Installation Guide

For the Automotive Dynamometer
Pit Model (248)

Dynojet® Research Inc.

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Dynojet Installation Guide for use with Dynojet's Automobile Dynamometer model 248.

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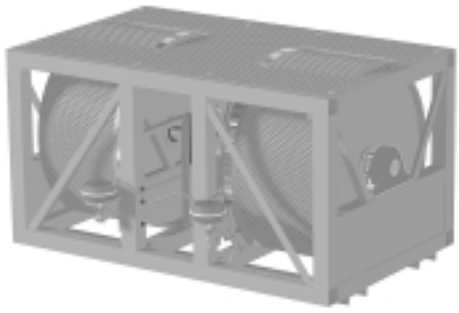
Chapter 1

Initial Setup

and Requirements



Thank you for purchasing the Dynojet Automotive Dynamometer. This document will give you the information you need to install the Dynojet Dynamometer (pit model). If you have any questions please call Dynojet at (800) 992-4993.

Introduction

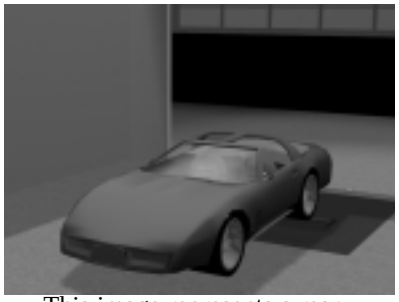
Before installing your Dynojet Dynamometer, there are a few factors to consider. This chapter "Initial Setup and Requirements" is a brief overview of what you need to know to install your Dynamometer and an overview of the installation steps. Comprehensive instructions are included in the remaining chapters. "Initial Setup and Requirements" should help you decide where to place your Dynamometer, where to place the Dynojet electronics, what you need to unload your Dyno, how to prepare your Dynamometer pit and what must be provided for the Dynamometer.

Dyno Placement

The first step to installing your Dynojet Dynamometer is to decide where you want to position the Dyno in your shop. Do you want to drive the vehicle into the shop forward, or back it in? Do you have equipment or tools located in your shop that would be more convenient to use based on the placement of the Dyno? There are two basic methods to position the Dyno in your shop.

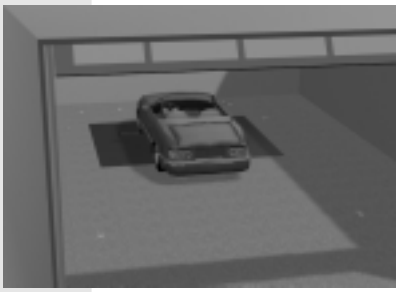
Method 1

This image represents a front wheel drive car on a dyno near the garage door.

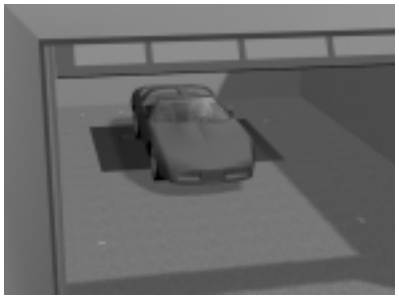


This image represents a rear wheel drive car on a dyno near the garage door.

Method 2

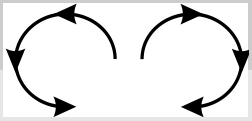


This image represents a front wheel drive car on a dyno away from the garage door.

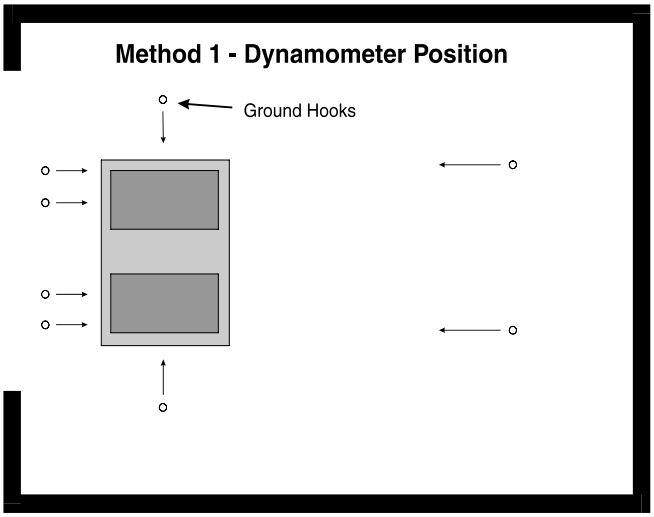


This image represents a rear wheel drive car on a dyno away from the garage door.

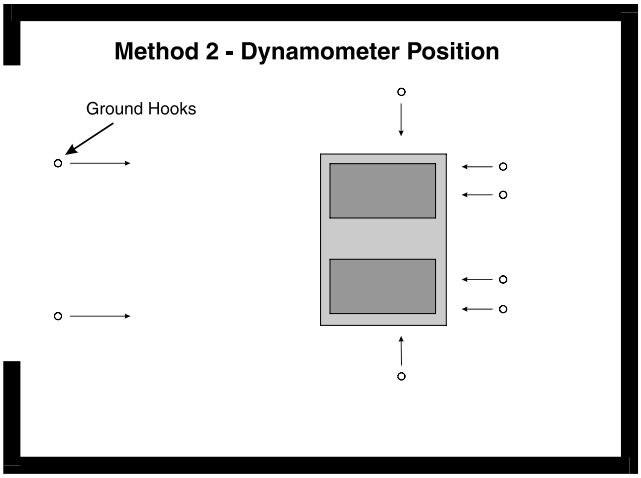
Note: ***The Dynamometer drums can rotate in either direction***



Choose the Dyno placement that best matches your shop and types of vehicles you work on.



This image represents a dyno near the garage door.



This image represents a dyno away from the garage door.

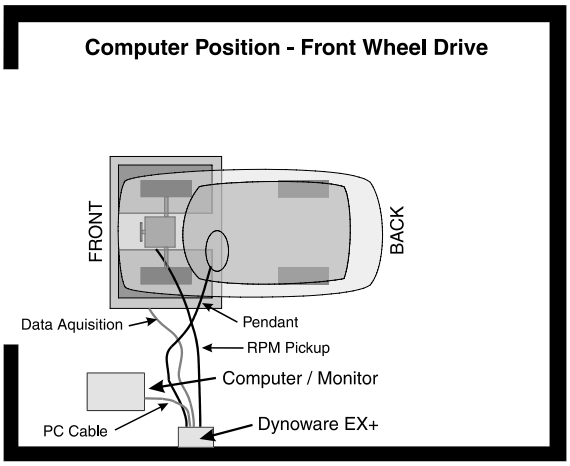
Note: ***Refer to the technical drawings in Appendix A.***

DynoWare EX+ Placement

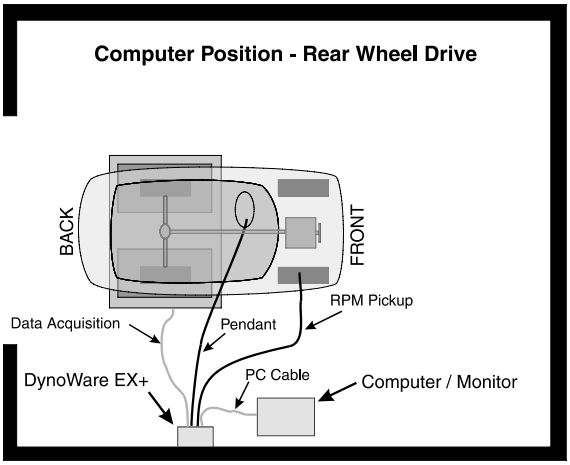
The DynoWare EX+ system is comprised of four modules: the CPU module, the Dynamometer Input/Output module, the RPM module and the Atmospheric module. The Dynamometer Input/Output module connects to the dynamometer. (A 20 foot (6.1 meter) long cable is provided.) The CPU module connects to a personal computer. (A 12 foot (3.7 meter) long cable is provided.) RPM Pickups and a Hand Held Pendant also connect to the modules. These modules need to be located where they will be visible during a dyno run. It is recommended that they be mounted on a shelf on the wall or on a cart along side the PC. An optional extended Hand Held Pendant cable is available if needed.

Computer Placement

The driver of the vehicle must be able to view the computer monitor and the DynoWare EX+ during a run. If you will be running both front and rear wheel drive vehicles you will need to find a way for the driver to see them both.



This image represents the location of the computer and DynoWare EX+ for a front wheel drive car.

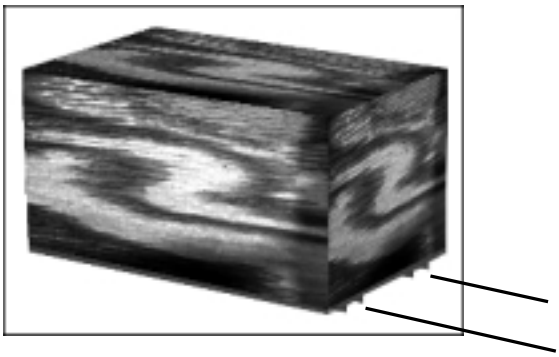


This image represents the location of the computer DynoWare EX+ for a rear wheel drive car.

Note: ***A possible solution would be to place the computer and the DynoWare EX+ modules on a movable cart.***

Requirements to Unload Truck

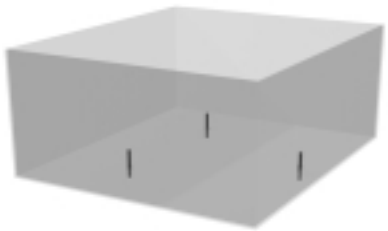
When your dyno arrives, you must provide equipment to unload the dynamometer from the truck, with skids or forks a minimum of 6 inchs wide by 6 feet long. It must be capable of lifting and moving at least 8000 pounds (3642 KG).



The dyno has 2 C-Channels that run lengthwise along the bottom of the dyno. Unload the dynamometer using these channels.

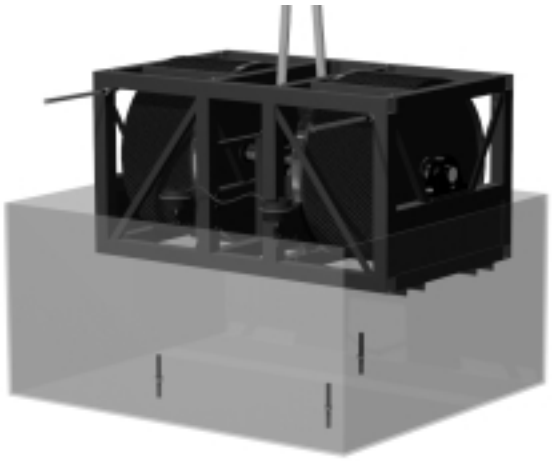
Pit Requirements

You must provide a dyno pit. Dyno pit dimensions are provided in the technical drawing CAR DYNO FINISHED PIT DIMENSIONS. Be sure to contact your local contractor for code specifications before digging a pit. After digging the pit you will pour the concrete and set 3 anchor bolts. The anchor bolts are included with your dynamometer. Follow the technical drawings CAR DYNO FINISHED PIT DIMENSIONS for placement of anchor bolts.



Requirements to Install the Dynamometer

When you install the dynamometer, you need equipment capable of lifting and moving at least 8000 pounds (3642 KG).



Other Requirements

Shop Air - The dyno air brake requires a $^{3}/_{8}$" air hose with a minimum pressure of 60 psi.

- You must provide a 3/8" air line that will reach from the dynamometer to the Air Pressure Regulator and another air hose to connect the regulator to your shop air supply.

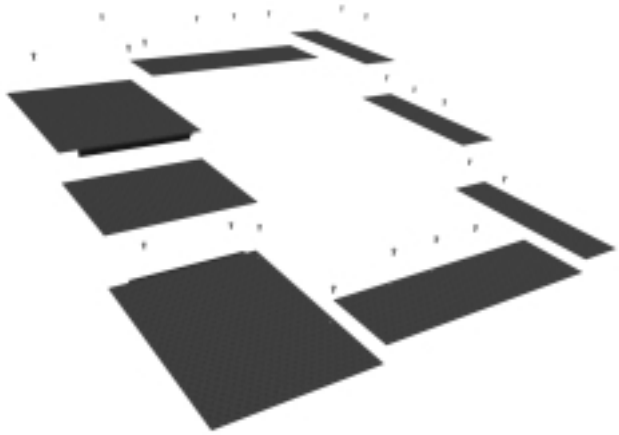
Computer - You must provide a compatible computer and printer. The system must meet the following minimum requirements:

- Pentium P5-100 or faster Pentium computer
- Windows 95
- 800 megabyte HD
- Eight megabytes of RAM
- 640 x 480 (SVGA) 16k color video
- One high density floppy disk drive (3 $^{1}/_{2}$")
- Color Printer (HP Deskjet color series recommended)

Optional Accessories

Covers

Dynojet can provide optional covers for your Dynamometer. You may purchase these covers at an additional cost or build them from the diagrams in Appendix B.



Extended Hand Held Pendant Cable

40 foot (12.2 meter) Hand Held Pendant cable

Part Number: DC100-104L

Uncrating the Dyno

Step 1

Use a crowbar or the like to remove the plywood shipping shell from the dynamometer.

- Remove the top of the crate. (If you ordered the dyno with the optional pit covers, they will be in the top portion of the crate.)
- Remove the sides of the crate.
- Remove the bottom skids and discard.

Step 2

Carefully remove the cardboard boxes and brake weldments that are stored within the dynamometer's frame.

