A copy of this warranty may be found on the Land & Sea, Inc. web site. At the time of this manual's creation, the address was:
http://www.land-and-sea.com/corporate/warranty_dynomite_rotary.htm

You may also reach this page by navigating through the site's menu system. That tree path to it is: "*Terms of Sale – Warranty-Rotary – Limited Warranty - DYNOmite On-Board & Miscellaneous Hardware."*

That General Limited Warranty supersedes all prior warranty statements. Inquiries concerning that warranty should be directed to:

Land & Sea, Inc.
Warranty Department
25 Henniker Street
Concord, NH 03301
USA

Land and Sea, Inc. (“Land and Sea”) grants to the end user purchaser (“Licensee”) a non-exclusive, non-transferable, non-assignable license, without the right of sublicense, to install and use the DYNO-MAX™ PC software and DYNOmite™ Data Acquisition Computer E-prom software, and any other software Land and Sea may provide (“Software”) solely in conjunction with the use of Land and Sea products – under the terms described within our:

END USER SOFTWARE LICENSE AGREEMENT

BY INSTALLING, DOWNLOADING, OR USING THE LAND AND SEA, INC. SOFTWARE, YOU AGREE TO THE TERMS OF THAT LICENSE.

A copy of this license agreement may be found on the Land & Sea, Inc. web site. At the time of this manual's creation, the address was:
http://www.land-and-sea.com/corporate/warranty_dynomite_software_disclaimer.htm

You may also reach this page by navigating through the site’s menu system. That tree path to it is: “*Terms of Sale – Warranty-Software – Limited Warranty - (End User Software License Agreement).”*

That Software License Warranty Disclaimer supersedes all prior warranty statements. Inquiries concerning that Software License Warranty Disclaimer should be directed to:

Land & Sea, Inc.
Warranty Department
25 Henniker Street
Concord, NH 03301
USA

As you probably already know, Hp = RPM x Torque / 5,252. DYNOmite dynamometers (like most dynos) provide both a way to load the engine (with some form of absorption brake) while monitoring both its RPM (via a computerized digital tachometer) and Torque (using an electronic strain gauge). The DYNOmite Data Acquisition Computer collects information at 200 readings per second (or faster depending on model). Depending on the configuration, data is either locally output (in one of several Horsepower vs. RPM formats) or transmitted to a DYNO-MAX equipped PC.

Below is a simplified example of how a basic water brake equipped system would work. However, except for the actual absorption method, even high end Eddy Current and AC Motor/Generator equipped dynamometers work the same way.

A typical DYNOmite water absorption brake receives inlet supply water (via its load control valve assembly) which it then pumps through specially designed recirculating toroidal flow vanes. It is the test engine which powers this "pump." So, horsepower (which is normally absorbed overcoming the drag and inertia of moving a vehicle) is instead absorbed in the process of pumping the water through the brake.

The inertia and drag of the water continually accelerating and decelerating, as it circulates from the rotating impeller's pockets to the stationary vaned stator pockets (inside the absorber's housing) tries to rotate the entire absorber assembly. However, a torque arm attached to the stator housing prevents this rotation. Instead, the forces acting on this torque arm actually bends it slightly (in direct proportion to the applied torque).

Where does the energy go? Into raising the temperature of the water from the work done (by the engine) turning the rotor of this inefficient pump. The heated water is eventually discharged from the absorber's drain outlet!

Keep in mind that while water temperature, flow rate, and pressure relate to the absorber's ability to load the engine, they do not effect the torque or horsepower readings! The DYNOmite Data Acquisition Computer directly measures the reaction torque at the absorber's housing! Consequently, no error-prone attempts to back calculate power from water flow, temperature, or pumping efficiency is ever required! A crankshaft mounted DYNOmite water brake's torque accuracy is immune to changes in bearing condition, seal drag, cavitation, etc.

The torque arm is equipped with an integral strain gauge grid (bonded to its surface) that is stretched as the arm bends. That slight elongation of the grid increases its electrical resistance, allowing the bending torque to be electronically measured by the DYNOmite Data Acquisition System's torque channel. The DYNOmite computer then scales the resistance change into a digital foot-pound value.

Some DYNOmite Data Acquisition Computers systems store the real time data and perform the calculations with the data RPM, to displays it locally on an LCD. Others are designed to transmit the information to a DYNO-MAX equipped PC, greatly expanding the storage and analysis possibilities. In either case, user controllable dampening, filtering, and averaging routines allow generating smooth, clean, and concise reports that are accurate and repeatable.

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An absorption brake's Hp capacity is a function of its ability to convert and dissipate an engine's power output as heat. Some engine dynamometers use large electric motor/generators to load the engine, with the electrical output absorbed by heating an air or water cooled resistor array (or regenerating the power to the electric utility). Eddy current absorbers use an electromagnetic field to apply rotational resistance to their spinning metal rotors, thereby generating heat, which is conducted away via air or water cooling of those rotors. Hydraulic oil pump absorbers force fluid through a tiny orifice, the power required to do this high pressure pumping heats the oil in the process. Water brake (centrifugal pump type) absorbers (like the DYNOmite's) are low efficiency water pumps. The engine's power is "absorbed" in the pumping process as a temperature rise in their discharge water.

Several advantages of water brake absorbers include their very high specific power capacity, high RPM limits, reliability, servicing simplicity, and relatively low cost. But, no matter what type (or make absorber) is used, the energy input (engine Hp) always equals the energy output (i.e. BTU's added to the air, oil, water, etc.).

To reduce damaging cavitation (boiling) inside the water brake absorber, adequate water volume and pressure must be available at the load valve. Also, appropriate drain hose orifice(s) or discharge auto control must be installed at the absorber's outlet to match its load characteristics to that of the engine's power curve.

Assuming 50 degree inlet temperature, the minimum water flow through the absorber needs to be at least one gallon per minute for every 20 horsepower (to keep discharge water temperature below 180 degrees Fahrenheit). Consequently, more powerful engines require larger diameter supply hoses, higher volume pumps, increased delivery pressures, and larger (or extra) absorber drain outlet area.

CAUTION: To avoid absorber seal damage, water discharge temperature must not exceed 180 degrees Fahrenheit.

Tip: *For remote testing, where no water supply is available, use our optional gasoline powered Portable Pump Kit. It provides sufficient water to load up to 400 Hp engines.*

If you are installing or upgrading a water supply system, here is information your plumber will need to know:

Water brake absorbers, including water cooled eddy current units, require a sustainable peak flow of *at least* 1 G.P.M. (for every 20 horsepower the engine produces). Depending on the model brake and load control valve used, this typically requires a delivery pressure in the 30-60 PSI range (measured dynamically at the DYNOmite's load valve inlet). The supply system must also be able to be safely dead headed (or it will require a small bypass drain to prevent overheating the pump). Ideally the dead headed (static) pressure should not exceed the peak flow volume's (dynamic) pressure by more than about 10 - 15 PSI.

When sizing your own system, here are some rough guidelines:

For testing up to 20 Hp you will need at least 1 G.P.M. delivered @ approximately 12+ PSI[1]
For testing up to 160 Hp you will need at least 8 G.P.M. delivered @ approximately 15+ PSI[2]
For testing up to 200 Hp you will need at least 10 G.P.M. delivered @ approximately 18+ PSI[3]

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For testing up to 400 Hp you will need at least 20 G.P.M. delivered @ approximately 30+ PSI[4]
For testing up to 800 Hp you will need at least 40 G.P.M. delivered @ approximately 40+ PSI[5] (and our high-flow valve assembly with -16 hose).
For testing up to 1200 Hp you will need at least 60 G.P.M. delivered @ approximately 50+ PSI[6] (and our high-flow valve assembly with -16 siamese hoses).
For testing up to 1600 Hp you will need at least 80 G.P.M. delivered @ approximately 60 PSI[7] (and our high-flow valve assembly with -16 siamese hoses).
For testing up to 2400 Hp you will need at least 120 G.P.M. delivered @ approximately 60 PSI[8] (and our ultra-flow valve assembly with -20 siamese hoses).
For testing over 2400 Hp contact Land & Sea for installation specific recommendations on dual load valves, plumbing, and pressure requirements.

[1] Typically this can be met with a ½" i.d. garden hose and standard sill-cock valve (because of the very low power)
[2] Typically this can be met with a ¾" i.d. garden hose and high-flow ball valve (in lieu of a standard restrictive sill-cock valve)
[3] Typically this can be met with a 1 Hp pump (e.g. Grainger #2P005 lawn sprinkler pump)
[4] Typically this can be met with a 2 Hp pump (e.g. Grainger #2P104 lawn sprinkler pump)
*[5] Typically this can be met with a 5 Hp pump (e.g. Grainger #4ZA41 centrifugal pump GGS3P608)**
*[6] Typically this can be met with a 7½ Hp pump (e.g. Grainger #3P703 lawn sprinkler pump)**
*[7] Typically this can be met with a 7½ Hp pump (e.g. Grainger #4ZA44 centrifugal pump GGS4P939)**
*[8] Typically this can be met with a 10 Hp to 15 Hp pump (e.g. Grainger #4ZA45 or #4ZA48 centrifugal pump GGS4P940 or GGS4P941)**
**Requires pressure reducing regulator (or bypass plumbing) to limit static pressure to 60 PSI.*

Tip: *Higher inlet pressures make the Electronic Auto Load Valve valve more susceptible to binding, and more difficult to start and idle small displacement engines. You want high volume capacity, not just high pressure. Contact Land & Sea for assistance with problem installations.*

Pump recommendations assume that unrestricted and appropriate (large) inside diameter supply lines are used. They further assume that suction side lift is less than 5 feet. Delivery lines should be up-sized appropriately for longer length runs, larger quantity of elbows, etc. When in doubt, oversize.

Tip: *If you are installing a pressure reducing valve or regulator, make sure it is a very high flow model. Anticipate about a 10 PSI drop in peak flow pressure and size the system accordingly. When in doubt, pick a larger reducing valve - even if it is a few pipe sizes larger that the rest of the system!*

CAUTION: Some pumps overheat with continuous dead heading! A small by-pass drain line (e.g. 1/4" tubing) might be required to always pass some water through the running pump.

A suitable way to dispose of the heated water is required. Many shops are able to dispose of the clean hot water right on the ground. Check your local plumbing and environmental regulations. If you are routing the drains to a drain pipe or storage tank, it must be a gravity feed from the absorber to the drain. Do not design the drains so that the absorber must push its discharge water uphill! A suitable sump pump and tank system can be used to pump the water back from a drain sump to a higher elevation storage tank.

CAUTION: If you try to make the DYNOmite pump the water uphill, residual water left in the absorber makes the engine hard to start and this leaves standing water in the absorber - accelerating corrosion.

Water cooled engines and absorbers both require a cold water supply. If you are using any type of water storage tank, review this information. Otherwise, continue on to the next section.

Bladder tank storage with pressure switch control of the pump is not actually required when using lawn sprinkler type pumps. However, if you decide to use pressurized storage, the pressure switch's cut-in and cut-out points should be set fairly close together. This helps maintain a more constant pressure at the DYNOmite's load valve. Consequently, the bladder tank should be quite large in capacity, to prevent short cycling of the pump.

A large in or above ground (un-pressurized) storage tank* provides an alternative to discharging hot waste water. If you are going to use a storage tank it must be large enough for your anticipated power levels, run durations, and testing duty cycle. 400 Hp will raise the temperature of 400 gallons of water by 150 degrees Fahrenheit in just 30 minutes While some air cooling of the water occurs just siting in the tank, for sustained testing you will need a water to air heat exchanger (e.g. a truck radiator and electric fan) to speed the storage tank cooling process.

CAUTION: Storage tank water can become contaminated with dangerous bacteria. Contact your plumber and building inspector for instructions on appropriate water treatments and health safeguards.

To read more about the treatment of storage tank water you may want to visit sites like: www.tramfloc.com or www.avantecsafe.com. Your local storage tank supplier may also have many useful suggestions. Some on-line suppliers of tanks include www.plastic-mart.com and www.watertanks.com (these are just a couple of many).

**Plastic storage tanks listed below (with molded in tie down lugs and gallon markers) are available from US Plastics at 1-800-537-9724*

Stock #10120
550 gallon capacity
54" diameter x 67" height
130 pounds
10" fill well
2" female pipe thread bulkhead fitting
(maximum temperature 140 degrees Fahrenheit)

Stock #10126
1050 gallon capacity
81" diameter x 57" height
205 pounds
10" fill well
2" female pipe thread bulkhead fitting
(maximum temperature 140 degrees Fahrenheit)

Stock #10121
1300 gallon capacity
81" diameter x 67" height

250 pounds
22” removable manhole cover (18” diameter access)
2” female pipe thread bulkhead fitting
(maximum temperature 140 degrees Fahrenheit)

Designing an engine dyno cell or chassis bay is a lot like laying out a new shop, there are no hard and fast rules! It is possible to spend just a little, or a small fortune, on both good and bad designs. Dimensioned pit drawings (for in-ground roller dynamometers only) and generic test cell (or chassis bay) plans are included with complete DYNOmite systems. They should be referred to, along with the information in this manual, when planning new installations.

The least expensive alternative is to just test outdoors - where most engines ultimately are run. Many DYNOmite units are designed to simplify this option. For example, engine stands can be outfitted with wheels, a self-contained fuel system, power supply, and even a portable water pump. The wheels allow rolling everything back into the shop for modifications. When testing outdoors, even a light breeze (with proper orientation of the dyno) handles ventilation well. Noise control can be handled with a decent muffler system (with the design dictated by your neighbors' tolerance). However, once you move inside, things get much more complicated.

Ventilation is typically the biggest issue with an indoor test cell. Matching the effectiveness of even a mild outdoor breeze requires huge fans! Most first time cell designers grossly under-size their cell's air handling system! It is not enough to just have high, localized, velocity immediately in front of the fan. Very high volume flow rates are required too, in order to get the required number of cell air changes per minute.

Assume a thermal efficiency of about 50% for internal combustion engines. So, a test engine delivering 100 flywheel Hp to the absorber (254,000 BTU/hr) radiates up to 127,000 additional BTU's per hour into the cell from its exhaust, cooling radiator, and block surfaces! Even at idle, when zero crankshaft Hp is available, significant heat energy must be dealt with - as the engine is still burning fuel in overcoming its internal friction.

For installations where the engine's exhaust will be routed out of the cell (in stainless steel flexible exhaust tubing, for example) plan on at least 2,000 CFM per 100 Hp. This is the preferred configuration, and quick disconnect flanges and locking clamps are available to speed engine changes. High temperature flexible silicone exhaust hoses and through-wall (or overhead door) fittings are available for chassis dynamometer bays.

Tip: *Use double wall exhaust piping to reduce heat load into the cell. This also protects against burns, melted wires, etc.*

If the engines will be dumping their exhaust directly into the cell or there is an air cooled eddy-current absorber in the room, then as much as five times more CFM per Hp may be required. Also, in such cases, the orientation of the engine's air intake and exhaust pipes in relation to the cells fresh air and exhaust ducts are crucial to successfully keeping all exhaust gases out of the engine's fresh air supply.

Tip: *Keep in mind that even a small volume of exhaust fumes, breathed into the engine, will ruin its power output.*

WARNING: BESIDES "KILLING" ENGINE PERFORMANCE, CARBON MONOXIDE EXHAUST IS DEADLY TO HUMANS!

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For near free-air (non-ducted) applications, axial fans provide the most CFM for the money. If your cell is on an outside wall (into which you may cut a large opening), then a 48” diameter 1-Hp axial exhaust fan (e.g. Grainger #CF31) can provide over 18,000 CFM. This will require installation of a similarly large size (4’x4’) air intake, with motorized louvers tied into the fan’s switch. Size the actual fan, up or down, to suit your unique testing requirements (contact a local HVAC supplier for assistance).

Chassis dyno test bays require that you also provide enough airflow to keep items like the engine compartment, radiator, exhaust systems, underbody, etc. from getting too hot. This may require (multiple) portable high power ducted fans, aimed at those various hot spots. Remember, the longer the tests and the higher the duty cycle, the more significant these cooling requirements become.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE!

Depending on your test environment, noise control can be either a large or small issue. At the least, good hearing protector “ear muffs” are required within the actual cell. Hearing protection may also be required in control room and surrounding area, if the cell's construction provides inadequate sound damping. Check with your insurance carrier for the latest noise exposure guidelines.

Relatively inexpensive noise control walls can be built using a “super-insulated” construction design. This is accomplished by building a pair of (parallel) 2”x3” studded and insulated walls - to create a single 6" thick finished wall. These 2" x 3" walls are each built 24” on center, but the studs of the adjacent wall pairs are offset by 12” from one another. Also, try to minimize any noise conducting mechanical connection between the wall pairs. For insulation, use horizontally lain fiberglass batts, woven between the individual 2” x 3” wall studs. Double 5/8 “ gypsum wallboard makes a cost effective sheathing for both the exterior and interior of the cell.

Although it is expensive, special acoustical sheathing, applied to the inner walls of the dyno cell, can significantly reduce reflected noise. This will be especially appreciated when you are working next to a running engine. In fact, for cells with concrete walls, acoustical sheathing may be a necessity to deaden the echo from the hard wall surface.

We suggest that the wall paint be a high gloss enamel (or epoxy) paint to ease cleaning chores. Bright white or a very light gray color makes the best of the available light.

Floor drains are frowned upon, from an environmental and safety standpoint, because of the inevitable fuel spillage. If you decide to install them, they should drain into some sort of explosion protected catch tank. Contact your building inspector for local requirements and regulations regarding such floor drains.

Cell floors are generally concrete - sealed and painted. Epoxy paint holds up best, but even a good gloss floor enamel cleans up better than bare concrete (and its inexpensive to renew). If your budget allows it, tile makes cleanup easier - and it can be laid in the popular “racing” checkerboard pattern for aesthetics.

Like the walls, the cell's ceiling can also be done in double 5/8” gypsum wallboard. Again, a bright white paint makes the best use of the available light.

Lighting is typically fluorescent, and more is better! Use plenty of tubes to keep things bright, but take care to place them where they will not interfere with any air ducts, fire extinguisher nozzles, overhead plumbing or wiring booms, or beams for an overhead hoist. Most OEM factory cells use explosion proof fixtures, again consult your electrical inspector for local requirements.

Tip: *Use 3-way switches on the cell's lights and fans so you can operate them inside or outside the cell. Shutting off the lights helps you catch sparkplug arching.*

WARNING: IN THE EVENT OF A CELL FIRE, YOU NEED IMMEDIATE ACCESS TO THE VENTILATION FAN'S SHUT-OFF SWITCH! A BIG RED BUTTON THAT IS ALSO INTERLOCKED WITH THE ENGINE'S IGNITION AND FUEL PUMP RELAYS IS RECOMMENDED!

Engine dyno test cells need a door wide enough to easily wheel the engine stand (or hoist) through. A single wide steel door works best. For best noise control this door should be insulated and have a magnetic seal. Avoid double doors as they are less soundproof.

Chassis dyno test bays will require an overhead door at one (or both) ends of the room. The heavier the door's construction, the better it will be as a sound insulator. If your installation requires a lift, make sure the door are installed so that opening the door will not hit the raised lift (or the vehicle on it)! Verify that the selected location for the dyno's roller assembly provides adequate clearance for the longest vehicle to be tested (check both front and rear wheel drive orientation). Remember to allow room for fans, other test equipment, and servicing the vehicle. Carefully planning is especially important if you must excavate for an in-ground chassis dyno installation, underground plumbing, or drain sump-pumps - be sure to consider the possibility of encountering sub-surface water or ledge during excavation.

All poured concrete pit walls and floors should be sealed (to limit dust) and painted a light color to aid visibility. Epoxy paint holds up best but a quality gloss floor enamel is less expensive t.

WARNING: EXPLOSIVE GASOLINE FUMES SETTLE INTO BELOW GROUND PITS! CONTACT YOUR BUILDING INSPECTOR FOR LOCAL PIT VENTILATION REQUIREMENTS AND REGULATIONS!

Any window into the cell should either be Lexan or wired safety glass. Use double (or triple) panes with silicone sealing for noise suppression. Size and locate the window cutout so that you can see all important areas of the cell (from the console) while running the engine. Mirrors (or a video camera) placed in the cell can be used to help you see what's going on in any"hidden" zones.

Tip: *DYNO-MAX "Pro" supports both viewing and capturing of test cell video and audio streams during testing!*

Besides access to light and ventilation switches, the control area should have power for computers, printers etc. Make sure that there is a phone by the console and that it has a long enough cord to reach into the test cell (or install a phone jack in the cell). Any PC used for testing should also have access to an Ethernet (or modem) hookup. Bells and whistles like quick disconnect hose fittings, overhead hoists, electrically operated Halon or CO2 cell fire extinguisher systems, electrically switched (and software controlled) alternate fuel sources, etc. make it nicer to dyno too. Just don't blow the whole testing budget on the room (it's happened)!

Plumbing, wiring, control cables, air lines, etc. (required for the test cell or control console) area can be run in almost any combination of overhead, on-ground, or underground conduit to best suit the installation. As you plan how to run them, consider each item's access and service requirements, as well as how their layout might interfere with the safety of personnel or operation of the engine.

To minimize problems with electro magnetic interference (EMI or RFI from ignition systems) bothering data acquisition or PC performance, ground your equipment properly. Plan to run all ground leads to either the engine's battery (or block if no battery is used) or to a clean common junction connected by a heavy duty ground cable to the engine's battery. Ideally this battery's negative terminal and/or dynamometer's frame itself should be connected directly to a quality earth ground (e.g. buried copper rod) via a large gauge wire (for a very low resistance connection). Avoid multiple ground points as this often creates a "ground loop" (where RFI can get onto the circuit).

If you run any supply or drain plumbing, wiring, control cables, airline, etc. to the test stand or control console room underground, it is a must to have everything on hand before you start digging! Remember, water brakes must gravity drain, so don't forget to plan for any required sump-pump reservoir. For in-ground chassis dyno roller systems (where professional excavation and concrete from work will be required), this is even more important. Otherwise, some oversights in the layout will invariably become apparent only after the parts are ready to be hooked up. It is zero fun breaking out concrete you just paid to have poured - to the wrong dimensions!

Tip: *Allow room for any engine hoists, overhead lifts, door swings, other maintenance and diagnostic test equipment, etc. when laying out walls, excavations, and equipment mounting. However, resist the temptation to start construction prior to delivery of your Dynamometer!*

Hooking up a DYNOmite water brake or liquid cooled eddy current absorber to your water supply is straightforward. Just make sure you read through this section before ordering any pipe, hose, fittings, regulators, etc.

Water Cooled (centrifugal pump) Absorbers

1 Your engine test stand, cooling tower (if any), and load control water valve should already be moved into their respective testing locations.

2 Determine the length of piping and hose required to run from your shop's water supply to the DYNOmite's load valve (located in the control console or dyno frame). Try to use a direct route, one that minimizes the number of restrictive elbow fittings.

Tip: *If you are running a standard DYNOmite cooling tower it has a 1" garden hose coupling teed into the thermostatic control valve at the bottom of the tower. At moderate power levels (only), you can use this "T" arrangement to feed both the cooling tower and the load valve inlet from your single supply hose. (See "OPTIONS - Cooling Tower" section 11.2.)*

3 Locally obtain pipe, hose, and fittings as required to plumb the delivery and drain system. You will need to make up a short hose assembly to connect your water supply's outlet to the dyno's load valve inlet. Be sure to use adequate diameters for the required peak Hp flows. (See "GETTING READY - Water Requirements" section 2.2)
DYNOmite water cooled eddy current absorbers have a stationary base which allows plumbing them with either hose or rigid plumbing. This plumbing should be sized equal to or larger than the fittings installed on the base.

CAUTION: Do not undersize the diameter of the supply plumbing. Under sizing will absolutely limit your ability to load larger engines - and can even damage the absorber. When in doubt - oversize!

Water cooled eddy current absorbers should use a flow-pressure switch to remove excitation power in the event of low water flow.

Garden hose (sill-cock) spigot valves and 5/8" i.d. hoses are inadequate for all but the lowest horsepower applications. Only high flow ball-valves should be used for your dynamometer's inlet supply line plumbing.

If you will be moving or changing the set-up frequently, quick disconnect fittings make hook-up faster. However, you should avoid restrictive checked quick disconnect fittings. Instead, use only very high-flow designs!

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Tip: *Newer (after 2003) style Auto-Load Valves have their supply (inlet) port located in the bottom of the valve body. Earlier Auto-Load Valves (and all manual valves) have their supply port on the side of the valve's body. (With the vale's knob oriented up.)knob being*

4 Water brake absorbers are shipped with a large diameter braided stainless inlet hose assembly. Use it to run from the load valve's outlet fitting to the inlet (largest) fitting that is nearest to the center of the absorber (Figure 1 - *Toroid* and Figure 2 - *Straight Vane*).

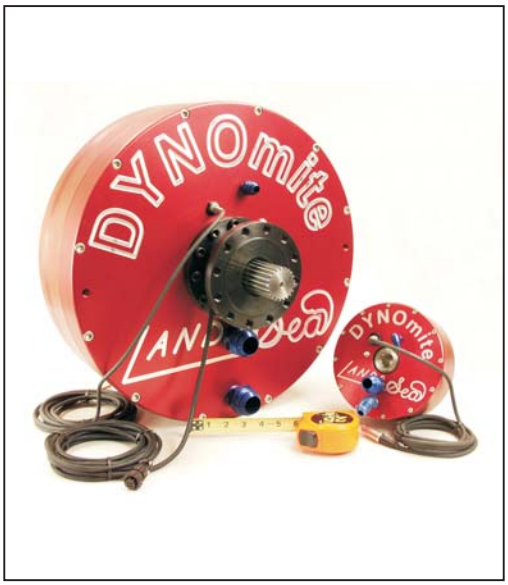


Figure 1

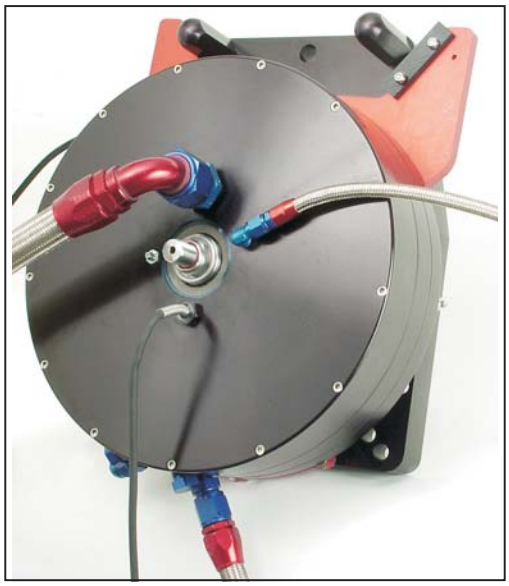


Figure 2

Tip: *Non-toroidal flow absorbers have their drain fittings on the o.d. of the absorbers, whereas toroidal flow units have both their inlet and outlet ports on the stator's lower face. Although some toroidal flow absorbers use the same size fitting for both the inlet and outlet, the inlet will still always be the large fitting closest to the centerline of the absorber.*

5 One or two braided stainless drain hoses are provided for routing the heated water away from the outlet orifice fitting(s) (near the bottom of the absorber) to an appropriate gravity drain, sump, or discharge area.

WARNING: DISCHARGE WATER IS HOT AND THE HOSES ARE UNDER PRESSURE. ROUTE AND SECURE THEIR ENDS ACCORDINGLY.

Tip: *The absorber's drain fitting(s) might contain screw in brass orifices to regulate flow. The orifice(s) set the unloading rate of the absorber (how fast it responds to closing the load valve). You can change orifice size (after testing) to best match the absorber to the type engines you test. (See "TROUBLE SHOOTING - Absorber Matching" section 13.3).*

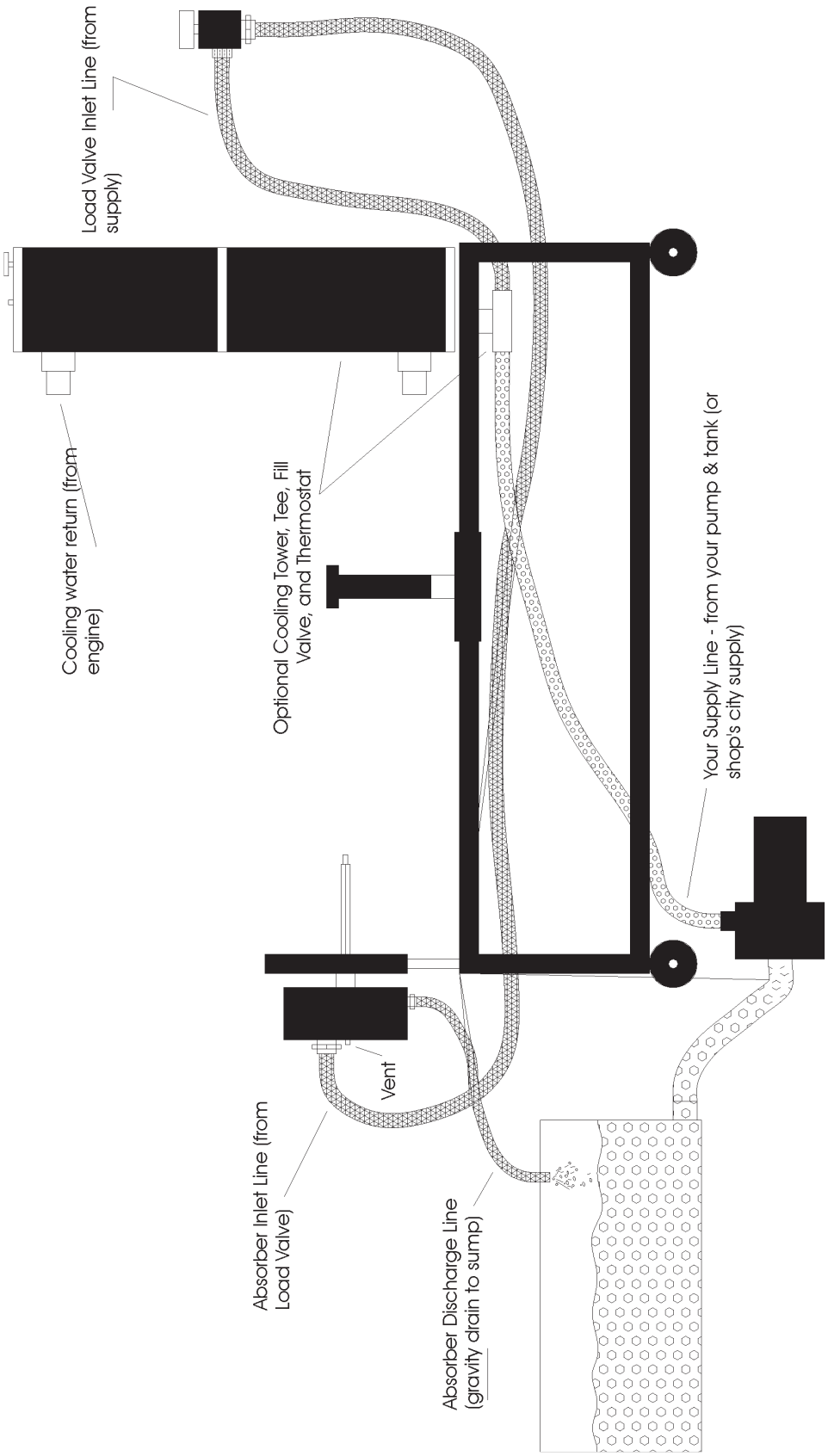
CAUTION: Some model absorbers have extra drains facing in the opposite direction. These are for running engines of opposite rotation. Do not leave both sets open at the same time, as air will be pulled in through the "reverse-angle" ports!
(Note: Toroidal flow model absorbers have an internal directional flow valve. They run in either direction of rotation, without changes.)

6 A short, typically -4 diameter, hose is supplied for attaching to the small vent filling on the face of the absorber. This line should be run uphill to a standpipe type drain as it may occasionally discharge water (i.e. If the absorber is completely full and it's RPM is low). The vent line's outlet must never be submerged or allowed to droop (trapping water in it).

Tip: *The vent and drain lines must be oriented so the absorber will be free to gravity drain. Otherwise, some water will remain inside, making the engine harder to start.*

Typical Plumbing (for toroid brake & bottom inlet valve)

Typical Plumbing (for straight vane brake & side inlet valve)



Before running a water brake DYNOmite absorber for the first time, test the adequacy of the water supply with this quick test of its static and dynamic water pressure.

Water Cooled (centrifugal pump) Absorbers

1 Connect you water system's supply hose to the DYNOmite's load valve inlet port.

2 The load valve outlet port hose should not be attached at the absorber end during this test (just drain it into a large bucket).

3 Turn on your main water supply but do not open the load valve. Note the reading on the load valve's gauge without any significant water flowing through it. This is the static pressure.

4 Now, open the load valve all the way. Take another reading of the load valve's gauge while the water is at full flow. This is the dynamic pressure.

DYNOmite water brake gasoline engine dynamometers typically require at least the following minimum dynamic pressures for acceptable load control response and absorber cooling. Because a water brake absorber's torque and Hp capacities are very RPM dependant, this list is only approximate!

5" single-stator absorber requires 5 PSI (minimum) dynamic pressure up to approximately 10 Hp
5" single-stator absorber requires 15 PSI (minimum) dynamic pressure up to approximately 20 Hp

7" single-stator absorber requires 5 PSI (minimum) dynamic pressure up to approximately 20 Hp
7" single-stator absorber requires 15 PSI (minimum) dynamic pressure up to approximately 40 Hp

9" single-stator absorber requires 5 PSI (minimum) dynamic pressure up to approximately 100 Hp
9" single-stator absorber requires 10 PSI (minimum) dynamic pressure up to approximately 150 Hp
9" single-stator absorber requires 15 PSI (minimum) dynamic pressure up to approximately 200 Hp

13" single-stator absorber requires 5 PSI (minimum) dynamic pressure up to approximately 275 Hp
13" single-stator absorber requires 10 PSI (minimum) dynamic pressure up to approximately 400 Hp
13" single-stator absorber requires 15 PSI (minimum) dynamic pressure up to approximately 500 Hp
13" single-stator absorber requires 20 PSI (minimum) dynamic pressure up to approximately 600 Hp
13" single-stator absorber requires 30 PSI (minimum) dynamic pressure up to approximately 750 Hp
13" single-stator absorber requires 40 PSI (minimum) dynamic pressure up to approximately 800 Hp[1]

13" dual-stator absorber requires 5 PSI (minimum) dynamic pressure up to approximately 550 Hp[1]
13" dual-stator absorber requires 10 PSI (minimum) dynamic pressure up to approximately 800 Hp[1]
13" dual-stator absorber requires 15 PSI (minimum) dynamic pressure up to approximately 1000 Hp[1]
13" dual-stator absorber requires 20 PSI (minimum) dynamic pressure up to approximately 1200 Hp[1]
13" dual-stator absorber requires 30 PSI (minimum) dynamic pressure up to approximately 1500 Hp[1]
13" dual-stator absorber requires 40 PSI (minimum) dynamic pressure up to approximately 1600 Hp[1]

19" dual-stator absorber requires 10 PSI (minimum) dynamic pressure up to approximately 1000 Hp[1]
19" dual-stator absorber requires 30 PSI (minimum) dynamic pressure up to approximately 2000 Hp[1]
19" dual-stator absorber requires 50 PSI (minimum) dynamic pressure up to approximately 3000 Hp[1]

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[1]*With our required higher flow valve assembly (and/or dual inlets).*

DYNOmite water brake chassis or diesel engine dynamometers - typically require at least the following minimum dynamic pressures for acceptable load control response and absorber cooling. Extra flow capacity (compared to gasoline engine dynamometers) must be available for these applications due to the increased low end torque. Because a water brake absorber's torque and Hp capacities are very RPM dependant, this list is only approximate!

9" single-stator absorber requires 20 PSI (minimum) dynamic pressure up to approximately 150 Hp
9" single-stator absorber requires 30 PSI (minimum) dynamic pressure up to approximately 200 Hp

13" single-stator absorber requires 20 PSI (minimum) dynamic pressure up to approximately 400 Hp
13" single-stator absorber requires 40 PSI (minimum) dynamic pressure up to approximately 800 Hp[1]

13" dual-stator absorber requires 20 PSI (minimum) dynamic pressure up to approximately 800 Hp[1]
13" dual-stator absorber requires 40 PSI (minimum) dynamic pressure up to approximately 1600 Hp[1]

[1]*With our required higher flow valve assembly (and/or dual inlets).*

Tip: *Even a 1" i.d. garden hose may not supply adequate water for a 200+ H.P. engine if it's only fed from a long run of ½" copper pipe and/or a restrictive sill-cock valve.*

If you come up short on water volume you can:

Upgrade to larger i.d. supply lines.

Replace any sill-cock (garden hose) valve with a high flow ball or gate valve. (See DYNOmite Accessories catalog .)

Plumb into your shop's water system closer to the main valve (with 1" to 2" copper pipe and high flow valves).

These modifications will usually greatly increase the available dynamic pressure, even with the same pump!

Very high static pressure (i.e. 60+ PSI when the load valve is closed) is not desirable. On smaller engines, too much static pressure makes the load valve overly aggressive as it just starts to open. Similarly, wildly fluctuating water supply pressure (common on well pump systems) makes it difficult to hold a steady operating RPM.

Tip: *Very high inlet pressures make the Electronic Auto Load Valve valve more susceptible to binding. Also, the high pressures more it more difficult to start and reliably idle small displacement engines. Contact Land & Sea for assistance with such installations.*

Both high static pressures and fluctuating pressures symptoms can be improved by installing a very high flow capacity pressure reducing valve (e.g. Watts Regulator - Model 223 Series, available at most plumbing supply houses). Use this valve's adjustment to limit your static pressure to only about 10 - 15 PSI above your dynamic pressure. A relatively small diameter bypass drain line, installed after any

regulator, will improve the stability of the system's pressure setting. Such drains also cool the pump under deadhead conditions (when the load valve is closed).

Tip: *Most residential and commercial water pressure reducers and regulators are sized with inlet and outlet pipe sizes that imply a higher flow rating than they are suitable for. Consequently, you should consider a unit that is one (or two) sizes larger and use pipe adapters to install it. Although the price of the larger valves is much greater, the end results will be much more satisfactory!*

Note: If you're exceeding 180 degrees Fahrenheit absorber discharge water temperatures (or if steam is coming out its hoses), you've reached the horsepower absorption capacity for that absorber and supply combination. You need to get more water though the same absorber.

However, if you can't load an engine down with a FULL absorber (indicated by cold water overflowing its vent), you have reached that absorber's torque limits (in that RPM range). You need a larger adsorption unit or to run the test at a higher absorber RPM.

Water Cooled Eddy Current Absorbers

DYNOmite **water cooled eddy current absorbers** - use the water supply for cooling the unit only, not for directly creating a load (dry-gap design). The mechanical energy developed by the engine being tested is transformed into heat, which is dissipated into the water circulating though the absorber's labyrinth cooling chambers.This water supply is normally designed to flow continuously whenever the dynamometer is in operation.

WARNING: DISCONNECT POWER SUPPLY BEFORE SERVICING THE ABSORBER OR CONTROLS.

CAUTION: Insufficient cooling water flow rate (even for a short time) can cause serious damages to the dyno.

1 Connect the inlet and outlet water supplies to the marked ports. (The flow-pressure switch is on the outlet port side.) To insure adequate flow, diameters of the shop water supply lines and pipe fittings should match that of the absorber stand's inlet/outlet fittings - these should not be reduced.

2 If the supply water source has significant impurities, install a suitable filtration and/or softening system (meeting the flow rate and pressure requirements of the absorber). A magnetic filtering anode is recommended on the inlet side to avoid deposits of small particles in the labyrinth cooling chambers.

3 The absorber cooling circuit must be periodically cleaned (with a solvent suitable for boilers). The interval depends on the outlet water's temperature, acidity, and alkalinity. For very hard water or outlet temperatures higher than 122° F, we suggest carrying out the cleaning every 500 work-

ing hours.We also suggest mounting a unit for periodic descaling of the absorber's labyrinth cooling chambers. This will consist of a small tank and a pump, having characteristics compatible with the cleaning solvent to be used.

Tip: *The cleaning and descaling of the cooling labyrinth can be reduced, if both a filter and de-calciner are installed before the inlet.*

4 A differential flow-pressure switch, at the water outlet ports, opens its contacts whenever water flow is insufficient. If the unit is not pre-wired, this switch must be wired to a relay which will interrupt power to the absorber's coli(s) should coolant flow drop during operation. It must never be bypassed or otherwise defeated.

CAUTION: Never break the flow-pressure switch's warranty seal. Doing so voids the unit's warranty!

5 Four 140 degree Fahrenheit RTD type temperature sensors monitor the outlet water manifold temperatures during operation. If the unit is not pre-wired, these sensors must must be wired to relays which will interrupt power to the absorber's coli(s) should outlet coolant temperatures exceed these limits during operation. They must never be bypassed or otherwise defeated.

CAUTION: Water cooled eddy current absorbers require a through-flow that keeps discharge temperature below 140 degrees Fahrenheit. Temperature sensors and flow-pressure interlock safety switches must always be utilized - to remove excitation power in the event of overheating or low water flow!

6 The absorber's housing is fitted with air bleeds to remove air at the time of initial filling. The fitting also help in draining the system if it will be subject to temperatures below freezing (preventing damage to the labyrinth cooling chambers, pressure switches, etc.). To drain all water from the absorber housing, close water supply to the dynamometer and remove both the inlet and outlet supply lines.

7 Verify that the water system's volume and pressure meet the requirements for the specific model absorber. The flow rate must take into consideration the maximum power to be removed while maintain a delta temperature of less than 70 degrees Fahrenheit. Differential pressure should be constant and not exceed 45 PSI. Any additional downstream head pressure or closed loop pumping losses must be taken into consideration.

NOTE: Minimum flow requirements for DYNOmite water cooled eddy current absorbers:

#200 requires 28 GPM flow @ 30 PSI* (inlet pressure)
#300 requires 41 GPM flow @ 30 PSI* (inlet pressure)
#400 requires 55 GPM flow @ 30 PSI* (inlet pressure)
#800 requires 110 GPM flow @ 30 PSI* (inlet pressure)

*assumes less than 3 PSI back pressure at absorber's outlet

CAUTION: Closed loop systems should have suitable degassing devices to remove air bubbles.

The DYNOmite's Data Acquisition module can be powered by either 110 volts AC or from the engine's 12 volt DC battery and/or alternator. If you have purchased a "PRO" DYNOmite system, it is pre-wired for the plug-in wiring harnesses that runs from the stand's subsystem to the console.

Tip: *You can equip any DYNOmite control console with relatively simple custom wiring. Switches and relay kits are available to speed this process and support custom control features for your specific testing requirements.*

1 Wire all ground leads of the DYNOmite's Data Acquisition harness(es) to a single common negative post of the engine or system battery.

CAUTION: Always attach all ground wires before hooking up any of the power leads for the DYNOmite Data Acquisition module, its accessories, or the engine. Failure to follow this precaution can lead to circuit damage not covered under warranty!

2 On "PRO" relay subsystem equipped stands only, the subsystem's 12-gauge black and red power leads run to a terminal block at the back of the stand. The matting 12-gauge leads on that terminal bock must be wired to the common engine and system battery (which should be clamped into the on-board battery tray).

CAUTION: Be sure to connect the black (ground) lead before connecting the red power lead. Failure to follow this precaution can lead to circuit damage not covered under warranty!

3 For "PRO" consoles, plug the included harnesses into the jack on the back of the console and the one on the dyno stand's relay subsystem box.
If you are wiring a DYNOmite console (which is not equipped with the optional relay subsystem box) connect all ground (black) 12-volt DC leads to the negative side of the engine's battery. After the black leads are wired it is okay to connect the positive (red) 12-volt DC leads to the engine's battery - via an appropriately fused lead (20 amp maximum).

4 Generic (un-wired) single pole switches are provided in all DYNOmite consoles. You can optionally wire them for manual control of main power, ignition, starter, and fuel pump.

5 If you have the optional Electronic Auto Load or Throttle Servo(s), locate their 2-wire power harnesses. They have black and red leads, a 5-amp fuse, and a connector match the servo's 2-wire power pigtail. This power harness must be connected to the system's 12.6-volt DC battery.

CAUTION: Be sure to connect the black (ground) lead before connecting the red power lead. Failure to follow this precaution can lead to circuit damage not covered under warranty!

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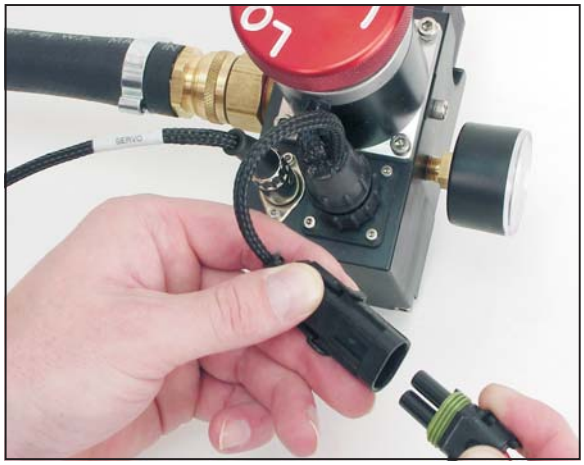
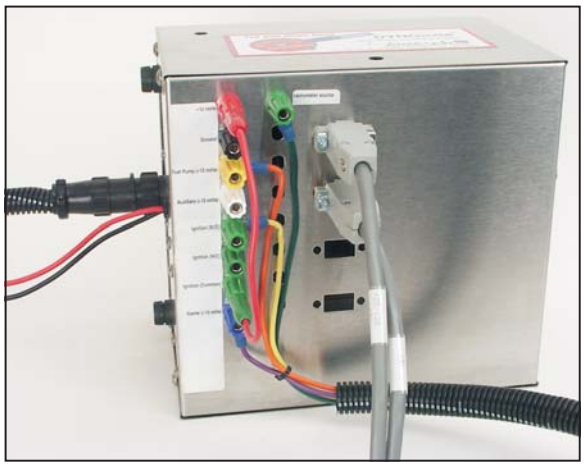
6 Plug the connector from the power harness into the servo's power pigtail (Figure 5).



5

Tip: *Wire any desired auxiliary analog gauges needed for the type of engine being tested. Gauges (if any) included with the DYNOmite may not be appropriate for every engine application. Analog gauges are independent of the DYNOmite data acquisition functions and can be hooked up at your option. If you need information on the applicability or wiring of accessory gauges for your engine, refer to that specific gauge manufacturer's instructions.*

7 If you are using the optional "Relay subsystem" (Figure 3), connect it to the PC's serial port cable(s) and the Data Acquisition Harness(s). Any applicable ignition, starter, fuel pump, etc. leads can be custom wired to the appropriate posts on the subsystem (per the subsystem's schematic).



3

8 If you have the optional "Pro-Test Stand Upgrade" package, the stand will have been pre-wired for the Fuel Pump and starter solenoid.(Figure 4).

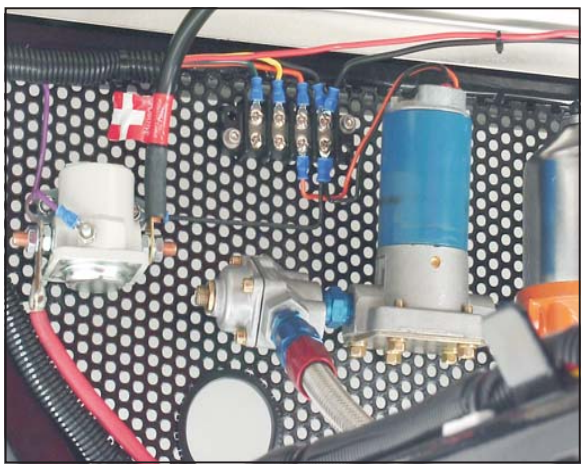
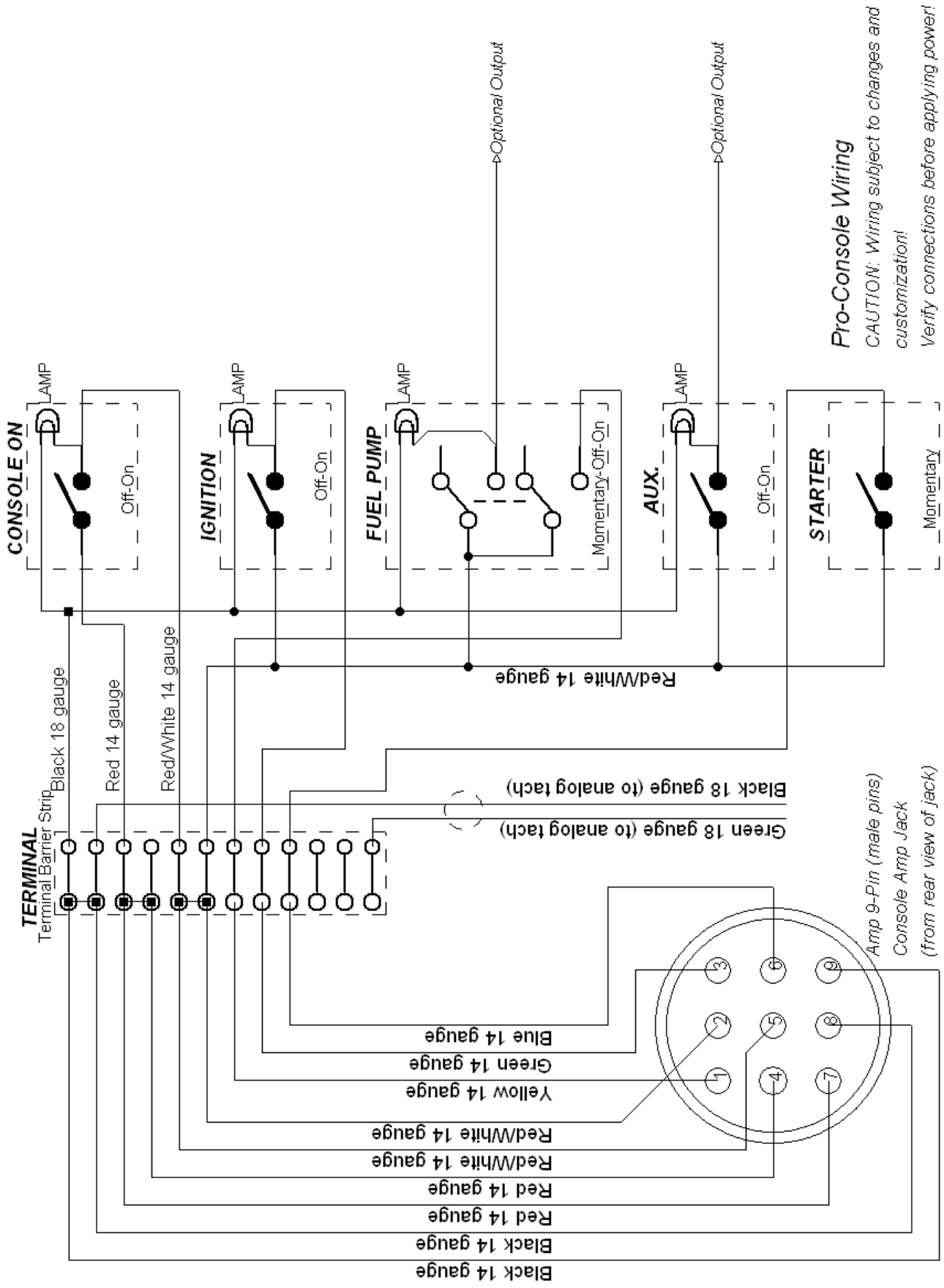
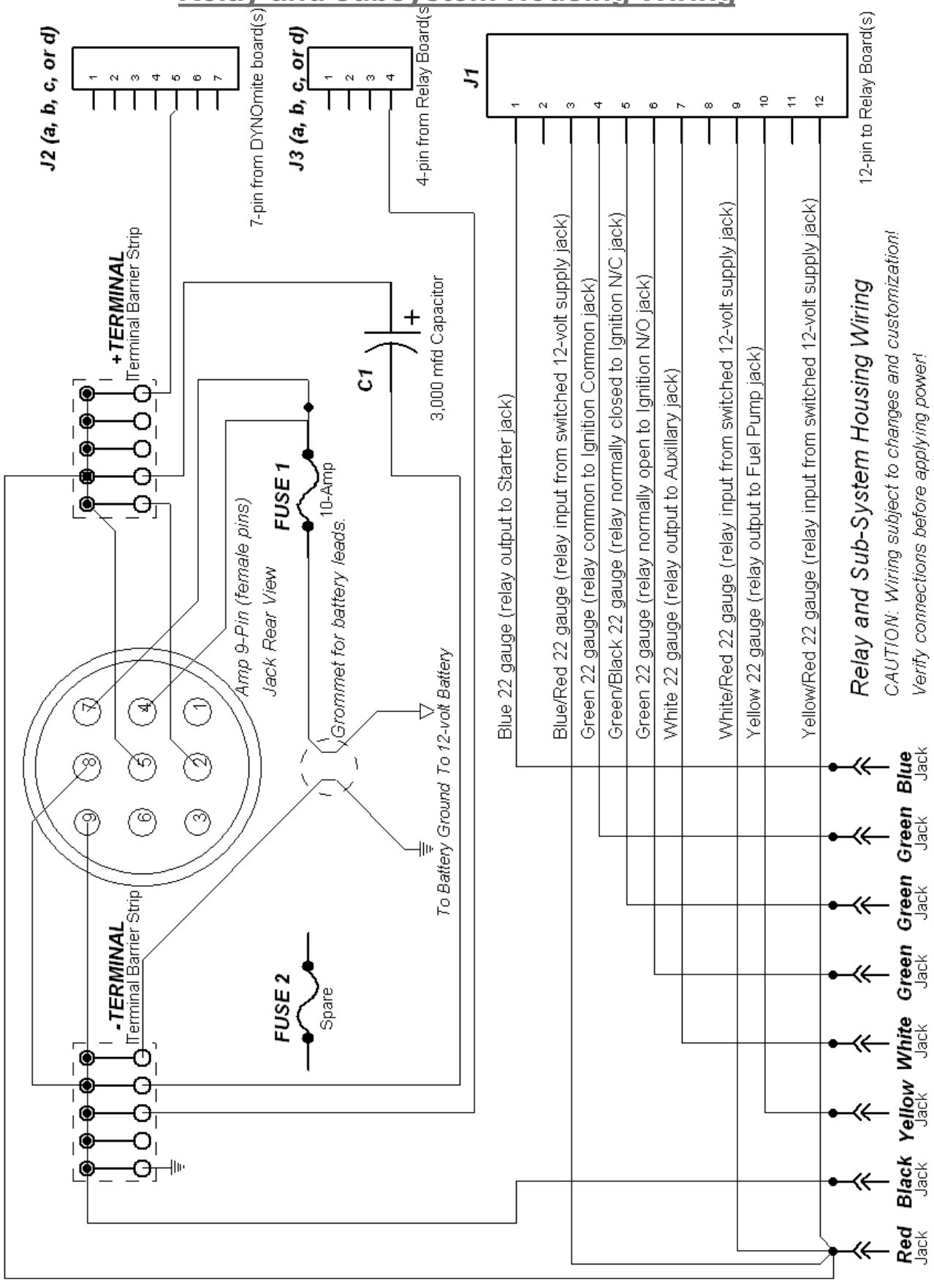


Figure 4

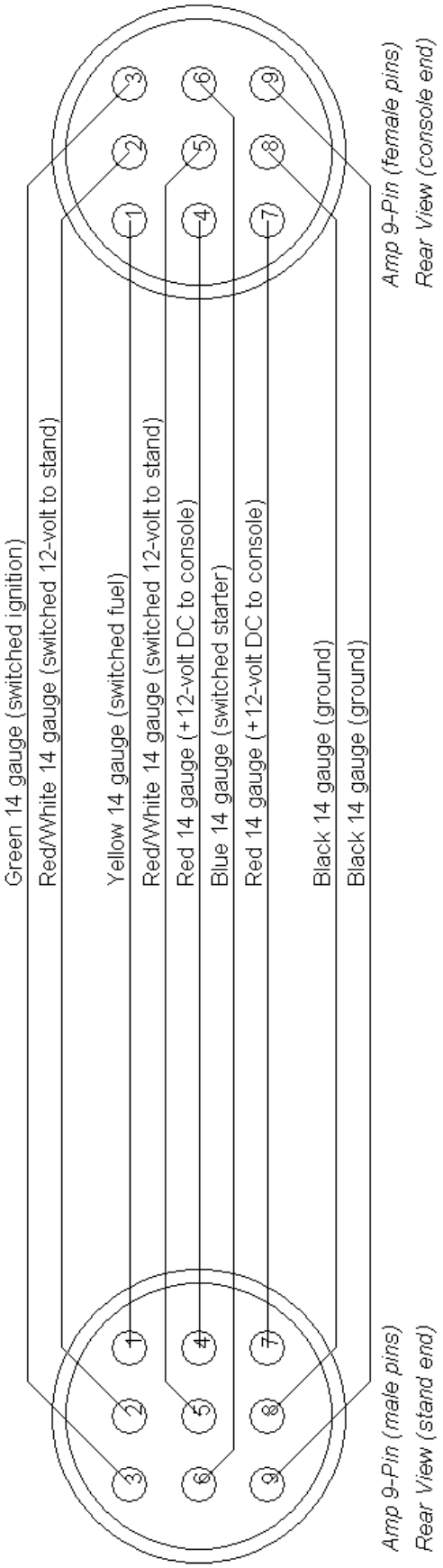
Pro-Console Wiring



Relay and subsystem Housing Wiring



#411-470 Console-Stand Harness-15'



#411-470 Console-Stand Harness-15'

CAUTION: Harness wiring subject to changes and customization!
Verify connections before applying power!

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Eddy Current and AC absorbers require higher current and voltage electrical supply wiring than do water brake or inertia only dynamometer installations. Except for 12-volt DC powered versions, local building codes typically require that you have a licenced electrician handle wiring the absorber's power supply/control module into your building's wiring system.

WARNING: THERE ARE NO USER SERVICABLE PARTS INSIDE THE POWERSUPPLY/CONTROLER MODULES. THE 115-VOLT (AND HIGHER VOLTAGE) MODULES SHOULD NEVER BE SERVICED WHEN POWER IS APPLIED. LETHAL VOLTAGES ARE PRESENT WITHIN THE MODULE'S HOUSING AND AT THE ABSORBER ITSELF!

Mount the power supply/controller module in a location convenient for observation of its readings and manual operation of its controls during testing. The output power cable should be within reach of the dynamometer's absorber connection.

Unlike AC motor/absorbers, the current necessary to power the various model DYNOmite Eddy Current Absorbers is not proportional to their torque loading capabilities! Most of the 115-volt and 230-volt supply units draw less than 30-amps. The power supply/control module converts your AC line voltage into a 96-volt (or 192-volt) pulse width modulated DC feed to the eddy current absorber.

Tip: *Since the magnetic force produced is function of both the current and the number of turns on the eddy current coils, strong magnetic force is available from relatively low supply wattage.*

CAUTION: For larger AC motor/absorbers with regenerative drives, their greater installation complexities and higher voltage and current demands require additional pre-installation planning. Consult the drive's (separate) documentation or contact the factory for assistance as required.

The supply voltage and current requirements for eddy current system are size and model dependant. Below is a list of several popular configurations. The electrical installation should take into consideration the need to power the required ventilation fans. any electric air duct louvers, etc..

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Note: Micro Eddy Current requires 12 volt DC supply @ 30 amps (12 Volt DC ouptut)

#100 Eddy Current 96-volt output version - requires 115-volt AC supply @ 24 amps (96 Volt DC output)
#100 Eddy Current 96-volt output version - requires 230-volt AC supply @ 24 amps (96 Volt DC output)
#100 Eddy Current 192-volt output version - requires 230-volt AC supply @ 12 amps (192 Volt DC output)

#300 Eddy Current 96-volt output version - requires 115-volt AC supply @ 24 amps (92 Volt DC output)
#300 Eddy Current 96-volt output version - requires 230-volt AC supply @ 24 amps (96 Volt DC output)
#300 Eddy Current 192-volt output version - requires 230-volt AC supply @ 12 amps (192 Volt DC output)

#400 Eddy Current 96-volt output version - requires 115-volt AC supply @ 30 amps (92 Volt DC output)
#400 Eddy Current 96-volt output version - requires 230-volt AC supply @ 30 amps (96 Volt DC output)
#400 Eddy Current 192-volt output version - requires 230-volt AC supply @ 15 amps (192 Volt DC output)

#200 Water Eddy Current 192-volt output version - requires 230-volt AC supply @ 10 amps (192 Volt DC output)
#400 Water Eddy Current 192-volt output version - requires 230-volt AC supply @ 10 amps (192 Volt DC output)
#800 Water Eddy Current 192-volt output version - requires 230-volt AC supply @ 10 amps (192 Volt DC output)

#650 Eddy Current 96-volt output version - requires 115-volt AC supply @ 30 amps (96 Volt DC output)
#650 Eddy Current 96-volt output version - requires 230-volt AC supply @ 30 amps (96 Volt DC output)
#650 Eddy Current 192-volt output version - requires 230-volt AC supply @ 15 amps (192 Volt DC output)

1. Connect the *power supply/controller modules* unit's "DC OUT" to the eddy current absorber.

2. The lower wattage AC powered eddy current *power supply/controller modules* have cord caps which can be plugged directly into a dedicated wall outlet of sufficient capacity. Larger AC powered units must be hard wired to a dedicated circuit breaker equipped panel.

WARNING: FOR ALL AC POWERED UNITS, VERIFY THAT UNIT"S THE GROUND WIRING IS CONNECTED AND THAT THIS CIRCUIT IS CONTINUOUS FROM THE SUPPLY WIRING PANEL THROUGH TO THE ABSORBERS FRAME!

CAUTION: Be sure to secure all cords so they can not become entangled in the absorber's hot, spinning rotors (or other moving parts of the dynamometer system).

If you are installing a 12-volt DC eddy current absorber with a DYNOmite 12-volt DC *power supply/controller module*, hook the power supply/controller module's positive and negative "Power In" leads to your test cell's appropriate 30 amp 12-volt DC power supply or heavy duty automotive battery (Figure 8).

If you are installing a 96-volt DC eddy current absorber with a DYNOmite 115-volt AC *power supply/controller module*, plug the power supply/controller module's "POWER IN" cord into your test cell's dedicated and appropriately grounded 20-amp 115-volt AC outlet.

Figure 6

If you are installing a 96-volt or 192 volt DC eddy current absorber with a DYNOmite 230-volt AC *power supply/controller module*, wire the power supply/controller module's "POWER IN" cord to your test cell's dedicated 20-amp 230-volt (single-phase) AC circuit breaker.

CAUTION: To protect the eddy current absorber and the power supply/controller module from overheating, do not leave the unit at a high current setting when tests are not being run. The air cooled absorbers require the pumping action of their spinning finned rotors; while the water cooled eddy units need a minimum through-flow to protect their labyrinth cooling chambers from overheating. Failure to heed these cautions can result in failure of the eddy current equipment that is not covered under warranty.

3 For pre-wired water cooled eddy current absorbers only, plug the absorber's safety relay interlock cable (for the cooling water outlet temperature sensors and pressure/flow switches) into the mating connector on the *power supply/controller module*.

CAUTION: Water cooled eddy current absorbers require a through-flow that keeps discharge temperature below 140 degrees Fahrenheit. Temperature sensors and flow-pressure interlock safety switches must always be utilized - to remove excitation power in the event of overheating or low water flow!

Air cooled eddy current absorbers (unlike water cooled or AC motor/absorbers) radiate 100% of their absorbed engine power into the test cell's air! The room must be equipped with adequate high flow ventilation fans and duct work to remove this heat.

For testing powerful engines, the required airflow volume is significant. Over 250,000 BTU's per hour will be radiated for every 100 brake horsepower being absorbed. Consult your heating ventilation system designer for sizing and placement of duct work and fans.

Figure 7

CAUTION: Do not forget to factor in the heat contribution that is radiated from the engine block, exhaust manifolds, cooling towers, etc. when calculating heat output into the cell.

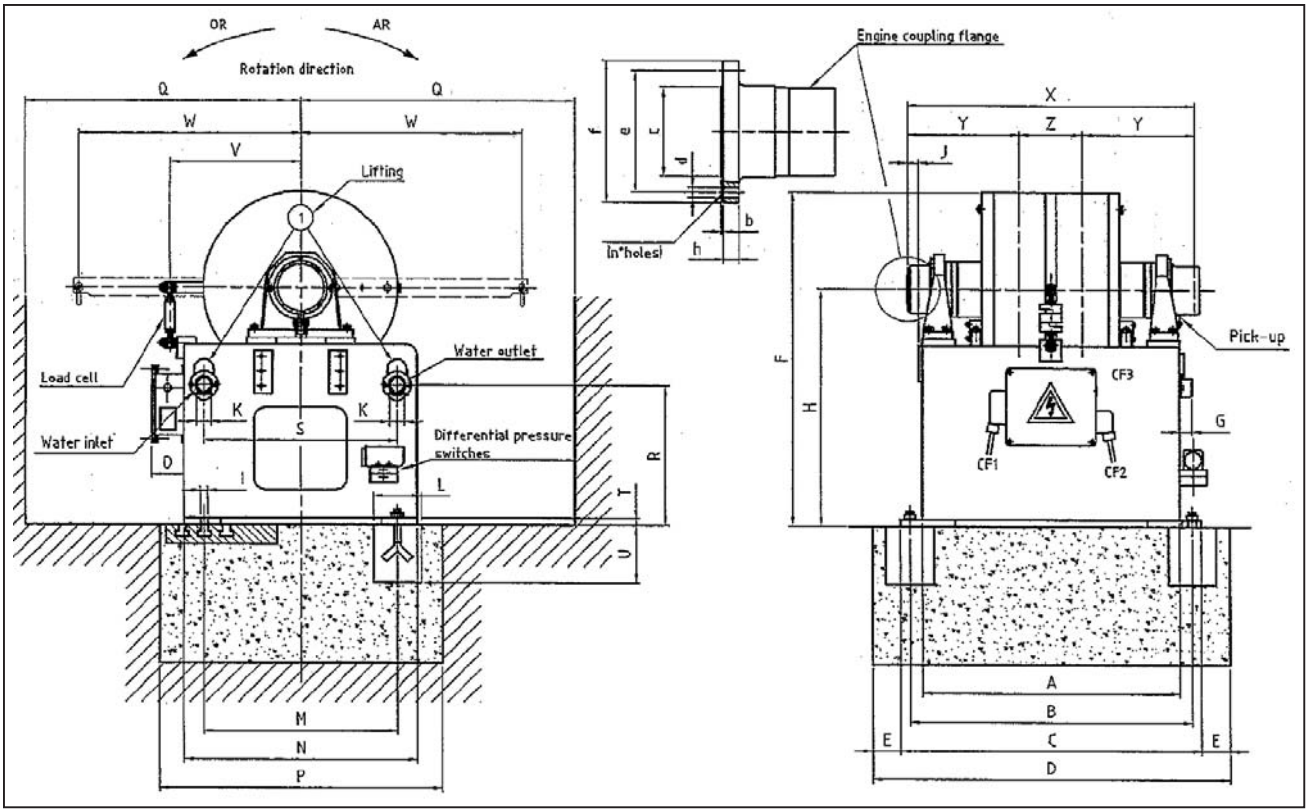

Figure 8

Tip: *If the dynamometer will only be performing short duty cycle tests (e.g. simulating drag race acceleration runs), considerably less ventilation may be required. This is because the heat sink properties of the absorber's high-mass rotors store the energy bursts and then cool gradually between tests*

For pit mounted chassis dynamometers cross flow ventilation ducting is typically cast into the pit's walls. For above ground installations and engine docking stations the cooling is usually provided by equipment mounted air moving fans or louvers that count on the cell's engine ventilation duct work to actually remove the hot air from the room.

Tip: *In all cases it is important that the placement of the inlet and outlets draw hot air away from the engine's air intake - so that only cool fresh air is inducted into the engine during power tests..*

Bolt the eddy current assembly's base to a solid test cell floor having a 12" depth (or equivalent structure) using suitable heavy-duty (vibration resistant) anchors. Anchors are not included with the dynamometer absorber assembly.

The water cooled eddy current absorber's shaft can rotate in either direction. Depending on wiring and software configuration, the load cell can read either the compression or tension loads imparted upon it. The connection to the transmission joint should only be applied to the front (non RPM pick-up) flange.

To couple the absorber to the test engine, use transmission joints which allow for axis displacements and that will decrease torque fluctuations. The coupling elements not supplied by us must be calibrated with a minimum balance degree corresponding to Q = 0.1"/second.

For the #200, #300, #400, and #800 absorbers:

Maximum weight of shafts @ absorber's drive shaft flange = 3.3 pounds to 13,000 RPM
Maximum weight of shafts @ absorber's drive shaft flange = 5.5 pounds to 10,000 RPM
Maximum weight of shafts @ absorber's drive shaft flange = 8.6 pounds to 8,000 RPM
Maximum weight of shafts @ absorber's drive shaft flange = 60 pounds to 3,000 RPM

The RPM pick-up uses 60-tooth gear on the rear flange of the absorber which it reads via an inductive sensor. The allowable air gap for the inducive sensor to gear tooth faces is .025" to .040".

From DYNO-MAX software's "Electronics - Calibrate DYNOmite Channels" menu selection, the Frequency-2 (RPM-C) channel must be configured for 60=1 PPR and set to use an ~ 2.6 volt trigger voltage setting.

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Separate manuals are included with each custom AC motor/absorber and vector less drive. However, it is a good idea to make a notation of any non-default setup parameters entered into the control during configuration.

Although the control has memory space for storing multiple backup copies of the setup parameters, it is still a good idea to maintain a separate hard copy. The page below can be used to list both settings and notes about them.

Tip: *Too much work goes into many highly customized installations to risk looking all the settings from a major hardware failure or technician's mistake!*

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The Axle-Hub Dynamometer assemblies allow “road” testing of medium powered FWD, RWD, and AWD vehicles – right in your shop. The systems left and right eddy-current absorbers permit support performing sweep, steady-state, and road-load simulation testing (under DYNO-MAX control).

This section's instructions only detail the procedures for setting up and using the axle-hub assemblies. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-ups and wiring, dynamometer operation, etc. (for this and other applications).

1 The axle-hub units should be used in an area with adequate ventilation (to remove exhaust fumes). If extended duration or higher power testing is to be conducted, the ventilation system needs to be much larger – in order to substitute for the cooling affects of highway airflow velocities. (See “GETTING READY- Cell Design” section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment, drive-line, and exhaust.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED DYNAMOMETER TESTING CAN LEAD TO A VEHICLE FIRE!

2 The selected location for testing should provide adequate room for accessories such as floor lifts, fans, and other test equipment – as well as for technicians to service the vehicle.

CAUTION: The axle-hub dynamometers are directional (for cooling and correct torque indication). Each unit's extended axle (for its red wheels) must extend towards the front of the vehicle.

3 For each (powered) vehicle axle the Primary (gauge-panel equipped) unit bolts in place of the vehicle's left-side tire and the Secondary axle-hub unit replaces the right-side's tire.

4 Provisions for running the Primary (gauge-panel equipped) unit's absorbers power leads, speed sensor cabling, and other data acquisition wiring, between the axle-hub assemblies and control console area, must be made. For new (permanent) installations, running these hook-ups via floor level raceways is suggested; cast-in PVC conduits are also suitable.

Tip: *Isolating the power leads from the data wiring is suggested to minimize potential electromagnetic interference.*

5 Jack the vehicle's tires off the ground with an appropriate commercial-duty floor jack. Use wheel chocks on the other axle to prevent fore-and-aft movement while jacking the first axle.

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WARNING: JACK STANDS SHOULD BE PLACED LOOSELY, AS A FAILSAFE, JUST BELOW THE JACKED HEIGHT. STILL, NEVER WORK UNDER THE VEHICLE WHILE ITS TIRES ARE OFF!

Tip: *Independent suspension cars should be jacked from a (suitable) suspension point that is near to the spindle. This avoids the extreme camber angles that can make aligning the drive hubs difficult.*

6 Remove each wheel and fit it with the appropriate bolt pattern drive-flange adapter.

CAUTION: Verify that each adapter fits flush to the vehicle's flange – without interference from any rivets, clips, shoulders, rust, etc. that would cause dangerous run out.

Tip: *Several other optional (hub-pattern, offset, and style) drive-flange adapters are available for applications that the included adapters do not fit.*

6 In most cases the OEM (acorn shaped) wheel nuts fit the drive-flange adapter's 60-degree bolt-hole taper. If not, obtain appropriate acorn nuts from a local automotive-supply store. Secure the adapters following the vehicle's manufacture's recommended tightening specifications.

WARNING: DO NOT TRY TO USE SHOULDERED OR WASHER STYLE ("MAG") WHEEL NUTS TO SECURE THE ADAPTERS.

CAUTION: Rotate the vehicle's drive-flange adapters to verify that there is no rubbing between them and any brake calipers, etc.

7 Roll each axle-hub unit into place, so that the unit's steel drive-flanges align with the drive-flange adapters (previously mounted on the vehicle). Carefully adjust the floor-jack's height, to vertically align the flanges, as required.

Tip: *The swivel caster on each axle-hub unit is designed to restrict its reversing (avoiding alignment "side shift") whenever the units are being rolled backwards (pulled) for flange alignment . Steering, while pulling backwards, consequently requires some getting used to. The red handle must be tugged slightly to the left, pre-orienting the caster, in order to turn to the right (and vice versa). When pushing the units forward, they steer normally.*

8 When the alignment is close enough, rotate the unit's steel drive flange to align its bolt pattern with the vehicle's drive-flange adapter. Lightly screw all five of the flange's (½"-13 UNC Grade-8) bolts into the adapter's (pressed in) flex-lock nuts.

CAUTION: The flex-lock nuts in the drive-flange adapters provide anti-vibration resistance to loosening. After repeated assembly and disassembly, once this locking-resistance fades, the pressed-in flex-lock nuts must be replaced.

9 Progressively tighten the five drive-flange bolts while making certain the flange's alignment shoulder cleanly nests into the vehicle's mating drive-flange adapter – without any damaging forces. Once the faces precisely meet, torque the bolts to 35 foot-pounds.

> ***CAUTION: Unless the vehicle runs extreme tire camber, the axle-hub unit's Automatic Camber Compensation should handle most installations. If the Automatic Camber Compensation's pointer (see side slot on each unit) is at the extreme top or bottom of its slot, shim (e.g. with plywood) the red wheels (or the black caster), as required, to correct the situation. Failure to do so will cause abnormal stress at the vehicle's wheel flange and on the axle-hub unit.***

10 Repeat the mounting process for the other axle-hub dyno unit(s).

11 Plug the "Fan Out" and "DC Out" cords into the "Primary" axle-hub unit panel's labeled receptacles. Run these two cords over to the, similarly labeled, receptacles on the "Secondary" axle-hub unit's panel and plug them in.

> ***CAUTION: Be careful to route these electrical wires so they will not be damaged during testing or vehicle maintenance. The cables are running at over 100 volts and may be live even when testing is not underway. For example, the thermostatically controlled fans may self-activate (from latent heat) long after the test ends. Always disconnect the units' main power source when servicing their hardware, cables, or any connections.***

12 The installation of the DYNOmite Data Acquisition Computer (DAQ) and its harness/sensor wiring was covered in a previous section of this manual. If you have not already done so, connect the harness's (four-wire AMP) "Torque" lead connectors to the Primary and Secondary axle-hub unit panels' jacks – labeled "DYNOmite (Torque)" and "Auxiliary (Torque)" respectively. Also connect the harness's appropriate leads to the Primary (only) unit's "DYNOmite (RPM)" and "DYNOmite (Servo)" panel jacks.

13 Before connecting your building's power cord to the Primary unit's "Power In (From Line)" receptacle, to activate the units, verify that its panel "Power" switch is rotated to the "Off" position.

> ***CAUTION: Always verify that the Power switch is off before making connections or after ending a test session.***

14 This step assumes a qualified electrician has already wired an appropriate style (230-volt @ 30-amp) receptacle, protected by an approved circuit breaker. Connect the power-supply cord between the building's power and the primary axle-hub's "Power In (From Main)" receptacle.

15 Temporarily set the Primary panel's load-control rocker switch to the "Manual (Knob)" position. Also, make sure its red "Load" knob is rotated to the 0% position (fully clockwise).

16 Rotate the primary-unit's power switch to the "On" position. Nothing should happen!

17 The panel's load-control rocker switch should still be in the “Manual (Knob)” position. Momentarily, just long enough to note the “Current” meter reading, rotate the red “Load” knob to its 100% position (fully counter clockwise). Immediately return the knob back to the 0% (fully clockwise) position. The meter should have gone up to (roughly) half scale.

Tip: *This quick test is useful for verifying the electrical behavior of the eddy-current absorbers. The “knob mode” is not otherwise used for normal dynamometer testing.*

18 While watching the current meter again, switch the load-control rocker switch to the “Computer (Hold/Auto)” position. The meter reading should stay at zero (0) amps.

CAUTION: If the amp meter climbs above one (1) amp, immediately return the rocker switch to the “Manual (Knob)” position and contact Land & Sea support to help you troubleshoot your setup.

19 If you have not already done so, see other related sections for setup of the DYNOmite data-acquisition computer, wiring the absorber, and configuring DYNO-MAX before continuing to operate the dynamometer.

20 Start the engine, release the parking brake, put the transmission into gear, and gradually bring the drive wheels up to a low speed (i.e. 10 MPH - 15 km/h) cruise. During this time, verify that the axle-hub units are not vibrating – otherwise check axle-adapter mating. Also verify that the DYNOmite data-acquisition computer (via DYNO-MAX) is receiving the axle’s speed signal.

Tip: *It is helpful to have an observer and/or mirrors oriented so that the test driver can see the axle-hub flanges turning.*

CAUTION: Even though the vehicle is not moving forward, its axles may still be turning. Do not put the vehicle into park or reverse until the axles stop! Always have the brake firmly applied before shifting into park! Avoid applying the brakes so hard that the suspension lurches!

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH THE SUSPENSION. DRIVER MUST STAY ALERT DURING TESTING – KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE – AND AWAY FROM AXLE-HUB UNITS.

21 Bring the the speed up into the 30 to 50 MPH (50 to 80 km/h) range to verify smooth running.

Tip: *If any significant shake or excessive vibration is noted, check that the aluminum adapters are properly seated on the vehicle's wheel flanges and into the dynamometer's drive-flanges. If they are, check the vehicle's axle-flange run out – with a dial indicator. It may help to reindex the relationship between the vehicle's wheel bolt pattern and the dynamometer's, by about 180 degrees – to cancel our any slight tolerance stack up.*

CAUTION: Excessive run out causes hardware-loosening vibration and may damage the axle-hub units and/or the vehicle's driveline! Vehicle wheel-flange run out in excess of 0.003" may indicate a bent axle or spindle.

WARNING: PERIODICALLY RE-TORQUE EACH AXLE-HUB FLANGE ADAPTER'S EIGHT HEX-HEAD SCREWS TORQUE TO 30 FT-LBS (41 NM).