Step 4

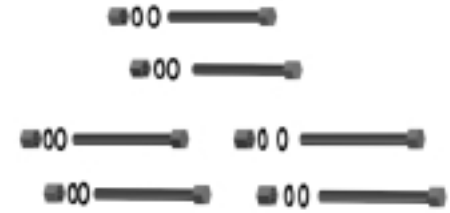
Verify that the cardboard boxes contain the following:

Brake Hardware:

- 2 brake weldments

(The following are attached to the dyno frame)

- six 5/8" bolts
- six 5/8" lock washers
- six 5/8" flat washers
- six 5/8" nuts



Mounting Hardware:

9- 1" UNC nuts

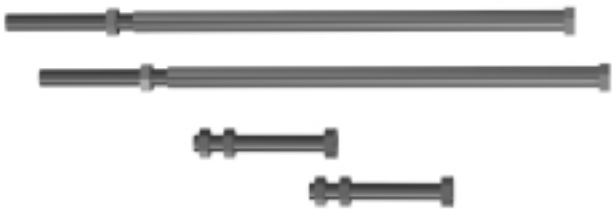
3- 1" Lock washers

6- 1" Flat washers

Support Hardware:

2 Long lateral Supports

2 Short lateral Supports (in the non brake side of the dyno frame).

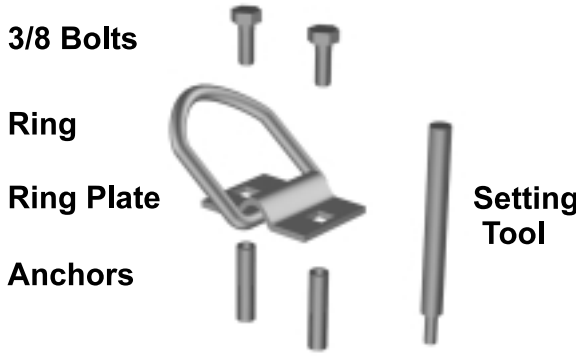


Electronic Hardware:

Pictures and descriptions on page 3-6:

Ground Hooks:

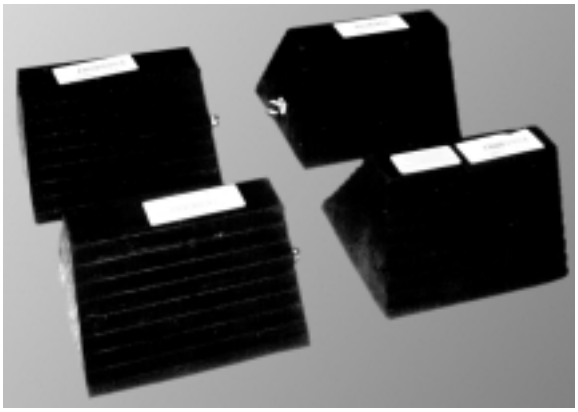
- 8 Ground Hooks



Straps:

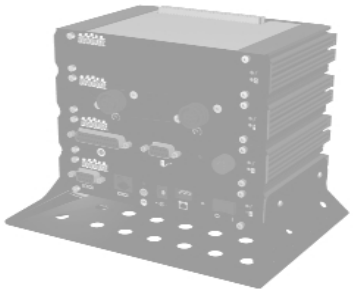
- 2 axle straps
- 4 ratchet straps
- 2 ratchet straps with sleeves

Chocks (4):



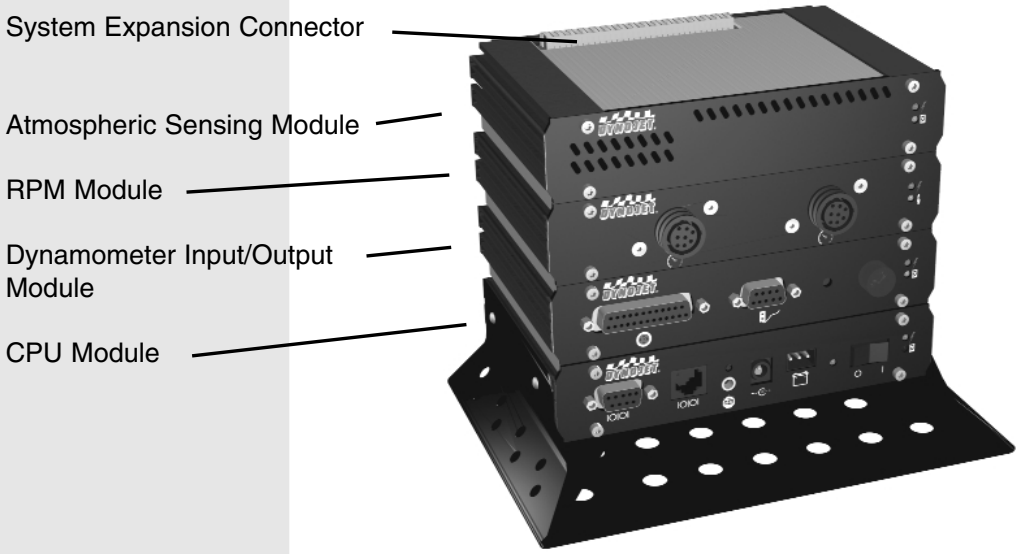
Chapter 2

Hardware Installation



DynoWare EX+

The standard dynamometer electronics package is comprised of 4 interconnected modules:



Atmospheric Sensing Module:

The atmospheric sensing module measures absolute pressure, air temperature and relative humidity. These measurements are used by WinPEP to correct power and torque measurements to standard atmospheric conditions according to a DIN, SAE or other formula.

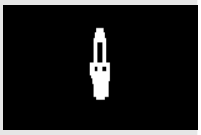
The green LED glows when the atmospheric sensing module is receiving power.

The flashing amber LED indicates the module processor is operating properly.

RPM Module:

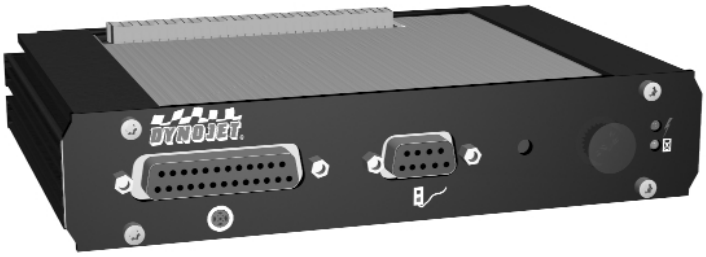
The RPM module receives and processes signals from up to 2 inductive pickups for measurement of engine RPM. Each input has an automatic gain circuit to compensate for a wide variance of ignition systems.

The green LED glows when the RPM module is receiving power.



The amber LED flashes when an RPM signal is detected. A steady flash rate, proportional to engine RPM, indicates a good RPM signal.

These connectors are the inputs for both primary and secondary inductive pickup clips. Either input may be used with a primary inductive pickup or a secondary inductive pickup on a single ended coil. Both inputs can be used for a wasted spark ignition.



Dynamometer Input/Output Module:

The dynamometer I/O module sends and receives data from the dynamometer and the hand held pendant. The module also contains a buzzer and light which are activated when either the vehicle or dynamometer speed limit is approached.

The green LED glows when the dynamometer input/output module is receiving power.

The amber LED flashes proportionally to dynamometer drum RPM.

This 25-pin receptacle connects to the shielded cable from the dynamometer.

This 9-pin receptacle connects to the hand held pendant which houses the button used to Start/Stop acquiring data. The pendant may also contain a brake switch.

CPU Module:

The CPU module contains a 32-bit processor which acquires data from the expansion modules and communicates to the main computer running the WinPEP software. The processor queries the expansion modules to determine their identity and capabilities.

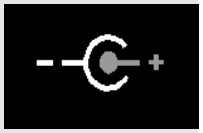
The green LED glows when the CPU module is receiving power.

The blue LED is lighted when data from the modules is being acquired and saved.

One of these connectors is used to communicate to the main computer. The 9-pin receptacle (left) connects to the PC's RS-232 serial communications port. The 8-pin modular connector (right) provides communications according to the RS-422/485 specification.

CPU Module: ..... Continued

This connector provides a synchronization signal to a 3rd-party data acquisition system.



This connector provides 12 Volt DC power to a 3rd-party data acquisition system.

This connector accepts 12 Volt DC power from a power supply or battery. The adjacent LED glows bright green when power is properly connected.

When this switch is on, power is supplied to all connected modules.

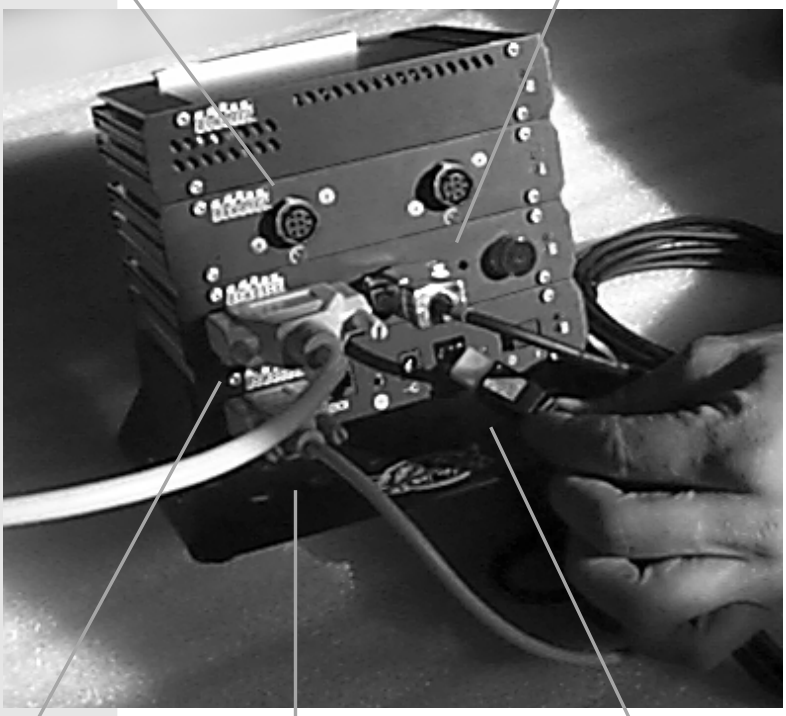
Connecting the DynoWare EX+

Use the cables that came in the DynoWare package to make the following connections:

- 9-pin shielded serial cable between the RS-232 connector of the *CPU Module* and a free COM (serial communications) port on the PC. A 9-pin to 25-pin adapter may be required at the PC.
- 25-pin shielded cable from the dynamometer to the *Dynamometer Input/Output Module*.
- 9-pin connector from the hand held pendant to the *Dynamometer Input/Output Module*.
- 3-pin plug from the power supply to the *CPU Module* with its flat side facing down.

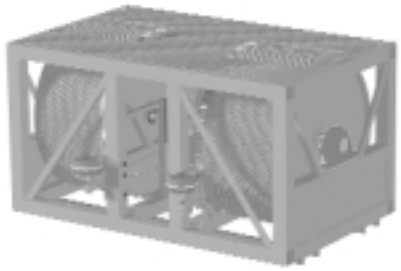
(Refer to the picture on the next page)

Note: ***The DynoWare EX+ stack must be mounted in your shop so as to be easily seen while making dyno runs.***


Primary Inductive Pickup Cable
(not shown)
Remote Switch
Breakout Board to
DynoWare Cable
Computer Serial Port Cable
Cord from Power Supply

Chapter 3

Installing Dynamometer



Now that you have the Dyno unpacked, you may begin the installation of the Dynamometer.

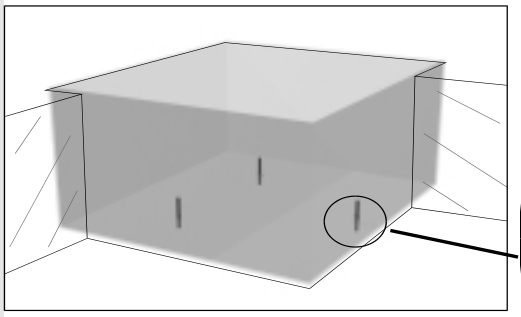
Preparing Pit For Dyno

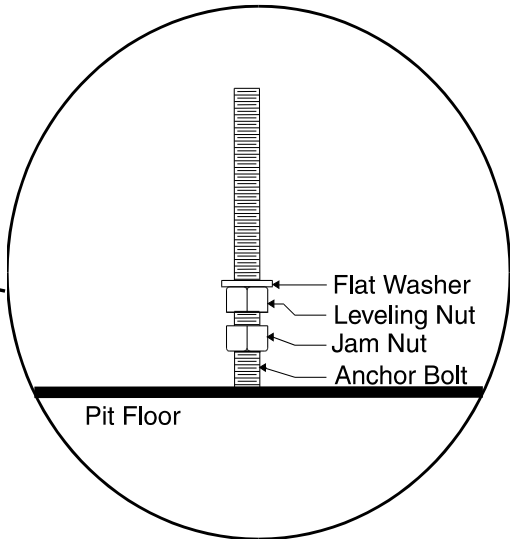
Step 1

Your Dynojet Car Dynamometer is designed to sit on three anchor bolts cemented into the floor of the pit. Thread one jam nut (1" UNC nut) on each of the three anchor bolts in the floor.

Step 2

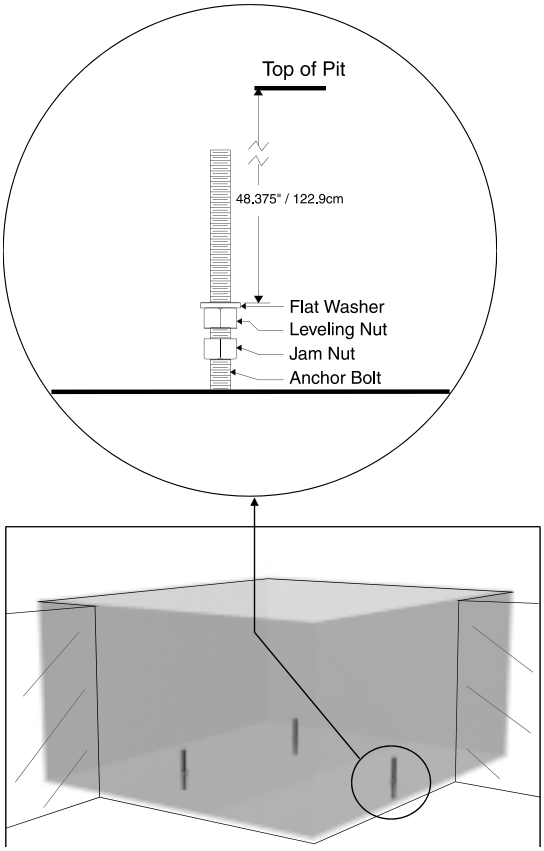
Thread one leveling nut (1" UNC nut) on one of the three anchor bolts. Place a flat washer on top of this nut.





Step 3

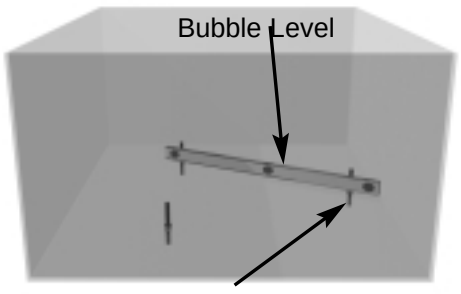
Adjust this leveling nut so that the distance from the top of the washer to the top of the pit is 48 $^{3}/_{8}$" ± $^{1}/_{16}$" (123 cm ± 0.4 cm.) (Shown on the next page).



Step 4

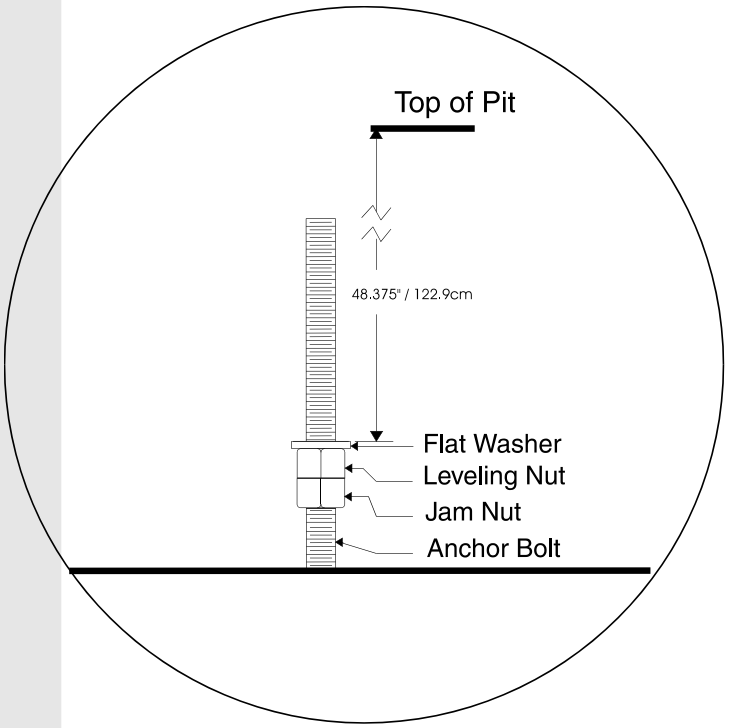
Thread the remaining two leveling nuts (1" UNC nuts) and washers on the anchor bolts. Use a bubble level or transit to adjust the leveling nuts so they are level with the first leveling nut. Use the first leveling nut as a reference for the others.

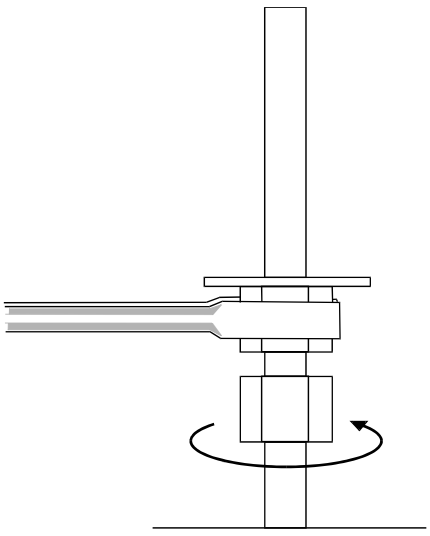
Warning!! ***Do not level all three nuts by measuring down from the top of the pit to the top of each leveling washer. The Dynamometer must sit level for correct operation.***



Step 5

Holding the leveling nut so it CANNOT turn, tighten the jam nut to the leveling nut. Be careful not to move the leveling nut! Both the jam nut and the leveling nut should not move when the jam nut is tight. Repeat this for the other two leveling nuts. Double check the leveling nut height on all three anchor bolts with the level or transit.



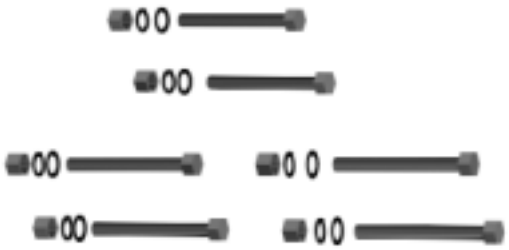


Installing the brakes.

Use the following steps to install the brakes on your Dynojet Dyno:

Step 1

Locate the brake hardware. You should have six 5/8" bolts, six lock washers, six flat washers, six nuts (mounted on the dyno) and two brakes.



Left

Right

Step 2

The brakes mount on the inside of the dyno frame with the air canister on the top. Identify the left and right brakes. As shown in the figure above, the brakes can only be mounted one way.

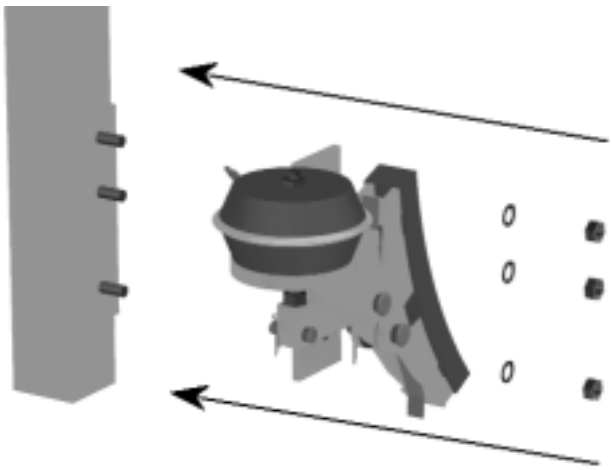
Step 3

Mount the brakes on the dyno frame. Use three bolts, three nuts, and three lock washers on each brake weldment.

Remove the nuts and lock washers from the dyno frame leaving the bolts in place.

Place the brake weldments over the bolts on the frame.

Finish the installation of the brake weldments with the nuts and lock washers.

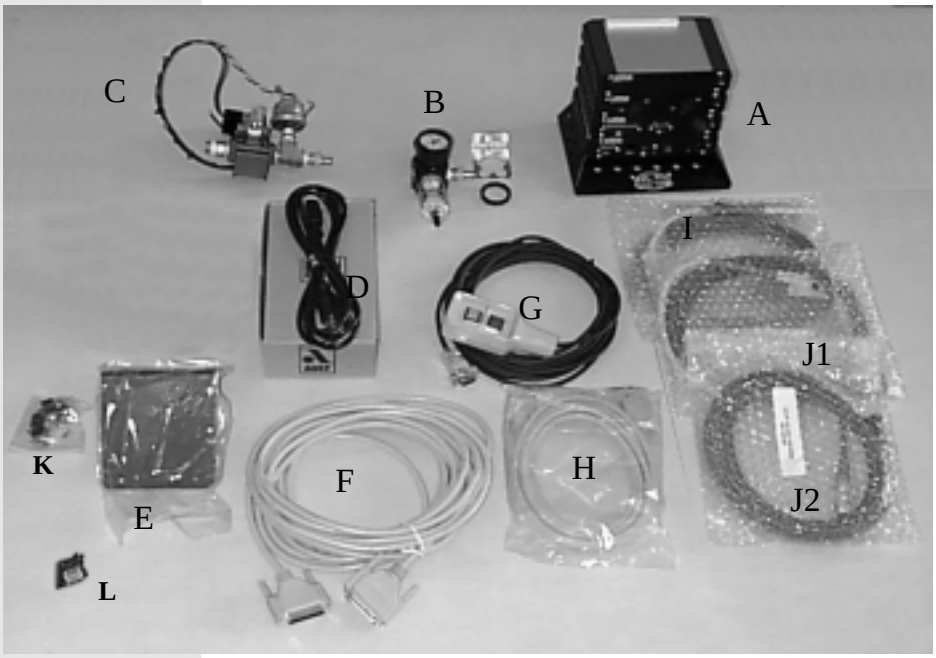


Step 4

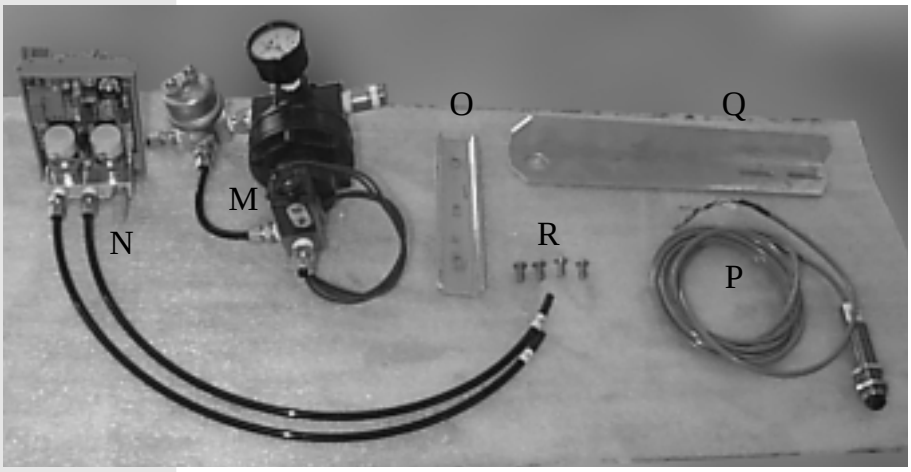
Install the air hose between the brakes, using the ports on the sides of the air canisters.

Wiring the Dyno

The following hardware and wires are shipped in boxes with the dyno except the DynoWare EX+ (A) that is shipped separately with the WinPEP software. Refer to the following page for item descriptions.



Basic Kit



Additional for the Optional Proportional Air Brake System

Basic Kit:

A: DynoWare EX+ Modules

B: Air Brake Pressure Regulator

C: Air Brake Control Valve (Replaced by N with Proportional Air brake systems)

D: DynoWare EX+ Power Supply and Cord

E: Wall Mount for DynoWare EX+

F: DynoWare Cable

G: Dynamometer Control Pendant

H: Serial Port Cable

I: Primary Inductive Cable

J1&2: Secondary Inductive Cables

K: Mounting Hardware

L: Pickup Card

Optional Proportional Air Brake Systems:

(M) Booster Valve Assembly (Replaces C)

(N) Electronic Pressure Regulator (EPR)

(O) DIN Rail (for mounting the EPR)

(P) Temperature Sensor

(Q) Temperature Sensor Bracket

(R) Four $^{1}/_{4}$" Button Head Allen Bolts

In addition to the parts listed above there is an EPR cable.

Note:

This section is laid out to aid the operator with the installation of Standard Air or Proportional Air braking systems. Steps with "Standard Air" in front of them are to be followed solely by operators that are installing the Standard Air Brake system. Steps with "Proportional Air" in front of them are to be followed solely by operators that are installing the Optional Proportional Air Brake system. Steps without any designation are to be followed by both.

Step 1

Install the pickup card.

Remove the pickup card and the 2 screws from the bubble bag.

Attach to the pickup bracket on the dyno so the optical pickup is facing the axle and the 3 pronged plug is facing away.

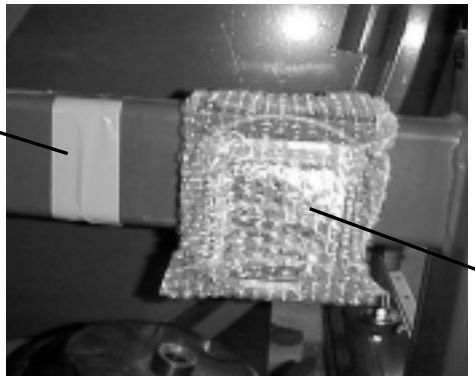
Turn the drum carefully and check to see that both pickup tabs on the dyno axle go through the center of the optical pickup on the pickup card.

Step 2

Prepare the Breakout Board

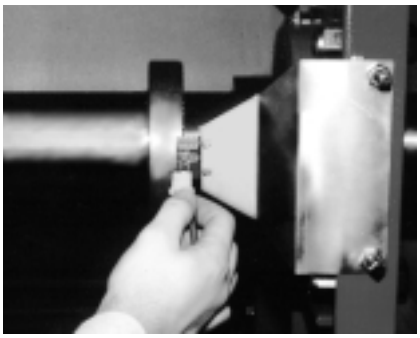
- Remove the Bubble Bag from the Breakout Board and bracket.

This tape secures the Pick Up Card to the dyno during shipping.



Break Out Board

- The Data Acquisition Cable is coiled around the Breakout Board. Uncoil the cable and Plug the cable into the Pickup Card on the dyno.



Standard Air Step 3

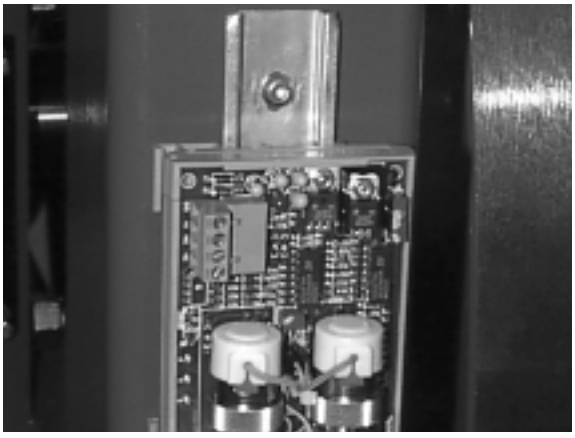
(Skip to Step 4)

Proportional Air Step 3

Install the electronic regulator.