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite data-acquisition computer and DYNO-MAX software. The DYNOmite data-acquisition computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, on-line help system.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick followup refresher to previously completed training only.*

As the vehicle accelerates its axles, the DYNOmite computer and DYNO-MAX software monitor the absorber and engine RPMs, run time, rate of acceleration, and absorber torque. It uses this information to calculate and display the applied power.

The load control (under manual or computer regulation) can adjust the resistance that the absorbers apply to the vehicle's driveline. By increasing or decreasing the absorber load, it is possible to simulate various road conditions – at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel-injection systems, etc.

When using the load control it is possible to specify a specific holding speed or engine RPM – which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the vehicle drag and weight information you input. In this mode you will notice an exponentially increasing load being applied to the vehicle, as it accelerates. This is a very convenient mode for doing engine management system mapping or diagnostic testing.

Below is just a quick review (from the training course) on performing an axle-hub dynamometer session using DYNO-MAX's *Simulate Road Loads* mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the absorber's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (F1 key). Use its "Help - Index" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer readings are significantly different, it is likely that your "RPM Pulses/Rev =" setting under "Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels" for the "Yellow AC input (Frequency)" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the *Number of Cylinders*, *Bore*, and *Stoke, (or Displacement*) as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the *Weight* and *Coast Down G's* for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "Coast Down G's at 55 MPH" can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
Bike(touring) 800 lb. = .070
SUV(mid-size) 4500 lb. = .031
SUV(full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for the vehicle's tire diameter.

7 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the vehicle's axles and the absorber's shafts. For example, enter 1.000 for the standard 1 to 1 (direct) coupling.

8 Still under the Run Information *Dyno* tab, you can enter the parasitic loss "*Dyno Power loss RPM B*" calibration values established for your system. This corrects for absorber windage and bearing drag losses

Tip: *Contact Land & Sea if you do not know the correct values for your axle-hub dynamometer assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You may adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto*) button must be depressed to activate the automatic control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and on-line help system for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Eddy-current brakes, for example, can't provide loading near zero RPM. An AC motor/generator absorber is able to simulate more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* button

The various Chassis Dyno Dual-Roller assemblies (parallel tandem rolls) allows "road" testing medium powered vehicles right in your shop. Although they can be configured for simple inertia acceleration testing only, they are usually upgraded with either an over-driven DYNOmite water brake, AC motor/generator or eddy current absorber. Doing so also allows performing steady state and road simulation testing (via DYNO-MAX)

This section's instructions only detail the procedures for setting up and using the roller assembly. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-up and plumbing, dynamometer operation, etc. (for this and other applications).

1 The roller assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger - in order to substitute for the cooling affects of highway airflow velocities. (See "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment drive-line, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY SMALL DIAMETER ROLLER ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CHORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING)

2 Double check that the selected location for the roller assembly provides adequate bumper clearance for the longest vehicle to be tested (both front and rear wheel drive orientation) as well as room for fans, other test equipment, and servicing the vehicle.

CAUTION: Make sure the "driven" roller is oriented towards the correct end of the test bay. It must be on the forward side of the vehicle's driving wheels. An arrow on the frame points in the forward direction the vehicle should face - while the text "DYNOmite" (that is cut into the deck plate) will be closest to the rear of the vehicle.

3 Provisions for speed sensor and any other data accusation wiring between the roller assembly and control console area must be made. Absorber equipped units require either running plumbing of inlet, drain, and vent hoses (for water brakes) or wiring of power lines (for electric absorbers).

4a If the roller assembly was ordered for above-ground (semi-portable) installation, move it into place in your test area (using appropriate handling equipment).

Tip: *Some units have casters, to make positioning the unit on a smooth floor easier.*

CAUTION: Integral casters are not designed to support the weight of the system during testing (or on rough terrain).

4b If the roller assembly was ordered for in-ground installation (into a custom cast concrete pit), move it into the pit with an adequately sized fork lift and four slings at the ends of the rolls.

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

5 Adjust the height of the anti-vibration support pads to level the frame rails with the test area's floor. The anti-vibration support pads must carry the dyno and vehicle weight during testing.

Tip: *Verify that all required plumbing supply lines, sump drains, wiring, vents, vehicle restraints, etc. will properly hook-up before permanently anchoring the roller assembly.*

6 Mark out the mounting hole location for the roller frame (and any pit cover) onto the floor of the test area. Use heavy duty fasteners (appropriate for the test area's floor material) to securely anchor the frame (and, later in these instructions, any pit cover) to the test area's floor.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for each roller assembly.*

WARNING: BEFORE OPERATION, ANY REQUIRED PIT COVER(S) MUST ALSO BE BOLTED TO THE TOP OF THE ROLLER ASSEMBLY'S FRAME RAILS.

7 If the test area is not already equipped with suitable vehicle restraint strap anchors, install them now. While many forms of restraining systems can be fabricated, most shop owners prefer heavy-duty flush (or recessed) mount "D" ring equipped plates.

For concrete floors, secure each plate with three or four concrete anchors. Several rings should be strategically placed in the test area so that the heavy-duty nylon restraint straps can be easily looped around the various tested vehicle's axle or frame members. Straps should be installed at a shallow angle (with the ground) to reduce the load on the anchoring hardware.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

WARNING: FOR EITHER ABOVE OR IN-GROUND INSTALLATIONS, FRAME TO FLOOR ANCHORS AND VEHICLE TIE DOWN STRAPS ARE REQUIRED TO SECURE BOTH THE ROLLER ASSEMBLY AND VEHICLE UNDER POWER! FRONT WHEEL DRIVE VEHICLES MUST BE SECURED WITH DIAGONALLY ORIENTED STRAPS TO PREVENT SIDEWARDS WANDER!

8 For absorber equipped roller assemblies, check drive belt (or chain) tension. For systems with slotted tensioners, adjusting as necessary. Verify the need for adjustment (or belt replacement) using the chart below - apply the correct deflection pressure (at the mid-point of the longest span) and measuring the total deflection (from a straight tangent line). (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber itself.)

NOTE: The correct deflection (+/- 1/16" with deflection pressure applied at mind-point of longest span) should be:

3/16" for belts (applying 95 pounds of pressure)
5/16" for chains (applying 10 pounds of pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts (or chains) after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

9 For water brake absorbers equipped with a DYNOmite Electronic Load Servo option, the load valve can be remote mounted or attached to the frame via the provided holes. For Pro Console (or in-ground installations), remote mounting of the load valve is recommended. Use the included stainless braid hose to plumb the load valve's outlet to the absorber's inlet fitting.

Tip: *Manual load valves need to be run from inside the vehicle. Longer hoses can be ordered for remote mounting.*

CAUTION: Install the Load Servo with its motor and manual knob oriented up - to prevent water from ever dripping into the motor.

10a For above ground drive-on installations, hook the included ramps over appropriately spaced locations on the fame rail.

10b For in-ground units, bolt any required pit cover(s) to the top of the roller assembly's frame rails. Use hardware compatible with your test area's floor material.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for each roller assembly.*

11 Carefully move a moderately powered vehicle (for initial testing) onto the rollers, while watching out for clearance problems with any low hanging spoilers, etc.

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered stock car tires should be replaced during testing), and inflated to the manufactures maximum recommended pressure.

Tip: *To drive a vehicle on or off the rollers, it may be necessary to temporarily slip the supplied locking pin into one of the holes in the end of the knurled roller (Figure 9).*

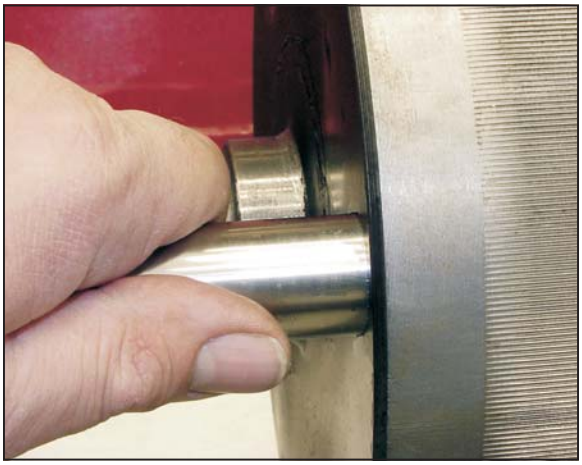

Figure 9

12 Place appropriate size wheel chocks around the tires remaining on the ground while you finish hooking up the restraining straps. The small chocks provided should not be relied upon alone for high power testing, as the vehicle can jump out of the rolls.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

CAUTION: An observer should watch the actions of the tires on the rollers during testing. If it is seen that applied power levels are causing the tires to climb off the rear roller, signal the driver to stop the test. Verify that the locking pin has been removed. The axle or frame of the vehicle must always be secured to the test bay's anchors using appropriate restraining straps or chains.

WARNING: INSPECT THE CONDITION OF THE STRAPS ON A FREQUENT BASIS.

13 If you have not already done so, see other related sections for setup of the DYNOmite Data Acquisition Computer, plumbing or wiring the absorber, and configuring DYNO-MAX before continuing to operate the dynamometer.

14 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheels up to a low speed (i.e. 10 MPH) cruise. During this time, verify that the vehicle is tracking properly (repositioning as necessary) and also verify that the DYNOmite Data Acquisition System is receiving the roller's speed signal.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rollers.*

CAUTION: Even though the vehicle is not moving forward, its wheels may still be turning. Do not put the vehicle into park or reverse until the wheels stop! Always have the brake firmly applied before shifting into park! To prevent flat scuffing the tires, avoid applying the brakes so hard that the tires skid on the rollers!

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OUT OF THE ROLLERS. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM ROLLER ASSEMBLY.

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the rollers, the DYNOmite computer and DYNO-MAX software monitors the roller and engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with a water brake or electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the rollers apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the vehicle drag and weight information you input. In this mode you will notice an exponentially increasing load being applied to the vehicle, as it accelerates. Conversely, a coasting effect will be felt during deceleration. This is a very convenient mode for doing engine management system mapping or diagnostic testing.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the roller's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your "" setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*' can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

ATV (mid-size)650 lb. = .090
ATV (full-size) 900 lb. = .150
Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
Bike(touring) 800 lb. = .070
Bike(cruiser) 700 lb. = .070
Bike(race) 550 lb. = .075
Kart (non-shifter)325 lb. = .080
Kart (shifter)350 lb. = .075
SUV(mid-size) 4500 lb. = .031
SUV(full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rollers' diameter.

7 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roller windage and bearing drag losses

Tip: *Contact Land & Sea if you do not know the correct values for your roller assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind rag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button must be depressed to activate the servo

control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The various Chassis Dyno Single and Twin Roll assemblies (single axle centerline for both rolls) allow "road" testing of medium to high powered vehicles right in your shop. Although they can be configured for simple inertia acceleration testing only, they are usually upgraded with either an over-driven DYNOmite water brake, AC motor/generator or eddy current absorber. Doing so also allows performing steady state and road simulation testing (via DYNO-MAX).

This section's instructions only detail the procedures for setting up and using the roll assembly. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-up and plumbing, dynamometer operation, etc. (for this and other applications).

Assuming the unit is to be used in a pit, become familiar with the service access points, deck plate overhang, and mounting holes before forming the pit or drilling any anchor holes. Pit models must have the deck plate secured to the dyno frame and anchored to the concrete floor whenever tests are run.

Tip: *It is easier to install the frame in a pit using studs as opposed to bolts in the floor anchors.*

1 The roll assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger - in order to substitute for the cooling affects of highway airflow velocities. (See "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment drive-line, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY ROLL ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CHORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING).

2 Double check that the selected location for the roll assembly provides adequate bumper clearance for the longest vehicle to be tested (both front and rear wheel drive orientation) as well as room for lifts, fans, other test equipment, and servicing the vehicle.

CAUTION: The dynamometer is directional. An arrow on the frame points in the forward direction the vehicle should face - while the text "DYNOmite" (that is cut into the deck plate) will be closest to the rear of the vehicle.

3 Provisions for speed sensor and any other data acquisition wiring between the roll assembly and control console area must be made. Absorber equipped units require either running plumbing of inlet, drain, and vent hoses (for water brakes) or wiring of electric power lines (for AC or eddy current absorbers and/or starer motor). Also, Single and Twin Roll systems require an air line run from the roll assembly's air brake "T" to the wall mounted red palm button (supplied from a clean 90 PSI shop air source).

4a If the roll assembly was ordered for above-ground installation, move it into place in your test area (using appropriate handling equipment). Above ground installations will require a suitably sturdy lift to raise the car to the running height of the deck plate.

4b If the roll assembly was ordered for in-ground installation (into a custom cast concrete pit), move it into the pit with an adequately sized fork lift and four slings at the ends of the corners of the roll's frame rails.

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

5 Level the frame rails (with steel plates or suitable anti-vibration support pads) with the test area's floor. The anti-vibration support pads will carry the dyno and vehicle weight during testing. Use heavy duty fasteners (appropriate for the test area's floor material) to securely anchor the frame.

Tip: *Verify that all required plumbing supply lines, sump drains, wiring, vents, vehicle restraints, lift ramps, etc. will properly hook-up before permanently anchoring the roll assembly.*

6 Mark out the mounting hole location for the roll frame (and any pit cover) onto the floor of the test area. Use heavy duty fasteners (appropriate for the test area's floor material) to securely anchor the frame (and, later in these instructions, any pit cover) to the test area's floor.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for each roll assembly.*

WARNING: BEFORE OPERATION, ANY REQUIRED PIT COVER(S) MUST ALSO BE BOLTED TO THE TOP OF THE ROLL ASSEMBLY'S FRAME RAILS.

7 If the test area is not already equipped with suitable vehicle restraint strap anchors, install them now. While many forms of restraining systems can be fabricated, most shop owners prefer heavy-duty flush (or recessed) mount "D" ring equipped plates.

For concrete floors, secure each plate with three or four concrete anchors. Several rings should be strategically placed in the test area so that the heavy-duty nylon restraint straps can be easily looped around the various tested vehicle's axle or frame members. Straps should be installed at a shallow angle (with the ground) to reduce the load on the anchoring hardware.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

WARNING: FOR EITHER ABOVE OR IN-GROUND INSTALLATIONS, FRAME TO FLOOR ANCHORS AND VEHICLE TIE DOWN STRAPS ARE REQUIRED TO SECURE BOTH THE ROLL ASSEMBLY AND VEHICLE UNDER POWER! FRONT WHEEL DRIVE VEHICLES MUST BE SECURED WITH DIAGONALLY ORIENTED STRAPS TO PREVENT SIDEWARDS WANDER!

8 For absorber absorber or starter equipped roll assemblies, check drive belt (or chain) tension - adjusting as necessary using their slotted tensioners. Verify adjustments, using the chart below, by applying the correct deflection pressure (at the mid-point of the longest span) and measuring the total deflection (from a straight tangent line). (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber itself.)

NOTE: The correct absorber drive deflection (+/- 1/16" with deflection pressure applied at mind-point of longest span) should be:

3/16" for belts (applying 95 pounds of pressure)
5/16" for chains (applying 10 pounds of pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts (or chains) after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

9a For water brake absorbers equipped with a DYNOmite Electronic Load Servo option, the load valve can be remote mounted or attached to the frame via the provided holes.For Pro Console (or in-ground installations), remote mounting of the load valve is recommended. Use the included stainless braid hose to plumb the load valve's outlet to the absorber's inlet fitting.

Tip: *Manual load valves need to be run from inside the vehicle. Longer hoses can be ordered for remote mounting.*

CAUTION: Install Load Servo with its motor and manual knob oriented up - to prevent water from ever dripping into the motor.

9b For electric absorber or starter motor equipped systems, have a qualified electrician size the circuit breaker, wring, motor starter/contactor, etc. (based on voltage/current nameplates). Complete the hook-up according to local codes. (See appropriate "Options section" for more information about installation.)

Tip: *Have the electrician mount any pushbutton panel (for your starter motor contactor) and/or the DYNOmite Controller/Power Supply within easy access of the dynamometer operator area.*

CAUTION: Properly fuse electrical supply wiring to protect the equipment. Since starter motors must be wired using their maximum starting torque motor lead configuration, size circuit breakers, contactor heaters, and wiring to allow for the significant increase in initial amperage draw!

10a Above ground installations will require a suitably sturdy lift to raise the car to the running height of the roll assembly. Depending on the brand you install, it may have to be modified at the ends of the lift's ramps slightly to clear the roll frame and to secure them together (when they are level with the frame's and deck plate) for testing.

Tip: *Land & Sea offers special lifts that are designed for our DYNOmite Single and Twin Roll systems.*

10b For in-ground units, bolt any required pit cover(s) to the top of the roll assembly's frame rails. Using the cover as a template mark out the its floor anchoring pattern. Temporarily remove the pit cover to drill the floor. Using hardware compatible with your test area's floor material, secure the cover to the floor and again to the frame.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for each roll assembly.*

11 Carefully drive a moderately powered vehicle (for initial testing) onto the rolls, while watching out for clearance problems with any low hanging spoilers, etc. Use the air brakes to hold the rolls from turning when driving onto or off of the rolls.

Tip: *To drive the vehicle on or off the rolls, temporarily depress the air brake button. (Figure). Be sure to release the brakes before testing.*

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered stock car tires should be replaced during testing), and inflated to the manufactures maximum recommended pressure.

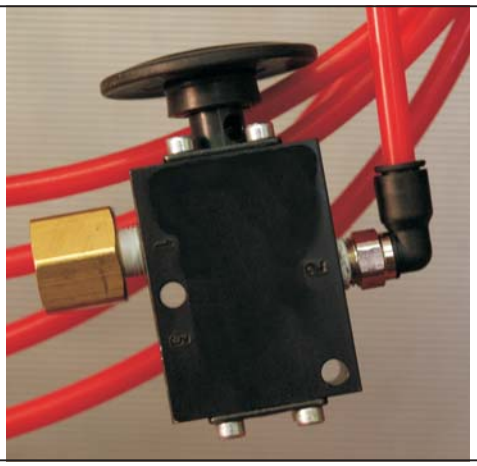

Figure 10

12 Place appropriate size wheel chocks around the tires remaining on the ground (or lift) while you finish hooking up the restraining straps. Wheel chocks should never be relied upon (alone) for actual testing, as the vehicle will shift off of the rolls.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

CAUTION: An observer should watch the actions of the tires on the rolls during testing. If it is seen that applied power levels are causing the tires to leave the rolls, signal the driver to stop the test. Verify that the air-brakes have been released. The axle or frame of the vehicle must always be secured to the roll assembly's and test bay's anchors using appropriate restraining straps or chains.

WARNING: INSPECT THE CONDITION OF THE STRAPS ON A FREQUENT BASIS.

13 If you have not already done so, see other related sections for setup of the DYNOmite Data Acquisition Computer, plumbing the system, and configuring DYNO-MAX before continuing to operate the dynamometer.

14 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheels up to a low speed (i.e. 10 MPH) cruise. During this time, verify that the vehicle is tracking properly (repositioning as necessary) and also verify that the DYNOmite Data Acquisition System is receiving the roll's speed signal.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rolls.*

CAUTION: Even though the vehicle is not moving forward, its wheels may still be turning. Do not put the vehicle into park or reverse until the wheels stop! Always have the brake firmly applied before shifting into park! To prevent flat scuffing the tires, avoid applying the brakes so hard that the tires skid on the rolls!

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OFF OF THE ROLLS. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM ROLL ASSEMBLY.

CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the drive-line, exhaust, and tires. Even with adequate ventilation, tires subjected to extended high power testing on the roll assembly should not be used on the road again.

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the rolls, the DYNOmite computer and DYNO-MAX software monitors the roll and engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with a water brake or electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the rolls apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input vehicle drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the vehicle, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing in.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the roll's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
SUV(mid-size) 4500 lb. = .031
SUV(full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rolls' diameter.

7 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your roll assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the Coast Down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The All Wheel Drive 12" Chassis Dyno Dual-Roller assembly (parallel tandem rolls) allows "road" testing of medium powered FWD, RWD, and AWD vehicles - right in your shop. Although the system may be run in a simple inertia acceleration testing mode, typically it is used in conjunction with its over-driven DYNOmite eddy current absorber engaged. Doing so also allows performing steady state testing and road load simulation (via DYNO-MAX).

This section's instructions only detail the procedures for setting up and using the roller assembly. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-up and wiring, dynamometer operation, etc. (for this and other applications).

This unit may be installed into a suitable floor pit. However, become familiar with its service access points and all mounting hole locations before forming the pit or installing any floor anchors.

1 The roller assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or higher power testing is to be conducted, the ventilation system needs to be much larger - in order to substitute for the cooling affects of highway airflow velocities. (See "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment drive-line, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY SMALL DIAMETER ROLLER ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING).

2 Double check that the selected location for the roller assemblies provides adequate bumper clearance for the longest vehicle to be tested. RWD drive vehicles must power the fixed (rear) roller set. Be sure to allow room for accessories such as floor lifts, fans, and other test equipment - as well as for technicians to service the vehicle.

Tip: *Orient the roller assembly so that the eddy current absorber will be on the left side of the vehicles during testing.*

CAUTION: The dynamometer is directional (for cooling and correct torque indication). If a rear-wheel drive vehicle is tested on the AWD unit, its driving wheels must set on the fixed (rear) roll set. Conversely, a front-wheel drive vehicle's driving wheels should set on the movable (forward) roll set.

3 Provisions for running the absorber(s) power leads, speed sensor cabling, and other data acquisition wiring, between the roll assembly and control console area, must be made. For pit installations, running these hook-ups via floor level raceways is suggested, cast-in PVC conduits are also suitable.

Tip: *Isolating the power leads from the data wiring is suggested to minimize potential electromagnetic interference.*

4 If you have equipped the roller assemblies with the optional Tire Airlift Unloading Kit, the (included) supply hoses must be plumbed between each roll assembly's air cylinder "T" fitting and the kit's (wall or panel mount) palm button. Like the wiring, air lines may be run in floor level raceways, conduits, or piping that is cast into the pit and shop flooring.

WARNING: TO AVOID ACCIDENTALLY ACTIVATING THE UNLOADER AIRLIFT DURING TESTING, MOUNT ITS PALM BUTTON AWAY FROM THE CONTROL CONSOLE (AND ADEQUATELY LABEL IT).

CAUTION: The palm button should be supplied from a clean shop air source, regulated to approximately 90 PSI.

5 Move the fixed (rear) roller assembly into place in your test area (using appropriate handling equipment). If the system was ordered for in-ground installation (into a custom cast concrete pit), verify that the dimensions of your custom cast concrete pit match the requirements on the included pit and anchor pattern drawings.

CAUTION: Anchoring hardware must be installed by a qualified contractor - into properly prepared and fully cured concrete (as specified on the included drawings). Maintain frame anchor hole relationships within 1/8" of square during layout. Failure to accurately locate and install the anchoring hardware will make it impossible to correctly install and align the assemblies!

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

Tip: *It is permissible to slightly enlarge some of the frame mounting holes to attain correct alignment. Measure twice - drill once!*

6 Using the fixed (rear) roller assembly's leg plate holes as a template, mark and then drill the floor for eight suitable concrete floor fasteners (such as Hilti HDI 3/4"-10 thread drop in anchors). Refer to your included pit and anchor pattern drawings for more information.

Tip: *Verify that all required wiring, air lines, sump drains, wiring, vents, vehicle restraints, etc. will properly hook-up before permanently anchoring either roller assembly.*

7 The adjustable wheelbase (forward) roller assembly rides on wheels - a smooth and level floor, plus accurate layout of all assemblies, is critical to avoid binding. If the surface under the wheels is uneven, we suggest plating it with ½" thick steel "track rails" (80" x 6"). Use suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors) to secure any plates, and carefully locate, align, and level shim them - for trouble-free travel.

Tip: *Keep in mind that, when the movable roller assembly is set into place, the top of its frame rails must sit 5/16" below the top of the fixed roller's frame rails. This insures that the telescoping deck ramps will all run level. Shim stock may be placed under the frame legs (and any track rail plates you fabricate) to attain the required installed height (and to correct for any unevenness of your floor). Allow for the added height of any required shims when selecting anchoring hardware.*

CAUTION: Any track rail plate shimming must supply adequate support - so that the plates do not sag during wheelbase adjustment.

8 Accurately square the fixed (rear) roller frame . If necessary, insert shims under the frame leg plates so that the top of the fixed (rear) roller's frame rails will be at the correct height offset to the telescoping deck ramps and movable (forward) roll assembly (see the included pit and anchor pattern drawing).Secure the frame with your selected anchoring hardware.

Tip: *If you mis-drilled, it is permissible to slightly enlarge a couple of the frame mounting holes - to attain correct alignment.*

9 Set the movable (forward) roll assembly unit into place. Verify that the movable assembly glides freely back and forth on the smooth and level floor or track surface.

CAUTION: Add or remove shims as necessary to attain smooth rolling and to set the required height offset between the fixed and movable roller assemblies.

Tip: *Both roller assemblies should be oriented so that their eddy current absorbers are on the left side of the vehicles during testing.*

10 Move the telescoping ramp assembly into place between the two roller frames.

Tip: *Note: The ramps with the diamond plate surface attach to fixed (rear) roller assembly, while the smooth surface telescoping ramps attach to the movable (forward) roller assembly.*

11 Using the eight included ½"-20 x 1-1/2" button head bolts and ½"-20 Nyloc nuts, temporarily attach the telescoping ramp assembly to both the fixed and movable roller assemblies.

12 Mark the floor for the drilling location of the four holes used to secure the telescoping ramp assembly's leg plates. Undo the eight bolts and then temporarily slide the telescoping ramp assembly out of the way - for drilling.

13 Drill the floor for the telescoping ramp assembly's leg plates. Use four suitable concrete fasteners (such as Hilti HDI 3/4"-10 thread drop in anchors) to secure the legs (shimming for height as required). Refer to the included pit and anchor pattern drawings for more information.

14 Again, using the eight ½"-20 x 1-1/2" button head bolts and ½"-20 Nyloc nuts, permanently secure the telescoping ramp assembly to both roller assemblies. Torque all bolts to 60 foot-pounds.

15 Have a qualified electrician wire the 115-volt ac wheelbase actuator motor and its directional SPDT power switch. Verify that the motor runs and adjusts the wheelbase in both directions, then mark the switch plate accordingly.

Tip: *A 230/115-volt transformer is available for countries where 115-volt ac power is not available.*

16 Lubricate the Acme lead screw, Acme lead screw nut, and underside friction points of the telescoping assembly with wheel bearing grease. Test that the wheelbase actuator motor smoothly runs the frame through its approximate 41" of travel (from 95" to 136" center-to-center roller frame spacing).

CAUTION: Watch the movable frame's wheels as they run over your floor or track rail plates. The wheels must not run beyond the ends of the plates. If binding occurs, recheck your drilling and installation alignment.

Tip: *The system can actually accommodate wheelbases from 90" to 141" if the vehicle's tire center lines are run slightly fore and aft of the roller frame's exact centerline.*

17 The test area requires suitable vehicle restraint strap anchors. While many forms of restraining systems can be fabricated, most shop owners prefer using several heavy-duty nylon restraint straps clipped to multiple heavy-duty “D” ring equipped anchor plates. For typical shop floors, each plate must be secured with two (or more) suitable concrete floor anchors (such as Hilti HDI 1/2"-13 thread drop in anchors).

WARNING: FRAME TO FLOOR ANCHORS AND VEHICLE TIE DOWN STRAPS ARE REQUIRED TO SECURE THE VEHICLE UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES REQUIRE DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS! PROVIDE RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be installed so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware. Extra plates and straps should be purchased and installed for testing higher powered vehicles.

Tip: *Trial fit several of your intended test vehicles when laying out the anchor pattern. Multiple rings will be required at both ends of the vehicles - strategically placed so that the heavy-duty nylon restraint straps can be easily looped around available axle, suspension, and frame members.*

18 Mount the absorbers's Load Control and Power supply near the control console. (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber, wiring, etc.).

Mounting a Vehicle

1 Prepare to drive a a suitable AWD vehicle onto the rollers. For above ground drive-on installations, hook the included ramps over appropriately spaced locations on the back rail of the fixed (rear) roller assembly.

Tip: *For your initial training and test sessions, use a moderately powered vehicle with adequate cooling, quiet exhaust, smooth running characteristics, etc.*

CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the drive-line, exhaust, and tires. Even with adequate ventilation, tires subjected to extended high power testing on the roll assembly should not be used on the road again.

2 Carefully drive onto the the rolls, while watching out for clearance problems with any low hanging spoilers, etc. Temporarily inert a roll lock pin (through the rollers' frame rails) into each roller set pulley (see figure 11) or, if you have purchased the optional Tire Airlift Unloading Kit, activate its palm button - to keep the rolls from turning whenever driving onto or off of the rolls.

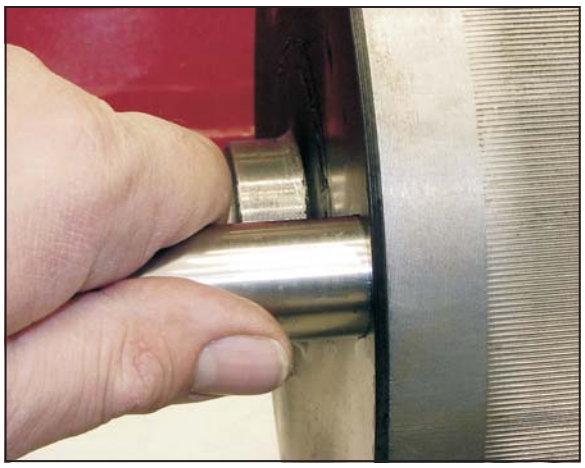

Figure 11

Tip: *Be sure to remove the pins (or lower the tire lift) before testing.*

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered stock car tires should be replaced during testing), and inflated to the manufactures maximum recommended pressure.

3 Secure the vehicle for testing using appropriate strapping.

WARNING: ATTACH VEHICLE TIE DOWN STRAPS TO SECURE IT UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES MUST BE SECURED WITH DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS, AS TORQUE VARIES! INSTALL RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be attached so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware.

4 If you have not already done so, see other related sections for setup of the DYNOmite Data Acquisition Computer, wiring the system, maintenance, and configuring DYNO-MAX before continuing on to operate the dynamometer.

5 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheels up to a low speed (i.e. 10 MPH) cruise.

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OFF OF THE ROLLS. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM ROLLER ASSEMBLIES.

CAUTION: Even though the vehicle is not moving forward, its wheels may still be turning. Do not put the vehicle into park or reverse until the wheels stop! Always have the brake firmly applied before shifting into park! To prevent flat scuffing the tires, avoid applying the brakes so hard that the tires skid on the rollers!

6 During this low power and speed rolling, verify that the vehicle is tracking properly (repositioning as necessary) and also verify that the DYNOmite Data Acquisition System is receiving both rollers' speed signals.

WARNING: INSPECT THE TENSION AND CONDITION OF YOUR STRAPS ON A FREQUENT BASIS - REPLACING AS REQUIRED!

CAUTION: An observer should watch the actions of the tires on the rollers during testing. If it is seen that applied power levels are causing the tires to leave the rolls, signal the driver to stop the test. Verify that any lock pins or air-brakes have been released. The axle or frame of the vehicle must always be secured to the roller assemblies and test bay's anchors using appropriate restraining straps.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rolls.*

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the rolls, the DYNOmite computer and DYNO-MAX software monitors both the front and rear roller speed, engine RPM, run time, rate of acceleration and, absorber torque. It uses this information to calculate and display the applied power.

The system's electric absorbers and load controls (under manual or computer regulation) can adjust the resistance that the rolls apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

It is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the controls to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input vehicle drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the vehicle, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system (remember both the front and rear rollers have RPM pick-ups) and that the Drive Ratio, rollers' inertia and parasitic drag values, etc. are known (or have been entered).

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0-DYNOmite Board*").

3 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

4 Still under the Run Information *Dyno* tab, you can verify (or modify) the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your roller assemblies.*

5 Under the Run Information *Engine* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

6 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#2- User Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque (rear) + Inertial (roller) Torque (front)* in determining displayed power.

7 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

ATV (mid-size)650 lb. = .090
ATV (full-size) 900 lb. = .150
Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
Bike(touring) 800 lb. = .070
Bike(cruiser) 700 lb. = .070
Bike(race) 550 lb. = .075
Kart (non-shifter)325 lb. = .080
Kart (shifter)350 lb. = .075
SUV(mid-size) 4500 lb. = .031
SUV(full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037

8 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rollers' diameter.

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Eddy current absorbers, for example, can't provide loading near zero RPM. An AC motor/generator is able to simulate much more "drive-away" inertia and even add in power to simulate "down-hill" coasting.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The All Wheel Drive 44" Chassis Dyno Twin Roll assembly allows "road" testing of medium to high powered FWD, RWD, and AWD vehicles - right in your shop. Although the system may be run in a simple inertia acceleration testing mode, typically it is used in conjunction with it over-driven DYNOmite eddy current (or AC motor/generator) absorber engaged. Doing so also allows performing steady state testing and road load simulation (via DYNO-MAX).

This section's instructions only detail the procedures for setting up and using the roll assembly. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-up and plumbing, dynamometer operation, etc. (for this and other applications).

This unit must be installed into a suitable floor pit. Become familiar with its service access points, deck plate overhangs, and all mounting hole locations before forming the pit or installing any floor anchors.

CAUTION: All deck plates must be secured to the dyno frame, and all fixed plates anchored to the concrete floor - prior to testing!

1 The roll assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger - in order to substitute for the cooling affects of highway airflow velocities. (See "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment drive-line, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY ROLL ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CHORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING).

2 Double check that the selected location for the roll assembly provides adequate bumper clearance for the longest vehicle to be tested. Non-AWD drive vehicles must power the primary (fixed) roll set. Be sure to allow room for accessories such as floor lifts, fans, and other test equipment - as well as for technicians to service the vehicle.

CAUTION: The dynamometer is directional. An arrow (on the fixed deck plate) indicates the forward direction the vehicle should face. If a two-wheel drive vehicle is tested on the AWD unit, its driving wheels must set on the primary (fixed) rolls. Otherwise, damage to the link-belt system will occur!

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3 Provisions for running the absorber(s) power leads, speed sensor cabling, and other data acquisition wiring, between the roll assembly and control console area, must be made. Running these hook-ups via floor level raceways is suggested, cast-in PVC conduits are also suitable.

Tip: *Isolating the power leads from the data wiring is suggested to minimize potential electromagnetic interference.*

4 An air line must be plumbed between each roll assembly's air brake "T" fitting and the supplied (wall or panel mount) palm button. Like the wiring, air lines may be run in floor level raceways, conduits, or piping that is cast into the pit and shop flooring.

CAUTION: Palm buttons should be mounted in an easily accessible area, uniquely labeled, and supplied from a clean shop air source, regulated to approximately 90 PSI.

5 If this AWD system is equipped with the optional link-belt clutch, for engaging and disengaging the secondary (movable) roll assembly, a second air line must be run from the clutch to its own palm button.

CAUTION: For long life, the air supply for the link-belt clutch assembly requires a standard shop air-line oil lubricator!

6 Verify that the dimensions of your custom cast concrete pit match the requirements on the included pit and anchor pattern drawings. The adjustable wheelbase secondary roll assembly rides on track rails (supplied). Layout all holes in the pit's floor - alignment is critical to avoid binding.

CAUTION: Anchoring hardware and epoxy must be installed by a qualified contractor - into properly prepared and fully cured concrete (as specified on the included drawings). Maintain frame anchor hole relationships within 1/16" of square - by also measuring diagonally during layout. Failure to accurately locate and install the anchoring hardware will make it impossible to correctly install and align the assemblies!

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

Tip: *If is permissible to slightly enlarge some of the frame or track rail mounting holes to attain correct alignment. Measure twice - drill once!*

7 Drill the 1" diameter holes x 6" deep holes (per your included Pit Drill Pattern drawing) for the four included 7/8"-9 x 15" studs - for the primary (fixed) roll assembly. Following the instructions on the included epoxy, prepare the drilled holes and install the four studs. When epoxied in place, the four studs must protrude 9" from the (properly dimensioned) pit floor.

8 Using the two track rails for the secondary (movable) roll assembly as templates, carefully locate, align, and mark the 32 anchoring holes into the pit's floor (per your included Pit Drill Pattern

drawing). Drill and install suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors) for securing the two track rails.

Tip: *Keep in mind that, when the secondary roll assembly is set into place, the top of its frame rails must sit 3/8" above the top of the pit. Be sure to consider the added height of any required shims when selecting anchoring hardware.*

9 Install, align, and level both track rails per the pit drawing. When the secondary (movable) roll assembly is later set into place, the top of its frame rails must sit 3/8" above the top of the pit. This insures that its moving deck plates can rest flush on the pair of 2" x 94" floor slide plates. Shim stock may be placed under the rails to attain the required installed height (and to correct for any unevenness of your pit's cast concrete floor). Secure the rails using flat washers, lock washers, and 3/8"-16 fasteners - suitable in length for your anchors.

CAUTION: Any track rail shimming must supply adequate support - so that the rails do not move or sag (during either wheelbase adjustment travel or dynamometer operation).

Tip: *If you mis-drilled, it is permissible to skip or slightly enlarge a couple of the track rail mounting holes - to attain correct alignment.*

10 Run a 7/8"-9 hex nut and large flat washer over each of the four primary frame's mounting studs. These nuts will later be used to set the height of the primary roll assembly.

11 Using an adequately sized fork lift and slings (at the four outside corners of the roll's frame rails), set the fixed mount primary roll assembly unit into the pit (over the four previously installed mounting studs). Adjust the four leveling hex nuts so that the top of the frame rails are exactly level with the top of the pit (shop's floor level).

Tip: *Verify that all required plumbing supply lines, sump drains, wiring, vents, vehicle restraints, etc. will properly hook-up before permanently anchoring the roll assembly.*

12 Accurately square the frame per the pit drawing. Secure each stud with another flat washer, lock washer, and 7/8"-9 hex head nut.

Tip: *If you mis-drilled, it is permissible to slightly enlarge a couple of the frame mounting holes - to attain correct alignment.*

13 Sling the movable secondary roll assembly unit into the pit, setting its four wheels onto the two track rails (previously anchored to the pit floor). Verify that the movable assembly glides freely back and forth on the tracks.

CAUTION: Take care not to roll the assembly off of its tracks prior to attaching the articulating arms and lead screw between the units.

14 Prepare to attach the two shaft mounts of the link belt's articulating arm assembly to the secondary roll frame - by lifting the arm mounts up to the four holes in that frame's top rail member. Slip the loose synchronizing belt over the toothed pulley on the secondary roll.

15 Using the four ½"-13 x 8-½" socket-head bolts, ½" i.d. (with small o.d.) flat washers, and Nyloc nuts, loosely secure the two mounting blocks up under the top frame rails. Carefully adjust the shaft so it is parallel with the roll shafts (using a tape measure) while adjusting the belt's tension (see chart below). Torque all bolts to 45 foot-pounds. Verify adjustment by applying the correct deflection pressure (at the span's mid-point) and measuring the total deflection (using a tangent straight edge).

NOTE: The correct deflection (+/- 1/16" with deflection pressure applied at mid-point of each belt's span) should be:

1" for articulating arm belts (@ 100 lbs. pressure)
3/4" for roll to idler belts (@ 100 lbs. pressure)
1/4" for absorber belts (@ 100 lbs. pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

16 Loosen the set screws on the two jaw couplers (shipped on the shafts of each secondary roll). Insert the two urethane jaw coupler inserts and the aluminum jaw coupler extension into place between the two shafts. Slide the two jaw couplers evenly inward to securely capture the inserts and extension. Torque the set screws on both jaw couplers.

17 Slip and hold the 1-½"-5 Acme thread nut up inside the secondary roll frame's lead screw mount. Next, thread the 96" long Acme lead screw through the Acme nut (roll pin end first) towards the fixed frame. Run the screw out until it protrudes 46" - measured from the face of the movable frame to the extreme end face (roll pin end) of the shaft.

Tip: *If this distance is not maintained - or if the electric motor is activated prior to making the coupling it will be necessary to re-adjust the motor's internal stop switches to synchronize them for the frame's travel. Contact Land & Sea for guidance.*

18 Slip a 1" i.d. flat thrust washer over the roll pin end of the Acme screw. Slowly and gently glide the secondary roll assembly towards primary roll assembly until the (roll pin) end of the Acme lead screw enters the bronze bushing in the fixed frame assembly.

Tip: *Apply a liberal amount of wheel bearing grease onto the entire lead screw. Also apply grease to the bronze bushings.*

19 Continue gliding (not threading) the Acme lead screw through the second bronze bushing. Slip a second 1" i.d. flat thrust washer and the 1"-14 castellated nut over the roll pin (as it exits the second bushings) - however, do not fully thread the nut onto the screw yet.

20 Slip the double-ended slotted drive coupling collar over the roll pin of the Acme Lead screw. Slip the other slotted end over the mating drive pin in the electric actuator motor's shaft. Finish threading the castellated nut onto the lead screw until only about 0.015" of end play exists between the thrust washer and bronze bushing faces. Secure the nut using the included cotter pin.

Tip: *You can glide the secondary roll assembly back and forth slightly to attain clearance to engage the drive coupling collar, just be certain to verify that the center-to-center spacing of the roll assemblies is 92" (+- ¼") - before activating the electric motor for the first time!*

21 Have a qualified electrician wire the 115-volt ac wheelbase actuator motor and its directional SPDT power switch. Verify that the motor runs in both directions and mark the switch plate accordingly.

22 Set the red pit cover deck plate for the primary roll assembly into place. Bolt it to the frame rail with the included 3/8"-24 x 1" button head screws.

23 Using the pit cover as a template, layout the perimeter bolt pattern onto your shop's floor. Remove the plate to drill and install suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors). Using the included 3/8"-16 x 1" button head screws, secure the plate to the test area's floor.

WARNING: BEFORE ACTUAL OPERATION, ALL PIT COVER ANCHORS AND SCREWS MUST ALWAYS BE IN PLACE AND SECURE!

24 Set the black 34" x 120" (flanged) deck plate extension (the plate with the 90-degree bent 5" edge leg) for the primary roll assembly into place on the floor. Bolt it to the red primary pit cover's T-rail using the included 3/8"-16 x 1" flat socket head screws.

25 Attach the support leg (with adjustable foot) to the two holes in the 90-degree bent 5" flange (just installed) of the black deck plate extension. Use the included 3/8"-16 x 2" hex head bolts and Nyloc nuts. Adjust the foot to support the plate level with the shop floor.

26a If a counterbalance weight is included, attach its pulley and cable to the mounting hole in the 90-degree bent 6" flanged edge of the black deck plate extension. Adjust the cable length so that the weight will not hit the floor or pulley during travel. (Figure 12.)

Figure 12

26b Test that the wheelbase actuator motor smoothly runs the frame through its approximate 28" of travel (from 92" to 120" center-to-center roll spacing).

CAUTION: Watch the movable frame's wheels as they run over their track rails. The wheels should come close to the ends of the tracks at either travel extreme. During travel, verify that less than 1/8" of wheel side play displacement occurs (on the two floating wheel's axles). This confirms that the tracks are parallel to the articulating arms.

Tip: *The system can actually accommodate wheelbases from 86" to 126" if the vehicle's tire center lines are run slightly fore and aft of the roll's exact centerline.*

27 Set the black 2" x 94" floor slide strips alongside the top edges of the pit (where the movable deck plate will slide). Using the slide strips as templates, layout their bolt pattern onto your shop's floor. Remove the strips to drill and install suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors). Using the included 3/8"-16 x 1" flat socket head screws, secure the strips to the test area's floor.

28 Set the black 34" x 120" (flat) floor slide plate (flat) alongside the aft (secondary roll) end of the the pit. Using the slide plate as a template, layout its bolt pattern onto your shop's floor. Remove the plate to drill and install suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors). Using the included 3/8"-16 x 1" flat socket head screws, secure the plate to the test area's floor.

29 Set the red pit cover deck plate for the secondary roll assembly into place. Bolt it to the frame rail with the included 3/8"-24 x 1" button head screws.

30 Attach the 34" x 118-¼" black deck plate extension to the secondary roll assembly so it spans the remaining gap between the the two roll assemblies. Bolt it to the red secondary pit cover's T-rail using the included 3/8"-16 x 1" button-head screws.

Tip: *Use the actuator motor to help adjust the gap and align the screw holes.*

31 Set the remaining (36" x 118-¼") black deck plate extension for the secondary roll assembly into place so it spans the gap between the the secondary roll assembly and the far end of the pit. Bolt it to the red secondary pit cover's T-rail using the included 3/8"-16 x 1" button-head screws.

32 The test area requires suitable vehicle restraint strap anchors. While many forms of restraining systems can be fabricated, most shop owners prefer using several heavy-duty nylon restraint straps clipped to multiple heavy-duty "D" ring equipped anchor plates. For typical shop floors,

each plate must be secured with two (or more) suitable concrete floor anchors (such as Hilti HDI 1/2"-13 thread drop in anchors).

WARNING: FRAME TO FLOOR ANCHORS AND VEHICLE TIE DOWN STRAPS ARE REQUIRED TO SECURE THE VEHICLE UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES REQUIRE DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS! PROVIDE RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be installed so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware. Extra plates and straps should be purchased and installed for testing higher powered vehicles.

Tip: *Trial fit several of your intended test vehicles when laying out the anchor pattern. Several rings will be required at both ends of the vehicles - strategically placed so that the heavy-duty nylon restraint straps can be easily looped around available axle, suspension, and frame members.*

33 Mount the absorbers's Load Control and Power supply near the control console. (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber, wiring, etc.).

Mounting a Vehicle

1 Prepare to drive a a suitable vehicle onto the rollers. If you are not using an AWD vehicle, disengage the link belt clutch by pulling out on its palm button to release the air pressure. Be sure to set the DYNO-MAX inertia value to the correct settings for whether both or one set of rolls are being used!

Tip: *For your initial training and test sessions, use a moderately powered vehicle with adequate cooling, quiet exhaust, smooth running characteristics, etc.*

CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the drive-line, exhaust, and tires. Even with adequate ventilation, tires subjected to extended high power testing on the roll assembly should not be used on the road again.

2 Carefully drive onto the the rolls, while watching out for clearance problems with any low hanging spoilers, etc. Use the air brakes to lock the rolls from turning whenever driving onto or off of the rolls.

Tip: *To drive the vehicle on or off the rolls, temporarily depress the air brake's palm button. Be sure to release the brakes before testing.*

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered stock car tires should be replaced during testing), and inflated to the manufactures maximum recommended pressure.

3 Secure the vehicle for testing using appropriate strapping. When testing 2-wd vehicles, place suitable size wheel chocks around the non-driving tires, while you finish hooking up the restraining straps. Wheel chocks should never be relied upon (alone) for actual testing, as the vehicle will shift off of the rolls.

WARNING: ATTACH VEHICLE TIE DOWN STRAPS TO SECURE IT UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES MUST BE SECURED WITH DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS, AS TORQUE VARIES! INSTALL RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be attached so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware.

4 If you have not already done so, see other related sections for setup of the DYNOmite Data Acquisition Computer, wiring the system, maintenance, and configuring DYNO-MAX before continuing on to operate the dynamometer.

5 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheels up to a low speed (i.e. 10 MPH) cruise.

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OFF OF THE ROLLS. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM ROLL ASSEMBLY.

CAUTION: Even though the vehicle is not moving forward, its wheels may still be turning. Do not put the vehicle into park or reverse until the wheels stop! Always have the brake firmly applied before shifting into park! To prevent flat scuffing the tires, avoid applying the brakes so hard that the tires skid on the rolls!

6 During this low power and speed rolling, verify that the vehicle is tracking properly (repositioning as necessary) and also verify that the DYNOmite Data Acquisition System is receiving the roll's speed signal.

WARNING: INSPECT THE CONDITION OF THE STRAPS ON A FREQUENT BASIS.

CAUTION: An observer should watch the actions of the tires on the rolls during testing. If it is seen that applied power levels are causing the tires to leave the rolls, signal the driver to stop the test. Verify that the air-brakes have been released. The axle or frame of the vehicle must always be secured to the roll assembly's and test bay's anchors using appropriate restraining straps or chains.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rolls.*

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the rolls, the DYNOmite computer and DYNO-MAX software monitors the roll and engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with an electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the rolls apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input vehicle drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the vehicle, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing in.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the roll's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

Tip: *If your system is equipped with a link belt clutch, be sure to set the DYNO-MAX inertia value to the correct settings for whether both or one set of rolls are being used!*

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
SUV(mid-size) 4500 lb. = .031
SUV(full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rolls' diameter.

7 Again, under the Run Information *Vehicle* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your roll assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The Heavy-Duty 20" Tri-Axle Chassis Dyno assembly allows "road" testing of light to medium/heavy class FWD, RWD, AWD, 4WD, and 6WD trucks – right in your shop. Although the system may be run in a simple inertia acceleration testing mode, typically it is used in conjunction with it over-driven DYNOmite eddy-current (or AC motor/generator) absorber(s) engaged. Doing so also allows performing steady-state testing and road-load simulation (via DYNO-MAX).

This section's instructions only detail the procedures for setting up and using the roll assembly. Other sections of this manual cover the Data-Acquisition Computer's installation, absorber hook-up and wiring, dynamometer operation, etc. (for this and other applications).

This unit must may be installed above ground or into a suitable floor pit. Become familiar with its service access points, deck plate overhangs, and all mounting hole locations before forming the pit or installing any floor anchors.

CAUTION: All deck plates must be secured to the dyno frame, and all fixed plates anchored to the concrete floor – prior to testing!

1 The roll assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or high-power testing is to be conducted, the ventilation system needs to be much larger – in order to substitute for the cooling effects of highway airflow velocities. (See "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine compartment, driveline, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING TO THE UNDERSIDE OF THE VEHICLE DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY ROLL ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CHORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING).

2 Double check that the selected location for the roll assembly provides adequate bumper clearance for the longest vehicle to be tested. Non-AWD drive vehicles must power the primary (lift-bar equipped) roll set. Be sure to allow room for accessories such as floor lifts, fans, and other test equipment – as well as for technicians to service the vehicle.

CAUTION: The dynamometer is directional. See the pit plan for the forward direction the vehicle should face. If a two-wheel drive vehicle is tested on the multi-roll unit, its driving wheels must set on the primary (lift-bar equipped) rolls!

3 Provisions for running the absorber(s) power leads, speed sensor cabling, and other data-acquisition wiring, between the roll assembly and control console area, must be made. Running these hook-ups via floor level raceways is suggested, cast-in PVC conduits are also suitable.

Tip: *Isolating the power leads from the data wiring is suggested to minimize potential electromagnetic interference.*

4 An airline must be plumbed between each roll assembly's air brake "T" fitting and the supplied (wall or panel mount) palm button. If the dynamometer is supplied with an optional tire-lift system, be sure to plumb the lift's palm button INLET to the OUTLET line, of the dynamometer's brake system. This prevents accidental tire-lift actuation while the rolls are spinning. As with the wiring, air lines may be run in floor level raceways, conduits, or piping that is cast into the pit and shop flooring.

CAUTION: Palm buttons should be mounted in an easily accessible area, uniquely labeled, and supplied from a clean shop air source, regulated to approximately 90 PSI.

WARNING: IF THE DYNAMOMETER IS SUPPLIED WITH AN OPTIONAL TIRE-LIFT SYSTEM, BE SURE TO PLUMB THE LIFT'S PALM BUTTON INLET TO THE OUTLET LINE OF THE DYNAMOMETER'S BRAKE SYSTEM. THIS IS TO PREVENT ACCIDENTAL TIRE-LIFT ACTUATION WHILE ROLLS ARE SPINNING!

5 If this system is equipped with the optional link-belt clutch, for engaging and disengaging the secondary (multi roll) assembly, a third airline must be run from the clutch to its own palm button.

CAUTION: For long life, the air supply for the link-belt clutch assembly requires a standard shop airline water separator and oil lubricator!

6 Verify that the dimensions of your custom cast concrete pit match the requirements on the included pit and anchor pattern drawings. Layout all holes in the pit's floor accordingly.

CAUTION: Anchoring hardware and epoxy must be installed by a qualified contractor – into properly prepared and fully cured concrete (as specified on the included drawings). Maintain frame anchor hole relationships within 1/16" of square – by also measuring diagonally during layout. Failure to accurately locate and install the anchoring hardware will make it impossible to correctly install and align the assemblies!

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

Tip: *It is permissible to slightly enlarge some of the frame or track rail mounting holes to attain correct alignment. Measure twice – drill once!*

7 Drill the holes (per your included Pit Drill Pattern drawing) for the recommended Hilti HDI 3/4"-10 x 10" drop-in anchors (studs) or equivalent brand/model. Follow the manufacturer's instructions to drill, prepare the holes, and install the anchors.

Tip: *Keep in mind that, when each roll assembly is set into place, the top of its frame rails must sit flush with the top of the pit. Be sure to consider the added height of any required shims when selecting anchoring hardware.*

8 Roughly pre-shim the floor anchor locations, so that all will be at the same (correct) finished depth for your as-cast pit.

CAUTION: Any frame shimming must supply adequate support – so that the frame will not flex during dynamometer operation.

9 Using an adequately sized fork lift and slings (at the four outside corners of the frame rails), set the primary (tandem-roll rear) roll assembly into the pit (over the previously installed mounting anchors). Final shim the mounting pads so that the top of the frame rails are exactly level with the top of the pit (shop's floor level).

10 Use a 3/4"-10 hex nut, lock washer, and large flat washer over each of the frame-mount anchors (studs).

11 Snug up, but do not fully tighten the nuts yet.

Tip: *Verify that all required plumbing supply lines, sump drains, wiring, vents, vehicle restraints, etc. will properly hook-up before permanently anchoring the roll assemblies.*

12 Accurately square the frame per the pit drawing. Torque each stud of the primary roll assembly (only) to the anchor-manufacture's specifications.

Tip: *If you mis-drilled, it is permissible to slightly enlarge a couple of the frame mounting holes – to attain correct alignment.*

13 Repeat the above few steps for the secondary (multi-roll front) roll assembly.

CAUTION: Do not torque secondary-unit's anchors yet!

14 Now sling the absorber module into the pit, ensuring its arrows (in the frame) point forward – the same as "vehicle direction" on the pit plan. Temporarily support the absorber frame so that the absorber shafts are at the same elevation as the rolls' shafts.

15 Remove all the absorber pulleys (they are shipped loose). Pass the absorber belts through the primary and secondary frames. Position each belt over its absorber shaft, along with its respective pulley. (Figure 13.)

Figure 13

16 Reinstall each pulley's taper-lock bushing loosely back into place. (Figure 14.)

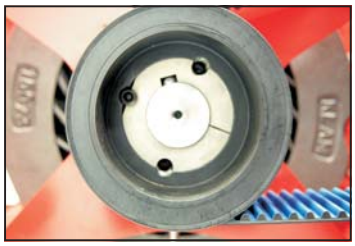

Figure 14

17 Finish lowering the absorber module into position over its anchor studs. Install the black frame-connector plates, as shown, ensuring arrows are aligned. (Figure 12.) The middle carriage-head bolt must be installed so its square "neck" is oriented as a diamond (♦) – for proper belt tensioning. Torque the connector-plates' bolts to 300 ft-lbs.

18 The absorber's pulleys and taper-lock bushings may now be aligned to the corresponding roll pulley and torqued to 800 in-lbs.

19 Fine adjustments to belt tension can be made by LOWERING (to increase) each absorber bearing block – using its adjuster screw (below each bearing). Evenly adjust each shaft's height for the correct belt tension (see chart below). Verify adjustment by applying the correct deflection pressure (at the span's mid-point) and measuring the total deflection (using a tangent straight edge).

NOTE: The correct deflection (+/- 1/16" with deflection pressure applied at mid-point of each belt's span) should be:

1/2" for absorber belts (@ 150 lbs. pressure)
3/4" for roll to roll belts (@ 100 lbs. pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

20 Re-check secondary roll-assembly's and absorber-module's alignment, before finish-torquing their anchor bolts.

21 Attach mid-span beam support-plate spacers (figure 15) and support plates (figure 16).

Figure 15

22 Install the five (black) mid-span beams, with their arrows pointing away from absorbers – this is with the exception of the second beam (from middle) which must point towards the absorbers. (Figure 17.)

23 Install Safety wheels on side of primary dyno frame. Do not over tighten – the wheels must be free to spin. (Figure 18.)

24 Set the red pit-cover deck plates for the roll and absorber assemblies into place. First bolt them to the frame rails with the included 3/8"-16 x 1¼" button head screws.

Figure 16

25 Using the pit plates as a template, layout the perimeter bolt pattern onto your shop's floor. Remove the plate to drill and install suitable concrete floor anchors (such as Hilti HDI 3/8"-16 thread drop in anchors). Using the included 3/8"-16 x 1¼" button head screws, secure the plate to the test area's floor.

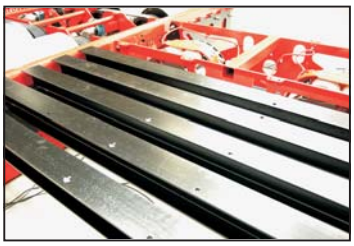

Figure 17

WARNING: BEFORE ACTUAL OPERATION, ALL PIT COVER ANCHORS AND SCREWS MUST ALWAYS BE IN PLACE AND SECURE!

26 Set the black 34" x 120" (flanged) deck plate extension (the plate with the 90-degree bent 5" edge leg) for the primary roll assembly into place on the floor. Bolt it to the red primary pit cover's T-rail using the included 3/8"-16 x 1" flat socket head screws.

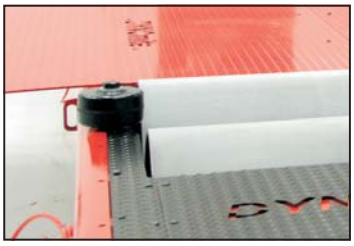

Figure 18

27 The test area requires suitable vehicle restraint strap anchors. While many forms of restraining systems can be fabricated, most shop owners prefer using several heavy-duty nylon restraint straps clipped to multiple heavy-duty "D" ring equipped anchor plates. For typical shop floors, each plate must be secured with two (or more) suitable concrete floor anchors (such as Hilti HDI 1/2"-13 thread drop-in anchors). See Pit Drawing for one example of a (minimum) suggested layout.

WARNING: FRAME TO FLOOR ANCHORS AND VEHICLE TIE DOWN STRAPS ARE REQUIRED TO SECURE THE VEHICLE UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES REQUIRE DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS! PROVIDE RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be installed so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware. Extra plates and straps should be purchased and installed for testing higher powered vehicles.

Tip: *Trial fit several of your intended test vehicles when laying out the anchor pattern. Several rings will be required at both ends of the vehicles - strategically placed so that the heavy-duty nylon restraint straps can be easily looped around available axle, suspension, and frame members.*

28 Mount the absorbers's load control and power supply near the control console. (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber, wiring, etc.).

Mounting a Vehicle

1 Prepare to drive a suitable vehicle onto the rollers. For dynamometers equipped with the optional front-to-rear link-belt clutch, the secondary rolls may be disengaged for testing non-AWD vehi-

cles. Do so by pulling out on the air-clutch's palm button – to release the air pressure. Be sure to set the DYNO-MAX inertia value to the correct settings – for whether one, or both, sets of rolls are in use!

Tip: *For your initial training and test sessions, use a moderately powered vehicle with adequate cooling, quiet exhaust, smooth running characteristics, etc.*

CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the drive-line, exhaust, and tires. Even with adequate ventilation, tires subjected to extended high power testing on the roll assembly should not be used on the road again.

2 Carefully drive onto the rolls, while watching out for clearance problems with any low hanging spoilers, etc. Use the air brakes to lock the rolls from turning, whenever driving onto, or off of, the rolls.

Tip: *To drive the vehicle on or off the rolls, temporarily depress the air brake's palm button. Be sure to release the brakes before testing.*

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered stock car tires should be replaced during testing), and inflated to the manufactures maximum recommended pressure.

3 Secure the vehicle for testing using appropriate strapping. Place suitable size wheel chocks around the tires, while you finish hooking up the restraining straps. Wheel chocks should never be relied upon (alone) for actual testing, as the vehicle will shift off of the rolls.

WARNING: ATTACH VEHICLE TIE DOWN STRAPS TO SECURE IT UNDER POWER! FRONT WHEEL DRIVE OR ALL WHEEL DRIVE VEHICLES MUST BE SECURED WITH DIAGONALLY ORIENTED STRAPS (IN A SIDE TO SIDE "X" PATTERN) TO PREVENT THE TIRES FROM TRACKING OFF THE EDGE OF THE ROLLS, AS TORQUE VARIES! INSTALL RESTRAINTS IN BOTH THE FORE AND AFT DIRECTIONS, AS LOADS REVERSE DURING VEHICLE BRAKING!

CAUTION: Straps should be attached so they will work at about a 30 degree angle up from the floor - this provides a good compromise between downward and horizontal loads on the straps and anchoring hardware.

4 If you have not already done so, see other related sections for setup of the DYNOmite Data-Acquisition Computer, wiring the system, maintenance, and configuring DYNO-MAX before continuing on to operate the dynamometer.

5 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheels up to a low speed (i.e. 10 MPH) cruise.

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OFF OF THE ROLLS. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM THE ROLL ASSEMBLIES.

CAUTION: Even though the vehicle is not moving forward, its wheels may still be turning. Do not put the vehicle into park or reverse until the wheels stop! Always have the brake firmly applied before shifting into park! To prevent flat scuffing the tires, avoid applying the brakes so hard that the tires skid on the rolls!

6 During this low power and speed rolling, verify that the vehicle is tracking properly (repositioning as necessary) and also verify that the DYNOmite Data-Acquisition System is receiving the roll's speed signal.

WARNING: INSPECT THE CONDITION OF THE STRAPS ON A FREQUENT BASIS.

CAUTION: An observer should watch the actions of the tires on the rolls during testing. If it is seen that applied power levels are causing the tires to leave the rolls, signal the driver to stop the test. Verify that the air-brakes have been released. The axle or frame of the vehicle must always be secured to the roll assembly's and test bay's anchors using appropriate restraining straps or chains.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rolls.*

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data-Acquisition Computer and DYNO-MAX software. The DYNOmite Data-Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, help system.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the rolls, the DYNOmite computer and DYNO-MAX software monitors the roll and engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with an electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the rolls apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input vehicle drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the vehicle, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing in.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the roll's inertia and parasitic drag values (for your specific dynamometer) have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's online help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- RPM-A, RPM-C*" (when you have wired an engine-RPM tachometer source) or "*#1- RPM-C, RPM-C*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

Tip: *If your system is equipped with a link-belt clutch, be sure to set the DYNO-MAX inertia value to the correct settings for whether both or one set of rolls are being used!*

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Auto (import) 3100 lb. = .031
Auto (compact / sport) 3500 lb. = .031
Auto (mid-size) 3600 lb. = .027
Auto (full-size) 4000 lb. = .030
SUV (mid-size) 4500 lb. = .031
SUV (full-size) 5200 lb. = .035
Truck (mid-size) 3500 lb. = .038
Truck (full-size) 4750 lb. = .037
Truck (heavy-duty) 10000 lb. = .035
Truck (tri-axle) 20000+ lb. = .030

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#0- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rolls' diameter.

7 Again, under the Run Information *Vehicle* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your roll assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water-brake absorbers, for example, can't provide loading near zero RPM. An AC motor/generator or eddy-current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The various Motorcycle/ATV assemblies allow "road" testing many bikes, all terrain vehicles, and some kart style vehicles right in your shop. Although they can be configured for simple inertia acceleration testing only, they are usually upgraded with either an over-driven DYNOmite water brake, eddy current absorber, or AC motor/generator. Doing so also allows performing steady state and road load simulation testing (via DYNO-MAX)

This section's instructions only detail the procedures for setting up and using the roller assembly. Other sections of this manual cover the Data Acquisition Computer's installation, absorber hook-up and plumbing, dynamometer operation, etc. (for this and other applications).

1 The roller assembly should be installed in an area with adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger - in order to substitute for the cooling affects of highway airflow velocities. (See the "GETTING READY- Cell Design" section for more information about ventilation, noise control, etc.)

CAUTION: Failure to provide adequate cooling airflow can lead to power loss and vehicle damaging heat buildup in the engine, drive-line, exhaust, and tires.

WARNING: FAILURE TO PROVIDE ADEQUATE EXHAUST SYSTEM COOLING DURING EXTENDED CHASSIS DYNO TESTING CAN LEAD TO A VEHICLE FIRE! ALSO, EVEN WITH ADEQUATE VENTILATION, TIRES SUBJECTED TO EXTENDED HIGH POWER TESTING (ON ANY SMALL DIAMETER ROLLER ASSEMBLY) SHOULD NOT BE USED ON THE ROAD AGAIN. THIS IS DUE TO THE POTENTIAL FOR HIDDEN CHORD DAMAGE (FROM LONG TERM SIDEWALL FLEXING)

2 Double check that the selected location for the roller assembly provides adequate clearance for the dyno, fans, other test equipment, and servicing the vehicle.

3 Provisions for speed sensor and any other data acquisition wiring between the roller assembly and control console area must be made. Absorber equipped units require either running plumbing of inlet, drain, and vent hoses (for water brakes) or wiring of power lines (for electric absorbers).

4a If the roller assembly was ordered for above-ground (semi-portable) installation, move it into place in your test area (using appropriate handling equipment).

Tip: *Casters make positioning the unit on a smooth floor easier.*

CAUTION: These integral casters are not designed for towing or rough terrain.

4b If the roller assembly was ordered for in-ground installation (into a custom cast concrete pit), move it into the pit with an adequately sized fork lift and four slings at the ends of the rolls.

WARNING: EXPLOSIVE GASOLINE FUMES CAN SETTLE INTO BELOW GROUND PITS! CONTACT YOUR LOCAL BUILDING INSPECTOR FOR PIT VENTILATION REQUIREMENTS AND REGULATIONS!

5 Adjust the height of the two anti-vibration support pads to level the deck with the test area's floor. Anti-vibration "shim" materials can also be placed under the casters - to prevent movement of dynamometer assembly (on slick floors with excessively vibrating vehicles).

Tip: *Verify that all required plumbing supply lines, sump drains, wiring, vents, vehicle restraints, etc. will properly hook-up before permanently anchoring the roller assembly.*

6 For permanently anchoring the frame assembly, mark out a four bolt pattern for the roller frame (and the pattern of any pit cover) onto the floor of the test area. Use heavy duty fasteners (appropriate for the test area's floor material) to securely anchor the frame (and, later in these instructions, any pit cover) to the test area's floor.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for below ground roller assemblies.*

WARNING: BEFORE OPERATION, ANY REQUIRED PIT COVER(S) MUST ALSO BE BOLTED TO THE TOP OF THE ROLLER ASSEMBLY'S FRAME RAILS.

7 Several heavy-duty adjustable length straps are included with the Motorcycle/ATV dynamometer. These must always be used to secure the vehicle (and hold bikes upright) during testing. A series of holes in the dynamometer's frame rails is provided for strapping each vehicle in an appropriate pattern.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

8 For absorber equipped roller assemblies, check drive belt (or chain) tension. Verify the need for adjustment (for systems with slotted tensioners), or belt replacement, using the chart below. Apply the correct deflection pressure (at the mid-point of the longest span) and measuring the total deflection (from a straight tangent line). (See the "ENGINE MOUNTING - Snowmobile" section 5.5 for more details about the water brake absorber itself (or the "ELECTRIC ABSORBER - Eddy Current Setup" section 4.1 for Eddy absorbers.)

NOTE: The correct deflection (+/- 1/16" with deflection pressure applied at mind-point of longest span) should be:

1/4" for belts (applying 95 pounds of pressure)
5/16" for chains (applying 10 pounds of pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts (or chains) after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

9a For water brake absorbers equipped with a DYNOmite Electronic Load Servo option, the load valve can be remote mounted or attached to the frame via the provided holes. For Pro Console (or in-ground installations), remote mounting of the load valve is recommended. Use the included stainless braid hose to plumb the load valve's outlet to the absorber's inlet fitting.

Tip: *Manual load valves need to be run from the handle bars. Longer hoses can be ordered for remote mounting.*

CAUTION: Install the Load Servo with its motor and manual knob oriented up - to prevent water from ever dripping into the motor.

9b For eddy current absorbers equipped systems, install the eddy current load control/power supply. (See the "ELECTRIC ABSORBER - Eddy Current Setup" section 4.1.)

10a For above ground drive-up installations, hook the included ramps over the appropriately spaced hooks on the frame rail. For motorcycle testing the two roll covers should first be closed, while for ATV or kart testing they must be open.

WARNING: NEVER TEST A MOTORCYCLE WITH THE TWO ROLL COVERS OPEN! THE COVERS HELP PREVENT REAR TIRE WANDERING AND THEY KEEP FEET AND OBJECTS OFF OF THE ROTATING ROLL!

10b For in-ground units, bolt any required pit cover(s) to the top of the roller assembly's frame rails. Use hardware compatible with your test area's floor material.

Tip: *Anchoring, suitable for use in a typical concrete floor, is detailed on the pit drawing for below ground roller assemblies.*

11 Push or carefully drive a moderately powered bike or ATV (for initial testing) onto the roller, while watching out for clearance problems with any low hanging pipes, fenders, etc.

CAUTION: The tires used during testing should be rated for the intended speed, be of the same circumference (staggered "oval track" kart tires must be replaced during testing), and inflated to the manufactures maximum recommended pressure.

12 For bikes, roll the front tire into the front wheel support and secure it with the ratchet strap clamp. The support is adjustable to accommodate various size tires and wheelbase lengths. Optional solid wheel clamps, electric wheelbase adjusters, special ATV front bar and wheel chocks are available to simplify mounting of various vehicles. For both bikes and ATVs you must install all the restraining straps before testing. Small chocks should not be relied upon alone for testing, as the vehicle can jump off of the roll.

Tip: *Install restraints in both the fore and aft directions, as loads reverse during vehicle braking.*

CAUTION: An observer should watch the actions of the tire(s) on the roll during testing. If it is seen that applied power levels are causing the tires to climb off the rear roller, signal the operator to stop the test. Modify strap tension, positioning, and angle, or the wheelbase adjustment as necessary - before continuing the test.

WARNING: INSPECT THE CONDITION OF THE STRAPS ON A FREQUENT BASIS.

13 If you have not already done so, see other related sections for setup of the DYNOmite Data Acquisition Computer, plumbing or wiring the absorber, and configuring DYNO-MAX before continuing to operate the dynamometer.

14 Start the engine, release any parking brake, put the transmission into gear. etc. and gradually bring the drive wheel(s) up to a low speed (i.e. 10 MPH) cruise. During this time, verify that the tires are tracking properly (repositioning as necessary) and also verify that the DYNOmite Data Acquisition System is receiving the roller's speed signal.

Tip: *It is helpful to have an observer or mirrors oriented so that the test driver can observe the rollers.*

CAUTION: Even though the vehicle is not moving forward, its wheel(s) may still be turning. Do not put the vehicle into reverse until the wheels stop! Always have the brake firmly applied before dismounting, etc. To prevent flat scuffing the tires, avoid applying the brakes so hard that the tire(s) skids on the roll!

WARNING: WITH A POWERFUL ENGINE, AN ABRUPT APPLICATION OF POWER CAN LURCH AN IMPROPERLY RESTRAINED VEHICLE OFF OF THE ROLL. DRIVER MUST STAY ALERT DURING TESTING - KEEPING VEHICLE UNDER CONTROL WITH THROTTLE AND BRAKES (AS DURING ANY ON-ROAD TEST). TO PREVENT INJURY, KEEP OBSERVERS CLEAR OF FRONT OR REAR OF VEHICLE - AND AWAY FROM ROLL ASSEMBLY.

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the vehicle accelerates the roll, the DYNOmite computer and DYNO-MAX software monitors the roll and engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with a water brake or electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the rollers apply to the vehicle's tires. By increasing or decreasing the absorber load, it is possible to simulate various road conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the vehicle drag and weight information you input. In this mode you will notice an exponentially increasing load being applied to the vehicle, as it accelerates. Conversely, a coasting effect will be felt during deceleration. This is a very convenient mode for doing engine management system mapping or diagnostic testing.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the roll's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your "" setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*' can be taken from your on-road test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

ATV (mid-size) 650 lb. = .090
ATV (full-size) 900 lb. = .150
Bike (touring) 800 lb. = .070
Bike (cruiser) 700 lb. = .070
Bike (race) 550 lb. = .075
Kart (non-shifter) 325 lb. = .080
Kart (shifter) 350 lb. = .075

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your rollers' diameter.

7 Again, under the Run Information *Vehicle* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 "step-up" overdrive - conversely, enter 0.500 for a 2:1 "step-down" transmission.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roller windage and bearing drag losses

Tip: *Contact Land & Sea if you do not know the correct values for your roller assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the vehicle (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct curb weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The Snowmobile Chassis Eddy Current Absorber Module unit allows "trail" testing sleds right in your shop. Its DYNOmite eddy current absorber and integral flywheel combination allows both inertia and steady state testing. Attachment to the sled's track is via a special cog drive assembly (which replaces the stock rear track idler wheels and shaft.)

The following instructions outline the procedures for using the absorption module. Other sections of this manual cover the Data Acquisition Computer installation, eddy current absorber hook-up, dynamometer operation, etc. for this and other applications.

1 Choose a test area with adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger in order to simulate real world airflow velocities for cooling the exhaust system, engine compartment, etc.

> ***CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the engine compartment and exhaust system. Likewise, liquid cooled sled's will require a closed or open loop cooling system since no snow will be available to cool the factory heat exchangers.***

2 The absorption module comes with locking casters and integral sled "bumper" jack to allow aligning the suspensions idler shaft with the absorber's input shaft centerline. Roll the unit into position by the sled to check for adequate clearance between the dyno and the sled's bumper, running boards, etc.

3 Replace the sled's stock rear idler shaft and wheels with an appropriate DYNOmite Drive Cog Assembly. (Non-standard cog combinations can be custom fabricated.) Make sure to use the correct combination of spacers for the sled's slider center to center dimensions. The outside idler wheel is held in place by the cupped retainer, lock washer, and appropriate size Ny-loc pellet bolt (or bolt with red Loctite). Initially, tighten the track to at least standard factory specifications.

> **Tip:** *The DYNOmite bearing blocks on the special cog drive assembly must not be loose (or binding) when the cupped retainer bolt is tightened.*

4 Slip the tapered end of the Drive Cog Assembly's shaft into the Eddy Current absorber's mating hole. Be sure that the drive key is in place. Tighten the shafts together with the long shaft bolt and torque it to 45 foot-pounds.

> ***CAUTION: Check the tightness of all bolts after the first minutes of testing and each hour thereafter. Periodically grease the Absorber Module's three grease fittings (see Maintenance Section).***

5 Use the adjustable "bumper" jack on the absorption module to extend the travel of the sled's suspension so that there is little or no weight on the absorber's shafting.

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WARNING: IF THE OEM TRACK FLAP DOES NOT EXTEND LOW ENOUGH TO PROTECT BYSTANDERS AND PROPERTY FROM THROWN TRACK DEBRIS, MOUNT A SUITABLE GUARD BEFORE CONTINUING.

Tip: *The track will tend to loosen and ratchet as the suspension compresses. If the sled has an older suspension WITHOUT any rear to front coupling, it may be necessary to mechanically lock the suspension in the extended position to prevent track racheting.*

6 Assuming the DYNOmite Data Acquisition system is already installed and functioning, start the engine and gradually increase track speed about 15 MPH.

Tip: *An observer should watch the actions of the track and suspension (from the side only) to verify the track will not contact the ground as it droops under increasing power. If applied power levels cause the track to ratchet, tighten the track slightly and retest. It may be necessary to lock the suspension in the extended position (or apply power more gradually) if the combination is too powerful to prevent ratcheting.*

WARNING: THE OPERATOR SHOULD STAY ALERT DURING TESTING AND KEEP THE VEHICLE UNDER CONTROL WITH THE THROTTLE AND BRAKES (AS A DRIVER WOULD DURING AN ON HIGHWAY ROAD TEST). TO PREVENT INJURY, MAKE SURE NO OBSERVERS ARE IN FRONT OF OR BEHIND THE SLED AND THAT THEY ALSO STAY CLEAR OF THE ABSORBER MODULE AND ROTATING TRACK ASSEMBLY.

7 As the engine is accelerated the load control (under manual or computer control) regulates the resistance that the absorber presents to the track through the rear cogs. If the DYNO-MAX software is set to simulate inertial and drag loads, then you will feel an exponentially increasing load being applied to the vehicle the faster and quicker you accelerate. Conversely, there will actually be a coasting effect felt decelerating. The sled's brakes can be used as needed to slow down and/or test the braking system.

CAUTION: Remember - even though the sled is not moving forward, its track may still be turning!

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impos-

sible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the snowmobile accelerates the dynamometer, the DYNOmite computer and DYNO-MAX software monitors the track speed, engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with a water brake or electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the dynamometer applies to the sled's track. By increasing or decreasing the absorber load, it is possible to simulate various trail conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input sled drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the track, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing in.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the dyno's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0-DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-trail test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Sled (trail) 700 lb. = .090

Sled (race) 600 lb. = .080

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your dyno's sprocket ratios.

7 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your dyno assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the snowmobile (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55 MPH* to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct trail weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The Snowmobile Track Dyno Assembly provides a "drive-on" test bed for servicing complete sled assemblies - without snow. Its over-driven integral flywheel and DYNOmite water brake absorber combination allows both inertia and steady state testing. The standard treadmill drive is compatible with most late model production sleds using 2.52" lug to lug separation. Even many studded and taller lug tracks can be used if power is applied gradually to prevent excessive track spinning.

The following instructions outline the procedures for using the track dyno. Other sections of this manual cover the Data Acquisition Computer installation, water brake hook-up, dynamometer operation, etc. for this and other applications.

1 Choose a test area with an appropriate water source (see the separate "GETTING READY - Plumbing the DYNOmite" section) and adequate ventilation (to remove exhaust fumes). If extended duration or high power testing is to be conducted, the ventilation system needs to be much larger in order to simulate real world airflow velocities for cooling the exhaust system, engine compartment, etc.

CAUTION: During extended high power testing, failure to provide adequate cooling air-flow can lead to damaging heat buildup in the engine compartment and exhaust system. Likewise, liquid cooled sleds will require a closed or open loop cooling system since no snow will be available to cool the factory heat exchangers.

2 The track dyno assembly comes with one or two drive up ramps, so select an installation area where adequate room is available to get the sleds on and off the treadmill. The test area must be clear front and rear to protect equipment and people from injury, flying track debris, etc. When the unit is installed and leveled, make sure that it has adequate ground clearance for the inertia flywheel and the absorber's drain lines.

3 Mount the DYNOmite 9" snowmobile water brake onto the tapered output shaft of the treadmill assembly. Follow the same procedures as you do for mounting the brake onto a standard snowmobile engine (see the separate "ENGINE MOUNTING - Snowmobile" section) for in-chassis engine testing. Torque the mounting bolt to 45 foot-pounds.