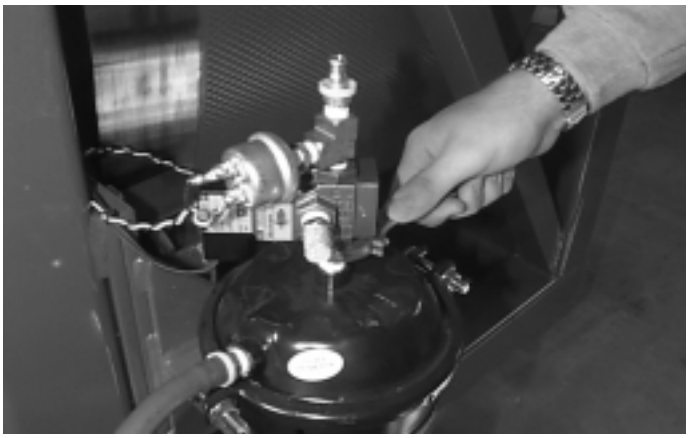
Locate the DIN rail on the right side 4X4 post.

The electronic pressure regulator snaps onto the DIN rail. Hook one side on the DIN rail then rotate electronic pressure regulator toward the DIN rail until it snaps into place.



Standard Air Step 4

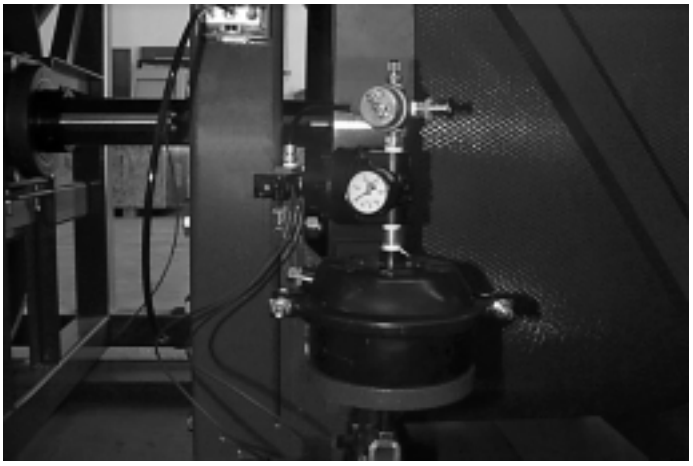
Screw the Air Brake Control Switch into the top of the right hand air canister as in the picture below.



Proportional Air Step 4

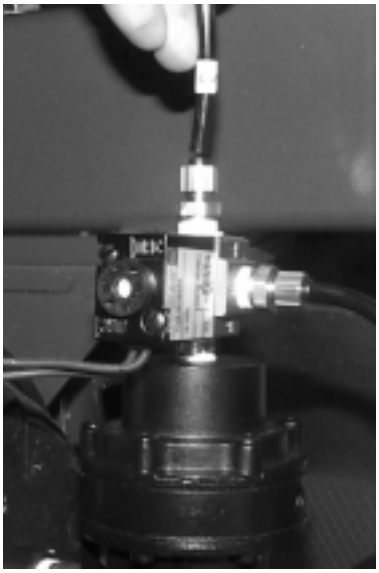
Install the Booster Valve Assembly.

Screw the booster valve assembly into the right side brake canister. Tighten it so the air gauge is facing out as shown below.

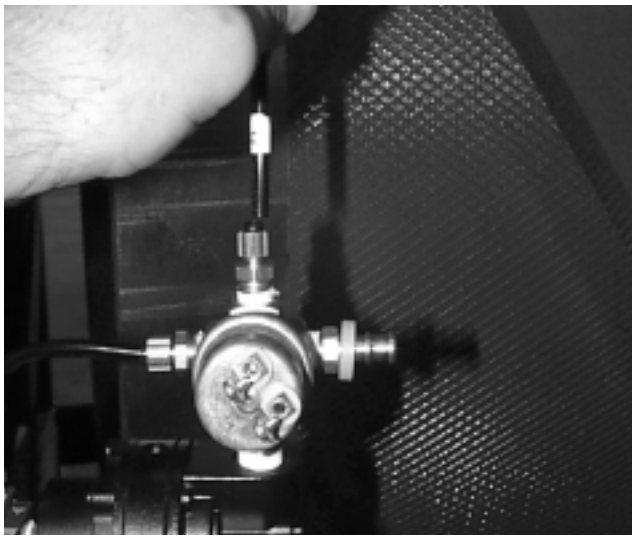


There are two air lines coming from the electronic pressure regulator labeled "IN" and "OUT".

The line labeled "OUT" is connected to the 3-way valve. Push the hose in then hand tighten the fitting. Pull on the hose to ensure it is seated properly. If it moves, tighten the fitting more.



The line labeled "IN" is connected to the brass cross. Push the hose in then hand tighten the fitting. Pull on the hose to ensure it is seated properly. If it moves, tighten the fitting more.



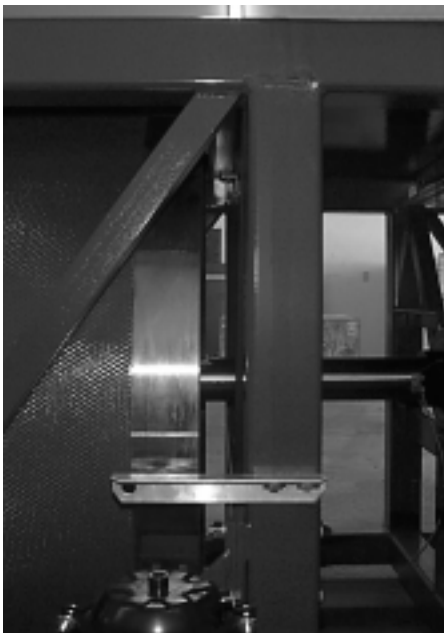
Standard Air Step 5

(Skip to Step 6)

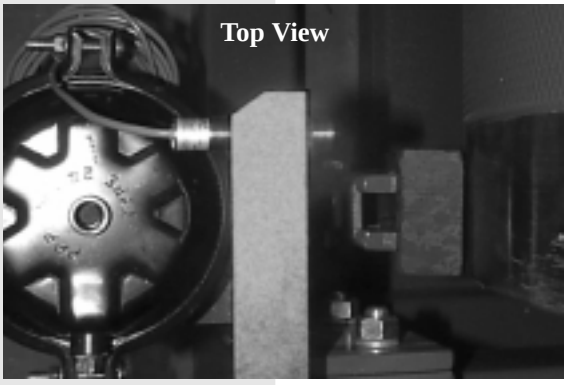
Proportional Air Step 5

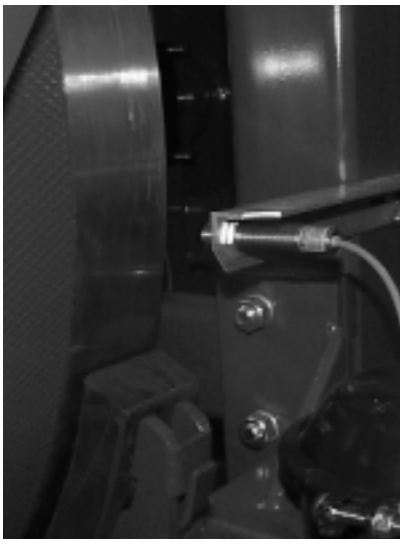
Install the Temperature Sensor on the left 4X4 post.

Locate the temperature sensor bracket on the left side 4X4 post.



Install the temperature sensor so it is approximately 3" from the surface of the drum.

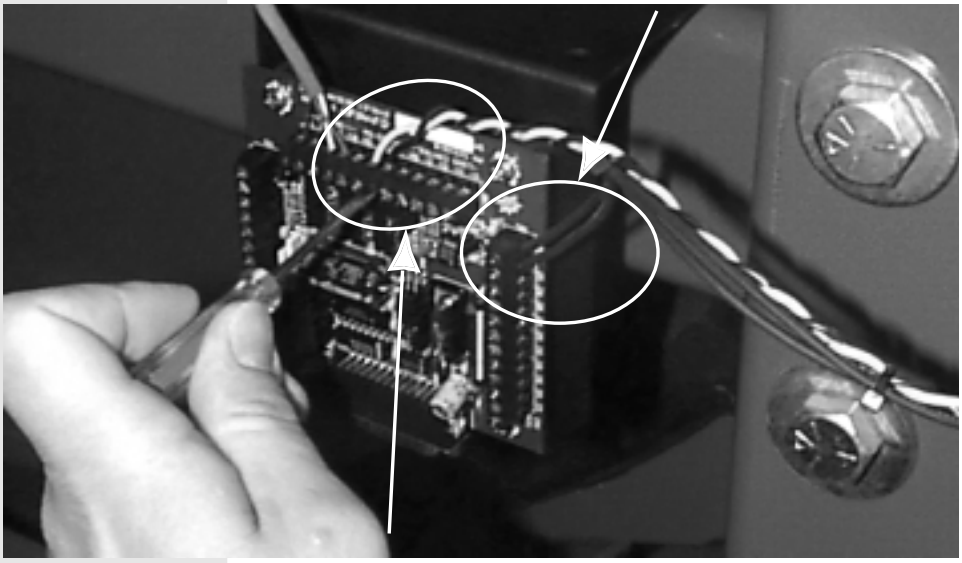




Standard Air Step 6

Connect the remaining wires to the Breakout Board.

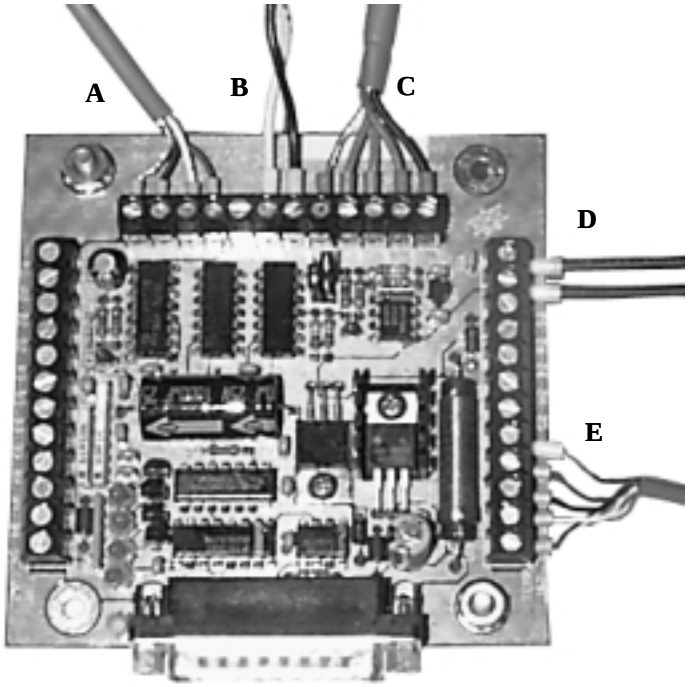
Fasten the two black wires into the connecting block in the connectors marked with the word BRAKE. (The 2 wires can go in either order.)

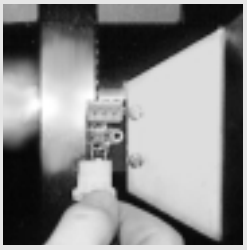


Connect the yellow and black wires from the Brake Control to the two connectors marked with the letters -SIG-. (The 2 wires can go in either order.)

Proportional Air Step 6

Complete the breakout board wiring as in the following descriptions:



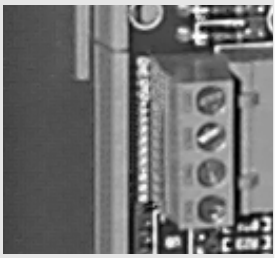


(A) Data acquisition cable coming from the optical pickup on the dyno shown on the left.

These four wires go to the section of the card Labeled “DRUM”:

The red wire connects to R1.
The white wire connects to W1.
The black wire connects to B1.
The silver wire connects to S1.

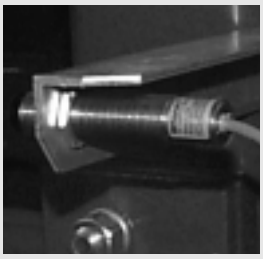
(B) One yellow and one black wire go to the two connections Labeled “PRESS”. They connect to the air sensor (shown on the left) located on the Booster Valve Assembly. They can connect in either order.



(C) There are five wires in the cable that connects the EPR (shown left) to the breakout board in the spot labeled “Load Control”:

The black wire connects to V-.
The red wire connects to V+.
The clear wire connects to 0+.
The green wire connects to 0-.
The silver or ground wire connects to SH.

(D) The brake wires (shown left) come from the air switch on the Booster Valve Assembly. They connect to the two connectors on the breakout board labeled “BRAKE”. They can connect in either order.



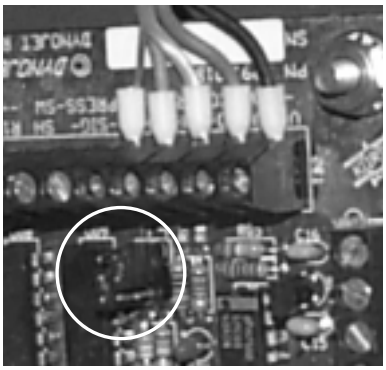
(E) The five wires in the cable coming from the Temperature Sensor (shown left) connect to the connectors labeled “TEMP”:

The green wire connects to G1.
The white wire connects to W1.
The black wire connects to B1.
The red wire connects to R1.
The silver or ground wire connects to S1.

Note: ***Make sure that the cables are clear from all moving parts.***

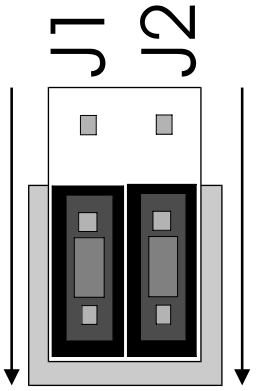
Step 7

The Breakout Board jumper settings are preset, though it is important that they be checked to ensure they are set for your application.