4 For you first trial sessions, we suggest using a moderate powered fan cooled sled. Place the ramp at the treadmill end of the dyno assembly and drive the sled up onto it as you would onto a trailer. Position the sled for maximum track engagement and secure the sled to the deck plate with one to two straps in all the four corners of the sled. (See Figure 7 for illustration). A total of eight straps should be used for high powered sleds.

Figure 19

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CAUTION: Check the tightness off all straps and bolts after the first minutes of testing and each half-hour thereafter. It is up to the operator to make sure that the tie down method is adequate for the sled being tested.

5 Make sure that the slide rail lubrication nozzles will spray through the track's "windows" as it spins. The position of the sled and/or spray nozzle orientation can be adjusted slightly if the alignment is poor.

CAUTION: If during testing the sled has any tendency to climb off the jack, secure it with a nylon ratchet strap.

WARNING: IF THE OEM TRACK FLAP DOES NOT EXTEND LOW ENOUGH TO PROTECT BYSTANDERS AND PROPERTY FROM THROWN TRACK DEBRIS, MOUNT A SUITABLE GUARD BEFORE CONTINUING.

Tip: *The track will tend to ratchet if excessive torque is applied, or if the sled's lug design is not compatible with the treadmill pattern. Often you can reduce throttle a bit until you accelerate to a sightly higher speed. Other treadmill styles are available for special testing applications.*

6 Assuming the DYNOmite Data Acquisition system is already installed and functioning, start the engine and gradually increase track speed to about 15 MPH.

Tip: *An observer should watch the actions of the track, treadmill from a safe distance to the side. Verify the track's lugs and/or studs will not contact the deck plate, etc. As power is applied.*

WARNING: THE OPERATOR SHOULD STAY ALERT DURING TESTING AND KEEP THE VEHICLE UNDER CONTROL WITH THE THROTTLE AND BRAKES (AS A DRIVER WOULD DURING AN ON HIGHWAY ROAD TEST). TO PREVENT INJURY, MAKE SURE NO OBSERVERS ARE IN FRONT OF OR BEHIND THE SLED AND THAT THEY ALSO STAY CLEAR OF THE ABSORBER AND ROTATING TRACK ASSEMBLY.

7 As the engine is accelerated, the load control (under manual or computer control) regulates the resistance that the absorber presents to the treadmill. If the DYNO-MAX software is set to simulate inertial and drag loads, then you will feel an exponentially increasing load being applied to the vehicle the faster and quicker you accelerate. Conversely, there will actually be a coasting effect felt decelerating. The sled's brakes can be used as needed to slow down and/or test the braking system.

CAUTION: Remember - even though the sled is not moving forward, its track may still be turning!

RUNNING WITH DYNO-MAX SOFTWARE

Before actually operating the system, first become familiar with setting up and operating the DYNOmite Data Acquisition Computer and DYNO-MAX software. The DYNOmite Data Acquisition Computer is covered in its separate section of this manual. DYNO-MAX includes a Multi-Media Demo CD plus an extensive, context sensitive, On-Line Help System.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Chassis Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the snowmobile accelerates the dynamometer, the DYNOmite computer and DYNO-MAX software monitors the track speed, engine RPM, run time, rate of acceleration and, if so equipped, absorber torque. It uses this information to calculate and display the applied power.

For systems equipped with a water brake or electric absorber, the load control (under manual or computer regulation) can adjust the resistance that the dynamometer applies to the sled's track. By increasing or decreasing the absorber load, it is possible to simulate various trail conditions - at the throttle opening of your choice. Such control is ideal for troubleshooting problems, tuning fuel injection systems, etc.

When using the Electronic Servo Load Control option it is possible to specify a specific holding speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various *Auto Tests* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX has a special *Road Load Simulation* mode. It controls the vehicle speed based on the cumulative power applied during the test calculated against the user input sled drag and weight information. In this mode, you will notice an exponentially increasing load being applied to the track, the faster and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode to do engine management system mapping and diagnostic testing in.

Below is just a quick review (from the training course) on performing a chassis dynamometer session using DYNO-MAX's Simulated Road Load mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the dyno's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 Under the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#3- Yellow, Magnet*" (when you have wired an engine RPM tack source) or "*#1 Shaft, Magnet*" (when *Smart Ratio* is used to match the tach for a single gear ratio).

Tip: *If the DYNO-MAX and engine tachometer read significantly different, it is likely that your setting under "*Electronics - Calibrate Dynomite RPM Pulses per Revolution Channels*" for the "*Yellow AC input (Frequency)*" are set incorrectly.*

2 Also under the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still under the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

4 Under the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (roller) Torque* in determining displayed power.

5 Under the Run Information *Vehicle* tab, enter the "*Weight*" and "*Coast Down G's*" for the vehicle being tested.

Tip: *For simulating vehicle inertia, you need to correctly enter the curb weight of the vehicle (including driver and fuel). The "*Coast Down G's at 55 MPH*" can be taken from your on-trail test data, or they can be estimated.*

NOTE: Below are various typical "Coast Down G" values:

Sled (touring) 800 lb. = .200
Sled (trail) 700 lb. = .200
Sled (race) 600 lb. = .220

6 Also under the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your dyno's sprocket ratios.

7 Again, under the Run Information *Dyno* tab, the *Drive Ratio* must match any step-up or down transmission between the roller system and absorber's shaft. For example, enter 2.000 for a 2 to 1 step-up drive.

8 Still under the Run Information *Vehicle* tab, you can enter the parasitic loss "*Driveline Power loss RPM B*" calibration values established for your system. This corrects for roll windage and bearing drag losses.

Tip: *Contact Land & Sea if you do not know the correct values for your dyno assembly.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Simulate Road Loads* button as the servo load control mode. This sets the system to simulate the real world inertia, wind drag, and rolling resistance of the snowmobile (through automatic adjustment of the DYNOmite absorber's load valve). The program uses the value entered under *Vehicle Weight* and *Coast Down G's at 55*

MPH to calculate the correct drag vs. acceleration curve and peak speed attainable by the test vehicle.

Tip: *You can adjust the coast down G's to match the vehicle's top speed on the dyno to its real world top speed. Increasing the Coast Down G's will cause the DYNOmite computer to simulate more vehicle drag. This simulated load increase will decrease the top speed the vehicle can attain on the chassis dyno.*
Make sure that you enter the vehicle's correct trail weight, as this weight is an important component in the DYNOmite's drag simulation calculations!

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

Tip: *DYNO-MAX's ability to simulate vehicle inertia may be limited at lower speeds by the low-RPM torque capability of your absorber. Water brakes, for example, can't provide loading near zero RPM. An AC motor/generator or eddy current absorber is able to simulate much more "drive-away" inertia.*

11 If you wish to do standard sweep or step testing under servo load control, just switch the servo control mode with either the *Hold Engine RPM* or *Hold Vehicle Speed* buttons.

The DYNOmite PTO Dynamometer allows "field" testing tractors right in your shop or yard. Its DYNOmite eddy-current absorber allows both sweep and steady-state testing. Attachment to the tractor's PTO is done via a standard accessory driveshaft assembly (available from most tractor-supply dealers.)

The following instructions outline the procedures for hardware installation and tractor coupling. Other sections of this manual cover the data-acquisition computer installation, eddy-current absorber hook-up, dynamometer operation, etc. – for this and other applications. If your DYNOmite PTO Dynamometer is equipped with the trailer-tongue and axle-assembly package, with or without (optional) brakes, those items include additional (and separate) documentation.

CAUTION: The steps below require that you be familiar using tractor PTO takeoffs - with driveshaft driven accessories.

1 Choose a test area with adequate ventilation (to remove exhaust fumes). If extended duration or high-power testing is to be conducted, the ventilation system needs to be of much higher capacity.

CAUTION: Failure to provide adequate cooling air-flow can lead to damaging heat buildup in the engine compartment and exhaust system.

2 The dynamometer's frame includes (four) leveling jacks, to maintain the position and stability of the system during testing. Adjust these jacks, on an appropriate surface, to obtain a secure and balanced setup. Avoid soft ground, where the jacks may sink during testing.

CAUTION: If the leveling jacks slide during testing on hard surfaces, use appropriate rubber (or leather) anti-vibration pads under each jack.

3 Remove the included driveshaft assembly from the frame's storage-tube compartment (right-side door). Temporarily slide the dynamometer-side plastic driveshaft guard away from the u-joint assembly – by depressing its (three) white tabs. This allows access to the drive-shaft yoke's quick-disconnect collar.

CAUTION: The included driveshaft's guard includes a "maximum extended length" decal and yellow warning tape. Whenever you can see this tape, the driveshaft is too-far extended – for safe operation.

Tip: *If the standard driveshaft's length, capacity, or splined yokes are not suitable for the tractor being tested, a wide array of driveshafts are available from most tractor-supply houses and tractor-driveshaft manufacturers.*

4 Slip the driveshaft's 1¾"-20 spline yoke onto the input shaft of the dynamometer. The input shaft is accessed through the 9" hole in the shroud's end panel. *Note: The driveshaft's grease fitting and guard's access hole must be aligned.* Be sure to engage the yoke to the input-shaft's groove –

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by turning the collar on the yoke. Slide the plastic guard back into its running position – covering the u-joint.

CAUTION: Check the tightness of all bolts after the first day of testing and each week thereafter. Periodically grease the absorber(s) and shaft bearings (see Maintenance Section).

5 Back the tractor into an appropriate alignment with and distance from the PTO dynamometer. Ideally the telescoping driveshaft should be run at about half its allowable extended length.

WARNING: THE SHAFT MUST NEVER BE RUN BOTTOMED OR BEYOND ITS INDICATED (BY CAUTION TAPE AND DECAL) MAXIMUM SAFE EXTENSION. IF THIS IDEAL EXTENSION CANNOT BE MET, EITHER MOVE THE TRACTOR, OR PROCURE A DIFFERENT-LENGTH SHAFT!

6 After verifying the tractor's positing and driveshaft length, slide the plastic driveshaft guard back over the driveshaft. Run the guard's anti-rotation chain through either dynamometer-shroud handle and secure its spring-clip. Secure the guard's anti-rotation chain to the tractor (PTO) end, in a similar fashion.

7 Slip the driveshaft's tractor-end yoke (indicated by "tractor" icon) onto the tractor's PTO-shaft spline. Be sure to engage the yoke to the PTO-shaft's groove – by turning its quick-disconnect collar.

8 Route the guard's PTO-end anti-rotation chain, and secure its spring-clip, in a similar fashion to that of the dynamometer's end.

WARNING: NEVER RUN THE DYNAMOMETER WITHOUT THE DRIVESHAFT GUARD IN PLACE. ALSO, NEVER ALLOW OPERATORS OR BYSTANDERS TO STAND ALONG THE "POTENTIAL LINE OF EXPLODING DRIVESHAFT COMPONENTS!" THIS PLASTIC GUARD CANNOT OFFER PROTECTION FROM FLYING (BROKEN) U-JOINTS, ETC.!

9 Wire the DYNOmite eddy-current power supply/controller's "*POWER IN*" to an appropriately rated, and GFI protected, AC electrical outlet. This controller may be wall mounted or attached to an (optional) portable control stand.

10 Using the supplied heavy-duty DC power cord, connect the eddy-current power supply/controller's "*DC OUT*" to the DYNOmite PTO Dynamometer's matching frame-mounted receptacle – found under the yellow, flip-up weather-tight, cover.

11 Run an AC extension cord to power the DYNOmite PTO Dynamometer's ventilation fans. The fan circuit runs to the (labeled) frame-mounted receptacle – found under the other yellow, flip-up weather-tight, cover.

CAUTION: The ventilation fans run anytime their receptacle is powered. A switched supply cord may be used, but you must then remember to activate the fans' power anytime the dynamometer is in use!

Tip: *Leave the ventilation fans running for several minutes after each test. The absorber rotors have a high thermal mass, and take time too cool. The cooler the rotors, the more power capacity the dynamometer will have.*

12 Using the included extension leads, connect the DYNOmite DAQ's harness leads for the "*Absorber RPM*" and "*Torque*" channels to their respective AMP and DIN connectors. These connectors will be found on the dynamometer's frame – under the gray, flip-up weather-tight, cover.

13 Assuming the DYNOmite data-acquisition system and eddy-current's power supply/controller are already wired and powered, start the tractor. Gradually increase the PTO speed to about 550 RPM – using a light throttle setting.

CAUTION: During the first run up, monitor the system for unusual (excessive) vibration.

Tip: *Some minor shaking may occur under very-light absorber loading. As more throttle and load are applied, this should disappear.*

RUNNING WITH DYNO-MAX SOFTWARE

Before actually testing with the system, first become familiar with setting up and operating the DYNOmite data-acquisition computer and DYNO-MAX software. The DYNOmite data-acquisition computer is covered in its separate section of this manual. DYNO-MAX includes a "Multi-Media Demo CD" plus an extensive, context sensitive, online help system.

More importantly, operator(s) should have already attended the free training session offered to new DYNOmite Dynamometer customers at our Concord facility. In situations where it is impossible to attend such training, a series of free phone training sessions (or paid on-site training) should be arranged.

Tip: *The following information is provided as a quick follow up refresher to previously completed training only.*

As the tractor accelerates the dynamometer, the DYNOmite computer and DYNO-MAX software monitors the PTO speed, engine RPM, run time, rate of acceleration, and absorber torque. It uses this information to calculate and display the applied power.

The load control (under manual or computer regulation) can adjust the resistance that the dynamometer applies to the PTO shaft. By increasing or decreasing the absorber load, it is possible to simulate various real-world conditions – at the throttle opening of your choice. Such control is ideal for trouble-shooting problems, tuning fuel-injection systems, etc.

When using the electronic servo load control option it is possible to specify a specific holding PTO speed or engine RPM - which the computer will then automatically maintain (under most throttle settings). Various "*Auto Tests"* may also be run using the servo(s) to sweep or step the engine over predefined test points.

Further, DYNO-MAX "*Pro*" users can create custom-control formulas to run *Equipment-Load Simulation* mode. Written correctly, such control formulas regulate the PTO resistance based on the cumulative power applied during the test – calculated against the user input equipment characteristics, for speed/drag and inertia. In this mode, you will notice an exponentially increasing load being applied to the PTO, the more and quicker it is accelerated. Conversely, there will be a coasting effect during deceleration. When your entered drag settings are appropriate, this becomes a very convenient mode for engine-management-system mapping and diagnostic testing.

Below is just a quick review (from the training course) on performing a PTO dynamometer session using DYNO-MAX's *Hold RPM* mode. This review assumes DYNO-MAX has already been used to calibrate the system and that the dyno's inertia and parasitic drag values have been entered, etc.

Tip: *Help on these subjects can be found with DYNO-MAX's On-Line Help (*F1 key*). Use its "*Help - Index*" tab and review the entries under "Run information."*

1 On the Run Information *Dyno* tab, select the *RPM Source* you will use for this test session. This is typically "*#1- RPM-C, RPM-C*" (use *Smart Ratio* to match the engine's tachometer for the PTO's gear ratio).

Tip: *If the DYNO-MAX "Shaft RPM" formula and actual tractor PTO RPM read significantly different, it is likely that either your "RPM* Pulses/Rev*" setting (under "Electronics - Calibrate DYNOmite Channels - Absorber RPM-C") is incorrect, or your Run Information Dyno tab's Drive Ratio is wrong.*

2 Also on the Run Information *Dyno* tab, verify the *Torque Source* being used (typically "*#0- DYNOmite Board*").

3 Still on the Run Information *Dyno* tab, the *Drive Ratio* must match the step-up (or down) pulley ratio between the dynamometer's driveshaft and its absorber(s). *For example, enter 2.105 for a 2.105 to 1 step-up drive.* Land & Sea will supply you with the exact entry for you specific dynamometer.

4 Lastly on the Run Information *Dyno* tab, you must enter the parasitic loss "*Dyno Power loss - RPM B*" and "*Dyno % loss - RPM B*" calibration values that were established for your system. This corrects for absorber windage, belt, and bearing drag losses. Land & Sea will supply you with the correct entries for you specific dynamometer.

Tip: *Contact Land & Sea if you do not have any of the the correct dynamometer-specific values for your system.*

5 On the Run Information *General* tab, enter the "*Number of Cylinders*", "*Bore*" & "*Stoke*" (or "*Displacement*") as these fields are used by the *Friction Compensation*, *Atmospheric Correction*, and other formulas.

Tip: *If you do not know the engine's exact specifications, enter a rough estimate for these fields.*

6 On the Run Information *Inertia* tab, verify the systems inertia settings and select *Calculate Torque with:* to "*#1- Compensation On*" which combines *Measured Absorber Torque + Inertial (absorber flywheel) Torque* in determining displayed power.

7 Also on that same Run Information *Inertia* tab, be sure to enter the "*RPM-C*" inertia value for the dynamometer's absorber(s), pulleys, belts, and shafts. Land & Sea will supply you with the exact RPM-C entry for you specific dynamometer. You may also enter inertia (estimates) for the tractor's engine and PTO-driveline components.

Tip: *The "Inertia Calculator" button may be used to bring up a list of typical inertia values. For steady-state testing, entering exact engine inertia is not required. Even zero will do.*

8 On the Run Information *Vehicle* tab, verify the *Speedometer Source* is set to "*#1- Shaft RPM*" and that the correct *Vehicle Speed Factor* has been entered for your dyno's sprocket ratios.

Tip: *A correct "Vehicle Speed Factor" is only required if you wish to display or graph tractor performance versus ground speed.*

9 Under *Electronics - Configure DYNOmite Controls* select the *Hold RPM* button as the servo load-control mode. This activates the load-control system. When in this mode, the control can maintain a (manually specified) "not-to-exceed" steady-state *Hold* RPM. This mode also allows running *Auto* mode – for conducting automated sweep or step RPM testing.

10 To begin testing, you must have an appropriate DYNO-MAX Console open and have its *Testing* mode button depressed. Also, the *Hold* (or *Auto* button) must be depressed to activate the servo control mode. Pressing the *Record* (or *Run* button) initiates data capture. Again, see the DYNO-MAX Multi-Media Demo CD and On-Line Help System for an explanation of testing and reporting features.

For systems with the optional eddy current electric absorber(s), follow the instruction below (instead of those for plumbing the water brake's load valve).

1 The teddy current's power supply/controller module should be mounted in a location convenient for manual operation of its controls during testing.

Note: Typically eddy current equipped DYNOmites are custom built to customer specifications. Consequently the following information is generic in nature.
Most of the instructions in the manual for operation of the WATER BRAKE manual and servo load control operation pertain to the eddy current versions.

WARNING: THE EDDY CURRENT ABSORBER HAS EXPOSED HOT SURFACES, ROTATING PARTS, AND HIGH VOLTAGE TERMINALS. IT MUST BE INSTALLED IN AN APPROPRIATE VENTILATED AND GAURDED TEST CELL PIT OR EQUIPPED WITH APPROPRIATE GAURDS OR TEST CELL DOOR INTERLOCKS AS APPROPRIATE!

2a If you are installing a 12-volt DC eddy current absorber with a DYNOmite 12-volt DC *power supply/controller module*, hook the power supply/controller module's positive and negative "Power In" leads to your test cell's appropriate 30 amp 12-volt DC power supply or heavy duty automotive battery (Figure 8).

2b If you are installing a 96-volt DC eddy current absorber with a DYNOmite 115-volt AC *power supply/controller module*, plug the power supply/controller module's "POWER IN" cord into your test cell's dedicated and appropriately grounded 20-amp (or 30-amp as required) 115-volt AC outlet.

Figure 20

2c If you are installing a 96-volt or 192 volt DC eddy current absorber with a DYNOmite 230-volt AC *power supply/controller module*, wire the power supply/controller module's "POWER IN" cord to your test cell's dedicated 20-amp 230-volt (single-phase) AC circuit breaker.

WARNING: THERE ARE NO USER SERVICABLE PARTS INSIDE THE POWERSUPPLY/CONTROLER MODULE. THE 115-VOLT or 230-VOLT AC POWERED MODULES SHOULD NEVER BE SERVICED WHEN POWER IS APPLIED. LETHAL VOLTAGES ARE PRESENT WITHIN THE HOUSING AND AT THE EDDY CURRENT ABSORBER!

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3 Connect the unit's "DC OUT" cord twist lock plug to the eddy current absorber's mating cord cap. Be sure to secure all cords so they can not become entangled in the absorber's hot, spinning rotors (or other moving parts of the dynamometer system).

4 The power supply/controller module has an "AUTO/KNOB" rocker switch to toggle between manual operator control and automated DYNOmite control of the absorber's load. Initially, set this switch to "KNOB" and turn the "LOAD" knob clockwise to minimum load.

5 The power supply/controller module has a circuit breaker equipped On/Off power switch to activate the power supply. Turn the power on while verifying that the panel's "CURRENT" amp meter stays at 0 amps.

CAUTION: If the meter reads above 0 amps, turn off the power and re-check that the rocker is in the manual "KNOB" position and that the "LOAD" knob is turned fully CLOCKWISE. If this does not solve the problem, make sure that the wiring to the absorber is not shorted.

6 You can now run tests using the knob for manual load control.

CAUTION: To protect the eddy current absorber and the power supply/controller module from overheating, do not leave the unit at a high current setting when tests are not being run. The absorber is air cooled by its rotating fins and failure to heed this caution can result in failure of the eddy current equipment that is not covered under warranty.

7a This step is only if you are going to use the eddy current absorber with a DYNOmite Data Acquisition System for automatic load control.
Plug the DYNOmite's servo load valve harness lead into the "DYNOmite" terminal in the underside of the power supply/controller module.

7b This step is only if you are going to use the eddy current absorber with a DYNOmite Data Acquisition System for automatic load control.
With your DYNOmite system powered up and operational, switch the power supply/controller module's rocker switch to "AUTO". The panel's "CURRENT" amp-meter should go to 0 amps.

Tip: *Always verify that the engine's operating RPM and the DYNOmite's holding RPM are appropriate before switching to "AUTO" mode. Likewise, make sure that the knob is pre-set to an appropriate load setting before switching back to manual control. This is important to avoid inducing unintentional changes in the test load upon switch-over.*

While much of the mounting is obvious, read thru these instructions at least once to note any special procedures and cautions. The DYNOmite absorber can be fitted to a variety of engines testing stand configurations. The following instructions detail the procedures for attaching the absorber via a DYNOmite bell-housing adapter plate. Other sections of this manual cover the Data Acquisition Computer installation, load control valve plumbing, dynamometer operation, etc. for this and other applications.

1 Make sure the engine's crankshaft is equipped with either an appropriate GM .590" i.d. pilot bushing (Ford and Mopar bushings are also supplied).

2 Mount the engine's flywheel and starter.

3 Install an appropriate clutch assembly, such as a Chevy 1-1/8" (or 1-3/8") x 10 tooth spline (as appropriate for the absorber's input shaft) and pressure plate, onto the engine's flywheel or mount an optional dynamometer drive-plate coupler onto the crank shaft (See the current DYNOmite Dynamometer Accessories Catalog or section 14.1.)

Note: Custom and semi-machined input shafts are available for fitting various engines.
"Off the shelf" DYNOmite input shafts include part numbers for select GM, Chrysler' Ford, Porsche, and VW models
Call for exact specifications!

CAUTION: Be sure the clutch disk is carefully centered. Failure to do so will result in side loads which can damage the adapter plate and absorber bearings.

4 Mount a suitable bell housing and starter motor onto the engine block.

Tip: *The crankshafts on engines for automatic transmission use normally will accept standard pilot bushings, flywheels, etc. A single clutch disk and pressure plate (or dyno drive plate) often fits several engines. Salvage yard or aftermarket bell-housings and adapters let you inexpensively couple various engines to the DYNOmite.*

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5 Bolt the bell-housing adapter plate (Figure 9) onto the bell housing (with the input shaft's 1 inch x 15-spline end facing away from the engine). Be sure the shaft slides freely through the clutch disk (or dyno flex-plate coupler) and is fully inserted into the pilot bushing. Tighten your attaching bolts to factory transmission mounting bolt specifications.

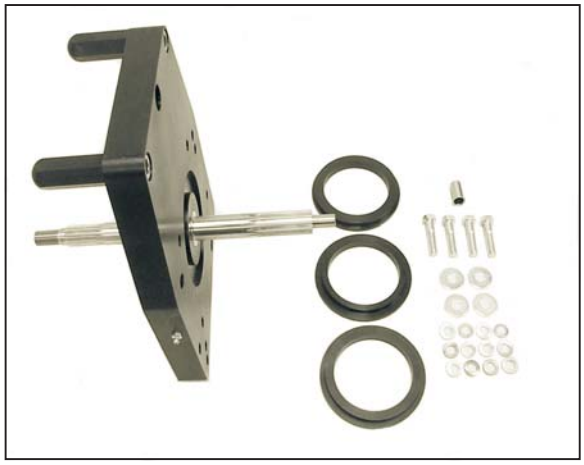

Figure 22

Tip: *The DYNOmite adapter plate fits most Ford, Chevy, and Lakewood bell housings, but check its bolt pattern before attaching **your** bell housing. Other patterns can be drilled into this plate.*

6 Using your shop's engine hoist, support the engine over the stand. Position the DYNOmite's engine mount cross member so that the rear engine support (worm jack screw) fits freely into the bushing in the bottom of the adapter plate. Adjust these mounts to a height and angle where the engine's exhaust, etc., clears the stand.

7 Slide the absorber onto the 1" x 15 spline shaft. The red torque arm will be towards the engine. The supplied dyno drive bushing and 3 stainless drive keys must be inserted to drive the absorber. The torque arm's two "ears" straddle the adapter plate's two stop pegs. The torque arm's plastic vibration pad should be able to rest against the right peg.

8 Use the large flat washer and special 3/4"-16 locking nut to secure the absorber at 60 ft-lbs (Figure 21).

Figure 21

Tip: *To prevent the shaft assembly from turning as you tighten the nut, TEMPORARILY slide the 6" long stainless dowel into the absorber's water inlet hole to lock the rotor.*

CAUTION: Be sure to coat the threads with NEVER-SEEZ (or other anti-galling compound) or the nut may gall on the stainless shaft!

9 Move the engine and test stand to your test area.

CAUTION: Remove the dowel before attempting to crank over the engine! Other wise damage to the absorber's rotor may occur.

CAUTION: Test area must provide adequate dyno and engine cooling water supplies, drainage, ventilation, noise isolation, etc.

The special 7" DYNOmite absorber is easy to mount directly onto standard ¾"- keyed straight crankshafts. The following instructions detail the procedures for attaching the absorber to kart engines. Other sections of this manual cover the Data Acquisition Computer installation, load control valve plumbing, dynamometer operation, etc. for this and other applications.

1 If you are going to test the engine on a stand remove it from the chassis. If you plan on testing the engine in the chassis, verify there is adequate clearance for the absorber and its torque arm. For any in-vehicle testing, you will also need to fabricate mounts to bolt a "torque arm support bar" to the chassis.

Tip: *If you wish to mount the absorber with a rear axle adapter you will require the higher torque 9" absorber and/or a change in the kart's chain sprocket ratios. See your absorber's torque load vs. RPM chart to calculate the available capacity.*

2 Make sure the shaft sizes (and keys) match (and are clean and free of nicks) before slipping the absorber onto the shaft. If the engine is mounted on Land & Sea's engine stand, the absorber's torque arm will slip onto the stands integral shaft "torque arm support bar".

CAUTION: If you have fabricated your own support, make sure that the slot in the absorber's torque arm floats over it! (Figure 23)

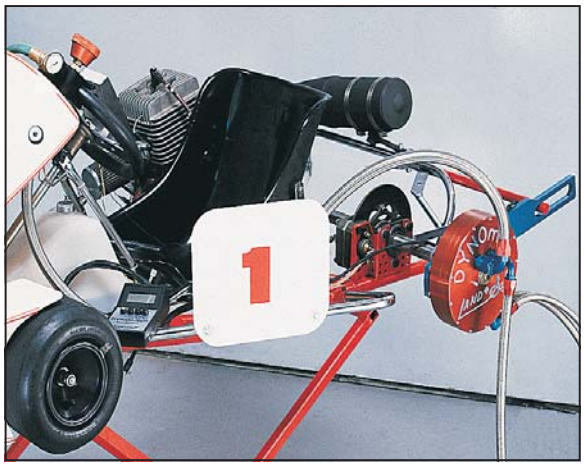

Figure 23

Tip: *Optional arbors and/or adapters are available for some other popular combinations. Custom machining of a standard arbor by a qualified technician can further expand the engine applications.*

CAUTION: If the installation requires a crankshaft or axle adapter, make sure the adapter is appropriate for the shaft and that it's tapers are clean and nick free.

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3 Use the appropriate thread and length bolt and washer from the DYNOmite package to secure the absorber to the crankshaft or rear axle adapter. Torque the mounting bolt to 25 foot-pounds.

Figure 25

Tip: *To prevent the shaft assembly from turning as you tighten the bolt, temporarily slide the 3" long x 7/16" o.d. stainless dowel into the brake inlet hose fitting (on the face of the brake) to lock the rotor (Figure 25).*

4 Clamp the load control valve assembly on the handle arms of the engine stand (or in another convenient location) with the pair of 1/4"-20 thread wing bolts provided (Figure 24).

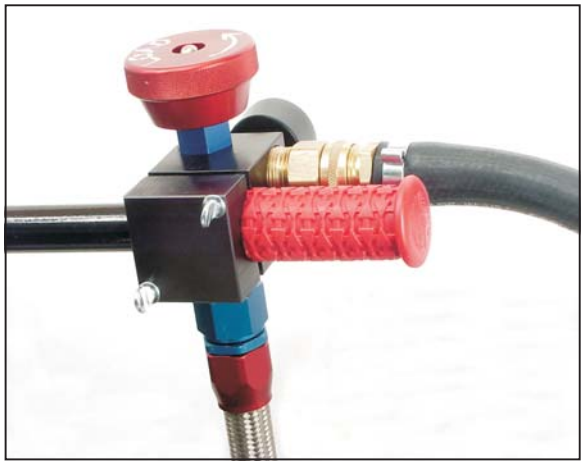


Figure 24

Tip: *The computer can be strapped to the "dash" or fuel tank for easy access during testing.*

Absorber Removal

1 Remove the absorber to shaft mounting bolt. (Again, slip the 3" stainless dowel into the absorber's water inlet fitting to prevent shaft rotation (Figure 25).)

2 Thread the 3/4"-16 x 3" puller bolt into the threads in the absorber's rotor hub until it bottoms on the shaft's end. Tighten the bolt as required to pull the absorber off the shaft (just like removing the drive clutch).

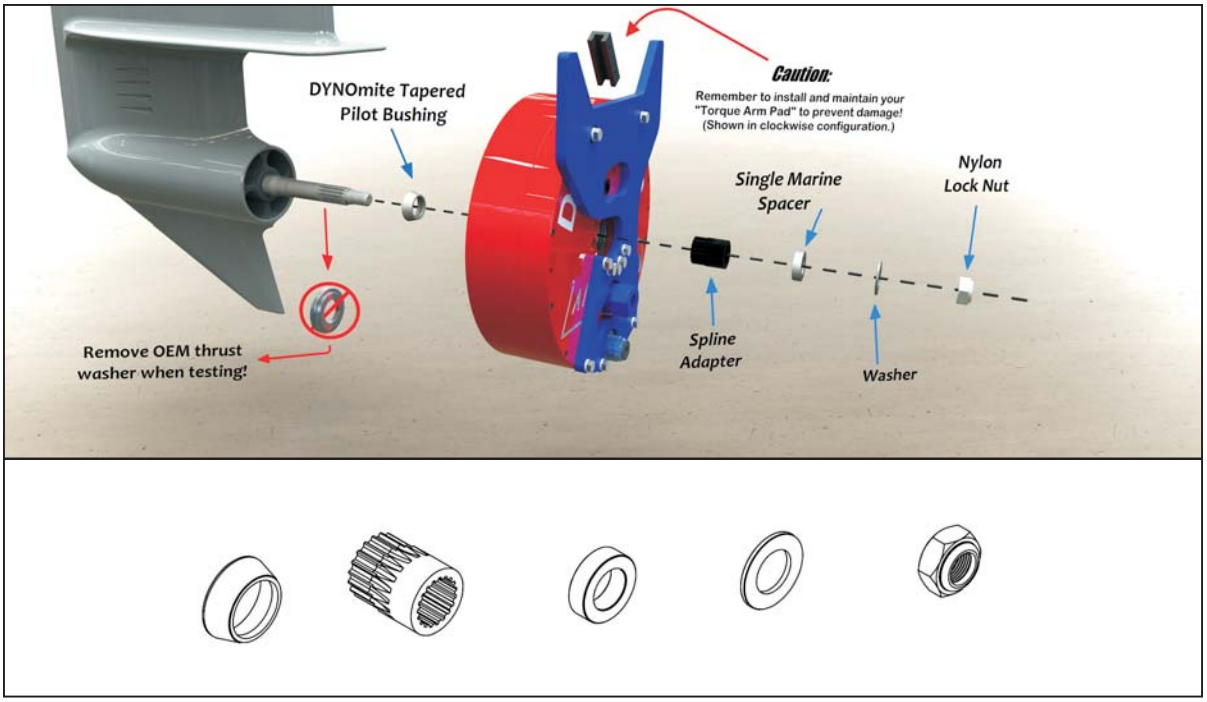
CAUTION: Always coat the absorber puller bolt's threads with NEVER-SEEZ (or other anti-friction compound) to ease removal!

The 13" DYNOmite absorber is easy to mount directly onto standard splined outboard and stern-drive prop-shafts. It lets you trouble shoot and read true prop-shaft horsepower readings, without removing the engine from the hull. This section details the procedures for attaching the absorber to the lower unit. Other sections of this manual cover the Data Acquisition Computer installation, load control valve plumbing, dynamometer operation, etc. for this and other applications.

1 Move the boat to a test area that provides adequate dyno and engine cooling water supplies, drainage area, ventilation, noise isolation, etc.

2 Remove the prop and OEM thrust washer from the lower unit.

3 Review the "hardware stack up" images (below) to determine the required components needed, for the outboard or (stern drive) lower unit being tested.



Johnson/Evinrude/Merc V6 & V8 (Single Rotor) Hardware Stack Up - Figure 26

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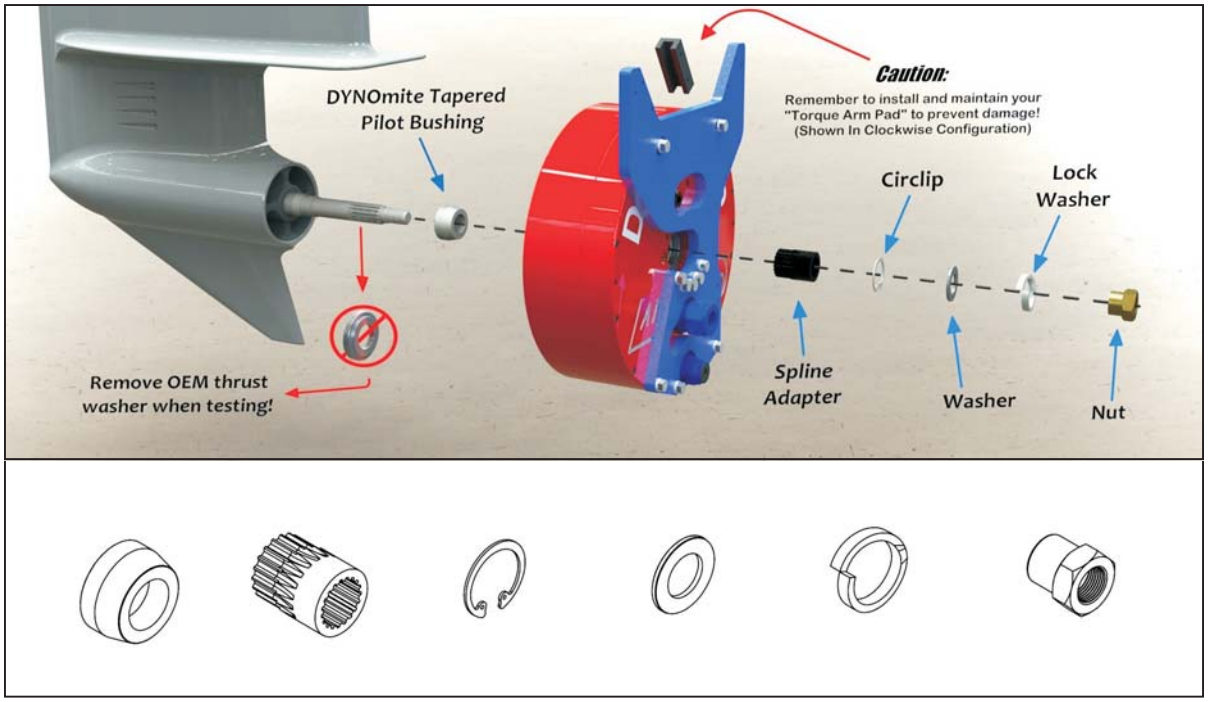
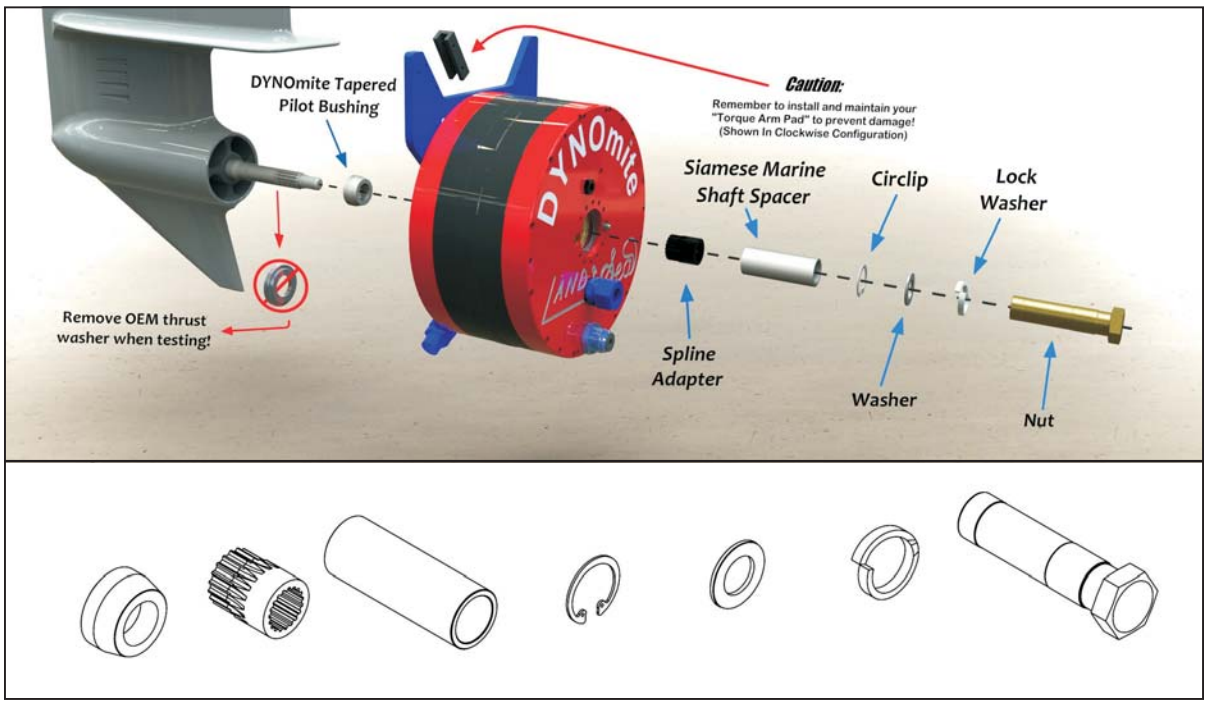
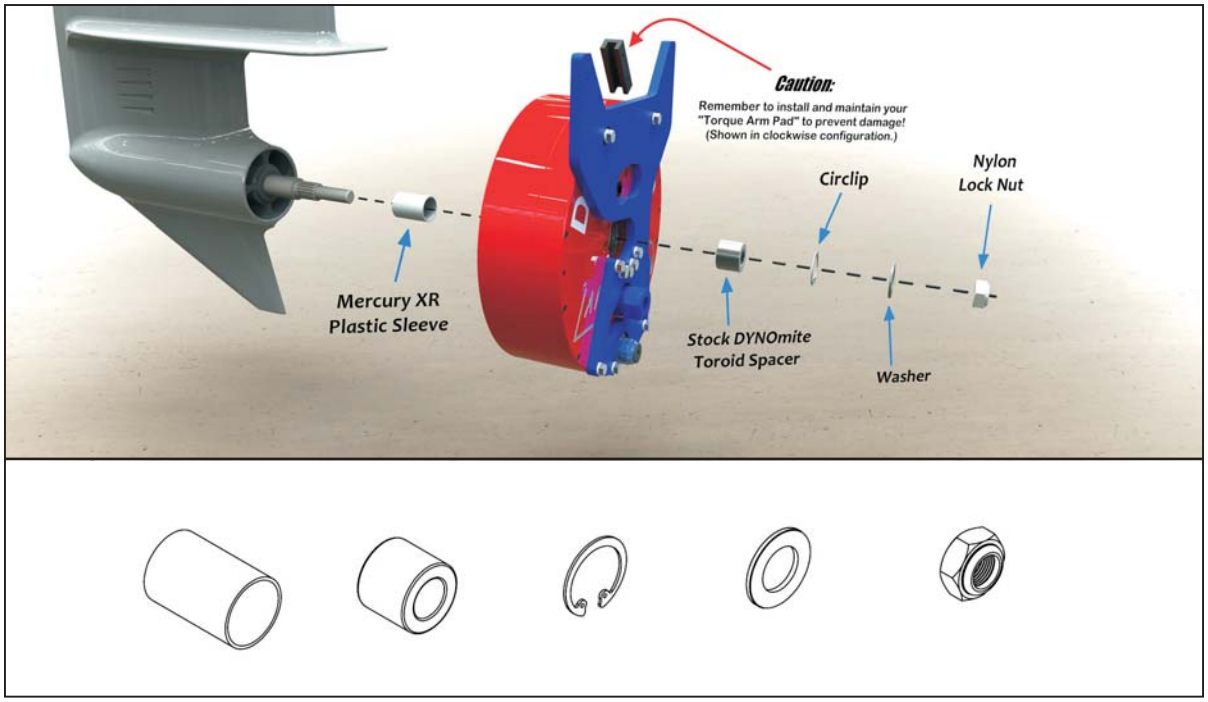


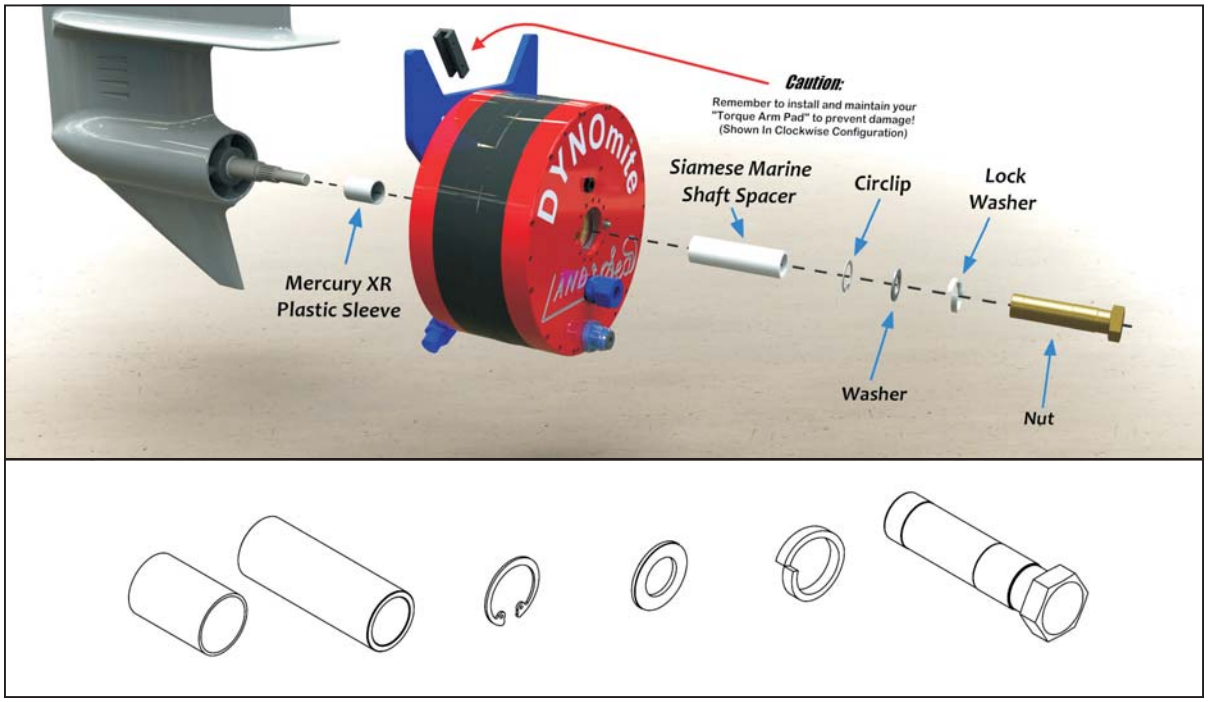
Johnson/Evinrude V4 (Single Rotor) Hardware Stack Up - Figure 27



Johnson/Evinrude/Merc/Volvo (Siamese Rotor) Hardware Stack Up - Figure 28



Mercury XR (Single Rotor) Hardware Stack Up - Figure 29



Mercury XR (Siamese Rotor) Hardware Stack Up - Figure 30

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4 Insert the appropriate Land & Sea splined prop shaft adapter drive bushing (may use three stainless steel drive keys for some applications) into the brake's arbor (Figure 32).

Figure 32

Tip: *The standard DYNOmite arbor and bushing combinations fit the popular industry standard 1" x 15-tooth and 7/8" x 13-tooth prop shafts. Optional arbors and/or bushing kits are available for some other less popular combinations. Custom machining of a standard arbor and/or bushings by a qualified technician can even further expand the engine applications.*

5 Slip the brake onto the prop shaft using an appropriate combination of thrust washer (may not require any in some applications), prop washer(s), lock washer and/or prop nut. (Figure 31)

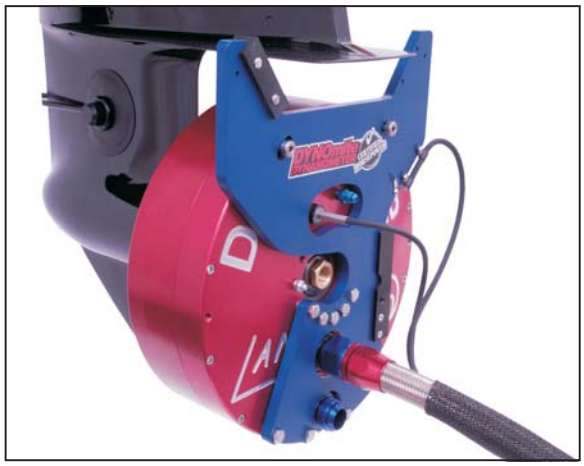

Figure 31

Tip: *The brake's arbor has an integral taper, and will not require a thrust washer for many popular applications.*

6 Tighten the prop nut to the factory recommended torque so that the arbor is secure and without end play on the prop shaft.

CAUTION: Make sure your selection of prop nut, washer, and/or lock washer can rotate without interfering with the torque arm's bending under full load.

Tip: *To prevent the shaft assembly from turning as you tighten the bolt, temporarily slide the 6" long x 7/16" o.d. stainless dowel into the water inlet hose fitting (on the face of the absorber) to lock the rotor.*

IMPORTANT: The brake's torque arm wear pad must be free to contact the cavitation plate without binding! If the gear-case has a swept back skeg (and/or Torque Tab) make sure that the brake's stator housing is not rubbing in those areas.

7 Clamp the load control valve assembly to the boat's steering wheel (or other convenient location) with the pair of the 1/4"-20 thread wing bolts provided.

Tip: *The computer can be strapped to the helm for easy access during testing.*

Absorber Removal

1 Remove the absorber to shaft mounting bolt. (Again, slip the 6" stainless dowel into the absorber's water inlet fitting to prevent shaft rotation.)

The 9" DYNOmite absorber and PWC adapters can be fitted to a variety of PWC and jet boat applications (or used out of the hull for stand testing PWC and Snowmobile engines). The following instructions detail the procedures for attaching the absorber to the PWC's pump. Other sections of this manual cover the Data Acquisition Computer installation, load control valve plumbing, dynamometer operation, etc. for this and other applications.
*If you are going to test the engine on a stand, remove it from the hull and see the "*ENGINE MOUNTING - Snowmobile*" section 5.5.*

1 Using the tools and procedures specified in your boat's factory service manual, remove the pump's extension outlet nozzle assembly and its tail cone.

2 Select the correct PWC adapter (black anodized aluminum housing) and stainless steel extension shaft for the boat being dyno tested.

Tip: *Make sure the extension shaft is fully inserted into the adapter's bearing.*

3 Fit the adapter assembly to the pump so that the impeller's shaft will drive the extension shaft (Figure 33).

CAUTION: The slotted side of the pump adapter must be oriented so that the boat's pump can drain onto the ground. (i.e. oriented so that the adapter's protruding torque arm stud and rubber bushing end up on the starboard side of the hull.)

Tip: *Optional adapters are available for other popular combinations. Custom machining of an existing adapter assembly by a qualified technician can further expand the engine applications.*

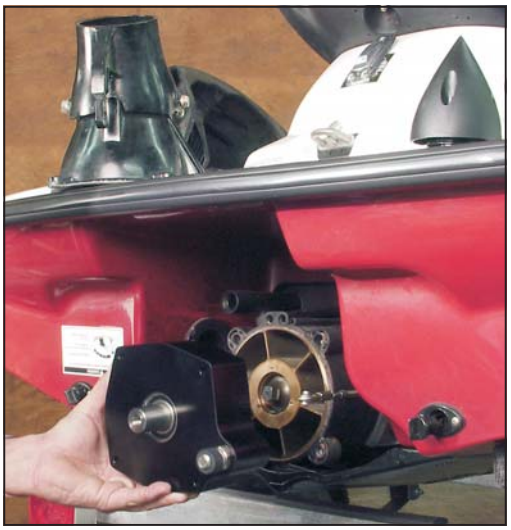

Figure 33

4 Secure the adapter to the pump housing with the adapter's four (included) hex head screws.

CAUTION: Make sure the extension shaft and absorber tapers are smooth, clean, and oil free.

Tip: *If there is any question about the taper's condition, use valve grinding compound to lap the two surfaces together and then swab clean them with alcohol.*

5 Use the appropriate thread and length bolt and washer from the DYNOmite package to secure the absorber to the crankshaft! Torque the mounting bolt to 45 foot-pounds.

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CAUTION: Do not over torque this bolt or you will damage the absorber's arbor!

Tip: *To prevent the crankshaft assembly from turning as you tighten the bolt, temporarily slide the 4" long x 7/16" o.d. stainless dowel into the brake inlet hose fitting (on the face of the absorber) to lock the rotor (Figure 25).*

CAUTION: The hole in the absorber's torque arm must float freely over the rubber bushing on the bearing adapter's anchor stud.

6 Clamp the load control valve assembly in a convenient location (i.e. onto the boat's left handle grip) with the pair of 1/4"-20 thread wing bolts provided.

Tip: *The computer can be strapped to the "dash" or seat for easy access during testing.*

Absorber Removal

1 Remove the absorber to shaft mounting bolt. (Again, slip the 4" stainless dowel into the absorber's water inlet fitting to prevent shaft rotation.)

2 Thread the 3/4"-16 x 3" puller bolt into the threads in the absorber's rotor hub until it bottoms on the shaft's end. Tighten the bolt as required to "pop" the absorber off the shaft.

CAUTION: Always coat the absorber puller bolt's threads with NEVER-SEEZ (or other anti-friction compound) to ease removal!

3 Remove the adapter assembly and replace the boat's pump parts.

While much of the mounting is obvious, read through these instructions at least once to note any special procedures and cautions. The 9" DYNOmite absorber can be fitted to a variety of sleds and snowmobile engine applications (or used with adapters for in-hull PWC engine testing). The following instructions detail the procedures for attaching the absorber to the PTO. Other sections of this manual cover the Data Acquisition Computer installation, load control valve plumbing, dynamometer operation, etc. for this and other applications.

1 Using the tools and procedures specified in the machine's factory service manual, remove both its drive and driven clutches.

CAUTION: Make sure the crankshaft runs true and that its taper and the absorbers are smooth, clean, and oil free - swab clean the crankshaft's and arbor's taper with alcohol. Excessive crankshaft run-out or a poor mating surface will damage the absorber and crankshaft - and is not covered by warranty!

Tip: *If there is any question about the taper's condition, use valve grinding compound to lap the two surfaces together and then swab clean them with alcohol.*

2 Check that the tapers on the crankshaft and absorber match, before slipping the absorber onto the crankshaft's PTO. Not all model snowmobile engines can be accommodated by the standard dual taper DYNOmite arbor!

Tip: *The standard DYNOmite 9" snowmobile absorber has a dual taper (3^o and 4^o) PTO mount.*

WARNING: NEWER ARCTIC CAT (LARGE TAPER) MODELS AND MODIFIED (HIGH OUTPUT) ENGINES MUST BE FITTED WITH A SPECIAL SINGLE (MATCHING) TAPER ABSORBER ARBOR!

Tip: *Optional arbors and/or adapters are available for some other popular combinations. Custom machining of a standard arbor by a qualified technician (or remote pillow block mounting) will further expand the engine applications that can be accommodated.*

CAUTION: The slot in the absorber's torque arm must float freely on the driven clutch's jack shaft! (Figure 34)

3 Use the appropriate thread and length bolt and washer from the DYNOmite package to secure the absorber to the crankshaft! Torque the mounting bolt to 45 foot-pounds.

CAUTION: Do not over torque this bolt or you will damage the absorber's arbor! Also, be sure to recheck the bolt's torque after the first test.

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Tip: *To prevent the crankshaft assembly from turning as you tighten the bolt, temporarily slide the 4" long x 7/16" o.d. stainless dowel into the brake inlet hose fitting (on the face of the absorber) to lock the rotor (Figure 25).*

4 Clamp the load control valve assembly in a convenient location (i.e. onto the sled's left handle grip) with the pair of 1/4"-20 thread wing bolts provided. (See Figure 35.)

Tip: *The computer can be strapped to the "dash" or fuel tank for easy access during testing.*

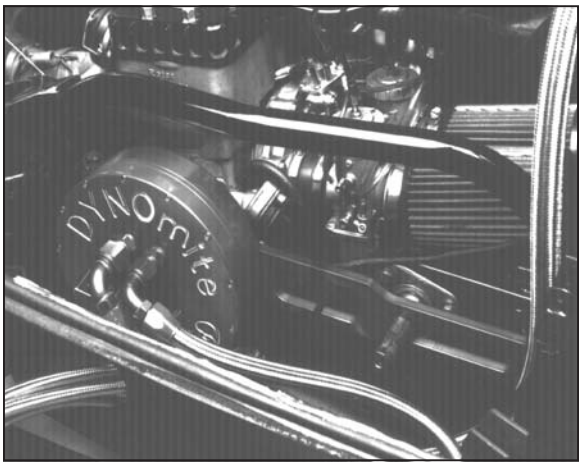

Figure 34

Figure 35

Absorber Removal

1 Remove the absorber to PTO mounting bolt from the engine's crankshaft snout. (Again, slip the 4" stainless dowel into the absorber's water inlet fitting to prevent crankshaft assembly rotation.)

2 Thread the 3/4"-16 x 3" puller bolt into the threads in the absorber's rotor hub until it bottoms on the crankshaft's snout. Tighten the bolt as required to "pop" the absorber off the crankshaft (just like removing the drive clutch).

CAUTION: Always coat the absorber puller bolt's threads with NEVER-SEEZ (or other anti-friction compound) to ease removal!

Each DYNOmite Data Acquisition Computer board set pair (Lite, Basic, or Pro) has the following minimum circuits and channels available Each DYNOmite harness has lead labels corresponding to the circuits below. You should also refer to the wiring harness schematics - located later in this section.

Tip: *If you are utilizing multiple board sets, this section's steps refer primarily to the "Board #1" (top) port and harness on the Data Acquisition module.*

Power is typically supplied via a mono phone jack located on the side of the Data Acquisition Computer's housing (or an internal Relay subsystem cable). The DYNOmite tolerates a flexible range of power sources - from 10 to 16-volt AC or DC supply that can handle its 500 milliamp current load. Because each board set handles its own rectifying, filtering, and regulation, an inexpensive low current AC wall charger (like the ½ ampere 12-volt unit supplied with each DYNOmite) may be used to power the units. Even the engine's 12.6-volt starter battery will work - provided it is fused at no greater than 1-amp. *Note: When using the optional Relay subsystem or Piggy-Back Rotary Torque Transducer, the DYNOmite board set is powered via an internal cable jack connection.*

Tip: *Of course, an expensive lab quality regulated DC supply may be used, but the improvement in channel stability is not significant.*

CAUTION: If your power supply is capable of delivering more than 1,000 milliamps, it must be fused! Also, if your supply can not stand momentary shorting - never insert (or remove) the phone plug while power is applied!

WARNING: FOR DC SUPPLIES, WIRE THE POLARITY FOR THE TIP OF YOUR PHONE PLUG AS + (POSITIVE)! ALTHOUGH ITS POLARITY IS IRRELEVANT TO THE DYNOmite, THE BARREL OF THE PHONE JACK COULD BECOME GROUNDED IF YOU MOUNT IT IN A METAL HOUSING!

Tip: *When powered on, the DYNOmite-Pro (and Lite) board sets display a small flashing (one flash per second) green LED (next to their power-in phone jack).*

GROUND is the DYNOmite harness's black main system ground lead, as well as the ground for many accessories). It must always be clamped directly to the single main engine/battery/building/chassis/power-supply ground.

CAUTION: Avoid connecting to engine mounted terminal blocks, frame ground straps, etc. Rubber mounts, bushing, corrosion, or even the slight added electrical resistance of extra junctions and wiring can electrically position the DYNOmite's electronics "above" true ground. Failure to follow this precaution can lead to electromagnetic data interference or power circuit damage - not covered under warranty!

TORQUE **(Strain 1)** "Torque Arm" input lead carries the signal from the DYNOmite's absorber mounted strain gage equipped torque arm or millivolt load cell. Plug the mating 4-pin connectors from both the DYNOmite harness and the torque source together. An optional extension harness is available for this lead for remote mounting of the console.

CAUTION: If you are using an amplified (0-5 volt output) S-beam or load cell type torque transducer, it must not be plugged into this Torque Arm connector. Rather, connect it to the "LOAD CELL 0-5 Volt" #1 channel.

Tip: *This must be a clean, dry, and tight connection to provide consistent torque readings. Keep the connector away from dripping water as even a tiny change in electrical resistance will make it read incorrectly.*

Engine RPM-A **(Frequency 1)** "AC input" yellow lead can often be tied into the engine's tachometer "sender" circuit. Like the engine's built-in tach, the DYNOmite computer counts the AC or sine or square wave pulses to determine RPM. On most engines this circuit is the primary (low voltage) wire connected between the ignition coil and the distributor. On engines with the coil in the distributor, a separate tachometer lead is usually provided. Aftermarket ignitions (especially multi-spark units) often have a dedicated tachometer output in the ignition module. While the DYNOmite alone is compatible with many tachometer sources optional accessories are available to adapt to most any problem installation.

Tip: *See "*DATA ACQUISITION - Engine Specific Tach Tips section 6.2*" for more detailed information on getting a tachometer signal from various engine types.*

CAUTION: The DYNOmite receives charging power on this AC INPUT. If your tach circuit voltage is too high, the DYNOmite displays an OVER-VOLTAGE warning. Various plug-in resistors are included to drop this voltage and/or reduce the DYNOmite's load on the ignition signal (to avoid engine mis-firing from the reduced primary voltage).

Tip: *A dedicated tach output must be found if the number of pulses (sparks) produced per revolution is variable. (e.g. MSD has a "Tach" terminal), alternatively a magnetic pickup kit can be mounted in the absorber.*

ABSOBER RPM-C **(Frequency 2)** "jack shaft" input lead supports the DYNOmite Magnetic (or inductive & toothed gear) RPM Pickup kits. For engine dyno testing this can be used as the main RPM source - by mounting the sensor at the absorber. DYNOmite water brakes have a 3/4"-16 threaded hole (near the center arbor) that the sensor screws into (after removing the blue anodized plug). The sensor's long lead routes back to the DYNOmite harness's matching 5-pin DIN Jack Shaft connector. An optional extension harness is available for this lead if you are remote mounting the console.

For obtaining MPH from a chassis dyno (with an eddy current or other absorber) or monitoring the shift-ratio via a secondary jack shaft's RPM, the pickup can read a rotating magnet in a shaft mounted. For these installations the sensor is held in close proximity to the collar via a threaded bracket.

REV LIMITER (Relay A) "Shut Off" is the DYNOmite's built in adjustable RPM-limiter control signal. This ignition "kill" circuit works by pulling the harness's black/white lead to near ground. If the ignition system being tested is compatible with this grounding method, the black/white lead may be safely connected directly to the ignition system - provided the circuit is not over 120 volts and is unable to deliver more than 1 amp. If this is not the case, an optional DYNOmite Kill Switch Relay Kit must be used to enable the rev-limiter function.

Tip: *Using the included wiring splice adapter terminals makes plugging and unplugging the computer simple. For a pack of additional terminals, you can order Land & Sea part #430-133.*

CAUTION: The above wiring information is only general. Consult your engine's service manual and/or Land & Sea if you are not sure about how to wire your specific application.

If you are also wiring additional channels via an optional Full Function Harness, see the "DATA ACQUISITION - 15-Channel Harness" section or "DATA ACQUISITION - 28-Channel Harness" section .

Below is some additional information for wiring many of the more popular (or confusing) engines to the DYNOmite Data Acquisition Computer. Feel free to call Land & Sea if you have a question about a configuration.

Tip: *There are multiple ways to get an RPM signal on most engines, only the most popular are listed below. For example: if your engine does not have a usable alternator pulse source, optional inductive and magnetic pickup transducer kits are available from Land & Sea.*

CAUTION: The following wiring information was correct for models examined by Land & Sea. However, you should consult your vehicle's service manual and/or Land & Sea if you are not sure that the above described colors or hook-up are correct for your specific application.

Automotive (GM, Ford, Mopar, etc.) type engine stand testing:
Use the included brake mounted Magnetic RPM Pickup Kit plugged into the Absorber RPM-C (Frequency 2) lead (aka "jack shaft lead).

Chassis dyno testing (typical engines):
For the vehicle's speed, use the included absorber (or roll shaft) mounted Magnetic RPM Pickup Kit (or inductive & toothed wheel pickup) plugged into the Absorber RPM-C (Frequency 2) lead.

For the engine's RPM there are several options:
a) Use an appropriate optional "clamp-on" Inductive Pickup (on a spark-plug lead), Optical RPM Pickup Kit, or Cigarette Lighter RPM Pickup - connected to the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead.
b) Direct wire the DYNOmite's yellow lead to the negative side of the engine's ignition coil (assuming the voltages are within the DYNOmite's limitations) or to the dedicated tach output of compatible devices like the MSD ignition system.
c) Alternatively, for single gear testing with a manual transmissions, DYNO-MAX's "Smart Ratio" feature can be used - without the need to wire up an Engine RPM lead.

Karts:
For the engine's RPM there are several options:
a) Use the optional "clamp-on" Inductive Pickup (on a spark-plug lead) connected to the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead.
b) Direct wire the DYNOmite's yellow lead to the engine's ignition coil primary (assuming the voltages are within the DYNOmite's limitations) or to the dedicated tach output of compatible third-party ignition system.
c) Alternatively, for single gear testing, DYNO-MAX's "Smart Ratio" feature can be used - without the need to wire up an Engine RPM lead.

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Motorcycles:
For the engine's RPM there are several options:
a) Use the optional "clamp-on" Inductive Pickup (on a spark-plug lead) connected to the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead.
b) Direct wire the DYNOmite's yellow lead to the engine's ignition coil primary (assuming the voltages are within the DYNOmite's limitations) or to the dedicated tach output of compatible third-party ignition system.
c) Alternatively, for single gear testing, DYNO-MAX's "Smart Ratio" feature can be used - without the need to wire up an Engine RPM lead.

Outboards:
Use the included absorber mounted Magnetic RPM Pickup Kit to capture prop-shaft RPM. Be sure to input the lower unit's gear ratio so that the DYNOmite can display accurate engine RPM.

The DYNOmite Data Acquisition Computer can automatically calculate the gear ratio if its yellow "AC INPUT" RPM-A (Frequency 1) lead is connected to an appropriate engine RPM source. Most modern outboards supply a gray color coded tachometer lead at the hand control or helm. Connect the DYNOmite's yellow lead to this gray lead RPM source.

If no gray lead is available (or it does not work) try connecting the DYNOmite's yellow lead directly to one of the un-rectified (yellow) alternator stator wires. Be sure to set the RPM pulses to the correct value - normally ½ of the number of poles in the alternator.

Splice the DYNOmite's Rev Limiter black/white "SHUT-OFF" lead into the engine's black/yellow safety kill switch wiring.

Polaris Snowmobiles and PWC's:
Splice the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead into the sled's yellow lighting harness lead. Be sure to set the RPM pulses to the correct value - normally ½ of the number of poles in the alternator.

Splice the DYNOmite's Rev Limiter black/white "SHUT-OFF" lead into the engine's black safety kill switch wiring.

Yamaha Snowmobiles and PWC's:
Splice the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1)lead into the sled's yellow lighting harness lead. Be sure to set the RPM pulses to the correct value - normally ½ of the number of poles in the alternator.

If you have the optional Ignition Kill Switch Relay Kit, connect the DYNOmite's Rev Limiter black/white "SHUT-OFF" lead to the Relay Kit's black/white lead. Attach the other leads from the Relay Kit as shown in its separate instructions. On some Yamaha ignitions you can connect the

DYNOmite's black/white "SHUT-OFF" lead directly to the engine's black/white safety kill switch wiring. You can try this method first to see if the rev-limiter works.

Arctic Cat Snowmobiles and PWC's:
Splice the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead to the sled's yellow lighting harness lead. Be sure to set the RPM pulses to the correct value - normally ½ of the number of poles in the alternator.

If you have the optional Ignition Kill Switch Relay Kit, connect the DYNOmite's Rev Limiter black/white "SHUT-OFF" lead to the Relay Kit's black/white lead. Attach the other leads from the Relay Kit as shown in its separate instructions.

Ski-Doo Snowmobiles and PWC's:
Splice the DYNOmite's yellow "AC INPUT" Engine RPM-A (Frequency 1) lead into the sled's lighting harness lead. Be sure to set the RPM pulses to the correct value - normally ½ of the number of poles in the alternator.

Splice the DYNOmite's Rev Limiter black/white "SHUT-OFF" lead into the engine's black/white safety kill switch wiring.

Tip: *In all cases you will have to insure that the DYNOmite Data Acquisition Computer is set to the correct Engine RPM1 Signal Type and RPM1 sources – harness hook-up for the connection you've made. (See "LCD INTERFACE - Run Setup" section and "LCD INTERFACE - Configure" section).*

The 15-channel (for Basic boards only) "Full Function" DYNOmite Data Acquisition harness supports extra transducer and controller functions beyond the standard harness leads. Refer to the labels on these extra connectors as you review the following instructions. This information pertains to both "single board" and "multiple-board" DYNOmites.

GROUND is the DYNOmite harness's black main system ground lead, as well as the ground for many accessories). It must always be clamped directly to the single main engine/battery/building/chassis/power-supply ground.

> ***CAUTION: Avoid connecting to engine mounted terminal blocks, frame ground straps, etc. Rubber mounts, bushing, corrosion, or even the slight added electrical resistance of extra junctions and wiring can electrically position the DYNOmite's electronics "above" true ground. Failure to follow this precaution can lead to electromagnetic data interference or power circuit damage - not covered under warranty!***

TORQUE ARM (Strain 1) input lead carries the signal from the DYNOmite's absorber mounted strain gage equipped torque arm or millivolt load cell. Plug the mating 4-pin connectors from both the DYNOmite harness and the torque source together. An optional extension harness is available for this lead for remote mounting of the console.

> ***CAUTION: If you are using an amplified (0-5 volt output) S-beam or load cell type torque transducer, it must not be plugged into this Torque Arm connector. Rather, connect it to the "LOAD CELL 0-5 Volt" #1 channel.***

Tip: *This must be a clean, dry, and tight connection to provide consistent torque readings. Keep the connector away from dripping water as even a tiny change in electrical resistance will make it read incorrectly.*

AC Input (Frequency 1) "Engine RPM-A" yellow lead can often be tied into the engine's tachometer "sender" circuit. Like the engine's built-in tach, the DYNOmite computer counts the AC or sine or square wave pulses to determine RPM. On most engines this circuit is the primary (low voltage) wire connected between the ignition coil and the distributor. On engines with the coil in the distributor, a separate tachometer lead is usually provided. Aftermarket ignitions (especially multi-spark units) often have a dedicated tachometer output in the ignition module. While the DYNOmite alone is compatible with many tachometer sources optional accessories are available to adapt to most any problem installation.

SERVO (Stepper - output) lead drives the optional Electronic Auto-Load Servo. It has a 6-pin DIN connector which should be plugged into the mating female receptacle (in the servo's control housing). An optional extension harness is available for this lead for remote mounting of the console. This Auto-Load Servo is to be controlled by the DYNOmite's "Board #1" only (top port and harness). The identical lead available on "Board #2" is meant for operating the optional Electronic Throttle Controller.

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EGT ##' (millivolt ##) input leads support each of the exhaust gas temperature channels available with the optional DYNOmite EGT kit. The engine's exhaust must be modified to accept Type-K thermocouples mounted via either 1/8" pipe thread adapters or 3/16" band clamps. The polarized yellow jacks (on the harness leads) plug into the thermocouples heat shielded pigtails. Thermocouples generate a millivolt level signal that increases in proportion to temperature. Optional sparkplug washer type thermocouples are available for use on air cooled engines; and a flexible "oil dip-stick" version works well for chassis dyno testing.

Tip: *Don't substitute other type thermocouples. Their voltage vs. temperature curves will not match the DYNOmite's programming.*

CAUTION: Avoid running the thermocouple leads parallel to the ignition wires, as this can induce electromagnetic energy into the thermocouples, causing them to display erroneously high readings.

E-TEMP (Thermistor A) input lead connects to a precision temperature thermistor for engine coolant, oil, or air temperatures up to 255 degrees Fahrenheit. It simply snaps onto the standard Bosch type temperature sender connecter.

Tip: *Don't substitute non-DYNOmite thermistors. Numerous Bosch thermistors are available with similar looking housings, but their resistance vs. temperature curves will not match the DYNOmite's programing. Avoid running the thermistor leads parallel to the ignition wires as it is possible to induce electromagnetic energy into the harness that may interfere with other sensitive data acquisition channels.*

FLOW SENSOR (Frequency 3) input lead supports the optional Brake Specific Fuel Consumption Transducer Test kit for monitoring various DYNOmite fuel-flow turbines. Route the engine, test stand, or cell mounted fuel flow turbine's pigtail (three wire connector) to the matching connector on the DYNOmite's harness. The primary (1st) fuel flow transducer goes on the DYNOmite's "Board #1" (top port and harness). An identical lead is available on "Board #2" for reading a second flow transducer. DYNO-MAX supports dual transducers for both parallel flow "A + B" or return flow "A - B" installations.

Tip: *It is possible to run two flow transducers on a single board DYNOmite. Call Land & Sea for details.*

PITOT (pressure) (0-5 Volt 4) input lead supports optional DYNOmite Pressure Transducers. Various ranges of transducers for monitoring fuel, manifold, and oil pressure, etc. are available - with matching 4-wire connectors.

JACK SHAFT (Frequency 2) input lead supports the DYNOmite Magnetic (or inductive & toothed gear) RPM Pickup kits. For engine dyno testing this can be used as the main RPM source - by mounting the sensor at the absorber. DYNOmite water brakes have a 3/4"-16 threaded hole (near the center arbor) that the sensor screws into (after removing the blue anodized plug). The sensor's long lead routes back to the DYNOmite harness's matching 5-pin DIN Jack Shaft connector. An optional extension harness is available for this lead if you are remote mounting the console.

For obtaining MPH from a chassis dyno (with an eddy current or other absorber) or monitoring the shift-ratio via an auxiliary shaft's RPM, the pickup can read a rotating magnet in a shaft mounted. For these installations the sensor is held in close proximity to the collar via a threaded bracket.

WEATHER STATION input lead supports the optional DYNOmite Weather Station for capturing Barometric Pressure, Air Temperature, and Relative Humidity for dyno testing. The Weather Station is usually mounted near the engine's air intake (but away from the hot exhaust). It simply plugs onto the DYNOmite harness's mating 9-pin connector.

Tip: *Only DYNOmite "Board #1" (top port and harness) supports the Weather Station. For additional board pair sets, this connector can be used to support extra engine temperature thermistors and/or pressure transducers (via a special adapter cable).*

AUX-2 in (0-5 Volt 1) is a generic 0-5 volt input lead with a 4-pin connector to support various 0-5 volt analog sensor options (particularly amplified 0-5 volt load cells). Call for more information prior to purchasing or installing any special sensors.

ACCELEROMETER (0-5 Volt 2) is a generic 0-5 volt input lead with a 4-pin connector to support various 0-5 volt analog sensor options (including an accelerometer kit for in-vehicle testing). Call for more information prior to purchasing or installing any special sensors.

SHUT OFF (Relay A - Rev Limit) is the DYNOmite's built in adjustable RPM-limiter control signal. This ignition "kill" circuit works by pulling the harness's black/white lead to near ground. If the ignition system being tested is compatible with this grounding method, the black/white lead may be safely connected directly to the ignition system - provided the circuit is not over 120 volts and is unable to deliver more than 1 amp. If this is not the case, an optional DYNOmite Kill Switch Relay Kit must be used to enable the rev-limiter function.

Tip: *Using the included wiring splice adapter terminals makes plugging and unplugging the computer simple. For a pack of additional terminals, you can order Land & Sea part #430-133.*

CAUTION: The above wiring information is only general. Consult your engine's service manual and/or Land & Sea if you are not sure about how to wire your specific application.

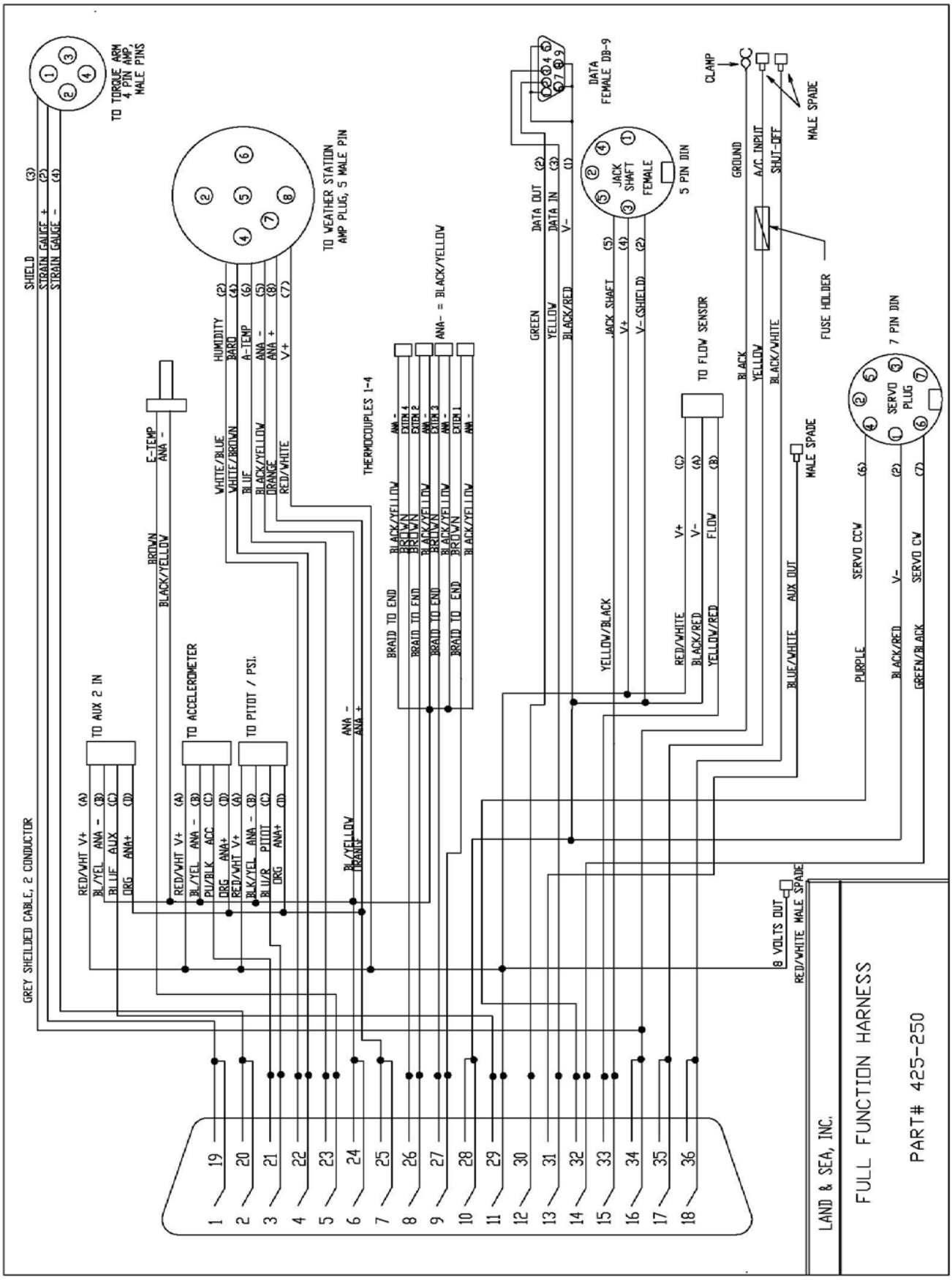
AUX OUT (output) is a reserved output lead (blue in color - and not available on all harnesses) used to activate the DYNOmite Relay Kit. It provides a low current (less than 100 milliamps) 7 volt DC output. If you are installing a DYNOmite Relay Kit, follow the special instructions included with it.

CAUTION: Never hook this blue 100-milliamp (maximum) output lead to directly drive a higher current device!
Failure to follow this precaution will lead to circuit damage not covered under warranty!

8-VOLTS OUT is a reserved output lead (red/white in color - and not available on all harnesses) that supplies 8-volt DC (at less than 50-milliamps) for powering special DYNOmite sensor options.

CAUTION: This is an OUTPUT ONLY voltage source only! Never hook this lead to an external battery!
Failure to follow this precaution will lead to circuit damage not covered under warranty!

Full Function Basic 15-Channel Harness



The 28-channel (for Pro boards only) "Full Function" DYNOmite Data Acquisition harness supports many optional transducer and controller functions beyond the standard harness leads. Refer to the labels on these extra connectors as you review the following instructions. This information pertains to both "single board" and "multiple-board" DYNOmites.

GROUND is the DYNOmite harness's black main system ground lead, as well as the ground for many accessories). It must always be clamped directly to the single main engine/battery/building/chassis/power-supply ground.

> ***CAUTION: Avoid connecting to engine mounted terminal blocks, frame ground straps, etc. Rubber mounts, bushing, corrosion, or even the slight added electrical resistance of extra junctions and wiring can electrically position the DYNOmite's electronics "above" true ground. Failure to follow this precaution can lead to electromagnetic data interference or power circuit damage - not covered under warranty!***

TORQUE (Strain 1) input lead carries the signal from the DYNOmite's absorber mounted strain gage equipped torque arm or millivolt load cell. Plug the mating 4-pin connectors from both the DYNOmite harness and the torque source together. An optional extension harness is available for this lead for remote mounting of the console.

> ***CAUTION: If you are using an amplified (0-5 volt output) S-beam or load cell type torque transducer, it must not be plugged into this Torque Arm connector. Rather, connect it to the "LOAD CELL 0-5 Volt" #1 channel.***

> **Tip:** *This must be a clean, dry, and tight connection to provide consistent torque readings. Keep the connector away from dripping water as even a tiny change in electrical resistance will make it read incorrectly.*

Engine RPM-A (Frequency 1) is the DYNOmite's yellow "AC INPUT" lead and can often be tied into the engine's tachometer "sender" circuit. Like the engine's built-in tach, the DYNOmite computer counts the AC or sine or square wave pulses to determine RPM. On most engines this circuit is the primary (low voltage) wire connected between the ignition coil and the distributor. On engines with the coil in the distributor, a separate tachometer lead is usually provided. Aftermarket ignitions (especially multi-spark units) often have a dedicated tachometer output in the ignition module. While the DYNOmite alone is compatible with many tachometer sources optional accessories are available to adapt to most any problem installation.

ABSORBER RPM-C (Frequency 2) input lead supports the DYNOmite Magnetic (or inductive & toothed gear) RPM Pickup kits. For engine dyno testing this can be used as the main RPM source - by mounting the sensor at the absorber. DYNOmite water brakes have a 3/4"-16 threaded hole (near the center arbor) that the sensor screws into (after removing the blue anodized plug). The sensor's long lead routes back to the DYNOmite harness's matching 5-pin DIN Jack Shaft connector. An optional extension harness is available for this lead if you are remote mounting the

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console.

For obtaining MPH from a chassis dyno (with an eddy current or other absorber) or monitoring the shift-ratio via a secondary jack shaft's RPM, the pickup can read a rotating magnet in a shaft mounted. For these installations the sensor is held in close proximity to the collar via a threaded bracket.

FUEL FLOW (Frequency 3) input lead supports the optional Brake Specific Fuel Consumption Transducer Test kit for monitoring various DYNOmite fuel-flow turbines. Route the engine, test stand, or cell mounted fuel flow turbine's pigtail (three wire connector) to the matching connector on the DYNOmite's harness. The primary (1st) fuel flow transducer goes on the DYNOmite's "Board #1" (top port and harness). An identical lead is available on "Board #2" for reading a second flow transducer. DYNO-MAX supports dual transducers for both parallel flow "A + B" or return flow "A - B" installations.

AIR FLOW (Frequency 4) input lead supports the optional Air Flow Specific Fuel Consumption Transducer Test kit for monitoring various DYNOmite air-flow turbines. Route the turbine's pigtail 5-pin DIN Jack Shaft connector to the matching connector on the DYNOmite's harness. The primary (1st) air-flow turbine goes on the DYNOmite's "Board #1" (top port and harness). An identical lead is available on "Board #2" for reading a second turbine. DYNO-MAX supports up to three turbines for parallel "A + B + C " flow readings.

Tip: *It is possible to run any combination of up to three air or fuel flow transducers on a single board DYNOmite Pro Board set. Call Land & Sea for details.*

ENGINE TEMP (Thermistor A) input lead connects to a precision temperature thermistor for engine coolant, oil, or air temperatures up to 255 degrees Fahrenheit. It simply snaps onto the standard Bosch type temperature sender connecter.

Tip: *Don't substitute non-DYNOmite thermistors. Numerous Bosch thermistors are available with similar looking housings, but their resistance vs. temperature curves will not match the DYNOmite's programing. Avoid running the thermistor leads parallel to the ignition wires as it is possible to induce electromagnetic energy into the harness that may interfere with other sensitive data acquisition channels.*

EGT ##' (milliVolt ##) input leads support each of the exhaust gas temperature channels available with the optional DYNOmite EGT kit. The engine's exhaust must be modified to accept Type-K thermocouples mounted via either 1/8" pipe thread adapters or 3/16" band clamps. The polarized yellow jacks (on the harness leads) plug into the thermocouples heat shielded pigtails. Thermocouples generate a millivolt level signal that increases in proportion to temperature. Optional sparkplug washer type thermocouples are available for use on air cooled engines; and a flexible "oil dip-stick" version works well for chassis dyno testing.

Tip: *Don't substitute other type thermocouples. Their voltage vs. temperature curves will not match the DYNOmite's programming.*

CAUTION: Avoid running the thermocouple leads parallel to the ignition wires, as this can induce electromagnetic energy into the thermocouples, causing them to display erroneously high readings.

LOAD CELL (0-5 Volt 1) input lead supports amplified 0-5 volt range load cells and torque transducers (for use with "Torque Source Q, R, S, or T" calibration selections offered by the DYNOmite LCD and DYNO-MAX software).

Tip: *If you have a choice between using a millivolt output torque source (on the "Torque - Strain 1" channel vs. a 0-5 volt transducer, use the millivolt version. It eliminates one more amplification stage - improving stability,*

AFR (0-5 Volt 2) input lead supports the DYNOmite Air Fuel Ratio modules This channels is also available for your other 0-5 volt sensors, including all the optional DYNOmite acceleration, knock %, position, pressure, and smoke opacity sensors - with their mating 4-wire connectors.

WEATHER STATION input lead supports the optional DYNOmite Weather Station for capturing Barometric Pressure, Air Temperature, and Relative Humidity for dyno testing. The Weather Station is usually mounted near the engine's air intake (but away from the hot exhaust). It simply plugs onto the DYNOmite harness's mating 9-pin connector.

Tip: *Only DYNOmite "Board #1" (top port and harness) supports the Weather Station. For additional board pair sets, this connector can be used to support extra engine temperature thermistors and/or pressure transducers (via a special adapter cable).*

PRESSURE (0-5 Volt 4) input lead supports the full range of DYNOmite Pressure Transducers This channels is also available for your other 0-5 volt sensors, including all the optional DYNOmite acceleration, air/fuel ratio, knock %, position, and smoke opacity sensors - with their mating 4-wire connectors.

KNOCK SENSOR (0-5 Volt 6) input lead supports the DYNOmite Universal Knock Sensor Module - for use with DYNO-MAX's "Knock Index %" formula. This channel is also available for your other 0-5 volt sensors, including all the optional DYNOmite acceleration, air/fuel ratio, position, pressure, and smoke opacity sensors - with their mating 4-wire connectors.

ACCELEROMETER (0-5 Volt 7) input lead supports the DYNOmite Vehicle Accelerometer kit. This channels is also available for your other 0-5 volt sensors, including all the optional DYNOmite air/fuel ratio, knock %, position, pressure, and smoke opacity sensors - with their mating 4-wire connectors.

HARNESS KNOB% (Position 2) input lead supports an optional panel potentiometer for custom applications. This channels is also available for your other 0-5 volt sensors, including all the optional DYNOmite acceleration, air/fuel ratio, knock %, pressure, and smoke opacity sensors - with their mating 4-wire connectors.

SERVO FEEDBACK% (Position 3) input lead supports the DYNOmite Throttle Position Indicator kit. This channels is also available for your other 0-5 volt sensors, including all the optional

DYNOmite acceleration, air/fuel ratio, knock %, pressure, and smoke opacity sensors - with their mating 4-wire connectors.

SERVO CONTROL (Stepper - output) lead drives the optional Electronic Auto-Load Servo. It has a 6-pin DIN connector which should be plugged into the mating female receptacle in the servo's (or eddy current control's) housing). An optional extension harness is available for this lead for remote mounting of the console. This Auto-Load Servo is to be controlled by the DYNOmite's "Board #1" only (top port and harness). The identical lead available on "Board #2" is meant for operating the optional Electronic Throttle Controller.

REV LIMITER (Relay A) "Shut Off" is the DYNOmite's built in adjustable RPM-limiter control signal. This ignition "kill" circuit works by pulling the harness's black/white lead to near ground. If the ignition system being tested is compatible with this grounding method, the black/white lead may be safely connected directly to the ignition system - provided the circuit is not over 120 volts and is unable to deliver more than 1 amp. If this is not the case, an optional DYNOmite Kill Switch Relay Kit must be used to enable the rev-limiter function.

Tip: *Using the included wiring splice adapter terminals makes plugging and unplugging the computer simple. For a pack of additional terminals, you can order Land & Sea part #430-133.*

CAUTION: The above wiring information is only general. Consult your engine's service manual and/or Land & Sea if you are not sure about how to wire your specific application.

D-A-1 0-5V-Output (Relay B) is a reserved 0-5 volt output lead (blue/white in color - and not available on all harnesses). The signal may be used to control the DYNOmite Relay Kit or under DYNO-MAX "Pro" formula control for custom applications. The channel provides a low current (less than 100 milliamps) 0-5 volt DC output. If you are installing a DYNOmite Relay Kit, follow the special instructions included with it.

CAUTION: Never hook this blue/white 100-milliamp (maximum) output lead to directly drive a higher current device!
Failure to follow this precaution will lead to circuit damage not covered under warranty!

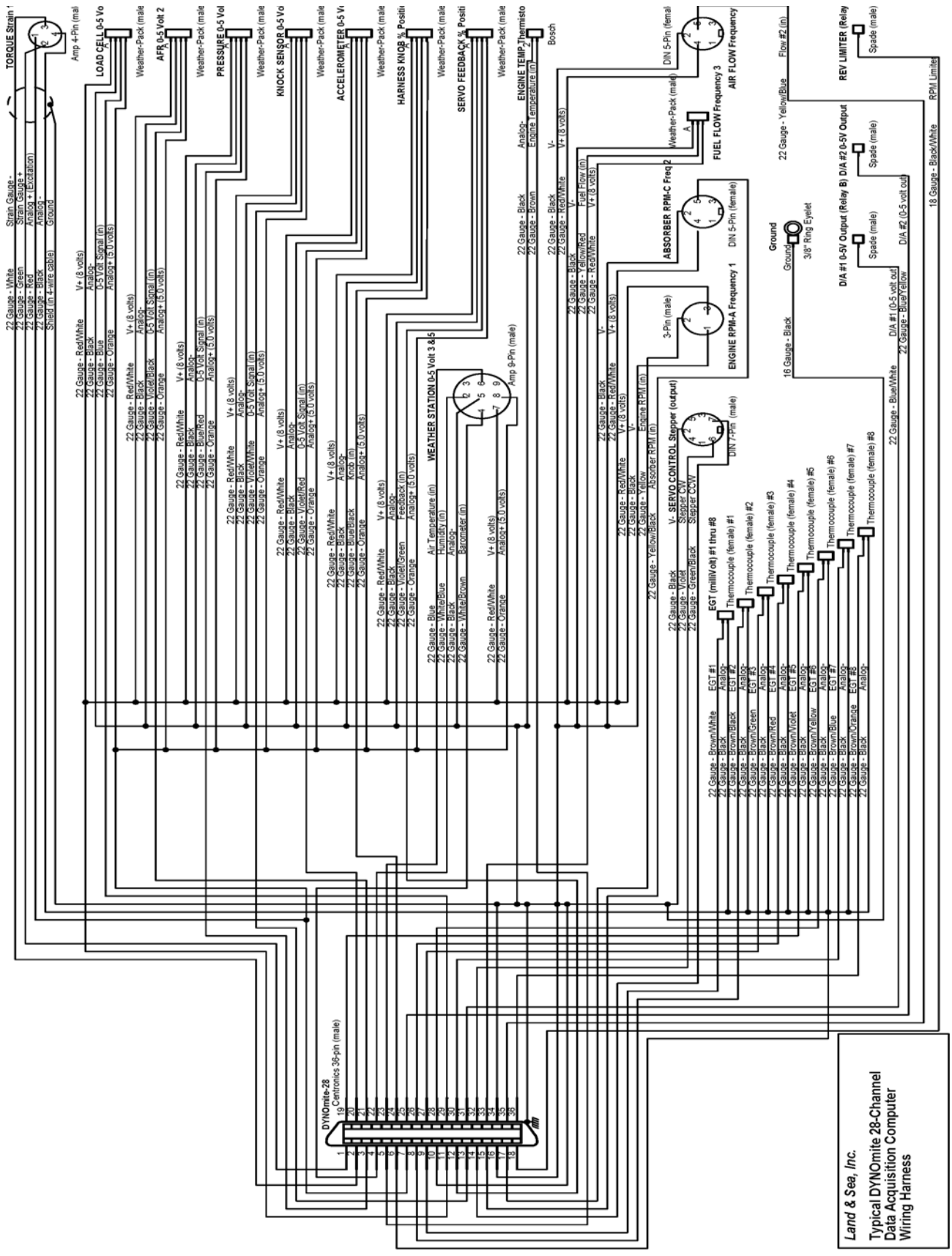
D-A-2 0-5V-Output is a reserved 0-5 volt output lead (blue/yellow in color - and not available on all harnesses). The signal may be used to control the DYNOmite Relay Kit or under DYNO-MAX "Pro" formula control for custom applications (such as controlling AC motor/absorber vector-less drives). The channel provides a low current (less than 100 milliamps) 0-5 volt DC output. If you are installing a DYNOmite Relay Kit, follow the special instructions included with it.

CAUTION: Never hook this blue/yellow 100-milliamp (maximum) output lead to directly drive a higher current device!
Failure to follow this precaution will lead to circuit damage not covered under warranty!

8+VOLTS (Output) is a reserved output lead (red/white in color - and not available on all harnesses) that supplies 8-volt DC (at less than 50-milliamps) for powering special DYNOmite sensor options - primarily the Inductive Engine RPM Clamp..

CAUTION: This is an OUTPUT ONLY voltage source only! Never hook this lead to an external battery!
Failure to follow this precaution will lead to circuit damage not covered under warranty!

Full Function Pro 28-Channel Harness



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Follow the steps below if you are adding a 0-5 volt (amplified) S-beam or load-cell type torque transducer to the DYNOmite Data Acquisition Computer system.
Note: This section does not pertain to the DYNOmite 3mv/Volt S-beam or Torque Arms normally supplied with our dynamometer systems!

LOAD CELL (0-5 Volt 1) is the input lead that supports amplified 0-5 volt range load cells and torque transducers for use with "Torque Source Q, R, S, or T" calibration selections offered by the DYNOmite LCD and DYNO-MAX software.

Tip: *If you have a choice between using a millivolt output torque source (on the "Torque - Strain 1" channel vs. a 0-5 volt transducer, use the millivolt version. It eliminates one more amplification stage - improving stability,*

1a If you are replacing a old torque transducer, first remove it from the brake's moment arm.

Tip: *If you wish (and if you have clearance) you may be able to mount the DYNOmite's Electronic Load Cell in-line (i.e. in series) with your dynamometer's original torque transducer - so that BOTH torque measuring devices are operational.*

1b If you are installing a PRESSURE LINE style transducer, use the included brass tee to plumb the DYNOmite's Electronic Pressure Line Transducer into your dyno's existing pressure gauge line. (Skip to Step #4 below)

2 Select a mounting location for the base of the DYNOmite load cell (either of the sides with the threaded bolt holes) on your dynamometer test stand. The location must have enough clearance for the included rubber vibration isolation dampener and the spherical rod end linkage. The rod end will need to be attached to the brake's torque arm - at exactly 90 degrees to the compressive rotation of the brake.

CAUTION: Your mounting arrangement must not apply side loads to the load cell. Also, unless otherwise noted, only compressive forces (in-line with the threaded mounting holes) are allowed on the rubber isolation dampener!

3 Using the supplied spherical rod end linkage and vibration mount (or appropriate equivalents as required by your custom installation) attach the brake housing's moment arm to the load cell. Depending on the installation, you may need to drill holes or fabricate custom mounts.

4 The transducer is wired to the included 0-5 volt Torque Transducer Amplifier Module. That module's connector must be plugged into the DYNOmite 28-channel harness's **LOAD CELL (0-5 Volt 1)** (or the 15-channel harness's **AUX 2 IN (0-5 Volt 1)** lead).

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Tip: *The DYNOmite provides both fixed analog electrical dampening and adjustable digital software damping. However, some dynamometer's absorber load cell coupling designs and/or engine characteristics require increasing the time-constant of this electrical dampening - to acquire a more suitable torque signal. For smoothing the torque signal, try adding about a 100 Microfarad capacitor (6, 12, or 16-volt) across the blue (+) and black (-) leads of the harness's "Load Cell" connector. (Note: You don't want to mask meaningful torque spikes, so if 100 provides too much dampening, retry with a 47 Microfarad capacitor, etc.)*

5a If you are using a DYNOmite LCD interface for set up, see either the "DYNOmite-Basic LCD INTERFACE - Configure" section 7.2 or the Pro board set's "PRO LCD INTERFACE - Calibrate Channels" section 7.10 (as appropriate) for instructions on selecting and calibrating your 0-5 volt source load cell.

5b If you are using DYNO-MAX see its On-Line Help under "Calibrate DYNOmite Channels" and "Torque Source".

The DYNOmite-Basic Data Acquisition Computer board sets support either RS-232 serial port communication with a DYNO-MAX equipped PC or printing directly to an optional DYNOmite Portable Thermal Printer. Additionally many RS-232 serial port compatible ASCII character printers are also compatible. All such communication requires an appropriate cable interface and configuration.

> ***CAUTION: Do not attempt to hook a parallel printer directly to the DYNOmite. You might damage both the printer and the DYNOmite. Such damage is not covered under the DYNOmite's warranty.***

DYNOmite Portable Thermal Printer Hook-Up

1 To print to the optional battery powered DYNOmite Portable Thermal printer just plug it in using the include DB-9 male to DB-9 female serial cable adapter.

> ***CAUTION: Do not use a standard straight through-serial cable without also having this special cable adapter in the line!***

2 The DYNOmite Portable Thermal printers (Model #DPU414) have software "DIP switches" that control their interface. Make sure they are set as follows:

SW-!	*Switch #1 = OFF*	*Input Method = Serial*
	Switch #2 = ON	*Printing Speed = High*
	Switch #3 = ON	*Auto Loading = On*
	Switch #4 = OFF	*CR function = Carriage return and line feed*
	Switch #5 = ON	*DIP SW Setting Command = Enable*
	Switch #6 = OFF	*Printing Density = 100%*
	Switch #7 = ON	*Printing Density = 100%*
	Switch #8 = ON	*Printing Density = 100%*
SW-2	*Switch #1 = ON*	*Print mode = Normal printing (40 columns)*
	Switch #2 = ON	*User defined characters = On*
	Switch #3 = ON	*Character Type = Ordinary characters*
	Switch #4 = ON	*Zero font = 0*
	Switch #5 = ON	*International character set = American*
	Switch #6 = ON	*International character set = American*
	Switch #7 = ON	*International character set = American*
	Switch #8 = OFF	*International character set = American*
SW-3	*Switch #1 = ON*	*Data bit length = Eight bits*
	Switch #2 = ON	*Parity permission = Without*
	Switch #3 = ON	*Parity condition = Odd*
	Switch #4 = ON	*Flow control = H/W Busy*
	Switch #5 = ON	*Baud rate = 4,800*
	Switch #6 = OFF	*Baud rate = 4,800*
	Switch #7 = OFF	*Baud rate = 4,800*

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Non-DYNOmite RS-232 Serial Port (ASCII character) Printer Hook-Up

Tip: *Only character based printers will work with the DYNOmite. You can not use any inkjet (or some laser) printers that require a Windows printer driver to function. However, you can use almost any type of Windows compatible printer (with your PC) via DYNO-MAX.)*

1 Interfacing and RS-232 serial device (like a printer) requires both a properly wired cable and the correct configuration of the device's serial interface.

Tip: *The information below is given to assist knowledgeable computer technicians in making this simple (but often frustrating) match-up.*

2 Just three wires are required between the DYNOmite and the serial device. They are:
DYNOmite's integral female DB-9 pin #5 (ground)
DYNOmite's integral female DB-9 pin #2 (data out of DYNOmite to your serial device)
DYNOmite's integral female DB-9 pin #3 (data into DYNOmite from your serial device)

3 The DYNOmite communicates at 4,800 baud rate and requires the device to be set for 8-bits, no stop bits, and no parity. Set up your printer accordingly (see the printer's manual).

4 The device must supply a Clear To Send (high) signal to the DYNOmite's female DB-9 pin #3 or the DYNOmite will assume that no printer is attached and instead send output data to its LCD display. Most printers can supply an appropriate Clear To Send signal on one or more pins (typically pins 20, 11, or 6) and the exact pins and polarity may be definable with DIP switches, jumpers, or in a set-up menu. Consult your printers manual for documentation. You will need a properly configured cable and/or adapter to connect your printer's Clear To Send cabling requirements to the DYNOmite's integral data in port (pin #3).

5 The device must have its data in port wired to the DYNOmite's data out port. Consult your printers manual for documentation. As with the step above, you will need a properly configured cable and/or adapter to tie your printers data in port to the DYNOmite's integral data out port (pin #2)

6 If your printer uses a DB-9 connector it most likely has its data ground on pin #5 (the same as the DYNOmite). In such cases the data ground will run straight through from pin #5 to pin #5.
If your printer uses a DB-25 connector it most likely has its data ground on pin #7. In such cases you will need a properly configured cable and/or adapter to tie your printer's data ground to the DYNOmite's pin #5.

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The DYNOmite-Pro Data Acquisition Computer board sets support either RS-232 serial (DB 9 pin port) or full speed USB (Universal Serial Bus) communications with a DYNO-MAX equipped PC. All such communication require an appropriate cable interface and configuration.

Tip: *Although DYNOmite-Pro boards support either RS-232 or USB communication, the slower RS-232 standard is more resistant to the electro interference (EMI or RFI). The 200-Hertz (200 records per second) speed capability of this serial port (at 115,200 baud rate) is more than enough for most types of dynamometer testing.*

Most quality straight through DB-9 male to DB-9 female serial cable will communicate fine between the DYNOmite and your PC - in an "electrically quiet" office environment. However, we strongly recommend the optional DYNOmite shielded and filtered cables for the best resistance to the severe ignition noise present in a typical dyno cell.

In order to communicate with DYNO-MAX, both the PC and the DYNOmite board set must be set to the same communication mode. To change a DYNOmite-Pro board from USB to serial mode follow these steps:

1a If the DYNOmite Data Acquisition Computer has the optional LCD with 16-button keypad interface option, use the Menu to go to "CALIBRATE CHANNELS - COMMUNICATION SET UP" and select "RS-232 115,200 Baud".

<COMMUNICATION SET UP is used to configure the serial link between the DYNOmite Data Acquisition Computer and a PC or laptop running DYNO-MAX software..

If you do not need to change the Communication mode, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *The modes selected here and in DYNO-MAX must match. Otherwise communication errors will occur and no data exchange can take place!.*

1b If the DYNOmite Data Acquisition Computer does not have the optional LCD with 16-button keypad interface option, you can short a pair of harness pins together and then power cycle the DYNOmite to force it into RS-232 mode.

If you have a Full Function Harness, disconnect any attached Weather Station and short the harness pins #5 and #6 (in the harness connector that is labeled for the Weather Station) together (these are its Air Temperature leads). If you do not have a Full Function harness, instead short pins #23 and #27 of the DYNOmite 36-pin Centronics harness connector (these pins are for the same Air Temperature circuit).

While the pair of pins is still shorted, power cycle the DYNOmite (turn it for 15 seconds and then back on). This will force a change in its communication mode to use only the RS-232 port

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(at its default 115,200 baud rate).

You will still have to put DYNO-MAX into RS-232 mode (using the correct Comm. Port and matching Baud Rate assignment) before actual communications can take place! This jumper trick just insures that the DYNOmite itself is in RS-232 mode.

Tip: *In RS-232 mode the DYNOmite's Orange (Output) LED will stay on for at least 1 full second during every power up. If it turns back off (and stays off) after 1-1/4 seconds, that is because it has not received any response from the DYNO-MAX on the PC.*

Note: The Red (Receive) LED will flash whenever the DYNOmite detects that DYNO-MAX is sending data via RS-232 mode.

In USB mode, the Orange (Output) LED flashes twice per second (but only when communications with DYNO-MAX are active. There will be no automatic 1 second flash of the light during power up (in USB mode).

Note: The Red (Receive) LED should not flash if you are using USB mode. That is an indication that DYNO-MAX is sending data via RS-232 mode - which will not work if the DYNOmite is in USB mode! Both the DYNOmite and DYNO-MAX must always be set to the same communication mode!

2 From DYNO-MAX's "Electronics - Communication Ports Set Up" menu, verify that the program is also in "Serial Port (RS-232)" mode. (See its On-Line Help for step-by-step instructions.)

TIP: *In cases where DYNO-MAX and the DYNOmite are already communicating - and you just to switch between USB and serial mode, you can use DYNO-MAX to change them both. (See DYNO-MAX's On-Line Help system - under "Communication Ports Set Up" for more details.)*

CAUTION: Do not attempt to use the DB 25 pin parallel printer port to communicate with DYNO-MAX. It is not a serail port! Doing so might damage both the printer and the DYNOmite.
Such damage is not covered under the DYNOmite's warranty.

DYNOmite (parallel port) Portable Thermal Printer Hook-Up

1 To print to the optional battery powered DYNOmite (parallel port) Portable Thermal printer, just plug it in using a standard 25-pin parallel port cable.

2 The DYNOmite (parallel port) Portable Thermal printers (Model #) has software "DIP switches" that control their interface. Make sure they are set to use the parallel port, etc. as follows:

SW-1	*Switch #1 = ON*	*Input Method = Parallel*
	Switch #2 = ON	*Printing Speed = High*
	Switch #3 = ON	*Auto Loading = On*
	Switch #4 = OFF	*CR function = Carriage return and line feed*
	Switch #5 = ON	*DIP SW Setting Command = Enable*

	Switch #6 = OFF	*Printing Density = 100%*
	Switch #7 = ON	*Printing Density = 100%*
	Switch #8 = ON	*Printing Density = 100%*
SW-2	*Switch #1 = ON*	*Print mode = Normal printing (40 columns)*
	Switch #2 = ON	*User defined characters = On*
	Switch #3 = ON	*Character Type = Ordinary characters*
	Switch #4 = ON	*Zero font = 0*
	Switch #5 = ON	*International character set = American*
	Switch #6 = ON	*International character set = American*
	Switch #7 = ON	*International character set = American*
	Switch #8 = OFF	*International character set = American*
SW-3	*Switch #1 = ON*	*Data bit length = Eight bits*
	Switch #2 = ON	*Parity permission = Without*
	Switch #3 = ON	*Parity condition = Odd*
	Switch #4 = ON	*Flow control = H/W Busy*
	Switch #5 = ON	*Baud rate = 4,800*
	Switch #6 = OFF	*Baud rate = 4,800*
	Switch #7 = OFF	*Baud rate = 4,800*
	Switch #8 = OFF	*Baud rate = 4,800*

Tip: *Only character based printers will work with the DYNOmite. You can not use any inkjet (or some laser) printers that require a Windows printer driver to function. However, you can use almost any type of Windows compatible printer (with your PC) via DYNO-MAX.)*

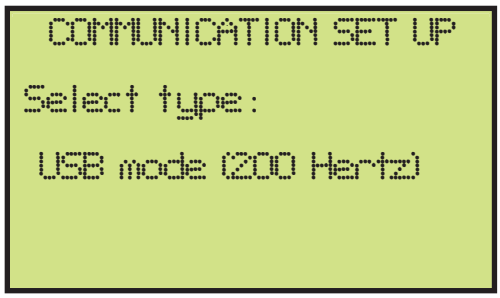
The DYNOmite-Pro Data Acquisition Computer board sets support either RS-232 serial (DB 9 pin port) or full speed USB (Universal Serial Bus) communications with a DYNO-MAX equipped PC. All such communication require an appropriate cable interface and configuration.

Tip: *Although DYNOmite-Pro boards support either RS-232 or USB communication, the slower RS-232 standard is more resistant to the electro interference (EMI or RFI). The 200-Hertz (200 records per second) speed capability of this serial port (at 115,200 baud rate) is more than enough for most types of dynamometer testing.*

A high quality USB cable should be used to insure it has a reasonable amount of shielding. Keep in mind that the USB signals are inherently more susceptible to RFI issues than the RS-232 serial interface.

In order to communicate with DYNO-MAX, both the PC and the DYNOmite board set must be set to the same communication mode. To change a DYNOmite-Pro board from serial to USB mode follow these steps:

1a If the DYNOmite Data Acquisition Computer has the optional LCD and 16-button keypad interface option, use the Menu to go to "CALIBRATE CHANNELS - COMMUNICATION SET UP" and select "USB mode (200 Hertz)" or "USB mode (1000 Hertz)" as desired.



<COMMUNICATION SET UP is used to configure the serial link between the DYNOmite Data Acquisition Computer and a PC or laptop running DYNO-MAX software..

If you do not need to change the Communication mode, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *The modes selected here and in DYNO-MAX must match. Otherwise communication errors will occur and no data exchange can take place!.*

1b If the DYNOmite Data Acquisition Computer does not have the optional LCD and 16-button keypad interface option, you can short a pair of harness pins together and power cycle the DYNOmite (while the pins are shorted).

If you have a Full Function Harness, disconnect any Engine Temperature sensor and short its pair of harness pins together (in the harness connector that is labeled for Engine Temperature). If you do not have a Full Function harness, instead short pins #5 and #23 of the DYNOmite 36-pin Centronics harness connector (these pins are for the same Engine Temperature circuit).

While the pair of pins is still shorted, power cycle (turn it for 15 seconds and then back on) the DYNOmite. This will force a change in its communication mode to use only the USB port.

You will still have to put DYNO-MAX into USB mode, have the correct Windows DYNOmite

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driver installed, and select the board's Serial Number before actual communications can take place! This jumper trick just insures that the DYNOmite itself is in USB mode.

Tip:*In USB mode, the Orange (Output) LED flashes twice per second (but only when communications with DYNO-MAX are active. There will be no automatic 1 second flash of the light during power up (in USB mode).*

Note: The Red (Receive) LED should not flash if you are using USB mode. That is an indication that DYNO-MAX is sending data via RS-232 mode - which will not work if the DYNOmite is in USB mode! Both the DYNOmite and DYNO-MAX must always be set to the same communication mode!

In RS-232 mode the DYNOmite's Orange (Output) LED will stay on for at least 1 full second during every power up. If it turns back off (and stays off) after 1-1/4 seconds, that is because it has not received any response from the DYNO-MAX on the PC.

Note: The Red (Receive) LED will flash whenever the DYNOmite detects that DYNO-MAX is sending data via RS-232 mode.

2 From DYNO-MAX's "Electronics - Communication Ports Set Up" menu, verify that the program is also in "USB (200 Hertz)" mode. (See its On-Line Help for step-by-step instructions.)

TIP: *In cases where DYNO-MAX and the DYNOmite are already communicating - and you just to switch between USB and serial mode, you can use DYNO-MAX to change the both. (See DYNO-MAX's On-Line Help system - under "Communication Ports Set Up" for more details.)*

This section is for the hand held Data Acquisition Computer module (with an LCD screen and 4-pushbuttons).

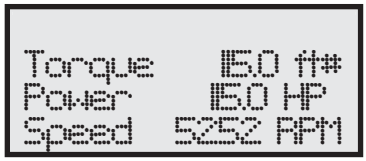
Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

CAUTION: This section's instructions pertain specifically to E-PROM Version 8.30. If you're running another version, check with Land & Sea to find out if these are applicable.

Before making the first runs on a newly mounted engine the DYNOmite Data Acquisition Computer needs to be configured for the type of engine and test. This section will describe each menu choice.

Tip: *Once you've learned to run the dyno this set-up takes only seconds. Between similar engines, just a couple of settings ever need to be changed.*

Turn on the hand held DYNOmite Data Acquisition Computer. It must be powered by a charged internal battery or running off its 12-16 volt (AC or DC output) AC wall charger.



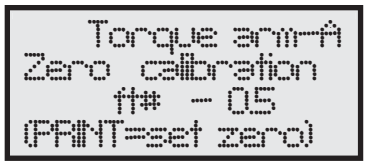
< *After a 3-second sign on message, the display will go to something like this Real-Time screen (The exact view depends on your selected display mode.)*
You will come back to this Real-Time screen when you are ready to actually test (it's what you watch during normal dynoing). However, right now you need to finish set-up calibration, so press the **CAL**ibration (**NEXT**) button.

< *This screen displays after the prior step.*
On the LCD you can select one of three menu branches (i.e. run setup, configure, and output). For this example, press **NEXT** to begin entering run setup data.

Tip: *Throughout most of the DYNOmite computer configuration, press the "**+**" button to increase "**-**" to decrease) each setting. The **NEXT** button takes you to the next screen.*

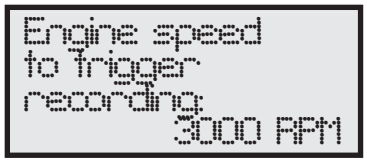
< The DYNOmite has a built in RPM limiter to help avoid inadvertent over revving. Press the "**+**" button to increase the over-speed cutout RPM or the "**-**" button to decrease it. Press **NEXT** to continue.

Tip: *Holding the **NEXT** button down while you are pressing "**+**" or "**-**" makes the numbers scroll by more quickly.*



< This allows automatically offsetting (zeroing) the strain gauge (to compensate for mechanical, electrical, and temperature induced "creep" of the DYNOmite's unloaded torque reading).
You may press the **PRINT** button if you wish to re-set the current torque reading as zero foot pounds (like the "tare" button on a meat scale). Always make sure that there is no load being applied at the torque arm before zeroing!
If you do not need to zero the arm, just press **NEXT** to continue.

Tip: *Check that you don't have cables or hoses pulling on the torque arm before zeroing the computer. You'll get an ERROR !! arm-Â torque reading is too far off to be zero. message if you attempt Zero calbration on excessive torque readings. The need to zero-out large torque readings is a sign that something is wrong... see "*TROUBLE SHOOTING - Questions & Answers*" section 13.1.*



< During a dyno test you often do not want to activate data capture until you get above a certain RPM. This setting sets an RPM you must initially exceed before recording begins. Once it triggers, the set point has no further effect during this test!

Tip: *If you are using the DYNOmite as an on-board data logger (i.e. monitoring a drag race run) you may want to set this below 100 RPM to 1 MPH. This tells the DYNOmite to instead trigger on the FIRST REVOLUTION of the DRIVE-SHAFT(about 1 MPH).*

< Like the previous Engine Speed... screen, this sets a load (horsepower level) that the engine must exceed before data capture actually begins. We include the Minimum output at trigger RPM so that revving the engine while trying to get it loaded won't prematurely initiate the recording session. Once recording starts, this setting is ignored for the duration of the test!

Tip: *If you are troubleshooting a No NEW test data recorded. error message, set this to 0 HP so the computer will begin recording data regardless of the horsepower level.*

< At the conclusion of a recorded dyno test, you usually do not want to continue recording the idling engine data. This setting controls the cut-out RPM point. After recording begins, if the engine falls below this RPM, the data capture stops!

Tip: *Don't try to set the Minimum speed to maintain recording above the Engine speed to trigger recording - you will get an error message! Otherwise, recording would stop the instant it started!*

Tip: *The preceding three screens are used to make testing easier for mechanics with less than three hands! Using Engine speed to trigger recording: and Minimum output at trigger RPM: correctly lets you push the* **TEST** *button before even starting the engine. Only after the engine is beyond your trigger RPM and loaded enough to exceed the minimum HP setting will actual recording of data begin. This prevents capturing a lot of data on an idling engine.*

```
Gear Ratio for
correct torque:

set to      1.000
```

< This must be set to the final ratio (normally 1.000) between the crankshaft and absorber shaft. Otherwise, the Torque (and consequently Hp) readings will be off by the gear multiplication factor.)

Tip: *Different manufacturers give the ratio backwards, for example:*
For testing through a transmission with a 2:1 reduction you enter 0.500
For a Yamaha V-Max 4 snowmobile witch has a 42:43 under-drive you enter 0.977
For an outboard with a 15:28 gear case enter 0.536.
For a 16:64 kart or bike chain reduction drive enter 0.250.

```
Set air temp.
for correction:

          60 F
```

< *If the optional Weather Station Module is connected you get the message:* Current Weather Station Air Temperature, *and can skip this setting.*
To compare dyno runs taken under different atmospheric conditions, it is necessary to correct the data to standard conditions. Prior to printing out your data in corrected mode, make sure the air temperature in this screen matches what the cell's air temperature was during the test run.

```
Set humidity
for correction:

        20 %
```

< *If the optional Weather Station Module is connected you get the message* Current Humidity xx%, *and can skip to the next paragraph.*
Like the Air Temperature setting in the previous step, you can set the relative humidity percentage in this screen so that it matches the cell's (as it was during the test run).

The following paragraph is only for systems with the optional Weather Station Module connected.
The previous screen only displayed the current real time relative humidity. If you need to calibrate the Weather Station's humidity reading, press the **PRINT** button.
Normally just press **NEXT** to continue.
Set Humidity for Calibration appears if you elected to re-calibrate above. Set the actual relative humidity here from a sling psychrometer reading (DYNOmite Accessories Part #950-250) or from a local weather report.

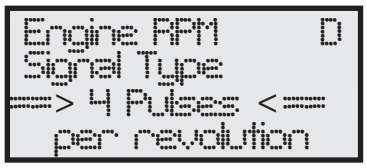
```
Absolute Baro-
metric Pressure
for correction
     29.92 inHg
```

< *If the optional Weather Station Module is connected you get the message:* Current Baro. xxxx in Hg, *and can skip to the next paragraph.*
Like the Humidity setting in the previous step, you can set the absolute barometric pressure in this screen, so that it matches the cell's (as it

was during the test run).

The following paragraph is only for systems with the optional Weather Station Module connected.
The previous screen only displayed the current real time barometric pressure. If you need to calibrate the Weather Station's barometer reading, press the **PRINT** button.
Normally just press **NEXT** to continue.
Set Barometric Pressure for Calibration appears if you elected to re-calibrate above. Set the actual barometric pressure here with an accurate absolute adjusted barometer.

Tip: *Do not use the altitude compensated barometric pressure announced in weather reports! That is not the same thing as absolute barometric pressure (except at sea level).*



< The DYNOmite gets its RPM data by counting Alternating Current pulses from the engine's tach signal (via the harness's yellow lead). Various engines and sources output different number of pulses per revolution. Scroll through the available pulses per revolution choices to match the engine being tested.

Note: Most 4-cycle engine tach signals are taken from the ignition coil primary. This generates 4-pulses per revolution for 8 cyl., 3-pulses for 6 cyl., and 2-pulses for 4 cyl. Respectively.

Tip: *If you don't know how many pulses an engine generates per revolution, test "Signal Type?" choices to match the DYNOmite to your engine's tach (a couple of hundred RPM error between your engine's analog tach and the DYNOmite's may be considered a normal error in the engine's tach). On engines that DO NOT have a suitable primary source, the yellow DYNOmite lead can often be connected to a dedicated tach signal. Optional clamp-on inductive pickups are available. If you experience RF interference, a magnetic pickup transducer in the absorber should be tried.*

< *You can skip this step if you are not using an optional magnetic shaft RPM pickup.*
The DYNOmite can get RPM data (and MPH) by counting pulses from an optional magnetic pickup on any rotating shaft (via the harness's "Jack-Shaft" lead). Scroll though to set the number of pulses per revolution to match the number of magnets on the shaft.

< *You can skip this step unless you are logging MPH data for onboard or chassis dyno testing.*
This factor calibrates the MPH display for the roller diameter (or on-board vehicles drive line). Adjust the factor up (or down) propor-

tionally until the DYNOmite's MPH display accurately duplicates the actual vehicle MPH.

Tip: *If the vehicle is actually doing 30 MPH but the display says 60 MPH, then you have to double the factor (60/30=2); so, if the factor was 70, change it to 140.*

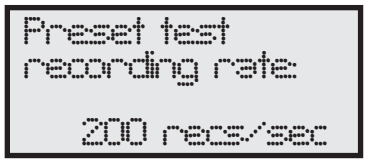
Note: For a chassis dyno the relationship of roller RPM to MPH is:

RPM Factor = 336.1 / Roller Diameter

The factor for 5" rollers = 67
The factor for -1/2" rollers = 40
The factor for 12" rollers = 28
The factor for 16" rollers = 21
The factor for 24" rollers = 14
The factor for 48" rollers = 8

< *This step is only for systems using the optional BSFC Fuel Flow Transducer kit.*
Enter your test fuel's specific gravity in this screen, as measured with a hydrometer, (DYNOmite Accessories Part #950-065) to allow the computer to accurately convert the fuel flow volume to pounds per hour.

Tip: *If you do not have a hydrometer available, entering ".730" is a good estimate (for casual testing only). Accurate but inexpensive hydrometers (for both gasoline and alcohol) are available from Land & Sea.*



< For long duration test recordings you can change from the preferred default 200 records per second setting (about 40 seconds of 200-Hz real time data capacity) to a coarser 20 or 2 records captured per second. These other settings increase recording capacity to 6 minutes and 1-hour respectively.

Tip: *For "simulated RPM step testing" and for tracking transient engine characteristics, you need to run the default "200" records per second mode.*

< *This step is only for systems using the optional Electronic Auto-Load Servo.*
This is where you set the initial "Holding" (start of test) RPM. This controls the RPM the DYNOmite holds the engine to (by automatically adjusting the Auto-Load Servo) before and after an automated sweep test cycle.

Tip: *You will use this setting often. For example: If you set the Holding RPM to 3,000 this is the RPM the Auto-Load Servo will try to hold the engine to as you move the throttle to wide-open!*

<*Like the previous step, this one is only for systems using the optional Electronic Auto-Load Servo.*
This is where you set your "End Auto Test" RPM. This selects the RPM at which DYNOmite quits Automatic Sweep Testing. This will be the peak RPM that the DYNOmite allows the engine to accelerate to during an automated test cycle (after which it will pull the engine back again to your selected Holding RPM.)

<This is the last screen for the Run Setup leg of the LCD menu system. Press **NEXT** to return back to the initial Real-Time data screen.

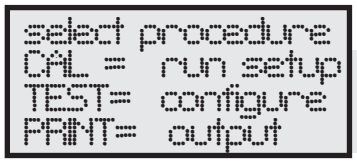
CAUTION: Before running your first dyno test, read the remaining "LCD INTERFACE - Configure and Output" sections !

This section is for the hand held Data Acquisition Computer module (with an LCD screen and 4-pushbuttons).

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

CAUTION: This section's instructions pertain specifically to E-PROM Version 8.30. If you're running another version, check with Land & Sea to find out if these are applicable.

Turn on the hand held computer and wait for the screen to change to one of the Real-Time data displays. Press the **CAL**ibration (**NEXT**) button.



< *This step displays after the prior step.*
From the LCD's choice of three menu branches (i.e. run setup, configure, and output) press **TEST** to begin entering to configure the Data Acquisition Computer module.

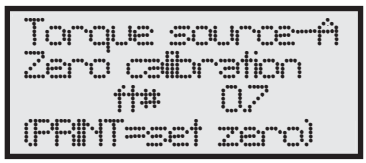
< The DYNOmite can simultaneously store calibrations for separate torque sources. This allows you to use your single DYNOmite computer on different dynamometers (e.g. automotive, kart, marine, snowmobile, etc. engines) without re-calibrating. Make sure the correct torque source is selected and press **NEXT** to continue.

Note: If you only have one torque arm, it will have been calibrated as Torque arm - "A".

If you are using a 0-5 volt Load Cell or S-beam type torque Transducer (instead of a DYNOmite absorber and Torque arm) then it is probably set up as Transducer-Q in this screen.

IMPORTANT:
Torque sources A-H are only used for Torque arms.
Torque sources I-P are only used for Rotary Boards.
Torque sources Q-X are only used for 0-5 volt Transducers.

< Unless you need to deadweight re-calibrate the torque arm (see "MAINTENANCE-Re-calibration" section 12.3) press **NEXT** to skip this function.



< This is the same Zeroing function described in the previous LCD Run Setup menu branch section. It is part of both menu trees for convenience during deadweight testing. As in the prior step, unless you need

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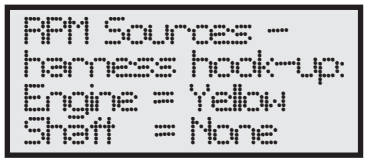
to deadweight re-calibrate the torque arm press **NEXT** to skip this function.

< As in the prior two steps, unless you need to deadweight re-calibrate the torque arm press **NEXT** to skip this function.

< *This step is only for systems using the optional Exhaust Gas Temperature thermocouple kit (see "DYNOmite Accessories Catalog")* .
The thermocouples can be individually reset to 70 degrees Fahrenheit (room temperature) for re-calibration. Press the **PRINT** button to begin selecting the channels to reset, or press the **NEXT** button to skip any resetting.
Before resetting a thermocouple channel, make sure that it has a thermocouple plugged in and has cooled to room temperature. As each numbered channel is listed, press **PRINT** to reset it or press **NEXT** to skip that probe.



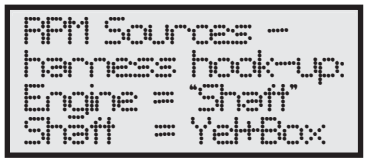
< The DYNOmite can read several optional sources for capturing engine (and drive shaft) RPM. Scroll through the following available choices to select one appropriate for the upcoming test.
Engine = Yellow, Shaft = None: *one of four RPM source choices.*
This sets the ENGINE RPM source as the harness's "AC INPUT" (yellow) lead. Typically the lead is connected to the ignition coil's negative primary post or dedicated tach circuit.
With this source:

Hp = EngineRPM x BrakeTorque x GearRatio / 5252
Torque = BrakeTorque x GearRatio
RPM = EngineRPM

Tip: *Measured torque is multiplied by the Gear ratio for correct torque factor. If you're displaying incorrect torque readings, check the factor (typically 1.000) you entered!*

< Engine = "Shaft", Shaft = Magnet: *one of four RPM source choices.*
This sets the ENGINE RPM source as the harness's "JACK SHAFT" (6-pin DIN connector) lead. Use this for optional magnetic pickups mounted in the absorber or drive-line.
With this source:

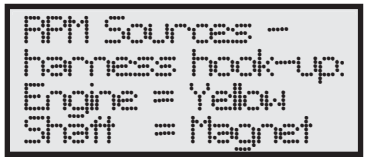
Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio
RPM = BrakeRPM / GearRatio



< Engine = "Shaft", Shaft = YeltBox: *one of four RPM source choices.*
This sets the SHAFT RPM source as the harness's "AC INPUT" (yellow) lead for use with an optional magnetic pickup adapter.

With this source:

Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio
RPM = BrakeRPM / GearRatio



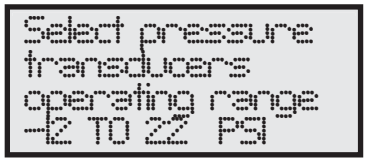
< Engine = Yellow, Shaft = Magnet: *one of four RPM source choices.*
This sets a special dual RPM source mode! The ENGINE RPM source is the harness's "AC INPUT" (yellow) lead and simultaneously SHAFT RPM is taken from the harness's "JACK SHAFT" (6-pin DIN connector) lead.
With this source:

Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio x (BrakeRPM / EnigneRPM)
RPM = EngineRPM

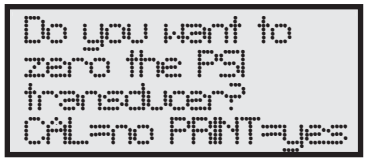
Tip: *This special RPM source mode automatically calculates a gear ratio factor "on the fly". This allows for measuring torque AFTER a shifting transmission, while still outputting data relative to the engine's crankshaft.*

Tip: *Unless you have a second reduction (e.g. rear end), set the Gear ratio for correct torque factor to 1.000 when using the Engine = Yellow, Shaft = Magnet: source mode.*

< Each type of RPM source has a unique wave-form. You can select either Falling Edge or Rising Edge triggering for the DYNOmite's RPM timer. Generally both give the same results, but try each if you get spurious RPM spikes with a particular engine.



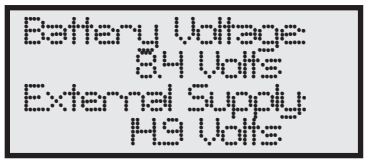
< *This step is only for systems using an optional Pressure Transducer (see "DYNOmite Accessories Catalog").*
Scroll through the various transducer pressure ranges to select the one being used.



< *This step is only for systems using an optional Pressure Transducer.*
This screen allows resetting the transducer's zero point (to compensate for any drift). Press the **PRINT** button to establish the current conditions as zero, or press the **NEXT** button to continue without resetting.

< *This step is only for systems using an optional BSFC Transducer Test kit (see "DYNOmite Accessories Catalog").*
This factor scales the fuel flow transducer's pulses (per unit flow) to the DYNOmite. Normally this factor does not have to be changed after its initial setup.
To accurately re-calibrate the transducer you must perform an accurate flow test in series with another calibrated test device. Then, if the DYNOmite's display is incorrect, raise or lower this calibration number (by the percentage of error) and re-test.

< Displays the installed EPROM's Software Version Number.



< Displays the Internal Battery Voltage and the External Charging Voltage. When the voltage is less than 6.5 volts, set-up calibration is impossible and operation is erratic. Use the charger or replace the 7.2 volt nicad battery.

Tip: *The battery is normally charged from the yellow tachometer lead during engine operation, but you can also run with the charger plugged in. Turn the computer off when not in use to avoid draining the battery.*

CAUTION: If the DYNOmite's AC INPUT (yellow) lead's <u>average</u> voltage exceeds 20 volts during testing, an OVER VOLTAGE warning screen will display. Stop the test and see the "TROUBLE SHOOTING" section for more information.
Failure to follow this precaution will lead to circuit damage not covered under warranty!

< This screen is provided for informational purposes related to initially calibrating torque arms. It is normally only used with assistance from a Land & Sea technician.

< *This step is only for systems using an optional Electronic Auto-Load Servo (see "DYNOmite Accessories Catalog").*
When using the servo there are several available load control methods.

Manual Knob mode is for totally manual hand operation of the load valve.

Manual Servo mode sets the DYNOmite to electronically regulate engine RPM (using the load valve) at a Holding RPM (which you will set during testing).

Auto 200 RPM/sec (or Auto 400 RPM/sec) mode sets the DYNOmite to electronically sweep (at the indicated rate) from an initial Holding RPM to an End Auto Test RPM (which you will set before testing).

< *This step is only for systems using an optional Electronic Auto-Load Servo.*
The larger the Rate factor the more the Auto-Load Servo "fights" changes in engine RPM. The Rate Factor is in the DYNOmite algorithm that anticipates how much to move the load valve to steady an oscillating engine.

Tip: *It is possible to increase the Rate Factor too much and actually increase oscillation. Keep the Rate, Drift, and Gain numbers in proportion until you have understood how they interact.*

<*This step is only for systems using an optional Electronic Auto-Load Servo.*

This factor adjusts the load valve's sensitivity to long term (1+ second) errors between actual Engine RPM and the desired Holding RPM. The larger the Drift factor the more aggressively the Auto-Load Servo works to gradually eliminate holding RPM deviation.

Tip: *Don't increase the Drift Factor to fight oscillation. Instead try lowering it slightly and/or concentrate on working out the Rate and Gain Factors.*

<*This step is only for systems using an optional Electronic Auto-Load Servo.*

This factor adjusts how much the Auto-Load Servo instantaneously moves in response to a change in either Engine RPM or Holding RPM. For example, with a larger Gain Factor, the load valve opens more in response to the RPM increase you get from opening the throttle.

Tip: *Avoid increasing the Gain Factor so much that it over-compensates. Ideally the load valve should initially under-compensate a bit, letting the Drift Factor close any RPM error within a second or two.*

Tip: *Limits imposed by an absorber's rate of filling (and draining) can make it impossible for any automatic valve to hold an RPM were the torque vs. RPM slope is extremely steep. In such cases, you can get some improvement by going to a dual port servo valve (which simultaneously controls both the inlet and outlet flow). Additionally, you can add enough rotating mass to stabilize ANY engine, but you will be trading off the ability to measure rapid transient conditions as you pile inertia on.*

Tip: *The larger the engine is in relationship to the absorber's limits, the larger the Rate, Drift, and Gain Factors tend to be. Because of the interrelationship between the factors, make moderate changes as you learn the system. Feel free to call Land & Sea for assistance.*

Note: The following Stepper Motor Factor settings should be a good starting point for DYNOmite-Basic boards:

Automotive engines (single rotor - water brake absorber) -
DRIFT = 16, RATE = 16, GAIN = 16

Automotive engines (dual-rotor water brake absorber) -
DRIFT = 8, RATE = 8, GAIN = 8

Automotive chassis dynos (medium inertia- water brake) -
DRIFT = 4, RATE = 24, GAIN = 16

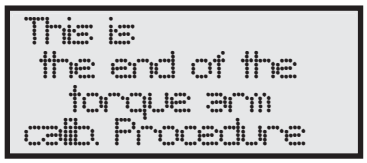
Automotive chassis dynos (high inertia - water brake) -
DRIFT = 6, RATE = 32, GAIN = 16

Automotive chassis dynos (high inertia - eddy current) -
DRIFT = 6, RATE = 8, GAIN = 32

Snowmobile and PWC engines -
DRIFT = 6, RATE = 6, GAIN = 6

Snowmobile track dynos -
DRIFT = 8, RATE = 8, GAIN = 8

Briggs and other kart engines -
DRIFT = 8, RATE = 8, GAIN = 8



< This is the last screen for the "Configure" leg of the LCD menu system. Press **NEXT** to return back to the initial Real-Time data screen.

This section is for the hand held Data Acquisition Computer module (with an LCD screen and 4-pushbuttons).

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

Turn on the hand held computer and wait for the screen to change to one of the Real-Time data displays. Press the **CAL**ibration (**NEXT**) button.

```
select procedure
CAL =   run setup
TEST= configure
PRNT=output
```

< *This screen displays after the prior step.*
On the LCD you can select one of three menu branches (i.e. run setup, configure, and output). For this example, press **NEXT** to begin entering run setup data.

```
Data-Averaging
during playback

Narrow Step mode
```

< From he LCD's choice of three menu branches (i.e. run setup, configure, and output) press **PRINT** to begin entering OUTPUT settings for the Data Acquisition Computer module. Output settings only affect playback and printout, not data collection!

```
Data-Dampening
during playback
100 records
```

< The time interval for each averaged playback line is based on this Data-Averaging setting. At the maximum of 200, one line is printed for every 1 second of recorded data (assuming the Preset test recording rate is set to the default "200" readings per second).

Tip: *Initially set Data-Averaging at 20 (preferred by professional engine builders). After gaining experience select whichever mode you need. You can reprint any run at different averaging settings! The averaging setting does not affect data collection!*

< A special Narrow Step rpm playback mode can be invoked during playback by setting Data-Averaging at 0. In this mode the computer averages all consecutive readings that are near an even 100 RPM multiple into single output lines. The DYNOmite needs at least 132 consecutive readings (within +/- 49 RPM of the same 100 RPM multiple) to average into an output a line.

Tip: *Beginners prefer the looks of STEP RPM mode printouts, but this can mask important information. When troubleshooting, print data out in a "time interval" mode - with DATA-AVERAGING set between 1 and 20.*

```
Printout and
display Mode:    1
Basic DYNOmite
engine testing.
```

< *Several LCD display and printout formats are available:*
Printout and Display Mode: 1 (default) shows Hp, Torque, RPM, and timer interval. If you are using options like EGT, BSFC, on vehicle data logging, etc., you will find that one or more of the other modes can be used to access that additional information.
Modes 9, 14, 15, and 16 are only for RS-232 serial data communi-

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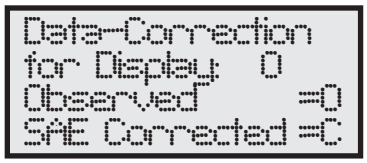
cation when using Land & Sea's optional DYNO-MAX for Windows personal computer software and RS-232 cable.

Tip: *During testing, select whichever display mode you prefer. You can change modes after recording data to review or print a run several ways. Except for Modes #9, #14, #15, and #16 (Real-time RS-232 Data Transmission), none of these modes affects data collection - only playback.*



< The DYNOmite offers both Observed and Standard Corrected data reporting during playback.
In the Observed mode "O" the Torque and Hp output is as it was actually recorded (uncorrected) during the test.
In the SAE Corrected mode "C" the computer applies the three Standard atmospheric correction factors. These factors "correct" the power readings to approximately what they would have been if you had tested at 60 degrees Fahrenheit, 0% relative humidity, and standard sea level barometric pressure (29.92"Hg.).
The heading on printed reports indicates wether correction has been applied to printed data. Use "C" (SAE Corrected mode) if you will need to compare a run with one done later (under potentially different atmospheric conditions).

Tip: *You can change the Data-Correction mode after you have recorded data (to reprint a run both ways). This setting has no affect on collecting data - only playback.*

This screen displays after the prior step.
This is the last screen for the output leg of the LCD menu system. Press **NEXT** to return back to the initial Real-Time data screen.

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

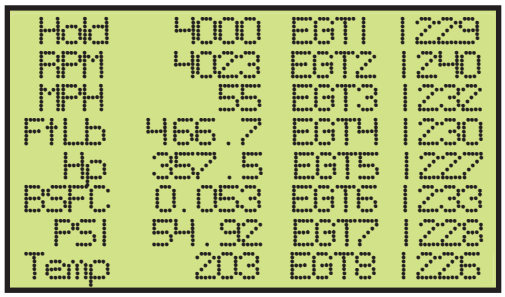
Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

CAUTION: This section's instructions pertain specifically to EEPROM Version 9.55. If you're running another version, check with Land & Sea to find out if these are applicable.

Before making the first runs on a newly mounted engine the DYNOmite Data Acquisition Computer needs to be configured for the type of engine and test. This section will describe each menu choice.

Tip: *Once you've learned to run the dyno this set-up takes only seconds. Between similar engines, just a couple of settings ever need to be changed.*

Turn on the hand held DYNOmite Data Acquisition Computer. It can be powered from (optional) alkaline, NiCad, NiMh, or Lithium internal batteries or from a 12-16 volt (AC or DC) external power supply (with a 500 milliamp minimum output rating). The (included) DYNOmite wall charger is supplied in either a 60-Hertz 115-volt input US model or 50-Hertz 230-volt input international model. Both versions output up to 500mA at (an acceptable) 12-volts .



<*After a 3-second sign on message, the display will switch to something like this "Most Fields" real-time screen. (The exact view depends on your selected display mode.)*
You should return to this real-time screen whenever you are ready to actually test (it's what you watch during normal dynoing). But first, you need to finish set-up calibration, so press the **Menu keypad button.**

The MAIN MENU screen displays (see the following "DYNOmite-Pro LCD INTERFACE - Menu" section 7.5).

Tip: *Whenever you are viewing the real-time display, pressing the Menu keypad button toggles to the MAIN MENU selection screen.*

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This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

The **MAIN MENU** (shown below) can be reached be pressing the **Menu keypad button** from the DYNOmite's real-time display screen.

The MAIN MENU *offers seven* ***submenu*** *choices (a short description for each of these options is provided below).*

To highlight one of the sub-menu selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated submenu).

To **return to the real-time display** from this screen, simply press the **Menu keypad button** again.

Tip: *Whenever you are in any of the menu system's screens, you can press the Menu keypad button to work back up the tree to the main menu or real-time display.*

Smart Record Set Up - selection option jumps to the submenu for entering your RPM, MPH, and Hp threshold points for triggering a test recording. This is also where you can change the Recording Rate (in Hertz).

LCD & Printing Set Up - selection option jumps to the submenu for selecting real-time and playback report data layout formats, dampening and averaging levels, and LCD brightness.

Enter Weather Data - selection option jumps to the submenu for entering the atmospheric conditions (prior to a test). This submenu also allows designating the data Atmospheric Correction Method to apply.

Set Up RPM Sources - selection option jumps to the submenu for picking the channel(s) to use for RPM(or speedometer) inputs, entering Gear Ratios and RPM Limiter data.

Calibrate Channels - selection option jumps to the submenu for scaling the DYNOmite's gains, offsets, etc. to match each of the currently installed input sources. This submenu also provides access to Communication Set Up - for selecting between USB and RS-232 serial mode (at various baud rates).

Configure Controls - selection option jumps to the submenu for setting up the optional Auto-Servo Load Control's behavior to match the characteristics of the test engine and absorber. *(These functions only apply if you are running the optional Servo Load Control.)*

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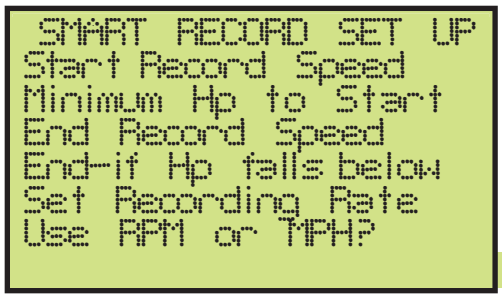
Auto/Hold Test Set Up - selection option jumps to the submenu for entering your initial Hold and End test speeds as well as the sweep rates for servo load controlled automated testing *(These functions only apply if you are running the optional Servo Load Control.)*

Tip: *Throughout the other DYNOmite-Pro menu and submenu tree screens, press the "**+**" keypad button to increase (or "**-**" to decrease) a selection. The* **Enter** *keypad button activates your selection while the* **Menu** *keypad button escapes back to the previous screen.*

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

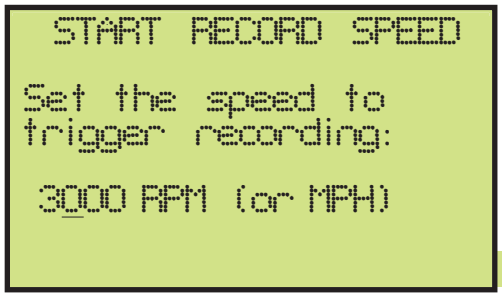
The **SMART RECORD SET UP Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<*The* SMART RECORD SET UP *offers six choices (as described below).*

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.



<START RECORD SPEED allows entry of an Engine RPM (or Vehicle Speed if you are in MPH mode) threshold that must be exceeded before any actual data logging occurs during a test.

Use the ← or → **arrow keypad buttons**. to position the black LCD cursor at the desired digit.

Press the desired numeric **# keypad button** or scroll to the number by using the "**+**" or "**-**" **keypad buttons**. Repeat this procedure for each digit you wish to modify

Press the **Enter keypad button** to accept your updates (or press the **Menu keypad button** to cancel changes) and return to the above sub-menu.

Tip: *You can enter 0 RPM (or MPH) to deactivate this trigger threshold.*

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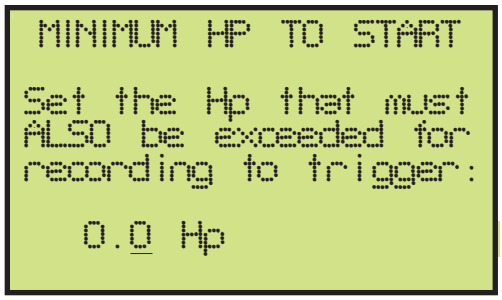
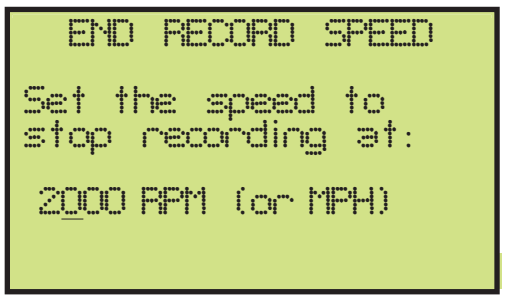


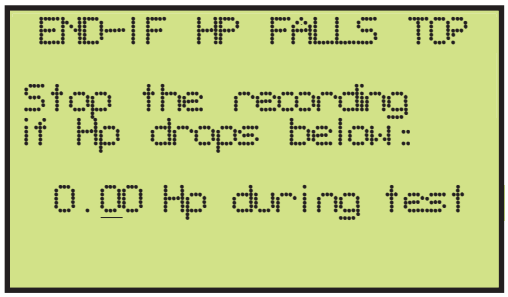
<MINIMUM HP TO START allows entry of a power threshold that must be exceeded before any actual data logging occurs during a test.

Tip: *If both a Start Record Speed and a Minimum Hp are set, no data logging begins until after both thresholds are exceeded!*
You can enter 0 Hp to deactivate this trigger threshold.



<END RECORD SPEED allows entry of a an Engine RPM (or Vehicle Speed if you are in MPH mode) minimum that must be maintained throughout a test recording. If at anytime after recording has commenced the speed falls below this setting, the recording and test will stop..

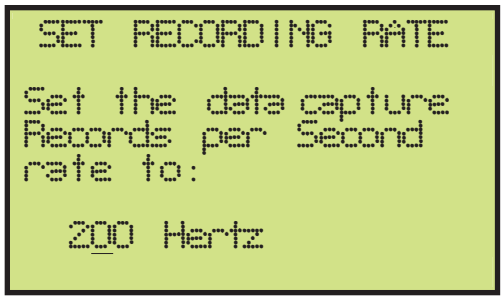
Tip: *You can enter 0 RPM (or MPH) to deactivate this low-limit shutoff feature.*



<END-IF HP FALLS TOP allows entry of a a minimum power level that must be maintained throughout recording.

If at anytime after recording has commenced the Hp falls below this setting, the recording and test will stop..

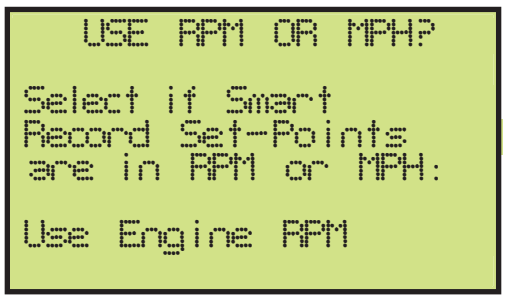
Tip: *If both an End Record Speed and an End-if Hp falls below are set, data logging halts as soon as either minimum is not exceeded!*
You can enter 0 Hp to deactivate this low-limit shutoff feature.



<SET RECORDING RATE allows entry of the number of full data sets (lines) to capture per second.

The default of 200 Hertz is a good compromise between resolution and storage area.

Tip: *The maximum rate of 1,000 Hertz is typically used only for analyzing rapidly changing transient behavior. While slower rates (like 20 or 2 Hertz are reserved for long duration on-board data capture or endurance testing*



<USE RPM OR MPH? allows controlling if Smart Record speed settings are to use Engine RPM or Vehicle MPH mode.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to toggle between the two modes. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the above sub-menu.

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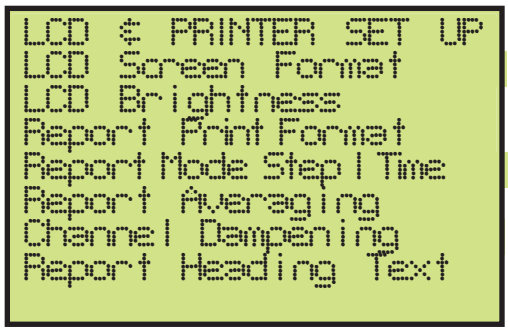
This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

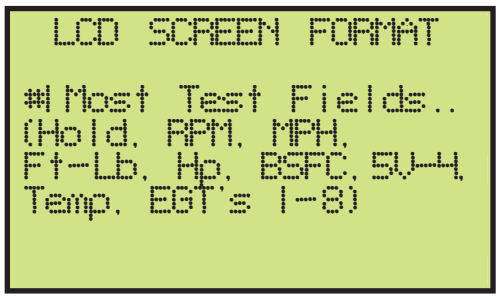
Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

The **LCD & PRINTER SET UP Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<*The* LCD & PRINTER SET UP *offers seven choices (as described below).*

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).



<LCD SCREEN FORMAT allows selection of real-time and playback data field layouts.

Each layout lists its displayed fields - in the order they will appear on the screen. (During playback, Hold speed will be replaced by Time (in seconds).

Select the layout that best suits the type of testing being done.Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to scroll among the various layouts. Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the above sub-menu.

Tip: *The "Most Test Fields..." screen layout is the default for typically dynamometer testing.*

CAUTION: The "#10 Diagnostics..." screen is primarily used for troubleshooting - under the guidance of technical support.

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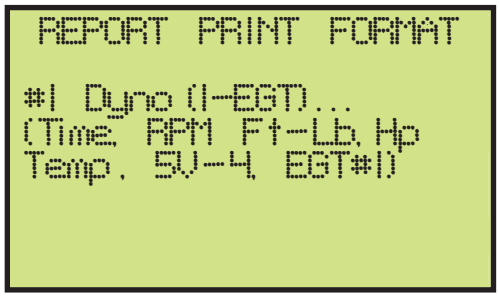
<LCD BRIGHTNESS allows selection of one of the three backlighting levels for the LCD's .display

Tip: *When running on batteries alone, use the lowest suitable backlighting level. This conserves the battery's power*



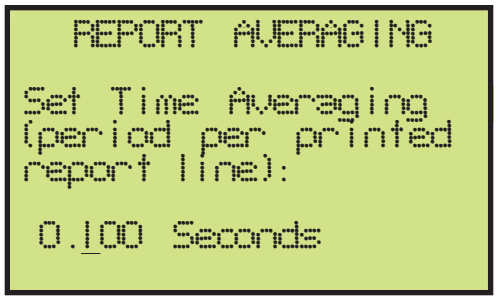
<REPORT allows selection of printer data layouts, .

Each layout lists the fields - in the order they will appear on the 40-character wide, thermal printer format.

<REPORT MODE STEP | TIME allows selection of playback listing method.

Choices include both Narrow or Wide "Step" Averaging (which outputs lines in even 100 RPM (or 10 MPH) increments. Only data that was captured at reasonably low acceleration rates is allowed into the report. This prevents transient (unsustainable) peaks from skewing the report.
Narrow Step averages together consecutive sets (of 40 to 200 readings) that are within +- 49 RPM of an even 100 RPM incurment.
Wide Step averages together consecutive sets (of 12 to 200 readings) that are within +- 49 RPM of an even 100 RPM increment
Alternatively, Time Mode outputs chronologically consecutive rows of data averaged into even time increments.

Tip: *For troubleshooting data collection or reporting problems, always examine data in Time Averaged mode first.*



<REPORT AVERAGING controls the duration of data averaged into each (Time Averaged) printed report (or LCD playback) line.

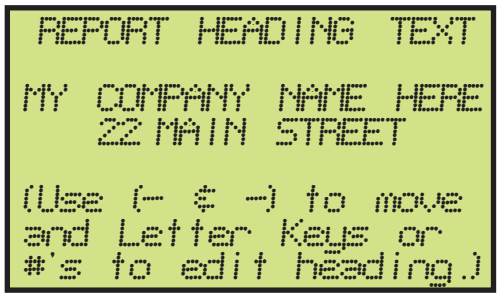
Selecting a higher value shortens the length of the report, but it also reduces the ability to analyze rapid transient data spikes.

Tip: *The default time period of 0.100 seconds per line is a good compromise between report length and resolution.*

<CHANNEL DAMPENING allows selection of the amount of mathematical dampening (smoothing) to apply to the raw digital data.during report printing and LCD playback

Selecting a higher value smooths out transient spikes, improving the presentation of the important data. However, too much dampening can mask significant engine mis-behavior.

Tip: *This setting only applies to reporting and playback, It does not effect the LCD display during testing or the actual stored data. Although the default dampening period (of 0.750 seconds) is a good compromise between report smoothness and resolution, you should experiment with periods from 0.250 to 1.000 seconds to find the report setting that works best for your type of testing.*



<REPORT HEADING TEXT allows entry of an optional 40-character line text that will appear on printed reports..

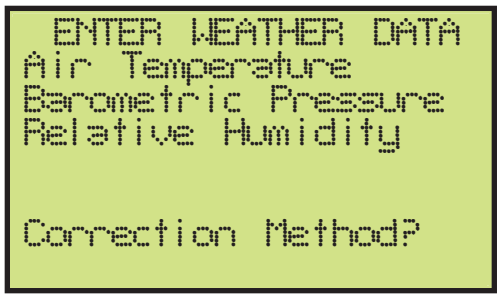
Use the "**ABC 1**" **keypad buttons**. to scroll among the various letters, numbers, and special characters that can be .entered. Use the ← or → **arrow keypad buttons**.to move between character positions.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the above sub-menu.

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

The **ENTER WEATHER DATA Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



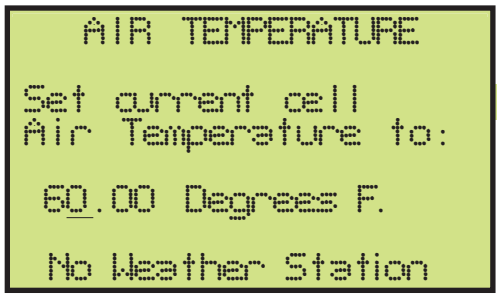
<*The* ENTER WEATHER DATA *offers four choices (as described below).*

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.

Tip: *You will need a high quality barometer that is calibrated to read the absolute barometric pressure - not one that is offset so that it reads the corrected local pressure for weather forecasting!*

If you have an airport or weather station nearby, you can call it for this pressure. Again, make sure you get the absolute barometric pressure, not a reading adjusted for your local altitude!



<AIR TEMPERATURE allows entry of the current cell Air Temperature in Degrees Fahrenheit.

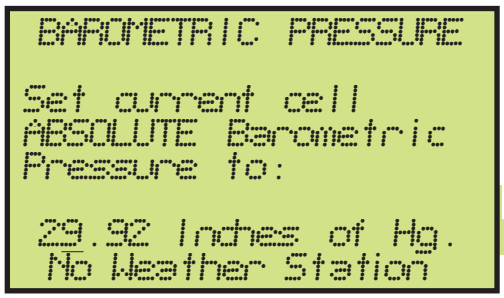
This information is used by the SAE and Standard Correction Factor Formulas to adjust the observed Torque (and Hp) test data to either of theses industry standards. "No Weather Station" will appear at the bottom of this screen, unless the optional Weatehr Station is installed.

If you are using the optional Weather Station, its data will be used automatically. *However you can use this screen to calibrate the Weather Station's channels.*

Press the **Enter keypad button** to accept your updates (or

press the **Menu keypad button** to cancel changes) and return to the above sub-menu.

Tip: *The temperature entered should be taken with any cell fans running, to best represent the inlet air temperature that the engine will experience during testing.*



<BAROMETRIC PRESSURE allows entry of the current cell atmospheric pressure in Inches of Mercury.

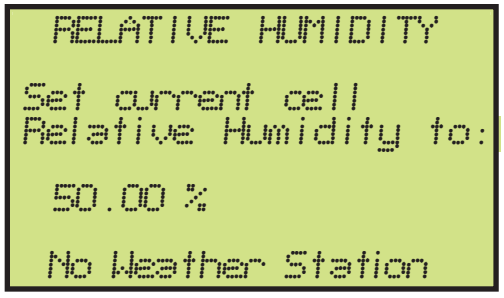
This pressure must not be the altitude compensated barometric pressure reported by weather forecaster! Make sure your entry is the absolute barometric pressure. Your local airport should be able to provide the number to you."No Weather Station" will appear at the bottom of this screen, unless the optional Weather Station is installed.

This information is used by the SAE and Standard Correction Factor Formulas to adjust the observed Torque (and Hp) test data to either of theses industry standards.

If you are using the optional Weather Station, its data will be used automatically. *However, make sure you have previously calibrated the Weather Station to the absolute barometric pressure.*

Tip: *The pressure entered should be taken with any cell fans running, to best represent the inlet air pressure that the engine will experience during testing.*

CAUTION: Do not use the altitude compensated barometric pressure announced in weather reports! That is not the same thing as absolute barometric pressure (except at sea level).

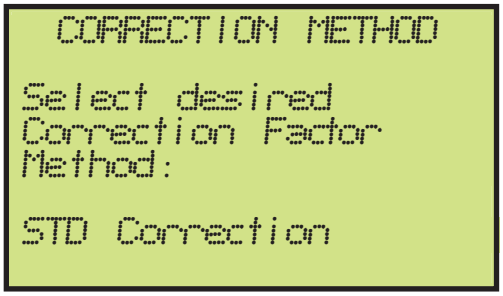


<RELATIVE HUMIDITY allows entry of the current cell moisture content as a Relative Humidity percentage.

This information is used by the SAE and Standard Correction Factor Formulas to adjust the observed Torque (and Hp) test data to either of theses industry standards."No Weather Station" will appear at the bottom of this screen, unless the optional Weather Station is installed.

If you are using the optional Weather Station, its data will be used automatically. *However, make sure you have previously calibrated the Weather Station's Relative Humidity with a sling psychrometer.*

Tip: *An optional DYNOmite sling psychrometer is available as an inexpensive tool for accurately measuring the relative humidity (and air temperature)*



<CORRECTION METHOD allows selection of one of the three data correction options..

The DYNOmite offers Observed, STD (standard), and SAE Corrected data display and playback.
In the Observed-uncorrected mode the Torque (and Hp) output is as it was actually recorded during the test.
In the STD Correction mode the computer applies the three Standard atmospheric correction factors. These factors "correct" the power readings to approximately what they would have been if testing occurred at 60 degrees Fahrenheit, 0% relative humidity, and standard sea level barometric pressure (29.92"Hg.).
In the SAE Correction mode the computer uses 77 degrees Fahrenheit, 0% relative humidity, and 29.38"Hg.).

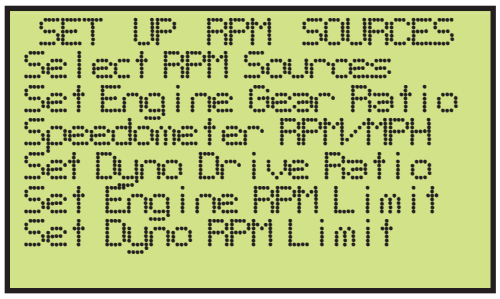
The heading on printed reports indicates which wether correction standard has been applied to the data. Always use corrected data to compare a run with one done later (under potentially different atmospheric conditions).

Tip: *You can change the Correction Method after you have recorded data (to reprint a run both ways). This setting has no affect on the actual stored data - only its display and report output.*

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

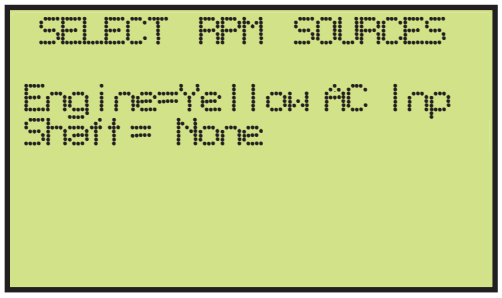
The **SET UP RPM SOURCES Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<SET UP RPM SOURCES offers six choices (as described below).