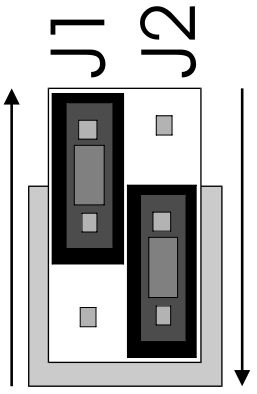


The jumpers circled in white above may need to be changed to look like one of the drawings below. (The wires in the picture above reflect a proportional air install. Ignore them if you are installing standard air.)

Proportional Air Jumper Settings.

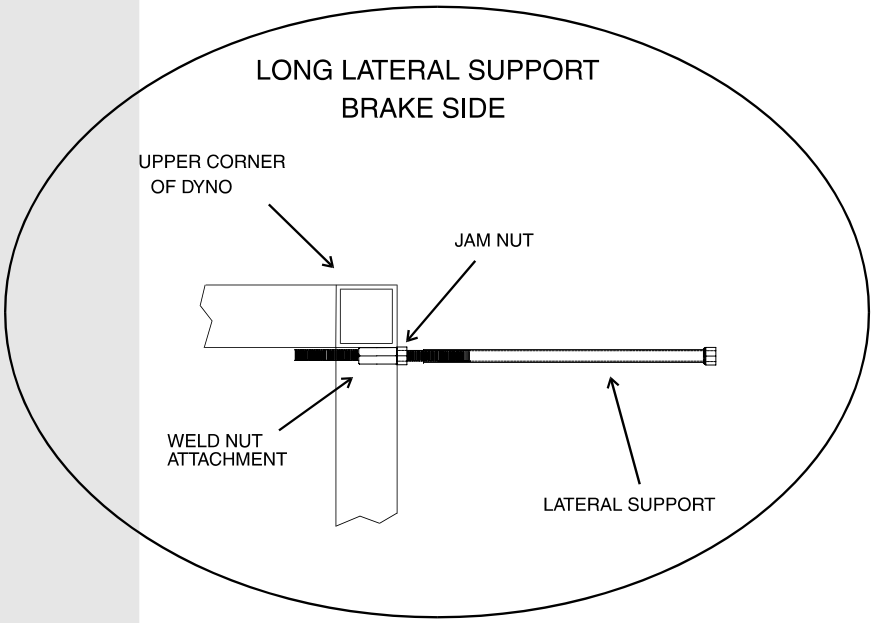


Standard Air Jumper Settings.



Installing the Long Lateral Supports.

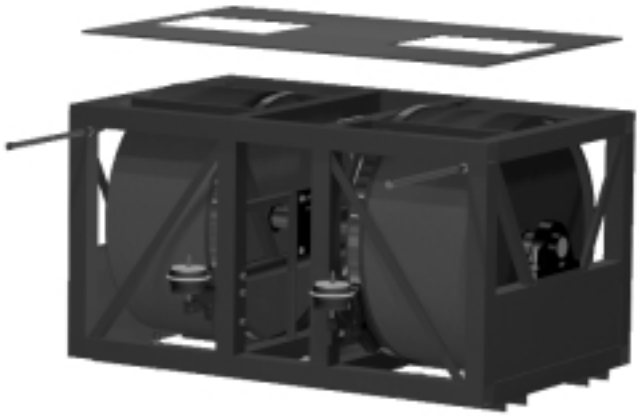
Install both of the Long Lateral Supports on the brake side of the dyno. Thread the supports all the way into the dyno providing clearance during the pit installation.



Lowering the Dyno Into the Pit

Step 1

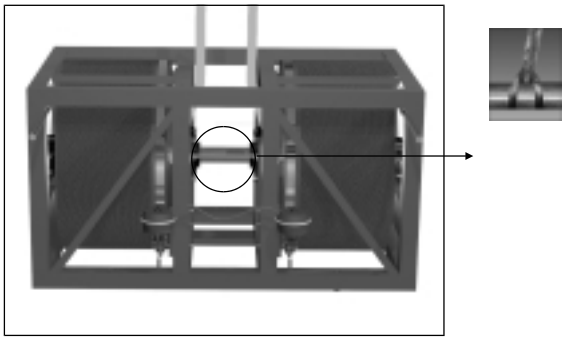
Remove the screws holding the dynamometer cover in place and remove the cover.



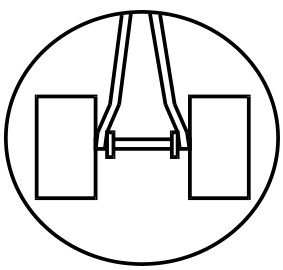
Step 2

Loop the straps around the shaft between the flange bearings and the drums. (If chains are used, then adequate protection must be placed between the shaft and the chain to insure that the shaft is not damaged by the chain.)

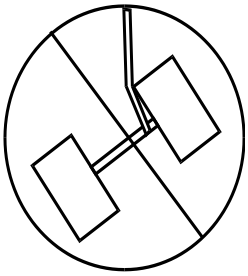
Note: ***Several types of straps or chains can be used to lower the dyno into the pit. Dynojet recommends using continuous nylon loop straps. (Dyno weight = 6000 lbs. (2724 kg.).)***



WARNING!! ***Do not loop straps around the middle of the shaft between the two bearings as the dyno will be unstable. Be sure that the strap is at no less than a 60 degree angle to the shaft.***



Yes!

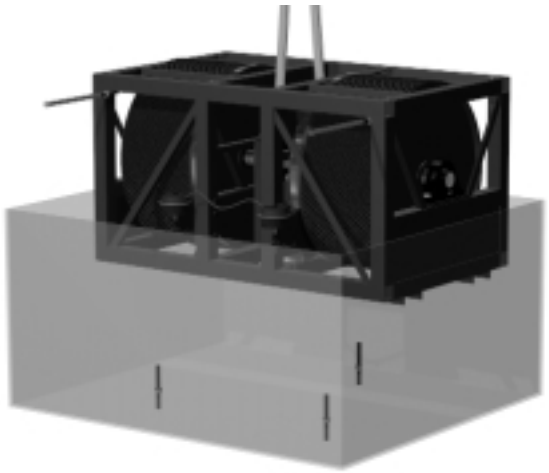


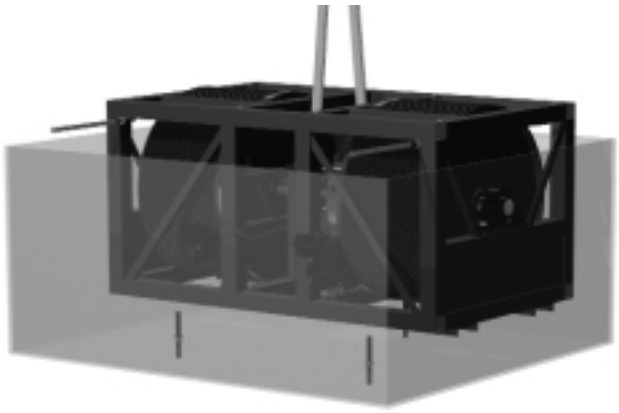
No!

Step 3

CAREFULLY lower the dyno into the pit. Align the three mounting tubes on the dyno with the anchor bolts. Lower the dyno until it rests on the leveling nuts and washers. (The mounting tubes are oversized so there will be play between the mounting tubes and the anchor bolts.)

WARNING!! ***The equipment used to move the dyno must be capable of lifting over 8000 lbs. (3632 kg.).***



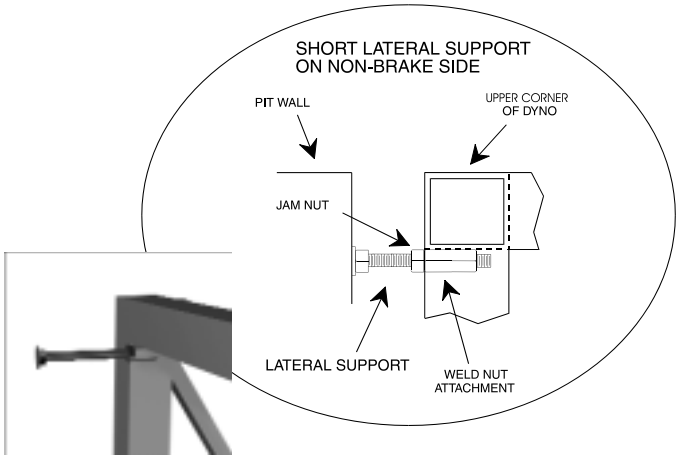


Adjusting Lateral Supports

Use the following steps to install the lateral supports:

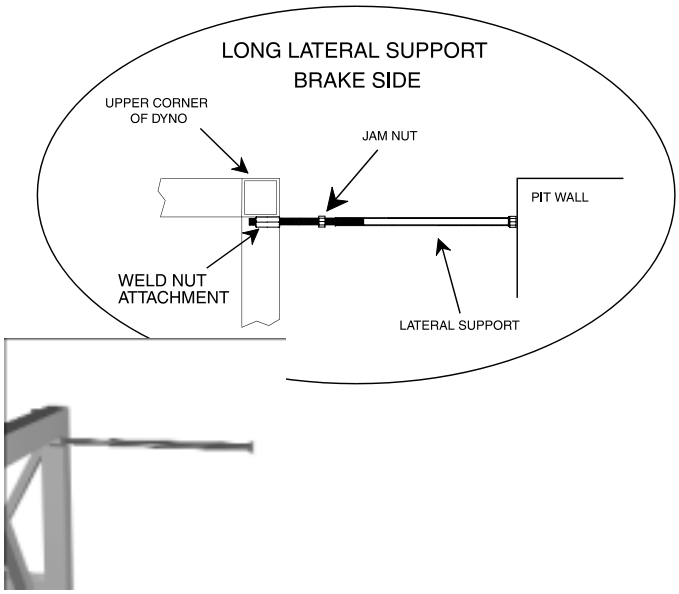
Step 1

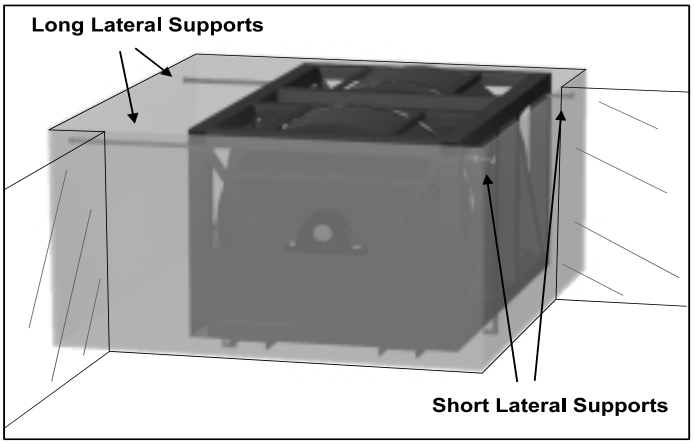
Back out the Short Lateral Supports on the non-brake side of the dyno until they fit snugly against the pit wall.



Step 2

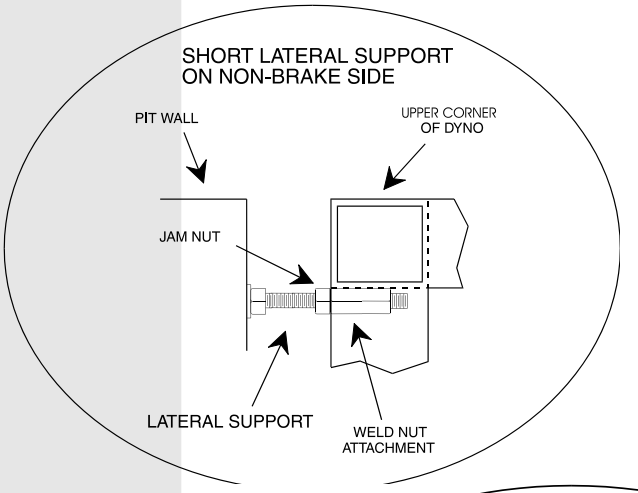
Back out the Long Lateral Supports on the brake side of the dyno until they are snug against the pit wall.

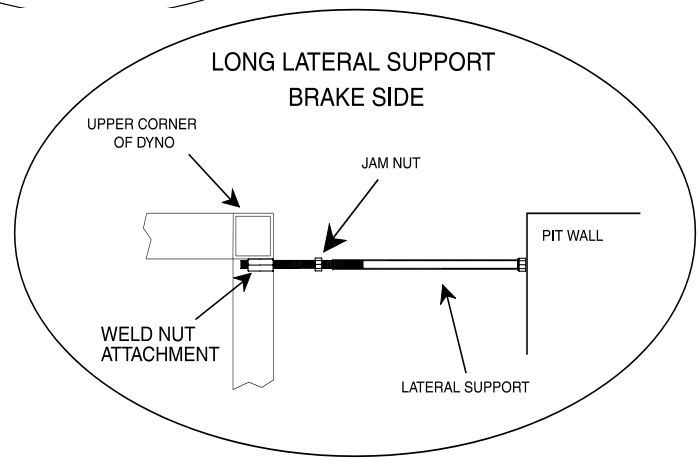




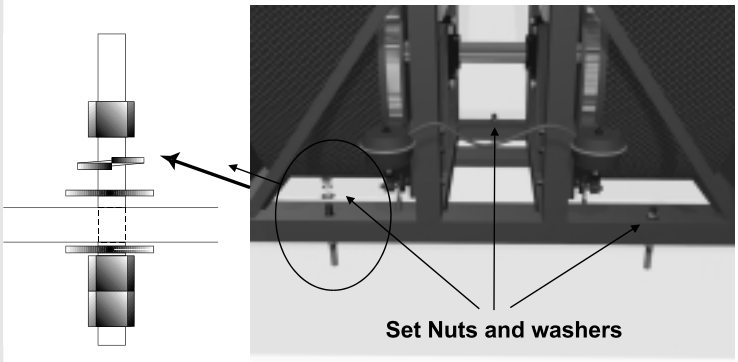
Step 3

Use the Lateral Supports to align the dyno in the pit. Once the dyno is aligned make sure all the Lateral Supports are tight against the pit walls, then tighten the jam nuts as displayed in the figures below.