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.



<SELECT RPM SOURCES allows configuring which channel(s) the DYNOmite will capture engine tachometer data (and optionally vehicle speed) from.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to scroll to the choice that matches your current hardware's electrical hook-up.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the previous sub-menu.

Engine = Yellow AC Inp, Shaft = None: sets the ENGINE RPM source as the harness's "AC INPUT" (yellow) lead". Typically the lead is connected to the ignition coil's negative primary post or dedicated tach circuit.
With this source:

Hp = EngineRPM x BrakeTorque x GearRatio x DriveRatio / 5252
Torque = BrakeTorque x GearRatio x DriveRatio
RPM = EngineRPM

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Tip: *Measured torque is multiplied by the Gear ratio and Drive Ratio factors. If you're displaying incorrect torque readings, check the factors (typically 1.000) you entered!*

< Engine = "Shaft", Shaft = Magnet: sets the ENGINE RPM source as the harness's "JACK SHAFT" (6-pin DIN connector) lead. Use this for optional magnetic pickups mounted in the absorber or drive-line.
With this source:

Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio x Drive Ratio
RPM = BrakeRPM / GearRatio / DriveRatio

< Engine = "Shaft", Shaft = Yellow+box: sets the SHAFT RPM source as the harness's "AC INPUT" (yellow) lead for use with an optional magnetic pickup adapter.

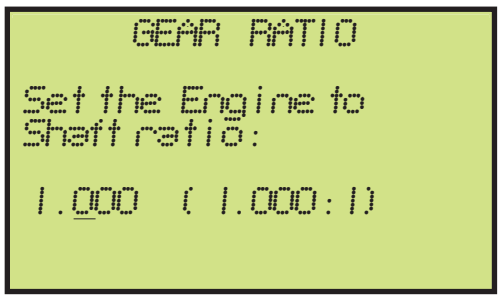
With this source:

Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio x DriveRatio
RPM = BrakeRPM / GearRatio / DriveRatio

< Engine = Yellow, Shaft = Magnet: This sets a special dual RPM source mode! The ENGINE RPM source is the harness's "AC INPUT" (yellow) lead" and simultaneously SHAFT RPM is taken from the harness's "JACK SHAFT" (6-pin DIN connector) lead"
With this source:

Hp = BrakeRPM x BrakeTorque / 5252
Torque = BrakeTorque x GearRatio x (BrakeRPM / EnigneRPM)
RPM = EngineRPM

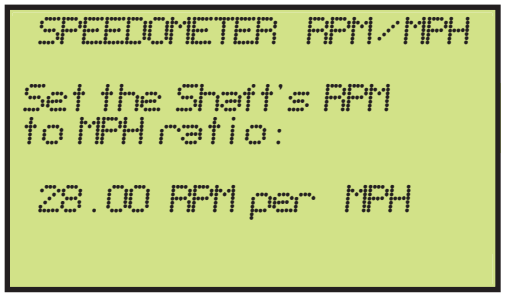
Tip: *This last mode is typically used during chassis dyno and on-board testing because it calculates transmission shift ratios (and adjusts torque accordingly) - in real-time.*



< SET ENGINE GEAR RATIO allows entry of the current transmission ratio between the engine and the transmission's output shaft. .

This must be set correctly to the final ratio (normally 1.000) between the crankshaft and absorber shaft. Otherwise, the Torque (and consequently Hp) readings will be off by the gear multiplication factor.)

Tip: *Some manufacturers specify this ratio in reverse, for example:*
For testing through an automotive transmission with a 2:1 reduction, you enter 0.500
For a Yamaha V-Max 4 snowmobile which runs a 42:43 under-drive, you enter 0.977
For an outboard with a 15:28 gear case, enter 0.536.
For a 16:64 kart (or bike) chain reduction drive, enter 0.250.



<SPEEDOMETER RPM/MPH allows entry of the drive shaft or roller RPM to Vehicle Speed factor. This calibrates the MPH display to a chassis dyno's roller diameter (or to an onboard dyno's vehicle drive train ratios). Adjust the factor up (or down) proportionally until the DYNOmite's MPH display accurately duplicates the actual vehicle MPH. *(You can skip this step unless you are logging MPH data for onboard or chassis dyno testing.)*

Tip: *12" diameter chassis dyno rollers would need to turn 28 revolutions (per minute) to simulate 1 MPH. So, a one-time entry of 28.00 would be made to calibrate the DYNOmite's speedometer readout. If a vehicle is actually doing 30 MPH, but the display indicates 60 MPH, then you need to double this factor (60/30=2). For example: if the factor was 28 - change it to 56.*

Note: For a chassis dyno the relationship of roller RPM to MPH is:

RPM Factor = 336.1 / Roller Diameter

The factor for 5" rollers = 67.22
The factor for 8-1/2" rollers = 39.54
The factor for 12" rollers = 28.01
The factor for 16" rollers = 21.00
The factor for 24" rollers = 14.00
The factor for 30" rollers = 11.20
The factor for 44" rollers = 7.63

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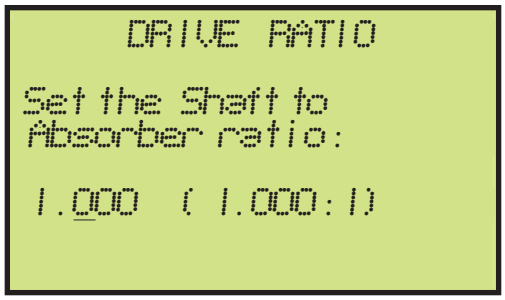
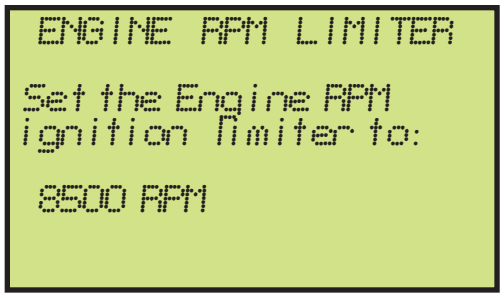


<SET DYNO DRIVE RATIO allows entry of a secondary transmission ratio between any intermediate shaft and the dynamometer's absorber..

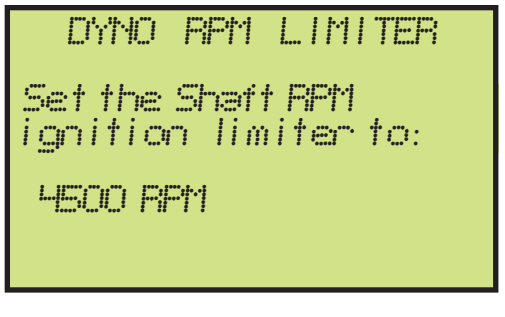
This must be set correctly to the final ratio (normally 1.000) between the drive-shaft and absorber. Otherwise, the Torque (and consequently Hp) readings will be off by the gear multiplication factor.)



<ENGINE RPM LIMITER allows setting the DYNOmite's built in RPM limiter to help avoid inadvertent over revving.

Tip: *The DYNOmite begins by applying a "soft" ignition kill as the RPM just reaches the limit. If the engine RPM rises more than a couple hundred RPM beyond that limit, the ignition interrupt will increase to 100%.*

CAUTION: If the dynamometer's only RPM source is from the absorber's magnetic pickup, then in the event of a broken drive shaft, or other loss of RPM signal, the RPM limiter will be unaware of the over-reving engine. An separate engine RPM limiter should be installed.



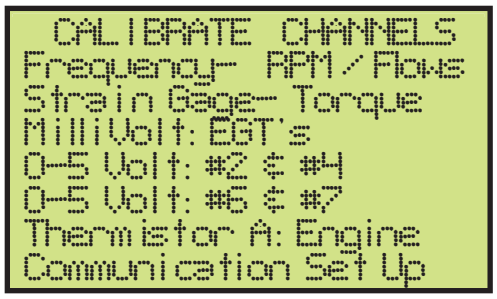
<DYNO RPM LIMITER allows setting the DYNOmite's built in absorber speed limiter to help avoid inadvertent over reving of the dynamometer system.

CAUTION: The DYNOmite-Pro supports this separate second RPM limit primarily to protect the dynamometer hardware (absorber, roller, etc.) as opposed to the test engine. Be sure to take any gear and drive ratio's into consideration when entering this limit value in terms of Absorber RPM.

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

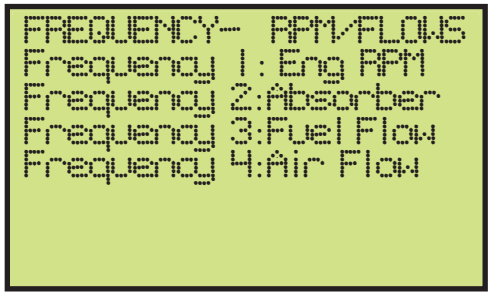
The **CALIBRATE CHANNELS Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<CALIBRATE CHANNELS offers six choices (as described below).

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to complete your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.

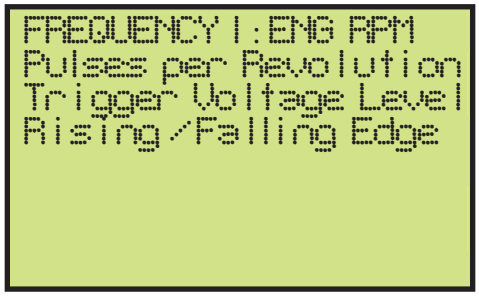


<FREQUENCY- RPM/FLOWS allows selecting which of the four DYNOmite frequency inputs to configure.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the channel you wish to set up.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel the selection) and return to the above sub-menu.



<FREQUENCY 1: ENG RPM is where you can calibrate the Engine Tachometer channel, set the channel's voltage threshold, and choose between reading each pulse on its first upward or downward swing.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the item you wish to set up.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel the selection) and return to the above sub-menu.

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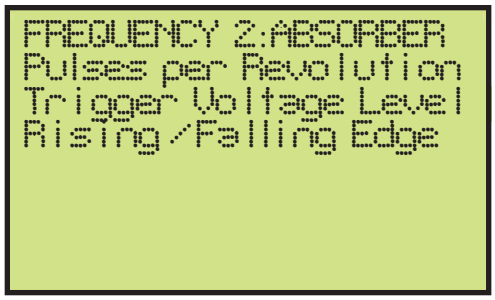
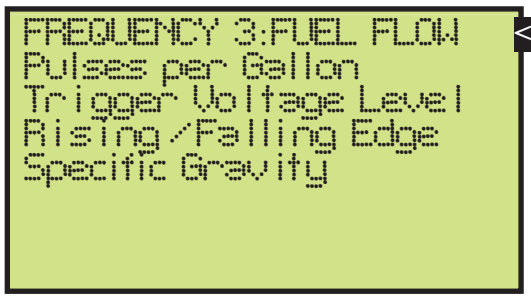
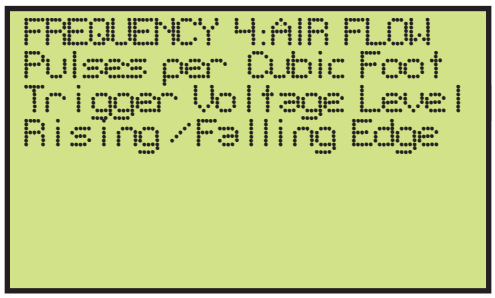


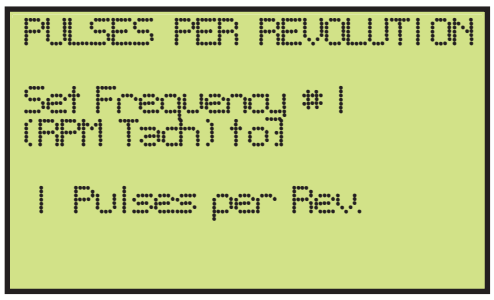
<FREQUENCY 2:ABSORBER is where you can calibrate the Absorber RPM pickup channel, set the channel's voltage threshold, and choose between reading each pulse on its first upward or downward swing.



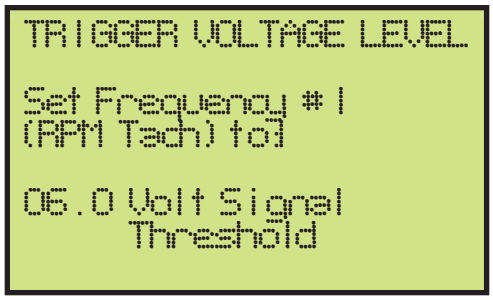
<FREQUENCY 3:FUEL FLOW is where you can calibrate the Fuel Flow transducer channel, set the channel's voltage threshold, choose between reading each pulse on its first upward or downward swing, and enter your fuel's Specific Gravity.



<FREQUENCY 4:AIR FLOW is where you can calibrate the Air Flow transducer channel, set the channel's voltage threshold, and choose between reading each pulse on its first upward or downward swing.



<PULSES PER REVOLUTION allows selecting between one of several calibration "counts" (per each shaft revolution). A special mode of 1/2 (one pulse every other revolution) is provided for reading from inductive plug pickups on many four-strokes (that only fire the plug firing the compression cycle). Another special mode of 2/2 (average two consecutive RPM samples) is for smoothing out the RPM deviation between compression and exhaust strokes on single cylinder four-strokes, etc.



<TRIGGER VOLTAGE LEVEL allows setting the (approximate) voltage crossover level at which the DYNOmite will register a Frequency counter event. The selected trigger level must fall between the high and low voltage peaks of a frequency signal's waveform. Most square wave, sine wave, or needle signals can be read if this setting is correctly made.

For example, a 0 to 8-volt sine wave signal would probably be set to trigger in the 4-volt range. If it were set close to 8.0 volts, it might fail to detect many of the pulses, as the signal peaks might not actually cross beyond the 8-volt level.

Tip: *The Trigger Voltage Level is not a calibration setting! It just needs to be set at a value within the range that the frequency signal (primary ignition pulse, magnetic RPM pick-up's square wave, flow transducer signal, etc.) reliably crosses over.*

Note: The nominal trigger voltage setting recommendations for several popular frequency signal sources are listed below:

DYNOmite Airflow Turbines = 4.5 volts
DYNOmite Cigarette Lighter RPM Pickups = 4.0 volts
DYNOmite Fuel Flow Transducers = 4.5 volts
DYNOmite Inductive RPM Pickup clamps= 4.0 volts
DYNOmite Jack Shaft RPM Pickups= 4.5 volts
DYNOmite Magnetic Absorber RPM Pickups = 4.5 volts
DYNOMite Optical RPM Pickup = 4.5 volts

Ignition point trigger - direct from coil post = 6.0 volts
Ignition trigger from MSD tach lead - = 6.0 volts
Ignition trigger from CD's coil primary = 6.0 volts
Snowmobile or PWC alternator's yellow lead = 6.0 volts

<RISING/FALLING EDGE allows selecting whether the frequency pulse will be detected as the signal rises above your pre-set trigger voltage of falls below it. For clean square or sine wave transducer signals either choice is equivalent. However, for multi-peaked ignition signals one side of the waveform may provide a more consistent RPM reading than the other.

Tip: *Most signal sources work fine with Rising Edge, but try both settings if you get erratic RPM drops (upward spikes are usually from RFI, not the wrong setting).*

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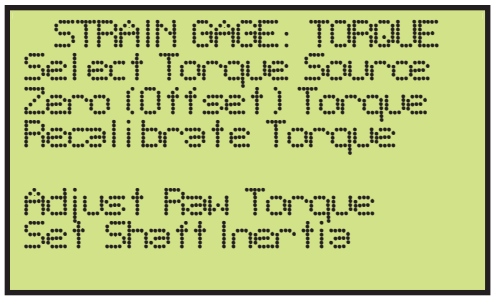
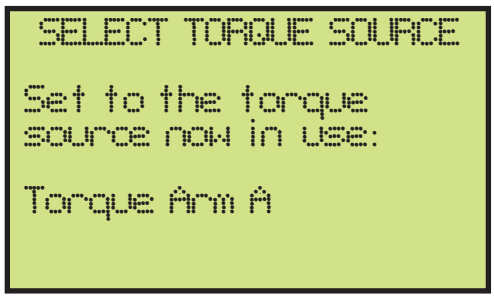


<STRAIN GAGE: TORQUE allows selecting which of the five DYNOmite torque calibration parameters to modify.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the channel you wish to set up.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel the selection) and return to the previous sub-menu.

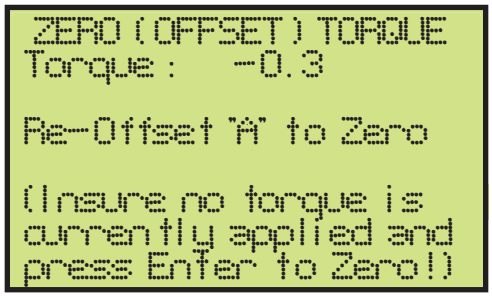


<SELECT TORQUE SOURCE allows selecting which of the 12 DYNOmite Torque Source calibrations to utilize. There are three Transducer Group Types to select from: Toque Arms (and most other millivolt output load cells and strain gauges), Rotary Torque (exclusively DYNOmite Piggy Back rotary board interfaces), or Load Cell Transducers (for most 0-5 volt torque sources).

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to scroll to type (and calibration letter) torque transducer currently attached to the torque channel.

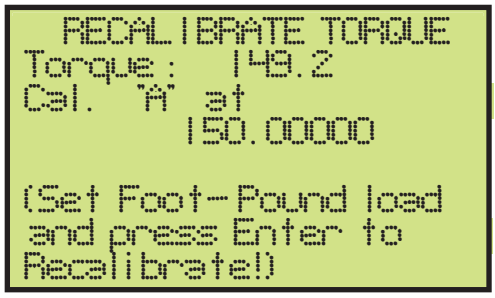
.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the previous sub-menu.



<ZERO (OFFSET) TORQUE allows automatically offsetting (zeroing) the strain gauge (to compensate for mechanical, electrical, and temperature induced "creep" of the DYNOmite's unloaded torque reading).
You may press the **Enter** button if you wish to re-set the current torque reading as zero foot pounds (like the "tare" button on a meat scale). Always make sure that there is no load being applied at the torque arm before zeroing!
If you do not need to zero the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Check that you don't have cables or hoses pulling on the torque arm before zeroing the computer. Otherwise, you may receive an error message like "RAW TORQUE TOO HIGH!" if you attempt zeroing excessive torque drift. The need to zero-out large torque readings is a sign that something is wrong… see "*TROUBLE SHOOTING - Questions & Answers*" section 13.1.*

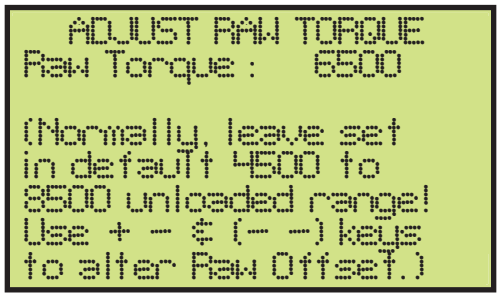


<RECALIBRATE TORQUE allows resetting the torque channel's gain to match its current reading to that of the entered calibration test force value.

#1 Be sure that you have already performed the Torque Zeroing procedure outlined above.
#2 Set the "Cal. "A" @ value to match the effective foot pound force of your calibration weight and moment arm. Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.
#3 Verify that the calibration weight is hanging still and that the display is steady.
#4 Press the **Enter** button - the display will re-calibrate so that it matches your entered Cal. value.

If you do not need to re-calibrate the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Check that you don't have cables or hoses pulling on the torque arm - and that the test weight is hung - before re-calibrating the computer. Otherwise, you may receive an error message like "RAW TORQUE TOO LOW!"*

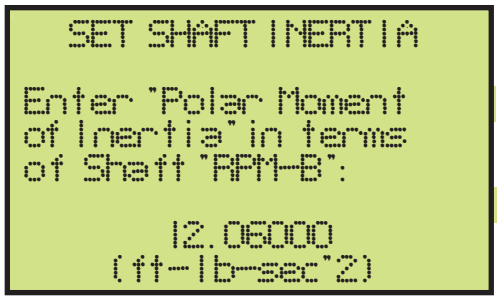


<ADJUST RAW TORQUE allows setting the torque channel's initial (unloaded) digital offset at an appropriate starting point. This should be checked whenever the physical torque transducer is changed.

The suggested value is 6500 (approximately10% of this 16-bit channel's 0-65,534 working digital range) to provide for some ability to read negative torque values.

If you do not need to change the Raw Torque setting, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *The Raw Torque is not a calibration setting! It just needs to be set at a value that provides some offset from the channels 0 and 65,534 extreme. For applications that must read equal magnitudes of positive and negative torque (e.g. bi-directional systems) a value like 32,700 may be used..*

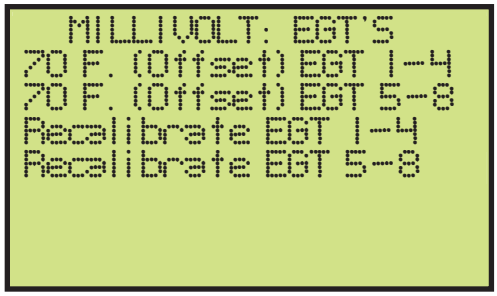


<SET SHAFT INERTIA allows inputting a Polar Moment of Inertia value for a chassis dynamometer's rolls or an engine and drive-line. This allows the DYNOmite to compensate its power readings for the rotating component's accelerated during (non steady state) testing.

The entered value is assumed to be the effective polar moment of inertia (in foot pounds per-second squared) rotating at the DYNOmite's Shaft "RPM-B" location.

If you do not need to change the inertia value, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *When testing at high rates of acceleration - or on chassis dynos where the inertia of the rotating components is high, entering the correct Polar Moment of Inertia is vital if accurate torque and power readings are expected.*

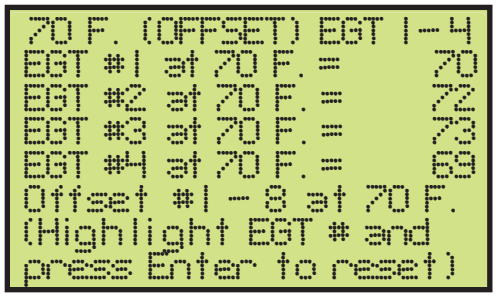


<MILLIVOLT: EGT'S is where you begin calibration of the Exhaust Gas Temperature channels.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the EGT channel calibration function you wish to perform.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel the selection) and return to the previous sub-menu.



<70 F. (OFFSET) EGT 1-4 allows automatically offsetting each (or all) of the displayed EGT channels to 70 degrees Fahrenheit (or 21.1 degrees Celsius) - room temperature. This compensates for individual channel electrical variations.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the EGT channel you wish to reset to 70 F. Then press the **Enter** button to re-set the channels current EGT reading as 70 degrees F. Always make sure that the EGT thermocouple probe has actually cooled to room temperature before performing this reset!

If you do not need to reset any channels, just press the **Menu keypad button** to return to the previous sub-menu.

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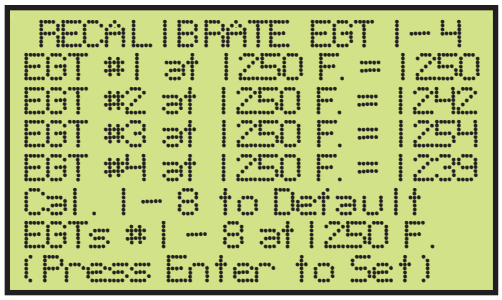


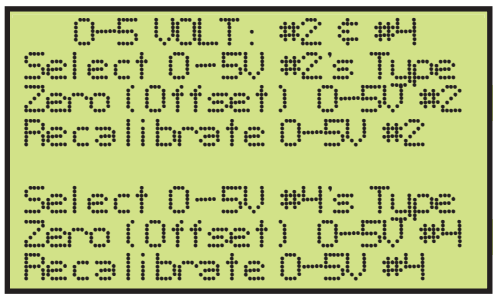
<RECALIBRATE EGT 1-4 allows resetting each EGT channel's gain so that its current reading matches that of a 1,250 degree Fahrenheit (or 676.7 degree Celsius) calibration temperature (or 28.144 millivolt simulation signal).

#1 Be sure that you have already performed the 70 degrees F. (offset) at room temperature procedure outlined above.

#2 Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the EGT channel you wish to reset to 1,250 F. Then press the **Enter** button to re-calibrate the channels current EGT reading as 1,250 degrees F. The EGT thermocouple probe must actually be at the 1,250 F. calibration temperature (or an appropriate simulation voltage applied) before performing this re-calibration!

"Cal. 1-8 to Default" will reset all eight EGT channels back to their default gains. Important: this operation overwrites any EGT re-calibrations you have performed!

If you do not need to re-calibrate any channels, just press the **Menu keypad button** to return to the previous sub-menu.

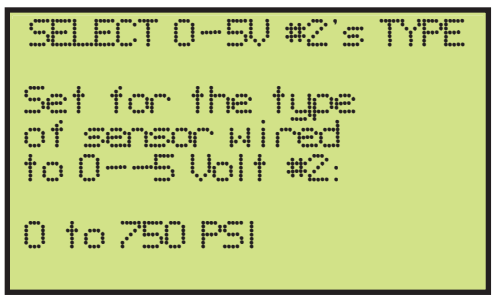


<0-5 VOLT: #2 & #4 allows selecting, zeroing, and calibrating the various 0 to 5 volt sensors and transducers supported by the DYNOmite.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to highlight the 0-5 volt channel calibration function you wish to perform.

.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel the selection) and return to the previous sub-menu.

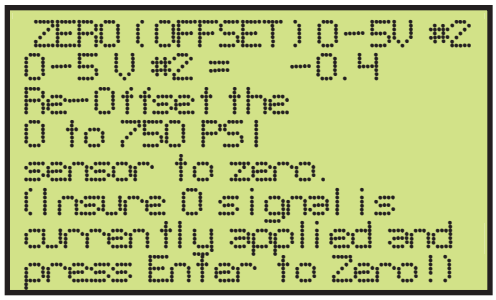


<SELECT 0-5V #2's TYPE allows selecting which of the several DYNOmite 0-5 volt transducers to utilize.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to scroll to type sensor currently attached to the chanel.

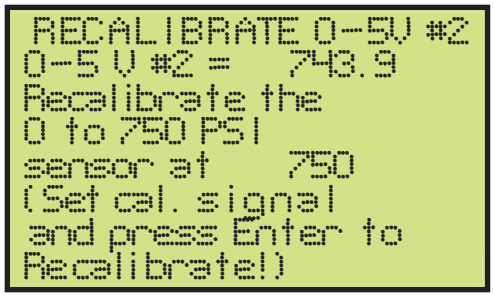
.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the previous sub-menu.



<ZERO (OFFSET) 0-5V #2 allows automatically offsetting (zeroing) the 0-5 volt channel (to compensate for mechanical, electrical, and temperature induced "creep" of the sensor's at rest reading).
You may press the **Enter** button if you wish to re-set the current reading as zero (like the "tare" button on a meat scale). Always make sure that there is no signal being applied before zeroing!
If you do not need to zero the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Before performing the offset, verify t hat you are not applying any signal (PSI, G's, %, etc.) to the sensor that would make "zeroing" the channel inappropriate!*

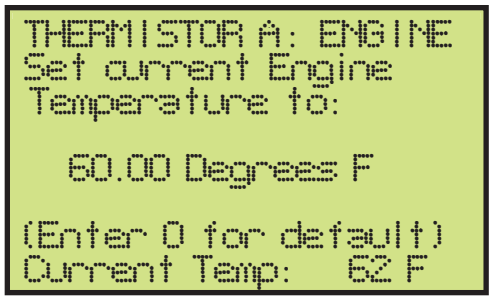


<RECALIBRATE 0-5V #2 allows resetting the 0-5 volt channel's gain to match its current reading to that of the entered calibration test force value.

#1 Be sure that you have already performed the Zero offset procedure outlined above.
#2 Set the "sensor @" value to match your applied transducer calibration vlaue (PSI, load, %, etc.). Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.
#3 Verify that the calibration signal and display are steady.
#4 Press the **Enter** button - the display will re-calibrate so that it matches your entered sensor calibration value.

If you do not need to re-calibrate the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Before performing the re-calibration, verify t hat you are applying the specified signal (PSI, G's, %, etc.) to the sensor!*



<THERMISTOR A: ENGINE allows offsetting the thermistor curve for the Engine Temperature channel - to match its current reading to that of the entered calibration temperature value.

#1 Set the "##.## Degrees F" value to match the temperature you are currently applying to the "Engine Temp Thermistor A" sensor. Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.
#2 Press the **Enter** button - the display will re-calibrate so that it matches your entered Degrees F calibration value.

If you do not need to re-calibrate the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *You can return to the DYNOmite's factory default calibration for Thermistor A by using 0 as your entered "Degrees F" calibration value.*

<COMMUNICATION SET UP is used to configure the serial link between the DYNOmite Data Acquisition Computer and a PC or laptop running DYNO-MAX software..

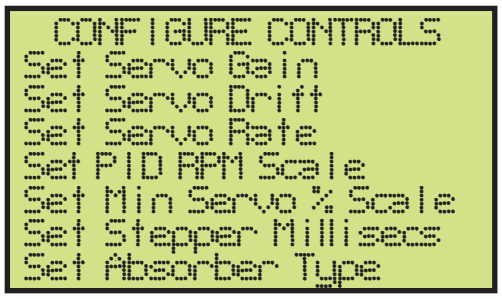
If you do not need to change the Communication mode, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *The modes selected here and in DYNO-MAX must match. Otherwise communication errors will occur and no data exchange can take place!.*

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

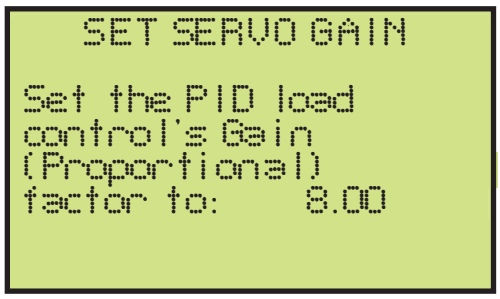
The **CONFIGURE CONTROLS Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<CONFIGURE CONTROLS offers seven choices (as described below) for modifying the optional Electronic Load Control's characteristics. *These settings can be ignored on systems not equipped with the option.*

To highlight one of the set up selections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.



<SET SERVO GAIN allows modifying the PID control's proportional multiplier. This adjusts how much the controller instantaneously moves in response to a change in either Engine RPM or Hold RPM (or vehicle speed on a chassis dynamometer). For example, with twice as large a Gain multiplier, the load control's action (valve travel or current output) doubles - in response to any RPM increase (i.e. from suddenly opening the throttle).

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the Gain factor, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Avoid increasing the Gain multiplier so much that it overcompensates. Ideally the load valve should initially under-compensate a bit, letting the Drift close any remaining RPM deviation within a few seconds – or less.*

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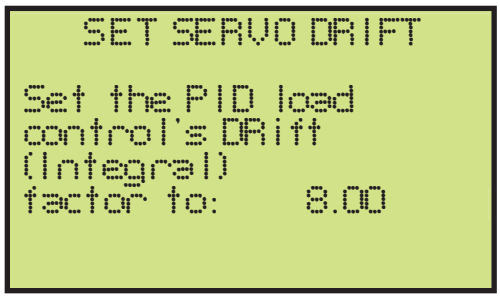
Important: Limits imposed by a water brake type absorber's rate of filling (and draining) time (latency) can make it impossible for any automatic valve to hold an RPM were the torque vs. RPM slope is extremely steep. In such cases, you may get some improvement by going to a dual port servo valve (which simultaneously controls both the inlet and outlet flow). Additionally, you can add rotating mass to stabilize ANY engine - but adding too much inertia reduces the dynamometer's ability to simulate rapid RPM changes (transient conditions).

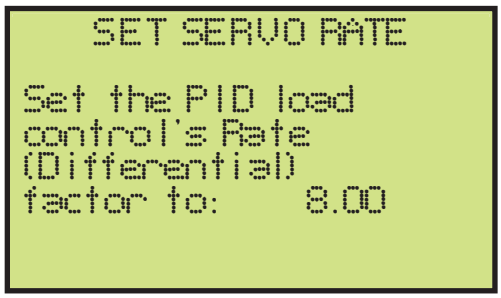


<SET SERVO DRIFT allows modifying the PID control's integral multiplier. This adjusts the load valve's aggressiveness in removing longer term (1+ second) steady state errors between actual Engine RPM and the desired Hold RPM (or MPH). The larger the Drift multiplier the more quickly the controller works (gradually) to eliminate holding RPM deviation.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the Drift factor, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Increasing the Drift multiplier too much induces a slow oscillation! So, initially set the Drift entry fairly low (less than 50% of its likely optimum value) while you work out your best Gain and Rate numbers. Once the Gain and Rate #'s seem optimum, experiment with incrementally larger Drift numbers - to reduce the time the Drift algorithm takes to gradually eliminate any remaining deviations between Holding speed and Actual speed.*



<SET SERVO RATE allows modifying the PID control's differential multiplier. The larger the Rate, the more the controller "fights" changes in actual engine RPM vs. the desired Hold RPM. The Rate multiplier scales the DYNOmite algorithm that compensates for control latency - deciding how far to momentarily "over travel" the load control to steady a rapidly accelerating engine.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the Rate factor, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *If you increase the Rate multiplier too much you may actually cause a rapid oscillation. So, maintain your Gain, Drift, and Rate numbers in relative proportion until you understand how they interact.*

Note: *The following Stepper Motor Factor settings should be a good starting point for DYNOmite-Pro boards:*

Automotive engines (single stator - toroid absorber) -
GAIN = 16, DRIFT = 16, RATE = 16

Automotive engines (dual-stator - toroid absorber) -
GAIN = 12, DRIFT = 12, RATE = 12

Automotive chassis dynos (medium inertia- water brake) -
GAIN = 16, DRIFT = 8, RATE = 24

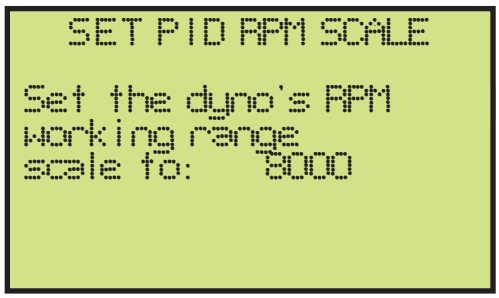
Automotive chassis dynos (high inertia - water brake) -
GAIN = 24, DRIFT = 8, RATE = 48

Automotive chassis dynos (high inertia - eddy current) -
GAIN = 64, DRIFT = 12, RATE = 12

Snowmobile and PWC engines -
GAIN = 6, DRIFT = 6, RATE = 6

Snowmobile track dynos -
GAIN = 12, DRIFT = 8, RATE = 16

Briggs and other kart engines -
GAIN = 8, DRIFT = 8, RATE = 8



<SET PID RPM SCALE allows modifying the PID control's nominal dynamometer operating RPM range. The Scale: #### is used to factor one combination of Rate, Gain, and Drift entries to match quite dissimilar engine operating bands. If you change the Scale factor from 3,600 RPM for a big diesel to 15,000 RPM for a race engine, the same Rate, Drift, and Gain settings may work well for both.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the RPM Scale, just press the **Menu keypad button** to return to the previous sub-menu.

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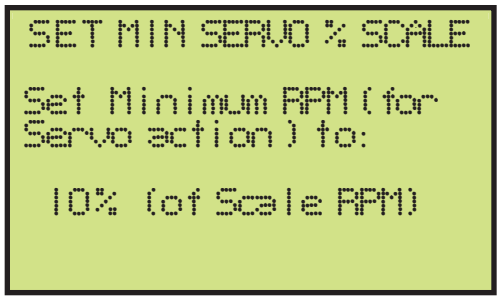
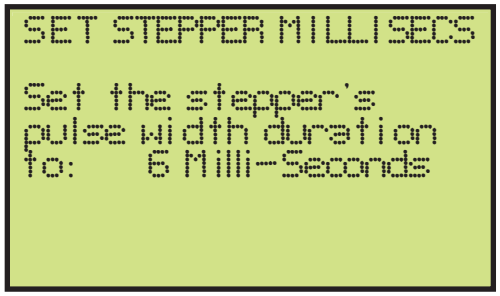


< SET MIN SERVO % SCALE allows modifying the deactivation RPM point for servo control below the default 10% of Scale RPM range (i.e. 10% of 8,000 RPM = 800 RPM deactivation point). This "sleep" feature can slightly reduce water consumption, servo noise and wear when the engine is just idling

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

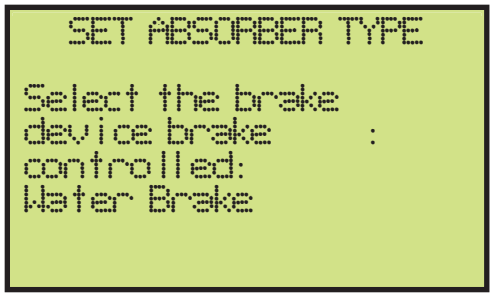
If you do not need to change the Servo %, just press the **Menu keypad button** to return to the previous sub-menu.



< SET STEPPER MILLISECS is normally left at the factory default for the stepper motor assembly being used (i.e. 6 Milliseconds). However, when using custom stepper motors, a lower or higher value may speed travel or prevent missed steps - respectively.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the milliseconds, just press the **Menu keypad button** to return to the previous sub-menu.



< SET ABSORBER TYPE allows selecting the type of absorber that helps match the controller's PID algorithm to the hardware.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to scroll to the type absorber used on the dynamometer.

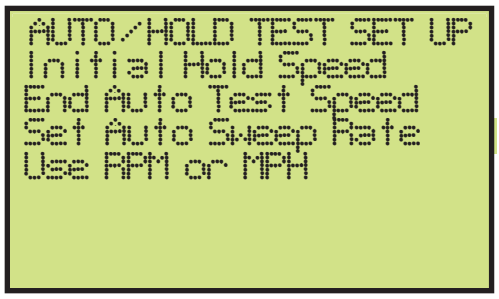
.

Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the previous sub-menu.

This section is only for DYNOmite-Pro (28-channel) hand held Data Acquisition Computer's equipped with the optional LCD module and 16-button keypad interface.

Tip: *If your interface is via a DYNO-MAX equipped PC or laptop, it is not necessary to read this section.*

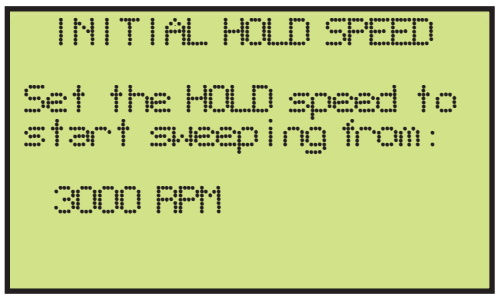
The **AUTO/HOLD TEST SET UP Sub Menu** (shown below) can be reached from the **MAIN MENU** screen.



<AUTO/HOLD TEST SET UP offers four choices (as described below) for creating automated tests using the optional Electronic Load Control's characteristics. *These settings can be ignored on systems not equipped with the option..*

To highlight one of the set up elections, scroll up or down the menu's listing with the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. Press the **Enter keypad button** to completer your selection (and jump to the indicated set up screen).

To **return to this sub-menu,** from any of the set up screens below it, simply press the **Menu keypad button** again.



<INITIAL HOLD SPEED is where you set the start of test RPM. This controls the RPM the DYNOmite holds the engine to (by automatically adjusting the Electronic Load Control) before and after an automated sweep test cycle.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the Hold Speed, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *You will use this setting often. For example: If you set the Holding RPM to 3,000 this is the RPM the Electronic Load Control will try to hold the engine to as you move the throttle to wide-open! .*

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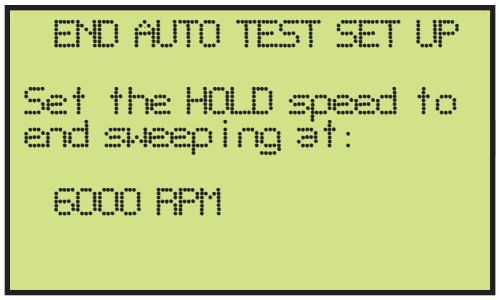
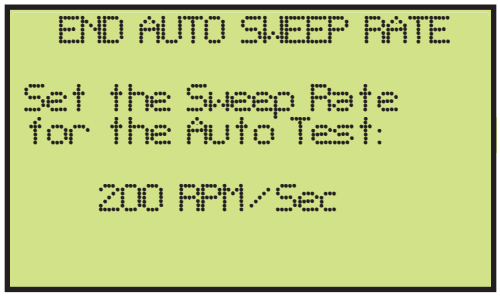


< END AUTO TEST SET UP is where you set the final RPM (or MPH) for an Automated Sweep Test - the point at which the DYNOmite quits Automatic Sweep Testing. Typically this will be the peak speed that the DYNOmite allows the engine to accelerate to during an automated test cycle (after which it will pull the engine back again to your selected initial Hold Speed.)

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

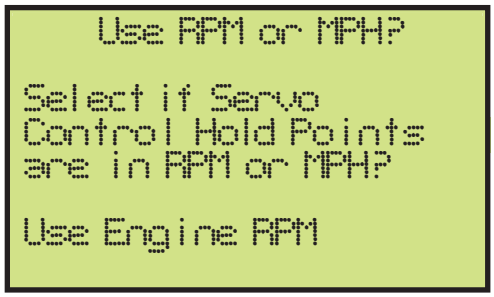
If you do not need to change the End Test Speed, just press the **Menu keypad button** to return to the previous sub-menu.



< END AUTO SWEEP RATE allows modifying the RPM (or MPH) per second acceleration rate for an Automated Sweep Test. Typically the default of 200 RPM/Sec is suitable for most engines however, faster rates (e.g. 400 RPM/Sec) may be more appropriate for high RPM or high specific output engines - where long test periods are undesirable.

Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.

If you do not need to change the Hold Speed, just press the **Menu keypad button** to return to the previous sub-menu.



< Use RPM or MPH? allows selecting the speed mode used for Automated Sweep Tests.

Use the "**+**" or "**-**" (or the ← or → **arrow**) **keypad buttons**. to toggle between RPM and MPH speed control modes.
.
Press the **Enter keypad button** to accept your selection (or press the **Menu keypad button** to cancel changes) and return to the previous sub-menu.

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This section is only for DYNOmite's equipped with the optional DYNO-MAX software and a compatible Personal Computer. If you only interact with the DYNOmite Data Acquisition Computer via its LCD interface, see the previous LCD INTERFACE - sections instead.

Tip: *You must already understand how to use a PC and Microsoft Windows to follow this section. While those subjects are beyond the scope of this manual, any bookstore will have dozens of good training manuals on both subjects.*

1 Turn on the PC to bring up Microsoft Windows. It is best if no other programs are running.

Tip: *PC's are inexpensive these days, so make sure that you buy a fast one - from a major manufacturer. A 2 GHz (or faster) machine with plenty of memory makes analyzing and graphing data faster and more enjoyable. Sound, video cameras, and a fast Internet e-mail connection are also used to advantage by DYNO-MAX. At the time this was written, Microsoft Windows XP was the recommended operating system for DYNO-MAX (although Windows 2000, NT, ME, and 98 will also support most functions).*

2 Insert the DYNO-MAX CD into your PC's drive. On most Windows systems this will *Auto Start* DYNO-MAX's Multimedia Demo and Installation routine. If within 45-seconds nothing happens, click the mouse on the Start button, then on Run, then type D:demo, and press Enter to manually launch the CD's demonstration program.

Tip: *Many users find it helpful to also print out the entire DYNOmite Help Manual (its on the CD) as a reference..*

3 It is a good idea to first review the Multimedia Demo of the software on the CD before you start the installation from the menu command. From there, follow the on-screen instructions to install and learn to run DYNO-MAX.

Tip: *You will require a sound card and speakers to listen to the Demo's 30-minute narration.*

4a Once the software is installed, hook up your PC to the DYNOmite Data Acquisition Computer boards. You will need an appropriate serial cable for each board set (pair) in the data acquisition system. Assuming you have only one board set, plug the serial cable into it's DB-9 connector and hook the other end into one of your PC's available (unused) serial ports (typically Com 1).

Tip: *If you have a built-in modem in your computer, it will generally have "stolen" one of the computer's Com ports. So even though it may have two physical serial ports (i.e. DB-9 male ports) one will be unavailable.*

4b If your PC has only USB ports you must first install a USB to RS-232 Serial Port adapter. Land and Sea (as well as most computer stores) offer these inexpensive devices.Make sure the model you buy includes the correct software drivers for your version of Microsoft Windows!

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DYNO-MAX allows a Personal Computer to monitor and (optionally) control your dynamometer. It communicates, via the PC's port(s), with one or more DYNOmite Computer (or third-party) Data Acquisition boards. Because the DYNOmite computer handles most of the high-speed data acquisition and control, it reduces the load on the PC. It primarily handles just the data display, storage, post processing, and printing.

DYNO-MAX leverages the PC's (and its Windows Operating System's) flexibility, permitting expanding and adapting the dynamometer system as needs change. Due to the extensive customization possible, initially configuring the setup is the most important (and involved) part of getting started.

Tip: *Invest adequate time customizing DYNO-MAX to fit your specific situation! Skipping this vital advice will make using the software endlessly frustrating!*

Important: *The following Getting Started instructions assume you are already comfortable using a PC under Microsoft's Windows. If not, we suggest reading a good book on Windows (or taking a Windows' computer class) before continuing!*

DYNO-MAX's Console Set Up, Graph Set Up, DYNOmite Channel Calibration, etc, are all stored in individual configuration files. After using DYNO-MAX for a few weeks, you will want to create your own configuration library. Once you have created configuration files specific to your test needs, it is far less tedious setting up for a new test session!

DYNO-MAX even makes it easy to pull together an appropriate set of configuration files with its Environment (.env) files. Each Environment file can point to a different group of your custom configuration files).

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1 If DYNO-MAX is not already running, go to your Windows Start button and select Programs - DYNO-MAX.

2 Each time DYNO-MAX starts it automatically opens (and minimizes) the last session's *Environment*. Initially, this will be the *default.env* file. A DYNO-MAX environment file contains the list of seven *Configuration* files that control settings for Run Information, Graphing, Console layout, etc. – changes made during any session become the defaults for the next.

Right now, *Restore* (expand) a minimized Environment window by selecting:

Window - 1 ENVIRONMENT: Default.env.

Leave things alone for now, but understand that you could change any of the displayed configuration file pointers by browsing to a different, previously saved (and appropriate format) configuration file.

3 Next, hook-up the appropriate cable(s) between your PC's serial port(s) and (each of) your DYNOmite Data Acquisition computer's board sets.

Tip: *See your "DYNOmite Owner's Manual" for more instructions.*

4 Power up the DYNOmite Data Acquisition computer.

Important: *If you are using a DYNOmite-Basic model with an LCD and 4-button panel, make sure it is in RS-232 Mode # 16.*

Tip: *See your "DYNOmite Owner's Manual" for more instructions.*

5 Select Electronics - Communication Ports Set-Up and verify that "Board: #1 ID: #1 Type: DYNOmite-Basic Board…" is the first Board on the list*. If you have multiple boards, the second listing must be "Board: #2 ID: #2 Type: DYNOmite-Basic Board…" If your listing is different, use the Replace, Add, or Delete buttons (as required) to Open the appropriate combination of DYNOmite-Basic Board ID #.daq files.

Important: *If you are using a DYNOmite-Pro (or -Lite) board set, select the matching type of board (instead of -Basic as in the above example).*

6 For each board listed, check that its Com Port # is assigned to same PC Com Port # that you have plugged your DYNOmite board sets into. Also make sure that the default DYNOmite-Basic Baud Rate of 57,6000 (or 115,200 for DYNOmite-Pro and -Lite board sets).

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7 Before trying to capture your own data, click File - Open Run to load the demo test Run Information file: Small Block sample.run. By default, it's located in your c:\Program Files\DYNO-MAX\Runs folder.

8 The Run Information panel opens to display the Small Block sample test header data. Spend time examining the Run Information window's many tabs and fields. Much of the displayed data is just optional information, but several required fields must always be correctly filled in for accurate test results.

Tip: *See the Help (use your PC's F1 Function Key) under Run Information for details about each panel tab.*

9 Whenever a Saved Run is open like this, you can examine its test data. Select View - Graph (or press your PC's F5 Function Key) to display the Run's (current default format) graph.

Tip: *Graphing may take several seconds depending on your PC's speed, the length of the Run, the complexity of its displayed Formula lines, and the maximum amount of dampening set for any one channel.*

10 The Graph's window has special Toolbar Icons (and right click menu choices) for zooming, panning, clipping segments, examining data points, print previewing, and Graph Set Up.

Tip: *Click on the Eyeglass icon button and then left-click on a Graph line (using the Eyeglass cursor). A yellow information balloon appears with information about that point on the graph.*

11 To modify the Graph's design, select View - Graph Set Up to open the Graph Set Up Editor.

Important: For access to most menu choices in DYNO-MAX you must have a Run open. This is because DYNO-MAX stores most configuration parameters within each Run file, thus allowing Runs to retain their last settings!

12 The Graph Set Up Editor has one or more tabs, each representing the available Graph layouts (currently stored within this Run). You can modify, add, and subtract layout tabs as needed. Right now, click on the "Hp vs. Time Averaging" layout tab (making it the active graph tab).

13 Notice the window listing several Formula Lines. Each is labeled with its data channel Formula's Short Line Name (i.e. RPM, Hp, etc.). By selecting other Formula's (from the Formula: drop down list) and then clicking on Insert Line, you can modify the information shown in any Graph layout. You can also change the axis scaling, axis legends, averaging method, and much more.

14 Next, click on the "Hp vs. RPM Steps" tab, and then click on "OK." Notice that the Graph redraws - but with Engine RPM as its X-axis. For more information on graphing, review this Help system's Graphing topics.

15 Try clicking the Graph's Print Preview toolbar icon (or select File - Print Preview) to see a close representation of how the Graph will look when output to your printer. You can click on the Preview window's Print… button to actually print this Graph now, or click Close to exit.

16 Click on the Small Block sample Run Information panel again (to give that window the focus). To review its full Run Information Report, select File – Print Preview. After several seconds (while your PC graphs and formats the data), the pages of the Report preview. Examine each page of this Report using the Preview's Next Page and Prev Page buttons.

Tip: *If your Preview is too small, use the Preview menu's Zoom In button.*

17 Notice that the Report has several Group boxes (Engine, Weather, Inertia, etc.) Each displays information about the Run's test conditions. The next step will show you how to turn any Run Information Group off (in Reports). Close the Preview for now.

18 Click back in the Small Block sample's Run Information panel. Perhaps you do not want every tab's information (say the Vehicle tab) on your own printed reports. To hide this tab, first click on the Vehicle tab. Notice that a Checkbox is checked next to Show on Run Information Report. Click on that check to toggle it off (un-checked).

19 Use the Print Preview feature again to verify that the Vehicle Group section is gone from the Run Information Report! Click Close to exit the Preview again.

20 Return to the Small Block sample Run Information panel. Toggle the Vehicle group back on (if you want it to print out on future reports).

21 Each of the Run Information's tabs also has a similar Show on Quick Report Checkbox. These toggle the respective Report Group sections in the same way, but "Quick" selections apply only to Reports printed while the Console has the focus (i.e. using the Console's Quick Print button)! (As opposed to Reports printed while your are within the Run Information panel.)

Tip: *With appropriate set up, you can have a long report (for use at the end of a test session), and a short "quick and dirty" report with just the essentials (for printing during testing). If you have the "Pro" version of DYNO-MAX, you will eventually want to experiment with its Report Designer to customize the individual Group fields.*

22 Select Console - Dyno Cell… (or click the Dyno Cell toolbar icon or just press your PC's F11 Function key) to open up the Console. This is DYNO-MAX's mission control center. Click on the Console's Replay Mode button (or press your PC's letter "M" key) to prepare for playback.

Tip: *You can press any Console Button's underlined letter to activate it (without using the mouse) from your PC's keyboard. This is much faster than the mouse during actual testing.*

23 Because the Console was started from the Small Block sample Run Information panel, that run's test file is already loaded.

Tip: *Notice that Small Block sample shows as the suffix on the Console window's blue Title Bar.*

24 The Console uses VCR like buttons to control recording and playback. Press you PC's "P" key to push-in the Play button (or click it with the mouse) to review the Small Block sample run. Since you have not modified the Console's Gauge and Alarm Properties, everything displays as it did during its original RPM Sweep Test recording. A Trace Chart also graphs selected Channel Formulas.

25 Notice that a WARNING! message flashes (in the trace chart) and that the Exhaust Gas Temperature and Tachometer gauges change color near the end of the sweep test. This is because the #5 Thermocouple and RPM exceed preset Alarm Limits. Different Alarm Limits and Actions can be programmed by you for any test session. Depending on you current preference settings, you may even hear the tachometer and audible voice alarms, or see a small video window showing the engine running in the cell.

Tip: *All of the Console Gauge's, Titles, Ranges, Scaling, Resolution, Units, Chart Axis, Alarm Limits and Actions can be reconfigured to suit your own testing.*

26 When the Run is finished re-playing, the Console's Test Run Time clock and the # of Recs. (Records Counter) stops. Its Status message also changes from "Playing" to "End of Run."

27 The Console has a Freeze button to temporarily halt playback, a Rewind button to return to the beginning of the run (ready to play again), and a Quick Print button to print the currently defined Quick Print Report. Lastly, the Open Run button loads a different run (from your PC's Hard Disk) ready for reviewing within the Console.

Tip: *You can also Import old "DYNO-MAX for Windows" run (.hdr) files to see how DYNO-MAX improves the display of files captured with older technology. DYNO-MAX also has a pull-down selection "16-bit Header Files (.hdr)" choice in its "File - Open Run" window for this same purpose.*

28 Prepare the Console for Real Time data collection by clicking on its Testing Mode button. If your DYNOmite Data Acquisition Computer is actively communicating with DYNO-MAX, the Status message will display Ready.

29 Several items on the Console change between Replay and Testing modes. For example: The Play button becomes a Record button (for capturing data), the Freeze button becomes a Pause button (to pause recording), and the Rewind button switches to an Erase button (that deletes any unsaved test recording). The nine Relay Control buttons change from gray to colors, indicating they're available to operate assigned hardware options. Five new Servo Mode buttons appear. These toggle between Manual, Servo, and Auto Testing mode for both the Electronic Load Valve and Throttle Gear options.

30 The Real Time Console's New Run button initiates closure of the last test recording (if one made in this session) and then opens a New Run file.

Finish exploring all of DYNO-MAX's basics, before coming back to the Real Time Console to capture data from a running engine.

Important: *After you have looked over more of DYNO-MAX on your own, we suggest reviewing this Getting Started Help topic a second time, spending more time reviewing each screen's individual Help Topics (which explain individual field functions).*

Tip: *Be sure to review all the required fields in the Run Information panel, as these settings influence test results!*

This section steps you through actual manual operation of the dynamometer controls during a test run. It requires that you have understood the previous sections on setting up the data computer, dynamometer hardware, and test environment.

CAUTION: Never use a powerful or peaky engine to learn to operate the DYNOmite! Run some reliable old high torque "beater"!

Tip: *Read the above caution and actually follow it! This will save you time, frustration, embarrassment, and maybe a bunch of money!*

1 Power up the DYNOmite's computer and go to an appropriate Real-Time data display screen (see previous sections).

WARNING: Make sure cooling lines are hooked up, kill switches are in place, spectators are out of line with potentially exploding rotating components (or pressurized hoses), and that exhaust will be blown away from operator, open windows, and the engine's intake.

Tip: *If you plan to print out Corrected Torque and Hp, remember to enter current atmospheric conditions (or use the optional Weather Station Module).*

2 Start the engine and compare the DYNOmite's RPM display with the engine's tachometer. If there is a gross discrepancy, re-check the Engine RPM Signal Type # Pulses per revolution setting you made.

Tip: *Minor variation between the tachometers is normal. The DYNOmite's digital tach is precise, and can be used for calibrating the engine's tach. However, don't bother watching the digital tach for loading the engine. Instead, use an analog gauge to follow the rapidly changing data.*

3 Apply about quarter throttle and practice opening and closing the load valve manually to control raising and lowering the engine's RPM.

Tip: *The load valve controls the water level in the absorber. The fuller the absorber is, the lower the engine RPM will be at a given throttle opening. During normal dyno testing you will regulate engine RPM with the load valve and you will use the throttle to regulate torque.*

4 Add a bit more throttle and continue practicing the art of moving the engine RPM up and down with just the load valve (leaving the throttle fixed).

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Tip: *Your first runs with a dyno may feel awkward, especially if you try to load a very peaky engine below its maximum torque RPM. However, after some load valve practice you will be able to hold a specific RPM, at most fixed throttle openings. (See "*TROUBLE SHOOTING - Absorber Matching*" section 13.3).*

5 Continue making practice dyno runs (using more throttle each time) until, at full throttle, you are able to make a controlled sweep of the engine's power band using just the load valve.

CAUTION: Monitor temperature during testing, letting the engine cool between tests. Engine temperature affects horsepower and excessive temperatures will cause damage. Any gearboxes in the drive line may also require cooling provisions.

Tip: *There's a slight delay between moving the load valve and actually seeing the response in engine RPM (like steering a heavy boat). Anticipating the engine's response soon becomes second nature (like riding a bicycle or balancing a broomstick).*

6 Once you are comfortable running the engine at full throttle (under manual load valve control) you will be able to glance at the data screen to monitor torque, Hp, etc. during testing.

Tip: *Experienced dyno operators move to full throttle in a smooth but brisk fashion, using only the load valve to prevent over-revving (watch that analog tach). Thinking about the shape of the engine's torque vs. RPM curve may help you anticipate how you will need to operate the load valve.*

7 To find peak horsepower, just adjust the load valve to the RPM that yields the highest (steady state) horsepower reading.

Tip: *Proper operation is vital to get usable data from any dyno session. Due to the inertial energy, only reasonably steady state dyno readings are meaningful. Keep acceleration below 800 RPM per second! Readings taken while rapidly decelerating the engine with the load valve include actual engine power plus the flywheel energy from the decelerating crank train. This provides an inflated (wrong) Hp reading. This is not a defect, at that moment this is the actual power being delivered at the output shaft. But it's not power the engine alone can sustain. Conversely, if the engine is rapidly accelerating, you get a low reading. So, maintain reasonably steady RPM (with the load valve) while reading power.*

If you have entered appropriate **CAL**ibration settings for controlling data capture thresholds and playback rates, follow these few steps (at the start of each test run) to record data for playback and printout.

1 From the standard Real Time data display screen, and with the engine idling and warmed up, press the **TEST** button. The following screen will now be displayed.

2 Gradually bring the engine to full throttle while adjusting the manual load valve to a steady RPM below your established Engine speed to trigger recording RPM.

Tip: *When using the optional Electronic Auto-Load Servo your Stepper Motor Holding RPM setting determines the RPM that the valve automatically restricts the engine to.*

3 Gradually back off the load valve to increase engine RPM past your Engine speed to trigger recording setting. Once both this RPM and your Minimum HP at trigger RPM are exceeded, data will be continuously recorded. If data is being captured, you will see the following screen.

4 Vary the RPM using the load valve (not the throttle) to record data over any RPM range you want.

Tip: *Under manual load control, most engines are easier to sweep from high RPM to low RPM. With the optional Electronic Auto-Load Servo, you can electronically control RPM with the "+" and "-" buttons (or program an automatic RPM Sweep Test). (See "*OPTIONS - Electronic Auto-Load Servo*" section).*

5 Recording will only stop if you either drop below your Minimum speed to maintain recording RPM setting, or exceed the DYNOmite (hand held) Data Acquisition Computer's 8,000 stored record memory limit (about 30 seconds at 200 record sets per second).

Tip: *If you want to capture longer duration test sessions, set the record rate to 20 or 2 records per second. This will stretch recording time up to one hour.*

6 When you are finished collecting data, smoothly cut the throttle while simultaneously un-loading the idling engine (by closing the load valve).

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Tip: *Say you want a power curve on an engine that should pull about 350 HP at 6.000 RPM. You might set the rev-limiter at 6,500 RPM (to protect the engine). To get data from 6,300 RPM to 2,500 RPM, set the Engine speed to trigger recording just under 6,300 RPM (6,000 is good) and Minimum HP at trigger RPM at about 50% of expected power at 6,000 RPM (150 HP would be reasonable). Set the Minimum speed to maintain recording at 2,500 RPM. Press the "**TEST**" button and proceed to load the engine at any RPM below the Engine speed to trigger recording point. Once you're comfortably at W.O.T. under load valve control, reduce the load to bring the engine to your maximum desired RPM of 6,300. Since that exceeds the 6,000 RPM/150 HP trigger points, recording begins automatically. Now, slowly load the engine so the RPM gradually (several seconds) sweeps to below 2,500 RPM (ending recording automatically). Now you have a Wide Open Throttle power curve from 6,300 RPM to 2,500 RPM!*

7 That's it! Your test data is now ready to playback for analyzing!

Tip: *You can even use the DYNOmite (hand held) Data Acquisition Computer on the vehicle as an on-board data collection system (without the absorber and torque arm). Just be sure to set the Minimum HP at trigger RPM to zero. The resulting RPM vs. elapsed time curve gives you a great snapshot of your acceleration/RPM curve. The addition of the optional On-Board Torque Transducer, EGT, BSFC, etc. hardware and software expands this capability to a full track data acquisition system (with real strain gauge torque and Hp)!*

This section is for the hand held Data Acquisition Computer module (with an LCD screen and 4-pushbuttons).

Tip: *If your interface is via a DYNO-MAX equipped PC, it is not mandatory to read this section.*

During playback, the DYNOmite Data Computer can increase data usability by filtering and averaging many individual reading sets before displaying them as a single "clean" data point set. The playback can be set to automatically ignore any data sets captured while the engine was sweeping too rapidly. Even the most basic DYNOmite systems can simulate the type of automated testing common on dynamometers costing thousands more!

After test data has been collected, simply press the **PRINT** button to display the last run (or print it on optional serial printer).

Tip: *Holding the* **NEXT** *button down freezes the display. Holding the "+" button down during data playback fast forwards the playback. Pressing the "-" button during playback rewinds the playback several frames. Simultaneously pressing* **NEXT, "+",** *and "-" aborts the playback session without erasing the data.*

CAUTION: Once you press the* TEST *button again (to start a new dyno pull), your last recorded data is overwritten!

Tip: *Don't be surprised if the engine's honest horsepower is different than the rating provided by the manufacturer or engine builder. There are several legitimate reasons for this: accepted industry standards allow engines to be +-10% of the advertised rated horsepower, a new engine takes as long as 20 hours to seat its rings and develop full power, changes in exhaust back pressure between running an engine on a stand vs. a full exhaust system will affect the power produced. The data must also be corrected for atmospheric conditions during testing.*

The DYNOmite offers several combinations of data averaging and playback modes. You can format it to play back every reading: Data-Averaging during playback = 1 records/line and Printout and Display Mode = 1

However, outputting every point creates an awkwardly long report! To trim it down to size, you should set Data-Averaging during playback = 20 records/line. This means that every 20 consecutive readings (1/10 second running time) will be averaged into one line for playback display (or printout). Besides reducing playback time, averaging smooths out the data.

If you held the engine at one particular RPM during the test you can evaluate your data now to see the effect of engine temperature changes on power, evaluate your engine's gauge readings, etc. If you had slowly swept operating RPM range during the test, this data output will pinpoint the precise peak power and torque points.

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Tip: *Keep in mind that the more readings you average, the steadier you need to hold the engine RPM during testing to have meaningful output.*

The DYNOmite also reports in even 100 RPM steps during playback. To choose this output mode, set Data-Averaging during playback = 0 (actually labeled Narrow STEP mode). This sets the computer to average the consecutive readings (at least those that were near an even 100 RPM multiple) into single data output lines in 100 RPM increments. As long as the DYNOmite has at least 12 suitable readings (they must be consecutive and within +/- 49 RPM of the same 100 RPM multiple) it will output a line. If there are more than 200 readings (over one second of run time) at a suitable RPM, then multiple lines will be printed for that RPM.

Tip: *This type of output is the one that most non-technical customer's like to look at.*

There is also a Wide STEP mode for engines that are not as stable that opens up the window to +/- 99 RPM but requires more consecutive readings to print a line. Use it if you seem to miss a lot of RPM multiples with the Narrow Step mode.

Tip: *When analyzing any dyno's data, just remember that only reasonably steady state HP readings are meaningful. Do not start believing flash readings that you can get by "cranking on the load" at high RPM.*

The torque and horsepower stored in the DYNOmite are the true readings Observed under the atmospheric conditions that existed during the test. However, if you need to compare testing from one day to another, or compare test data taken at a different altitude, you will want to correct to standard atmospheric conditions.

The DYNOmite provides screens for entering temperature, humidity, and absolute barometric pressure prior to testing. During data output, you can select to have it SAE Corrected to standard atmospheric conditions. To select this mode, chose "C" under Data-Correction for Display.

Correction is done by applying Standard SAE factors to estimate what the power would have been at 60 degrees Fahrenheit, 0% relative humidity, and standard sea level barometric pressure (29.92"Hg absolute). The heading of printed reports indicates which correction mode the data is in.

Tip: *If you need to manually correct your existing dyno data, you can. A sheet showing the standard Society of Automotive Engineers test correction factors is included with this manual. To use all the factors you must know the air temperature, relative humidity, and absolute barometric pressure that existed during your test. You then look up the correction factor for each weather parameter.*

i.e. Say testing indicates 304 peak horsepower but you want to compare those results to a manufacturer's published information (engine manufacturers typically correct their power figures to Standard SAE conditions). During testing the absolute barometric pressure was 29.1 inches of mercury, relative humidity was 30%, and air temperature was 54 degrees Fahrenheit.

The Standard SAE Correction Chart shows the factor for 29.1 in. hg. = 1.025, the factor for 30% relative humidity @ 54 deg. = 1.006, and the factor for 54 deg. air = .996. Simply multiply all the factors against the measured power to estimate what it would have produced at 29.92 inches of mercury (sea level) on a 60 degree day with 0% humidity.

1.025 x 1.006 x .996 x 304 HP = 312.2 Standard SAE Hp!

Tip: *Standard Hp is what you should quote and compare. Unless you always test under identical conditions (which would be ideal), you need to correct dynamometer readings. Otherwise you won't know if power is changing due to the engine or the weather!*

Tip: *Your local weather station will not announce the absolute barometric pressure. Instead, they give a barometric pressure that has been adjusted to eliminate the effects of local altitude (this is necessary for weather reporting but useless for dynamometer correction!) Do not use that number; either call the station and get the absolute pressure, or use a barometer that has been calibrated to read absolute pressure.*

(0% Relative Humidity, 29.38 in. Hg., 77 degrees Fahrenheit)

Relative Humidity vs. Air Temperature = Humidity Correction Factor

Air Temperatures (in degrees Fahrenheit)

	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0%	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5%	1.000	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.002	1.002	1.002	1.003	1.003
10%	1.001	1.001	1.001	1.001	1.001	1.002	1.002	1.002	1.003	1.004	1.004	1.005	1.006	1.006
15%	1.001	1.001	1.001	1.002	1.002	1.003	1.003	1.004	1.004	1.005	1.006	1.007	1.008	1.010
20%	1.001	1.001	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.008	1.010	1.011	1.013
25%	1.001	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.009	1.010	1.012	1.014	1.016
30%	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.009	1.011	1.013	1.015	1.017	1.020
35%	1.002	1.002	1.003	1.004	1.005	1.006	1.007	1.009	1.010	1.012	1.015	1.017	1.020	1.023
40%	1.002	1.003	1.003	1.004	1.005	1.007	1.008	1.010	1.012	1.014	1.017	1.020	1.023	1.026
45%	1.002	1.003	1.004	1.005	1.006	1.008	1.009	1.011	1.014	1.016	1.019	1.022	1.026	1.030
50%	1.003	1.003	1.004	1.005	1.007	1.008	1.010	1.013	1.015	1.018	1.021	1.025	1.029	1.033
55%	1.003	1.004	1.005	1.006	1.008	1.009	1.011	1.014	1.017	1.020	1.023	1.027	1.032	1.036
60%	1.003	1.004	1.005	1.007	1.008	1.010	1.012	1.015	1.018	1.022	1.025	1.030	1.035	1.040
65%	1.003	1.004	1.006	1.007	1.009	1.011	1.014	1.016	1.020	1.023	1.028	1.032	1.037	1.043
70%	1.004	1.005	1.006	1.008	1.010	1.012	1.015	1.018	1.021	1.025	1.030	1.035	1.040	1.047
75%	1.004	1.005	1.007	1.008	1.010	1.013	1.016	1.019	1.023	1.027	1.032	1.037	1.044	1.050
80%	1.004	1.005	1.007	1.009	1.011	1.014	1.017	1.020	1.024	1.029	1.034	1.040	1.047	1.054
85%	1.005	1.006	1.007	1.009	1.012	1.014	1.018	1.022	1.026	1.031	1.036	1.043	1.050	1.057
90%	1.005	1.006	1.008	1.010	1.012	1.015	1.019	1.023	1.027	1.033	1.039	1.045	1.053	1.061
95%	1.005	1.006	1.008	1.010	1.013	1.016	1.020	1.024	1.029	1.035	1.041	1.048	1.056	1.065
100%	1.005	1.007	1.009	1.011	1.014	1.017	1.021	1.025	1.031	1.036	1.043	1.050	1.059	1.068

Barometric Pressure in inches of mercury = Barometric Pressure Correction Factor

31.0 = 0.948	29.2 = 1.006	27.4 = 1.072	25.6 = 1.148	23.8 = 1.234
30.9 = 0.951	29.1 = 1.010	27.3 = 1.076	25.5 = 1.152	23.7 = 1.240
30.8 = 0.954	29.0 = 1.013	27.2 = 1.080	25.4 = 1.157	23.6 = 1.245
30.7 = 0.957	28.9 = 1.017	27.1 = 1.084	25.3 = 1.161	23.5 = 1.250
30.6 = 0.960	28.8 = 1.020	27.0 = 1.088	25.2 = 1.166	23.4 = 1.256
30.5 = 0.963	28.7 = 1.024	26.9 = 1.092	25.1 = 1.171	23.3 = 1.261
30.4 = 0.966	28.6 = 1.027	26.8 = 1.096	25.0 = 1.175	23.2 = 1.266
30.3 = 0.970	28.5 = 1.031	26.7 = 1.100	24.9 = 1.180	23.1 = 1.272
30.2 = 0.973	28.4 = 1.035	26.6 = 1.105	24.8 = 1.185	23.0 = 1.277
30.1 = 0.976	28.3 = 1.038	26.5 = 1.109	24.7 = 1.189	22.9 = 1.283
30.0 = 0.979	28.2 = 1.042	26.4 = 1.113	24.6 = 1.194	22.8 = 1.289
29.9 = 0.983	28.1 = 1.046	26.3 = 1.117	24.5 = 1.199	22.7 = 1.294
29.8 = 0.986	28.0 = 1.049	26.2 = 1.121	24.4 = 1.204	22.6 = 1.300
29.7 = 0.989	27.9 = 1.053	26.1 = 1.126	24.3 = 1.209	22.5 = 1.306
29.6 = 0.993	27.8 = 1.057	26.0 = 1.130	24.2 = 1.214	22.4 = 1.312
29.5 = 0.996	27.7 = 1.061	25.9 = 1.134	24.1 = 1.219	22.3 = 1.317
29.4 = 0.999	27.6 = 1.064	25.8 = 1.139	24.0 = 1.224	22.2 = 1.323
29.3 = 1.003	27.5 = 1.068	25.7 = 1.143	23.9 = 1.229	22.1 = 1.329

Air Temperature in degrees Fahrenheit = Air Temperature Correction Factor

0 = 0.923	24 = 0.947	48 = 0.971	72 = 0.995	96 = 1.019
2 = 0.925	26 = 0.949	50 = 0.973	74 = 0.997	98 = 1.021
4 = 0.927	28 = 0.951	52 = 0.975	76 = 0.999	100 = 1.023
6 = 0.929	30 = 0.953	54 = 0.977	78 = 1.001	102 = 1.025
8 = 0.931	32 = 0.955	56 = 0.979	80 = 1.003	104 = 1.027
10 = 0.933	34 = 0.957	58 = 0.981	82 = 1.005	106 = 1.029
12 = 0.935	36 = 0.959	60 = 0.983	84 = 1.007	108 = 1.031
14 = 0.937	38 = 0.961	62 = 0.985	86 = 1.009	110 = 1.033
16 = 0.939	40 = 0.963	64 = 0.987	88 = 1.011	112 = 1.035
18 = 0.941	42 = 0.965	66 = 0.989	90 = 1.013	114 = 1.037
20 = 0.943	44 = 0.967	68 = 0.991	92 = 1.015	116 = 1.039
22 = 0.945	46 = 0.969	70 = 0.993	94 = 1.017	118 = 1.041

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(0% Relative Humidity, 29.92 in. Hg., 60 degrees Fahrenheit)

Relative Humidity vs. Air Temperature = Humidity Correction Factor

Air Temperatures (in degrees Fahrenheit)

	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0%	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5%	1.000	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.002	1.002	1.002	1.003	1.003
10%	1.001	1.001	1.001	1.001	1.001	1.002	1.002	1.002	1.003	1.004	1.004	1.005	1.006	1.006
15%	1.001	1.001	1.001	1.002	1.002	1.003	1.003	1.004	1.004	1.005	1.006	1.007	1.008	1.010
20%	1.001	1.001	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.008	1.010	1.011	1.013
25%	1.001	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.009	1.010	1.012	1.014	1.016
30%	1.002	1.002	1.003	1.003	1.004	1.005	1.006	1.007	1.009	1.011	1.013	1.015	1.017	1.020
35%	1.002	1.002	1.003	1.004	1.005	1.006	1.007	1.009	1.010	1.012	1.015	1.017	1.020	1.023
40%	1.002	1.003	1.003	1.004	1.005	1.007	1.008	1.010	1.012	1.014	1.017	1.020	1.023	1.026
45%	1.002	1.003	1.004	1.005	1.006	1.008	1.009	1.011	1.014	1.016	1.019	1.022	1.026	1.030
50%	1.003	1.003	1.004	1.005	1.007	1.008	1.010	1.013	1.015	1.018	1.021	1.025	1.029	1.033
55%	1.003	1.004	1.005	1.006	1.008	1.009	1.011	1.014	1.017	1.020	1.023	1.027	1.032	1.036
60%	1.003	1.004	1.005	1.007	1.008	1.010	1.012	1.015	1.018	1.022	1.025	1.030	1.035	1.040
65%	1.003	1.004	1.006	1.007	1.009	1.011	1.014	1.016	1.020	1.023	1.028	1.032	1.037	1.043
70%	1.004	1.005	1.006	1.008	1.010	1.012	1.015	1.018	1.021	1.025	1.030	1.035	1.040	1.047
75%	1.004	1.005	1.007	1.008	1.010	1.013	1.016	1.019	1.023	1.027	1.032	1.037	1.044	1.050
80%	1.004	1.005	1.007	1.009	1.011	1.014	1.017	1.020	1.024	1.029	1.034	1.040	1.047	1.054
85%	1.005	1.006	1.007	1.009	1.012	1.014	1.018	1.022	1.026	1.031	1.036	1.043	1.050	1.057
90%	1.005	1.006	1.008	1.010	1.012	1.015	1.019	1.023	1.027	1.033	1.039	1.045	1.053	1.061
95%	1.005	1.006	1.008	1.010	1.013	1.016	1.020	1.024	1.029	1.035	1.041	1.048	1.056	1.065
100%	1.005	1.007	1.009	1.011	1.014	1.017	1.021	1.025	1.031	1.036	1.043	1.050	1.059	1.068

Barometric Pressure in inches of mercury = Barometric Pressure Correction Factor

31.0 = 0.965	29.2 = 1.025	27.4 = 1.092	25.6 = 1.169	23.8 = 1.257
30.9 = 0.968	29.1 = 1.028	27.3 = 1.096	25.5 = 1.173	23.7 = 1.262
30.8 = 0.971	29.0 = 1.032	27.2 = 1.100	25.4 = 1.178	23.6 = 1.268
30.7 = 0.975	28.9 = 1.035	27.1 = 1.104	25.3 = 1.183	23.5 = 1.273
30.6 = 0.978	28.8 = 1.039	27.0 = 1.108	25.2 = 1.187	23.4 = 1.279
30.5 = 0.981	28.7 = 1.043	26.9 = 1.112	25.1 = 1.192	23.3 = 1.284
30.4 = 0.984	28.6 = 1.046	26.8 = 1.116	25.0 = 1.197	23.2 = 1.290
30.3 = 0.987	28.5 = 1.050	26.7 = 1.121	24.9 = 1.202	23.1 = 1.295
30.2 = 0.991	28.4 = 1.054	26.6 = 1.125	24.8 = 1.206	23.0 = 1.301
30.1 = 0.994	28.3 = 1.057	26.5 = 1.129	24.7 = 1.211	22.9 = 1.307
30.0 = 0.997	28.2 = 1.061	26.4 = 1.133	24.6 = 1.216	22.8 = 1.312
29.9 = 1.001	28.1 = 1.065	26.3 = 1.138	24.5 = 1.221	22.7 = 1.318
29.8 = 1.004	28.0 = 1.069	26.2 = 1.142	24.4 = 1.226	22.6 = 1.324
29.7 = 1.007	27.9 = 1.072	26.1 = 1.146	24.3 = 1.231	22.5 = 1.330
29.6 = 1.011	27.8 = 1.076	26.0 = 1.151	24.2 = 1.236	22.4 = 1.336
29.5 = 1.014	27.7 = 1.080	25.9 = 1.155	24.1 = 1.241	22.3 = 1.342
29.4 = 1.018	27.6 = 1.084	25.8 = 1.160	24.0 = 1.247	22.2 = 1.348
29.3 = 1.021	27.5 = 1.088	25.7 = 1.164	23.9 = 1.252	22.1 = 1.354

Air Temperature in degrees Fahrenheit = Air Temperature Correction Factor

0 = 0.940	24 = 0.964	48 = 0.988	72 = 1.012	96 = 1.036
2 = 0.942	26 = 0.966	50 = 0.990	74 = 1.014	98 = 1.038
4 = 0.944	28 = 0.968	52 = 0.992	76 = 1.016	100 = 1.040
6 = 0.946	30 = 0.970	54 = 0.994	78 = 1.018	102 = 1.042
8 = 0.948	32 = 0.972	56 = 0.996	80 = 1.020	104 = 1.044
10 = 0.950	34 = 0.974	58 = 0.998	82 = 1.022	106 = 1.046
12 = 0.952	36 = 0.976	60 = 1.000	84 = 1.024	108 = 1.048
14 = 0.954	38 = 0.978	62 = 1.002	86 = 1.026	110 = 1.050
16 = 0.956	40 = 0.980	64 = 1.004	88 = 1.028	112 = 1.052
18 = 0.958	42 = 0.982	66 = 1.006	90 = 1.030	114 = 1.054
20 = 0.960	44 = 0.984	68 = 1.008	92 = 1.032	116 = 1.056
22 = 0.962	46 = 0.986	70 = 1.010	94 = 1.034	118 = 1.058

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Many dyno operators have been confused by the difference between absolute (actual) barometric pressure readings and the corrected (altitude adjusted) barometric pressure reported by weather meteorologists (or read off locally adjusted weather barometers). Some explanation should clear up the mystery and help you understand why you must use absolute barometric pressure for dyno corrections.

Tip: *"Barometric pressure" refers to the air pressure around us which, over time, averages 14.7 psi at sea-level. As barometric pressure increases so does air density. Running an engine at higher air density means it gets more oxygen and consequently can produce more power.*

As altitude increases average barometric pressure decreases. But for weather forecasting (only), meteorologists need to know what the local barometric pressure would be if the entire world were at the same altitude! So, they back out the effect of altitude from the true (absolute) barometric pressure and call it Corrected Barometric Pressure. Even on top of Mount Everest the average corrected Barometric Pressure is the same as sea level! So, getting the Barometric Pressure from a Weather Broadcast is useless for dynoing.

Tip: *Since most people buy barometers for predicting weather, they all adjust that screw on the back to match the local Corrected Barometric Pressure (making the numbers useless). Only at sea level are absolute and corrected barometer readings the same.*

Since air density is a function of the absolute (not the corrected) barometric pressure this is what you need to correct your dyno test results to sea level conditions. To get uncorrected readings try calling a local weather station and ask for both the corrected and uncorrected barometric pressure. Then use the uncorrected (lower) number for dyno work. Also, reset your cell barometer to read absolute pressure.

Tip: *You can use the following altitude Offset Amount chart below to adjust the weatherman's corrected barometric pressure report.*
Example: If you live at 2,000 feet and the report says the days pressure is 29.92" Hg, subtract 2.10" to get the absolute barometric pressure of 27.82" Hg.

Local Altitude	Average Pressure	Offset Amount
0'	29.92	-0.00
1,000'	28.86	-1.06
2,000'	27.82	-2.10
3,000'	26.81	-3.11
4,000'	25.84	-4.08
5,000'	24.89	-5.03
6,000'	23.98	-5.94
7,000'	23.09	-6.83
8,000'	22.22	-7.70
9,000'	21.38	-8.54

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Aliasing, in the recording of dynamometer data, is the inducement of anomalies in the captured signals as a result of using tool long a sampling at interval. In video capture, using too slow a frame rate, you see aliasing as the slowing or reversing of a spinning wheel's spokes.

During engine testing, if the selected sampling interval is too long, high-frequency events may induce low-frequency humps and bumps into the recorded data. Aliasing effects can vary with things like the test RPM!

Consider the torque channel, it is subjected to a high/low oscillation every time a cylinder fires. So, it's data inherently contains a ripple - the frequency of which varies with RPM. That is why you see the magnitude of aliasing errors change as the RPM frequency comes in and out of phase with a data acquisition system suing a fixed sampling interval.

Accurate capture theoretically requires a sampling interval less than one-half the inverse of the highest Fourier frequency component within the sampled channel. This is referred to as the Nyquist interval.

The effects of aliasing in the recorded data may be avoided by filtering (e.g. electronically dampening with capacitors) the source signal to remove any frequency components that are higher than those required in the captured data.

Tip: *If you are having aliasing problems, contact your Land & Sea support technician for help sizing the optimum filtering capacitors. Note: Most applications will not need them!*

The following schematic (Figure 36)shows an example of using inexpensive capacitors to build a simple pre-filter that dampens out high frequency transients before they are received by the DYNOmite's full-bridge Torque channel. Capacitors C1 and C2 are 6.3 WVDC 1,000 MFD electrolytics.

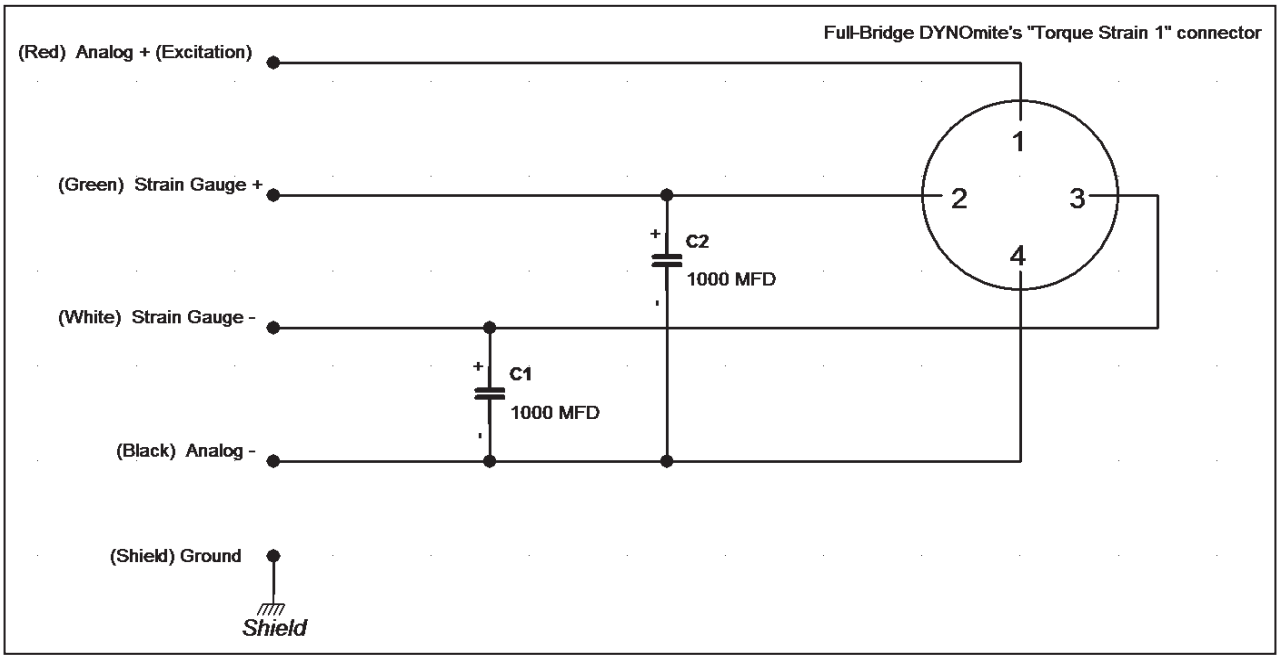

Figure 36

The Airflow Turbine Kits expands the data logging capabilities of DYNOmite-Pro LCD equipped data acquisition computer (or other DYNOmite models running through DYNO-MAX). Each kit features a turbine fan type airflow transducer, mounting clamp, and (if required) an EPROM software upgrade. When installed, this option monitors and records the engine's real time air consumption and calculates the Brake Specific Air Consumption of the engine during dynamometer testing. In conjunction with the optional Fuel Flow and Brake Specific Fuel Consumption kit, Air/Fuel ratios may also be calculated.

To use the airflow transducer option you may need to upgrade to the latest DYNOmite software and Full Function harness. You will also need to enter special configuration set-up codes for your particular version DYNOmite computer. Please call for free technical assistance in performing the upgrade and/or code entry.

1 The Airflow Transducer must be mounted to the engine's air inlet. Various size turbines and adapters are available to allow direct mounting of the turbine on many popular carburetors.

Tip: *For odd size carburetors, throttle bodies, etc., or for highly pulsating intakes, the transducer can be mounted to an intermediate plenum. The plenum should be large enough in volume to just dampen the intake pulsations.*

2 Plug the transducer's 3-pin male connector into the DYNOmite's (Frequency 4) "Air Flow (in)" lead (found on the optional "Full-Function" harness).

Tip: *The remaining steps assume your DYNOmite Data Acquisition Computer already has the correct software version and configuration set-up codes. Also, for specific step-by-step LCD or DYNO-MAX screen shots see this manual's DYNOmite-Pro (section 7.5), DYNOmite-Basic (section) or DYNO-MAX's On-Line Help!*

3 Once the airflow transducer kit is correctly installed, the DYNOmite computer will always be monitoring the airflow (in CFM or pounds per hour) and calculating BSFC (in pounds per hour per HP).

4 To view or print this extra information, just select appropriate DYNOmite display screens and printed reports, or in DYNO-MAX attach to the desired formula, to display or graph airflow and BSAC data.

Tip: *If you record a run, the DYNOmite will also record the airflow and BSAC information - even if you were not in a display mode that showed that information during the test. You can always print (or redisplay) all the data fields your DYNOmite is capable of reading, even after a run is captured.*

5 The default DYNOmite Frequency 4 channel calibration provides a relative adjustment "Flow Factor" for precision calibration to the individual airflow transducer being used. While, the DYNOmite is pre-calibrated for our standard capacity transducers, if you substitute a different ca-

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pacity transducer, (or require extra precision) you may need to change this calibration flow factor. Calibration requires a calibrated airflow test bench. Any error in the DYNOmite's flow reading is simply offset out by adjusting the factor by the percentage of deviation. Retest until the DYNOmite's reading matches the test instrument's reading.

Tip: *You must always insure that this calibrated "Transducer Calibration Factor:" is entered (for this turbine) during subsequent engine testing!*

Note: The standard 3" airflow transducer outputs an approximately 60 Hz signal at a flow rate of 18.4 CFM.
Its nominal DYNOmite-Pro "Pulses per Cubic Foot" is ??? (or a DYNO-MAX "Recalibration Flow Factor" of 0.714 using a Power of 0.9 and a multiplier of 0.01).
For the DYNOmite-Basic board set the nominal DYNO-MAX "Recalibrate Flow Factor = 14000."

The standard 4" airflow transducer outputs an approximately 60 Hz signal at a flow rate of 37.3 CFM.
Its nominal DYNOmite-Pro "Pulses per Cubic Foot" is ??? (or a DYNO-MAX "Recalibration Flow Factor" of 0.120 using a Power of 0.9 and a multiplier of 0.1).
For the DYNOmite-Basic board set the nominal DYNO-MAX "Recalibrate Flow Factor = 6470.")

The standard 6-1/2" airflow transducer outputs an approximately 60 Hz signal at a flow rate of 128.4 CFM.

Its nominal DYNOmite-Pro "Pulses per Cubic Foot" is ??? (or a DYNO-MAX "Recalibration Flow Factor" of 0.474 using a Power of 0.9 and a multiplier of 0.1).
For the DYNOmite-Basic board set the nominal DYNO-MAX "Recalibrate Flow Factor = 1636.")

The standard 9" airflow transducer outputs an approximately 60 Hz signal at a flow rate of 343.1 CFM.
Its nominal DYNOmite-Pro "Pulses per Cubic Foot" is ??? (or a DYNO-MAX "Recalibration Flow Factor" of 0.1094 using a Power of 0.9 and a multiplier of 1.0).
For the DYNOmite-Basic board set the nominal DYNO-MAX "Recalibrate Flow Factor = 548.")

CAUTION: For DYNOmite-Pro (or Lite) board sets adjust the "Trigger Voltage" for the Frequency 4 channel to 4.5 volts. This setting has nothing to do with calibration! Rather, it matches the threshold of the DYNOmite's pulse counter to the various Airflow Transducers' 5 volt square waves (that drop to 1 volt between pulses). The default DYNOmite "Trigger Voltage Level" for these transducers is 4.5 volts.

Tip: *It is possible to use an Air-Flow Turbine Kit on a single board DYNOmite system with the correct wiring and DYNO-MAX options (Figure 37).*

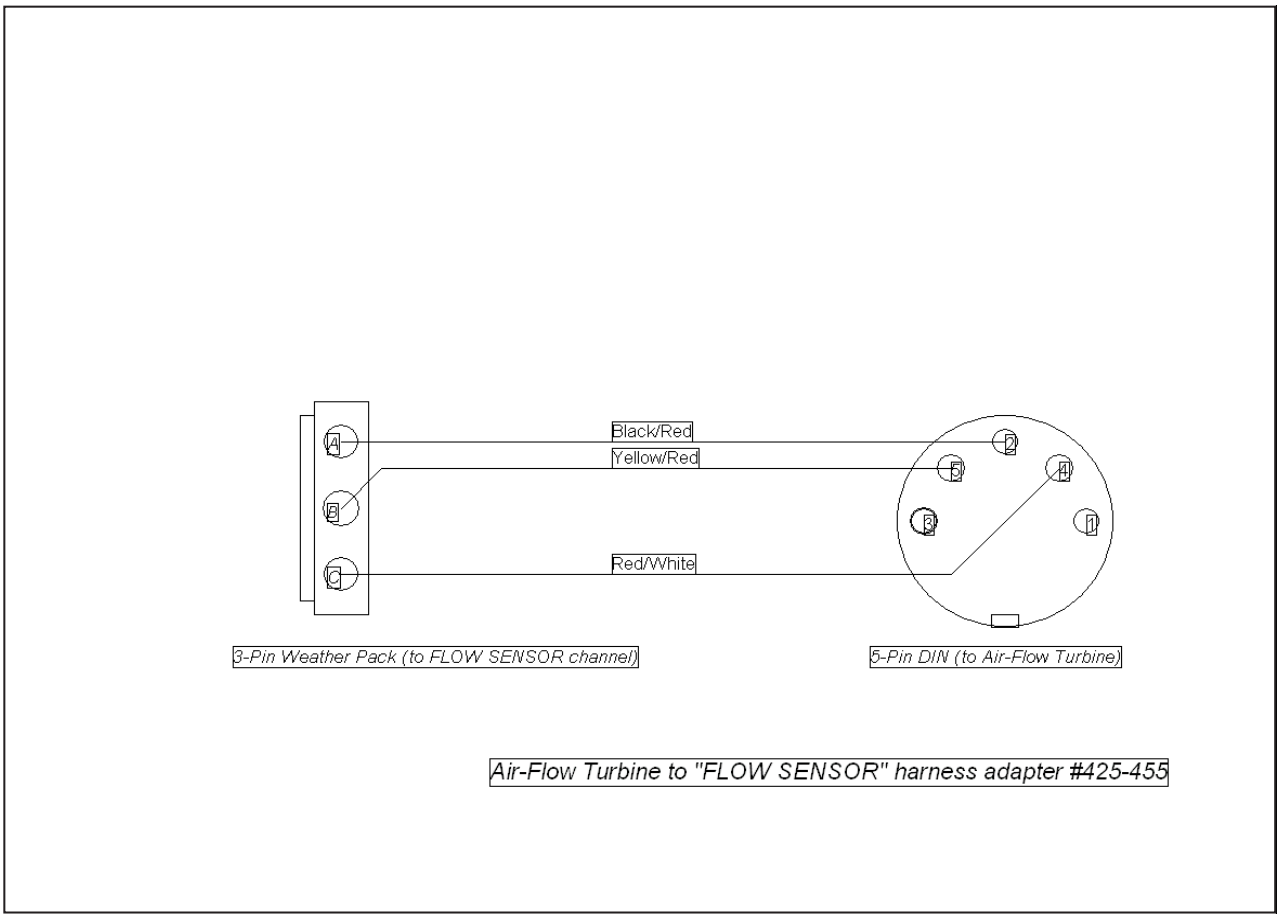

Figure 37

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The DYNOmite Wide-Band AFR O_2 Module (Figure 38) with a Bosch (or NTK) UEGO sensor is designed to monitor the air/fuel ratio of carburetor or fuel-injection equipped engines. It uses the latest wide-band technology heated oxygen sensors in the exhaust system to sample the residual gasses of a running engine. Air/fuel ratios are then calculated within the control module and output, in real-time, during dynamometer or on-road testing sessions.

Technology

Figure 38

The DYNOmite Wide-Band AFR O_2 Module supports several Bosch and NTK wide-band UEGO sensor models, all sharing a standard 18 mm diameter mounting hole with 1.5 threads/mm pitch and similarly including these state-of-the-art design characteristics:

Surprisingly, a rather typical Lambda narrow-band type heated oxygen sensor (comprised of a reference and nernst cell) acts as the first sage of these new high-tech sensors. However, instead of directly sampling the engine's exhaust, this sensor monitors a small sample volume of gas from within a special (second stage) pumping cell chamber. It is this pump chamber which receives the engine's exhaust samples – though a small internal diffusion gap.

This pumping cell portion of the sensor is designed to regulate a catalytic reaction with a special pair of electrode inside the diffusion chamber. The catalytic reaction ca n actually consume either oxygen or (depending on the polarity of its pumping current) hydrocarbons. During operation, the first stage's oxygen sensor outputs simple rich/lean (from stoichiometric) voltage signals to the AFR control module - similar to how narrow-band O_2 sensors signaled early ECMs.

The circuitry in the module then regulates the pump's current flow and direction, so as to try and force the chamber's mixture back to a stoichiometric condition. If the module detects a lean mixture, it outputs just enough positive pump current to consume the excess oxygen. If it detects a rich mixture, it sends a negative polarity pumping current, consuming the excess hydrocarbons. *(Note: The module outputs no pump current if a stoichiometric exhaust condition is detected by the senor's first stage.)*

As you can see, the pumping current itself is thus able to serve as a direct indication of the exhaust's real-time air/fuel ratio. Since the actual pumping currents are not perfectly promotional and linear with the exhaust's air/fuel ratio, for interfacing convenience additional on-board signal linearization scaling is provided within the AFR module.

The DYNomite Wide-Band AFR O_2 Module converts and outputs its high level mixture information as both a linearized 0-5 volt analog signal and (more precise) digital RS-232 data. *(Note: only the new black housing modules offer the digital RS-232 data port).* The module's semi-automatic calibration algorithm allows quick re-calibration adjustments referenced against the 20.9% oxygen content of clean open free-air. With proper attention to sensor location, operating temperature, and calibration, accuracy of + - 0.1 AFR units is attainable. Replacement DYNOmite wide-band sensors also include a trimming resistor to maintain this level of accuracy even after sensor replacement.

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Specifications - DYNOmite Wide-Band AFR O2 Module
(box is black - with RS-232 port)

Air/Fuel Ratio Range: 9 to 18 *(using most pump gasoline blends)*
Calibration: Semi-automatic digital (via push-button) in open free-air
Analog Output: 0-5 volt linearized for use with DYNOmite and third-party data acquisition systems
Digital Output: RS-232 serial data for use with DYNO-MAX option
Supply Voltage: 11-19 VDC
Supply Current: Up to 3 amps surge (during heated sensor tip warm up) and approximately 1,400 milliamps continuous (after about 1 minute)
Maximum recommended O2 Sensor Temperature: 1,400 degrees Fahrenheit
Nominal O_2 Sensor Temperature range: 600 to 1,200 degrees Fahrenheit
Maximum recommended exhaust (or turbine inlet) back pressure: 4 PSI
Maximum recommended exhaust vacuum: -6 inches Hg.
Fuel types: Gasoline, Ethanol, Methanol, and Diesel

Specifications - DYNOmite AFR O2 Module
(box is silver - without RS-232 Data port)

Air/Fuel Ratio Range: 9 to 18 *(using most pump gasoline blends)*
Calibration: Semi-automatic analog (via potentiometer) in open free-air
Analog Output: 0-5 volt linearized for use with DYNOmite and third-party data acquisition systems
Digital Output: None
Supply Voltage: 11-19 VDC
Supply Current: Up to 3 amps surge (during heated sensor tip warm up) and approximately 1,400 milliamps continuous (after about 1 minute)
Maximum recommended O2 Sensor Temperature: 1400 degrees Fahrenheit
Nominal O_2 Sensor Temperature range: 600 to 1,200 degrees Fahrenheit
Maximum recommended exhaust (or turbine inlet) back pressure: 4 PSI
Maximum recommended exhaust vacuum: -6 inches Hg.
Fuel types: Gasoline

Specifications - ECM AFR O2 Module
(box is blue - without RS-232 Data port)

Air/Fuel Ratio Range: 8 to 18 *(using most pump gasoline blends)*
Calibration: Analog (via cal. screw) in open free-air
Analog Output: 0-5 volt linearized for use with most third-party data acquisition systems
Digital Output: None
Supply Voltage: 11-28 VDC
Supply Current: Up to 5 amps surge (during heated sensor tip warm up) and approximately 1,400 milliamps continuous (after about 1 minute)
Maximum recommended O2 Sensor Temperature: 1,700 degrees Fahrenheit
Nominal O_2 Sensor Temperature range: 600 degrees to 1,100 degrees Fahrenheit
Maximum recommended exhaust (or turbine inlet) back pressure: 4 PSI
Maximum recommended exhaust vacuum: -6 inches Hg.
Fuel types: Gasoline

Installation (applies to all AFR module types)

1 Determine a suitable location for the O_2 sensor in the engine's exhaust system. Ideally the sensor should be located approximately 12" from the engine's exhaust valve(s). If exhaust temperatures (at the 12"location) exceed 1,400 degrees Fahrenheit (e.g. a turbo-charged application) or if leaded race fuels will be used – select a location at least another 24" downstream. A location further from the engine may be used, as long as the sensor is at least "ten times the exhaust pipe's diameter" upstream from the end of the exhaust system.*

**Example: With a 2 1/2" diameter exhaust pipe, the sensor should be at least 2 feet upstream of the exhaust's outlet. Locations further downstream (than ten diameters) is that air may be trapped in the exhaust giving leaner than actual readings, especially at lower flow rates.*

Tip: *A DYNOmite exhaust pump system should be used when sampling close to the end of an automotive or motorcyle exhaust pipe.*

CAUTION: Locating the O_2 sensor too close to the exhaust valve(s) can overheat the sensor. Placing it too far from the exhaust valve(s) exposes it to more condensation in the exhaust system – which can also damage the sensor. Similarly, the O_2 sensor should not be placed in a water injected exhaust system.

2 Install the O_2 sensor by lightly coating its threads with a non-lead containing anti-seize compound and tighten it to 30 ±3 ft-lb (40 ±4 Nm). Attach the sensor to the wiring harness and route the harness to the module.

3 Secure the sensor's harness with wire ties to protect it from chafing and hot exhaust components.

4 To install the adapter you will need to drill a 3/4" diameter hole into the exhaust system. Orient this hole near the top of the pipe so that any condensed liquid in the exhaust will not enter the sensor.

CAUTION: Verify that your location which will provide adequate ground and frame clearance as the suspension and motor mounts move thought their travel.

5 The O_2 sensor is mounted in the engine's exhaust with an included threaded adapter. Weld or braze the boss to the exhaust pipe.

Tip: *The DYNOmite sensor's thread size is identical to that used to mount OEM automotive exhaust oxygen sensors.*

6 After welding, re-tap the adapters threads (18 mm diameter mounting hole with 1.5 threads/mm pitch) and file the top of the boss (as required) to provide a flat sealing surface for the sensor's sealing washer.

CAUTION: Do not strike the module or dropping it on a hard surface.

7 Before installing the O_2 Sensor, apply a small amount of lead free anti-seize compound to its threads.

CAUTION: Do not get any of the anti-seize compound on the sensors tip. Also, over time, silicon sealant poisoning, use in an overly rich or oil burning engine's exhaust, or running leaded fuels will damage or reduce the sensitivity of the O_2 sensor. Avoid exposing the O_2 sensor to flammable liquids or solvents, also never attempt to clean the sensor with compressed air as this can damage the sensor's internal pumping elements.

Tip: *When the O_2 sensor is not being used, insert the included plug (using the same anti-seize compound) to seal the boss. Do not leave the O2 sensor in running engine's exhaust if the module is not attached and powering the sensor's tip heater.*

8 Determine the route for the O_2 sensor's wiring. Take care to run the harness between the O_2 sensor and the module away from the hot exhaust pipe.

CAUTION: Do not operate the engine for more than three minutes with the O_2 sensor in the exhaust unless the module is also powered. Running the sensor without its tip heater power applied will reduce its sensitivity (due to condensation and soot build-up that can occur).

9 The module requires clean DC power from a standard automotive or motorcycle battery. A DC power supply can be used for fixed location cells.

CAUTION: Never power on the module without the O_2 sensor connected.

Tip: *The module's power leads must be connected directly to the battery or supply. Avoid extending the module's leads, as a voltage drop will occur. Also, any extension could also increase the chance of RFI bothering the air/fuel ratio or other data acquisition system readings.*

10 The blue/red wire on the module's 4-pin WeatherPak connector is its +analog output. And the black (ground) lead is the -analog output. This ground is electrically connected to the power source ground through the common ground for the entire data acquisition system.

11 After energizing the module, start the engine. It will take just over 30 seconds for the senor's internal heater and the engine's exhaust to warm the O_2 sensor's tip to the point where it begins outputting valid air/fuel ratio readings.

12 After warmup, the DYNOmite Wide-Band AFR O_2 Module delivers a near linear 0 to 5 volt analog output signal. An output of 0 volts is equivalent to a 9.0 AFR (or 8.0 for the blue box ECM

module), while 5.0 volts (full scale) is equivalent to an 18.0 AFR. *Note: For newer DYNOMite (black box) AFR Modules a more precise digital RS-232 Data stream is also output – for direct serial port interfacing with a DYNO-MAX equipped PC.*

Tip: *An output signal of 2.50 volts would represent a 14.0:1 air/fuel ratio on the gasoline configuration of the DYNOmite Wide-Band AFR O_2 Module (or 13.0:1 for the blue box ECM module).*

Calibration - DYNOmite Wide-Band AFR O2 Module (box is black - with RS-232 Data port)

A Power-on the DYNOmite AFR Module by wiring it to a clean 12-volt DC source (e.g. automotive or motorcycle battery, or regulated DC power supply).

B If installed already, remove the from the sensor from the engine's exhaust. Hold the sensor in open air (with its tip down) for 3 to 10 minutes after powering on the module.

Tip: *Do not attempt re-calibration with the O2 sensor still in the exhaust system as residual fumes will cause a miss-calibration. This module's calibration algorithm relies on the 20.9% oxygen content of clean open free-air.*

C Press the module's Calibrate button for at least 5 seconds, until its Status (red) LED starts fast-flashing – indicating that automatic re-calibration is underway. After 15 seconds (if the O_2 sensor was in stable free-air) the Status LED will fall to a slow-flashing rate, indicating a successful re-calibration.

Tip: *If the Status LED does not indicate a successful re-calibration, try replacing the O2 sensor.*

D To store the new calibration values as the default for future sessions, again press the Calibrate button for at least 2 seconds (but less than 4 seconds). The Heater (amber) LED must fast-flash for about 1.5 seconds, indicating that the current calibration settings have been stored as the default.

Tip: *To avoid saving your current re-calibration as the default for future sessions, only press the Calibrate button for less than 1 second. This way you can return to your old default calibration simply by power cycling the module.*

E Once the module's re-calibration procedure is completed, the Status (red) LED should resume normal (e.g. steady glow) monitoring.

Calibration - DYNOmite Wide-Band AFR O2 Module
(box is silver - without RS-232 Data port)

A Power-on the module by wiring it to a clean 12-volt DC source (e.g. automotive or motorcycle battery, or regulated DC power supply).

B If installed already, remove the from the sensor from the engine's exhaust. Hold the sensor in open air (with its tip down) for 3 to 10 minutes after powering on the module.

Tip: *Do not attempt re-calibration with the O2 sensor still in the exhaust system as residual fumes will cause a miss-calibration. This module's calibration algorithm relies on the 20.9% oxygen content of clean open free-air.*

C Using the included non-metallic tuning screwdriver (inserted about ½" through the hole in the housing of the module), adjust the CAL POTentiometer until the orange CAL LED just changes from off to bright.

Tip: *If the CAL LED can not be turned from off to on with the potentiometer, try replacing the O2 sensor.*

D Gradually turn the potentiometer CLOCKWISE until the orange CAL LED just begins to flicker.

Calibration - ECM Wide-Band AFR O2 Module
(box is blue - without RS-232 Data port)

A Power-on the module by wiring it to a clean 12-volt DC source (e.g. automotive or motorcycle battery, or regulated DC power supply).

Tip: *During the module's power-on initialization the analog output signal is sequenced thorough outputting 0 volts (8.0 AFR), 3.28 volts (14.56 A/F Ratio), and 5.00 volts (18.0 AFR) for a period of 5 seconds per reading. Use these readings for verification of the proper hook-up, operation, and calibration of the O_2 sensor, module, and data acquisition system.*

B If installed already, remove the from the sensor from the engine's exhaust. Hold the sensor in open air (with its tip down) for 3 to 10 minutes after powering on the module.

Tip: *Do not attempt re-calibration with the O2 sensor still in the exhaust system as residual fumes will cause a miss-calibration. This module's calibration algorithm relies on the 20.9% oxygen content of clean open free-air.*

C Using the included non-metallic tuning screwdriver (inserted about ½" through the hole in the housing of the module), adjust the CAL POTentiometer until the orange CAL LED just changes from off to bright.

Tip: *If the CAL LED can not be turned from off to on with the potentiometer, try replacing the O2 sensor.*

D Gradually turn the potentiometer CLOCKWISE until the orange CAL LED just begins to flicker.

Troubleshooting (applies to all AFR Module types

Is the O2 sensor good? When in doubt, retest with a know fresh sensor. Be sure to check for disconnected or melted cables and the battery voltage before assuming the O_2 sensor has failed.

Tip: *DYNOmite O2 sensors have a compensation resistor on the sensor's connector, so you do not need to re-trim replacement DYNOmite O_2 sensors to their modules. We can not support troubleshooting of non-DYNOmite O2 Sensors.*

Here are the most common causes of premature sensor failures:

Tip: *Always check battery voltage and sensor cable before assuming sensor is faulty. A burned out or crushed cable can cause any trouble code!*

The sensor's ceramic element does not survive mechanical or thermal shock well. Treat it carefully.

Long periods of usage on the rich or very lean side of stoichiometric will shorten these O_2 sensor's lives. Many tuners try to do their initial *"rough"* mixture calibration before installing the sensor for the subsequent serious fine tuning.

In contaminated conditions, the sensor deteriorates, drastically shortening its life. O_2 sensor contamination examples include: leaded fuels, excessive oil or moisture in the exhaust, silicon sealant vapor poisoning. Running the sensor installed but without its heater circuit activated will also significantly shorten the sensor's life.

Tip: *When monitoring the air-fuel ratio on Mercury Marine cast iron manifolds which inject water at the flanges, it is best to use cylinder #1. On the bottom side just after the head there is a flat area for the first 2 inches. Drill a hole and tap a 18mm x 1.5p for the sensor in the center of this area. It is never recommended to install the sensor with the wires down but this is the only simple choice for this application where the metal is single wall and the water is least.*

Only turn the AFR module on after the engine is running and above 1,000 RPM). At lower engine speeds, valve overlap causes water to enter the combustion chamber from the exhaust and will damage the sensor. At times there could be water in the intake manifold but it's usually gone above 1,000 RPMs. This is also a problem if the engine stalls or backfires, at any speed, as water can enter the exhaust as the boat slows down. Always be ready to turn the power off.

Notice : Sensors are not warrantied in this application!

CAUTION: To protect the Air/Fuel Ratio Module, always observe the following precautions:

Never apply voltage to its output terminal (Vout).
Never apply reverse voltage to its source input terminal.
Never apply excessive voltage to its source input terminal.
Do not expose it to temperatures outside its operational range.
Do not expose it to rapid temperature changes.
Do not expose it to direct sunlight.
Do not expose it to severe vibration.
Do not expose it to excessive moisture.
Do not expose it to corrosive gases.
Do not expose it to water or other liquids.
Do not expose it to excessive dust.
Do not expose it to strong electronic magnetic field.

If the O_2 sensor is known to be good (and calibrates correctly) but the still AFR module outputs erroneous air/fuel ratio voltages, one of these conditions may exists:

1. The unit is being confused by noisy power or operating near too much ignition RFI. Try rerouting the module's wiring harness away from the engine's ignition wires, installing graphite core ignition wires and/or resistor sparkplugs.

2. The ground wire on the DYNOmite Wide-Band AFR O_2 Module's wiring harness is not attached directly to the ground at the vehicle's battery. If you connect a single wire from the wiring harness's ground to the vehicle's battery, a voltage drop occurs across that wire. This causes the analog output ground at the WeatherPack connector to be elevated above battery ground. Since battery ground is typically also the data acquisition system's ground, hooking up both the analog output ground (at the WeatherPack connector) and the ground at the data acquisition system creates a current loop (through the ground of the data acquisition system to the vehicle battery). In this situation, try eliminating the duplicate ground circuit.

3. The module has circuit damage and must be returned to the factory for repair. There are no user repairable components inside the module. The warranty is void if the Module is opened or wiring harness modified. Contact Land & Sea for an RMA # before returning the module.

LED Trouble Codes - DYNOmite Wide-Band AFR O2 Module (box is black - with RS-232 Data port)

Normal conditions:
Power (green) LED solid 'ON' = Module is active and receiving 12-volts DC.

Status (red) LED solid 'ON' = O2 sensor and module are operating fine.

Error 1 (yellow) dark 'OFF' = Okay.
Error 2 (yellow) dark 'OFF' = Okay.

Heater (amber) solid 'ON' = Heating element circuit is working correctly.

Abnormal condition:
Power (green) LED dark 'OFF'= Module is not-active (powered-off).

The Status (red) LED uses from zero to six repeating FLASH sequences to indicate normal or error status. There will be a 1-second pause between sequences, and each flash lasts 0.1 second with 0.25 seconds between flashes.

Status (red) LED dark 'OFF' = No power, or if green LED is ON, processor failure.

Status (red) LED solid 'ON' = O2 sensor and module are operating fine.
Status (red) LED 1-FLASH = O2 sensor in warm-up cycle (wait 30 seconds).
Status (red) LED 2-FLASH = O_2 sensor disconnected (or open heater element circuit).
Status (red) LED 3-FLASH = Battery voltage less out of 10.5 to 19.5 volt range (or FET error).
Status (red) LED 4-FLASH = Heater element circuit is shorted.
Status (red) LED 5-FLASH = O_2 sensor is operational but tip is too cold.
Status (red) LED 6-FLASH = O_2 sensor is operational but tip is too hot.

During regular operation –
Error 1 (yellow) solid 'ON' = AFR module unable to regulate O_2 sensor's temperature.
Error 2 (yellow) solid 'ON' = AFR module unable to regulate O_2 sensor's mixture.

During O2 sensor warm-up period –
Error 1 and 2 (yellow) both dark 'OFF' = Open or disconnected heater element circuit.
Error 1 (yellow) solid 'ON' = Heater element circuit shorted, bad cable or O_2 sensor.
Error 2 (yellow) solid 'ON' = Battery voltage out of 10.5 to 19.5 volt range.
Error 1 and 2 (yellow) both solid 'ON' = FET internal switching error detected.

Heater (amber) dim or slowly flashing (only a few flashes per second) = heating element has failed or the O_2 sensor is disconnected.

LED Trouble Codes - DYNOmite Wide-Band AFR O2 Module (box is silver - without RS-232 Data port)

Normal conditions:
STATUS LED flashes during the first 35 seconds of operation - the warm-up period.
STATUS LED solid ‘ON’; The O_2 sensor and module are operating fine.

Abnormal condition:
The number of flashes per flashing set coincides with the trouble code sequence below.

LED 1-FLASH = Battery voltage is too low (less than 11.0 volts) or O_2 sensor heater is shorted.
LED 2-FLASH = Battery voltage is too high (over 19 volts – disconnect it!
LED 3-FLASH = O_2 sensor is disconnected or sensor heater has an open circuit.
LED 4-FLASH = O_2 sensor is disconnected or wrong type sensor attached.
LED 5-FLASH = Bad cable or sensor.

LED Trouble Codes - ECM Wide-Band AFR O2 Module
(box is blue - without RS-232 Data port)

If the PWR (green) LED is solid Green, the module is OK.

If the PWR (green) LED is flashing continuously, the unit is warming up. The O_2 Sensor requires about 30 seconds of tip warm-up time after the unit is powered on.

If the ERR (red) LED is flashing 1, 2, 4, 5, or 6 times per second, the O_2 Sensor is either not connected or requires replacement.

Tip: *Ignore any Red LED error codes which occur within 1 minute of the module's initialization power-up period.*

If the red LED is flashing 3 times per second, the battery voltage is either too low (less than 11 volts) or too high (greater than 28 volts). If this occurs, immediately stop the engine, and disconnect the module until the problem can be corrected.

Normal conditions:
LED 4-FLASH per 2.5 seconds, after that LED flashes at 10Mz for 10 seconds for the warm-up period.
LED solid 'ON'; The O_2 sensor and Module are operating fine.

Abnormal condition:
The number of flashes per 2.5 second period coincides with the trouble code sequence below.

LED 1-FLASH = O_2 sensor is disconnected.
LED 2-FLASH = Power supply voltage is too low (less than 11 volts)
LED 3-FLASH = Power supply voltage is too high (over 28 volts) – disconnect it!
LED 4-FLASH = Temperature of O_2 sensor tip is too low.
LED 5-FLASH = O_2 sensor is deteriorated or surrounding atmosphere is too rich.
LED 6-FLASH = Sensor is deteriorated or surrounding atmosphere is too lean.
LED 7-FLASH = Sensor element is damaged.

The DYNOmite's thermostatically controlled cooling tower option makes it easy to precisely control the operating temperature of water cooled engines during extended dynamometer testing. Maintaining the correct and constant engine temperature is a must for getting maximum performance, reliability, and repeatable test data.

The tower uses a closed cooling design that gradually mixes in cold water (from your supply) to regulate temperatures without creating thermal stresses in the engine. Cold water enters the cooling system only as needed to keep engine temperature where you set it.

1 Remove the ½" -13 stainless steel acorn nut from the top of the cooling tower. This will let you lift off the o-ringed mid-sections of the tower.

2 The base plate of the tower has o-ringed mounting holes in it for attachment (with the two included 3/8"-16 x 4" stainless steel bolts and elastic lock nuts) to your engine stand or cell wall bracket. Mount the base plate (using the o-rings to seal the bolt heads to the base plate) in an appropriate location.

3 Carefully slide the cooling tower sections together and align the individual swiveling sections to best align with the engines water inlet and outlet ports.

CAUTION: Use a light grease on the o-rings to avoid tearing them during assembly and alignment of the cooling tower's sections.

4 Bolt the cooling tower's top plate back onto the tower and tighten the acorn nut to 30 foot pounds.

5 Run the inlet water supply line to the 1" brass Tee (or elbow) fitting on the bottom of the tower.

CAUTION: Make sure that your water supply and line size are adequate for the combined flow requirements of your absorber and engine's cooling.

Tip: *For under 400 Hp applications, you can use the other leg of the Tee fitting equipped cooling towers to supply the dynamometer's load control valve inlet fitting - simplifying your plumbing.*

6 The three position valve at the base of the tower must be set to the "**FILL**" position (Figure 39) to initially fill up the engine block and cooling tower assembly. Once the block is full (determined

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by water flowing out the 5/8" drain hose fitting at the bottom of the tower) move the valve to the normal "**RUN**" position (Figure 41).

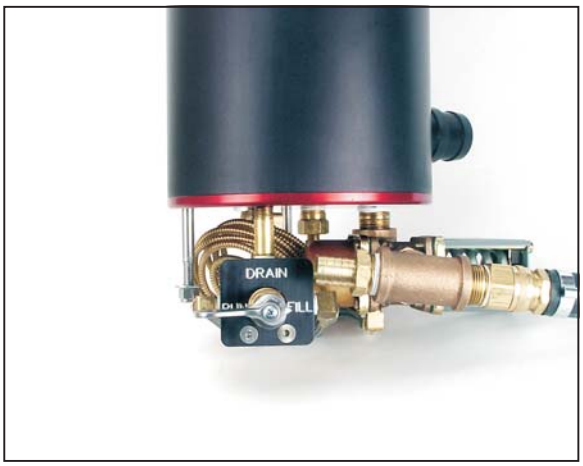


Figure 39

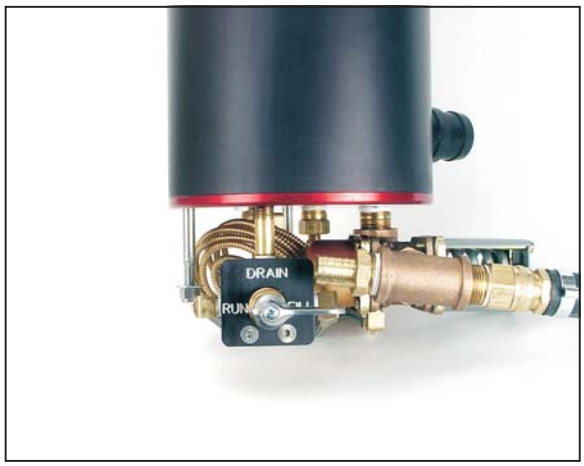


Figure 41

WARNING: MAKE SURE THAT THIS DRAIN IS NEVER PLUGGED. IT WILL HAVE NEAR BOILING WATER FLOWING OUT OF IT DURING OPERATION AND SO SHOULD BE SECURELY ATTACHED TO AN APPROPRIATE DRAIN OR SUMP!

7 The thermostat on the bottom of the cooling tower has a temperature dial setting that can be adjusted with a screwdriver (Figure 40). Set it now for the temperature you want the tower to maintain. Whenever the temperature in the tower goes above this setting, additional supply water will be added and the overflow will flow out the drain.

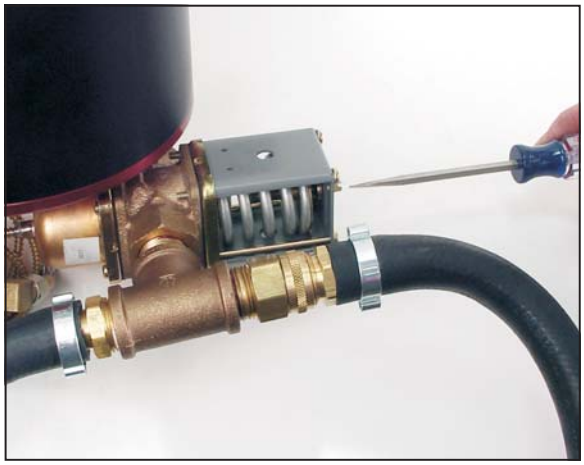


Figure 40

Tip: *Use the dial temperatures for initially setting the temperature. You can tune it up after running the engine and monitoring the engine's temperature gauge.*

To raise the temperature at which the cooling control water valve begins to open, turn its adjusting screw counter-clockwise; to lower the valves opening point turn the adjustment screw clockwise

8 When you want to drain water from the block, simply turn the valve to the "**DRAIN**" position (Figure 42) and wait for the water to gravity flow from the tower.

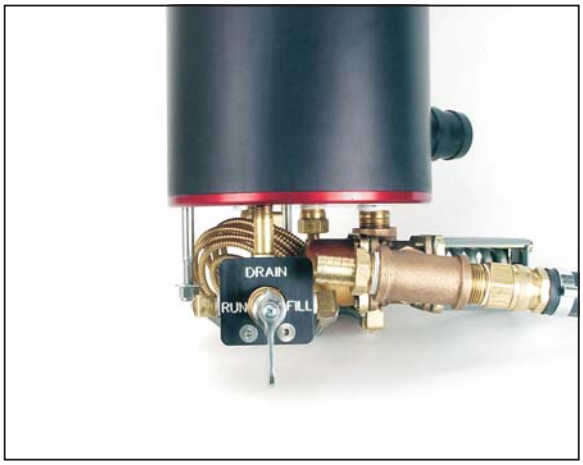


Figure 42

CAUTION: Never forget to fill the block and return the valve to the "RUN" position for actual engine operation. If you leave the valve in the "DRAIN" position severe engine overheating damage can result.

The Electronic Auto-Load Servo control valve kit upgrades our manually loaded water brake absorbers. The kits provide automatic computerized control of the test engine's RPM. Additionally, the included DYNOmite Data Acquisition Computer software upgrade adds new automated sweep and recording algorithms (for LCD or DYNO-MAX models).
Note: The optional Full Function Harness is required to use the Electronic Auto-Load Servo.

The instructions below take you through installation and operation of the valve kit.

1 Using the hardware and brackets provided, mount the Electronic Auto-Load Servo to either your control console, the vehicle's steering wheel (or handle bars), or chassis roller assembly frame.

Tip: *Even if you will never plan to run the valve manually, it is best to use a location where you can easily observer and access the valve during testing. This eases valve maintenance and troubleshooting.*

CAUTION: Install Load Servo with its motor and manual knob oriented up - to prevent water from ever dripping into the motor.

2 Plumb the Electronic Auto-Load Servo in the same manner described in the DYNOmite Owner's Manual for the manual control valve. (See "GETTING READY - Plumbing the DYNOmite" section 2.5.)

Tip: *Newer (after 2003) style Auto-Load valves have their supply (inlet) port in the bottom of the valve body. Earlier valves had their supply port on the side of the valve body.*

3 Connect the 2-wire servo power harnesses black ground lead to the negative post of a fully charged (12.6 volt) automotive battery (or suitable 13.8-volt 10-amp DC power supply).

CAUTION: The DYNOmite Data Acquisition Computer and option grounds must be connected to a common battery ground. Do not hook-up any positive leads and do not try to power up the engine or its accessories until all the grounds are attached. Failure to follow this precaution can lead to electromagnetic data interference or power circuit damage not covered under warranty.

4 Connect the 2-wire servo power harnesses red power lead to the positive post of the battery.

Tip: *Always verify that the battery is up to 12.6 volts before troubleshooting a servo problem!*

5 Plug the servo's power pig-tail into the 2-wire servo power harness (Figure 43). Make sure the required 5-amp fuse is installed in the harness.

6 The optional Full Function Harness (required) has a "SERVO" lead with a 6-pin DIN connector. Plug that lead into the servo's mating 6-pin DIN jack.

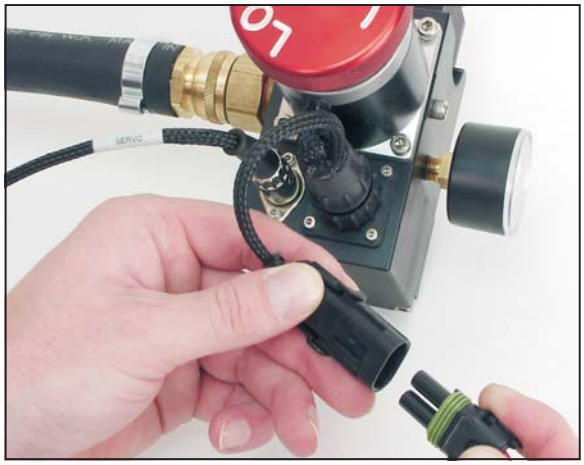


Figure 43

Tip: *The Auto-Load valve requires periodic cleaning to prevent sticking from corrosive water deposits. (See "TROUBLE SHOOTING - Electronic Load Control" section 13.2, 13.2.)*

Electronic Auto-Load Servo Operation

With the Electronic Auto-Load Servo installed, you can select from several load control methods. Use the Stepper Motor Control Mode: screen (as described in the "LCD INTERFACE - Configure" section) to choose one of the following control modes.

Tip: *The optional DYNO-MAX "Pro" software has equivalent menu settings and console buttons for each of the following described features (and more).*

```
Stepper Motor
Control Mode:
    Manual Stepper
```

< This screen sets the servo to control the load based on the Stepper Motor Holding RPM setting you will enter. (See next step.)

```
Stepper Motor
Holding RPM
      3000 RPM
```

< This is where you set the initial "Holding" RPM. Anytime the engine exceeds that Holding RPM, the servo automatically opens the load valve further to return the engine to this RPM (and closes it if RPM drops).
During an "automatic sweep test" this presets the RPM the DYNOmite holds the engine to (by automatically adjusting the Auto-Load Servo) at the beginning and end of the sweep.

Tip: *Typically you pre-set your initial Stepper Motor Holding RPM and then, after starting the engine, steadily accelerate the engine from idle to just above the Holding RPM. The computer will automatically open the load valve (in response). Keep adding more throttle trying to maintain an RPM higher than the Holding RPM. After conditions stabilize at Wide Open Throttle, begin monitoring data on the computer's Real Time display (or start a recording).*

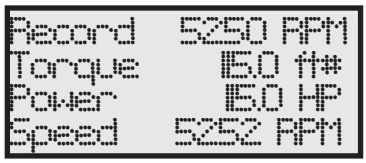
If you press the **TEST** button to begin recording data (while under Manual Stepper control), you can then change the Stepper Motor Holding RPM (on the fly) by pressing the "+" and "-" buttons to raise and lower the RPM respectively.

Tip: *Remember, simultaneously depressing **NEXT** while you are pressing "+" or "-" makes the numbers change faster.*

Tip: *If you are using DYNO-MAX you can move the holding RPM (during testing) using the PC's four arrow keys.*

< This screen sets the servo to run a constant acceleration sweep (at the indicated rate) from the initial Stepper Motor Holding RPM to the End Auto Test RPM you have entered.

< This is where you set your "End Test" RPM. This is the RPM at which DYNOmite quits Auto Testing, (after which it automatically resumes your selected Holding RPM).



< This screen displays during "auto test recording". You initiate the actual running of your selected "auto test" by pressing the **TEST** button (from any of the standard Real Time data screens).

Tip: *To actually conduct an automated test (using the above settings) you gradually apply full throttle to the running engine. The Auto-Load Servo regulates the engine at your pre-set "Holding RPM". Once it is holding steady, press the TEST button to begin the actual Automated Sweep Test. After the engine reaches the pre-set "End Auto Test RPM", the DYNOmite automatically reloads the engine to the initial 3,000 RPM holding point.*
Just back off the throttle and your data is ready to examine.

CAUTION: For proper control, the Stepper Motor Rate, Drift, and Gain Factors must be properly configured for the engine and absorber combinations being tested. (See the "LCD INTERFACE- Configure" section and the "GETTING READY - Water Requirements" section 2.2.)

Tip: *Extremely narrow power band (very high specific output) engines with low crank train inertia may be almost impossible to control (manually or electronically) in certain RPM bands (i.e. just below peak torque). You can either exclude that RPM range from your tests, or add drive line inertia (heavier flywheel(s) for example) to vastly improve RPM control.*

TROUBLE SHOOTING

For diagnosing problems with the Electronic Auto-Load Servo valve see the "TROUBLE SHOOTING - Electronic Load Control" section 13.2, 13.2.

The optional Exhaust Gas Temperature Kit expands the data logging capabilities of the DYNOmite Data Acquisition Computer. The kit includes fast response (exposed junction) Type-K thermocouple(s) and required EPROM software upgrade. When installed, this option monitors and records up to four channels (per board-pair set) of real-time, high temperature engine data

The Exhaust Gas Temperature Kit also requires the optional Full Function Harness and the entry of special configuration set-up codes in your DYNOmite Data Acquisition Computer. Please call for free technical assistance in performing the upgrade and/or code entry.

1 The Exhaust Gas Temperature probes must be mounted in the exhaust manifold of the engine. Ideally, one probe will be placed several inches downstream of each cylinder's exhaust port. Various style thermocouples and mounting arrangements (described below) can be used to simplify installation for different applications.

Tip: *On most engines you should try to top mount the thermocouples about 6" to 8" from the exhaust valve and/or port. If you place the probe too far from the port the exhaust's actual temperature (and consequently its readings) drop due to the extra cooling time traveling down the manifold. However, placing the probe too close to the exhaust port may also provide low readings due to the cooling effects of cylinder scavenging (intake air moving slightly out into the port during the engines overlap period).*
With a little experimentation you will come to know the appropriate mounting position for different configuration engines and exhausts. For multiple cylinders, mount each probe the same distance from the cylinders (so that the relative readings will not be influenced by probe placement). Also, avoid placing the probe near "Y" or "T" junctions in the manifold, as the temperatures near these spots tend to be effected by flow in adjacent branches.

2a *Steps #2 (a-d) are for the "Band Clamp Mount" style thermocouples only. If your thermocouples do not have the integral band clamp, skip to Step #3 (a-h) below!*
The band clamp type mount is preferred for many snowmobile and similar thin sheet metal exhaust tube installations to avoid the need to weld adapter tubes to the header pipe.

2b Once you have selected the mounting spot as described in step #1 above, drill a 3/16" diameter hole for each thermocouple.

2c Insert a thermocouple into each drilled hole and snug it to the manifold tube using the integral band clamp.

2d If clearance permits, align the transition spring and lead wire at a 90 degree angle from the exhaust pipe. This will position the sender tip correctly in the exhaust stream.
Skip ahead to ***"CALIBRATION & SETUP"****.*

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3a *Steps #3 (a-h) are for the "Compression Fitting Mount" style thermocouples only. If your thermocouples have an integral band clamp, skip to Step #4 below!*
Once you have selected the mounting spot as described in step #1 above, drill a 5/16" diameter hole for each thermocouple.

Tip: *The compression fitting mount is preferred for aluminum manifold engines, small diameter manifolds or headers, and applications where the more professional looking threaded installation is preferred.*

3b If you are installing the thermocouple in a thin gauge steel tube manifold or head pipe, center one of the included weld-in pipe thread adapters around the drilled hole. Clamp the adapter securely in place and weld a 360 degree bead around it to secure it to the pipe.

3c Install the male connector portion of the compression fitting into the weld-in adapter and tighten.

3d Now, using a marker or pencil, make a mark on the probe that is about half the diameter of the header pipe plus one inch (the length of the weld-in adapter and compression fitting) from the exposed tip of the probe.

3e Slip the nut (with its cup side to the exposed tip of the probe) and the ferrule onto the probe. Insert the probe into the compression fitting base to the point where the ferrule and your marked line come together (this insures that the probe is set in the middle of the exhaust stream).

3f Holding the probe in place, tighten the compression nut on the ferrule and probe sheath.

3g Loosen the nut to the point that the probe will turn, and, if room permits, align the transition spring and the lead wire at a 90 degree angle from the exhaust pipe. This will position the sender tip correctly in the exhaust stream.

3h Tighten the nut back down to secure the probe.

CAUTION: Do not harness the lead wire tightly. Make long sweeping bends and loosely guide the lead wire to the instrument using appropriate wire ties. This will allow the wire to absorb the vibration along the wires length and prevent the lead from touching the exhaust pipe.

4 Assuming your DYNOmite computer has been upgraded to support the Exhaust Gas Temperature Kit option, go to the Do you want to zero the exhaust temp. sensors? screen and press **PRINT**

5 Make sure that you have the #1 cylinder's probe plugged into the #1 cylinder EGT harness lead and that the probe's tip is at room temperature. Press **PRINT** to reset this probe to read 70 degree Fahrenheit at this temperature.

6 You will now be consecutively presented with each of the remaining three cylinders with the options to reset them to 70 degrees. You can press **CAL**ibration to skip past any probe without changing its calibration.

Tip: *You do not have to reset the probes calibration more than about once a month (unless you interchange probes) .*

Once the Exhaust Gas Temperature Kit is correctly installed and the probes have been calibrated, the DYNOmite computer will always be monitoring the probe(s) temperature.

To view or print this extra information add the EGT Formulas to DYNO-MAX's console and graphs. Or, if you are using the DYNOmite-LCD version, just select one of the Printout and Display Mode: choices that lists the EGT and other data you want to view (instructions for selecting the various Printout and Display Modes are contained in the "LCD INTERFACE -Output" section 7.3).

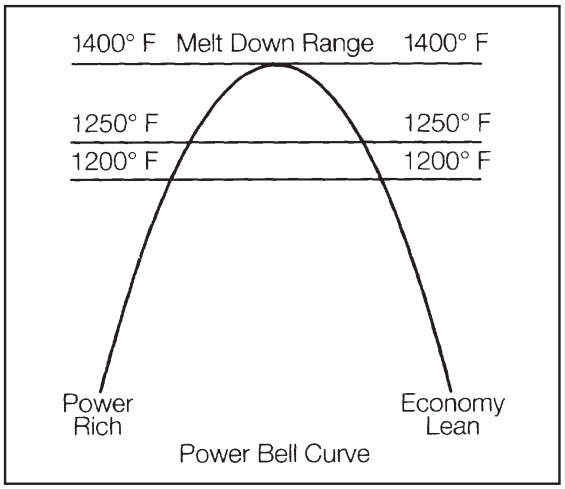

Figure 44

Tip: *If you record a run, the DYNOmite will also record the EGT information even if you were not in a display mode that showed that information during the test. You can always print (or redisplay) ALL the data fields your system is capable of recording, even after a run is completed.*

Tip: *Exhaust Gas Temperatures (EGTs) are extremely important in determining the proper jetting or fuel injection curve calibration for the engine during dyno testing or on vehicle tuning. While each engine produces its own exhaust thermal signature, once you have experience with EGT readings on various similar engine designs, the EGT values will help you determine if the engine is properly tuned. Also, since excessive temperatures will cause the pistons to melt, knowing the EGT can help avoid expensive engine rebuilding, lost races, and wasted time. Changes in the weather, altitude, fuel supply and tuning can all adversely effect the exhaust temperatures. Knowing that temperature changes have occurred, before trouble sets in, allows you the luxury of changing your tuning or driving pace, to prevent that breakdown at the worst possible time.*

Note: In general, if all cylinder temperatures are within +/-50 degrees Fahrenheit of each other, and the readings are 150 to 200 degrees Fahrenheit below the maximum temperature obtainable on the power side of the bell curve (Figure 44) you are usually operating safely and at top efficiency.

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The Fuel Flow and Brake Specific Fuel Consumption option expands the data logging capabilities of the DYNOmite Data Acquisition Computer. The kits features a turbine wheel type fuel flow transducer, miscellaneous plumbing hardware, and required EPROM software upgrade. When installed this option monitors and records the engine's real time fuel consumption and calculates the Brake Specific Fuel Consumption of the engine during dynamometer testing.

To use the fuel flow transducer option you may need to upgrade to the latest DYNOmite software and Full Function harness. You will also need to enter special configuration set-up codes for your particular version DYNOmite computer. Please call for free technical assistance in performing the upgrade and/or code entry.

Tip: *For engines equipped with a fuel bypass return line (i.e. most fuel injected engines) the transducer needs to be installed on the engine side of the return branch. Otherwise it will inappropriately record flow bypassed to the tank! Alternatively, a second transducer can be inserted into the return line with DYNO-MAX used to mathematically subtract the bypassed flow from the indicated fuel consumption.*

1 The Fuel Flow Transducer must be spliced into the engine's fuel inlet line. Various hose fittings and adapters are included to accommodate a wide variety of installation situations. Arrows on the top of the transducer indicate the direction of fuel flow.

Tip: *Most fuel pumps tolerate the added flow restriction of the transducer better if the transducer is installed after the fuel pump rather than on its suction side. If your engine has multiple fuel pumps and/or carburetors, you should "T" the lines together where they exit at the outlet of the fuel pumps and then split them again after the transducer with another "T" to go to the carburetors.*

2 Select a convenient location on the vehicle where you can mount the Fuel Flow Transducer and mounting bracket assembly so that the transducers wires exit up. A vapor separator ahead of the transducer will prevent misreading of air bubbles as fuel.

Tip: *For improved fuel flow on marginal fuel delivery installations, avoid mounting the transducer or hoses higher than the fuel pump(s).*

3 Plug the transducer's 3-pin male connector into the DYNOmite's (Frequency 3) "Fuel Flow (in)" lead (found on the optional "Full-Function" harness).

Tip: *The remaining steps assume your DYNOmite Data Acquisition Computer already has the correct software version and configuration set-up codes. Also, for specific step-by-step LCD or DYNO-MAX screen shots see this manual's DYNOmite-Pro (section 7.5), DYNOmite-Basic (section) or DYNO-MAX's On-Line Help!*

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4 Enter the Specific Gravity of the fuel you are using. If you do not know what the specific gravity of the fuel is, you must check it with a hydrometer.

Tip: *If you do not have a hydrometer and just want some "quick and dirty" flow numbers, you might use 0.73 for gasoline (or 0.80 for methanol). However, for accurate comparison of BSFC numbers with published data, you must actually check the fuel's specific gravity periodically with a hydrometer.*

5 Once the Fuel Flow Transducer Kit is correctly installed and the fuel's specific gravity has been correctly entered, the DYNOmite computer will always be monitoring the fuel flow (in pounds per hour) and calculating BSFC (in pounds per hour per HP).

6 To view or print this extra information, just select appropriate DYNOmite display screens and printed reports, or in DYNO-MAX attach to the desired formula, to display or graph fuel flow and BSFC data.

Tip: *If you record a run, the DYNOmite will also record the fuel flow and BSFC information - even if you were not in a display mode that showed that information during the test. You can always print (or redisplay) all the data fields your DYNOmite is capable of reading, even after a run is captured.*

The default DYNOmite Frequency 3 channel calibration provides a relative adjustment "Flow Factor" for precision calibration to the individual fuel flow transducer being used. While, the DYNOmite is pre-calibrated for our standard capacity transducers, if you substitute a different capacity transducer, (or require extra precision) you may need to change this calibration flow factor. Calibration requires steady state test flowing the transducer in series with another calibrated flow measuring device. Any error in the DYNOmite's flow reading is simply offset out by adjusting the linear factor by the percentage of deviation. Retest until the DYNOmite's reading matches the test instrument's reading.

Tip: *You must have the correct specific gravity entered for the fluid used during the calibration test if you are comparing test results by weight*

Note: The standard gasoline fuel flow transducer outputs an approximately 60 Hz signal at a flow rate of 5.143 gallons-per-hour (31.3 pounds per hour using .730 specific gravity gasoline).

Its nominal DYNOmite-Pro "Pulses per Gallon" is 42000 (or a DYNO-MAX "Recalibration Flow Factor" of 0.08571). Its nominal DYNOmite-Basic "Calibration factor for BSFC flow transducer:" is 892 (and the same for DYNO-MAX).

The high-flow gasoline fuel flow transducer outputs an approximately 60 Hz signal at a flow rate of 40.18 gallons-per-hour (244.7 pounds per hour using .730 specific gravity gasoline).

Its nominal DYNOmite-Pro "Pulses per Gallon" is 5376 (or a DYNO-MAX "Recalibration Flow Factor" of 0.66961). Its nominal DYNOmite-Basic "Calibration factor for BSFC flow transducer:" is 6973 (and the same for DYNO-MAX).

The very high-flow gasoline fuel flow transducer outputs an approximately 60 Hz signal at a flow rate of 111.6 gallons-per-hour (679.6 pounds per hour using .730 specific gravity gasoline).

Its nominal DYNOmite-Pro "Pulses per Gallon" is 1936 (or a DYNO-MAX "Recalibration Flow Factor" of 0.18594). Its nominal DYNOmite-Basic "Calibration factor for BSFC flow transducer:" is 19363 (and the same for DYNO-MAX).

The standard diesel fuel flow transducer outputs an approximately 60 Hz signal at a flow rate of 24.11 gallons-per-hour (177.0 pounds per hour using .880 specific gravity gasoline).

Its nominal DYNOmite-Pro "Pulses per Gallon" is 8960 (or a DYNO-MAX "Recalibration Flow Factor" of 0.40177). Its nominal DYNOmite-Basic "Calibration factor for BSFC flow transducer:" is 4184 (and the same for DYNO-MAX).

The low-flow precision (non-linearized) gasoline fuel flow transducer outputs an approximately 60 Hz signal at a flow rate of 0.60 gallons-per-hour (3.64 pounds per hour using .730 specific gravity gasoline).
Its nominal DYNO-MAX "Recalibration Flow Factor" or "Gain" is 0.18742 and, because it is non-linear, requires a "To Power" entry of 0.91 with a "Multiply By" of 0.001.

CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 3 channel to 4.5 volts. This setting has nothing to do with calibration! Rather, it matches the threshold of the DYNOmite's pulse counter to the various Fuel Flow Transducers' 5 volt square waves (that drop to 1 or 3 volts between pulses). The default DYNOmite "Trigger Voltage Level" for these transducer's is 4.5 volts.

Note: These lists are samples of typical fuel flow transducer volume vs. pulse count (K-Factor) data.

The following list is for a DYNOmite model #231 transducer flowed using a volume of calibration fluid = 0.254 gallons (0.9614 liters) flowing through the sensor at a rate of 20 GPH (75.7 LPH).

ID	Label Color	Pulse Range
A	Brown	4651 - 4700
B	Dark Green	4701 - 4750
C	Yellow	4751 - 4800
D	Beige	4801 - 4850
E	Dark Blue	4801 - 4850
F	Pink	4851 - 4900
G	Light Green	4901 - 4950
H	Violet	4951 - 5000
I	Light Blue	5001 - 5050
J	Red	5051 - 5100
K	Black	5151 - 5150

The following two lists is for a DYNOmite model #264 transducer flowed using a volume of calibration fluid = 1.0 gallon flowing through the sensor at a rate of 14 GPH.

ID	Label Color*	Pulse Range
W	Red Square	47,400 - 47,874
X	Yellow Square	47,300 - 46,826
Y	Black Square	46,827 - 46,533
Z	Blue Square	46,354 - 45,880

* square labels

ID	Label Color*	Pulse Range
A	Brown	45,881 - 45,407
B	Dark Green	45,408 - 44,934
C	Yellow	44,935 - 44,461
D	Beige	44,462 - 43,998
E	Dark Blue	43,989 - 43,515
F	Pink	43,516 - 43,042
G	Light Green	43,043 - 42,569
H	Violet	42,570 - 42,096
I	Light Blue	42,097 - 41,623
J	Red	41,624 - 41,150
K	Gray	41,151 - 40,677
L	White	40,678 - 40,204
M	Black	40,205 - 39,731

* Round labels

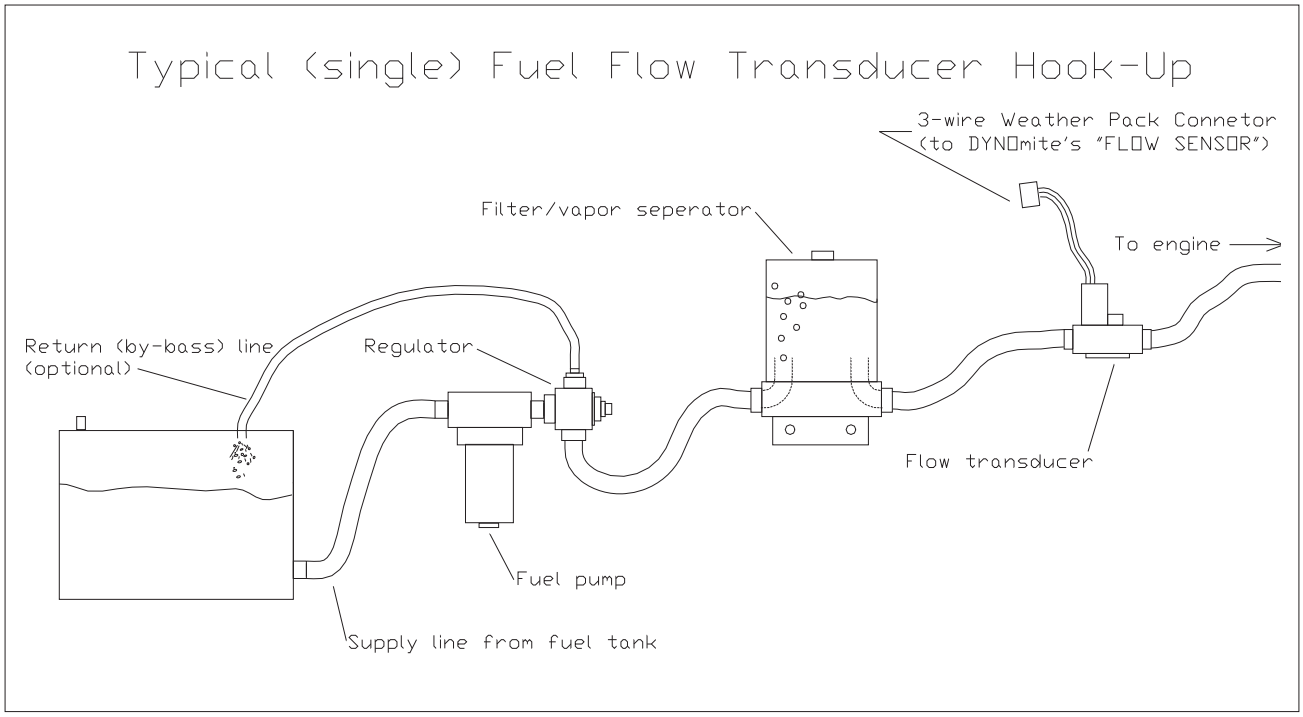
Typical (single) Fuel Flow Transducer Hook-Up
3-wire Weather Pack Connetor
(to DYNOmite's "FLOW SENSOR")
Filter/vapor seperator
To engine
Return (by-bass) line
(optional)
Regulator
Flow transducer
Fuel pump
Supply line from fuel tank

Figure 45

The standard DYNOmite Data Acquisition Computer has a tachometer circuit that works by counting electronic pulses from the engine's ignition or alternator. This yellow AC input (Frequency 1) "Engine RPM (in)" lead is normally spliced directly into the engine's wiring. Optionally, on compatible sparkplug lead equipped engines, you can use a convenient "clamp-on" Inductive RPM Pickup instead.

The following installation instructions assume you already have the DYNOmite Data Acquisition Computer wired and operational on the engine.

CAUTION: Not every ignition system provides a suitable signal for the inductive clamp. Aftermarket multi-spark ignition systems that do not deliver a consistent number of pulses per revolution may not work with the Inductive Pickup at low RPM. Call Land & Sea for information on alternative solutions.

1 Connect the DYNOmite's yellow (Frequency 1) "Engine RPM (in)" lead to the Inductive RPM Pickup's yellow lead.

Tip: *If you are using the DYNOmite-Pro harness, it's 3-wire connecter makes this a simple plug in connection.*

2 Connect the inductive clamp's black ground lead to the black ground lead of the DYNOmite Data Acquisition Computer.

Tip: *If you are using the DYNOmite-Pro harness, it's 3-wire connecter makes this a simple plug in connection.*

3 Connect the inductive clamp's red/white lead into the red/white "V+ (8 volts out)" supply from the the DYNOmite Data Acquisition Computer harness.

Tip: *If you are using the DYNOmite-Pro harness, it's 3-wire connecter makes this a simple plug in connection.*

4 Clamp the the inductive pickup over one of the engine's sparkplug wires.

Tip: *If you do not get a reading (or it spiking occurs), try re-orienting the clamp (clamping to another wire). Attach the clamp at right angles to the wire - avoid running the pickup's lead parallel other high tension wires. You can also often use the Inductive Pickup on the ignition's primary (low voltage) coil wire.*

Tip: *You may need to equip the engine with resistor plugs and/or graphite core sparkplug wires to prevent electromagnetic radio interference (RFI) from affecting the operation of the DYNOmite Data Acquisition Computer.*

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5 Set the Engine RPM Signal Type # Pulse per revolution for the DYNOmite's Frequency 1 channel to match the number of times the sparkplug fires per revolution. (See "LCD INTERFACE - Run Setup" section .)

Note: Examples:

Most Automotive 4-cycle engines fire the plug every other revolution - so use "1 Pul/2Rev" setting ("Pro" boards sets also offer "2/4" and "4/8" modes to dampen our spikes).

Most Briggs 4-cycle Kart engines fire the plug every revolution - so use "1 Pulse" setting ("Pro" boards sets also offer "2/2" and "4/4" modes to dampen our spikes).

Most outboard 2-cycle engines fire the plug every revolution - so use "1 Pulse" setting ("Pro" boards sets also offer "2/2" and "4/4" modes to dampen our spikes).

Many snowmobile 2-cycle twin cylinder engines fire the plug twice per revolution - so use "2 Pulse" setting ("Pro" boards sets also offer "2/1" mode to dampen our spikes).

Many snowmobile 2-cycle triple cylinder engines fire the plug three times per revolution - so use "2 Pulse" setting ("Pro" boards sets also offer "3/1" mode to dampen our spikes).

Tip: *if you do not know how many pulses your ignition sends per revolution, just test each signal type choice until your engine's tach and the DYNOmite match.*
A couple hundred RPM error between your engine's analog tack and the DYNOmite may be considered normal; the DYNOmite is accurate and may be used to calibrate your engine's tach.

Tip: *DYNOmite-Pro boards feature some additional dampened modes (like 2/2 and 4/4) that minimize spiking from 'ringing" or adjacent wire interference. See the DYNOMite-Pro board setup section for more information.*

CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 1 channel to approximately 4 volts. This setting has nothing to do with the ignition system's signal! Rather, it matches the threshold of the DYNOmite's pulse counter to the clamp's square wave signal level. If RPM is ever indicated without the engine running, try re-setting the trigger voltage from 4 to 5 volts.

The Jack Shaft Pickup expands the on board data logging capabilities of the DYNOmite computer. The kit features a bolt on Hall Effect magnetic pulse sensor to monitor a secondary shaft RPM. The computer uses this information together with engine RPM to calculate the shift ratio and (assuming zero-slip) vehicle MPH (assuming zero-slip).

To use the Jack-Shaft MPH option you may need an EPROM upgrade and special configuration set-up codes for the DYNOmite Data Acquisition Computer. Please call Land & Sea for technical assistance in performing the upgrade modifications.

1 Select a location along the secondary drive axle or jack shaft where you have room to both clamp on the magnetic trigger collar and to securely mount the Hall Effect magnetic sensor and cable to the frame.

Note: *The angled face of the transducer pickup will need to be within about 3/32" (+ - 1/32" of the collar's o.d.)!*

2 Clamp the correct i.d. collar to the shaft at the selected location. Use blue Loctite on the two socket head screws when securing the collar.

Tip: *An extra magnet is supplied for adaptation to large diameter shafts. It is possible to secure this magnet to a low RPM shaft with 1" wide, nylon reinforced shipping tape loose. Use several wraps around the shaft. The pole orientation of such custom magnet installation must match the ready-made collars.*

3 Using either two sheet metal screws (included), or machine screws, epoxy, Velcro, etc. secure the electronic transducer pickup to the frame. The centerline of the pickup's angled face must be in-line with the centerline of the rotating magnetic collar

Tip: *To get reliable RPM readings, the sensor's face must be within 3/32" (plus or minus 1/32") of the outside diameter of the rotating magnetic collar.*

4 Plug the sensor cable's 5-pin DIN connector into the mating DYNOmite Data Acquisition Computer harness "JACK SHAFT" lead.

CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 2 channel to 4.5 volts. This setting has nothing to do with calibration! Rather, it matches the threshold of the DYNOmite's pulse counter to the RPM pickup's 5 volt square wave (that drops to 1 volt between pulses). The default DYNOmite "Trigger Voltage Level" for these transducers is 4.5 volts.

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5 Assuming your shaft has been fitted with a standard single magnet collar, the correct setting for the Jackshaft RPM Signal Type is 1 pulse per revolution. (See LCD INTERFACE - run setup" section .)

6 Assuming your DYNOmite Data Acquisition Computer's EPROM software has been upgraded to support the Jack-Shaft MPH Pickup option, you can read MPH by setting the Printout and Display Mode at 2 On-board vehicle MPH testing. (See LCD INTERFACE - output" section 7.3.)

7 From the initial real time display screen (see above), test run the vehicle on stands (or in an open test driving area). The DYNOmite should be displaying real time **Vehicle mph, Jack-shaft RPM, Shift Ratio, and Engine RPM** (If not, see "TROUBLE SHOOTING - Questions & Answers" section 13.1.) To calibrate the MPH display, you must note the deviation from the actual vehicle speed (from its speedometer, radar gun, etc.) and the DYNOmite's displayed MPH. Correct the deviation by adjusting the DYNOmite's Vehicle speed transfer factor: up or down until the actual and displayed MPH match.

Tip: *If the vehicle is actually doing 30 MPH but the display indicates 60 MPH, then you have to double the factor (60/30=2); so, if the factor was 40, change it to 80.*

Tip: *If you later change the vehicle's gear ratio, you need to re-calibrate the DYNOmite's Vehicle speed transfer factor (by the same percentage).*

Just as in an engine dynamometer test session, you can use the TEST and PRINT modes of the DYNOmite to record runs in memory and then play them back to the display (or optional printer).

Tip: *For a typical drag race recording, you normally would set the "**Engine speed to trigger recording: RPM**" to start data capture just below your clutch engagement RPM or, optionally, set it to "**0**" so the recording will trigger with the first revolutions of the jack shaft.*

You can use the Minimum speed to record data at: to stop the recording session automatically as you return to idle at the end of a test run.

Tip: *For example: during a typical drag recording session some racers set the Engine speed to trigger recording" to 0 RPM and the Minimum speed to record data at: just below their clutch engagement point "i.e.5,000 RPM". Then the recording session will trigger as the jack-shaft starts to turn, and continue to record until the RPM finally falls back below 5,000 RPM when they lift off the throttle.*

Tip: *Make sure that you do not inadvertently set the Minimum speed to record data at: above the trigger RPM (or above the clutch engagement RPM if you set a "0" trigger RPM) otherwise the recording will stop as soon as it triggers.*

After recording a test run playback the data to carefully examine the run second by second.

Tip: *You can use the time and MPH displays to help you mentally picture approximately where you were along a test run, as you playback your test data.*

Example-a: You can monitor your drag run's shift ratio and engine RPM relationships to insure that the clutches are properly up-shifting to hold engine RPM at or just below peak power (to maximize acceleration).

Example-b: The amount of overdrive that the clutches are providing is easily observed by looking at the shift ratio. Any ratios over 1.00 indicate the clutches are operating in overdrive.

Note: A ratio of .25 indicates a 4.00 to 1 under-drive; a ratio of 1.10 would indicate that you are running 10% overdrive.

Example-c: Watch the MPH figures for evidence that you have traction problems. If at only a couple of seconds into a run the INDICATED MPH is obviously high, the are probably spinning. By looking further along the data playback for a droop in the MPH, you can see where it starts hooking up.

Example-d: Circle track racers can use the playback to monitor acceleration and spin out of the turns, etc.

Every DYNOmite Data Acquisition Computer has a standard internal rev-limiter system that pulls its black/white "SHUT-OFF" lead to near ground (if you exceed your pre-set RPM limit). Unfortunately, some ignition systems either need to open a circuit or achieve a near perfect ground to kill the engine. The Kill Switch Relay Kit is designed to adapt the standard DYNOmite rev-limiter circuitry to those applications. The following installation instructions assume you already have the DYNOmite Data Acquisition Computer wired and operational on your engine.

1 The Kill Switch Relay needs power (into its yellow lead) to run, either from an AC alternator or a 12-volt DC battery source.
If you are currently using the DYNOmite's yellow "A/C INPUT" lead to read an alternator powered RPM signal, remove that yellow lead now (from the engine) and reconnect it at the tap in the Relay Kit's own yellow wire. Then connect the remaining end of Relay Kit's yellow lead back to the engine's AC alternator circuit.
If you were not using the DYNOmite's yellow "A/C INPUT" lead for capturing an alternator powered RPM signal, just hook the Relay Kit's yellow lead alone to 12-volts DC.

CAUTION: Do not wire the DYNOmite's yellow "A/C INPUT" lead to a battery. It will blow the fuse whenever the Rev-Limiter kicks in.

2a **Follow this step only for applications needing a circuit opened to kill the engine!**
Cut into the circuit in a convenient place. Connect a pair of male and female spade connectors (included) to each end of the break (this will also allow you to easily restore the system when you are done). Connect the black/red lead from the Relay Kit to the female terminal at your break, and the black/yellow lead from the relay to the male terminal at your break.
Go to step #3

CAUTION: Do not wire the Relay Kit's black lead to anything!