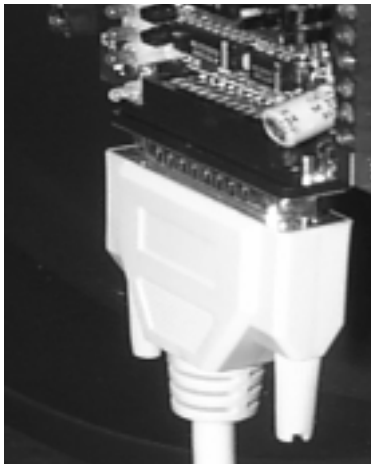
Install a 1" flat washer, 1" lock washer and set nut (1" UNC nut) on each anchor bolt. Torque each set nut to at least 140 ft. lb. (190 Nm.).



Connect the Dyno

Step 1

Plug the 25 pin DynoWare Cable into the bottom of the Breakout Board and hand tighten the thumb screws. (This step finishes the electrical installation on the dyno.)



Step 2

Connect your shop air to the dyno.

Mount the Air Pressure Regulator on the wall in the shop with the bracket provided.

Connect a supply air hose to the inlet of the regulator from your shop air supply.

Note: ***Make sure the arrow on the regulator is the same as the direction of the air flow!***

Connect a $^{3}/_{8}$" air hose to the outlet side of the regulator. Connect the other end of the air hose to the barbed inlet fitting on the Air Control Switch (Standard Air) or the Booster Valve Assembly (Proportional Air) on top of the right air canister on the dyno.

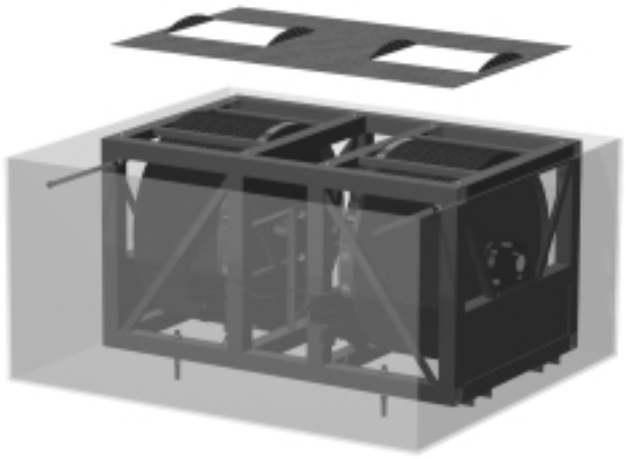
Note: ***The regulator should be set to 60 psi.***

Install the Dyno Cover(s)

Use the following steps to install the dyno cover(s):

Step 1

Check the anchor bolts and lateral supports to make sure they are tight. Install the dyno cover.

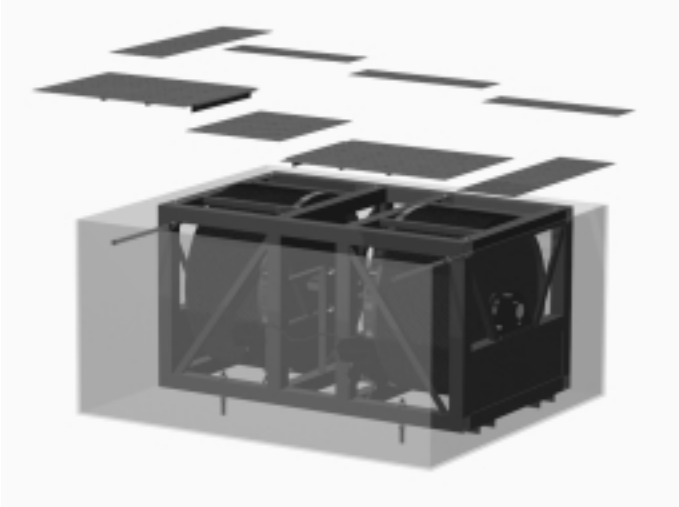


Step 2

Check the brakes. The DynoWare Stack must be on to release the brakes. Slowly rotate the drums (this can be done manually) then press the brake button (the red button on the Remote Pendant). The button should light up and engage the brakes stopping the drums. Press the button again and the light will go off, disengaging the brake. If the brakes do not engage, make sure the pressure gauge Air Brake Regulator is set to 40 PSI (276 kPa), and check all connections.

Step 3

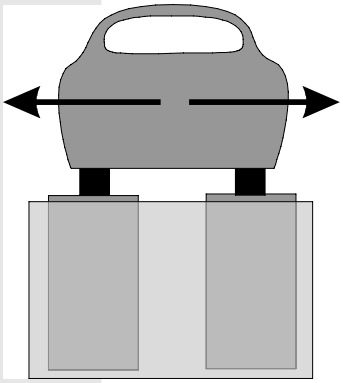
Install the optional auxiliary pit cover plates over your dyno. A sample layout drawing for the auxiliary covers is provided in Appendix B.



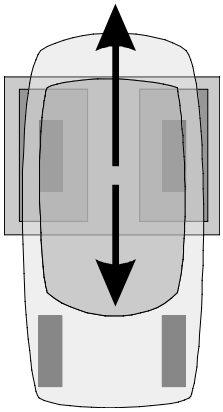
If you have any installation questions, call Dynojet at (800) 992-4993.

Installing Ground Hooks

Ground hooks are points at which you can connect the straps that hold down the car that is being tested. This keeps the vehicle from sliding side to side or off the drum of the dyno during a run.



Side To Side



Forward and Back Shifting

Ground Hook Installation Hardware:

Ground Hook:

8 or 10 Rings

8 or 10 Ring Plates

Anchors:

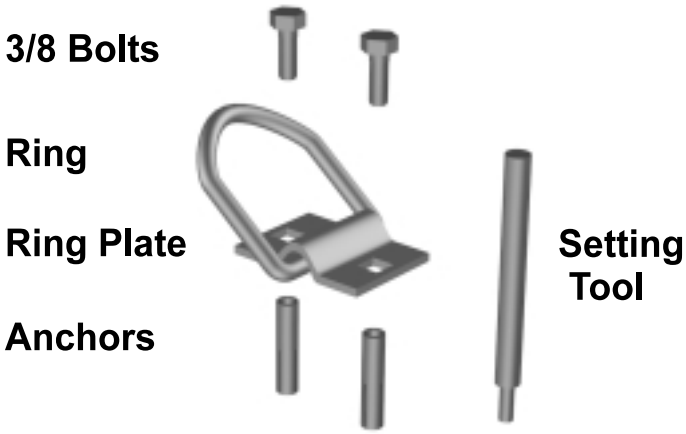
16 or 20 Drop-In Anchors

Bolts:

16 or 20 1" x 3/8" UNC Grade 5+

Setting Tool:

Used for expanding the anchors.



Drop-In Anchor

A drop-in anchor is a heavy duty internally threaded anchor used to bolt the ground hooks onto a concrete floor.

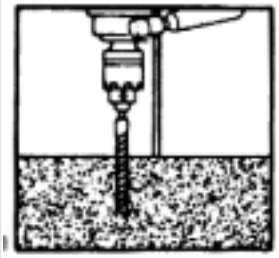
Ground Hook Placements

The placement of the ground hooks can be found in Appendix A.

Installing the Anchors

Step 1

Using an Impact Drill, drill the two holes in the cement at each location on the drawing in Appendix A. (Use a ring plate as a template for the precise hole placement.) You will need a 1/2" drill bit to drill a hole to a minimum depth of 1 5/8". Clean the cuttings and debris from the hole.



Clean out Debris

Note:

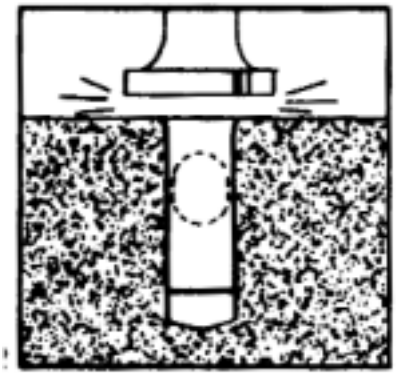
(1) The use of a carbide drill bit is recommended for the installation of this anchor.

(2) Do not use core drills to drill hole for this anchor.

(3) Always wear safety glasses and other necessary protective devices or apparel when installing or working with anchors.

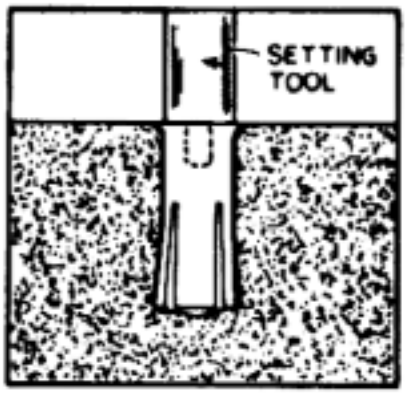
Step 2

Drive anchor into the hole flush with the surface of the concrete.



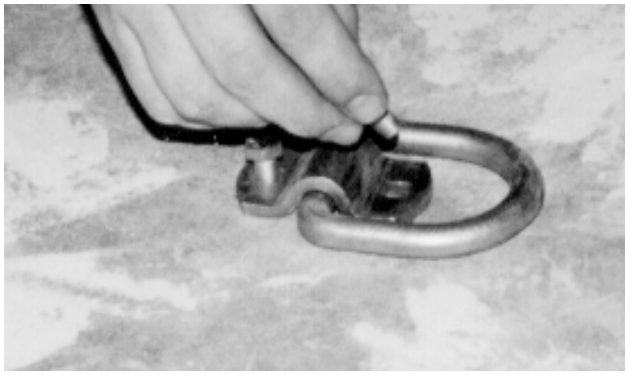
Step 3

Expand the anchor with the setting tool. The anchor is properly expanded when the shoulder of the setting tool is flush with the anchor.



Step 4

Bolt the ground hooks onto the anchors to complete the ground hook installation.

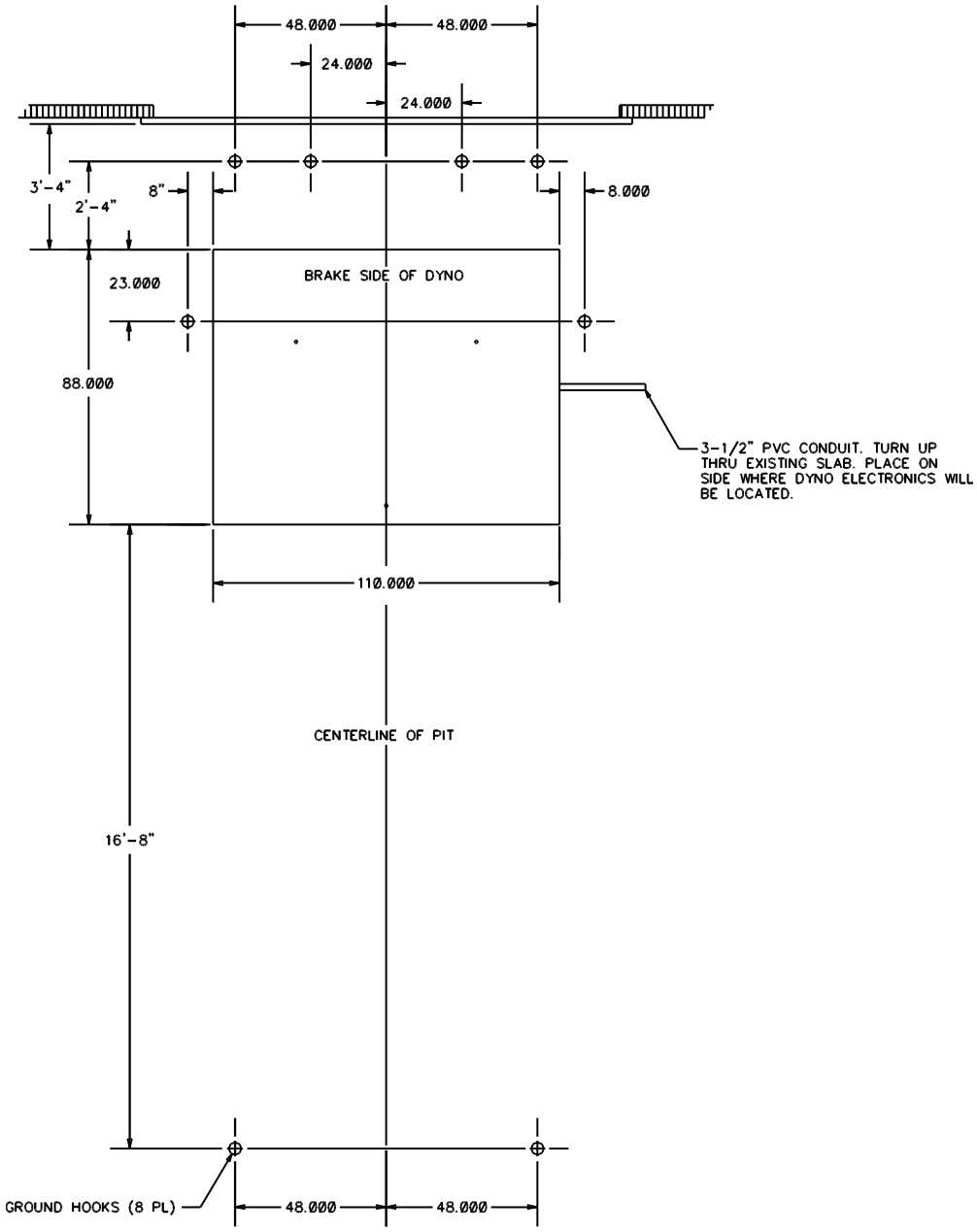


Notes:

Appendix A

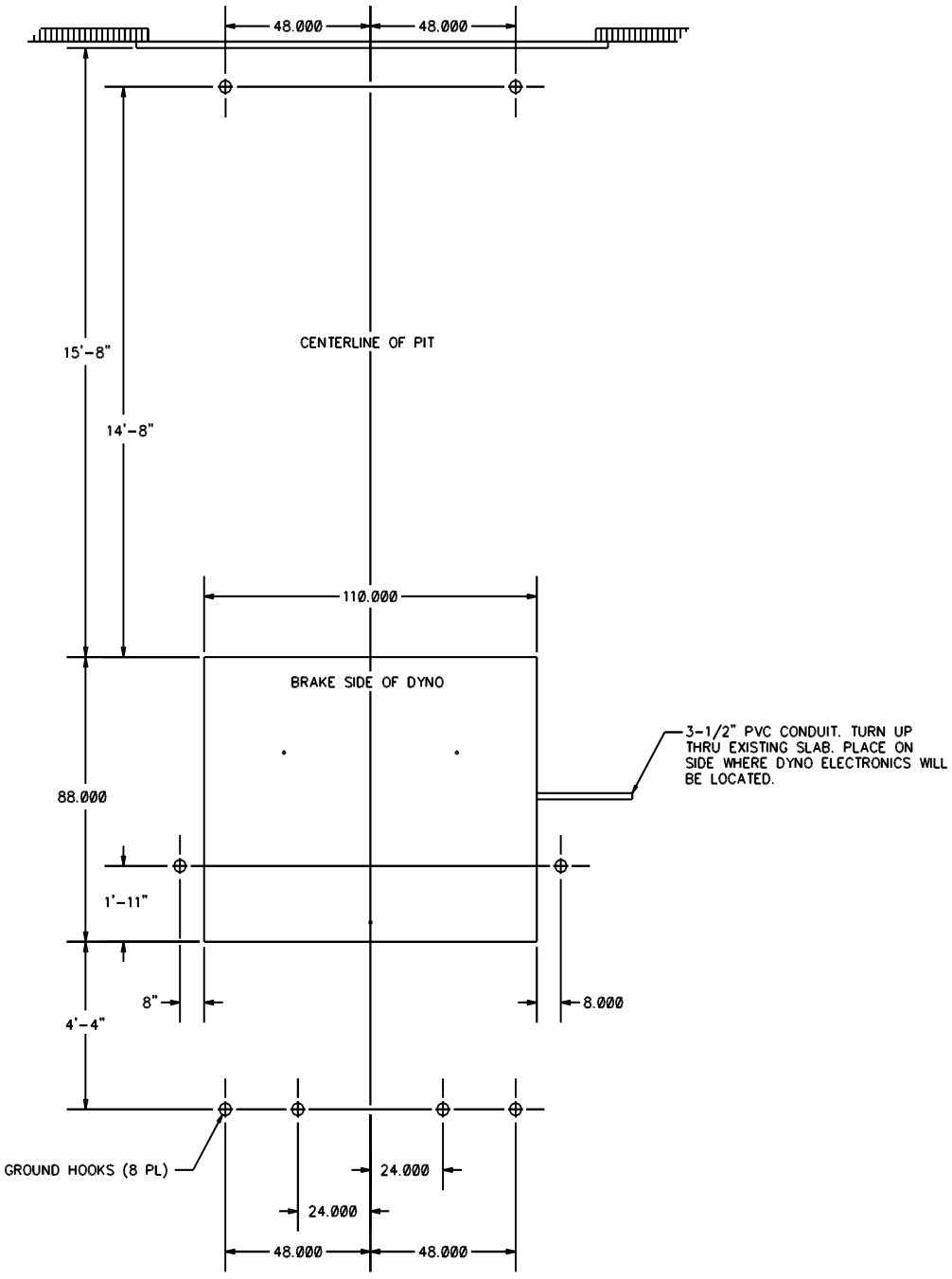
Ground Hook Layout

Ground hook diagram with the pit near the front of the shop. Align Pit and Dynamometer to the center of door opening for ease of use.



OPTIMUM REAR WHEEL INSTALLATION

Ground hook diagram with the pit near the back of the shop. Align Pit and Dynamometer to the center of door opening for ease of use.