2b **Follow this step only for applications needing a perfect ground to kill the engine!**
Connect the black/red lead from the Relay Kit to the engine's ignition kill circuit.
Connect the black lead from the Relay Kit to a good engine ground (you can use the included ground clamp or make a more permanent connection).

CAUTION: Do not wire the Relay Kit's black/yellow lead to anything!

3 Remove (if installed) the DYNOmite Data Acquisition Computer's black/white "SHUT-OFF" lead from the engine's ignition circuit and reattach it to the black/white lead from the Relay Kit.

4 Set a relatively low Rev.limiter setpoint: RPM in the DYNOmite's **CAL**ibration screen and run the engine to test the Relay Kit's operation. It should prevent the engine from exceeding the set RPM.

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The Knock Sensor Module is a universal sensor kit* for converting the acoustical vibration (rattle) of damaging engine detonation knock into a 0-5 volt signal. That output can then be monitored and recorded during engine testing (via DYNO-MAX "Pro's" Knock Index % Formula). This helps you to detect damaging engine detonation, ideally, before it leads to any mechanical damage.

The following installation instructions assume you already have the DYNOmite Data Acquisition Computer wired and operational on your engine. These instructions further assume that you have at least one available 0-5 volt channel to plug the knock sensor into.

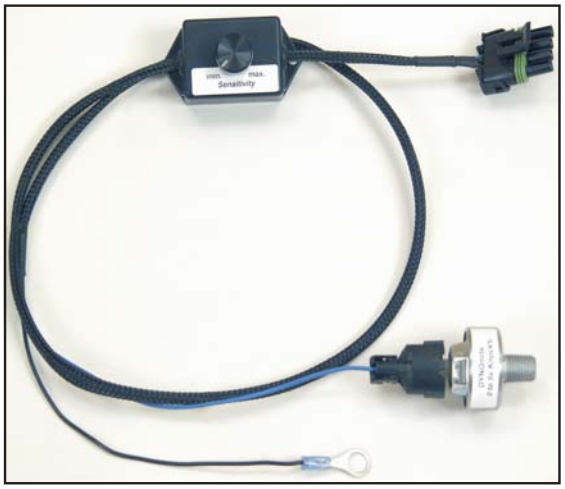

Figure 46

**Note: Requires appropriate Full Function Harness and DYNO-MAX software equipped PC or laptop.*

1. The knock sensor itself incorporates an integral ¼" male NPT thread mount that is easily adaptable to many engine locations. In fact, several late model engine block's will already have a compatible female threaded location specifically for installing a knock sensor.

> **Tip:** *While the ideal sensor location will vary by engine design, typically the most useable knock signals are obtained by mounting the sensor into the side of the engine block. Try to select a spot that is near to the cylinder walls and which places the axis of the sensor perpendicular to the thrust side of the piston skirt. This location provides a strong "rattle" as detonation slams the piston's skirt against its bore.*

2. Route the included knock sensor module's harness leads between an available DYNOmite 0-5 volt harness WeatherPack connector and the knock sensor's push-on terminal post.

3. Bolt the knock sensor's harness ground lead under any clean metal surface on the engine block.

4. Firmly snap the knock sensor module's harness push-on connector over the knock sensor's terminal post.

5. Now snap the knock sensor module's harness WeatherPack into your selected DYNOmite 0-5 volt harness channel.

> **Tip:** *Although any of the 0-5 volt channels are electrically compatible with the knock sensor module's output we suggest that you try to use the lead labeled "KNOCK SENSOR." Besides avoiding confusion, DYNO-MAX's formulas and the DYNOmite are already pre-configured to this channel assignment.*

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6 Set the adjustable sensitivity knob to the 50% mid-point as the initial trial setting. This sensitivity control sets the module's 0-5 volt output signal to match the vibration characteristics of the test engine.

Tip: *The (0-5 Volt 6) input lead supports the DYNOmite Universal Knock Sensor Module - for use with DYNO-MAX's "Knock Index %" formula. This channel is also available for your other 0-5 volt sensors, including all the optional DYNOmite acceleration, air/fuel ratio, position, pressure, and smoke opacity sensors - with their mating 4-wire connectors.*

7 From DYNO-MAX's "Electronics - Calibrate Channels"menu, select the tab of the channel you wired the Knock Sensor Module to. No matter which 0-5 volt channel you are using, select “Knock Sensor %” in the drop-down transducer type list.

Tip: *Out-of-the-box, DYNO-MAX's 0-5 volt 6 tab is pre-labeled as “Knock Sensor” and this channel is the one what the included “Knock Index %” formula is written to reference by default.*

8 Now that the sensor is properly installed, adjusted, and configured you should be able to see some activity in your tab's Final Reading field as you run the engine under near knocking loads. Adjust the module's sensitivity knob so that under known safe running conditions the Final Reading does not reach more than about 25.0 to 33.0 (which indicates 25% to 33% of the "relative knock scale").

9 You should put the Knock Index % formula onto a console gauge or graph. Soon, after some testing time with particular engine combinations, you will recognize their knocking “signatures”. Once a safe vs. danger threshold is established for a combination you can configure DYNO-MAX's Console Alarms to warn you or shut down a detonating combination.

Tip: *You may want to take advantage or the hysteresis features of the Alarm Properties. They can help avoid setting off an alarm during occasional transient engine rattles. See DYNO-MAX's on-line Help for more information.about setting Alarm Properties.*

With the "Pro" version of DYNO-MAX, you can use its channel and formula Edit Tables to create non-linear responses to the degree of Knock Sensor module signal. Even more sophisticated torque vs. RPM and/or throttle position knock alarm curves can be built using the Formula Editors advanced capabilities.

The standard DYNOmite Data Acquisition Computer has a tachometer circuit that works by counting electronic pulses from the engine's ignition or alternator. Optionally you may use a Magnetic Absorber RPM Pickup to take RPM readings from a Hall Effect magnet and sensor you mount in the dyno's absorber.
The following installation instructions for the optional Magnetic Absorber RPM Pickup assume you already have the DYNOmite Data Acquisition Computer wired and operational on your engine.

1 Using a 13/16" wrench, remove the blue 9/16"-18 straight thread plug and o-ring from the face of the DYNOmite absorber.

> ***CAUTION: These instructions assume your absorber is machined for the pickup and has the required rotor magnet installed. Call Land & Sea if you need these pieces installed into your brake.***

2 Making sure its o-ring is in place, replace the plug with the magnetic pickup sensor and cable assembly included in the kit (Figure 47).

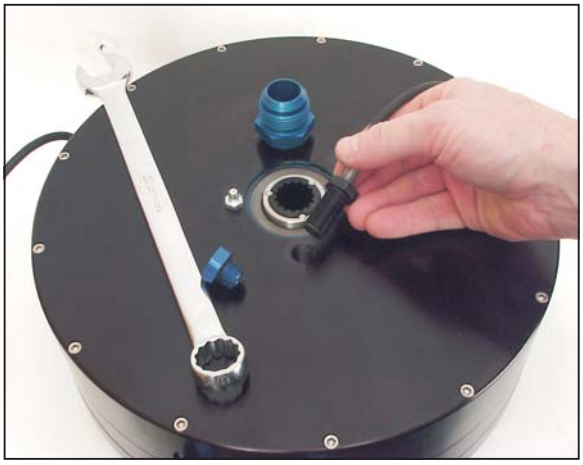

Figure 47

> **Note:** To get reliable RPM readings, the sensor's face must be within 3/32" (plus or minus 1/32") of the magnet installed in your brake's rotor.

3 Plug the sensor cable's 5-pin DIN connector into the mating DYNOmite Data Acquisition Computer harness "JACK SHAFT" lead.

> ***CAUTION: Secure the cable so that it does not tug at the end of the sensor.***

4 Assuming your absorber has the standard single magnet, the correct setting for the Jackshaft RPM Signal Type is (in the DYNOmite's **CAL**ibration menu screen) is pulse per revolution.

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CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 2 channel to 4.5 volts. This setting has nothing to do with calibration! Rather, it matches the threshold of the DYNOmite's pulse counter to the RPM pickup's 5 volt square wave (that drops to 1 volt between pulses). The default DYNOmite "Trigger Voltage Level" for these transducers is 4.5 volts.

The Portable Water Pump kit allows for remote, all season, testing away from any garden hose supply.

> ***CAUTION: Read this section and the pump manufacturers separate operating instructions before using the pump.***

1 Install the DYNOmite on the engine and connect the 3/4" i.d. garden hose (included) between the pump's outlet and the DYNOmite's load valve as per the DYNOmite's normal hook-up procedure.

2 Place the pump's inlet hose and metal strainer into a suitable cold water supply.

> **Tip:** *For short runs (even with fairly high HP engines) just a 5 gallon pail of water may be sufficient*

3 Run the brake's drain hose(s) into the water supply.

> **Tip:** *If the water supply is not below the brake's drains, then the brake will not drain during runs, making restarting extremely difficult. You should either elevate the engine or temporarily lay the drains on the ground during starting. The end of the vent hose should NOT be submerged in water, or it will siphon water into the brake during operation!*

4 Start the pump (per its following instructions) and with the pump at full throttle (and the test engine not running), check the adequacy of the water supply as outlined in the DYNOmite's manual.

> ***CAUTION: If you use the unit in freezing conditions, either drain the pump, brake, and all lines after operation, or use a 50/50 mixture of water and antifreeze for testing.***

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The chassis dyno starter motor kit allows testing race cars that are not normally equipped with an engine mounted starter. A large high torque 3-phase electric motor (15 or 20 Hp depending on ordered model) drives the dynamometer's roller, duplicating 20 MPH push starting of the vehicle.

WARNING: HAVE A QUALIFIED ELECTRICIAN SIZE THE CIRCUIT BREAKER, WRING, MOTOR STARTER/CONTACTOR, ETC. (BASED ON VOLTAGE/CURRENT NAMEPLATES). COMPLETE THE HOOK-UP ACCORDING TO LOCAL CODES!

CAUTION: Properly fuse electrical supply wiring to protect the equipment. Starter motors must be wired using the maximum starting torque motor lead configuration! Be sure to size all circuit breakers, contactors, heaters, wiring, etc. to allow for the significant increase in initial amperage draw (over 300% of nameplate rating)!

The starter motor kit may optionally be equipped with an AC drive controller to allow using it for light absorption loading and simulation of downhill coasting during Road Load Simulation testing (under DYNO-MAX "Pro" control). The drive supplies a 0 - 5 volt torque signal output to measure its load contribution. Even in this configuration the motor may may still be used for starting the vehicle.

Figure 48

1 Fasten the supplied electric motor to its supplied steel mounting plate using the included hardware. The motor plate has a pair of thread holes for its two vertical height adjustment screws. When installed, these will be oriented to the top of the frame (Figure 48).

Tip: *Do not tighten any of the hardware until you have test fit and aligned both pulleys and the drive belt.*

2 Using the included taper lock bushing, key, and hardware, mount the supplied large diameter pulley onto the roll's shaft. Follow the bushing's instructions.

3 Using the included taper lock bushing, key, and hardware, mount the supplied small diameter pulley onto the starter motor's shaft. Again, follow the bushing's instructions.

4 Using the included mounting bolts, spacer washers, and nuts, loosely fasten the motor and mounting plate assembly to the dynamometer's frame.

CAUTION: Use a suitable floor jack and blocking to support the weight of the motor and mounting plate during assembly.

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Tip: *Slip the belt over the pulley's before drawing up the mounting plates fasteners.*

5 Place the drive belt over the pulleys and align the pulleys using a straight edge and square. The thickness of the spacer washer stack should be adjusted to square the pulleys.

6 A pair of vertical height adjustment screws are installed in the upper flanges of the mounting plate to help control the belt's tightness. Use them as you tighten all the hardware to obtain the correct belt tension.

NOTE: The correct starter belt deflection (+/- 1/16" with deflection pressure applied at mind-point of longest span) should be:

3/16" for belt (applying 30 pounds of pressure)

7 Have an electrician size a suitable momentary pushbutton controlled magnetic starter motor contactor and housing. The type and size of this equipment will be determined by your building's available voltage, the starter motor's nameplate data, and the type of interface desired. The standard motor models allow wiring for either 208-230 or 460-volts. The higher voltage option significantly reduces the required wiring gauge.

Tip: *Have the electrician install a wall mounted, spring loaded pushbutton controlled, magnetic starter motor contactor housing within easy access of the dynamometer operator area. If starting control via DYNO-MAX is desired, the selected contactor should also allow remote operation via a 24-volt relay control circuit.*

Operation

Once the installation of the starter motor kit (and the rest of the chassis dynamometer) are complete, you can use the system to start compatible vehicles. When engaged, by holding your motor contactor's start button in, the roll will gradually run the vehicle's tires up to 20 MPH.

Tip: *Just as with starting a race car via pushing, the transmission must be in a suitable gear (to reduce skidding and excessively hard starting), the ignition on activated at the correct time, and the throttle held at an appropriate opening to start. Practice will smooth the process.*

CAUTION: To protect the starter motor from overspeed damage, remove its drive belt for dynamometer testing over 140 MPH!

The "On-Board" DYNOmite Dynamometer allows directly measuring the torque of a rotating shaft. Its Rotary Torque Transducer uses temperature compensated strain gauges to electronically convert the torsional twisting force applied to the drive line coupling into a digital foot-pound output.

The transducer does not actually absorb any of the engine's power, and custom units can be applied (without power limit) to any appropriate drive. Because they read 100% of the power going into the drive line, you do not have to "guesstimate" parasitic losses from u-joints, ring & pinions, tires, rollers, etc. More importantly – it tests power with the engine cooling, airflow, and fuel delivery systems under real-world conditions.

The standard automotive versions of the DYNOmite Rotary Torque Transducers are designed to be installed in place of the vehicles original forward drive-shaft yoke. The following instructions will guide an experienced mechanic through certain special steps required to install those transducer kits.

WARNING: INSTALLER MUST INSURE THAT THE SELECTED TRANSDUCER'S STRENGTH IS APPROPRIATE FOR THE LOAD RANGE OF THE DRIVE LINE BEING TESTED. APPLICATIONS SHOULD HAVE APPROPRIATE DRIVE SHAFT LOOPS OR GUARDS TO PROTECT EQUIPMENT AND PERSONS FROM INJURY IN THE EVENT OF DRIVE LINE FAILURE (MOST RACING ORGANIZATIONS REQUIRE SUCH DEVICES ON MODIFIED VEHICLES)!

Tip: *This section does not cover configuration or operation of the DYNOmite Data Acquisition Computer. (See "*LCD INTERFACE " sections ,, & 7.3.*)*

1 Using the tools and procedures specified in your vehicle's factory service manual, remove both its drive shaft and forward yoke.

2 Make sure the replacement DYNOmite Rotary Strain Transducer yoke matches the one being replaced.

CAUTION: The DYNOmite "On-Board" technology can be adapted to an unlimited number of applications. However, you need to order the Rotary Torque Transducer to match not only the drive line's mechanical strength and dimension requirements, but the data resolution and range desired. A Land & Sea technician will be glad to assist you in selecting the most appropriate range.

3 Again, following the factory service manual, install the transducer equipped yoke onto the drive shaft.

4 With the supplied stainless hose clamp, mount the Transducer Pickup Coil onto the transmissions tail shaft. Slide this coil (either fore or aft) so it's windings will be centered over the yoke's transducer housing.

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Tip: *Orient the phono jack and (any secondary RPM pickup probe) so that you have easy access for installing and routing their cable(s).*

5 Reinstall the drive shaft.

6 Run the included coaxial cable (white) between the coil's phono jack and the vehicle's instrument area. Plug the cable into both the coil and the DYNOmite Rotary Interface Module.

Tip: *The Rotary Interface Module computer can be "Velcroed" or strapped in any convenient location near the driver.*

7 If you will be using the drive-shaft RPM/MPH Pickup option, push its probe into the O-ringed hole in the coil's housing. Set the depth of the probe 2-notches (about ¼") out from bottoming against the transducer.

CAUTION: If the probe is set too deep it will strike the transducer during suspension movement. If it is too far back, MPH readings will be unreliable.

8a *Skip to step #8b if you are using the 0-5 volt version of the Rotary Transducer Interface module.*
The Rotary Transducer Interface's 4-pin connector must be connected to the DYNOmite Data Acquisition Computer (for torque readings).
Likewise, any optional drive-shaft/MPH pickups must plug into the DYNOmite's 5-pin DIN "JACK SHAFT" lead.
A short patch cable is provided to power the hand held DYNOmite Data Acquisition Computer from the Rotary Interface Module (so they both draw power from the interface's 12-volt supply).

Tip: *An additional power patch cable for the thermal printer is also supplied.*

8b *Skip to step #9 unless you are using the 0-5 volt version of the Rotary Transducer Interface module.*
Connect the positive side of your data acquisition system's 0-5 volt torque input channel to Pin #2 in the DYNOmite Rotary Transducer Interface module's 4-pin Amp connector. Connect its negative side to Pin #3.

Note: Alternatively, programers can write a custom program to read from the included RS-232 serial port. The 0 - 5 volt units have a DB-9 port which outputs a continuous stream of data (at 9,600 Baud with no parity, 8-data bits, and 1-stop bit). Write your custom programing to read the data in the following format: There are three 8-bit numbers sent in a continuous stream. The first two make up the 12-bit torque reading (The first byte is the low order of the 12-bit number and the second byte is the high order of the 12-bit number). The third byte is the temperature of the torque transducer in degrees F.

9 Plug the Rotary Strain Gauge Interface Module's fused (3-amp slow blow) power lead into the vehicle's cigarette lighter.

Tip: *If you hard wire the module, make sure that you provide the same fuse protection found in the tip of the power plug.*

10 Power up the Data acquisition computer and interface module and prepare it so that you are ready to read torque from the new "On-Board" torque transducer. The interface's amber LED should illuminate (steady) when it is properly powered up. At this time the green LED should be illuminate (steady or flashing rapidly). The red LED should be off (or flashing less than the green LED).

11 The Rotary Interface Modules have three LED's.
GREEN LED: blinks each time a reading is successfully received by the interface module from the torque transducer (up to several hundred times per second).
RED LED: blinks each time a bad transmission check byte is encountered. This does not mean that bad data is actually being displayed though! The unit samples data several hundred times per second and throws out bad transmissions.
YELLOW LED: lights when the unit is powered up. If the yellow LED blinks rapidly (twice per second or faster) the Interface Module's power supply is below 12 volts - and you need to charge the vehicles battery. If it blinks slowly (once per second or slower) the torque transducer is not getting a good power coupling with the coil - and the receiver coil might need to be moved closer to the transducer.

Tip: *The Rotary Interface Module's green LED flashes each time it receives a complete data set from the Wireless Torque Transducer. The red LED flashes if an unsuccessful transmission occurs. As long as the green light glows at least as brightly as the red LED, you are getting plenty of good transmissions.*
An almost solid red LED with only a little green flashing indicates RF interference or a poorly positioned pickup coil. A solid red with no green flashing may indicate a failed transducer.

Note: Catch-22...The slow blinking yellow LED signal (from the shaft mounted transducer) can only be transmitted when successful communication exists between the units (i.e. the green LED is alive). If there's no "green", then it's impossible to determine (via the yellow LED) wether low transducer voltage is the cause!

If you do not get appropriate LED signaling as described above (even after rechecking your installation), call Land & Sea for assistance.

12 The stand alone Rotary Interface Modules have three buttons:.
ON/OFF Button: will power the unit on or off.
LOW Button: will transmit 0.5 volts (10% of full scale) when depressed.
HIGH Button: will transmit 2.75 volts (55% of full scale) when depressed.

Turn on your data acquisition system and test that the button functions output the approximate values as shown above. If you do not get appropriate readings (even after rechecking your wiring to the data acquisition computer), call Land & Sea for assistance.

Tip: *The High and Low button functions can be used to help re-scale an interface to a new data acquisition system. The correct High and Low button torque values are included with the transducers calibration sheet.*

13 To verify that your system is operational, apply the parking brake firmly and start the engine. Then, while watching the real time torque display on the DYNOmite's LCD, place a light load on the drive line. The torque should increase and decrease as you change the throttle load.

14 You are ready to test. See your data acquisition system's instructions for configuring it to collect and output useful dynamometer and vehicle real-time data.

15 *Skip this step if you are using the 0-5 volt version of the Rotary Transducer Interface module. You can also skip this step unless you find that you require transducer zero-drift temperature compensation.*

The interface box can automatically compensate for torque reading drift due to temperature changes at the transducer. As the yoke and vehicle drive line get hot, the torque readings may drift. To check for temperature drift, run the vehicle to full operating temperature and zero out the unit (unloaded). After the vehicle cools to room temperature, check the unloaded torque reading again. If there is a positive torque reading error, you need to increase the compensation (and vise versa).

To increase compensation, hold down the **HIGH** button and (without releasing that button) push the **LOW** button once. The red LED will blink once for each 1% (per 100 degrees F.) of compensation. (The Green LED will be on if it's positive compensation). 0% compensation is indicated by just the green light flashing once. Adjust the compensation until there is no unloaded torque error.

Tip: *Don't worry about the temperature compensation if you zero the torque after the vehicle is up to temperature. Compensation is only required if temperatures will be changing significantly during data capture. The adjustable range of compensation is from -12 units to +12 units.*

Prior to assembly, match your purchased components and review terminology in the following parts list(s). In addition to the basic parts listed, examine any listed (and unlisted) options you may have selected. You need this familiarization to understand the remaining instructions.

Small Engine Test Stand Parts Listing

Qty.	Description	Part #
1	Small Engine Stand Back	541-097
1	Small Engine Stand Bottom Tray	541-096
1	Small Engine Stand Top Tray	541-095
1	Small Engine Stand Console	541-093
1	Small Engine Stand Leg (throttle side - left)	541-094
1	Small Engine Stand Leg (load valve side - right)	541-099
22	¼"-20 x ½" Allen Button Heads	378-104
22	¼"-20 x ½" Nyloc Nuts	303-120
4	Rubber Sandwich Mounts	540-100
4	Mounting Pads	540-102
2	Mounting Feet	540-101
6	5/16-18 Nyloc Nuts	303-218
1	Small Engine Mounting Plate	541-110
2	3" x 1 ¼" Polyolefin Wheels	540-104
1	Small Engine Stand Torque Arm Stop	363-620
1	Throttle Cable 6'	540-105
1	Manual Throttle Controller	970-114
4	Machined Rubber Sandwich Mounts	540-103
4	½"-13 Nyloc Nuts	303-513
2	Snap Bushings	540-106
1	Console Load Valve Bracket	543-111
2	1/4"-20 x 5/8" Flat Socket Head Screws	322-105
1	Tachometer (optional)	105-5897
6	#10-32 x ½ Button Head Screws	378-005
1	Large Pressure Gauge	540-109
1	1/8" Female NPT Brass Hose Barb Fitting	540-107

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1	1/8" Male NPT Brass Hose Barb Fitting	540-108
2	½"-13 Hex Head Bolt	316-521
1	¼" 0.d. Plastic Tube	200-0229-100
4	5/16"-18 Socket Head Bolt	318-212
24	3/8"-16 Standard Nut	307-316
24	3/8" Split Lock Washers	411-102

CAUTION: Review parts list before assembly!

Stand Assembly

Assembly of DYNOmite Small Kart Engine Stand is relatively easy and requires only standard hand tools.

Figure 49

1. Fasten both rubber feet *(#540-101)* to the forward ends (the edges that are completely curved and without holes) of each Side Panel *(#541-094 and #541-099)* using 5/16-18 Nyloc nuts *(#303-218)*.

2. Fasten both polyolefin wheels *(#540-104)* to the rearward end of each Side Panel using ½"-13 x 4" hex-head cap screws *(#316-521)* and ½"-13 Nyloc nuts*(#303-513)*.

3. Assemble the Bottom Shelf *(#541-096)* to the Side Panels, using ¼"-20 X ½" button socket-head screws *(#378-104)* and ¼"-20 nyloc nuts *(#303-120)*.

Tip: *Leave all shelf and panel fasteners loose until after all the panels are aligned.*

4. Using the same type fasteners as in the previous step, assemble the Top Shelf *(#541-095)* to the Side Panels.

5. Again using the same type fasteners as in the last two steps, fasten the Back Panel (#541-097) to the rear of the partially assembled Engine Stand.

6. Using eight standard 3/8"-16 nuts *(#307-316)* and 3/8" split lock washers *(#411-102)*, attach the four shortest rubber sandwich mounts *(#540-100)* to the lower holes in the Control Panel's extended mounting arms *(#541-093)*. Attach the four longest mounts *(#540-103)* to the similar upper holes in the Side Panels.

Tip: *The shorter threaded studs of each rubber mount should go into the the red control panels - while the longer threads go into the stand's legs.*

7 Fasten the Control Panel's sandwich mount's studs to the Engine Stand and secure with eight 3/8"-16 standard nuts *(#307-316)* and 3/8" split lock washers *(#411-102)*.

Tip: *To avoid scratching the Engine Stand, it helps if another person pulls the sides of the Control Panel outward.*

8 Using four 3/8" lock washers *(#411-102)* and nuts *(#307-316),* fasten the four rubber mounting pads *(#540-102)* through the Engine Mounting Plate's *(#541-110)* counterbored holes (along the outside perimeter of the plate).

9 Secure the Torque Arm Stop to the red aluminum Engine Mounting Plate *(#541-110)* using four 5/16" x 1-¾" socket head bolts and four 5/16-18 Nyloc nuts*(#303-218)*.

Tip: *On many engine applications, one of the torque arm stop bolt holes will align with an engine mounting hole. In theses cases substitute a longer bolt (not included). The torque arm stop can be positioned on either side of the engine plate - depending on the crankshaft's rotation. For standard rotation, this arm should be on the load control valve (right) side of the plate (Figure 49).*

10 Using four 3/8" lock washers *(#411-102)* and nuts *(#307-316),* secure the Engine Mounting Plate *(#541-110)* through any of the available sets of holes in the top of the stand's legs. Multiple for and aft mounting positions allow customizing the engine's location for the best torque arm orientation and engine component clearance.

Control Mounting

1 Using a hex key wrench, remove the load control valve's red hand knob.

2 Remove the small water pressure gauge, it will not be used, as the stand includes a panel mount gauge.

3 Remove the wing nuts and handle bar clamp from the load control valve (you may want to save these parts for possible future use). Mount the console's load valve bracket *(#543-111)* using two ¼"-20 flat head screws *(#322-105)*.

Tip: *The "U" shaped cutout mounts against the bottom of the control panel (with the opening facing the left side of the console).*

4 Install the load control valve from the bottom of the console using hardware *(378-005)*.

Tip: *The port for the pressure gauge should be facing towards the throttle (left hand) side of the stand.*

5 Remove the retaining bracket from the new panel pressure gauge *(#540-109)*. Install the included female threaded hose barb fitting *(#540-107)* onto the gauge. Use Teflon tape on the threads to seal this fitting.

6 Install the panel pressure gauge through the top of the gauge mounting hole of the control console (near the load valve) and secure it using the previously removed bracket.

7 Install the male threaded hose barb *(#540-109)* into the load valve's pressure port (again using Teflon tape).

8 Push on the included length of clear tubing *(#200-02229-100)* to plumb the load valve to the gauge.

9 Align the non-threaded end of the included universal throttle cable with the throttle control and clamp its cable housing to the throttle bracket.

10 Remove the three black button head screws from the throttle control assembly. Position the throttle control assembly under the control console's throttle slot and mount it with these same (just removed) three screws.

Tip: *Due to the varying engine designs, you may have to fabricate appropriate brackets (and/or adapters) to attach the throttle cable to your specific engine.*

11 The throttle control has multiple travel holes and adjustable limit stops to help you match it to the travel required for specific engines. Prior to starting your engine, make certain that both completely closed and full throttle can be reached.

12 Reinstall the load valve's red load control knob. If your valve is electronically controlled, make sure to align the knob's sets crew with the indentation machined into the valve's shaft.

13 Install the universal power switch into the hole provided in the console panel.

Tip: *The switch can be used to either control the data acquisition, engine ignition, or any other required function.*

CAUTION: If you have any questions about installation or operation, contact Land & Sea for assistance.

The Toothed Gear RPM Pick-Up allows capturing absorber RPM from a ferrous 60-tooth gear tooth, rotating bolt head, or similar pulse inducing boss. The kit features a threaded inductive pulse sensor readily adaptable to many existing or custom mounting bracket arrangements. Its integral leads is pre-wired with the correct plug-in connector for the DYNOmite's "ABSORBER RPM-C Frequency2" harness channel. When closely coupled to the outside diameter of a rotating ferrous gear, each passing tooth provides the excitation for the pick-up to deliver a square-tooth shaped pulse signal.

Figure 50

For some retrofit projects, using the Toothed Gear RPM Pick-Up with an old dynamometer's integral 60-tooth (or other compatible tooth-count) gear simplifies providing the RPM source. This is especially true if a compatible frame hole or right-angled mounting bracket is also there. The DYNOmite pickup's red anodized housing is threaded and includes two adjusting nuts that allow precise adjustment even when mounted via a fairly unsophisticated bracket.

If your dynamometer's shafting is not pre-equipped with a suitable ferrous (non aluminum) toothed wheel you should first evaluate the application's signal requirements and installation constraints. Inductive pick-up from toothed wheels have both advantages and disadvantages compared to other available solutions – consider:

High pulse-per-revolution counts - This is good for providing more frequent RPM updates on very low RPM shafts (compared to 1 or 2 magnets driving a Hall-effect RPM pick-up). However, at higher shaft speeds the tooth to tooth tolerances, inductive field strength variation, timing clock resolution, shaft run-out, etc. begin to turn this into a disadvantage. The DYNOmite-PRo Data Accusation Computer includes features to minimize these disadvantages, but unless you need the low RPM updates, make sure you evaluate whether it is easier to use a single (or few) magnets.

Sensing distance - Inductive toothed pickups require fairly close proximity between the gear tooth (or other triggering bolt head, boss, etc.) and the tip of the sensor. In some applications this distance will only be 0.010" – so there is virtually no allowance for shaft run-out. Rarely will the pick-up work reliably at distances greater than about 0.040". Hall-effect RPM pick-up's using special magnets often work at distances approaching 1/8". If maintaining an accurate close proximity due to run-out or vibration is a problem, then the toothed-wheel arrangement is not a good solution.

Encoder wheel requirements - suitable 60-toothed ferrous gears are readily available in many sizes from gear and bearing supply houses. Even very large diameter wheels can be fabricated by turning down a suitable chain sprocket. By comparison, creating a non-magnetic disk or collar to mount one or more magnets into typically requires more machining effort. IN cases where a spinning aluminum flywheel face is available the about of work is about a draw. It is equally easy to machine that type object to accept either a pair of press in magnets or steel bosses as appropriate for either a Hall effect or the toothed gear pickup, respectively.

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1 If your shaft is not already equipped with a suitable ferrous toothed gear or bossed encoder wheel, buy and/or fabricate a suitable piece. While special gears are available for this purpose many ferrous gears or machined down chain sprockets will work fine.

Select a location along the shaft where you have room to bracket hole mount the pick-up so that it points squarely at the the outside diameter or the gear tooth (or face of a raised boss disk).

CAUTION: Any encoder gear must be installed on a shaft with minimal run-out (less than 0.003") to avoid mechanical contact and to reduce signal timing variation.

Tip: *The optimum tooth count depends on the shaft's working RPM range and compatibility with the data acquisition system's characteristics. Contact your Land & Sea support technician for advice on selecting the optimum combination.*

Note: The flat face of the toothed gear pickup will need to be within 0.010" to 0.040" depending on the characteristics of the toothed wheel and the working RPM range being measured.

Below is the encoder gear's ideal tooth layout:
Tooth Height = approximately 0.200"
Tooth Radial Width = approximately 0.100"
Distance Between Teeth = approximately 0.400"
Tooth Axial Thickness = approximately 0.250"

2 If your dynamometer's frame is not already equipped with a bracket and/or hole suitable to accept the DYNOmite toothed wheel RPM pickup, fabricate one that meets its mounting requirements (specified in above Step #1).

3 Use the include pari of mounting nuts to secure the pick-up into its mounting hole. In italy adjust the air gap to 0.030" of clearance between it and the encoder wheel tooth or boss.

Tip: *To get reliable RPM readings, the sensor's face must be within 0.010" to 0.040" (plus or minus 0.003") of the outside diameter of the rotating gear tooth.*

4 Plug the sensor cable's 5-pin DIN connector into the mating DYNOmite Data Acquisition Computer harness Frequency 2 (Absorber RPM-C) lead.

CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 2 channel to 6.19 volts. This setting has nothing to do with calibration! Rather, it matches the threshold of the DYNOmite's pulse counter to the RPM pickup's 5 volt square wave (that drops to 1 volt between pulses). The default DYNOmite "Trigger Voltage Level" for these transducers is 6.19 volts.

5 Assuming your shaft is fitted with a common 60-toothed gear, the correct pulse per revolution setting for the Frequency 2 channel would typically be to use the 60=1 selection (available under Electronics - Calibrate DYNOmite Channels in DYNO-MAX or via the DYNOmite's LCD interface).

Tip: *The 60=1 choice works well for most high performance engine testing applications where the monitored shaft spins at speeds above 3,000 RPM's. For very low RPM applications he 60/1 selection is better. Consult DYNO-MAX 200's on-line Help or contact your Land & Sea support technician for advice on selecting the optimum setting for you particular applications.*

6 Test run the system to verify that you get clean RPM data throughout the working RPM band. If the signal is non-existent, erratic, or drops out at high RPM, close the air gap slightly and retest.

CAUTION: Reducing the air gap below 0.010" is not usually recommended as contact between the gear's teeth and pick-up are likely if any significant vibration or run-out is present.

The DYNOmite Exhaust Measuring System (EMS) is a 5-gas emissions analyzer perfect for tuning engines for optimum combustion efficiency. Setup is quick and easy, but it is important to observe the cautions and warnings below to protect the equipment and its operators.

The pushing of any button (and its consequent acknowledgment by the DYNOmite EMS) is indicated by the LCD display going blank while the button (or buttons) are pushed. Operation is then resumed when the button (or buttons) are released. This acknowledgment may require up to 2 seconds.

When pushing the "Z" and "C" buttons together, be sure to push the "C" button before the EMS goes into its "Zero Mode". This is a period of about 1.5 seconds.

1. Connect the cigarette lighter adapter to a nominal 12 volt DC power source. This is usually the automobile adapter or a suitable AC power supply. We recommend the included 115-volt AC power supply (or something like the Radio Shack #22-504). A power LED on the front panel indicates that power is applied.

2. Immediately after applying power, the LCD's will change their display from "----------" (or blanks) to "8888's". This is the indication that the DYNOmite EMS is working properly.

3. The EMS then goes into its "Warm-Up Mode" - while the electronics stabilize. During this time, the LCD displays will show 0's (except that a 1 may walk across all displays). This will continue for about 10 minutes, depending on how long the machine has been turned off. Once WARM UP is complete, the EMS goes into the "Sample Mode."

4. At this time, the "Sample" light comes on and the vacuum pump will be running.

5. The exhaust hose can now be connected (to the fitting on the back of the DYNOmite EMS) and the "sniffer probe" placed into the tailpipe. Secure the probe with the attached chain and clip.

WARNING: Exhaust gases pass through the gas analyzer and are exhausted through its clear plastic exhaust tubing. Use the DYNOmite EMS only in well vented areas.

CAUTION: Exhaust gas analyzers are designed for diagnostic and verification of repairs. Probes should be removed from the tailpipe at other times - in order to save on analyzer maintenance costs.

Vacuum Pumps

The vacuum pump runs during sampling periods, and will shut off automatically after the CO2 level has been below 3% for at least 15 minutes. The pump can be reactivated by using the "P" or "Z" buttons.

If the gas flow becomes restricted, the EMS will display "LO" in the HC display (and -8888 on the DYNO-MAX HC channel). If this occurs check the filter and/or exhaust hose for restrictions.

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CAUTION: Watch the upper clear hose between the filter assembly and the cabinet. If moisture appears in this tubing, stop sampling immediately and disconnect the exhaust hose from the EMS. Next, blow air down the exhaust hose toward the probe until the hose and probe are dry. Run the EMS without the exhaust hose connected until its internals are dry. Once all gas lines are dry, the hose may be reconnected and normal operation can continue.

Zeroing

At any time after warm up, you can manually zero the gas readings (and calibrate O2) by pressing the "Z" button. If the vacuum pump is off, it will start automatically.

The DYNOmite EMS will, from time to time, recognize a need to perform a zero operation. It will indicate this via the LED's on its front panel. If the EMS does not sense exhaust gases, it will immediately begin the zero operation. However, if gases are sensed, the EMS waits until gases are not sensed – before performing the zero operation.

DYNOmite EMS to DYNO-MAX Digital Link

A PC (or laptop) equipped with optional DYNO-MAX software can be used to display and capture information from the DYNOmite Exhaust Measuring System. This all digital data transfer requires an available RS-232 serial communication port on the PC.

1 Connect the 9-pin RS-232 (DB-9) connector on the back of the EMS to the PC's RS-232 port with a suitable serial cable.

2 DYNO-MAX supports both O2 "Resolution Modes" for the DYNOmite EMS. Resolution is selected using the "Display/Computer" switch on the back of the EMS. Follow DYNO-MAX's On-Line Help (under Electronics - Communications Set Up) for assistance on selecting and configuring the appropriate "Exhaust Measuring System (5-gas xxxxx).daq" file (see next step) for the EMS's current "Resolution Mode."

3a Setting the "COMPUTER/DISPLAY" switch to the "COMPUTER" (up) position activates the 0.01% high resolution mode (of the O2 sensor) and deactivates all LCD displays. This DYNO-MAX only mode requires selecting DYNO-MAX's "Exhaust Measuring System (5-gas **Computer**).daq" file.

3b Setting the "COMPUTER/DISPLAY" switch to the "DISPLAY" (down) position activates the normal 0.1% O2 sensor resolution and simultaneous LCD readout. This mode requires using DYNO-MAX's "Exhaust Measuring System (5-gas **Display**).daq" file.

Tip: *The display on the EMS will turn blank until the "COMPUTER/DISPLAY" switch is returned to the "DISPLAY" position.*

CAUTION: The center position of the switch is OFF for both functions.

PORTABLE USE

1 Power the machine from the cigarette lighter socket. Insert the long water disposal hose into some type of water collection container (which is not susceptible to tipping).

2 Carefully place the exhaust probe into the tailpipe and route the hose to the back of the EMS.

3 To continuously record and graph gas readings, use the optional DYNO-MAX software on a portable laptop commuter.

CAUTION: Make sure the hose is secure and does not lay next to the tires or drag on the ground.

WARNING: The gas analyzer has exhaust gases flowing through it and into its surroundings! Use only with plenty of ventilation.

Maintenance

For optimal performance, periodically change the filter. The gas flows from the inside of the filter to the outside. To check the condition of the filter, view it from the bottom of the bowl. Depending on usage, the exhaust hose should be disconnected from filter assembly and shop air should be blown down the exhaust hose. This should be done daily for regular use, and no more than weekly for intermittent use.

Always check that water is exiting the long drain hose.

Troubleshooting - No Operation

1 Check fuse in the cigarette lighter plug – replace with a fuse of the same value.

2 Displays flashing “E” in CO window –
a) Disconnect sample nose.
b) Press the manual zero button.
c) Power down for 30 seconds.
d) Reapply power – if error continues to flash, contact Land & Sea for service.

Gas Calibration

1 Calibration requires gases in known concentrations.

2 Push the “Z” button and the “C” button together. (If the “C” button is not pushed soon enough, the unit will zero.) The displays will go blank when the machine recognizes the switches being pushed and remain so until both buttons are released. Within a couple of seconds, numbers will be

displayed showing the calibration numbers which are stored in the gas analyzer. These numbers can be changed using the “Z” and “C” buttons. The “C” button will increment the number which is flashing. The “Z” button will step to the next digit and will cycle back through the displays if continuously pushed.

3 When the displays correspond to the gas concentrations in the calibration bottle, again push both “C” and “Z” and release them both. The machine will again acknowledge the command by blanking the display.

4 When the buttons are released, the machine will go into the sampling mode, but will alternate that with dashes (indicating that the calibration operation is not complete). Calibration gas should now be allowed to flow. When the displays stabilize and no longer are increasing, the final step can be taken.

5 Push “C”, and the machine will capture the gas concentrations and calibrate itself. Calibration is now complete. If the operation was unsuccessful, error numbers will be alternated with the sampling numbers.

The Exhaust Vacuum Pump with water vapor separator can be used to draw a steady supply of hot exhaust gas across your DYNOmite AFR Module's wide band O_2 Sensor, while protecting it from damaging condensation vapors. This pump runs conveniently from any (clean) shop air supply, eliminating the need for problematic electric motor vacuum units and filters.

INSTALLATION

1. Remove the vacuum pump's stainless steel "Siamese port" tailpipe probe assembly from the larger shipping box.
2. Remove its two stand legs from the longer second box.
3. Cut the tape from the end of one of the legs to remove the semi-flexible copper exhaust probe.
4. Remove all the tape covering the probe's inlet, outlet, sensor mounting, and regulator inlet ports.
5. Install a 1" OD leg into each holder, and secure with a knob.
6. Install a rubber cup onto the top end of each leg.
7. Rotate any of the air inlet fitting and regulator to a desirable position.
8. Install the semi-flexible copper probe extension onto the stainless steel tailpipe probe assembly, and tighten the flare nut.
9. Install your shop's standard air line quick coupling connector into the inlet side of the vacuum pump's ball valve.
10. Attach a (clean) air supply (of 30 to 90 psi) to the vacuum pump's inlet.
11. Install your DYNOmite AFR Module's wide band O_2 Sensor into the top port on the vacuum pump's stainless steel tailpipe probe assembly.

OPERATION

1. Apply air pressure by rotating the vacuum pump's inlet ball valve to the "on" position.
2. Making sure the shop's air supply pressure remains above 30 psi, adjust the vacuum pump's probe pressure regulator to 20 psi.
3. Make sure that the copper probe is in clean open air – positioned away from any exhaust fumes.
4. Connect and power up your DYNOmite AFR Module – following its standard installation and offset calibration instructions (See "OPTIONS - Air/Fuel Ratio Module" section).

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5 Slide the copper probe into the vehicle's exhaust pipe. Adjust the stand's legs to hold the stainless steel section of the tailpipe probe assembly at a level just slightly below the exhaust pipe's outlet.

6 We recommend rotating the stainless steel tailpipe probe assembly away from the major exhaust flow by approximately 20 to 45 degrees – by carefully bending the semi-flexible copper tube (near the flare nut).

7 You are now ready to begin vehicle testing.

Tip: *Allow one full purge cycle for the exhaust system before recording Air-Fuel Ratio data. On a chassis dyno this can be a long time idling or at least one full throttle run. This evacuates the stored air (O_2) in the exhaust system. After purge cycle is complete, the DYNOmite AFR Module is ready to provide accurate Air-Fuel Ratio data.*

The Smoke Opacity Meter provides real time smoke opacity monitoring of a diesel engine's exhaust stack emissions (on its integral LCD). It also supports simultaneous data capture and display through the DYNOmite-Pro Data Acquisition Computer to DYNO-MAX. The kit's included full-flow head features an adjustable stack mounted sensor that adapts to most diesel exhaust stacks. A partial-flow sensor is also available as an option.

INSTALLATION and OPERATION

1 Follow the separate instructions included with the Smoke Opacity Meter to configure it for stand alone operation.

DYNOmite Smoke Opacity to DYNO-MAX Link

A PC (or laptop) equipped with optional DYNO-MAX software can be used to display and capture information from the DYNOmite Smoke Opacity Meter . This data transfer requires that the DYNOmite-Pro be equipped with the optional Full Function Harness.

1 Connect the included wring pigtail link to the analog output on the Smoke Opacity Meter. Plug that pigtail's 4-pin connector into the mating "AFR (0-5 volt 2)" of the DYNOmite-Pro's full function harness.

Tip: *Actually, any of the DYNOmite-Pro 0-5 volt channels support this meter. However, DYNO-MAX's built-in smoke opacity formulas default to reading from the "AFR (0-5 volt 2)" channel.*

2 In DYNO-MAX, under *Electronics - Calibrate DYNOmite Channels*, select *Smoke Opacity %* from the transducer type list from the "AFR (0-5 volt 2)" channel tab (or for whatever channel you have plugged the meter into).

3 Several built-in DYNO-MAX formulas support reading Smoke Opacity Meter %, Smoke Density*, and HSU* (Hartridge Smoke Units).
**Important: To accurately read Smoke Density or HSU, the inside diameter of the exhaust stack (at the full-flow sensor's mounting point) mut be entered as the Collector Diameter on the Run Information - Exhaust tab. However, if you are using the optional partial-flow sensor - then always enter a fixed value of 5" instead!*

Maintenance

For optimal performance, follow the separate maintenance instructions included with the Smoke Opacity Meter.

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The DYNOmite Cylinder Pressure Mapping Kit is an inexpensive starter package that allows engineers to experiment with features available in the DYNO-MAX "Pro+" Oscilloscope Option Pak. The oscilloscope features are for advanced users, who understand the principalis involved in analyzing high speed engine data. *Note: Support for DYNO-MAX "Pro +" does not include any consulting services or engineering training required to utilize these third-party products.*

Hardware Installation

1 A partially machined crankshaft encoder mounting adapter and other universal components are included to help you install the encoder onto some of the more popular V8 engines.

Tip: *For other applications modify or custom fabricate similar components – using these pieces as conceptual guides.*

2 The pilot flange on the pulley side of this black anodized adapter is deliberately oversized – so that you can machine your engine's dampener and pulley assembly (face and diameter) flat and true (within 0.001"). We suggest first truing the engine's dampener and pulley in a lathe to accept the pilot flange on the adapter. Then, without removing the pieces from the lathe, bolt the adapter onto the dampener using the (included) three longer screws and washers (or other hardware appropriate for your engine).

3 Machine the (mounted) adapters 3/8+" diameter encoder mounting stub to a concentric 0.375" diameter. This procedure will help insure that, when the entire assembly is installed onto the engine, it has minimal run-out.

Caution: Excessive run-out will greatly reduce the encoder's life. Try to maintain the installed run-out (at the far end of the 3/8" stub) below 0.003" (radially).

4 Slide the encoder assembly onto the 3/8" stub (with its shaft set screw collar away from the engine). Secure it to the stub using the two set screws.

5 The long #10-32 threaded rod assembly (with adjustable spherical rod ends and anchor boss) is used to index the encoder's housing and prevent it from rotating during operation. Find a suitable spot and bolt the anchor boss to the engine. In a later step it will be rotated to correctly index the linkage to the encoder's arm.

Tip: *For many popular V8 engines the anchor boss can be simply bolted under any convenient water pump bolt. It may be necessary to cut the threaded rod and/or fabricate custom anchor components for your specific engine application.*

6 Carefully route the encoder's wiring from the engine towards the control console area. We suggest tic-wrapping the wires along the threaded rod to keep things clear of moving parts.

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CAUTION: Avoid moving or hot parts when routing this wiring!

7 Connect the encoder's 7-pin DIN connector to the mating connector on the included harness.

Tip: *The other (68-pin connector) end of this harness will later be run to your control console PC.*

8 Install your piezoelectric transducer (using appropriate adapters as required) at the desired engine monitoring point.

Tip: *One high pressure piezoelectric pressure transducer is included with the basic kit. However, you can substitute other style and range (but electrically equivalent) transducers as required. While the included transducer comes with a 1/16" NPT pipe thread adapter, other adapters (including sparkplug mounting options) are available.*

9 Connect one end of the included white coax cable's BNC connector to the pressure transducer.

10 Locate a suitable spot for the pressure transducer amplifier module. It must be located close enough to the engine that the white coax (from the pressure transducer) will reach the amplifier module. This module requires 115-AC power, so ideally it should also be near a wall outlet.

11 Connect the remaining end of the white coax cable to the small rear BNC jack on the pressure transducer amplifier module.

12 Connect the black coax cable's BCN connector (its part of the included harness) to the large BNC rear jack on the pressure transducer amplifier module. Again, the 68-pin end of the harness will be run to your control console PC.

13 Install the included third-party National Instrument's High Speed Data Acquisition Card into an available PCI buss slot in your PC (following its separate instruction manual).

14 Install National Instrument's Measurement and Automation Explorer software and required hardware drivers (according to NI's included instructions).

15 Connect the included harness's 68-pin connector into its jack on the High Speed Data Acquisition Card.

16 Plug in and switch on the pressure transducer amplifier module.

17 Follow NI's software help files to configure Measurement and Automation Explorer to read the transducer's and encoder's 05 volt analog and TTL signals respectively.

Tip: *When the engine is started, it should be possible to view these signals on Measurement and Automation Explorer's, oscilloscope like, utility screen.*

18 Once operation of the basic hardware is complete. Go to DYNO-MAX's "Help - Contents - Electronics - Scope Module" to begin configuring it to capture, graph, and output data from your tranducer(s).

Troubleshooting

Again, it is imperative that the high-speed data acquisition board be properly installed (and its operation verified) in NI's Measurement and Automation Explorer before diagnostics are attempted on the crankshaft encoder, transducers, or the DYNO-MAX "Pro+" Oscilloscope Option Pak.

Any RF interference with the encoder signaling will make it impossible for DYNO-MAX to reliably index the crankshaft with its collected data. Again, use Measurement and Automation Explorer (or a standard oscilloscope) to verify that the encoder's square waves are correctly reaching the NI board (and DYNO-MAX "Pro+").

It takes a very fast PC to keep up with all the data handling chores during high speed "Oscilloscope Option Pak" data acquisition, especially trying to compute multiple channels at high RPM (and/or with high resolution encoders). If you frequently have to stop the engine and reinitialize the encoder position with the Alt+F 12 keystroke combination, this is probably an indication that the PC is having trouble keeping up with all the data flow.

The DYNOmite Optical RPM Pickup Kit with infrared sensor, amplifier module, and universal magnetic mounting base works on all DYNOmite Dynamometers and DYNOmite Data Acquisition systems. The sensor works by monitoring the light bounced off a piece of reflective target tape on a rotating dampener, shaft, or wheel. Its high immunity to inductive noise allows it to work in many applications where inductive pickups can not.

The standard DYNOmite Data Acquisition Computer has a tachometer circuit that works by counting electronic pulses from the engine's ignition or alternator. Although this yellow AC input (Frequency 1) "Engine RPM (in)" lead is normally spliced directly into the engine's wiring, it can optionally monitor this Optical RPM Pickup instead.

Hardware Installation

The following installation instructions assume you already have the DYNOmite Data Acquisition Computer wired and operational on the engine.

1 Select a rigid metal mounting spot (i.e. inner fender wall) for the adjustable magnetic base that provides a clear line-of-sight to a rotating crank-train component (i.e. the crankshaft's harmonic vibration dampener). This location should be about 12" - 36" from the rotating target. Use the base's On/Off lever to magnetically clamp it in place. Adjust the optical sensor's orientation so that its red lense points towards the target.

CAUTION: Take care when selecting the mounting location that the magnetic base can not vibrate off or fall into spinning components!

WARNING: When working in the engine area, always disconnect the negative (ground) lead of the battery - to prevent accidental starting or engagement of temperature controlled fans!

Tip: *Avoid targets, such as an alternator pulley, that are driven by a V-belt. Slippage may prevent them from providing a constant relationship between their RPM and the actual engine RPM.*

2 Clean a few inches of the target's outside diameter surface - where you can apply a short stripe from the included roll of reflective tape.

Tip: *Dirt and oil will prevent the tape from sticking in place at high RPM. Using sandpaper and/or acetone, clean the surface well the first time!*

3 Cut a 1" long section of tape (or up to 2" for higher RPM applications) and apply the strip along the circumference of the area cleaned in step #2.

4 Screw the 4-pin connector, from the end of the yellow harness, onto the optical pickup's mating receptacle.

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5 Plug the 3-pin connector, at the other end of the yellow harness, into the DYNOmite harness's matting *(Frequency 1) "Engine RPM (in)"* lead connector.

Tip: *If you are using the DYNOmite-Pro harness, it's 3-wire connecter makes this a simple plug in connection. However, for earlier harnesses with individual tachometer leads, the DYNOmite's yellow AC input tach lead connects to the pickup's blue lead, while the black (ground) leads connect to each other (and to the vehicle's battery).*

6 Clamp the optical pickup's red lead to the positive (+) post of the vehicle's 12-volt battery.

CAUTION: Do not connect the DYNOmite's red/white 8-volt B+ output harness lead to anything! That power lead is only designed to supply current to other DYNOmite accessories - connecting it to a 12-volt battery will damage the DYNOmite!

7 Set the Engine RPM Signal Type # Pulse per revolution for the DYNOmite's Frequency 1 channel to *1 Pulse Per Revolution*. (See "LCD INTERFACE - Run Setup" section .)

Tip: *DYNOmite-Pro boards feature some additional dampened modes (like 2/2 and 4/4) that minimize spiking from 'ringing" or adjacent wire interference. See the DYNOMite-Pro board setup section for more information.*

CAUTION: For DYNOmite-Pro (or Lite) board sets, set the "Trigger Voltage" for the Frequency 1 channel to approximately 6.0 volts. This setting has nothing to do with the ignition system's signal! Rather, it matches the threshold of the DYNOmite's pulse counter to the optical pickup's square wave signal level.

Adjustment

If the pickup fails to read the rotating target's reflective tape, try the following:

a Reexamine your aiming of the red lens (on the optical pickup) towards the reflective tape target.

b The background surface color of the rotating target should contrasts with the silver/white reflective tape. If the background surface itself is reflective, try painting it flat-black paint (or covering it with dull black friction tape) before reapplying the reflective target strip.

c The green light on the sensor will be lit when the unit is properly aimed and adjusted. Its red light blinks each time the reflective tape target passes by the sensor's light beam. (At high RPM the red light may appear to be constantly on.) A sensitivity screw on the sensor can be readjusted (see Figure 51) for changes in mounting distance, ambient lighting, and surface reflectivity. Watch the

behavior of the lights while adjusting the screw with the included tool (or a small bladed screw-driver).

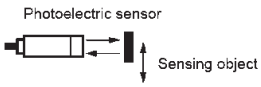
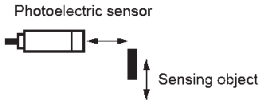
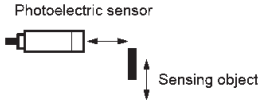
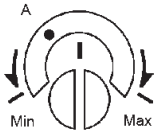
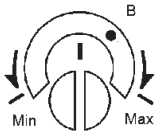
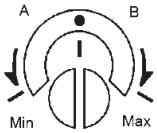
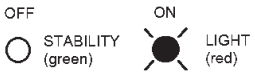
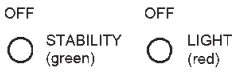
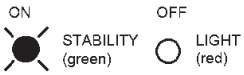
Steps	Step 1	Step 2	Step 3
Function	Determine Position A	Determine Position B	Adjust to optimum setting
Sensing Condition			
Sensitivity adjuster			
Indicators			
Procedure	Place target at the desired sensing distance. Set sensitivity adjuster to the minimum scale position, and gradually increase sensitivity by turning the sensitivity adjuster clockwise until the Light Incident indicator (red LED) turns ON. Position A designates the point at which the LED has turned ON.	Remove the target. Starting from the maximum scale position, gradually decrease sensitivity by turning the sensitivity adjuster counterclockwise until the Light Incident indicator (red LED) turns OFF. Position B designates the point at which the LED has turned OFF.	Set the sensitivity indicator to the position between Positions A and B (in some cases, Positions A and B are opposite of the above example). The photoelectric sensor will then work normally if the stability indicator (green) is lit with and without the target. If it is not lit, stable operation cannot be expected, in which case a different detection method should be applied.

Figure 51

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The Electronic Throttle Control kit upgrades your manual throttle control for fully automatic operation via DYNO-MAX. Together the kit and software can provide computerized control of the test engine's throttle opening percentage, its torque, or its power level. Additionally, the included DYNOmite Data Acquisition Computer EEPROM upgrade (for the required second board set) adds the necessary control logic so that the electronics can carry out DYNO-MAX's commands.
Note: The 2nd board set will also require its own (optional) Full Function Harness to support the Electronic Throttle Control.

The instructions below take you through installation and operation of the throttle kit.

1 Using the hardware and integral bracket provided, mount the Electronic Throttle Control into your control console. Note: If you plan to mount an optional DYNOmite Throttle Position Sensor Kit (at the throttle control end of the cable) install that kit before mounting the throttle into the console,

Tip: *You may find it easier to install and adjust the control cable and throttle stops before you mount the throttle assembly into place. However, read through all the installation instructions once before beginning.*

CAUTION: Even if you plan to always run the throttle automatically, it must be in a location where you can easily observer and access the manual override handle during testing. This eases setup and provides for emergency manual override control!

2 Thread one of the included quick-disconnect swivel ball socket end onto your low-friction throttle control cable ("33C" style). Use the included clamp and screws to secure the cable's sheath to the throttle mounting bracket.

Tip: *The cable clamp end of the throttle goes towards the rear of the console (away from the dyno operator).*

3 Thread the other included quick-disconnect swivel ball socket end onto the engine end of your throttle control cable. Install or fabricate suitable bracket(s) and hardware to mount the throttle cable swivel ball socket to the engine's throttle arm linkage.

4 Adjust the two mechanical throttle handle stop screws (located on the throttle's mounting bracket). These ¼"-20 socket head screws and lock nuts should be adjusted to just allow full travel in each direction, thereby protecting your engine's linkage against over-travel stresses!

CAUTION: Be sure that the integrity of your throttle attachment is robust enough to handle the travel, loads, and vibration of extended dynamometer test sessions. Failure of your throttle linkage might make it impossible to return th engine to idle!

5 Connect the 2-wire servo power harnesses black ground lead to the negative post of a fully charged (12.6 volt) automotive battery (or suitable 13.8 volt 10-amp DC supply).

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CAUTION: The DYNOmite Data Acquisition Computer and option grounds must be connected to a common battery ground. Do not hook-up any positive leads and do not try to power up the engine or its accessories until all the grounds are attached. Failure to follow this precaution can lead to electromagnetic data interference or power circuit damage not covered under warranty.

6 Connect the 2-wire servo power harnesses red power lead to the positive post of the battery.

Tip: *Always verify that the battery is up to 12.6 volts before troubleshooting a servo problem!*

7 Plug the servo's power pig-tail into the 2-wire servo power harness - just like you did for the dynamometer's Electronic Load Control Servo (Figure 43). Make sure the required 5-amp fuse is installed in the harness.

8 The optional Full Function Harness (required) has a "SERVO" lead with a 6-pin DIN connector. Plug that lead into the throttle controller's mating 6-pin DIN jack.

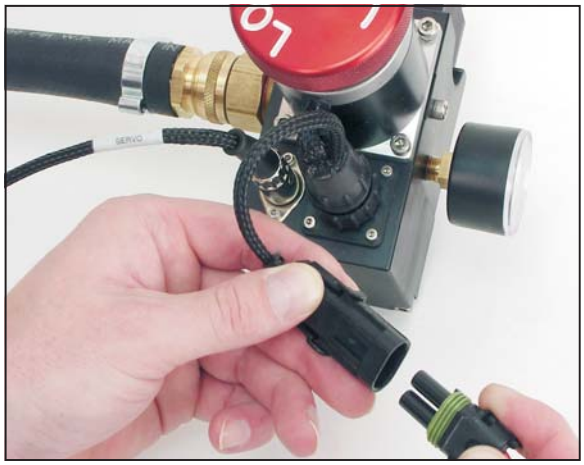

Figure 52

8 If you installed the optional DYNOmite Throttle Position Sensor Kit, plug its 4-pin pigtail into an appropriate channel's mating harness lead (e.g. the "Servo Feedback %" lead).

Tip: *Wiring of the Electronic Throttle is similar to the hookup of the Electronic Auto-Load Servo valve.*

Electronic Throttle Control Operation

With the Electronic Throttle Control installed, you can select from several of DYNO-MAX's load control methods. See the DYNO-MAX's Online Help system (under the "Electronics - Configure DYNOmite Controls" section) for more information about configuring an automatic hold control mode.

Tip: *If you are using DYNO-MAX you can move the throttle settings (during testing) using the PC's PgUp, PgDn, Home, and End keys.*

CAUTION: For proper control, the 2nd Board Set's parameters under "Electronics - Configure DYNOmite Controls" (e.g. Rate, Drift, Gain factors) must be properly configured for the engine and absorber combinations being tested.

Tip: *Extremely narrow power band (very high specific output) engines with low crank train inertia may be almost impossible to control (manually or electronically) in certain RPM bands (i.e. just below peak torque). Take this into consideration when programing your custom automated tests.*

TROUBLE SHOOTING

For diagnosing problems with the Electronic Throttle Control see the similar "TROUBLE SHOOTING - Electronic Load Control" section 13.2, 13.2.

The Blowby Transducer Kit allows monitoring your engine's ring sealing, real-time, during engine or chassis dyno testing. Blowby flow may be used to determine the effectiveness of cylinder preparation or distortion, piston and ring clearances, end gap, ring design, wear, etc. Monitoring blowby flow during testing is a good way to track engine degradation.

The transducer is inserted into the crankcase's breather hose – and plugs into any available DYNOmite 0-5 volt channel lead. DYNO-MAX 2010 then records the blowby gas flow (in CFM) passing through the transducer's precision flat-plate orifice. By swapping between any of the transducer's four (included) orifice (inside) diameters, the single kit adapts to engines passing from 0.5 to 19.8 CFM. This range covers (healthy) internal-combustion engines from under 50 to over 2,000 horsepower.
(Requires DYNO-MAX 2010 with appropriate Full-Function Harness and current EEPROM upgrade.)

The instructions below take you through installation and operation of the blowby transducer kit.

1 The blowby transducer must be plumbed into the engine's sole breather-outlet hose. For V-type engines, with breathers on each valve cover, any extra hoses should either be T'd together – or temporarily plugged off. If the engine is equipped with a PCV valve, it must be blocked off during blowby flow measurements.

WARNING: The blowby transducer's outlet hose must route the poisonous and flammable crankcase gasses back into the engine or other appropriate discharge area.

CAUTION: The housing's "→" arrow and "UP" text indicate the desired flow direction and calibration-port plug orientation for the transducer. Keep these threaded-plug ports pointed up to reduce the volume of (damaging) oil seeping into the differential-pressure sensor. Doing so extends service life between sensor replacement (user serviceable).

Tip: *Hose (size) adapters, elbows, etc. may be used to adapt the blowby transducer – minor flow restrictions and exact hose lengths are not critical.*

2 Plug the transducer's 4-pin male connector into the DYNOmite's "0-5 Volt 7" lead (found on the optional "Full-Function" harness).

Tip: *DYNO-MAX "Pro" users may select any available 0-5 volt lead and then by edit the "Blowby Flow" formula so it points to the selected channel. For specific DYNO-MAX steps and screen shots, see DYNO-MAX's on-line help.*

3 In DYNO-MAX's "Electronics - Calibrate DYNOmite Channels" screen, select the 0-5 volt channel tab corresponding to the lead you plugged the blowby sensor into. Use the drop-down device list and click the appropriate range "Blowby Sensor #.# CFM" selection. This will inject the

DYNOmite channel with appropriate offset, gain, to-power, and multiply-by values – so that the channel will read in CFM flow units.

Tip: *See the chart at the end of this section to determine the CFM range based on the ID of the orifice plate you have installed in the transducer's housing. As a rule of thumb, assume about 1 CFM of blowby per 100 horsepower.*

4 As with other DYNO-MAX channels, the blowby transducer may be be monitored (or graphed) via a formula pointing to its channel's data. DYNO-MAX 2010"s formula list includes a built-in "Blowby Flow" formula. By default this formula points to Board #1's "0-5 volt 7" channel lead.

Tip: *DYNO-MAX "Pro" users may select any available 0-5 volt lead and then edit the "Blowby Flow" formula so it points to the selected channel. For specific DYNO-MAX steps and screen shots, see DYNO-MAX's on-line help.*

Swapping Flat-Plate Orifices

The DYNOMite blowby transducer determines gas flow by monitoring the pressure differential across one of its four (included) precision-machined and calibrated flat-plate orifices. These plates are easily interchanged by removing the sensor housing's four 1/4"-20 socket-head screws.

CAUTION: Take care to not drop any of the rubber sealing quad-rings.

Tip: *When installed, the tapered "funnel" side of the orifice's hole must be on the downstream face of the plate. This is opposite what many mechanics intuitively feel is the "logical" orientation!*

The relationship between each orifice's internal hole diameter usable flow range is as follows:

Note: The relationship between each orifice's internal hole diameter usable flow range is as follows.

Nominal ID	=	Flow Range (in CFM)
1/4"	=	0.5 to 3.3 CFM
3/8"	=	1.0 to 6.6 CFM
1/2"	=	2.0 to 13.2 CFM
5/8"	=	3.0 to 19.8 CFM

The low-flow fuel transducer option, with required EPROM software upgrade, provides for precision monitoring of fuel consumption on very-small engines. Coupled with DYNO-MAX software, this laboratory-grade transducer allows monitoring and recording a small engine's real time fuel consumption (and calculated Brake Specific Fuel Consumption).

Pre-Installation

a The low-flow fuel transducer is an in-line volumetric flow metering device utilizing a bladed rotor and jewel bearings. It is a precision device, with the ability to measure very-low liquid or gas flows – under high temperature and pressure conditions with accuracy and reliability. Due to its sensitivity, it must be unpacked and handled carefully. Make certain that the transducer is clean and free from packing materials or debris.

C A U T I O N: The DYNOmite low-flow fuel transducers are precision instruments and will be damaged if a shop-air hose is ever used for cleaning or checking the rotation of the transducer's rotor.

b The transducer must be spliced into the engine's fuel inlet line. Various hose fittings may be required to accommodate a wide variety of installation situations. The arrow on the transducer body indicate the direction of fuel flow.

Tip: *Most fuel pumps tolerate the added flow restriction of the transducer better if the transducer is installed after the fuel pump rather than on its suction side. If your engine has multiple fuel pumps and/or carburetors, you should "T" the lines together where they exit at the outlet of the fuel pumps and then split them again after the transducer with another "T" to go to the carburetors.*

c Inlet and outlet ports are indicated on the housing by observing the flow direction arrow. The transducer's design makes it quite insensitive to upstream or downstream fluid flow disturbances, therefore, it is not necessary to be concerned about the length of the straight-line run either upstream or downstream of the transducer. However, the inside diameter of all connecting plumbing must be larger than the transducer's orifice.

Tip: *Filtering is recommended, both upstream (to 100 microns) to protect the transducer from debris, and downstream, to protect your equipment – from dislodged parts, in the event of a turbine-wheel failure.*

d The connecting plumbing must not impose any bending stresses on the transducer housing or end connections.

e The transducer should be located upstream of all final control elements, bypass throttling, or on-off valves. It should never be installed so the transducer drains completely when flow ceases.

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CAUTION: Hydraulic hammering is a term used during start-up (initial introduction of fuel into the lines) to describe a high velocity flow impacting on the transducer's rotor. This must be avoided to prevent damage to the mechanical parts. Pressure should be built up gradually, at initial start-up, to avoid damage from over-speeding the rotor. Severe hydraulic hammering, from improper start-up or flow surges during operation, must be avoided to prevent shaft or rotor-blade breakage.

Tip: *Care should be taken not to locate the transducer or connector cable in close proximity to strong electro-magnetic fields such as electric motors, transformers, spark-ignition components, or other high-voltage lines. These may induce spurious signals in the pickup coil or cable.*

f Pickups should bottom out in the well of the transducer housing but should only be finger tightened, to approximately 4 in-lb, to prevent distortion of the coil housing. The pickup is secured in position by tightening the lock nut to approximately 25 in-lb. The pickup is removed by loosening the hex lock nut and unscrewing the pickup from the housing.

Installation

1 Select a convenient location in the test cell where you can mount the transducer that will be free from vibration.

Tip: *For improved fuel flow on marginal fuel delivery installations, avoid mounting the transducer or hoses higher than the fuel pump(s).*

2 Mount the transducer with the rotor shaft horizontal and the pickup vertical (wires exit up). A vapor separator ahead of the transducer will prevent misreading of air bubbles as fuel.

Tip: *For engines equipped with a fuel bypass return line (i.e. most fuel injected engines) the transducer needs to be installed on the engine side of the return branch. Otherwise it will inappropriately record flow bypassed to the tank! Alternatively, a second transducer may be inserted into the return line with DYNO-MAX used to mathematically subtract the bypassed flow from the indicated fuel consumption.*

3 The connecting plumbing must not impose any bending stresses on the transducer housing or end connections.

4 Plug the transducer's 3-pin male connector into the DYNOmite's (Frequency 3) "Fuel Flow (in)" lead (found on the optional "Full-Function" harness).

Tip: *For the remaining steps also refer to DYNO-MAX's on-line help.*

Troubleshooting

CAUTION: Once a low-flow fuel transducer has been installed, the greatest hazard is over ranging the device (e.g. running more than 10% over range). These transducers remain quite linear when they are over ranged, and it may not be immediately apparent that the device is being misused. However, the pressure drop will become excessive, and over-speeding of its jewel bearings and rotor will cause permanent damage.

Besides damage from improper checking of the transducer with a shop-air line, the next two most common reasons for over-speeding are:

a) Miss sizing the flow transducer for the application. If the system will ever flow more fuel than the transducer's maximum range – do not install it.

b) Failure to bleed the system before allowing full fuel flow (e.g. starting when there is still air in the lines). Air must be bled carefully from lines before high flow range is established – or the upstream flow restricted so that it can never exceed the transducer's maximum flow range.

Tip: *When used below the minimum specified range, turbine-type fuel transducers may become very non-linear due to clearance leakage and bearing drag.*

Maintenance

Maintenance of the low-flow fuel transducer consists of periodic inspection to insure that the internal parts have not been fouled or suffered any corrosion. Should the assembly be damaged in any fashion, it should be returned to the factory for repair.

Turbine-type transducers are precision devices and must be treated as such. The freedom with which the rotor is allowed to rotate is the major contributor to this precision. The majority of fuels measured by turbine meters contain impurities, which if allowed to remain within the transducer after use, would form hard or gummy residues. When these residues are deposited within the transducer, the unit's freedom of rotation will be severely degraded. Therefore, it is highly recommended that whenever possible the turbine meter should be THOROUGHLY FLUSHED with an appropriate solvent immediately after use. The solvent should be chemically neutral, and HIGHLY VOLATILE so that COMPLETE DRYING can take place soon after the flushing operation. Some appropriate solvents would be ethyl alcohol, stoddard solvent, or trichloroethane.

C A U T I O N: DO NOT OVER SPEED BEARINGS. Care must be taken when flushing the transducer, not to over-speed or otherwise damage the bearings and rotor assembly.

Transducer field repairs are generally limited to the replacement of the capsule assembly. The complete capsule must be removed and replaced. The capsule malfunction may be field replaced with a new one and/or returned to the factory for repair. When ordering parts, it is necessary to provide the complete model number and serial number of the transducer.

DYNOmite ACtiveSync™ (axle synchronization and/or motoring) modules match front-to-rear axle speeds (for traction controlled ABS equipped vehicles) – during eddy-current axle-hub dynamometer testing. They can also provide "downhill" (motoring) inertia simulations – if fitted with (optional) encoders. *Note: Optional resistive load banks are available, to significantly increase motor's absorption capacity and synchronization authority.*

Installation

1 Select a mounting location for the ACtiveSync-Module's AC Drives. Ideally, mount the drives on a wall – closest to the driver's door.

2 Have a qualified electrician power each drive from a dedicated, appropriately sized, circuit breaker. See the drive's electrical requirement's label.

3 If your ACtiveSync Modules were ordered with (optional) DC resistor banks or regenerative inverters, wire them to the AC drive's appropriate terminals. See drive's wiring manual (PDF format) for details.

WARNING: The voltages powering each ACtiveSync's AC drives, motors, DC resistor banks, and/ or regenerative inverters are potentially lethal. Be sure all wiring is done to applicable codes and that any flexible cords and connections are regularly inspected for wear-and-tear damage.

4 Mount the *Emergency-Stop* button housing (*Enable, Start-CF / Stop* switches) in a spot that will be readily accessible during testing. For convenience, this switch comes (temporarily) pre-wired with color-coded leads. Depending on your selected mounting location, these 24-volt wires may be shortened or extended as needed.

Tip: *During operation, the drives can be disabled (stopped) from either the Emergency-Stop button (both drives) or by hitting the red button on each drive's HIM (Human Interface Module) keypad. To re-enable the drives, the "Start-CF / Stop" switch (just under the Emergency-Stop button) must be switched – off and then back on again (two presses). Note: As wired, the HIM's green (enable) button cannot be used to start the drives.*

5 Plug the ACtiveSync control harnesses into their respective drives. Each drive's color-coded control wiring is already done and ready to accept its respective 9-pin plug – from the (supplied) ACtiveSync control harness. The "*Left*" drive's 9-pin connector is labeled as such, and has two corrugated wiring looms going into it. In contrast, the "*Right*" drive's connector has only one corrugated loom attached.

6 Run the other end of the drives' control-wiring harness to the *Drive-1* (primary) DYNOmite Data-Acquisition Computer (DAQ ID #1). Connect the labeled leads to that DYNOmite's wiring harness. This includes a single *DA #1* lead, Ground and two (4-pin) Weather Pack connectors (labeled "*Load Cell*" and "*Accelerometer*").

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7 If your dynamometer system was ordered with a second pair of ACtiveSync Modules (fourdrives total) its drive pair will be labeled as "*Drive-2*" (*Left* and *Right*). This configuration aids the response and precision of wheel-to-wheel axle synchronization and requires (optional) encoders with load banks and/or regenerative inverters. Run this second pair of drives' control-wiring harness to the *Drive-2* (secondary) DYNOmite Data-Acquisition Computer (DAQ ID #11).

CAUTION: The drives are commissioned (pre configured) at the factory. While most of the drive's 800+ parameter settings stay at the drive-manufacturer's defaults, many do not. Several of these custom parameter settings are to match the ACtiveSync's motor specifications, while others interface the drive for interfacing with the DYNOmite's electronics – for axle synchronization. If these parameters are improperly altered, the system will not function correctly and may cause equipment damage or personal injury.

8 Before initial operation, the ACtiveSync feature must be configured by editing several of DYNO-MAX's formulas. Below is a list of the specific formulas to set up – note the leading underscore in their names (see DYNO-MAX's on-line help for details):

_ACtiveSync 1 Channel for Left-Drive Torque
For ACtiveSync-motor equipped vehicle dynamometers, edit for correct DAQ 0-5 volt channel to return #1-Left drive's torque signal. (Default is *DAQ ID #1: Load Cell*)

_ACtiveSync 1 Channel for Right-Drive Torque
For ACtiveSync-motor equipped vehicle dynamometers, edit for correct DAQ 0-5 volt channel to return #2-Right drive's torque signal. (Default is *DAQ ID #1: Accelerometer*)

_ACtiveSync 1 Torque-Source Toggle
Edit to set ACtiveSync Torque Source: 0=off, 1=active (Change from default of *0* to a *1*)

_ACtiveSync AC Motor-Tag Power
Edit to reflect ACtiveSync AC motor's (each) rated maximum power – in Hp Units. (Default = *20*)

_ACtiveSync AC Motor-Tag RPM
Edit to reflect ACtiveSync AC motor's base RPM. (Default = *1775*)

_ACtiveSync Flying-Start RPM
Edit to set ACtiveSync Flying-Start Drive-Enable RPM. Use encoders for reliable flying starts. (Default = *64000*, disabled – set to *1*, if using encoders, to enable flying starts)

Tip: *If using a second pair of ACtiveSync-Modules, also edit those three equivalent ACtiveSync 2 formulas.*

9 Your (selected) "Left-Drive" and "Right-Drive" torque channels must be configured from DYNO-MAX's *Electronics - Calibrate DYNOmite Channels* screen. This allows the ACtiveSyncs' motoring torque to be subtracted (or added if absorbing) from DYNO-MAX's "*Measured-Torque*" readings. Set up both channel tabs (identically) as shown in the following example image (or see DYNO-MAX's on-line help):

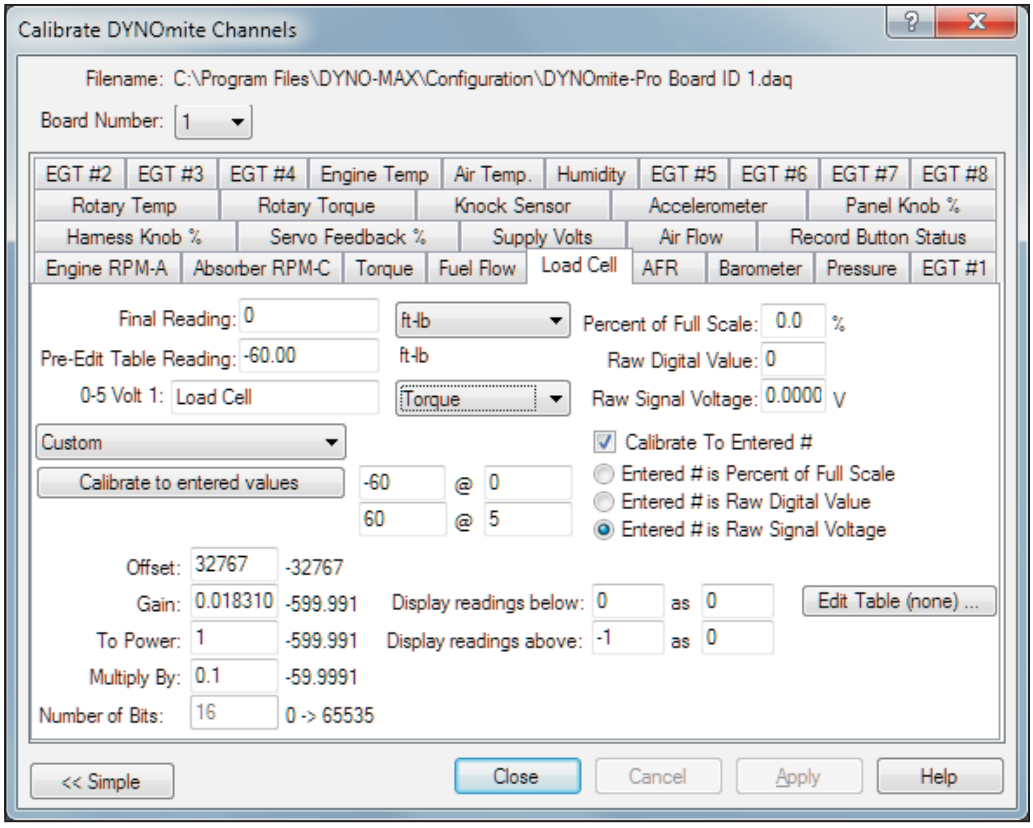

Figure 53

Mounting

1 For normal ACtiveSync Module operation you want to motor a traction-controlled vehicle's unpowered spindles – to match the speed of its powered (under test) axle. For such situations, if only one pair of your DYNOmite axle-hub dynamometer units is equipped with the ACtiveSync option, mount the ACtiveSync units to the unpowered spindles.

For two-wheel drive vehicles (FWD or RWD) DYNO-MAX automatically detects which axle turns first and selects the ACtiveSync operating mode accordingly. ACtiveSync motors on an unpowered axle go into "traction control" speed-matching mode. ACtiveSync motors on a powered axle go into synchronization-assist mode (requires encoders and resistive load-banks). If non-encoder equipped ACtiveSync Modules are connected to the powered axle, their drives should simply be left unpowered.

For four-wheel drive (or AWD) applications (ACtiveSync motors on both axles) you must first select a 4WD dynamometer type in DYNO-MAX's Define Dyno Configuration screen. ACtiveSync will then run the motors in synchronization-assist mode (requires encoders and resistive load-banks) – no matter which axle turns first. If non-encoder equipped ACtiveSync Modules are connected to the powered axle, their drives should simply be left unpowered.

2 After mounting all four DYNOmite Axle-Hub Dynamometer units, connect each motors' twist-lock power-in cord to its matting drive's power-out cord.

CAUTION: Be sure the drives breakers are powered <u>off</u> before making or breaking any power-cord connections. Take care when routing the high-voltage motor cables along your shop's floor. Pay particular attention to sharp or hot objects that might cut or melt these cables' insulation.

Operation

1 Prepare the dynamometer system for testing. This includes mounting the vehicle, powering on the DYNOmite Data-Acquisition Computer, configuring DYNO-MAX, activating an appropriate Hold mode for the DYNO-MAX console, etc. *See the appropriate DYNOmite Owner's Manual sections and DYNO-MAX on-line help for details.*

2 Power on your shop's circuit breakers for the ACtiveSync drives – to activate them. Their HIMs LCDs should show a sign-on routine and then change to an RPM display.

3 The HIM may be used to display drive data, diagnose drive problems, alter drive parameters, test the drives, and back-up/recover all the drive's settings. It is suggested that you now explore the HIM's interface. See the HIM's instructions (supplied in PDF format) for details.

Tip: *Be sure to backup your drive's parameters once you first power up the system. Backing up the entire parameter set, to either the drive memory or into the HIM, takes only a minute.*

CAUTION: <u>Never</u> enable the ACtiveSync-Module's drives unless the axle-hub dynamometer units are already mounted to the vehicle's axles, and an operator is in control of the vehicle's brakes. When operating on un-powered axles, the ACtiveSync motors will automatically spin up to match the vehicle's powered axle's speed. If you leave an unattached pair of ACtiveSync-Modules <u>powered</u>, there is the danger of their exposed-hubs spinning (unexpectedly) – while testing with another 2WD axle-hub pair or chassis dyno! Test cell personnel or other equipment might get injured! Therefore, keep the ACtiveSync motors' power cords unplugged (and safely stored) when not actually in use.

4 Release (twist) the red Emergency-Stop (enable) button into its run (out) position. Press the black Start button (once) to enable the drives into their "Sleep Mode" state. They are now monitoring for first rotation of the powered axle – to match that powered-axle's speed.

CAUTION: ACtiveSync motors will immediately spin (using up to their full power) to attempt to match the speed of the powered axle. All personal in the test area must be made aware of this – to avoid possible personal injury. Remember to deactivate the drives as soon as each individual test is completed. Otherwise, the innocent-looking (idle) drives may be forgotten and left "armed"!

5 Refer to the other relevant Axle-Hub Dynamometer, DYNOmite Data Accusation, and DYNO-MAX documentation for information on actual testing and data analysis procedures.

Miscellaneous

Note: When using ACtiveSynch-equipped DYNOmite (eddy current) axle-hub dynamometers, start with the following PID setting.

Scale Factor = 4000

Gain = 24, Drift = 24, Rate = 128

Do not check the "Also output Hold control on Board's D/A #2 (0-5v)" box.

It takes only minimal maintenance to keep the DYNOmite up and running. Be sure to follow these instructions to avoid expensive and time consuming down time.

WARNING: After mounting a new engine, and at 20 operational hour intervals, inspect the entire system - checking the torque of all dynamometer and engine mounting hardware.

Water Brake Absorber Lubrication

1 At the conclusion of a day's test session, pump a squirt of a quality marine (trailer) wheel bearing grease into each of the absorber's and chassis roller bearings grease fittings. Do not over-grease, when adequately lubricated, the bearings will just "drool" a little grease when running! Greasing the absorber bearings after testing helps force damaging moisture out of them - for storage.

CAUTION: Failure to grease after test sessions, or using the dyno on shafts with excessive run-out will reduce bearing and seal life. Do not over-grease! When adequately lubricated, the bearings will just "drool" a little grease while running!

Eddy-Current Absorber Lubrication

Every 250 hours of normal use, grease the absorber manually. The grease must be high quality NLGI grade 2 lithium base, with 350 degree Fahrenheit (180 degree Celsius) minimum drop point.

1 Lubrication is via the grease fitting (in one outside corner of the frame). Add grease until it just overflows the vent hole in the adjacent corner (Figure 53).

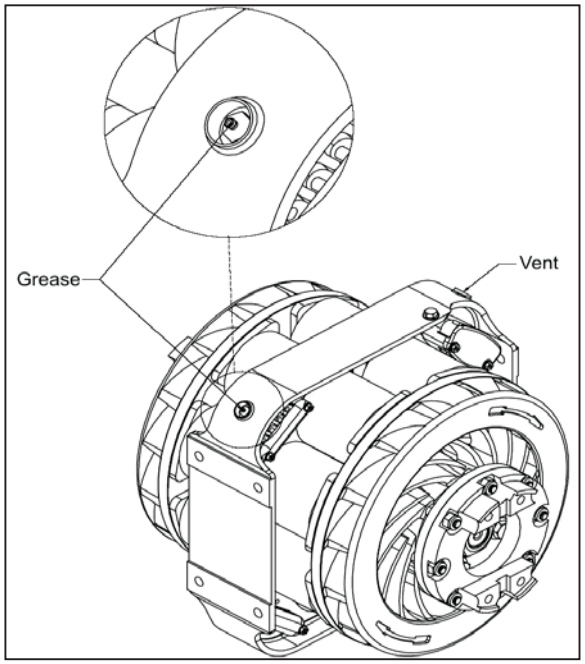

Figure 54

Note: Some appropriate lubricants include

Molykote BR2-S
Mobil Mobilgrase MP
Shell Gadus S2 V220
Texaco Regal AFB2

Bearing Replacement

Replace any absorber, roller, or pillow block bearings that become noisy, or feel rough while turning the dynamometer's absorber rotor or chassis roller by hand.

CAUTION: Avoid running with excessively worn bearings, as they can fail suddenly - damaging their housing, shaft, etc.

1 You can open the water brake absorbers, to replace their bearings, by removing the 12 socket head screws (around the outside circumference of the absorber).

2 The absorber's stator halves can then be slid apart from the rotor and arbor assembly. The stator halves are sealed with an o-ring (which is include in the standard DYNOmite replacement bearing and seal kits).

3 The seals and bearings are a light press fit into the inside of the absorber's stator halves. The outer seals (if any) may be retained with spiral lock rings.

NOTE: Torque values for the 12 outside circumference stator to cover socket head screws:

150 inch-pounds for 19" toroid absorbers (3/8"-16 screws)
75 inch-pounds for 13" toroid absorbers (¼"-20 screws)
50 inch-pounds for 13" non-toroid absorbers (#10-32 screws)
50 inch-pounds for 9" and 7" absorbers (#10-32 screws)

Seals

1 As required (by inspection), the absorber's seals may be field replaced. Avoid running with worn seals as they can leak and damage the absorber's bearings. (See "BEARINGS" above for steps to replace the seals.)

Water Cooled Eddy Current Absorber Lubrication

The rotor shaft bearings must be periodicity disassembled and lubricated based on the duty cycle. After about 4,000 working hours they should be washed with Kluber TCA 30 and inspected. Worn bearings must be replaced.

Tip: *Disassembly requires the use of an SKF hand injector pump kit to expand the absorber shaft's flanges for easy removal without excessive puller pressure.*

Bearings should be greased with “KLUBER ISOFLEX NB U15" grease. We suggest filling the bearing with grease to 30% of its free volume, taking care to make it rotate left and right several times.

The trunnion bearings should be greased to about 15% of the bearing free volume. During topping up, rotate the bearing right and left several times. New bearings with their original packing are covered with anti-corrosive oil, which is not suitable for all the different kinds of bearing grease. it is necessary to wash them with detergent type “KLUBER TCA 30".

CAUTION: Avoid overfilling the bearings. Too much grease can cause overheating.

After topping up, the absorber must not be immediately run to maximum speed. We suggest running for about 10 minutes at a speed equal to only 25% of the absorbers maximum rated RPM.

The maximum working temperature of the bearings is 165° F.. All the dynos are arranged to enable fitting of two K-type thermocouples, which are inserted in contact to the external rings of the bearings.

Batteries

Both the DYNOmite-Basic and DYNOmite-Pro Data Acquisition Computers can be equipped with on-board batteries for running without an external power supply (and to maintain data during power outages). It is possible to use either rechargeable (NiCad or Nickle Meta Hydride) or non-rechargeable (Alkaline or Lithium) batteries.

Tip: *A "Battery Type vs. Run Time" matrix chart is available in the DYNOmite Support section of our web site at www.land-and-sea.com.*

When depleted (to less than 6.5 volts), otherwise healthy rechargeable batteries can be restored using the included recharger/power supply.

Tip: *Allow 12 hours to fully recharge the batteries. To avoid inducing a memory effect on NiCad batteries, always fully discharge them before re-charging.*

1 Handheld DYNOmite Data Accusation Computers have a battery compartment that is accessed via a slide cover on the back of the plastic housing. This compartment accepts a single rectangular 9-volt style battery.

2 The DYNOmite-Pro board sets also have a battery holder sandwiched between the board pairs. It is necessary to first unscrew the two standoffs along the left (charger jack) side of the boards. Then the bard halves 50-pin connector can be carefully pulled apart to access the six AAA style batteries.

CAUTION: Do not overcharge batteries, and never attempt to recharge Alkaline or Lithium batteries. Two marked jumpers on the Pro board sets can be removed (as appropriate) to individually prevent either the 9-volt or AAA batteries from being charged by the included recharger/power supply.

2 Healthy rechargeable batteries will reach about 8.4 volts during charging, and maintain about 7.2 volts with the recharger/power supply disconnected.

Tip: *During testing of snowmobiles, outboards, or other applications where the RPM source is the yellow lead hooked to the engine's alternator output, the batteries will actually be charged during testing! In an emergency, a 9-volt alkaline battery can be used to power the DYNOmite.*

3 A separate 3.6 volt NiCad memory backup battery is soldered to the DYNOmite Basic circuit board sets (only). To prevent loss of internal settings and stored data, this battery should be factory replaced every three years.

CAUTION: Never leave old batteries in the hand held Data Acquisition Computer. They could leak and ruin it.

Chassis Dynamometer Chain Lubrication

For absorber equipped roller assemblies with chain drives, periodic lubrication is required.

1 Each 20 hours of operation (approximately) spray on high adhesion industrial (or motorcycle) chain lube to the side link plates of the absorber/roller chains.

Tip: *It is normal for the chains to get warm during operation.*

Chassis Dynamometer Belt (or Chain) Adjustment

For absorber equipped roller assemblies, periodically (as your testing duty cycle requires) check drive belt (or chain) tension as follows:

1 Verify adjustments, using the chart below, by applying the correct deflection pressure (at the mid-point of the longest span) and measuring the total deflection (from a straight tangent line). (See the "ENGINE MOUNTING - Automotive" section 5.1. for more details about the absorber itself.)

NOTE: The correct deflection (+/- 1/16" with deflection pressure applied at mind-point of longest span) should be:

3/16" for belts (applying 95 pounds of pressure)
5/16" for chains (applying 10 pounds of pressure)

CAUTION: Check the tension and tightness of all bolts for tensioning drive belts (or chains) after the first hour of running and each 20 hours thereafter. More frequent readjustment may be required during component run-in.

2 If re-tensioning is required, adjust as necessary using their slotted tensioners

3 With belts (or chains) on their sprockets, check alignment of the absorber shaft sprockets to the roll sprockets. If they must be repositioned, use Blue Loctite when re-tightening sprocket set screws.

4a For 12" Dual Roller chain units, adjust each slotted tensioner to achieve the appropriate chain deflection (per above chart). Once this is achieved, re-tighten all tensioner bolts.

4b For 24" and 44" Twin Roll units, adjust both tensioners equally - to keep absorber shaft parallel to the rolls' shafts. Adjust to achieve the appropriate deflection (per above chart). Once this is achieved, tighten both tensioner screws' locking nuts.

5 Recheck your adjustments after running a vehicle for a few minutes.

Chassis Dynamometer Twin Roll Alignment

If a roll is moved for bearing assembly, etc. they should be realigned following the procedure below.

CAUTION: Premature belt (or chain) wear can result from runnig with badly misaligned rolls.

1 Using a 24” square & 36" bar clamp (to pull roll), square the roll closest to the absorber end of the dynamometer. Measure from pillow block to outside frame on both pillow blocks.

2 Adjust roll position as required using the bar clamp. Once roll is located in frame, lock the pillow blocks in place, by tightening their 5/8" mounting bolts and elastic locking nuts.

3 Center the roll between the inside of the dynamometer frame rails - measuring from the end edges of the roll to the inside frame rail until equal distance. Lock the locking collars on the pillow blocks by rotating the collars in the same direction the roll will be normally be turning in operation. Using the spanner wrench tap the wrench until tight on shaft. Tighten the setscrew.

4 On the second roll, use the same process as for the previous roll. However, only lightly snug this roll's 5/8" bolts.

5 Compare the distance between both roll's faces to determine parallelism of their faces. Adjust the 2nd roll (using the bar clamp on pillow blocks) to achieve an equal distance between both rolls inside faces.

6 Using a straight edge, check parallelism of both clamp on pillow blocks & frame. Once achieved tighten 5/8 bolts & nuts on pillow blocks.

DYNOmite Data Acquisition Computer E-PROM chip upgrades periodically become available to add features to your existing DYNOmite system. The chip is easy to change by following these simple steps and precautions.

1 Find a relatively static free work area. Before opening the DYNOmite computer or handling the new chip, ground yourself by touching a grounded metal pipe or electrical plate. This will discharge any static electricity from your body.

> ***CAUTION: A static spark from your body can damage computer chips. Inexpensive static wrist straps are available from companies like Radio Shack.***

2 Make sure the DYNOmite Data Acquisition Computer is turned off and that all cables are disconnected from it.

3 Open the back of the Data Acquisition Computer's case by removing its screws. Carefully separate the halves of the case, taking care not to tug on its wiring.

4 Locate the original E-PROM chip. It is near the middle of the visible circuit board.

> ***CAUTION: Note the location of the matching indicator notch's molded into the chip and its socket. You will need to put the new chip in with the notch oriented the same way.***

Tip: *The old chip will probably have a white sticker on it with an earlier version number - like Version 8.13 .*

5 Carefully remove the old chip by progressively lifting it up at each end with a small flat blade screwdriver.

Tip: *Avoid bending the chips pins by lifting each side just a little at a time.*

6 While making sure that you have the indicator notch on the new E-PROM chip at the same end as the notch in its socket, carefully press the new chip into place.

> ***CAUTION: Do not put the chip in backwards as it can damage the chip and computer. Make sure that all the pins on the chip are in their respective socket holes. Bending a single pin can ruin the EPROM.***

Tip: *It may help to squeeze the two rows of pins (on the new chip) towards each other (with side pressure) as you seat it into its socket.*

7 Replace the DYNOmite computer's cover and power it up.

8 As long as it signs on in the normal manner you are done. You are ready to use its new features.

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Tip: *If the computer does not work properly after the upgrade, check for bent pins. Also, inspect the notches to make sure you did not put it in backwards.*
Otherwise replace the original chip.
If you inadvertently damaged the upgrade E-PROM, return it to Land & Sea for a free replacement.

Annually (or as required to demonstrate calibration accuracy - for certification or publication of data) the torque-arm(or load cell should be dead-weight tested.

Tip: *The re-calibration examples in this section describe a DYNOmite Data Acquisition Computer equipped with the LCD and keypad option. If your interface is via a DYNO-MAX equipped PC, you can perform each of the required steps via its menus. See DYNO-MAX's On-line Help screens to guide you through the steps.*

CAUTION: "Re-calibration" over-writes Land & Sea's factory calibration! Make sure you have confidence in your calibration weight and "effective foot pound calculations."

1 Verify that you are running under AC power of a fully charged battery to provide stable voltage during re-calibration.

2 Verify that the torque arm or load cell is plugged into the DYNOmite Data Acquisition Computer.

3 Turn on the DYNOmite and let it warm up for at least 15 minutes (to stabilize internal temperatures).

4a For DYNOmite-Basic board sets (only) go to the DYNOmite's RAW TORQUE menu screen and verify that the Raw Torque is showing between 500 to 1,200. If it is not, first turn to the "MAINTENANCE - Torque Arm Replacement" section 12.4.
Otherwise, continue from step #5 (below).

Tip: *If the RAW TORQUE is over 4,000 (or under 300) check again that have the torque arm's harness plugged in and that you do not already have a test load applied!*

4b For DYNOmite-Pro (or Lite) board sets (only) go to the DYNOmite's ADJUST RAW TORQUE menu screen and verify that the Raw Torque is showing between 4,000 to 9,000. If it is not, first turn to the "MAINTENANCE - Torque Arm Replacement" section 12.4.
Otherwise, continue from step #5 (below).

Tip: *If the RAW TORQUE can not be adjusted into this 6,500 range check again that have the torque arm's harness plugged in and that you do not already have a test load applied!*

5 Verify that the correct torque source is selected in either the LCD Data Acquisition Screen (Figure 55) or under DYNO-MAX's "Electronics - Calibrate DYNOmite Channels."

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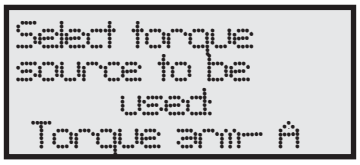
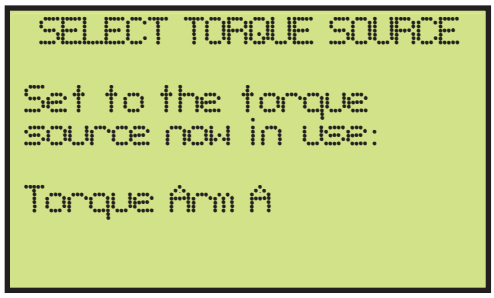


Figure 55

DYNOmite-Pro



<SELECT TORQUE SOURCE allows selecting which of the 12 DYNOmite Torque Source calibrations to utilize. There are three Transducer Group Types to select from: Toque Arms (and most other millivolt output load cells and strain gauges), Rotary Torque (exclusively DYNOmite Piggy Back rotary board interfaces), or Load Cell Transducers (for most 0-5 volt torque sources).
.

Tip: *The DYNOmite can simultaneously store calibrations for separate torque arms. This allows you to use your one DYNOmite computer on different dynamometers (e.g. automotive, kart, marine, snowmobile, etc. engines) without re-calibrating. If you only have one torque arm, it will have been calibrated as Torque Arm - "A".)*

6 There are two procedures that can be used to apply calibration load on the torque arm.

Direct Weight Method *- requires hanging the full calibration load at the same radius point where the torque arm's stop (or linkage) restrain its rotation. The load must be hung tangent (90 degrees to the rotation) to the contact point. This method clearly demonstrates if the DYNOmite is delivering accurate torque readings.*

Extension Arm and Weight Method *- is required for heavier duty applications where the direct weight method would require awkwardly large weights. Instead, an extension arm (and a corresponding torque multiplication factor) is used with more convenient size weights.*

Done properly, both methods deliver exactly the same calibration results!

Tip: *Don't forget to also include the weight of the chain, etc. used to support the actual calibration weight.*

Example of calibrating a 13" marine straight vane water brake using the direct weight method:

Tip: *All re-calibration must be done in foot-pounds. Even if you are using DYNO-MAX's metric display units, all calibration is still assumed to be in foot-pound base units.*

a) Remove the torque arm from the absorber.

b) Draw a pencil line on the arm's face from the center of the absorber to where the torque arm normally contacts the engine framed during testing.

c) Carefully measure the moment arm radius (along this line) from that contact point to the center of the absorber.

d) Holding the torque arm so its engraved letters "& Sea" are above the pencil line (and using a level to insure the line is parallel to the floor), tightly clamp the arm (well below the pencil line and near the mounting hole portion of the torque arm) in a soft jaw vise.

e) Now calculate your Torque Arm Factor by multiplying the moment arm radius in feet by the calibration weight (in pounds).

Note: You must add the torque arm's Torque Load Factor (foot pound contribution of the overhanging arm's own weight at this angle) to your calculated Torque Arm Factor as follows:

13" absorber all torque arms = add 0.7 foot pounds.
9" absorber Snow torque arms = add 0.51 foot pounds.
9" absorber PWC torque arms = add 0.1 foot pounds.
7" absorber Kart torque arms = add 0.56 foot pounds.

Tip: *Example: Your factor for a 13" absorber's arm (with a measured moment arm distance of 9.12") using a 300 pound weight would be...*
9.12"/12" x 300# = 228 + .7 = 228.7 effective foot pounds

The effective 228.7 foot pounds from this example would be entered in the Torque Arm for arm?: screen.

SKIP NOW TO THE "**EXECUTING THE ACTUAL RE-CALIBRATION:"** SEVERAL PARAGRAPHS BELOW!

Example of calibrating a 13" marine straight vane water brake using the Extension Arm and Weight Method:

a) Remove the torque arm from the absorber.

b) Holding the torque arm with its strain gauge cover up and using a level to insure the cover is exactly parallel to the floor, tightly clamp the arm (well below the strain gauge area and near the mounting hole portion of the torque arm) in a soft jaw vise.

c) Remove the black plastic wear pad from the end of the torque arm and mount the included red aluminum Calibration Arm Extension from the small 1/8" hole in the torque arm.

d) The foot pounds you enter must match the effective foot pounds of deadweight torque being used to re-calibrate the unit. To figure out what the effective foot pounds is you must add the effective torque contribution of the extension supporting the actual calibration weight, as well as multiply

the calibration weight by both its moment arm radius (in feet) and a small Geometry Angle Factor (to compensate for the geometry of the extension arm calibration method). These three factors are provided for Land & Sea's deadweight extension arms.

Note: You must add the both the torque arm's and the extension arm's Torque Load Factors (foot pound contribution of the overhanging arms' own weight at this angle) to your calculated Torque Arm Factor as follows:
13" absorber - all torque arms = add 0.9 foot pounds.
24" Land & Sea deadweight extension arm (for 13" absorber's torque arm) = add 1.7 foot pounds.

13" absorber - in place (i.e. gas docking station) load cell using deadweight calibration extension arm = add 11.75 foot pounds.

19" absorber - in place (i.e. diesel docking station) load cell using deadweight calibration extension arm = add 13.44 foot pounds.

Plus you must also multiply the weight you are using by the appropriate Geometry Angle Factor as follows:
13" absorber all torque arms = multiply by 0.92 Geometry Angle Factor.

Tip: *Example: Your formula for a 13" absorber's arm with a measured moment arm distance of 24" using a Land & Sea's nominal **2 foot radius** extension arm that has a Torque Load Factor of **1.7 foot pounds** and a **.92 Geometry Factor**) with a 100 pound weight would be...*
24"/12" x 100# x 0.92 = 184

then
184 + 0.9 + 1.7 = 186.6 effective foot pounds

The effective 186.6 foot pounds from this example would be entered in the Torque Arm for arm?: screen.

EXECUTING THE ACTUAL RE-CALIBRATION

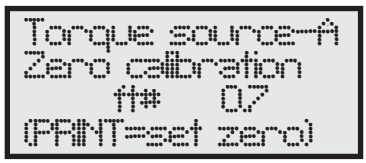
7 The exact calibration procedure (below) will vary depending on the DYNOmite (or DYNO-MAX) version you are working with.

DYNOmite-Basci

Figure 56

< Enter the effective foot pounds that you will be hanging on the torque arm. The physical weight and moment arm length used should be selected to load the arm at between 1/3 to 2/3 of its full scale limit. Contact Land & Sea if you do not know the arm's torque limit.

Tip: *This Torque Arm Factor for arm-? only has an effect during actual re-calibration of the active (indicated "A", "B", etc.) torque arm. The foot pounds you enter must match the effective foot pounds of deadweight torque being hung to re-calibrate the arm.*



< Press the hand held's **PRINT** button (or DYNO-MAX "Zero" button) to re-set the current torque reading as zero foot pounds. Make sure that there is no load being applied at the torque arm before zeroing! The torque arm should be relaxed and in its normal operating position during zeroing.

Tip: *Check that you don't have cables or hoses pulling on the torque arm before zeroing the computer. You'll get an ERROR!! arm-A torque reading is too far off to be zero. message if you attempt Zero calibration on excessive torque readings. The need to zero-out large torque readings is a sign that something is wrong... see the troubleshooting section.*

< Make sure the weight is hanging still and that the display is steady. Assuming it shows a ft# reading that is incorrect, press the hand held's **PRINT** button (or DYNO-MAX's "Re-calibrate" button). The display will re-calibrate so that the display matches the foot pounds set in the previous Torquearm for arm-?: screen.

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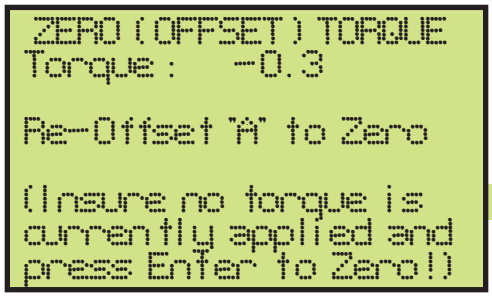
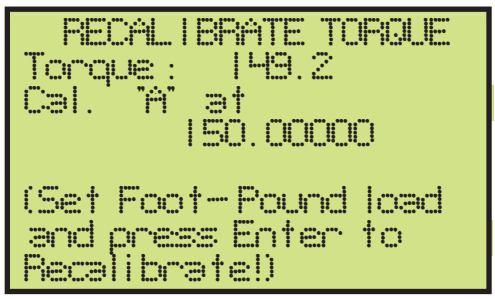


<**ZERO (OFFSET) TORQUE** allows automatically offsetting (zeroing) the strain gauge (to compensate for mechanical, electrical, and temperature induced "creep" of the DYNOmite's unloaded torque reading).
You may press the **Enter** button if you wish to re-set the current torque reading as zero foot pounds (like the "tare" button on a meat scale). Always make sure that there is no load being applied at the torque arm before zeroing!
If you do not need to zero the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Check that you don't have cables or hoses pulling on the torque arm before zeroing the computer. Otherwise, you may receive an error message like "RAW TORQUE TOO HIGH!" if you attempt zeroing excessive torque drift. The need to zero-out large torque readings is a sign that something is wrong… see "*TROUBLE SHOOTING - Questions & Answers*" section 13.1.*



<**RECALIBRATE TORQUE** allows resetting the torque channel's gain to match its current reading to that of the entered calibration test force value.

#1 Be sure that you have already performed the Torque Zeroing procedure outlined above.
#2 Set the "Cal. "A" @ value to match the effective foot pound force of your calibration weight and moment arm. Use the ← or → **arrow keypad buttons**.to move between digit positions. Then key in the **#**'s (or use the "**+**" or "**-**" keypad buttons) to enter the desired numbers.
#3 Verify that the calibration weight is hanging still and that the display is steady.
#4 Press the **Enter** button - the display will re-calibrate so that it matches your entered Cal. value.

If you do not need to re-calibrate the channel, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *Check that you don't have cables or hoses pulling on the torque arm - and that the test weight is hung - before re-calibrating the computer. Otherwise, you may receive an error message like "RAW TORQUE TOO LOW!"*

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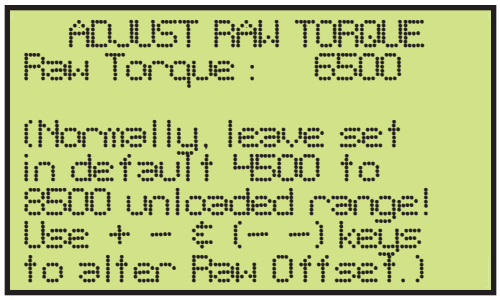

<ADJUST RAW TORQUE allows setting the torque channel's initial (unloaded) digital offset at an appropriate starting point. This should be checked whenever the physical torque transducer is changed.

The suggested value is 6500 (approximately10% of this 16-bit channel's 0-65,534 working digital range) to provide for some ability to read negative torque values.

If you do not need to change the Raw Torque setting, just press the **Menu keypad button** to return to the previous sub-menu.

Tip: *The Raw Torque is not a calibration setting! It just needs to be set at a value that provides some offset from the channels 0 and 65,534 extreme. For applications that must read equal magnitudes of positive and negative torque (e.g. bi-directional systems) a value like 32,700 may be used..*

8 Remove the weight and recheck the zero calibration. You can go through the zeroing and re-calibration procedures a couple of times to really fine tune the accuracy.

Tip: *The DYNOmite stores information on and can calibrate each of the arms individually. You can swap between calibrated arms by plugging the desired one in and selecting its calibration letter in this screen.*

Note: If you forget to hang the weights on when you push the PRINT button you get an "ERROR" message - instead of a bad re-calibration!

Tip: *Many dynamometer operators use a dead weight load near the peak power torque of the test engine. This provides maximum accuracy (at that specific torque).*

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Sample Calibration Photos

Typical Automotive Setup - unloaded

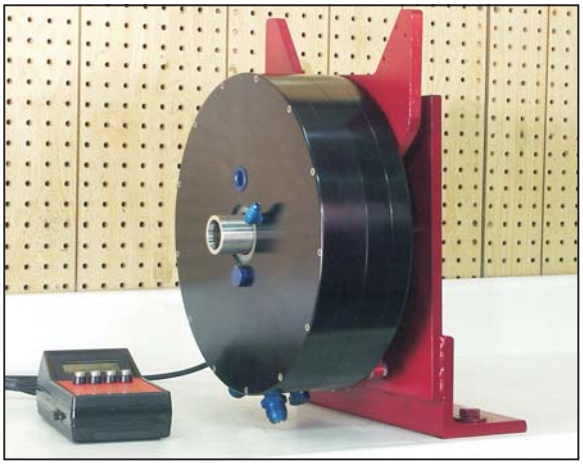

Figure 57

Typical Automotive Setup - loaded

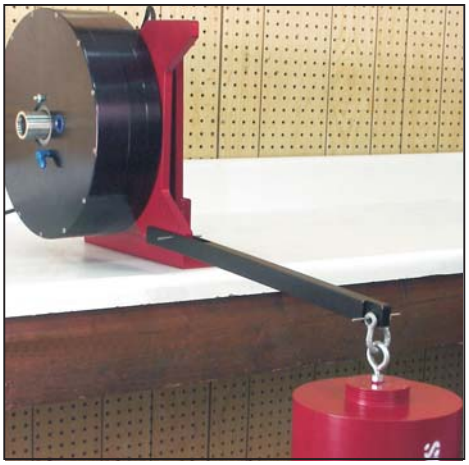

Figure 58

Typical Personal Water Craft Setup - unloaded

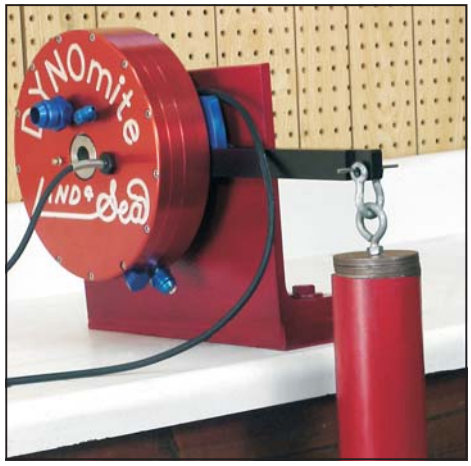

Figure 59

Typical Personal Water Craft Setup - loaded

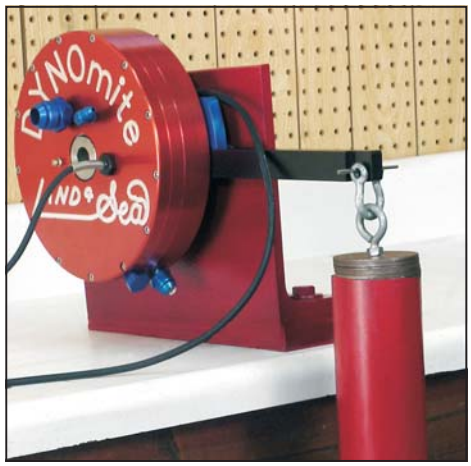

Figure 60

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Typical Snowmobile Setup - unloaded

Figure 61

Typical Snowmobile Setup - loaded

Figure 62

Follow the instructions below when removing or replacing the torque arm on a DYNOmite absorber.

WARNING: Installation of a heavier duty torque arm indicates that you will be using the dyno under non-standard conditions; Land & Sea does not have control over such use and consequently this voids the DYNOmite's warranty! The customer is responsible for maintaining the safety and mechanical integrity of each application.

1 To detach the torque arm from the absorber's stator housing, remove its five screws, five lock-washer spacers, and two "safety shoulder screws."

Tip: *The lock-washers are hidden between the arm and the housing to also serve as spacers.*

CAUTION: These screws are secured with red Loctite. Heat them carefully with a propane torch to avoid breaking them during removal.

2 To remount the torque arm, carefully position the five split lock washers between the absorber's stator housing and the torque arm so they act as spacers. Place a drop of red Loctite on the threads of each of the five mounting screws, install them through the arm, making sure the lock-washer spacers do not slip out. Torque these five screws per the chart below.

NOTE: Torque values for the five water brake torque arm mounting screws:

150 inch-pounds for 13" absorbers (5/16" screws)
100 inch-pounds for 9" and 7" absorbers (¼" screws)

3 Place a drop of red Loctite onto the threads of the two Safety Shoulder Screws and install them through the arm. Make sure they will not rub on the arm as it flexes under engine torque loads. lock-washer spacers do not slip out. Torque these two screws per the chart below.

NOTE: Torque values for the two torque arm safety shoulder screws:

75 inch-pounds for 13" absorbers
50 inch-pounds for 9" and 7" absorbers

CAUTION: Do not exceed the recommended torque on the two safety shoulder screws or they will break.

WARNING: Running without both safety shoulder screws in place allows the absorber to spin dangerously if the torque arm fails during dyno testing.

4 If you are installing a different torque arm than was previously used on this DYNOmite Data Acquisition Computer, you need to check the setting (and possibly readjust the Computer's Raw-Torque Offset) prior to re-calibration.

Tip: *If you have not changed the torque arm you can skip the steps below!*

5 Make sure you are running under AC power (to provide stable voltage during re-calibration) and connect the torque arm to the DYNOmite Computer.

6 Turn on the DYNOmite Computer and let it warm up for at least 15 minutes (to stabilize internal temperatures).

7 Go to the DYNOmite's RAW TORQUE menu screen and verify that the Raw Torque is showing between 500 to 1,200. If it is, you can skip the steps below and should turn to the "MAINTENANCE - Torque Re-calibration" section12.3.
Otherwise, follow the procedure below.

Tip: *If the RAW TORQUE is over 4,000 you probably do not have the torque arm's harness plugged in!*

8 Temporarily un-power the DYNOmite Data Acquisition Computer.

9 Open the back of the Data Acquisition Computer's case by removing its screws. Carefully separate the halves of the case, taking care not to tug on its wiring.

10 Find the raw torque offset adjustment, which is a small brass metal screw just below the 3/16" diameter hole in the DYNOmite's circuit board - labeled **STR +/-**.

Tip: *This hole is on the left side of the board (holding the boards so you can read their text) and about half-way down.*

11 Re-power the DYNOmite and, using a small flat blade screwdriver, turn the screw to set the RAW TORQUE number between 500 to 1,200.

Tip: *You may need to turn the screw several revolutions before the RAW TORQUE changes.*
The exact setting does not affect the accuracy of the DYNOmite!

12 Un-power the DYNOmite while you replace its cover. Turn to the "MAINTENANCE - Re-calibration" section12.3.

Tip: *If you swap between torque arms on a regular basis, realize that adjusting the raw torque offset screw changes the zero offset for each arm channel. If each of your torque arms is not within the 500 -1,200 window, Land & Sea can match the arms to make readjustment unnecessary.*

Dynamometer systems shipped with our optional trailering packages include separate maintenance pages from the trailer's axle and (if so equipped) brake manufacture. Refer to this literature, your trailer-axle manufacturer's web site, your trailer's axle-capacity label, your trailer-tires' sidewalls, for important information on operating and servicing your trailer.

WARNING: Failure to follow the service and maintenance procedures outlines in the axle-manufacturer's literature could lead to equipment failure and/or trailering accidents. The customer is responsible for maintaining the safety and mechanical integrity of their trailer. If you have lost your literature, please refer to the axle-manufacturer's web site – or contact Land & Sea, Inc.

Regularly check the tires' inflation pressure, along with their tread and sidewall condition. The correct inflation pressure will be found on the trailer's axle-capacity label.

WARNING: Be sure to regularly check the wheels' lug nets, for correct torque. If you do not know the correct toque specification, contact Land & Sea, Inc.

If you trailer's tongue is removable (e.g. 1" adjustable height increments) periodically check the tightens and condition of its attaching hardware.

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Before calling for technical assistance, please be sure you have reviewed this manual including the Q & A section below (and if relevant, DYNO-MAX's help screens and Multimedia CD Tutorial). If you do call, make sure that your phone location has access to the dynamometer and computer. It is best to e-mail (or fax) your questions (including test data) in advance of calling, that way we both have them in hand.

Tip: *An inexpensive 100' phone line extension is much more practical than using an expensive cell phone!*

Q Why does my engine overpower the dyno even with the load valve fully open?

A See "GETTING READY - Water Supply" section .

Q Why can't I maintain steady RPM with the load valve (except at very high and very low RPM)?

A This is normal on peaky engines at RPM's near maximum torque. Because torque is dropping on both sides of the RPM curve, you suddenly have to switch the direction you rotate the load knob as you pass through this RPM range! So, anticipate the required valve action as you get near this RPM, avoid overcompensating, and practice!
Adding more inertia to the drive line helps too.

Q Why is my engine hard to restart after a dyno run:

A Make sure the absorber's discharge line(s) run downhill without any "traps" so it gravity drains between runs. Make sure that the vent line runs up from the absorber and also has no sags to trap water. For fast draining neither of these lines should be immersed in water.
Also, after a hard run the engine may be too hot for easy starting.

Q Why are my power readings consistently way off?

A Make sure DYNOmite tach is displaying true engine RPM; make sure you have correctly selected the torque arm to be used, done a Zero torque arm? and do not need to RE-CALBRATE Torque arm?.
Make sure that the Gear Ratio for correct torque is set correctly (normally its set to 1.000).
Make sure the torque arm wear pad is not cut through.
Make sure you are applying SAE correction factors properly.
Check that engine temperature is consistent from run to run (this can make a big difference and is a genuine power loss or gain).
Watch for exhaust blowing back into the engine's air intake.
Lastly, perhaps what you see is what you've got!

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Q Why are my power and RPM readings intermittently way off?

A Make sure DYNOmite tach is displaying true engine RPM throughout the run. If you see unrealistic RPM spikes during data playback (use "Time" playback mode with minimum data averaging for diagnostics) then electromagnetic ignition noise (Radio Frequency Interference) is most likely the culprit. In this case, make sure that the DYNOmite's ground lead is securely on a good ground near the ignition (the engine block is a good spot).
Also make sure that the engine has both resistor plugs and resistor wires or caps. It may help to pull the DYNOmite computer itself further back from the engine during testing. (See "TROUBLE SHOOTING - RFI" section 13.4, 13.5.)

Q Why are my power and torque readings intermittently way off?

A Make sure that you do not have any water shorting the 4-wire plastic torque arm harness's connector (shorts make the DYNOmite read low). Corrosion on these connector pins or a break in the torque arm wiring will make the DYNOmite read high. Do not "Zero out" these errors, fix the problem!
Make sure that the Gear Ratio for correct torque is set correctly (normally its set to 1.000).

Q Why don't I get any RPM reading?

A Check that the yellow lead is attached to an appropriate RPM source (See "DATA ACQUISITION- Basic Hook-Up" section 6.1.) Check that the ¼ amp fuse (located in the DYNOmite harness's yellow lead) was not blown from over-voltage. Land & Sea's technicians can take you through a simple test (over the phone) using your DYNOmite's battery charger (as an RPM signal simulator) to verify the data acquisition system and harness hook-up

> ***CAUTION: Do not substitute a larger fuse (1/4 amp maximum), or you can burn out the DYNOmite's charging and tachometer circuits (which is not covered under warranty)!***

Q Why am I getting an over voltage warning screen when running at high RPM?

> ***CAUTION: Stop testing immediately or you will burn out the DYNOmite's charging system and tachometer circuits (which is not covered under warranty)!***

A If you are taking tachometer readings from the engine's charging system, make sure the engine's voltage regulator is working. Without a load, most alternators deliver well in excess of 20 volts at high RPM!

Tip: *For engines with a tiny battery and no load (i.e. lights, electric fuel pump, etc.) you can install one or more 100 ohm to 500 ohm (2 watt) resistors in series with the DYNOmite's yellow tach lead. A 100 ohm (Brown-Black-Brown-Gold), 200 ohm (Red-Black-Brown-Gold), 300 ohm (Orange-Black-Brown-Gold), and 500 ohm (Green-Brown-Brown-Gold) resistor are included in the DYNOmite kit for this purpose. (Note: This might reduce charging of the DYNOmite's internal battery during low RPM operation.)*

Q Why are "No data points recorded" during my tests?

A Make sure you pressed the **TEST** button to initiate the test run. In the "Run Set-up" branch, make sure that Engine speed to trigger recording is higher than minimum speed to record data at:. In the "Output" branch, if you had set Data-averaging during playback to 0 (for RPM STEP mode, change it to 1. If you get the data set to 1, but not in the RPM STEP mode, it means that you swept through the power curve too quickly to get at least 12 readings at any 100 RPM increment. If after these changes, you still are not getting data points, you may be experiencing RF interference. (See "TROUBLE SHOOTING - RFI" section 13.4, 13.5.) Also, see "*Why are my power and RPM readings intermittently way off*?" question above.

Q Why does my RPM change ok during testing but my torque stay fixed?

A Make sure torque arm lead is plugged into the harness and that the connection is clean and dry. As a quick check, the torque reading should change if you open and close this connection. You may have selected the wrong torque source during set-up. (See Fig. 1 and the "LCD INTERFACE - Configure" section .)
If you are using a Rotary Torque Transducer, make sure that it's green LED is on and that the **High** and **LOW** Interface Module's buttons work.

Q Why doesn't my DYNOmite's top MPH print-out match my drag strip's trap MPH?

A You can reset the DYNOmite computer's Vehicle speed transfer factor: to correctly match the MPH, but, keep in mind that if you had slippage as you went through the traps, or if you kept accelerating after the drag strip's equipment had recorded your speed, the two speeds should not match!

Q Why do I get very few (or no) data lines to print out even though the DYNOmite says "thousands" of data points were recorded?

A Check that you are playing back the data in Time: not RPM mode and that data averaging is set to a reasonable number like 20 (1/10th second time interval). Also, be sure you have the Preset test recording rate: set to a fast enough rate (normally use 200 records per second) to capture adequate acceleration data for smooth looking playback.

Q Why is no jack-shaft RPM (or vehicle MPH) displayed even though the shaft is turning?

A Make sure the Magnetic Pickup Sensor is within 3/32" of the magnetic collar and they are on the same centerline. If you are using an infrared "On-Board" Torque Transducer pickup,

make sure the pulse pickup is in place and that the LED. Check that the wiring is intact. Land & Sea's technicians can take you through a simple test (over the phone) using your DYNOmite's battery charger (as an RPM signal simulator) to verify the data acquisition system and harness hook-up.
You must also have the correct E-PROM upgrade option installed in the DYNOmite Data Acquisition Computer to read MPH.

Q Why are the unused thermocouple channels reading erratically during testing?

A This is normal! You must either install a probe in the extra channel or short the leads at the end of the unused channels (to hold them to a low temp reading).

Q **Why do the fuel flow and BSFC fluctuate quite a bit even during steady state testing?**

A Because of the uneven demand characteristics of float bowl needle and seat controlled fuel delivery (especially on engines that vibrate the carburetor bowls a lot) the fuel being **delivered into the engine** at any instant may not match that being **delivered into the bowl**. Since the transducer is actually measuring the delivery into the bowl, it is necessary to average the fuel flow over a long enough period of time for the two flows to match. Generally, flow numbers that are averaged over less than one second are not a reliable indication of exactly the amount of fuel that made it into the engine. This is not a function of the accuracy of the DYNOmite or transducer. Note: fuel injected engines are subject to pulsation's in the fuel line which can give similar (but less severe) problems. In all cases, the readings get more reliable as averaging time (and flow) increases.

Q **Where do I put a fuel flow transducer if the engine is injected and has a separate bypass return line off its fuel regulator?**

A You must place the transducer between the regulator output and the fuel injector(s). If you install it before the regulator you will only be reading the continuous full flow of the fuel pump. A Land & Sea technician can give you some tips on working this out. However, if you also have DYNO-MAX and more than one DYNOmite board pair set, you can simply run a second transducer in the return line (and have DYNO-MAX subtract flow from the other).

If the Electronic Auto-Load Control Servo fails to properly control the engine, review the following checks:

> ***CAUTION: If you must disassemble the load valve body and brass barrel valve for service, do not remove the stepper motors shaft assembly from its housing. Doing so will permanently degrade the magnetism and performance of the motor.***

1 When the servo is in one of its active modes, it should close the load valve upon DYNOmite power up. This is a simple verification that the servo is active, has power, and can at least close under computer control. If the servo fails the preceding check, (i.e. it never moves under computer control) verify that it has a full 12.6 volts at its red and black power leads. Also, make sure that you have actually activated the servo and have not accidently left it in "Manual Knob" mode! (See "OPTIONS - Electronic Auto-Load Servo" section .)

2 If the servo closes upon power up, turn on your water supply and repeat the test to make sure the valve will close when water pressure is present. If not, it may need to be cleaned, or you may have too much water pressure for proper operation (See "GETTING READY - Water Supply" section.). A properly serviced valve will turn smoothly with just light "finger tip" torque.
If the valve turns freely, skip to Step #4.

3a The valve may be opened for cleaning by removing the four 1/4"-20 socket head screws (that attach its stepper motor to the valve's body) and the single #10-32 socket head travel limit screw (in the side of the valve's body).

3b If the valve is dirty inside, use a rag with a non-abrasive metal cleaner (like Brasso) on the brass barrel to remove any dirt particles and/or corrosion. Use a very-fine plastic scouring pad (like "Gray" ScotchBrite) with a light detergent motor oil to clean the valve's bore. Lightly scrub the bore in a rotational (not up and down) direction.

> ***CAUTION: Do not scratch or sand material from the brass barrel valve or it's housing bore. If you increase the barrel to bore clearance (with an abrasive cleaning) the valve may seep too much when closed. Excessive seepage will load the engine at cranking RPM.***

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3c Before reassembling the valve, check its brass barrel's "run-out" with a dial indicator (by turning the stepper motor's shaft) (Figure 64).

Figure 64

3d If run-out exceeds .0015", true the barrel by applying light palm pressure (to straighten its shaft). Use the bore of the valve body as a straightening support fixture for the brass barrel (slide it in about 3/8" short of seating during this process). (Figure 63).

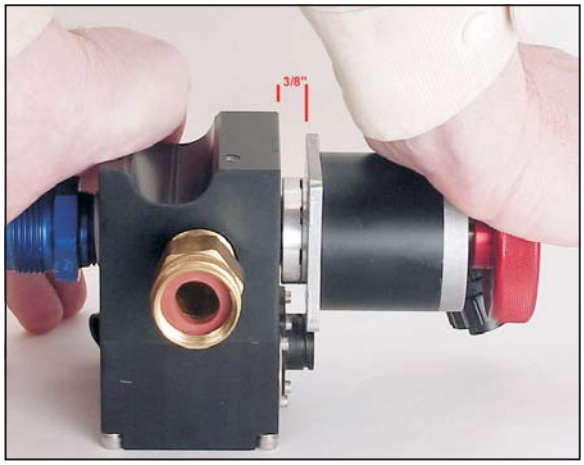


Figure 63

CAUTION: Do not over-bend the shaft while straightening. Work slowly and re-check run-out frequently during the procedure.

4 It the valve passes the above checks, make sure that the Rate, Gain, and Drift settings are appropriate for the engine and absorber combination. (See "DYNOmite-Basic LCD INTERFACE - Configure" section 7.2 or the "PRO LCD INTERFACE - Configure Controls" section 7.11.)

5 Run the engine with the Holding RPM set about 1,000 RPM above normal idle speed. Apply light throttle and see if the load servo valve opens to hold the engine to that RPM. You can also manually force open the valve and watch to see if the computer closes it back down (to bring the engine back to the Holding RPM). If the valve only closes (never opens under computer control) you may have a broken harness lead and should contact Land & Sea.

6 If you are running DYNO-MAX, you can test the valve by running it in "*Hold % Position*" mode (under DYNO-MAX's "Electronics - Configure DYNOmite Controls" menu choice. Verify that the setting for the Keyboard Hold/ Point Control for the Left/Right arrow keys is is 10%. Without the water presure on (but without the engine running) key the servo from closed to open and back

again. You are checking that the valve reliably moves 10% with each click of an arrow key. If not, should contact Land & Sea

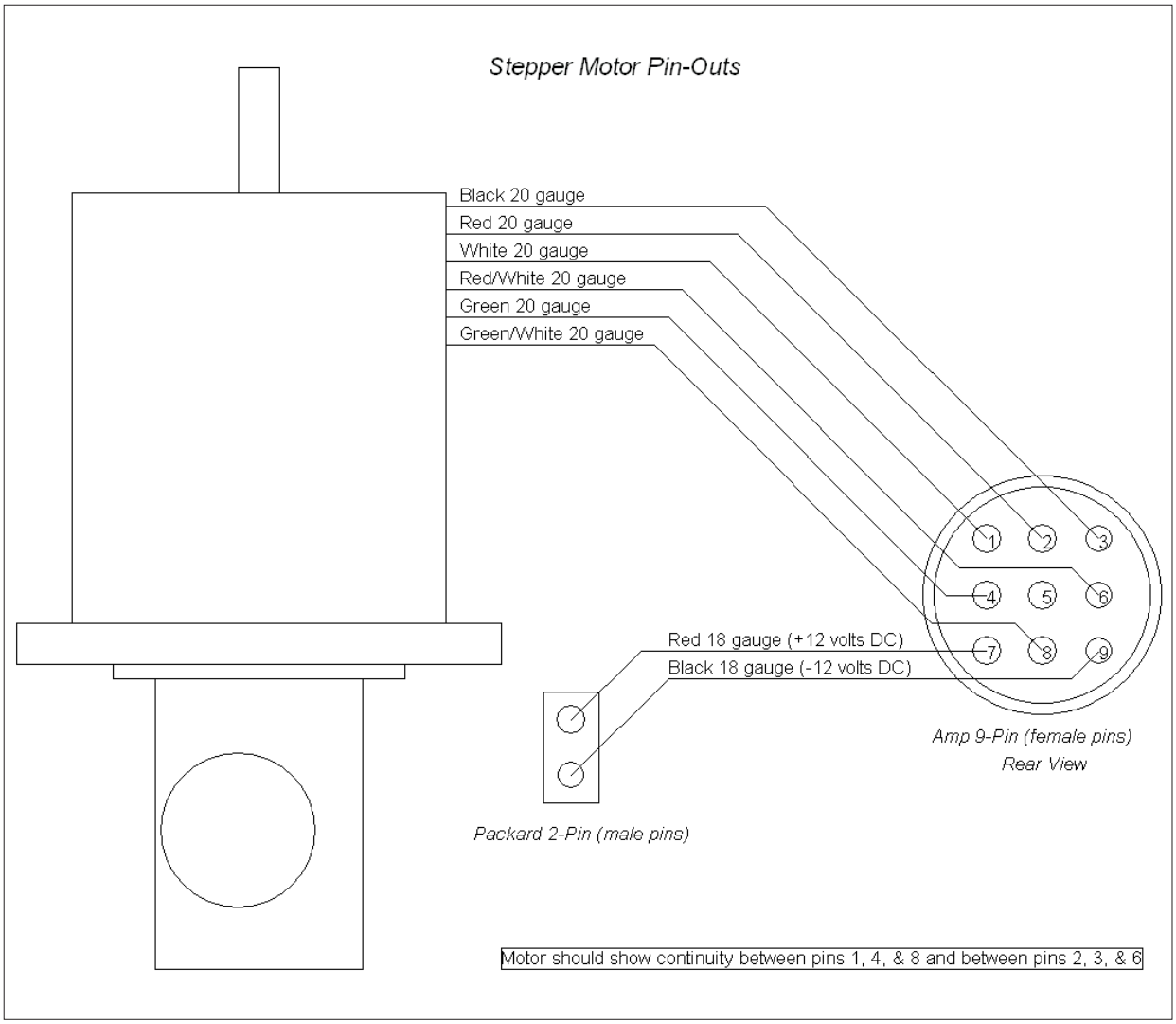
6 If the valve passes all the above checks, but behaves erratically under full power testing, you need to confirm that the problem is not RFI (electromagnetic Radio Frequency Interference from the engine's ignition system). De-activate the servo by placing it in "Manual Knob" mode and re-run a full power test operating the load valve manually. The stepper motor should not move the valve at all during this test. If you notice that the servo still seems to be active (it moves erratically on its own even though it is turned off) then RFI signals are entering through the harness and directly activating the servo. You will need to reroute the harnesses and/or follow the recommendations in the "TROUBLE SHOOTING - RFI" section 13.4, 13.5.

7 If the load valve passes the above tests, record a manually controlled test (at the problem RPM and throttle opening) and examine the captured RPM data (with data averaging and dampening set to the lowest values). Look for sudden un-explained RPM spikes in the data. If they exist, then the problem is not with the servo, but with the RPM data the servo is responding to. To cure the RFI tachometer errors, see the "TROUBLE SHOOTING -RFI" section 13.4, 13.5.

8 If the valve passes all the above tests, the problem is most likely one of tunning the load valves Rate, Gain, and Drift settings to the engine and absorber. (See "LCD INTERFACE - Configure" section .)
Or, if even manual control of the engine is difficult, then it is a matter of better matching the absorber's discharge drain orifice(s) and water supply to the engines being tested. (See "TROUBLE SHOOTING - Absorber Matching" section 13.3.)

9 If the engine is experiencing an RPM oscillation problem under Electronic Auto-Load Servo control, check to see if it is stable under "Manual Knob" control at that same RPM. Assuming it is stable under manual control, then it is most likely that the Rate, Gain, and/or Drift settings are too aggressive. This causes the servo control to induce oscillation by overcorrecting each time it makes an adjustment. Cut back on the settings and try again. (See "LCD INTERFACE - Configure" section .)

10 If the engine is not experiencing an RPM oscillation problem but instead is slow to eliminate errors between actual RPM and the desired Holding RPM the problem is usually that one or more of the that the Rate, Gain, and/or Drift settings is too low. (See "DYNOmite-Basic LCD INTERFACE - Configure" section 7.2 or the "PRO LCD INTERFACE - Configure Controls" section 7.11.)


Stepper Motor Pin-Outs
Black 20 gauge
Red 20 gauge
White 20 gauge
Red/White 20 gauge
Green 20 gauge
Green/White 20 gauge
1
2
3
4
5
6
7
8
9
Red 18 gauge (+12 volts DC)
Black 18 gauge (-12 volts DC)
Amp 9-Pin (female pins)
Rear View
Packard 2-Pin (male pins)
Motor should show continuity between pins 1, 4, & 8 and between pins 2, 3, & 6

The DYNOmite water brake absorbers are designed to work properly on a wide range of engine power and RPM combinations - often right out of the box. To improve load valve "drive ability" with some very high torque low RPM engines, you may need to restrict the absorber's discharge rate). Conversely, near the upper horsepower/temperature/RPM limits of the absorber, you often need to increase the discharge volume.

The drain(s) in the bottom of the DYNOmite absorber stator's housing serve two separate functions. As covered in the "GETTING READY - Water Requirements" section, one is to carry away the engine's delivered energy - as waste heat. The other is to allow the absorber to un-load whenever you close down its load control valve.

Tip: *Only the load valve's sensitivity and water discharge temperatures are affected by changing the discharge rate. The accuracy of the DYNOmite's torque readings are unaffected!*

Some drain fittings will have a replaceable screw in brass flow restricting orifice (Figure 65 provides a view of one model absorber's drain orifice). The orifice's i.d. can be selected (or drilled) to alter the rate at which the absorber drains. Larger orifices (or none at all) allow the absorber water level to drop faster (unloading the engine more quickly) thus making the valve more responsive (when reducing load).

For systems without screw in restrictions, changing the diameter of the drain hoses can often provide the same effect.

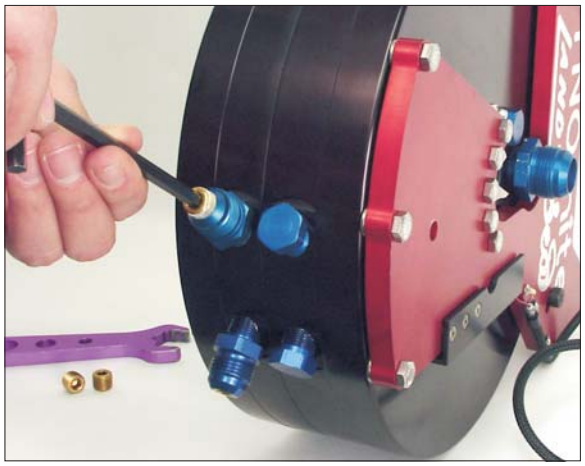


Figure 65

Tip: *The orifice can be removed altogether and/or dual drains can be used to get faster draining.*

Unfortunately there is one drawback to large drains, they make it take slightly longer to fill the absorber (when the valve is opened). Selecting the optimum drain rate is a compromise between these conflicting requirements. You want the absorber to load and unload at a similar rate. Generally, larger drains coupled with a high enough flow load valve and fed from a high capacity water supply (to keep the dynamic pressure at the load valve up and steady) provides the most responsive dynamometer control.

Tip: *As a rule of thumb, select a drain orifice (or hose) size that lets the load valve run about half open during peak power loading. That way, you have plenty of reserve valve travel (in both directions) when you need to respond to a change in loading .requirements.*

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While it is possible to run the dyno on a minimal water supply (by reducing discharge orifice size), such configurations require more operator load valve “anticipation” - to maintain RPM control. Operating like this is tough when testing peaky engines, where you need very responsive control.

CAUTION: To avoid absorber seal damage, water discharge temperature must not exceed 180 degrees Fahrenheit. Recheck the discharge temperature (at peak steady state Hp) when determining the correct orifice size and/or drain hose to engine match.

Absorber capacity also has a great affect on the load control's ability to responsively control the engine’s RPM. While it’s possible to test engines near the absorber’s Torque vs. Hp absorption chart limits, such operation leaves little reserve for control.

Tip: *Think of trying to tow a heavy trailer with a compact car. It is ok when going smoothly along a flat level road, but when you need to pull up a hill (or stop quickly), you are in trouble!*

It is also difficult to get good engine control (and data resolution) when using an oversized system to test very small engines. In some cases a reduction drive (e.g. a jack shaft mounted absorber with a belt, chain, or gear box under-drive) can be used to match a large absorber to a smaller high RPM engine.

Tip: *DYNO-MAX even has a parasitic "Driveline Power Loss” function available to compensate for such drive system unmeasured losses.*

The following graphs will help you determine if the absorbers' load capacity vs. RPM curve is a suitable match for the engine to be tested.

WARNING: The following charts are for the hydraulic loading capabilities of the absorbers only. See current DYNOmite catalog for the maximum mechanical limit of each package.

CAUTION: These curves are for a full absorber. If you have an inadequate water supply system then you may not be able to reach these maximums, so adjust accordingly.

Each absorber unit has one or more discharge drain orifices to help you tune the absorbers load characteristics for the Torque and RPM range to be measured.

Tip: *For better control the engine being tested should not be at the extreme high or low range of the absorber's capacity.*

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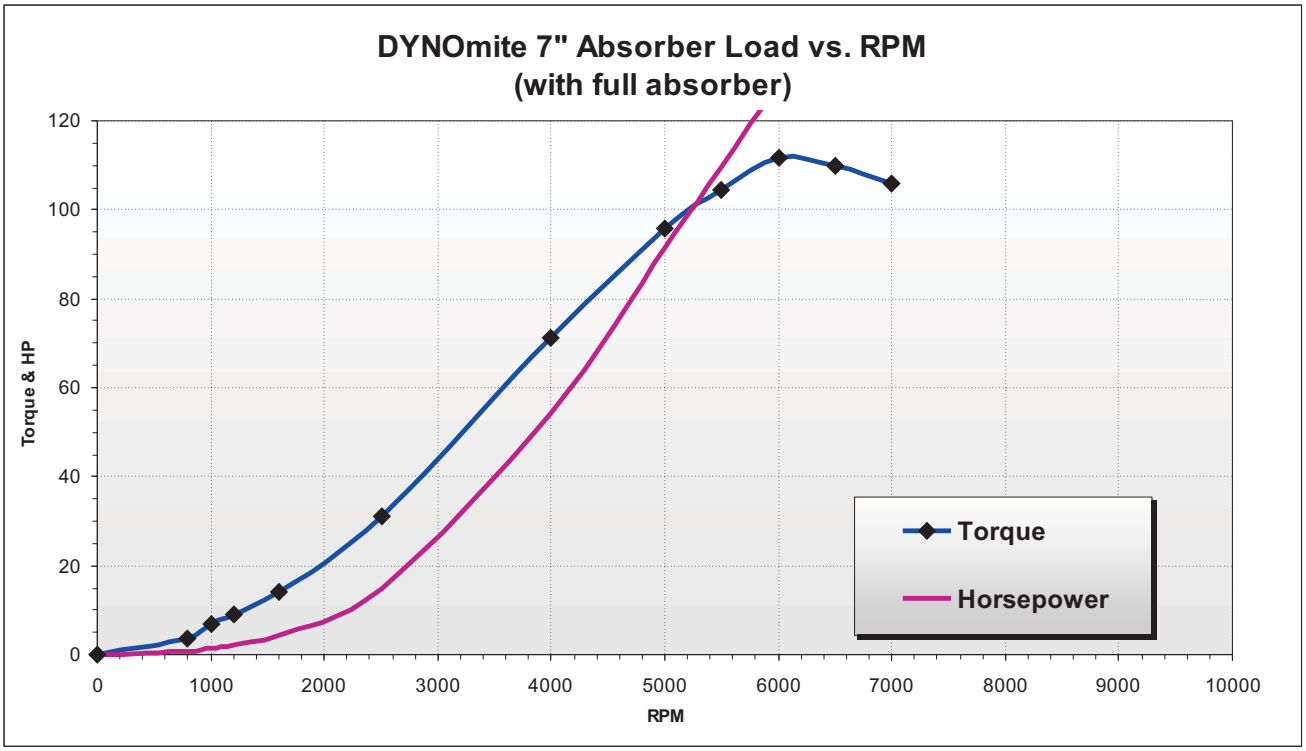
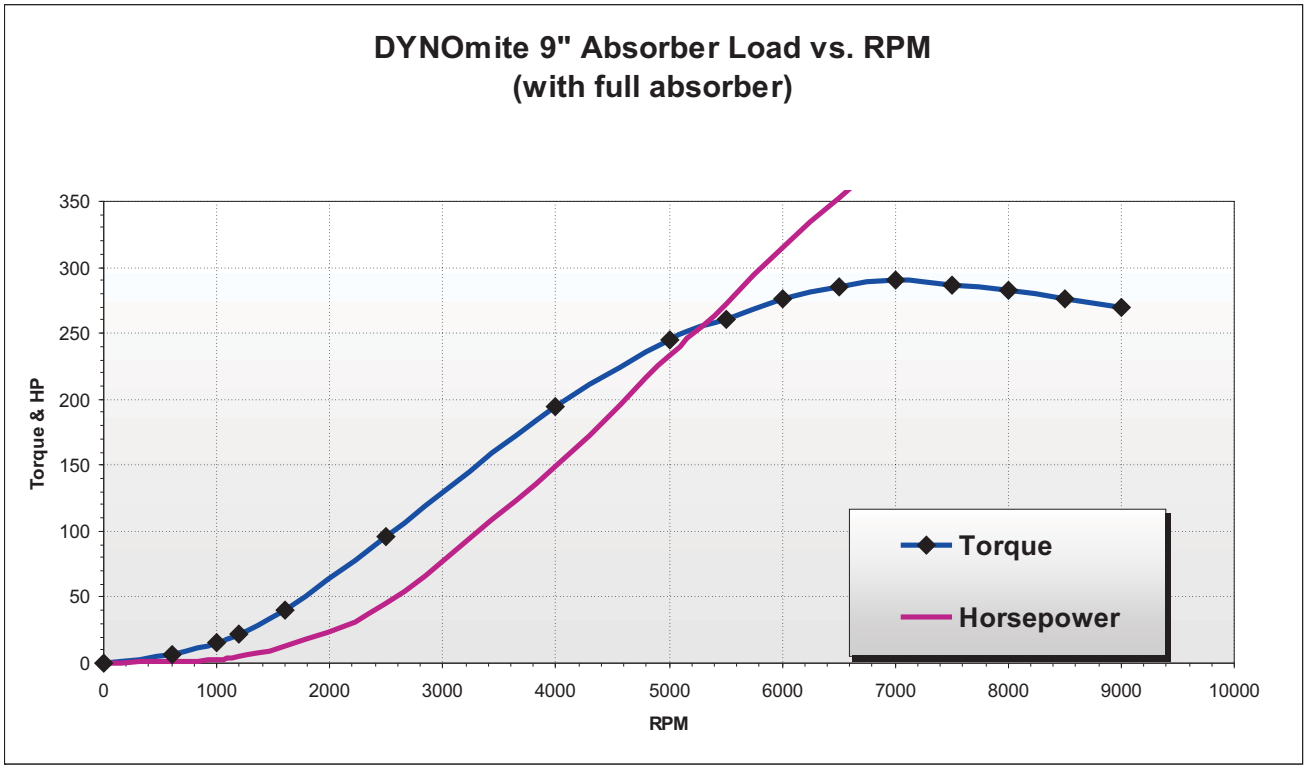
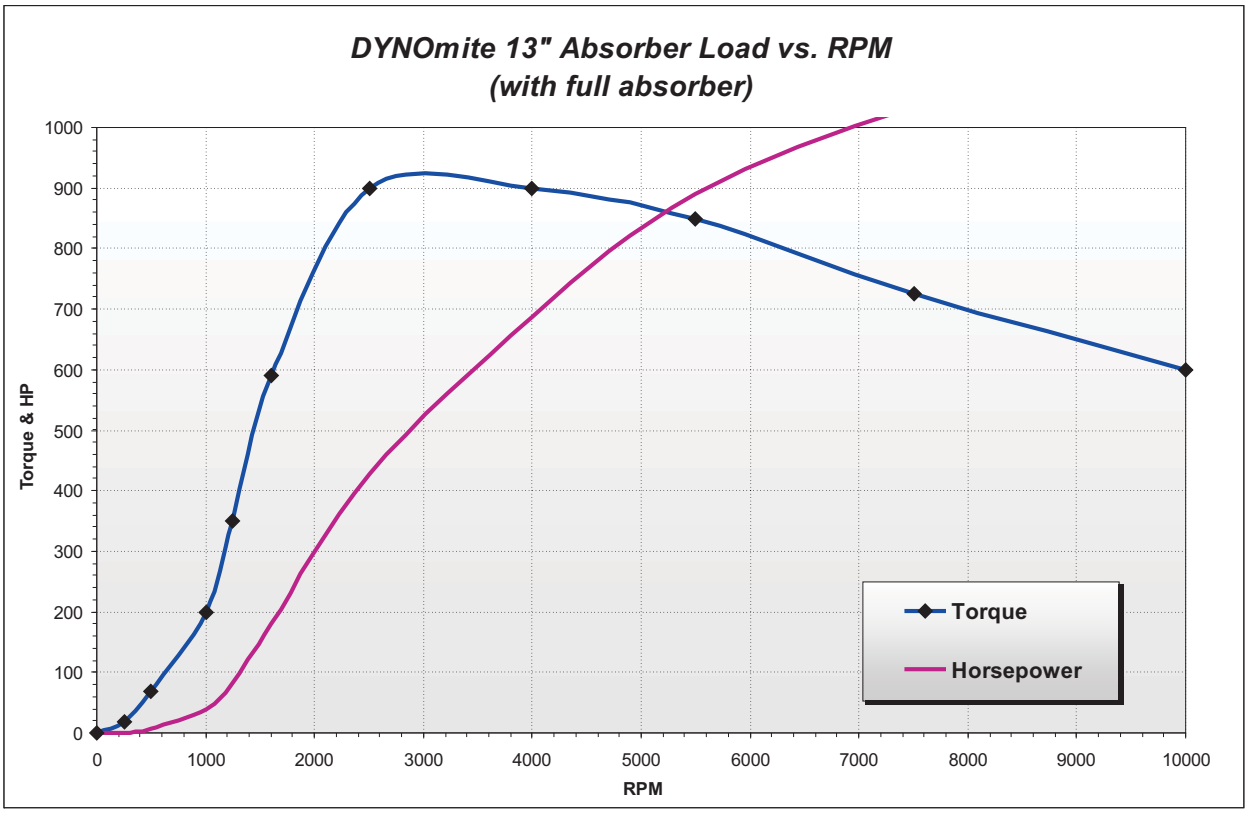
Absorber Load Chart: 7”



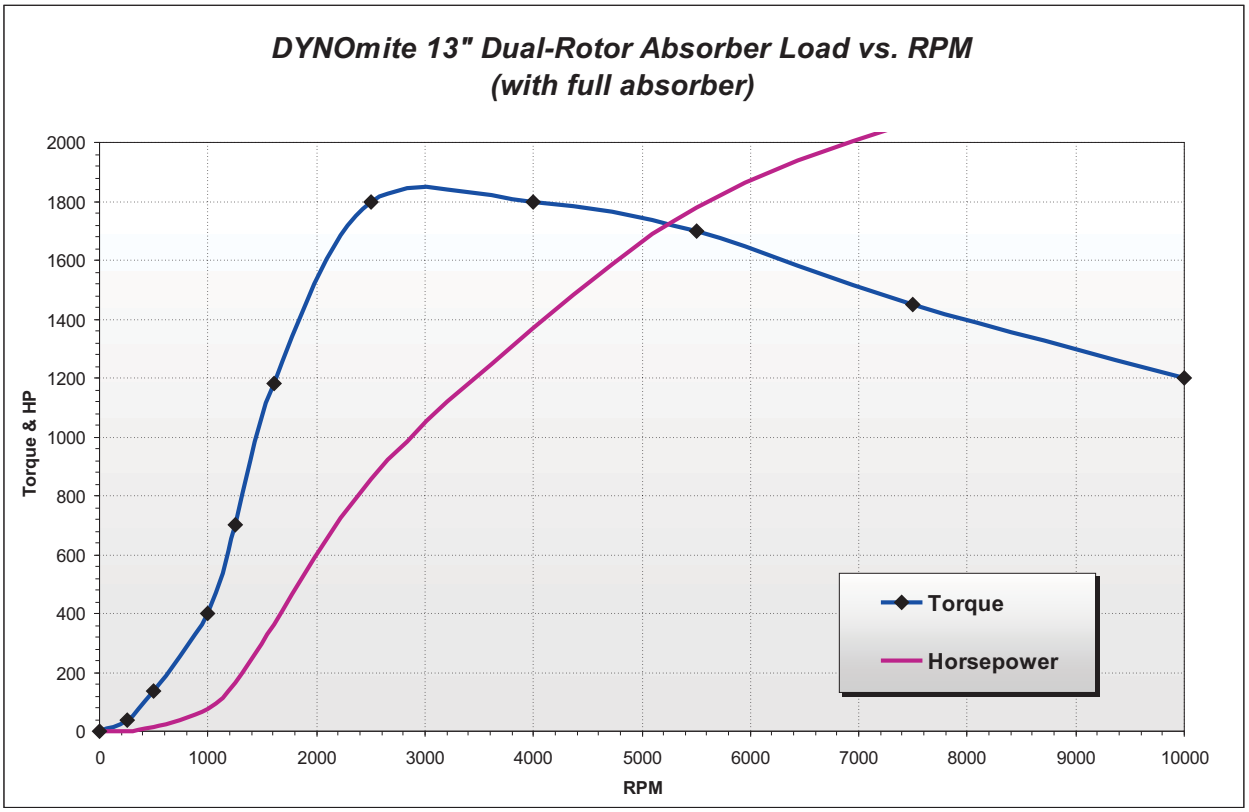
Absorber Load Chart: 9”



Absorber Load Chart: 13” Single



Absorber Load Chart: 13” Dual



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Electromagnetic Radio Frequency Interference (RFI) from the engine's ignition can be a major problem when trying to capture sensitive electronic instrument data adjacent to a high compression spark-ignition engine. RFI problems worsen as the engine's throttle is opened (increased cylinder pressure raises the peak ignition voltage) and may more severe as RPM increases (raising the RFI's frequency). RFI symptoms include erratic DYNOmite tachometer and/or servo operation, Personal Computer lock-up, spikes in the data.

Taking one or more of the following preventive steps will generally allow testing of even the wildest combinations. These problems are not specific to the DYNOmite, so your ignition system's manufacturer may have other suggestions you can follow.

1 Run all ground leads to either the engine's battery (or block if no battery is used) or to a clean common junction connected by a heavy duty ground cable to the engine's battery. Ideally this battery's negative terminal and/or dynamometer's frame itself should be connected directly to a quality earth ground (e.g. buried copper rod) via a large gauge wire (for a very low resistance connection). Avoid multiple ground points as this often creates a "ground loop" (where RFI can get onto the circuit).

CAUTION: Always hook up all the ground leads before hooking up any of the power leads for the DYNOmite Data Acquisition module, its accessories, or the engine. Failure to follow this precaution can lead to circuit damage not covered under warranty!

2 Try using resistor sparkplugs (or caps) and also run graphite ignition cables. These components tremendously reduce the level of RFI generated by the ignition. Killing the noise at the source is much more effective than chasing down every dyno harness lead that might be receiving these unwanted random signals.

CAUTION: Spiral wire wound "suppression" ignition cables are not anywhere near as effective (at reducing RFI) as true graphite core cables. The cheapest set of graphite wires will "out-suppress" the most expensive wound metallic wires.

Tip: *Keep an inexpensive set of graphite core cables in the dyno cell for troubleshooting problem ignitions. You don't need expensive high temperature 8+ mm silicone jacket wires with high quality boots to survive on the dyno. Even installing just a graphite core coil lead may do the trick. New graphite cables will not reduce the engine's power.*

3 Keep the ignition wires (and coil wire) as short as practical and avoid routing the DYNOmite's harness leads parallel or near to the ignition wires.

Tip: *The EGT probes have extra shielding on them to allow operation near the ignition. Conversely, the Engine Temperature leads are quite sensitive to RFI, keep them away from the ignition if you can.*

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Tip: *Install braided metal shielding (grounded at one end to the engine block) over all the sparkplug (and coil) wiring. (As used on early Corvettes.)*

4 If RFI is interrupting communications between the DYNOmite Data Accusation Computer and your PC running DYNO-MAX (via a RS-232 serial port connection) the use of Land Sea's special shielded and filtered cables may help. Typically such interference is much more troublesome as the throttle is opened (increasing cylinder pressure and spark intensity).

Tip: *In extreme cases fiber optic RS-232 serial "cabling" is available from several manufactureres. Such hook-ups use a convertor at each end theat translates the normal hard-wired connection into a light signal that runs along the fiber optic link.*

The DYNOmite Dynamometer Accessories Catalog includes a brief description and photo of many products which add features or aid installation, operation, or maintenance. Some of the more popular items include:

Air *Flow Meter Turbine Kit* *fo*r measuring the intake airflow of most internal combustion engines.

Air/Fuel Ratio Exhaust Sensor Module and harness for measuring the engine's mixture on the dyno or road.

Brake Specific Fuel Consumption Fuel Flow Transducer Kits for monitoring the fuel consumption of the engine. The kit includes flow transducer, hoses, mounting hardware, and additional EPROM software functionality.

Briggs & Stratton Adapter for mounting 9" water brake with light duty torque arm directly on Briggs & Stratton heavy duty crankshafts for special testing needs.

Compact Thermal Printer for paper data printout. Battery powered for remote operation.

Dead-Weight Calibration Kits for easy re-calibration and certification of the DYNOmite's accuracy.

DYNO-MAX "Pro" software to expand the data analysis and display potential of the DYNOmite on Microsoft Windows equipped PC's and laptops.

DYNOmite Portable Pump Kit for 100% portable all season testing away from a garden hose supply.

Electronic Auto-Load Servo valve allows for convenient one-hand operation of all our DYNOmite dynamometer systems. Input your sweep rate and holding RPM, give it throttle, and the computer will take over loading the engine automatically.

Exhaust Gas Temperature Thermocouple Kits includes additional EPROM software functionality, and thermocouple temperature sensors.

Exhaust Measuring System 5-gas analyzer monitors and displays engine emissions (including air fuel ratio and Lambda) via its included exhaust pipe probe, pump, and filter.

Full Function Data Harnesses are needed to allow the Data Computer to record the optional EGT, BSFC and other advanced functions.

OBD-II (Scan Tool Port) Interface reads engine RPM, road speed, and other diagnostic data from late model vehicles' OBD-II dashboard port directly into DYNO-MAX "Pro".

O***il Temperature Dip Stick*** thermocouple probe is super convenient for chassis dyno work.

Ignition Kill Switch Relay Kits for engines that can not be killed by the DYNOmite's grounding of the black/white lead.

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Pressure Transducers for monitoring everything from manifold vacuum boost pressure to oil or fuel pressure, whatever you need to measure from -12 PSI to 150 PSI.

RPM Pickup Kits for applications with radio frequency interference and engines without a tach output to get RPM readings without a direct connection to the ignition.

R*TD Probe Assemblies* (Resistive Temperature Devices) support reading from -100 to over 1,200 Fahrenheit.

Smoke Opacity Meter provides real time monitoring of diesel engine's exhaust stack emissions

.***Sparkplug Thermocouples*** replace the plug's washer to read the plug seat temperature on air cooled engines

Thermal Printer Paper for the portable printer (in packs of three rolls).

Universal Knock Sensor Module for converting the acoustical rattle of damaging engine knock into a signal that can be monitored via DYNO-MAX "Pro's" Knock Index % Formula.

Weather Station automatically enters air temperature, barometric pressure, and relative humidity into your test data for correcting horsepower and torque test data to Standard SAE atmospheric conditions.

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