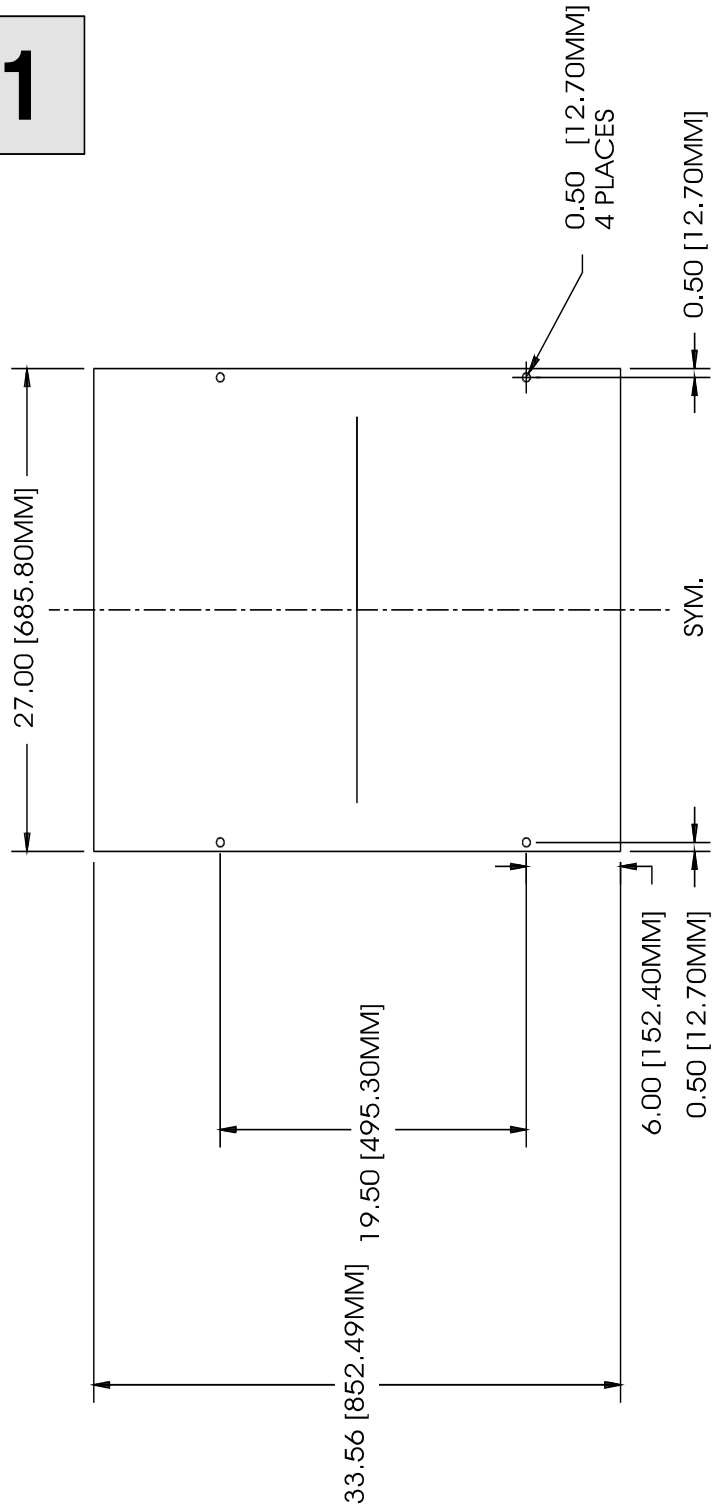


OPTIMUM FRONT WHEEL INSTALLATION

Appendix B

Auxiliary Cover Plate Diagrams

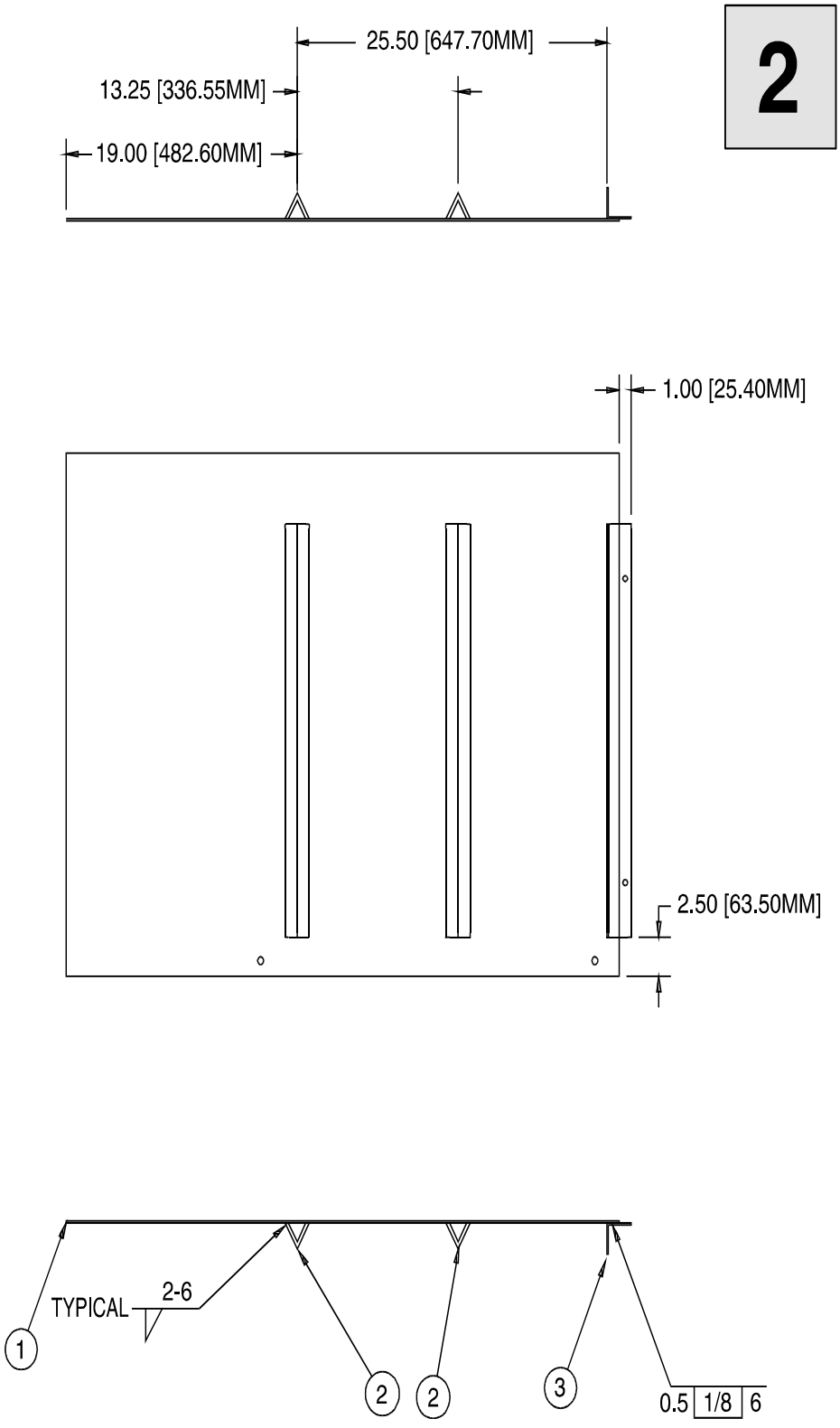
1



Build Auxiliary Covers using 1/8" Steel Tread Plate

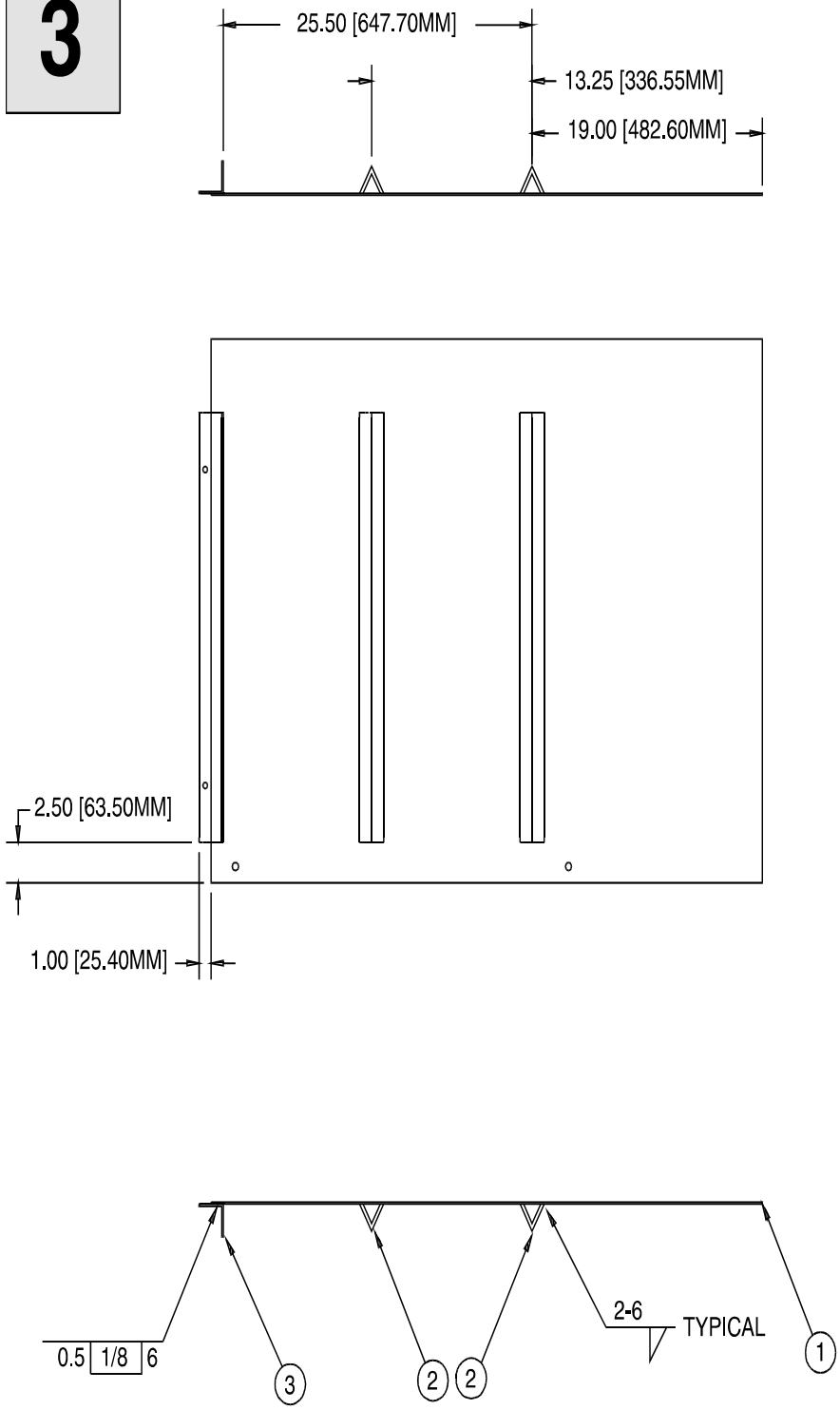
2

Build Auxiliary Covers using 1/8" Steel Tread Plate



Build Auxiliary Covers using 1/8" Steel Tread Plate

3



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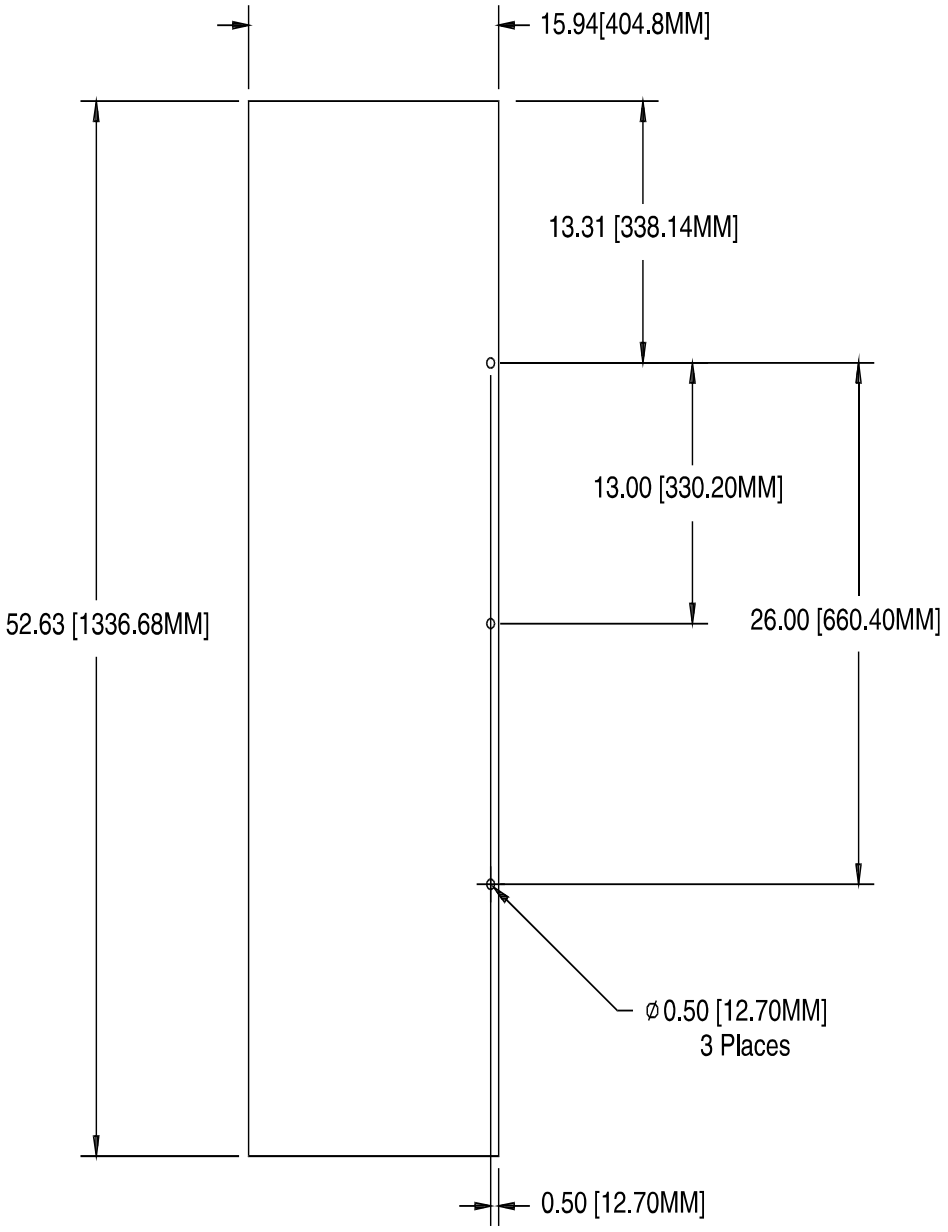
Build Auxiliary Covers using 1/8" Steel Tread Plate



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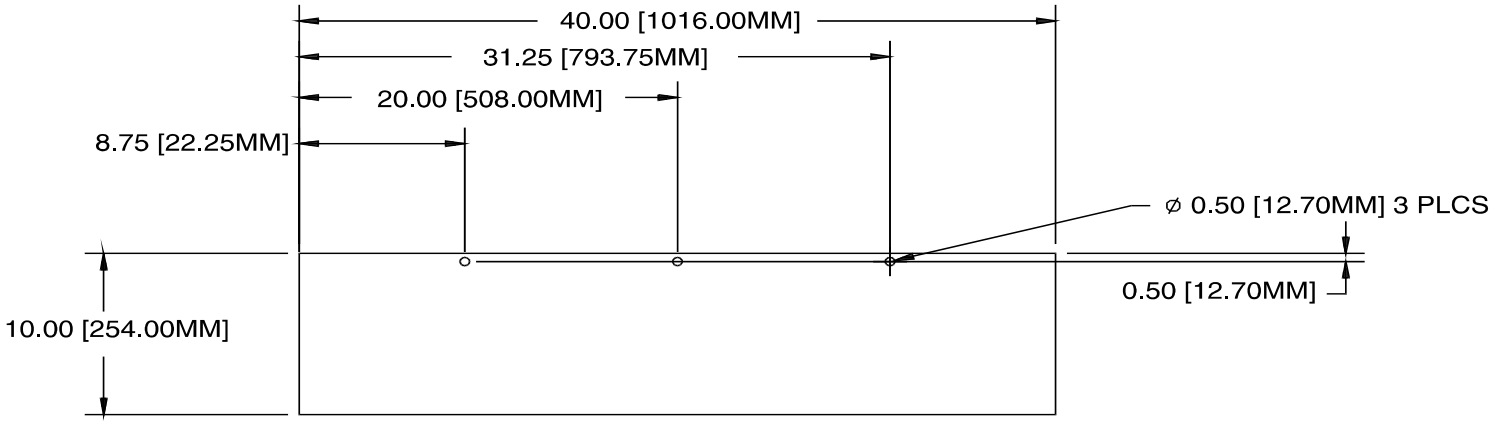
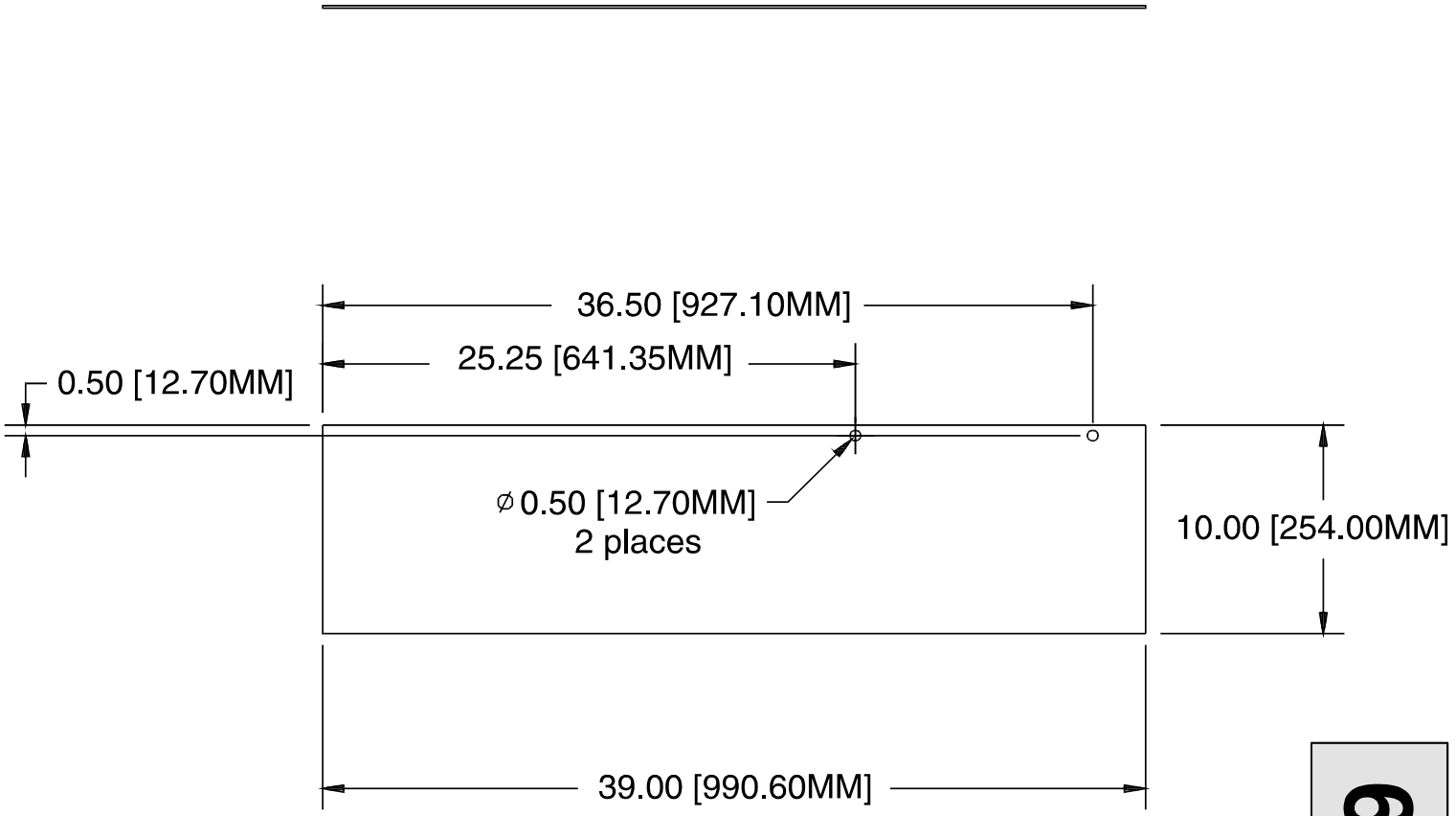


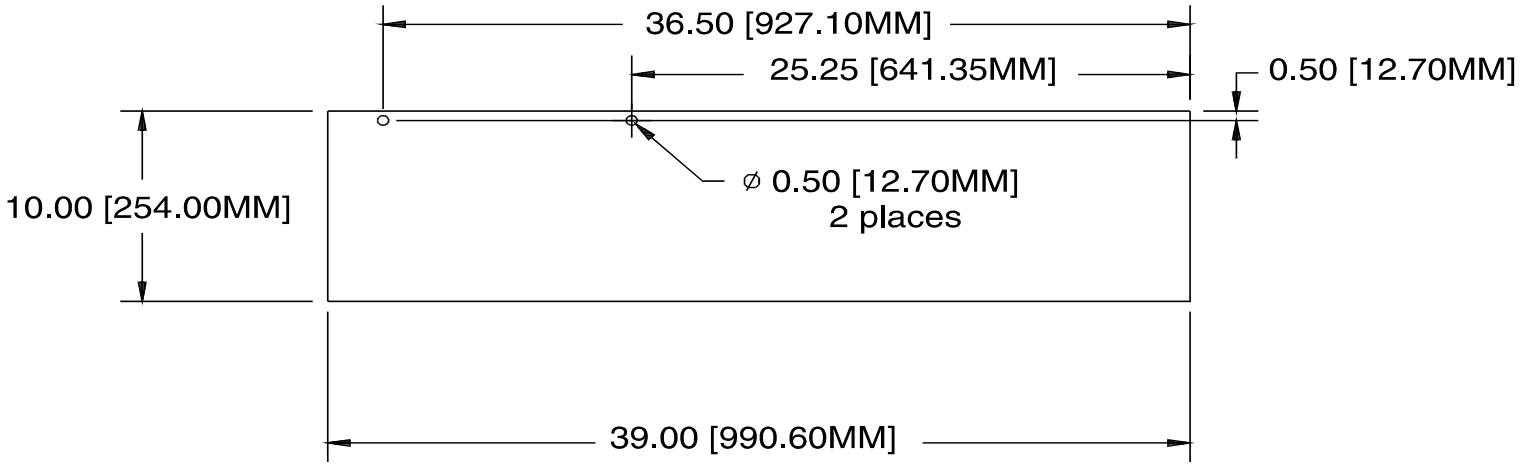
Build Auxiliary Covers using 1/8" Steel Tread Plate



6

Build Auxiliary Covers using 1/8" Steel Tread Plate

7



Build Auxiliary Covers using 1/8" Steel Tread Plate

Notes: