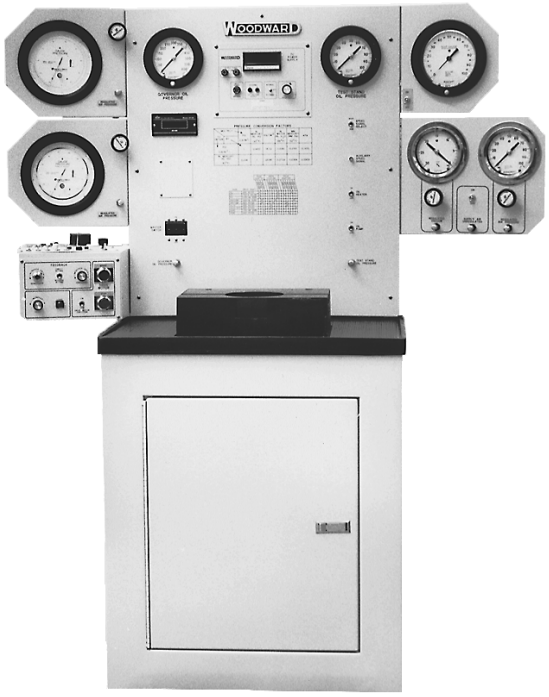
WOODWARD

Product Manual 25805
(Revision D 4/2003)
Original Instructions



Governor Test Stand

Model 8909-051 (3 Horsepower / 2.2 kW)
Model 8909-053 (5 Horsepower / 3.7 kW)

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:

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The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Manual 25805

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This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Chapter 1.
General Information

Introduction

This manual describes the Woodward Basic Electric Drive Test Stand, 8909-051 (3 hp / 2.2 kW) and 8909-053 (5 hp / 3.7 kW) for testing most Woodward governors and actuators. This manual describes only the basic test stand. Chapter 4 includes information about the most common accessories.

Description

The Electric Test Stand is a self-contained unit built to provide oil pressure, rotation, and heated oil to test most types of Woodward and other makes of governors.

Circuits allow the operator to set a standard minimum speed of the drive motor and then regulate the speed through a potentiometer attached to the output of the governor being tested. All controls on the stand are conveniently located to permit efficient one-person operation.

Pneumatic pressure is not included in the basic stand. If air-pressure devices on the governor are to be tested, a separate air-pressure source must be provided to operate air pressure regulators or other options added to the test stand. The basic test stand does not require air pressure for its operation.

All electrical circuits on the test stand are protected against accidental damage from incorrect operation.

NOTICE

The oil pressure gauges can be damaged by excessive pressure. To prevent accidental damage, always set the oil pressure at 0 before shutting down the test stand.

IMPORTANT

The test stand does not test hydraulic amplifiers built by Woodward. The 5 hp test stand is required to test governors and actuators with outputs at or above 200 lb-ft (270 N·m).

Test Stand Features

The basic test stand features a reversible, variable-speed, 180 Vdc motor, a magnetic pickup on the motor rotation, a digital tachometer, a portable potentiometer for governor output feedback, a 5 gallon (US) (19 L) oil sump, an oil pump, and an oil heater.

All electrical controls are solid-state design, using semiconductor devices.

The basic 3 hp stand tests UG-8, UG-32, UG-40, 3161, and PG governors with standard bases and drive shafts. Auxiliary kits (see Chapter 4) are required to test SG, PSG, EGB-2 through EGB-58, LSG-10, PG-PH, EG-3, EG-10, TG-13, 3199, UA, and PG-EG governors and actuators. The stand also provides test facilities for many governors not manufactured by Woodward.

The 5 hp stand tests all of the units listed above plus PG and EGB 200, 300, and 500 governors.

Special bases and drive shafts may require an auxiliary kit.

Figure 1-1. All-Electric Test Stand

Test Stand Applications

The Electric Drive Test Stand provides a reliable governor drive and accurately calibrated gauges for conveniently setting up a governor off the engine or turbine.

The test stand is not an engine or turbine simulator. The user should not expect the stand to replace final calibration on the engine or turbine. The test stand does provide a quick, convenient method to set up a governor to factory specifications in preparation for final adjustments when the governor is installed on an engine or turbine.

The Woodward test stand lets the operator set the different pressures, speeds, shutdowns, limiters, and other governor variables and adjustments.

The test stand also provides a reliable and convenient source of heated oil to aid the operator in the accurate setup of a governor by quickly getting the governor to its operating temperature. The electric drive test stand has no provisions to simulate engine or turbine drive torque, drive torsionals, engine-generator couplings, turbocharger effects, or acceleration and deceleration effects.

The electric motor drive is relatively smooth and can provide a governor with completely different attributes than are found when the same governor is installed on an engine or turbine. Woodward test procedures are designed within the drive characteristics of the test stand.

In most cases, a governor set up on a test stand according to factory specifications will operate satisfactorily on an engine or turbine, although minor tuning may be necessary. The engine drive can present characteristics to the governor which cannot be duplicated or assessed on the test stand. In these cases, changes to the system and governor may be necessary before satisfactory operation of the complete system can be obtained. Changes may involve one or more internal governor parts.

The test stand permits the following checks and/or adjustments of the governor being tested:

- Governor pump pressure
- High speed and low speed stops
- Air, oil, water, or electric safety shutdown devices *
- Pneumatic or hydraulic speed setting *
- Solenoid and ac/dc-motor speed setting *
- Droop setting
- Terminal shaft range
- Limiter and/or load control functions *
- Electric/hydraulic actuators *
- Governor stability, as it is reflected by the test-stand drive
- A check for major leaks
- A facility for a technician to conduct a general check on governor assembly and operation *

*—Optional equipment may be required.

Governor response time can be adjusted on the test stand, but remember that the response is to the test-stand drive. The test stand cannot provide information about the characteristics of the linkage between the governor and the engine or turbine to be controlled.

Although the test stand presents definite limitations to determining the match of a governor to the total system, it can provide a great savings of time and protection to the system by enabling a known setting to be made before mounting the governor on an engine or turbine. A governor carefully and completely set up on a test stand should provide safe control of an engine or turbine while final adjustments are being made.

Should a governor work well on a test stand, but still present unacceptable control of an engine or turbine, check first for obvious fault or binding in the linkage or fault in the governor drive. If unacceptable control continues, contact someone familiar with engine-governor problems for advice.

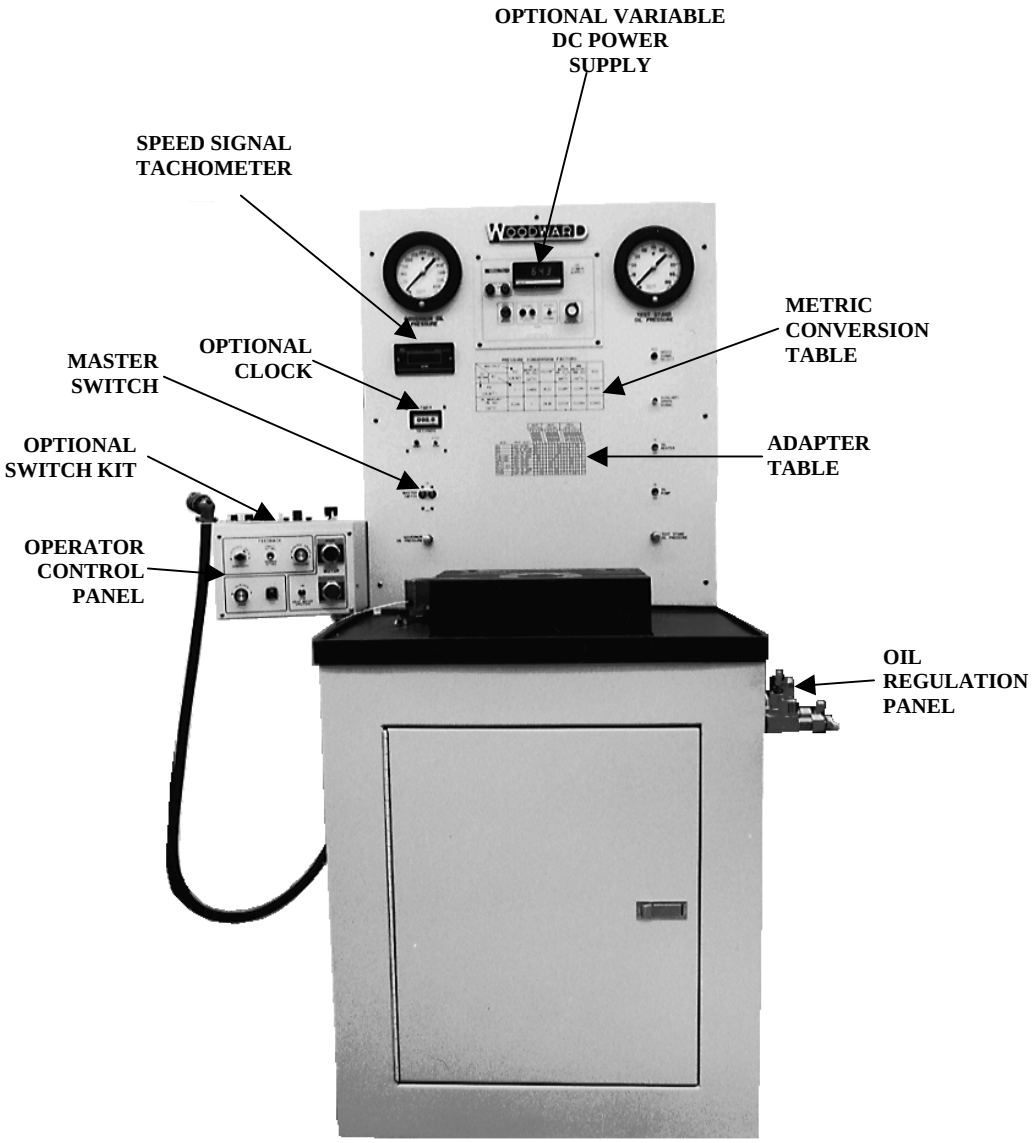


Figure 2-1. Basic All-Electric Test Stand

Chapter 2. Installation

Shipping

The basic Electric Drive Test Stand is shipped from the factory bolted to a wooden shipping platform. A shipping box is attached to the platform for protection of the test stand during shipment. Spare parts, additional mounting plates, test items, and accessories are shipped in accompanying cartons.

The basic 3 hp test stand weighs about 360 kg (800 lb) when shipped. The 5 hp stand weighs between 360 and 450 kg (800 and 1000 lb), depending on auxiliary options which have been installed.

The stand and shipping platform may be moved by nearly all types of fork lift equipment. Lift eyes are not provided and should a hoist have to be used, a sling must be used.

NOTICE

Do not attempt to move the test stand by lifting on the control panel, hydraulic fittings, or electrical connectors. Pressure gauges, which are often attached to the control panel, must be handled with particular care during unpacking and installation.

Receiving

The test stand has been painted before leaving the factory. Exposed metal surfaces have been coated with a protective oil which may be removed with mineral spirits and a cloth. Upon receipt, inspect the test stand for external damage. Verify that attached gauges have not been damaged by the shipper. Refer to the packing slip to be sure the correct number of additional boxes or crates are present.

Storage

If the test stand is to be in storage for an extended time before installation (more than six months), follow Woodward manual 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*.

Location Requirements

The test stand should be located on a concrete or reinforced floor. Although the stand is self contained, the floor surface should be oil resistant in case of accidental hydraulic-oil spills. The test stand can pump out 20 L (5 US gal) or more of oil could by accident. It is recommended that this possibility be taken into consideration when locating the test stand.

A minimum area of 1.2 x 1.2 m (4 x 4 ft) is required by the test stand and operator. Additional space to the front and back is recommended. If plans include testing larger, heavier governors, hoist facilities should be included.

The area selected should be well lighted and have a constant room temperature. Some governors are temperature sensitive, and excessive ambient-temperature change can make accurate governor calibration difficult or impossible.

Leveling Bolts

Four leveling bolts are packed with the test stand. These should be installed, as convenient, while removing the stand from the shipping platform. The bolts should be installed in the four tapped 0.750 inch holes in the corners of the base. After the stand is leveled, tighten the jam nuts.

Electrical Connections

The 3 hp test stand requires a supply of single phase 208-240 V, 50 or 60 Hz, with 5.5 kVA. A 30 A breaker is included in the main power switch.

The 5 hp stand requires a supply of 3-phase 208–240 V, 50 or 60 Hz, with 9.0 kVA. A 40 A breaker is included in the main power switch.

Connecting wiring should be made to meet local and national electrical code. Flexible or solid conduit wiring can be used.

3 HP Stand Wiring

Attach the two power leads to the "Line" posts of the master switch. Attach the earth ground feed with a #10 insulated ring terminal which is shipped on an appropriate grounding post on the side of the upper cabinet. It may be necessary to transpose the positions of the power leads to obtain the correct rotation of the oil-pump motor. Allowance for this possible change should be made during the initial connection of the power feed to the test stand.

5 HP Stand Wiring

Attach the three supply legs to the "Line" posts of the master switch. Attach the earth ground to the #10 insulated ring terminal which is shipped on the grounding post located on the inside right-hand side of the upper cabinet. It may be necessary to transpose the position of the A phase and B phase power leads to the master switch to obtain proper rotation of the oil-pump motor.

Stop Clock (optional)

Test stands equipped with a Stop Clock are factory-wired for 60 Hz power supply. If 50 Hz power is used, the jumper on the three pins located on the back side of the clock must be moved. The pins are located on the right side of the board. The jumper is small (the pins are 3.2 mm / 0.125 inch apart). Be sure to disconnect the power from the stand before changing the jumper. The clock will run slow if it is set for 60 Hz but is supplied with 50 Hz power. See Figure 2-2.

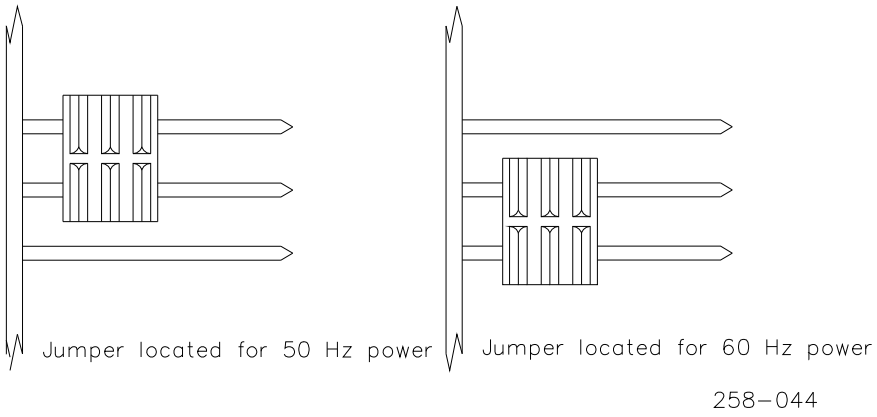


Figure 2-2. Stop Clock Jumper

The stop clock measures elapsed time for certain governor tests. The clock records seconds in 0.1 second intervals, and records up to 1999.9 seconds before reverting to 0.

Hydraulic Connections

All connections to test-stand gauges are standard 1/4 inch (6.4 mm), 37-degree-flare fittings. A standard 3/8 inch (9.5 mm), 37-degree-flare fitting is supplied on the oil connection.

Filling The Oil Reservoir

The test stand is shipped with about 2 gallons (7.6 L) of 20W50 engine oil in the oil reservoir. The oil level is above the heater element but below the oil-pump supply. The reservoir must be full before operating the stand. Fill the oil reservoir by pouring new, clean governor oil through the screen on the table top. Fill until oil shows in the center of the sight glass on the left-hand side of the lower stand.

The proper oil level should be maintained with oil visible in the center of the glass at all times. Check the oil level when the stand is idle and oil is not being used in a test governor.

Accessories

Vacuum accessories and air-pressure accessories, when specified, must be connected to an air-pressure source during installation. Most air-pressure accessories require a minimum of 100 psi (690 kPa) air pressure. The vacuum accessory kit requires a minimum of 80 psi (550 kPa) air and a flow of 0.5 ft³/min (14 L/min) to produce vacuum to test governor applications.

All air pressure accessories include pressure regulators which determine maximum pressure at air gauges.

NOTICE **Air pressure in excess of 125 psi (862 kPa) can damage the precision gauges on the stand.**

Chapter 3. Operation

Test Stand Upper Cabinet

IMPORTANT **Many test stands have air pressure and/or vacuum accessories mounted on the sides of the upper cabinet. These accessories and special gauges, which are also mounted on the side of the upper cabinet, are described in Chapter 4 (Accessories).**

The upper cabinet of the basic test stand includes two oil-pressure dials. The left-hand dial records the internal oil pressure of the governor being tested. The right-hand dial shows the oil pressure being generated by the test-stand pump. The oil-pressure connections are located at the bottom of the control panel. Test-stand oil pressure is also available at the governor-fill valve on the right-hand side of the lower cabinet.

The left-hand connection, labeled "Governor Oil Pressure," should be fitted to the pump-pressure test port in the governor. A hose is included with the basic stand for this purpose.

The right-hand connection, labeled "Test Stand Oil Pressure," goes to the lube oil shutdown connection, if present, or to other governor accessories which require a supply of pressure oil. Otherwise, it must be capped. A hose and a cap for use with the test-stand-pressure connection are supplied with the basic stand.

Switches On The Back Panel

See Figure 3-1 of the upper cabinet to identify the controls and switches.

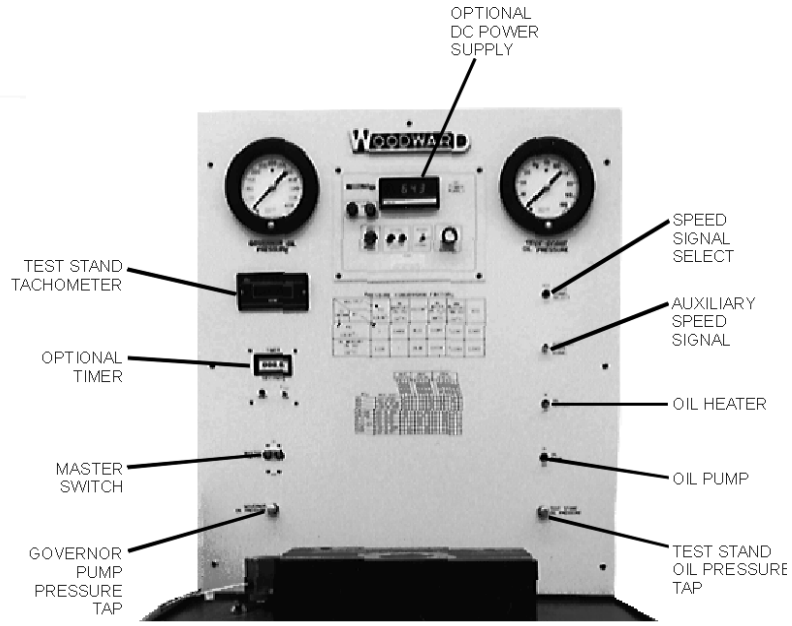


Figure 3-1. Test Stand Back Panel

Master Switch
This double-toggle switch and 30 A circuit breaker activate power to all functions of the 3 hp test stand. The switch must be on for test stand operation.

A triple-toggle switch and 40 A circuit breaker activate power to all electrical functions of the 5 hp test stand. The switch must be on for test-stand operation.

Auxiliary Speed Signal BNC Connector
The auxiliary magnetic pickup wire from the speed multiplication drive accessory plugs into this connector on the back panel.

Speed Signal Select
When this toggle switch is up (main), the digital tachometer on the back panel reads the speed of the main drive motor in rpm. When this toggle switch is down (aux), the digital tachometer on the back panel reads the speed of the multiplication drive final drive in rpm.

The tachometer converts frequency from a 60-tooth gear to rpm. A 60-tooth gear is used in both the main drive and the multiplication drive.

The tachometer is set at the factory to read test stand rotation in rpm. The number displayed is updated once a second. The switches are set as shown here to update once a second.

UP				4		6	7	8
DOWN	1	2	3		5			

UP	1	2			5			
DOWN			3	4		6	7	8

UP	1							
DOWN		2	3	4	5	6	7	8

The update time can be changed to once every half second by removing the cover on the back of the tachometer and changing the switch setting as shown below.

UP			3		5	6	7	8
DOWN	1	2		4				

UP	1							
DOWN		2	3	4	5	6	7	8

UP	1			4				
DOWN		2	3		5	6	7	8

Oil Heater
The Oil Heater switch turns the test stand oil heating system on and off. This switch should normally be left in the ON position. When the main power switch is turned OFF, it also turns off the oil heaters. The oil heater is connected through the oil pump switch so that the heater will not turn on unless the pump is turned on.

The oil temperature is controlled by a thermostat located near the oil reservoir on the side door of the cabinet.

Test stand oil is normally heated to 200 °F (93 °C).

WARNING

Normal thermostat setting of the oil heater is 200 °F (93 °C), hot enough to cause personal injury if oil is accidentally spilled. The heaters can be set for even hotter oil, which can be extremely dangerous if improperly handled.

Oil Pump

The Oil Pump ON/OFF switch controls the oil pump in the test stand. This switch can be left ON at all times, if desired. The Oil Pressure Regulation Valve should always be opened when the test stand is shut down. (The Test Stand Oil Pressure Gauge reads nearly "0" with the oil pump running and the regulator open.)

Oil Pressure Control Valves

Oil pressure within the test stand, shown on the right-hand pressure dial, is controlled by the Pressure Regulator Valve on the right-hand side of the test stand.

NOTICE

A closed Pressure Regulator Valve on start-up may cause the oil pressure to exceed the range of the gauge. This may cause permanent damage to the gauge.

The Pressure Regulator Valve should always be set to minimum pressure before the test stand is started to prevent possible damage to the pressure gauge. After the oil pump has been started, the operator should use the Pressure Regulator Valve to set the desired pressure in the stand. The Pressure Regulator Valve may have to be readjusted as the test stand reaches operating temperature. Pump pressure is indicated on the right-hand dial on the test stand panel.

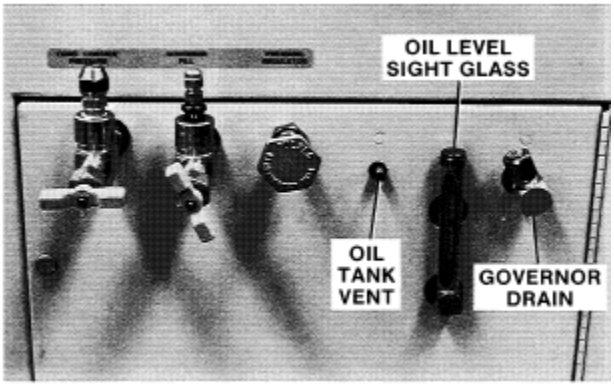


Figure 3-2. Oil Controls on Side of Test Stand

IMPORTANT

Opening the Pressure Regulator Valve before shutting down the stand is a good practice. The Regulator Valve must be open when starting the pump to avoid possible gauge damage.

Optional DC Power Supply

The center panel on the back panel is provided for dc power supply and related test equipment. The operation of the items included in this panel is explained in the Accessories portion (Chapter 4) of this manual.

Governor Feedback

Feedback Potentiometer

A portable potentiometer, driven by a combination of a return spring and monofilament line, provides the feedback needed to calibrate and check a governor. The test stand's universal output lever is attached to the output shaft of the actuator or governor under test. The monofilament line is then attached to the universal lever with the take-up spool either 20 degrees before the maximum stop or 20 degrees in front of the minimum stop. Figures 3-3, 3-4, and 3-5 show methods of connecting the feedback system to various governor outputs.

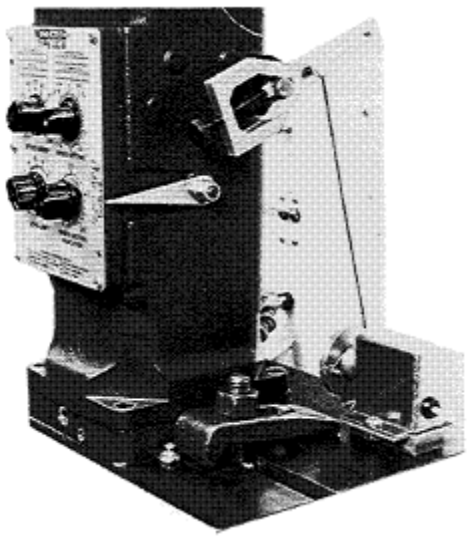


Figure 3-3. Typical Rotary Output Connected to Feedback

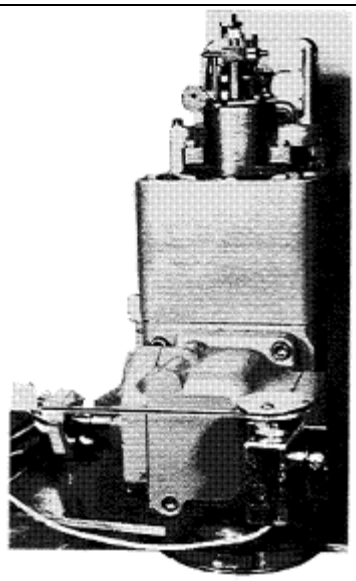


Figure 3-4. Linear Output Connected to Feedback

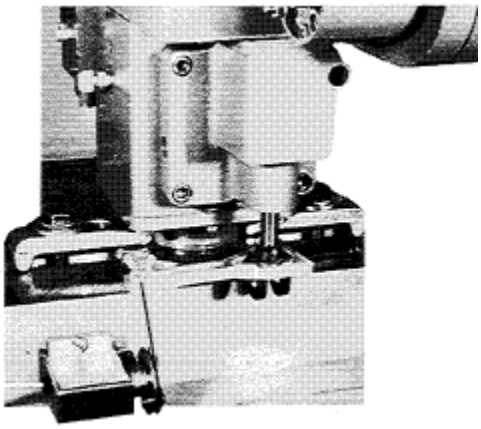


Figure 3-5. Downstroke Output Connected to Feedback

Figure 3-6. Operator Control Panel

Operator Control Panel

The Operator Control Panel, on the left-hand side of the test stand, provides the switches and controls which are needed to test most governors.

IMPORTANT

A number of switches and control lights needed to test electrical accessories on PG Rail governors are mounted in an Accessory Panel on top of the Operator Control Panel. These switches are described in Chapter 4 (Accessories).

Direct Acting/Reverse Acting Switch
This switch is up (at Direct Acting) when the output shaft of the governor being calibrated pulls the monofilament line from the feedback spool on increase fuel. This switch is down (at Reverse Acting) when the output shaft of the governor being calibrated pulls the monofilament line from the feedback spool on decrease fuel. The pulley on the feedback potentiometer must turn counterclockwise to increase when the switch is up and clockwise to increase when the switch is down. When the lever switch is down, the pulley takes up line on increased fuel.

Increase Speed, Centering
This adjustment sets the drive speed of the test stand, clockwise for increased speed and counterclockwise for reduced speed. Test stand drive speed is adjusted to center the output of the governor at a given governor speed setting. The electric motor circuits are protected from unintentional overloads by requiring that this potentiometer always be at the minimum (counterclockwise) setting before the START button can activate the drive circuit.

Increase Gain–Sensitivity
This potentiometer, turned counterclockwise, retards the rate of response of the test stand drive motor to a speed change. On initial operation, this potentiometer should be set totally counterclockwise. After the test stand drive is set at the desired speed, the Increase Gain–Sensitivity potentiometer should be turned clockwise until the governor being tested loses stability. Response time can then be set in the counterclockwise direction until governor stability is reached under control of the feedback potentiometer connected to the governor output.

The response time set by the Increase Gain-Sensitivity potentiometer is not related to the ability of the governor to respond to speed changes, but rather to the ability of the governor to operate with acceptable stability.

The sensitivity pot may be locked in a desired position. To lock the setting, turn the button on the back of the adjustment clockwise. To unlock, turn the button counterclockwise.

Drive Motor Buttons
(Black button is the START button, red button is the STOP button.)

The electrical circuits in the test stand automatically open the run circuits when the stop switch is pushed in or when an overload occurs. The run circuit is always opened when the forward-reverse switch is moved.

When the run circuit is opened, it cannot be reinstated by the START button until the Increase Speed–Centering potentiometer is turned counterclockwise to "0". The START button likewise does not start the drive motor, as this must be done by advancing the Increase Speed-Centering potentiometer after the circuit is energized by the START button.

When the motor is stopped by use of the potentiometer, the run circuit does not open, and restarting is possible by adjusting the potentiometer.

Reversing the drive direction always opens the drive circuit, and the START button must be used, even if the speed adjusting potentiometer is at "0".

Drive Motor Direction (CW/CCW)
When this two-position switch is "up" (CW/clockwise) the drive shaft turns clockwise. When this switch is "down" (CCW/counterclockwise), the drive shaft turns counterclockwise.

If this switch is changed, it causes the motor circuit to open. The Centering (speed-adjustment) potentiometer then has to be moved to the zero-speed setting and the START button pushed before the motor can be restarted.

Load
The test stand is equipped with a control circuit which simulates load to an engine. When the Load switch is held down, the drive speed increases or decreases by an amount determined by the setting of the Load Potentiometer on the operator control panel. With the speed change, the governor under test should call for a change in fuel setting with the test-stand drive responding to the output of the portable feedback potentiometer. The load switch tests a governor's ability to return to normal after a load transient. The feature is also used to test droop settings.

To Calibrate a Governor

Select the drive adapter with the proper serration or keyway and the drive coupling (if needed) for the test stand motor. Select the proper pilot adapter plate to fit the governor base to the stand. Clamp the governor to the stand and adapter plate with the two hold-down clamps provided (see Chapter 5).

Attach the applicable oil lines between the governor and the test stand. The valve on the right-hand side of the test stand is the oil fill connection. A second valve on the side of the test stand is optional and provides pressure oil to test certain hydraulic options on governors. To fill a governor, first establish the desired oil pressure (indicated on the Test Stand Oil Pressure Gauge) by adjusting the pressure-regulating valve on the right-hand side of the test stand (10 to 30 psi / 70 to 210 kPa is normally adequate). Connect a fill line to the governor and adjust flow to the governor with the fill valve.

Oil is drained through the slotted screen on the test stand table, through an oil return line to the side of the lower stand, or through the governor drive. The oil return line is generally preferred over the table drain because it allows return oil to retain its heat, without heating the table.

An optional oil level control is available to allow hot test stand oil to circulate through governors with self-contained sumps, reducing the warm-up time required before testing the governor. Oil from the oil level control option supplies the governor. The governor drain is then connected to the oil return line or opened onto the test stand table.

The drain line provided with the standard test stand is designed to connect to the oil return connection on the side panel. Most governors which do not have self-contained sumps drain through the base. These drains are automatically accommodated by the test stand. Proper flow is set by adjusting the oil fill valve on the side of the stand. In most cases, this valve is opened 1/4 to 1/2 a turn during the test of a governor. Governors with oil-feed through the base must be tested with the optional multiplication drive.

The test stand oil heater should be used whenever possible, as most governors are sensitive to temperature. Most governors reach operating temperature in about 30 minutes on the test stand.

A surface thermometer is supplied with the test stand. This thermometer should usually be attached to the lower portion of the governor case. Actual governor temperature is about 10 Fahrenheit degrees (6 Celsius degrees) hotter than indicated on the surface thermometer.

Turn on the test stand master switch. The pressure relief valve must be open to prevent pressure build-up when the pump is started. Be sure the oil heat thermostat, inside the side door of the stand, is set at the desired temperature (usually 200 °F / 93 °C). Turn on the pump switch and the heater switch. Allow the test stand at least 30 minutes to heat the oil and the governor to the desired temperature.

When the governor is full of oil or the oil lines are connected, attach the universal lever to the output of the governor and adjust the monofilament line length to set the portable potentiometer in the middle of its travel. Set the lever position switch as necessary for the output of the governor.

Set the drive motor forward/reverse switch as necessary.

Starting The Test

Set the Sensitivity and Centering potentiometers on the control panel full counterclockwise. Push the black START button momentarily, then slowly turn up the Centering potentiometer until either the drive motor just starts to move or until the tachometer shows the desired number of rotations at minimum fuel according to the governor's test specification (TSP) available from Woodward.

The drive motor does not start when the START button is pushed. The Centering setting starts the drive motor as the setting is moved from the full counterclockwise position.

When the test stand drive is rotating the governor at the desired minimum fuel speed, turn the Sensitivity potentiometer clockwise until the governor becomes unstable. Then turn the adjustment counterclockwise until stability is just reached. The setting of the Sensitivity control does not hinder the ability to test the governor if stability can be attained. You may have to adjust the Centering pot as you turn up the Stability pot.

Make tests and adjustments as required by the appropriate TSP. Use the red button or the Centering potentiometer to shut down the test stand motor while leaving the oil heater and pump operating.

Load Switch

The Load control contains a potentiometer which can be set to momentarily raise or lower the test stand speed from the speed setting of the Centering potentiometer. A momentary (push button) switch includes this setting in the test stand drive circuit while the button is pushed, causing a reaction that is the same as that which occurs when load is added or removed from an engine or turbine.

When the momentary switch is pushed, it allows testing of a governor in relation to load changes. When the Load control is in about the middle of its travel, it shows little effect on drive speed. Turning the control clockwise allows the simulation of a reduction in load. Turning the control counterclockwise simulates an increase in load while the momentary switch is closed.

IMPORTANT

The governor being calibrated should be allowed to run on the test stand for at least 30 minutes before making final adjustments.

To start the motor after the STOP button is pushed, the Centering potentiometer must be turned to full counterclockwise, the START button pushed, and the Centering potentiometer turned slowly clockwise.

If motor direction is changed, the drive stops, and the Speed Adjustment potentiometer must be returned to full counterclockwise and the motor circuit re-engaged with the start button.

Test Stand Jiggle

Oscillation of governor output while under test can be caused by either the governor or the test stand.

To determine the source of output shaft instability (jiggle), disconnect the feedback pot. This "opens the loop" between the test stand drive and the governor.

If the jiggle continues, replace the governor with a known good governor. If the jiggle still occurs in open-loop operation, it is caused by the test stand or by the mechanical connection between the motor and the governor. If the jiggle stops when the loop is opened, it can be assumed the test stand drive is stable and the problem is caused by the governor or actuator under test, or by the feedback potentiometer. Refer to the schematic in this manual to check the operation of the feedback potentiometer.

Test stand jiggle that continues can be caused by the electrical drive of the stand, by the electrical supply to the stand, or by the connection between the drive shaft and the governor under test.

Troubleshooting Jiggle

To troubleshoot jiggle which continues when the test stand loop is open, follow this procedure as closely as possible:

1. Check the drive connection between the test stand and the governor. The connection must be correctly installed with the right fittings between the test stand motor and the drive shaft of the governor. The drive shaft must fit into the connecting linkage without binding. If the drive shaft is splined or serrated, make certain that the shaft slips into the connecting fittings freely enough to drop into place of its own weight. If a keyed drive shaft is used, there must be neither excessive backlash or binding in the connection. Irregularities in the connection or run-out in the shaft may cause jiggle.

2. Mount a different governor on the stand to compare output before determining that the jiggle is in the electric test stand drive or electric supply.

⚠WARNING

HIGH VOLTAGE—Remove the test stand from electrical supply before checking or working on any of the drive components. Life-threatening voltages are present throughout the drive circuits.

3. On the 3 hp model, check the filter capacitor on the output of the printed circuit board for an open circuit. The capacitor is rated at 2500 µF at 350 working Vdc. The 5 hp model does not use a capacitor.

4. Tighten and inspect ALL terminal connections, including those on the dc drive motor. Cleaning and tightening these terminal connections can improve the operation of the electric test stand.

5. Check the incoming electric supply which must provide 200 to 260 Vac without high noise spikes. The motor alone can pull 24 A for short periods (40 A on the 5 hp model), and the entire stand can pull much more than this, especially if the oil heaters and other options are operating at the same time as the drive motor. The check of the entire power supply system is important if a new installation is causing jiggle. In the case of established stands which develop jiggle, check particularly for any changes which may have occurred in the supply wiring or the power source. Large cyclic electrical load changes from other machines can cause problems with test-stand operation.

Drive Boards

The drive boards cannot be checked with normally available test equipment. Contact Woodward in Fort Collins, Colorado, USA, if the boards are suspected as the cause of test-stand problems.

IMPORTANT

Most jiggle problems which persist after the test loop has been broken by separating the feedback potentiometer from the test governor can be found in the mechanical mounting of the governor to the test stand. Before any extensive testing of electrical drive components, be sure that all aspects of the mechanical mounting of the governor on the test stand table have been carefully inspected.

Chapter 4.
Accessories

Introduction

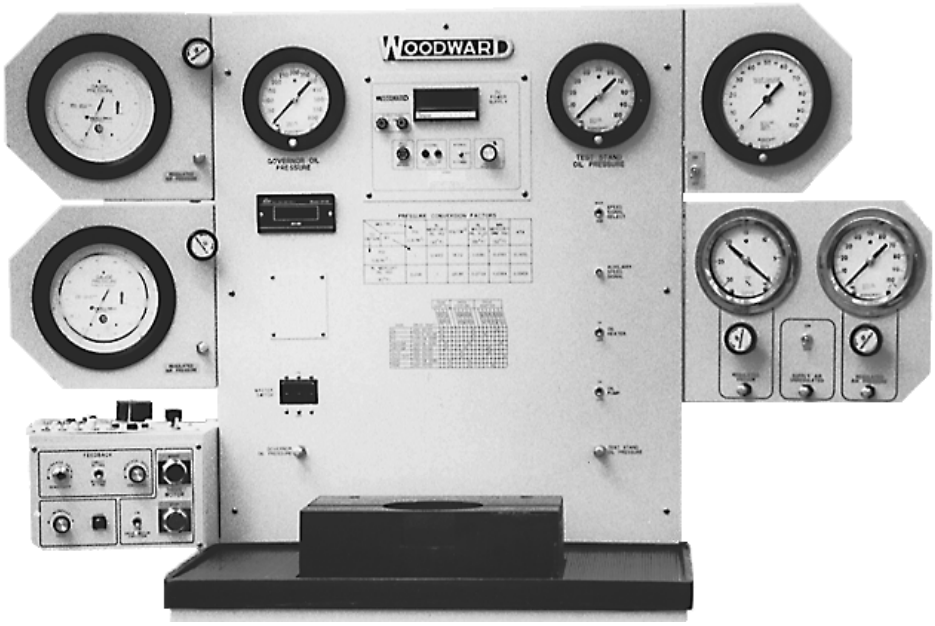


Figure 4-1. Test Stand with Most Options Installed

Several accessories are available for the Woodward Electric Test Stand. These range from drive multipliers for testing high-speed governors to special electrical services to allow testing of electric solenoids and electric-hydraulic actuators.

Universal Accessories

Air Pressure/Vacuum Accessories

Many Electric Test Stands feature an optional air pressure/vacuum accessory panel. The air pressure system accepts a maximum of 200 psi (1380 kPa) compressed air at a fitting on the upper back of the control panel. A filter is supplied at this fitting when the vacuum accessory is included on the stand. Various gauges are available to provide the accuracy of measurement and size of gauge needed by the particular test conditions.

NOTICE **Gauges used in the air pressure accessories can be damaged by pressures above the dial limit.**

The air supply is made available at up to four locations:

- Through a pressure regulation valve and a 0-120 inches of mercury (0–406 kPa) pressure gauge on the left-hand side of the stand
- Through a pressure regulation valve and a 0-100 psi (0–690 kPa) gauge on the left-hand side of the stand
- Through a pressure regulation valve and a 0-100 psi (0–690 kPa) gauge on the right-hand side of the stand (available with or without vacuum option)
- Through a toggle-controlled valve on the right-hand side of the stand, providing unregulated air at the same pressure as that supplied to the stand (available with vacuum option only)

Air Pressure Gauge

Gauges available for use with the air pressure supply include:

Auxiliary Panel 6995-721—Kit includes an air pressure regulator and auxiliary instrument panel to simulate air, oil, or water shutdown during governor calibration. Air pressure supplied must be between 80 and 200 psi (550 and 1380 kPa). The air toggle switch, which permits the use of supply pressure air for certain governor options, is included in the panel. The same panel also holds the vacuum option.

0-120 Inches of Mercury Air Pressure Gauge (8959-049)—8.5 inch (216 mm) diameter, accuracy at 0.066%. Mounted on the left side of the stand. Also available with a dual regulator and selector valve, part number 6995-975,

0-120 Inches of Mercury Air Pressure Gauge (8959-057)—6 inch (152 mm) diameter, accuracy at 0.1%. Mounted on the left side of the stand. Also available with dual regulator and selector valve, part number 6959-969.

0-100 PSI Air Pressure Gauge (8959-055)—8.5 inch (216 mm) diameter gauge. Accuracy at 0.066%. Mounted on the left side of the stand. Also available with dual regulator and selector valve, part number 1816-111.

0-100 PSI Air Pressure Gauge (8959-059)—6 inch (152 mm) diameter gauge. Accuracy at 0.1%. Mounted on the left side of the stand. Also available with dual regulator and selector valve, part number 6995-971.

Vacuum Option (6995-723)

Vacuum is provided by a venturi-principle vacuum generator located on the right-hand panel, behind the vacuum gauge. Requiring a minimum supply air pressure of 80 psi (550 kPa), the accessory provides up to 18 inches of mercury (61 kPa) of regulated vacuum recorded on a 0-30 inch (0–102 kPa) gauge. The gauge is accurate within 0.5%. The vacuum generator uses less than 0.5 ft^3/min (14 L/min) of shop air to provide the needed vacuum to test governor accessories.

When the vacuum option is installed, all the pressure air is filtered through a 20 µm or better filter located at the connection with the shop air. The filter element is replaceable or may be washed. Remove the filter by unscrewing the sediment bulb at the bottom of the filter fitting.

Air from the vacuum generator is exhausted to the table drain area. Oil from the exhaust tube is an indication of an oil leak in the governor being tested. The vacuum generator may be removed from the stand and washed with ordinary shop solvents. Disassembly of the generator should not be necessary.

The vacuum accessory is designed to provide the vacuum needed to check limiters and lube-oil vacuum trips. The vacuum accessory is not designed to move oil or help in keeping the test stand clean and must not be used for this purpose, as excessive dirt or oil will plug the orifice in the venturi vacuum pump.

Variable DC Power Supply (8272-618)

The variable power supply provides 10 to 140 Vdc power to permit testing electric speed-setting and solenoid devices used on many governors. The power supply is necessary to use the PGE (rail governor) switch set which mounts on the operator control panel. The device may also be used to test the mechanical side of EGB units.

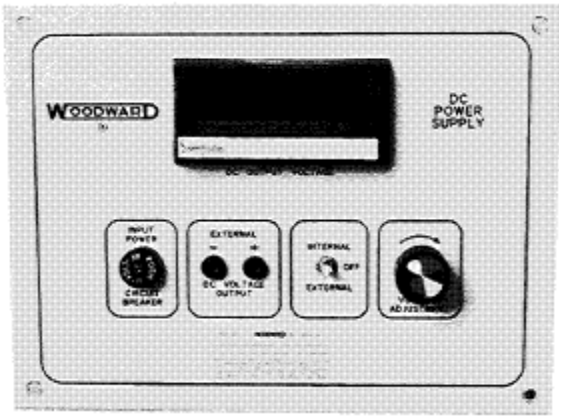


Figure 4-2. Variable DC Power Supply

Located in the center of the back panel, the optional device converts 110 Vac power to dc voltage. A three-position switch provides variable dc output up to 140 Vdc to the optional PGE switch set when in the up (Internal) position. In the center position, no voltage is available from the dc option. In the lower (external) position, the output of the option is between 10 and 140 Vdc as set with the potentiometer and read on the digital voltmeter.

The external output is available only at the (+) and (–) jacks on the back panel, and no voltage is available from the switch set. A 2.5 A fuse protects the dc supply.

110 Volt Plug

A 110 V, single-outlet plug is provided on the side of the test stand for the convenience of the operator. The plug is protected by a 3 A "SloBlo" fuse.

Transformer Assembly (5435-049)

This transformer converts 460 V supply to 230 V supply needed by the test stand. A General Electric isolation transformer, indoor/outdoor type QM, is included in the transformer kit. The general purpose transformer converts 460 V source to 230 V, and 230 V source to 115 V as a secondary function. The single-phase device provides 10 kVA of power. The supply voltage must be direct to the transformer, not to the test stand circuit breaker.

Right-Angle Drive Box (5332-603)

A right-angle drive box is available for installation on the Multiplication Drive Assembly. Horizontally mounted governors are then tested while mounted to the drive box. This accessory is necessary to test certain SG, PSG, EGB, EG, EGR, and EG-3 governors and actuators. The right-angle drive accessory permits base oil feed and drain of the governor or actuator.

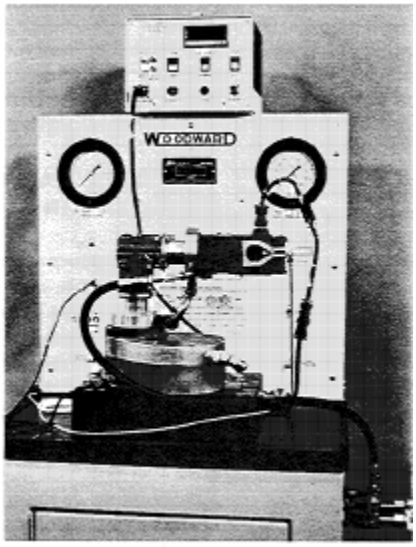


Figure 4-3. Right-Angle Drive with EG-3 Actuator

TG-10 Adapter Kit (6995-629)

Requires Speed Multiplication Drive kit. Used to test TG-10, -13, and -17 governors (see Figure 4-3). Kit 6996-639 is available to test TG-13 governors used to control Ajax engines. This kit does not use the Multiplication Drive.

SG, PSG, and EG Adapter Kit (6995-637)

A mounting kit to permit testing SG and PSG governors. Requires Multiplication Drive and EG Actuator Tester for EG actuators (see Figure 4-4).

Multiplication Drive Assembly (4X) (5337-509)

The governor drive motor is capable of operating at 2000 rpm. The addition of a Multiplication Drive Assembly increases the upper speed limit. The multiplication drive fits on the test stand table. No additional power is added to the drive system with the addition of a multiplication drive, and the increased speeds are accompanied by a corresponding reduction in drive power. Multiplication Drive Assemblies are needed to test TG, SG, PSG, EG-10, EG-3, and EGB-2 governors and actuators or any other governor which has a maximum test drive speed in excess of 2000 rpm.

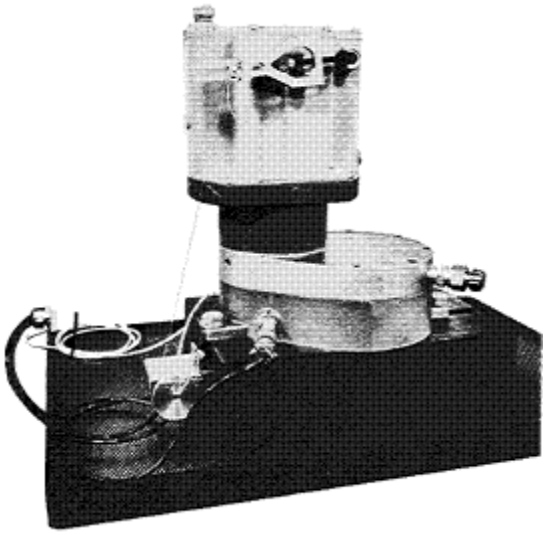


Figure 4-4. Multiplication Drive Assembly with TG Adapter and Governor

The drive assembly permits base oil feed or drain.

An alternate magnetic pickup is included with the multiplication drive assembly.

Governors which use engine oil through a connection in the base require the multiplication drive. The optional drive has fittings which allow connection to the governor fill valve. Drain from the multiplication table is into the test stand drive.

If the Multiplication Drive Assembly is used to test governors that do not have drainage through the governor, fill the multiplication drive with the same oil that is in the test stand until the level is visible in the sight gauge.

Oil Level Control Kit (6995-727)

The Oil Level Control Kit provides a convenient method to circulate heated oil through a governor with a self-contained sump. The kit includes a level monitor to control the flow of heated oil through the governor. Governor drain to the test stand oil reservoir is through a butterfly control valve. Stable oil level requires that drain be slowed from an open setting when using the oil level control.

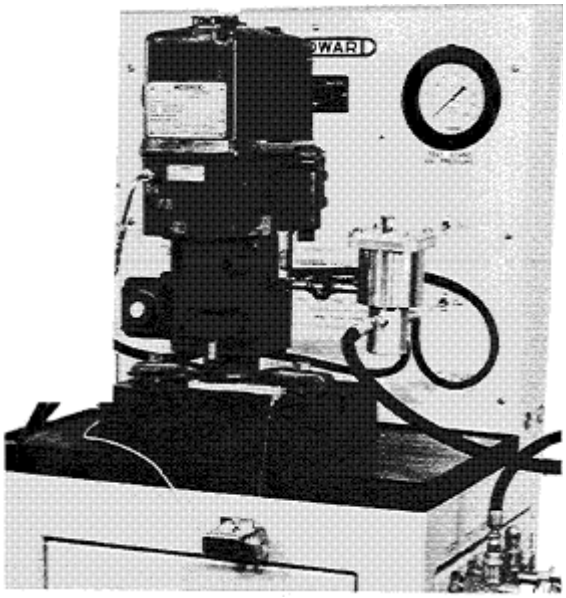


Figure 4-5. Oil Level Control Kit on PG Governor

PG Rail Switch Panel and Cranking Test (6995-747)

Used to test rail governors with solenoid speed setting. Requires the dc power supply. Includes five dedicated switches, three test points for Minimum Field, Wiper, and Maximum Field feedback, and three lights which indicate low water, lube oil pressure limit, and overload condition.

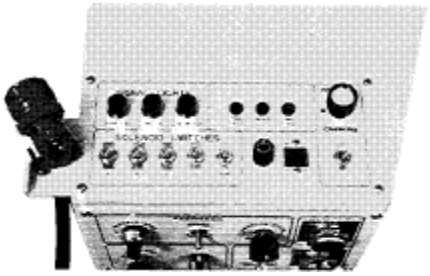


Figure 4-6. PG Rail Switch Panel

A special section allows setting a cranking speed for the test stand drive. The cranking speed makes it easy to switch between two drive speeds that are preset into the test stand.

A cable with a 16-pin connector is part of the kit. Pins N, P, R, and S are provided for numerous miscellaneous governor options. A mating plug is supplied to make construction of special purpose test equipment using the panel connections (see diagram of wiring and function of panel, Figure 4-9).

Cords and Electrical Connectors

Patch cords used between the PGE switch panel cord and various PGE governors are available for use with the PGE switch panel option.

Load Control Indicator (6995-949)

Used to set load controls on some PG governors. Simulates position of excitation settings for generators.

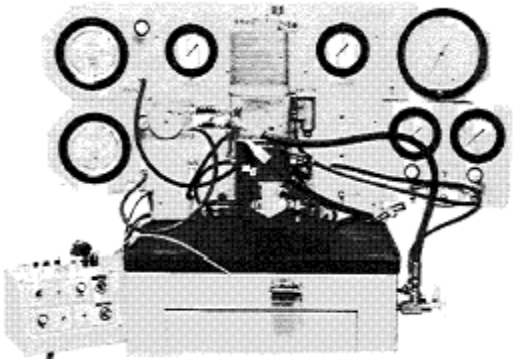


Figure 4-7. Load Control Indicator on PG Governor

5 HP, 3-Phase Option (8909-053)

Provides a more powerful drive motor to permit testing of 200/300 and 500 lb-ft (271/407 and 678 N·m) governors on the test stand. All other features of the stand remain the same as on the standard 3 hp stand. Drive boards and other electronics are changed on the 5 hp stand to accommodate the larger drive motor.

Auxiliary Oil Gauge (6995-725)

Available with either a 6 inch (152 mm) diameter gauge (6995-725) accurate to 0.25% or an 8.5 inch (216 mm) diameter gauge (6995-719) accurate to 0.1%. The gauge selected measures governor oil pressure and is mounted on the right side of the upper panel.

Optional Couplings

Coupling 3387-285 is available for testing certain 3199 actuators. Coupling 3387-283 is needed to drive some PG governors with 1.031” (26.19 mm) keyed drive shafts.

EGR Actuator Test Device (8959-063)

The EGR device allows testing of remote power cylinders (servos) and EGR actuators. The device provides a separate servo to measure output from the actuator. The servo may be removed from the device to provide facilities to test remote servos.

EG Actuator Tester (8909-041)

The EG tester fits on the top of the back panel of the test stand. It provides the dc current outputs needed to test the operation and repeatability of both compensated (integrated) and proportional electric actuators (see Woodward Manual 55021, *EG Actuator Tester 8909-041*). The Actuator Tester is shown in Figure 4-4.

Testing Other Governors

Special kits are available to allow the use of the test stand with governors made by other manufacturers. Contact Woodward about these special adapter kits.

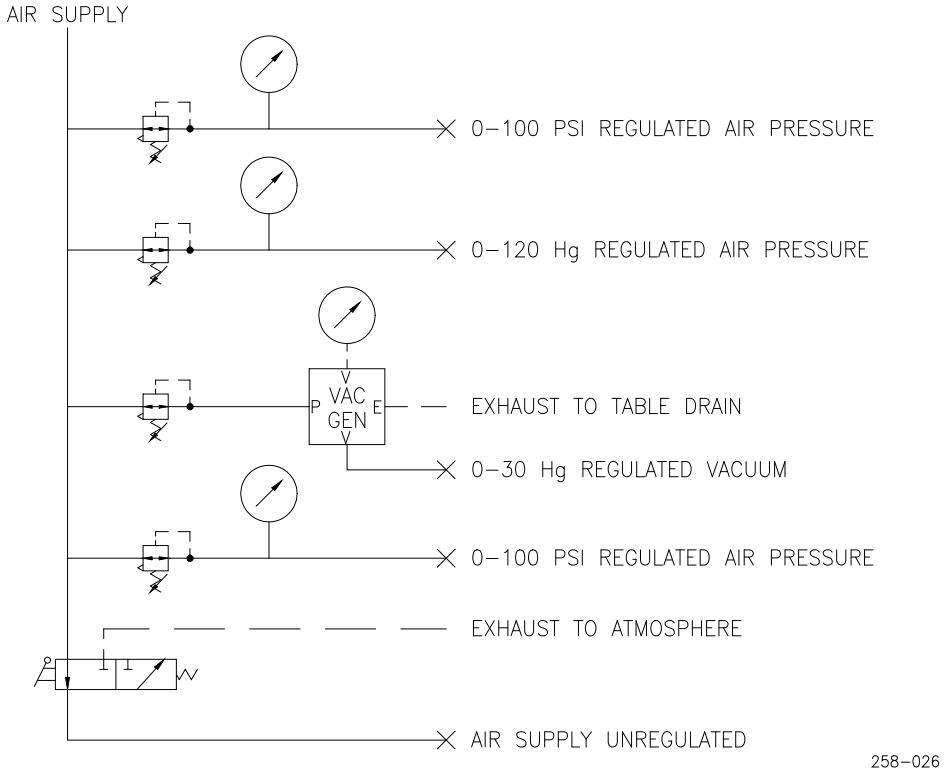


Figure 4-8. Optional Air Pressure Layout

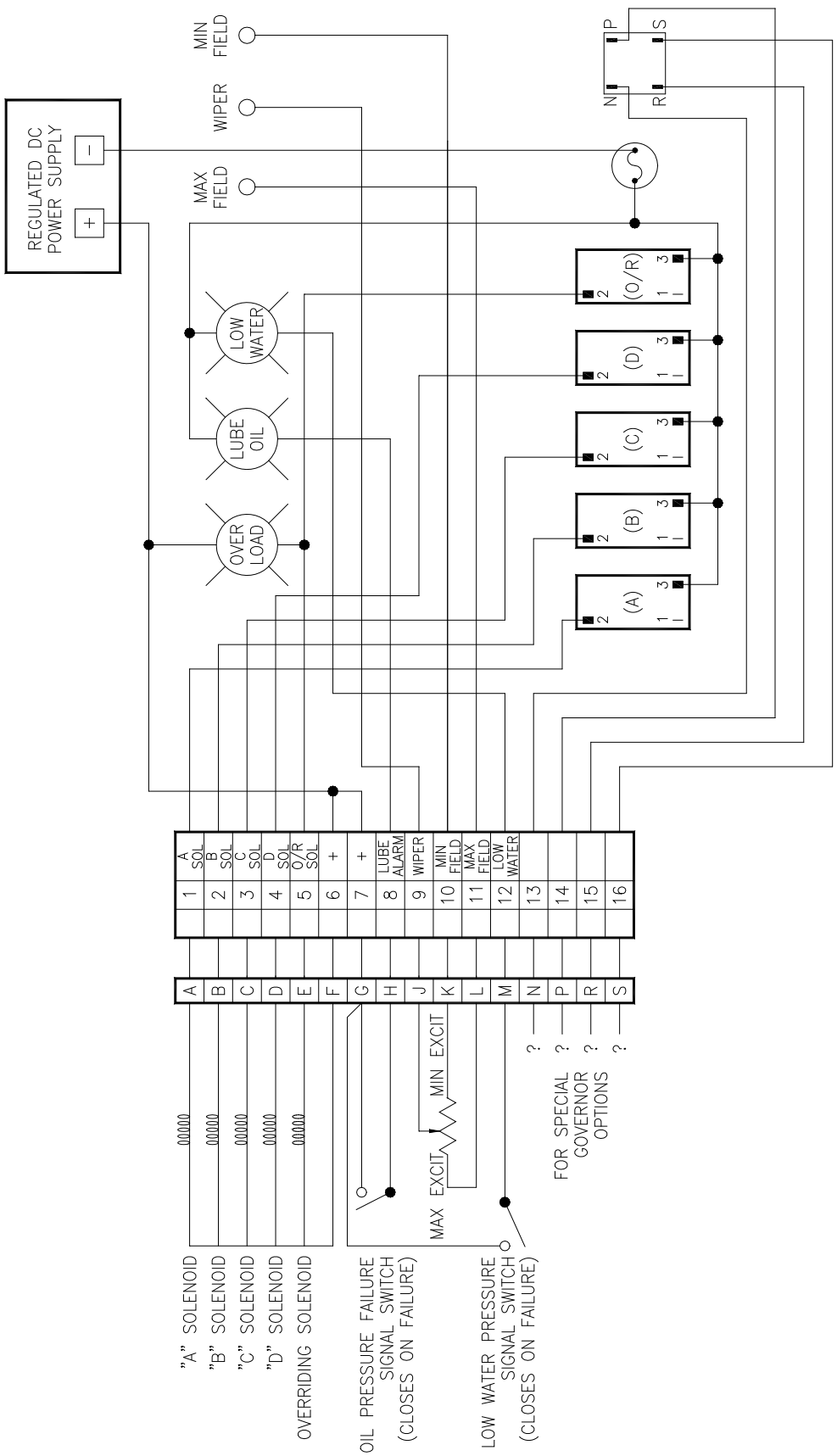


Figure 4-9. Functional Drawing of PG Rail Switch Panel

Chapter 5.
Governor Connection Instructions

Adapter Plates and Drives

The drawings in this chapter contain locations for various electrical, pneumatic, and hydraulic connections available on Woodward governors and actuators. Consult the appropriate drawing to determine connections for the governor to be tested and calibrated on the test stand.

Figure 5-9 provides a selection chart for pilot-adapter plates and drive adapters which are needed to test individual governors. The chart is silk-screened on the Test Stand back panel for the convenience of the operator.

The part numbers are stamped on each of the adapter parts which accompany the test stand. Base types are further identified in Figure 5-9.

Figure 5-8 shows the various pilot adapter plates and drive adapters which are provided with the basic test stand. Additional adapters are available for special governor drives.

Universal Connectors for Test

The following items are included with each test stand to be used to attach a governor to the stand and to test the governor:

Three 36 inch (914 mm) long hoses with a 0.438” (11.13 mm) female swivel fitting at each end (the hoses fit 37 degree, 0.250 inch [6.35 mm] tube fittings).

- One for governor fill to governor case fittings, oil level control, or governor fill cup as appropriate
- One from governor pump pressure bulkhead to governor pump pressure port fitting
- One from test stand oil pressure bulkhead to any governor option requiring regulated oil pressure

A fourth hose is provided for the governor drain line from the governor to the drain fitting on the side door of the cabinet.

A serration wrench to be used on serrated output shafts of governors being tested.

Two governor hold down clamps with Tee nuts, 0.625-11 x 1.5 and x 2.5 hex head screws and flat washers.

A surface thermometer which has a magnetic connection to be used on the outside of governors being tested.

An extra oil filter replacement element for use should the original filter become clogged with dirt.(Automotive oil filters do not have adequate burst pressure ratings.)

Adapters, couplings and set screws are included to permit testing of most governors on the test stand.

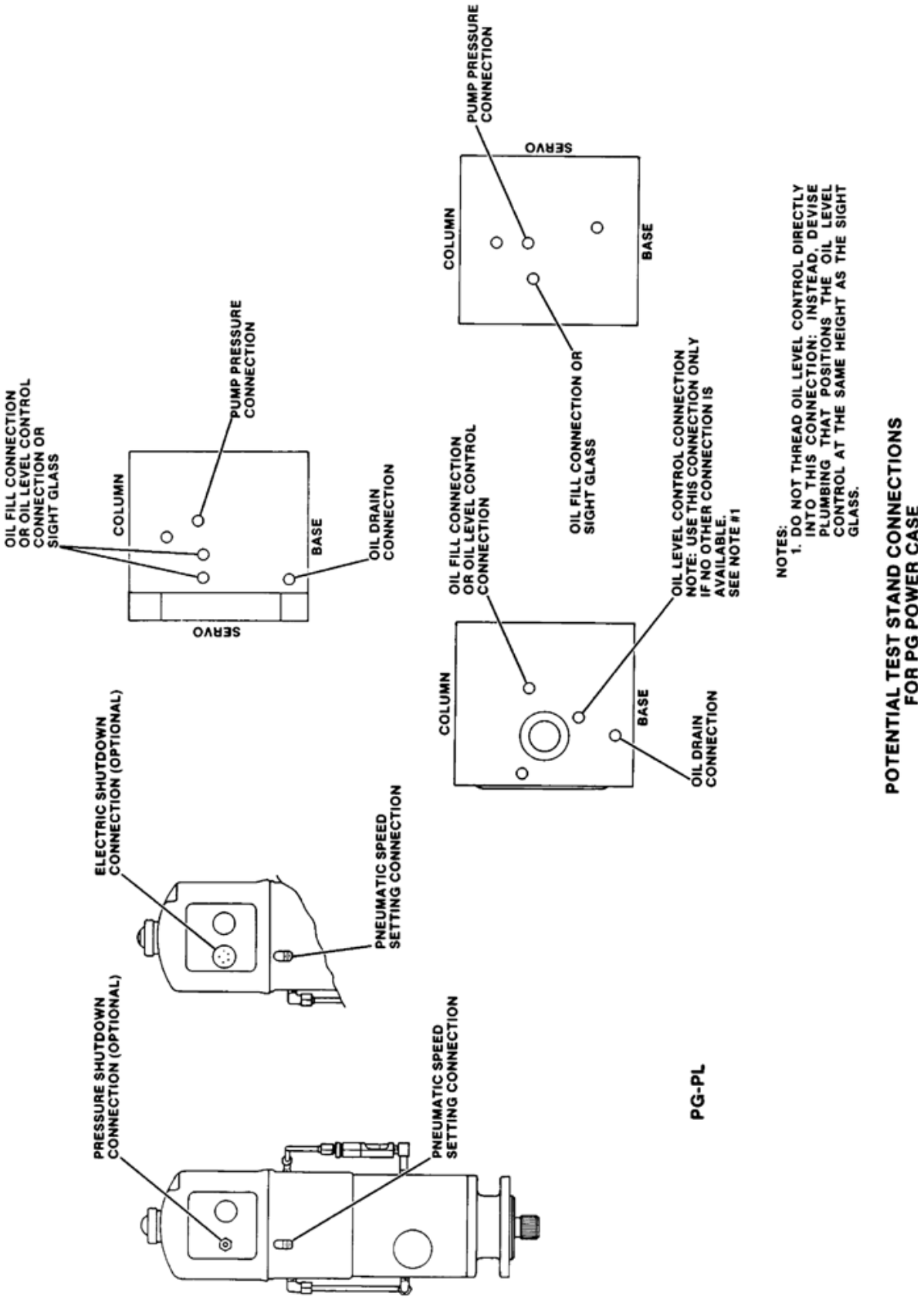


Figure 5-1. PG Power Case Connections, PG-PL Connections

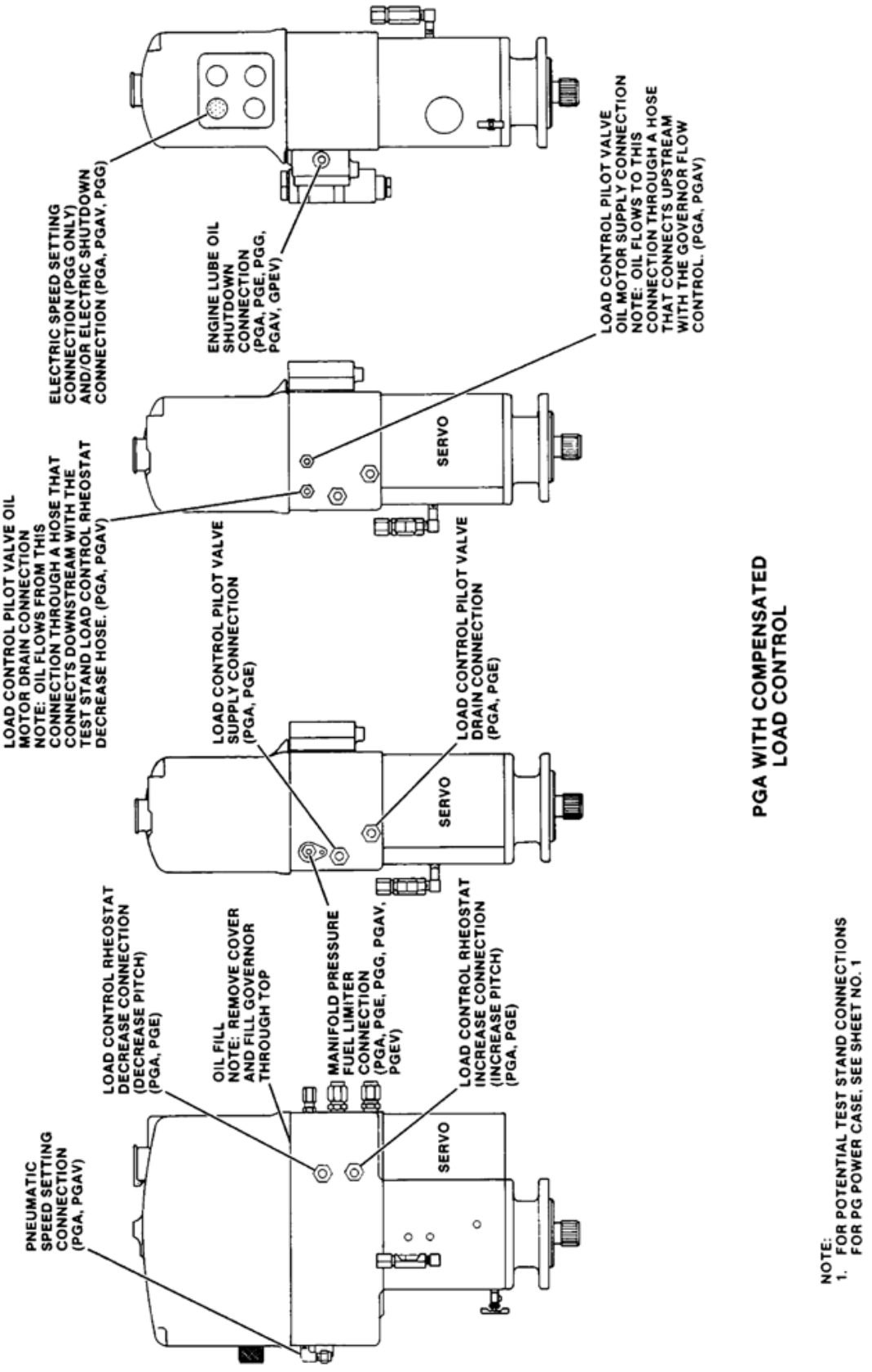


Figure 5-2. PGA Connections

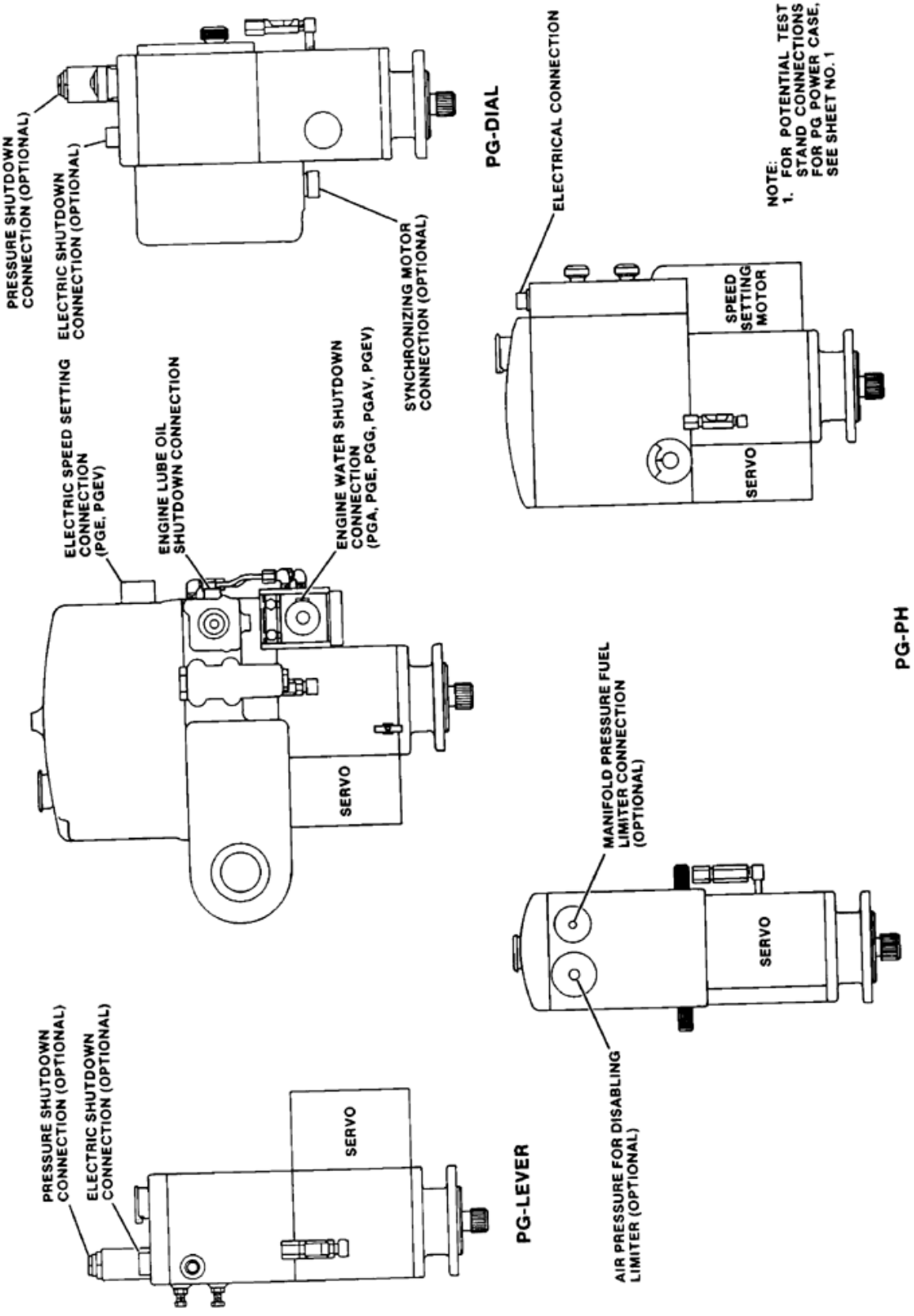


Figure 5-3. PG Lever, PG Dial, PG-PH Connections

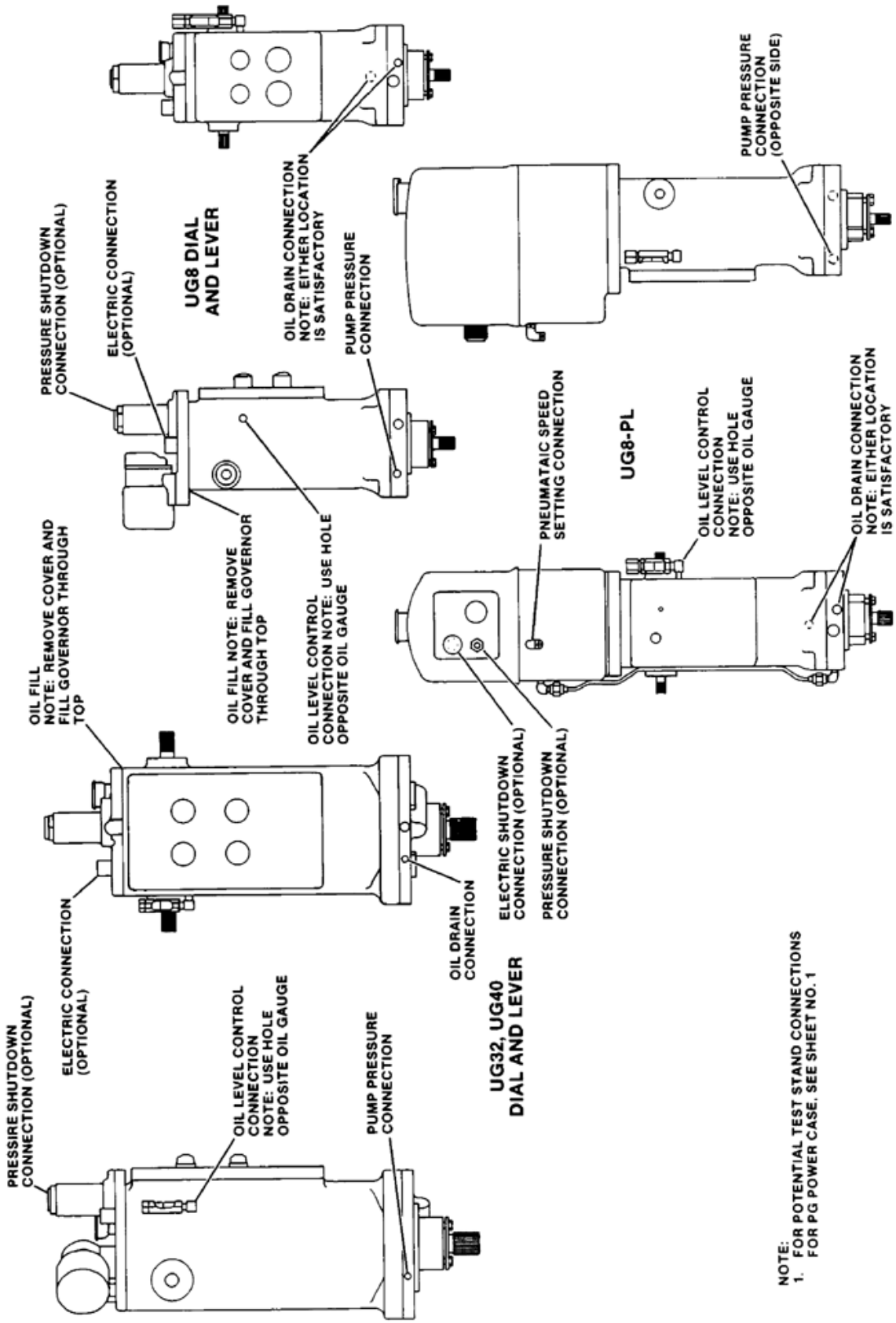


Figure 5-4. Test Stand Connections for UG Governors

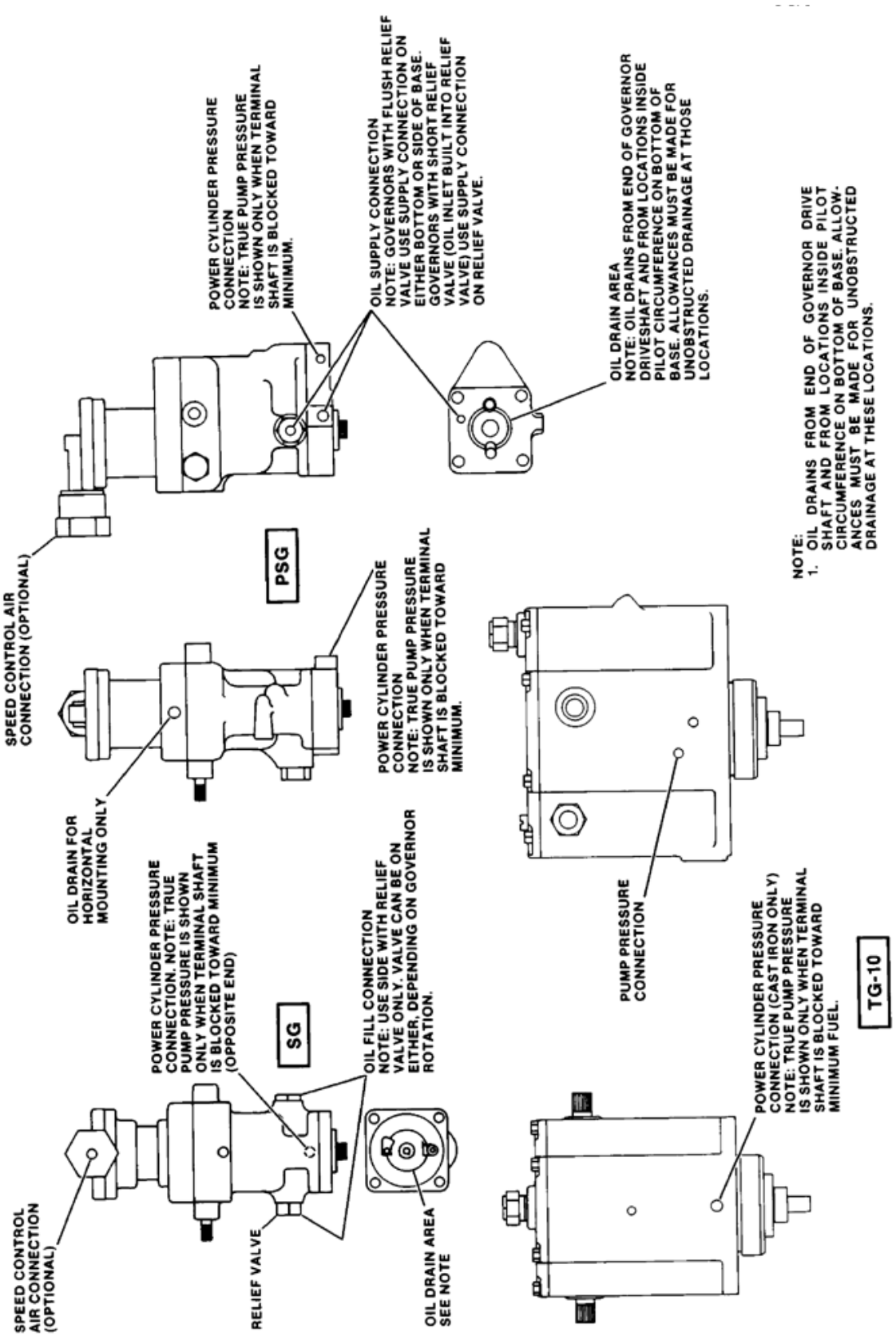


Figure 5-5. Test Stand Connections for SG, PSG and TG Governors

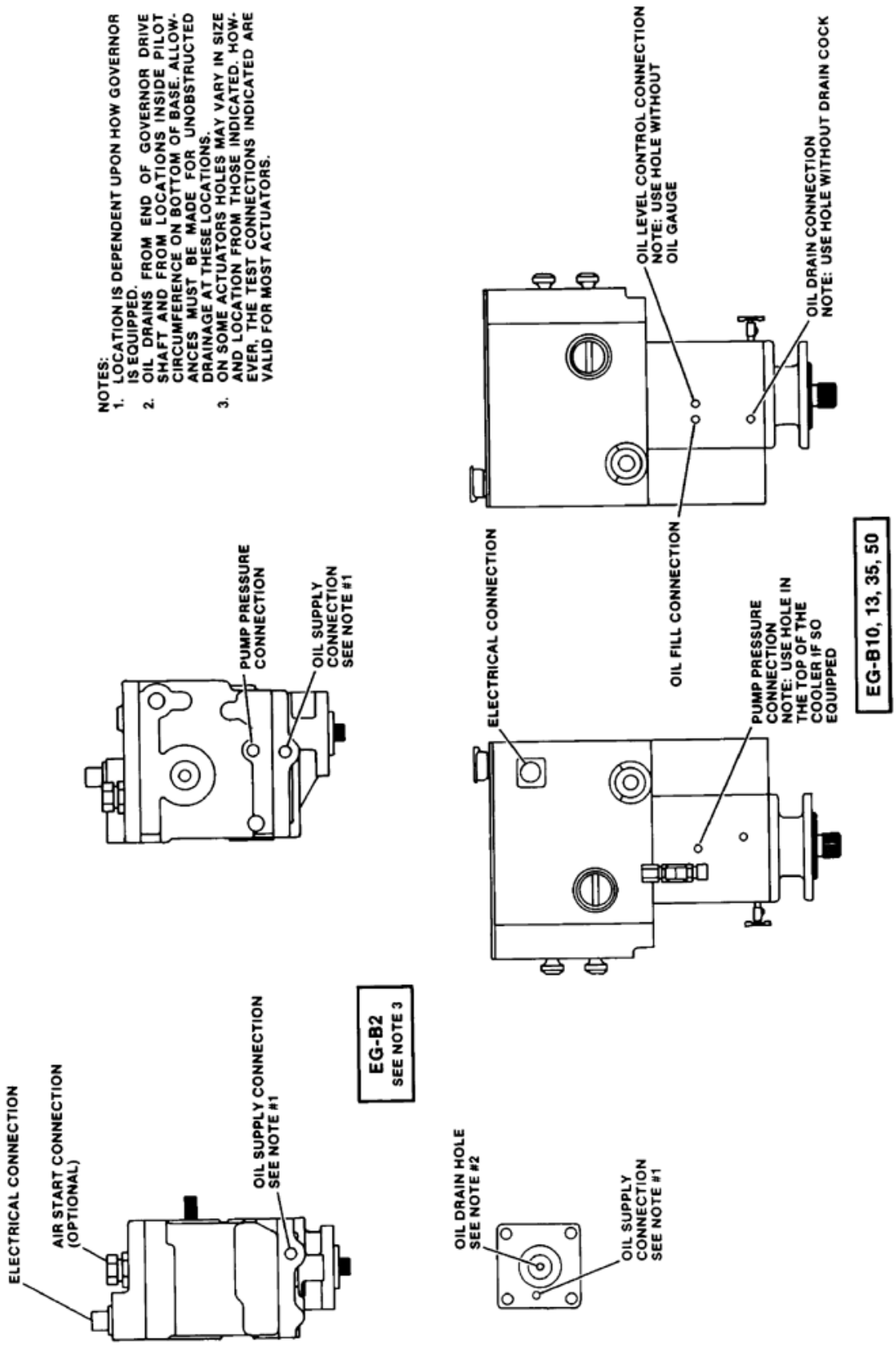


Figure 5-6. Test Stand Connections for EGB Governors

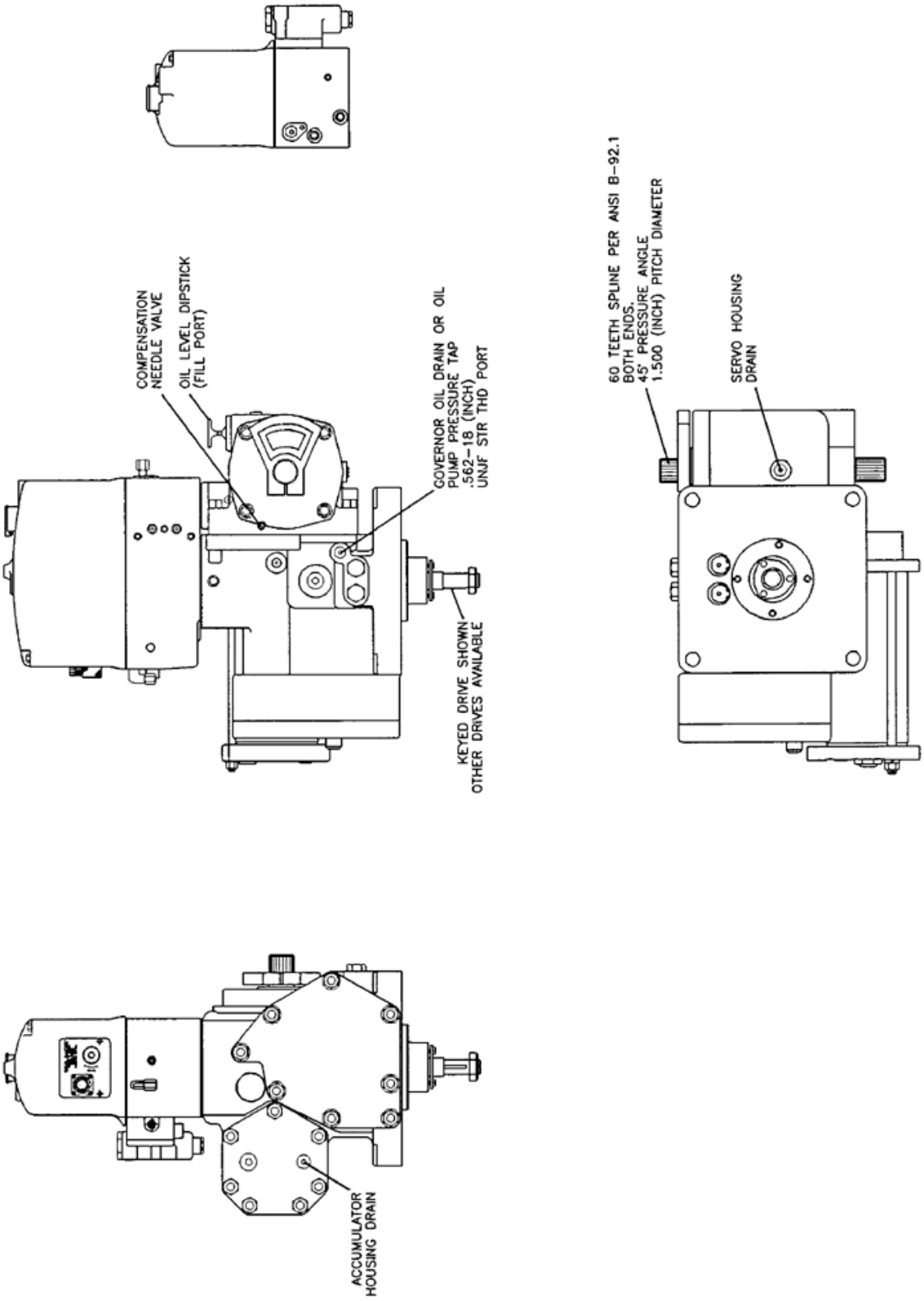


Figure 5-7. Connections for EGB and PG-200, -300, and –500 Governors

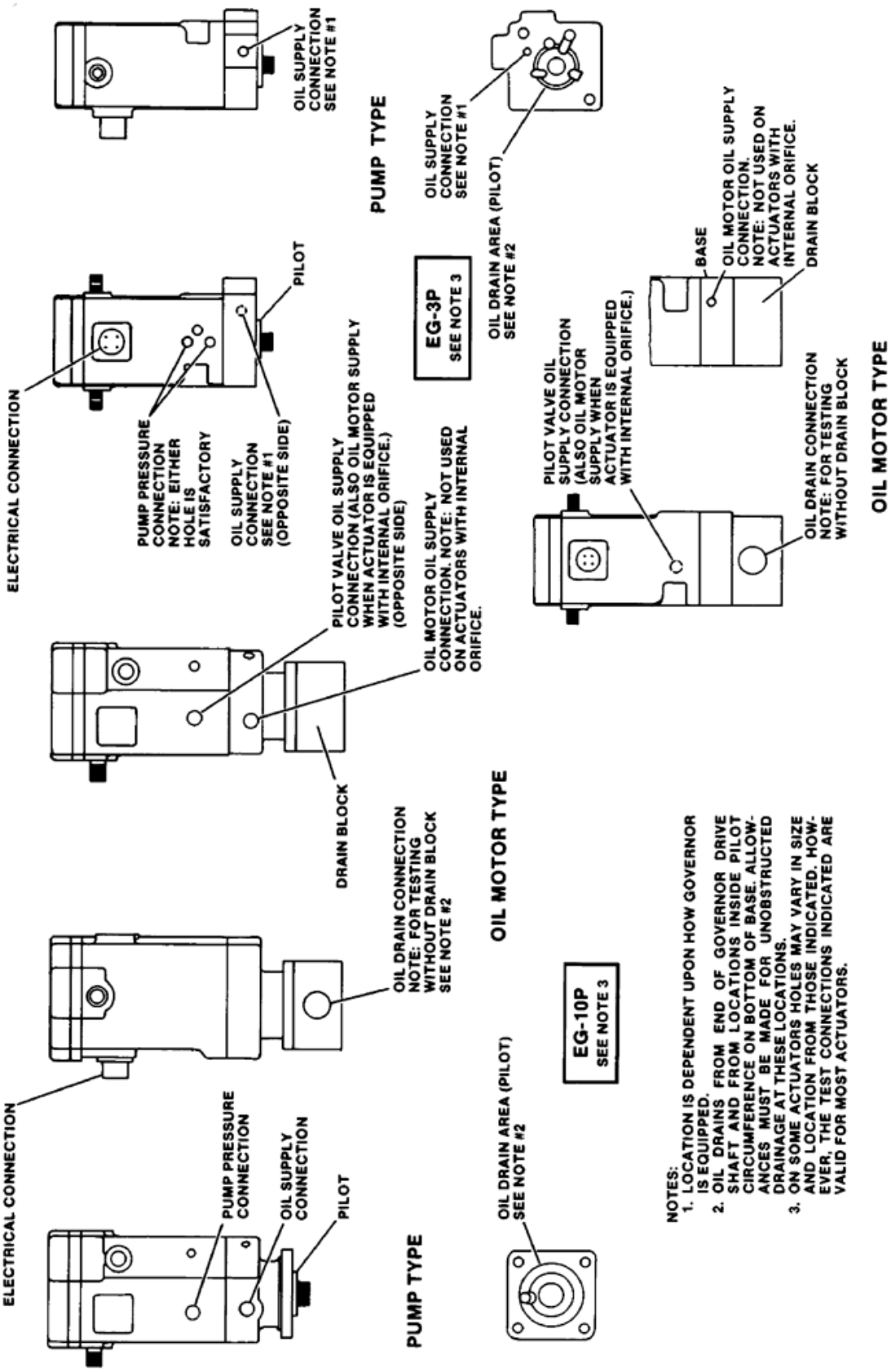


Figure 5-8. Test Stand Connections for EG Actuators

Figure 5-9. Adapters Needed for Various Governors

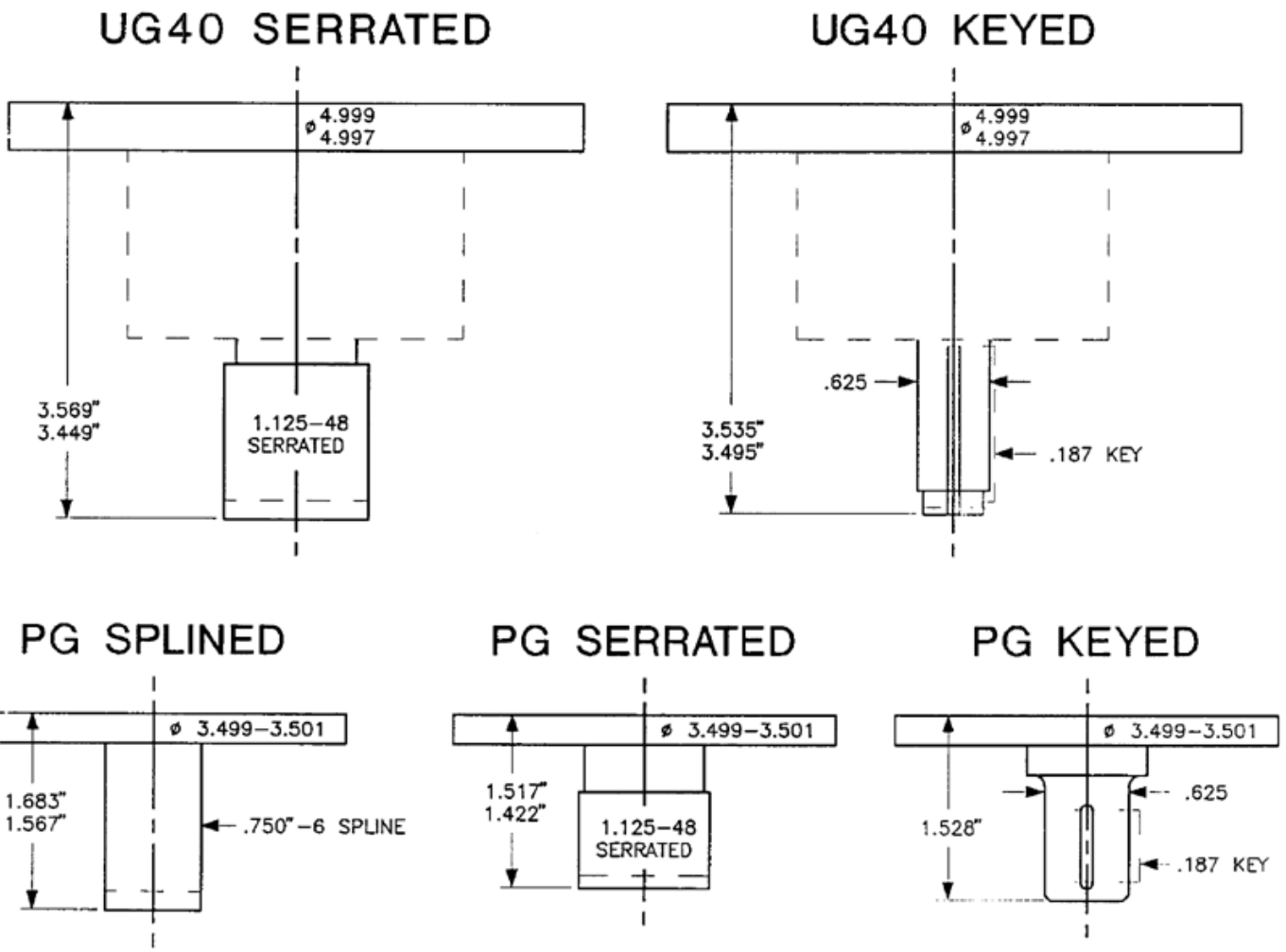


CHART MATCHING ADAPTERS TO GOVERNORS

BASE	DRIVE SHAFT	BASE ADAPTER 3219-049	BASE ADAPTER 3219-051	BASE ADAPTER 3219-053	DRIVE COUPLING 3387-287	DRIVE COUPLING 3387-289	DRIVE COUPLING 3387-291	DRIVE COUPLING 3387-293	DRIVE ADAPTER 3295-129	DRIVE ADAPTER 3497-071	DRIVE ADAPTER 3497-073	DRIVE ADAPTER 3497-075	DRIVE ADAPTER 3497-077	DRIVE ADAPTER 3497-079
PG	.625 KEYED	X						X					X	
PG	.750–6 SPLINE	X						X		X				
PG	1.125–48 SERR	X						X						
3161/UG8	.625–36 SERR		X				X						X	
3161/UG8	.625 KEYED		X			X					X			
ALCO	.625 KEYED					X					X			
ALCO EXT.	.625 KEYED					X								X
UG40	1.125–48 SERR			X			X							
UG40	.625 KEYED			X			X					X		

Figure 5-10. Chart Matching Adapters to Governors

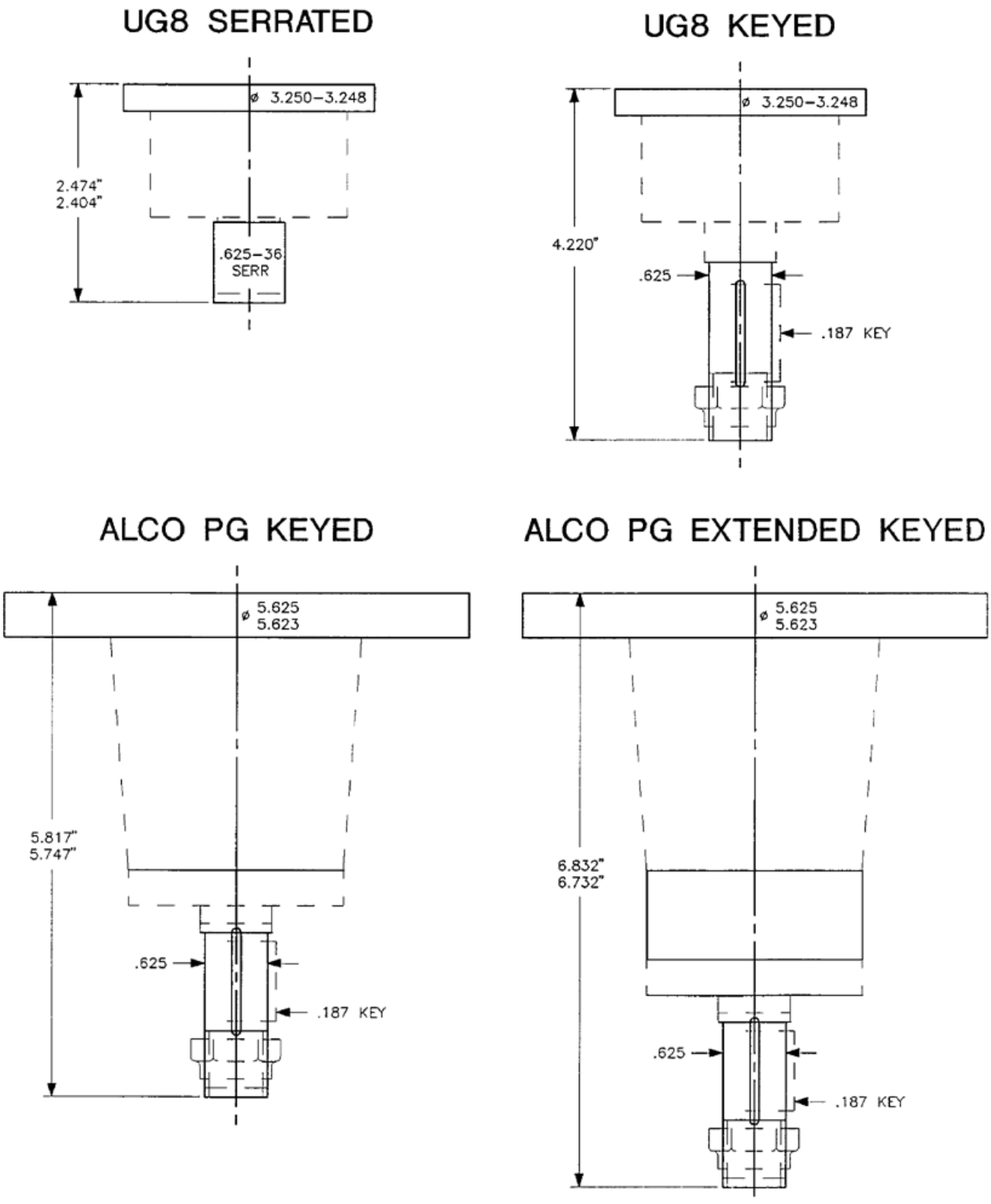


Figure 5-11. Governor Bases (reference for Figure 5-10)

Chapter 6.
Maintenance and Troubleshooting

Oil Strainer

The oil filter inside the base of the test stand is manufactured by Parker, Filter Division, Metamora, Ohio (Parker part number 925023 / Woodward number 1327-131). The 25 µm spin-on filter element cannot be replaced with a standard automotive type filter, as an element with a burst point of 250 psi (1724 kPa) and a temperature range to 250 °F (121 °C) is required. The filter system should be inspected on a regular basis and serviced anytime the filter is dirty or the oil in the test stand becomes contaminated. Clean test stand oil is necessary to assure the most accurate results from the stand. It is important not to contaminate the governor being tested.

IMPORTANT

The 25 µm filter is used for oil supply to mechanical governos with less than 350 psi (2400 kPa) pump pressure. For electrical actuator applications or for pump pressures greater than 350 psi (2400 kPa), use 10 µm filter (Woodward number 1326-8001).

To change the oil in the test stand, remove the oil line from the table to the oil reservoir and lower the end to a pan on the floor. Oil leaves the reservoir by gravity. Replace the hose to the test stand table as soon as possible to avoid a possible flood of the test stand base. Add oil by pouring into the top of the table. Overfilling the system will cause oil to leak into the base of the test stand (see Figure 3-2).

IMPORTANT

Oil causes many of the problems experienced with modern, quality governors. Take care that governors are calibrated while using the best oil possible. Do not contaminate the governor being tested with dirty test stand oil.

Base Contents

Figure 6-1 shows the interior of the base with the door in the front of the test stand open. The oil pump and motor are visible at the bottom of the figure.

Oil Reservoir

The oil reservoir is a welded steel box, about 9.5 x 9.5 inches and 16 inches high (240x240x406 mm). It holds about 5 US gallons (19 L) of oil. Oil should be added by pouring through the screen on the table. Drain the reservoir by disconnecting the hose that connects the table to the reservoir and bringing it to floor level. The pump draws oil from about mid point in the reservoir, preventing the oil level from dropping below the heater level. A hole in the top of the reservoir is a vent. The vent is extended out the side door. If the reservoir is overfilled, oil will leak from this vent.

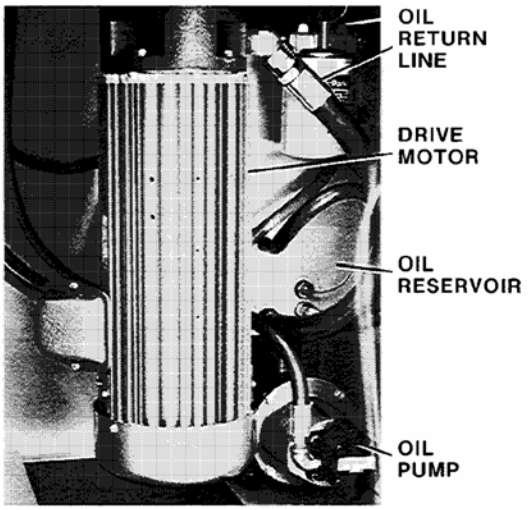


Figure 6-1. Interior of Base

Oil Heater

A 2000 W oil heater, shown in Figures 6-1 and 6-2, is near the bottom of the reservoir. The heater is a WatLow model 1726-120. The heater is immersion type, 240 Vac, single phase. The reservoir must be drained before the heater can be replaced. The heater extends from a 4 inch (102 mm) junction box into the reservoir. The heater is connected to the reservoir with 2.500-8 NPT threads.

The reservoir thermostat is mounted on the door, shown in Figure 6-2. The plate on the unit is graduated into degrees F and the knob should be turned to the proper setting (usually 200 °F [93 °C]). The control is manufactured by Athena Control, Inc., Model 86-10-D-03F. It includes a solid-state electronic board and a single-turn potentiometer.

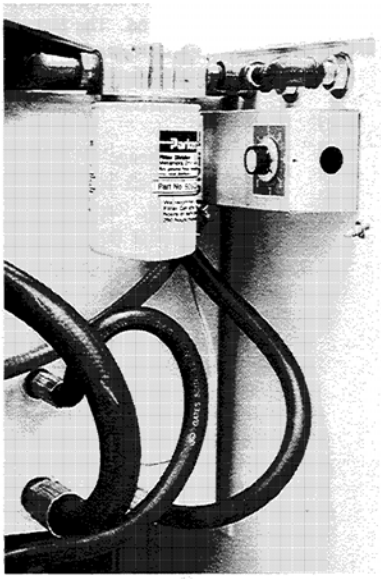


Figure 6-2. Interior of Side Door

The Type JH thermocouple is installed in the oil reservoir, thread size is 500 NPT. The thermocouple extends 2 inches (51 mm) into the reservoir. The thermocouple is manufactured by Durex International Corp., model GU-102-0-7-24-188-U, 2 inch, type J.

All test stand oil plumbing is built from 3/8 inch (9.5 mm) pipe, hydraulic hose, and nylon tubing. Internal wiring in the base is twisted copper in flexible cables.

Cleaning the Table

The steel mesh screen on the table top is easily removed to allow access to the oil drain sump in the cast table. Remove the screen by lifting straight up. Keep the sump as clean as possible to avoid contamination of the test stand oil filter or the test governor.

Drive Motor Speed Reference

The magnetic pickup, which drives the tachometer, is located on the left-hand side of the table extension.

The magnetic pickup generates an electrical frequency proportional to the speed of the motor rotation. Since there are no moving parts, any problems are usually found in the distance between the pickup and the motor gear, in the wiring from the pickup to the tachometer, or in the tachometer.

To set the distance for the magnetic pickup (MPU): loosen the locknut and thread the MPU in until the tip of the pickup just touches the motor gear, then back the MPU out one-half turn. Reset the locknut. Do not have the pickup too close or too far from the gear on the motor. The MPU wire can pick up interference from the motor supply current cable, and this relationship should be inspected if problems are suspected.

Removal of Drive Adapter and Seal

The drive adapter is attached to the motor drive shaft with a set screw. See Figure 6-3 for removal of the adapter. The magnetic pickup must be removed before the pipe elbow can be removed. The pipe plug covers access to the set screw in the drive adapter. A worn-oil seal will result in oil leaking onto the top of the drive motor and from there into the base of the cabinet. The seal is Woodward part number 1369-113 or is available from the manufacturer, Forsheda Shaft Seal Corp., Cleveland, OH, Forsheda part number V55A.

Electrical Circuits

Figure 6-6 is a schematic of the test stand control and drive circuits. Circuits are on the back door of the upper panel.

Figure 6-5a or 6-5c shows the control circuits viewed with the test stand back door open. Call-outs on Figure 6-5a or 6-5c are for reference only. All circuits in the upper panel are solid state, and routine maintenance should not be necessary. Complete circuit boards may be replaced, if necessary. Additional gauges are normally mounted on the side of the upper panel. These additional gauges are seldom connected to the drive boards shown in Figures 6-5 and 6-6. Replacement potentiometers, switches, and mechanical parts may be obtained from Woodward. Information from the manufacturer of various elements included in the test stand is provided with the test stand. Problems may be directed to either the manufacturer of a specific element or to Woodward.

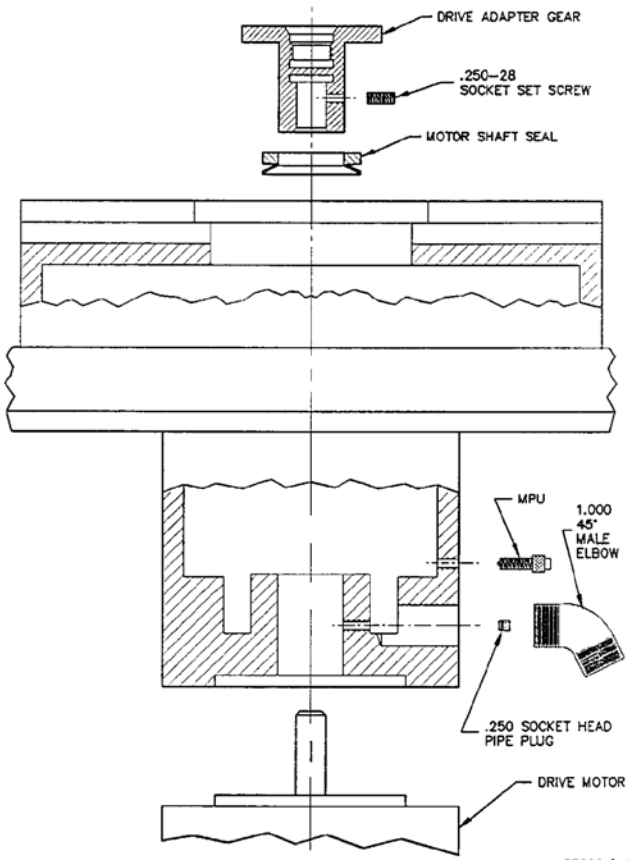


Figure 6-3. Drive Adapter and Seal Installation

Fuses

All circuits in the test stand are protected by fuses as indicated in the schematic. Refer to the photograph of the electrical panel for location of fuses. On the 3 hp stand, fuses 1 and 2 are 20 A. Fuses 3 and 4 are 15 A, and fuse 5 is 3 A. In addition, the master switch on the front of the upper cabinet is a 20 A circuit breaker. The 5 hp stand has three fuses. Fuses 1 and 2 are 15 A, and fuse 3 is 3 A. A 40 A three-phase breaker is on the front of the cabinet.

The PG Rail test panel is protected with a 2.5 A fuse accessible from the switch panel. A 1.5 A fuse protects the optional dc variable power supply.

Drive Motor Maintenance

The drive motor should have maintenance every 1000 to 1500 hours of operation (twice a year for full-time one-shift operation). To service the motor, remove the brushes and the cover on the bottom of the motor. Replace with new brushes if necessary. While the brushes are out, the commutator area should be blown out with compressed air or otherwise serviced according to the shop standards for motor service.

The drive adapter must be removed before the drive motor can be removed. Do not attempt to remove the motor from the test stand unless absolutely necessary.

The 3 hp motor is a permanent magnet type, 180 Vdc, 1750 or 1800 rpm, TEFC, Nema C face with 4.5 inch (114 mm) pilot, vertical shaft operation, rated continuous duty with an attached conduit box. The shaft from the motor is 0.875 inch (22.22 mm) diameter with a 0.188” (4.78 mm) square by 1.375” (34.92 mm) key drive.

The 5 hp motor is a permanent magnet type, 230 Vdc, 1700 rpm, TEFC, Nema C face with 4.5 inch (114 mm) pilot, vertical shaft operation, rated continuous duty with an attached conduit box. The shaft from the motor is 1.375 inch (34.92 mm) diameter with a 0.313” (7.95 mm) square by 2.000” (50.80 mm) key drive.

Vacuum Generator

The vacuum generator has no moving parts and should not require maintenance except to remove it and wash with shop solvent. Check for a reduced pressure air supply if vacuum pressure decreases. The filter on the left-hand side of the stand could cause reduced air supply. This filter may be removed and washed with solvent if necessary.

Oil Pressure Regulator

The pressure regulator valve is factory set to prevent overpressure of gauges on the stand. These settings should not be changed. Inability to attain desired test stand oil pressure is more likely to be caused by a low oil level, plugged oil filter, worn pump parts, or oil that is too thin at the temperature being used.

Feedback Potentiometer

The line on the feedback potentiometer is 5 ft (1.5 m) long, standard monofilament, 40 lb (178 N) test, fish line. Any quality monofilament line of sufficient test can be used to replace the feedback line. Nylon line is ***not*** recommended. Remove the magnet from the bottom of the case to access the feedback potentiometer. The feedback pulley is held onto the potentiometer shaft by a set screw located beneath the feedback spring. Loosen this set screw to remove the pulley from the potentiometer shaft. To set up a new potentiometer on a 3 hp stand, hold the pulley at one of the travel limits and position the potentiometer shaft to provide 1 kΩ resistance measured inside the upper cabinet at TB 1, terminals 4 (CCW), 5 (wiper), and 6 (CW). Tighten the set screw. The potentiometer should now read 9 kΩ of resistance at the other end of the pulley's travel.

On the 5 hp stand, the readings will be 0.5 kΩ CCW and 5.5 kΩ full CW.

The potentiometer is a 10 kΩ, single-turn model, Woodward part number 1657-965.

Oil Pump Rotation

Oil Pump motor rotation is determined by the phases of the power feed to the test stand. To reverse the oil pump motor rotation, transpose the terminals on the master switch circuit breaker.

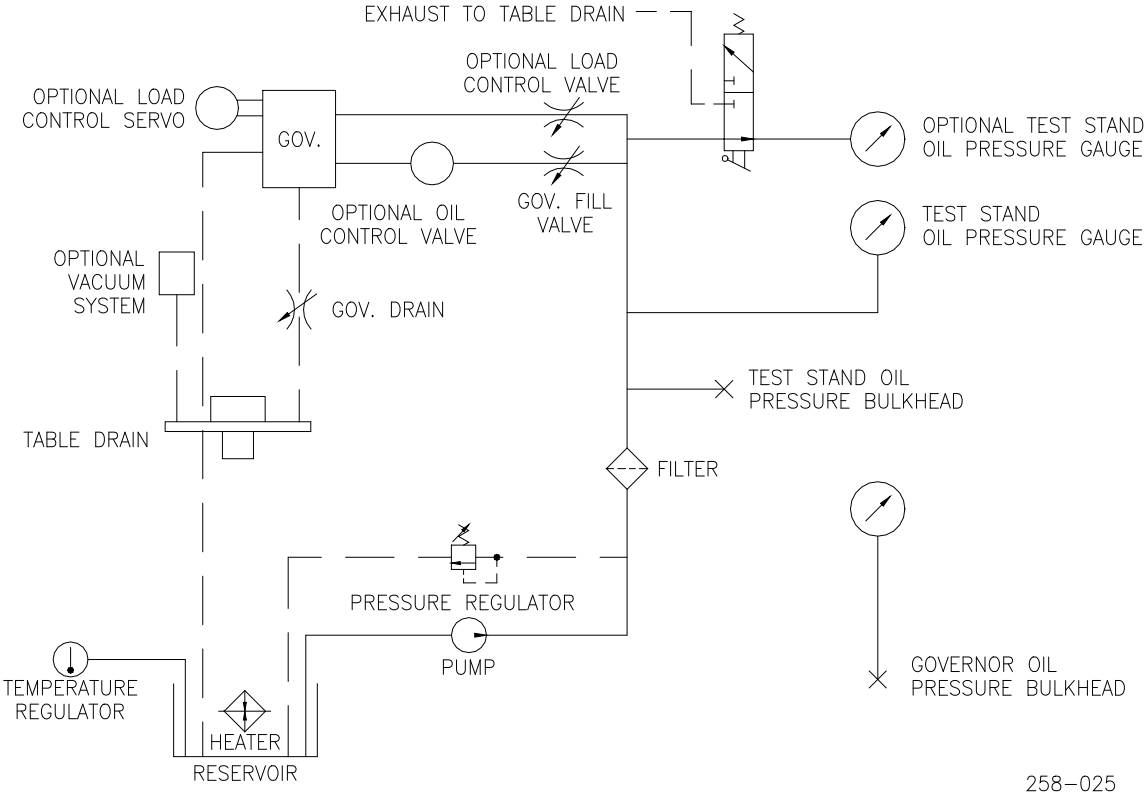


Figure 6-4. Schematic of Oil Pressure System

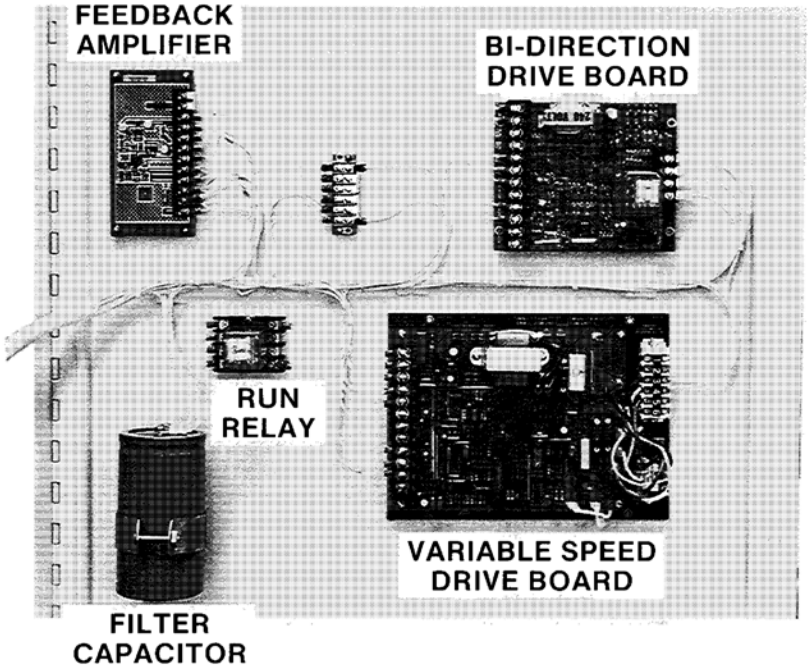


Figure 6-5a. Interior of 3 HP Upper Panel Door

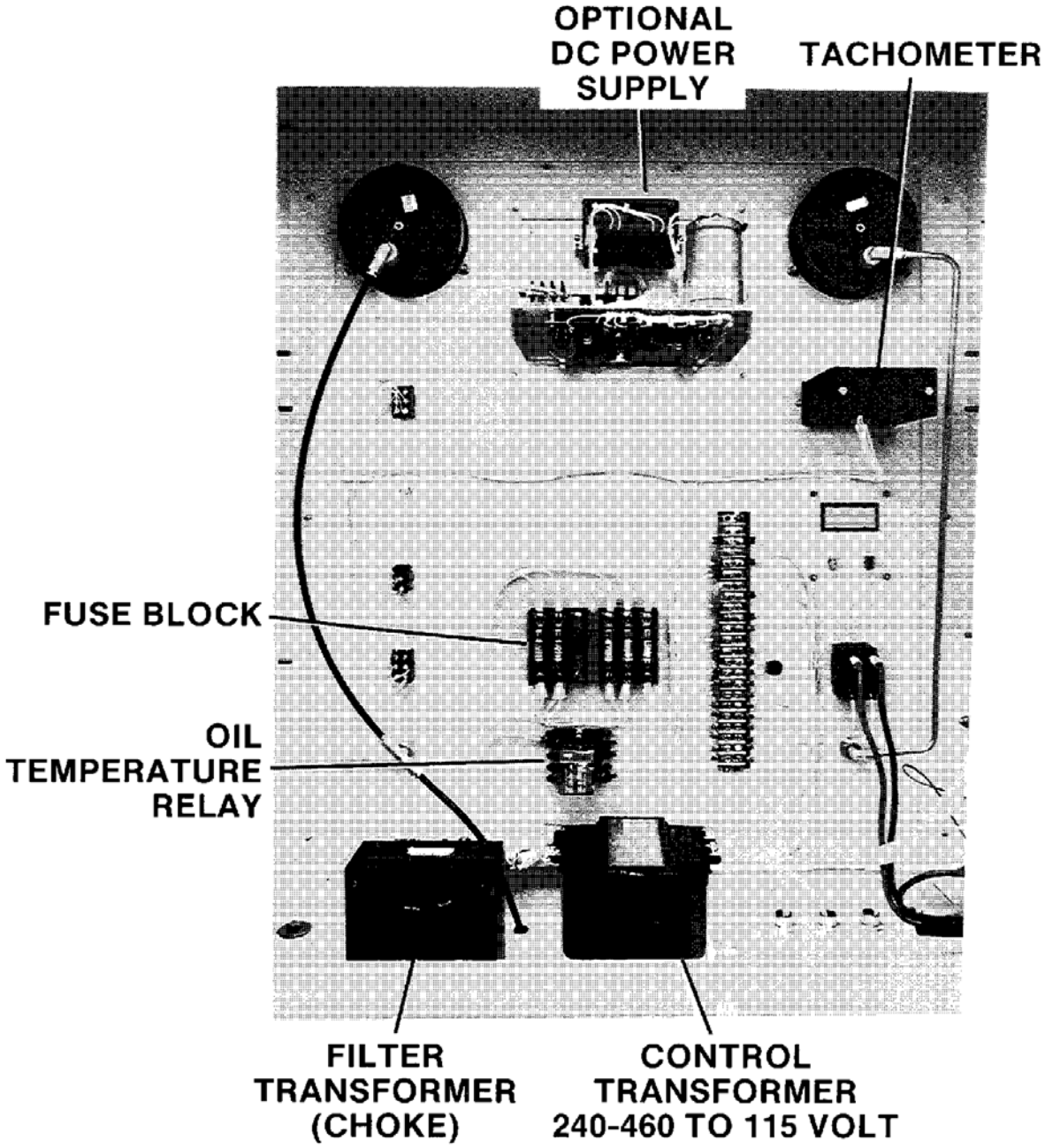


Figure 6-5b. Interior of 3 HP Upper Panel

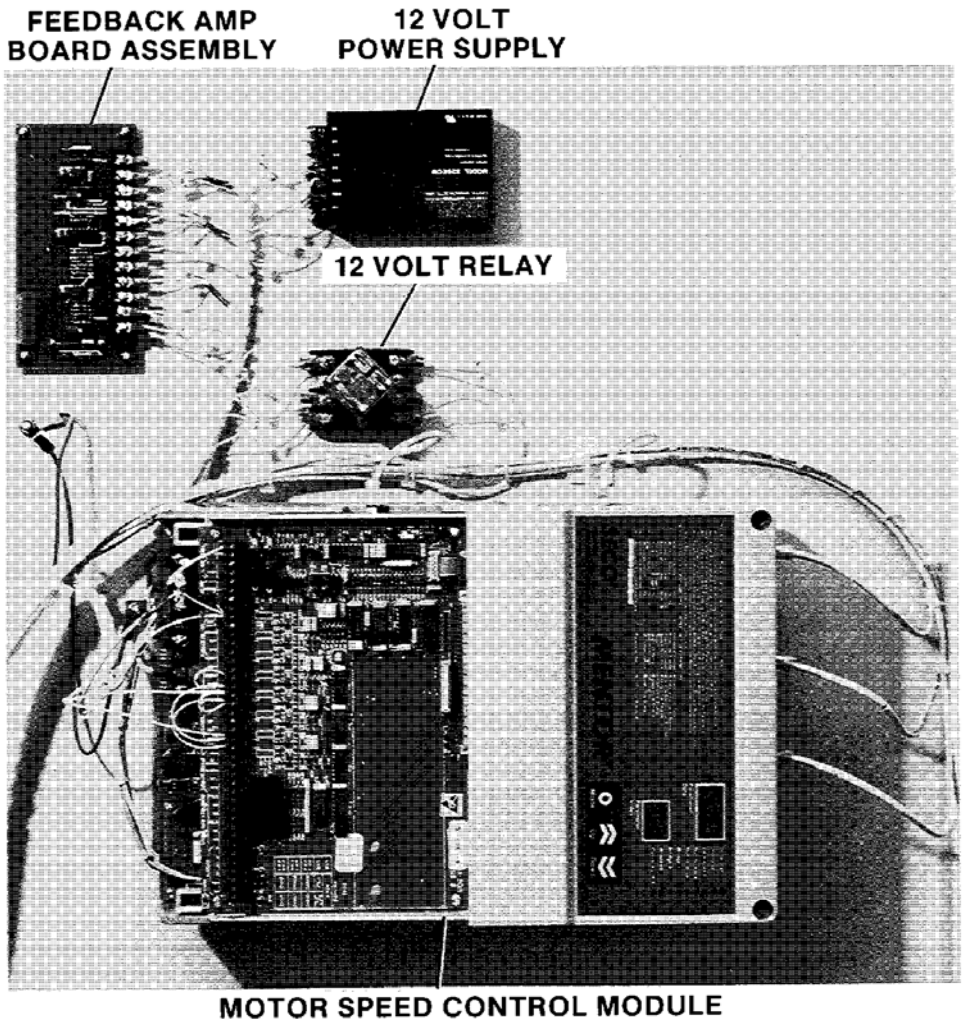
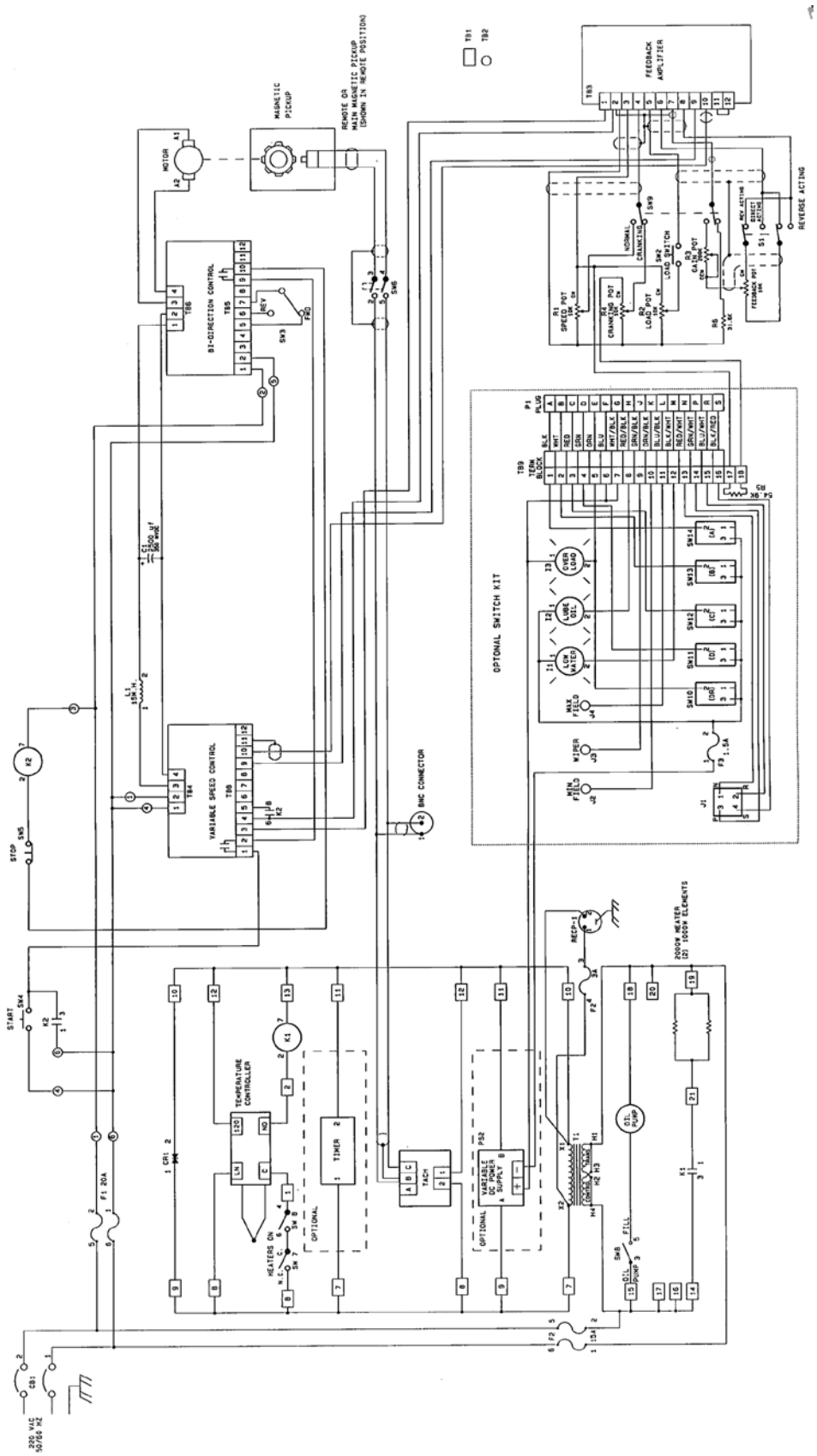


Figure 6-5c. Interior of Back Door on 5 HP Test Stand



9970-808

Figure 6-6. Schematic of 3 HP Electric Test Stand

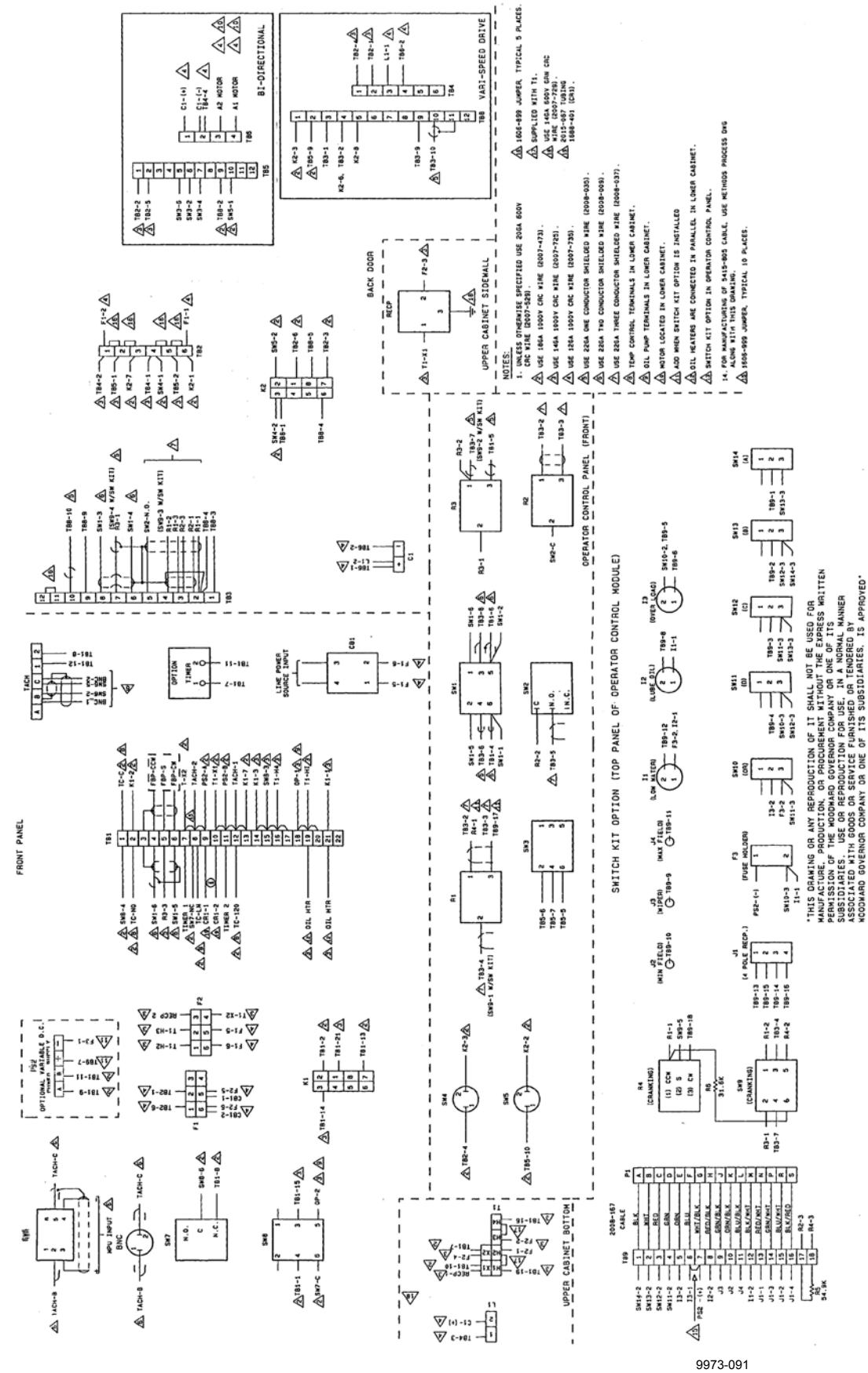


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Figure 6-7. Wiring Layout of 3 HP Electric Test Stand

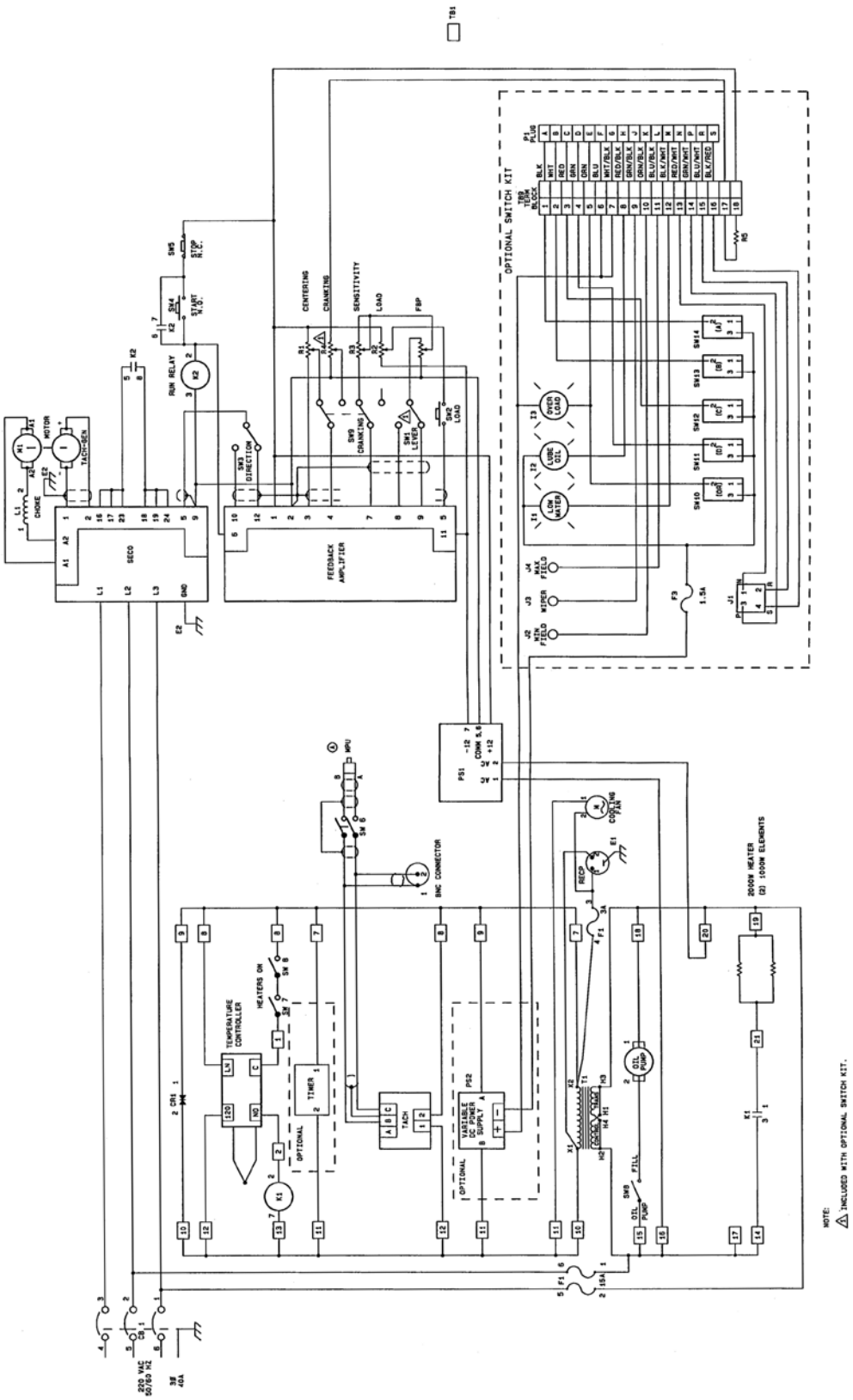

Figure 6-8. Schematic of 5 HP Test Stand

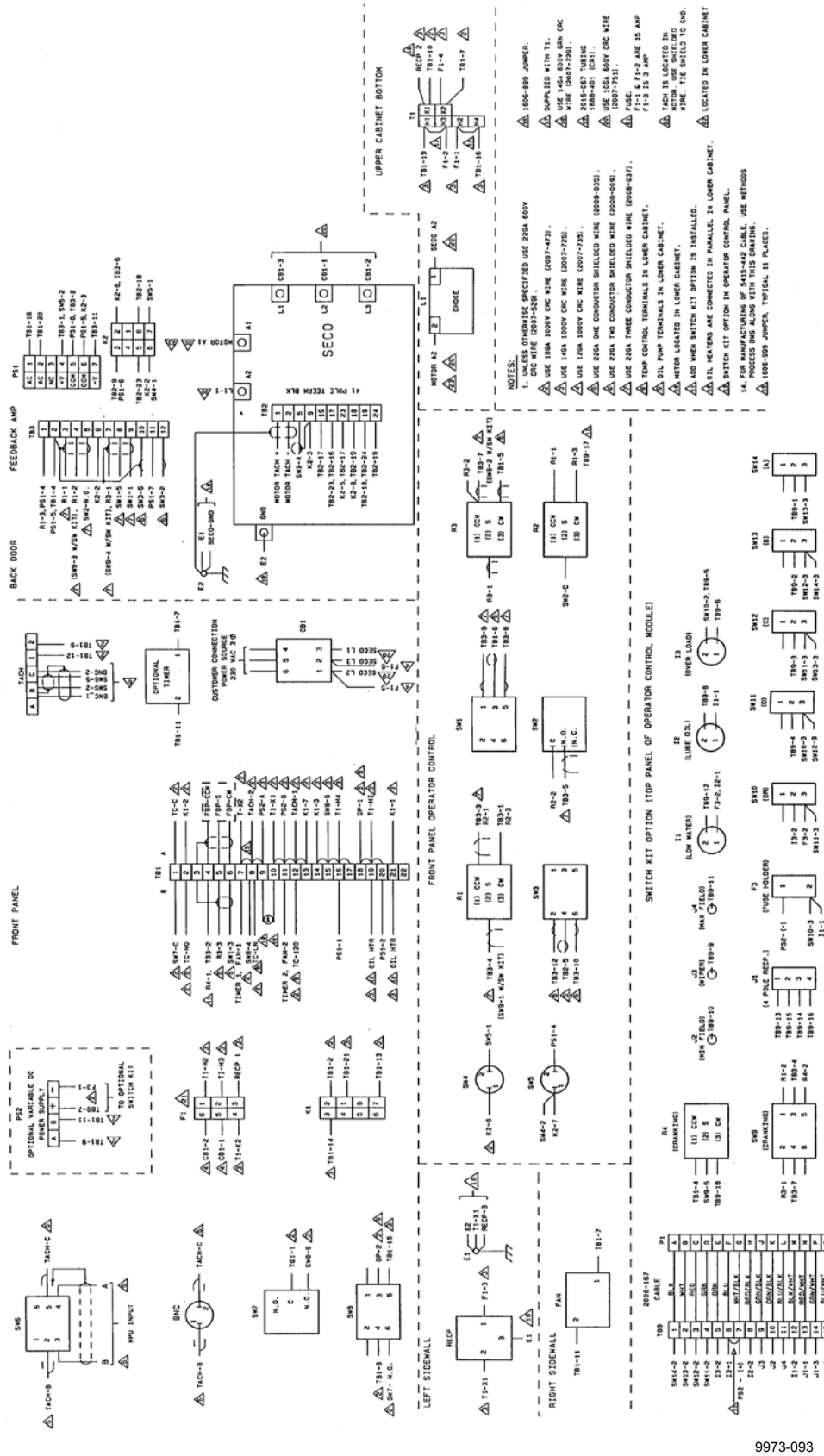

Figure 6-9. Wiring Layout of 5 HP Test Stand

Chapter 7.
Replacement Parts

Parts Information

When ordering parts, give the following information:

- The test stand type, serial number, and part number.
- Manual number (this is manual 25805).
- Part reference number given in the parts list and part name.

Parts List for Figure 7-1

Ref. No.	Part Name	Quantity
25805-1	Upper Cabinet Assy	1
25805-2	Cover, Vent	1
25805-3	Screw, 6-32 X .438	4
25805-4	Lower Cabinet Assy	1
25805-5	Table, Test Stand	1
	Screw .500-13 X .625	4
	Washer, .540 X 1.248 X .103	4
25805-5a	Screen, Test Stand Table	1
25805-6	Oil Sight Gauge	2
25805-7	Nipple, .125 NPT Close	1
25805-8	90 Degree Elbow Fitting	1
25805-9	Pressure Relief Valve	1
25805-10	Governor Fill Valve	1
25805-11	Load Control Pressure Valve (option) or Cover Assembly	
25805-12	Captive Screw, Number 17	2
	Retainer, Number 17	2
	Clip-on Nut	2
25805-13	Cap Screw, .750-10 x 2.5	4
	.750-10 Jam Nut	4
25805-14	Test Stand Door Latch	1
25805-15	Operator Module Assembly	1
25805-16	-4 Bulkhead Connector, Female	2
25805-17	Circuit Breaker	1
	Screw, 6-32 X .312	4
	Terminal	4
25805-18	Stop Clock (Optional)	1
25805-19	Digital Tachometer	1
25805-20	Pressure Gauge, 0-600 PSI	1
25805-21	Pressure Gauge, 0-100 PSI	1
25805-22	DPDT Toggle Switch	2
25805-23	Coaxial Connector	1
25805-24	Switch, SPST Toggle	1
25-50	Not Used	

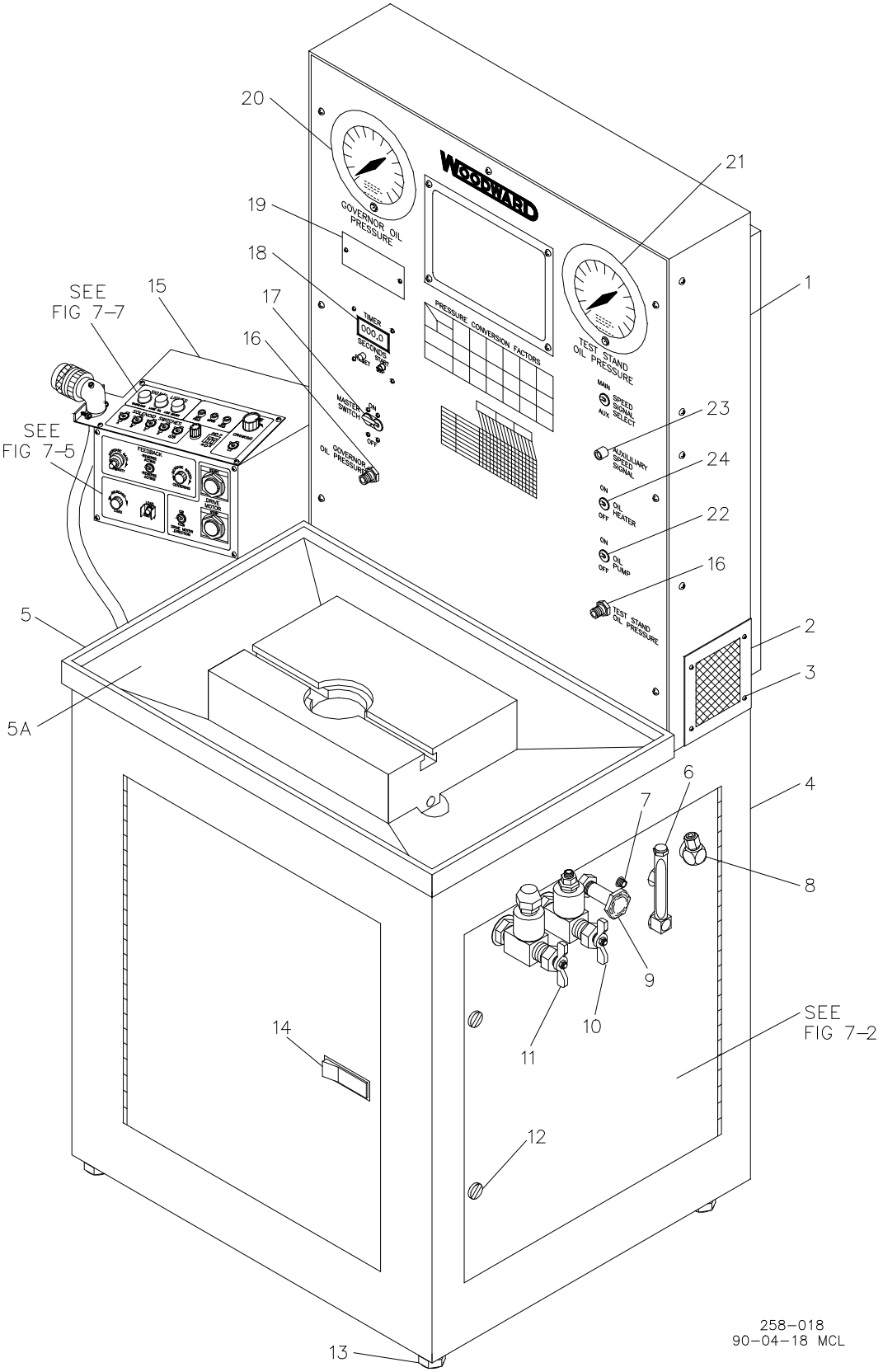

Figure 7-1. Test Stand Cabinet

Parts List for Figure 7-2

Ref. No.	Part Name	Quantity
25805-51	Valve, Needle	1
25805-52	Connector, .125 NPTF/.250 OD Tube	1
25805-53	Cap, 370 -4 Flare	1
25805-54	Nipple, .375 NPT Bulkhead	1
25805-55	Valve, 3/8 In. NPT, 30-100 PSI Relief	1
25805-56	Jam Nut, .438-20	
25805-57	Cross Tee, .375-18	2
25805-58	Socket Plug, .375-18	1
25805-59	Filter and Fitting	1
	Reducer, .750 to .375 NPT	2
25805-60	Elbow, .375 NPT 900, Street	1
25805-61	Nipple, .375 NPT x 4	1
25805-62	Elbow, Male, .375 NPT x .500 tube	1
25805-63	Hose, 25 Inches long, 375 NPT	1
25805-64	Elbow, .375 NPT 900, Street	1
25805-65	Elbow, Male, .375 NPT x .500 tube	1
25805-66	Motor Mounting Pads	4
25805-67	Nut, Hex .312-18	4
	Flat .312 Washer	8
25805-68	Pump Motor, Oil	1
	Conduit, 3/8"	9FT
	Connector, Wire (2 #12)	3
25805-69	Hose, 19 Inches long, .500 Male NPT	1
25805-70	Oil Tank	1
	Washer, .250 lock	4
	Nut, .250-20	4
	Washer, .250 x .064	4
25805-71	Heater, Immersion	1
	Coupling, .375 Sealtite	1
25805-72	8-32 Elastic Hex Nut	2
	.375 450 Connector	1
	Nut, 1/2" Conduit Lock	1
	Temperature Regulator	1
25805-74	Fitting, .500 Conduit Nipple	1
	Plug, .875 Diam.	1
25805-75-76	Not Used	
25805-77	Hose, 23 Inches, .375 Male NPT x 37 0	1
25805-78	Connector, .500 Male NPTF x .500 Diam	1
25805-79	Type J Thermocouple Sensor	1
25805-80	Teflon Tubing	1 ft.
25805-81	Hose, 1" x 25" Hydraulic	1
25805-82-85	Not Used	
25805-86	Drive Motor	1
25805-87	25 Amp Choke	1
	Washer No. 8 x .032	4
	Nut, 6-32 Elastic Hex	2
	10-32 Elastic Hex Nut	4
	Screw, 6-32 x .500	2
25805-88	230-460 to 115 V Transformer	1
	.250-20 Elastic Hex Nut	4
25805-89	.375 Sealtite Coupling	4
25805-90	Strain Relief Bushing or Rubber Grommet	2
25805-91	Washer, No. 10 x .032	4
25805-92	Magnetic Pickup	1
	Thread Seal	1
	Washer	1
25805-93	Washer, .250 x .032	8
25805-94-95	Not Used	
25805-96	Screw, Sock Set, .260-28 x .250	1
25805-97	Elbow, Male 45 Degree, 1.000 OD Tube	1
25805-98	Sock Plug, .250-18	1
25805-99	Drive Adapter`	1
25805-100	Seal, Motor Shaft	1

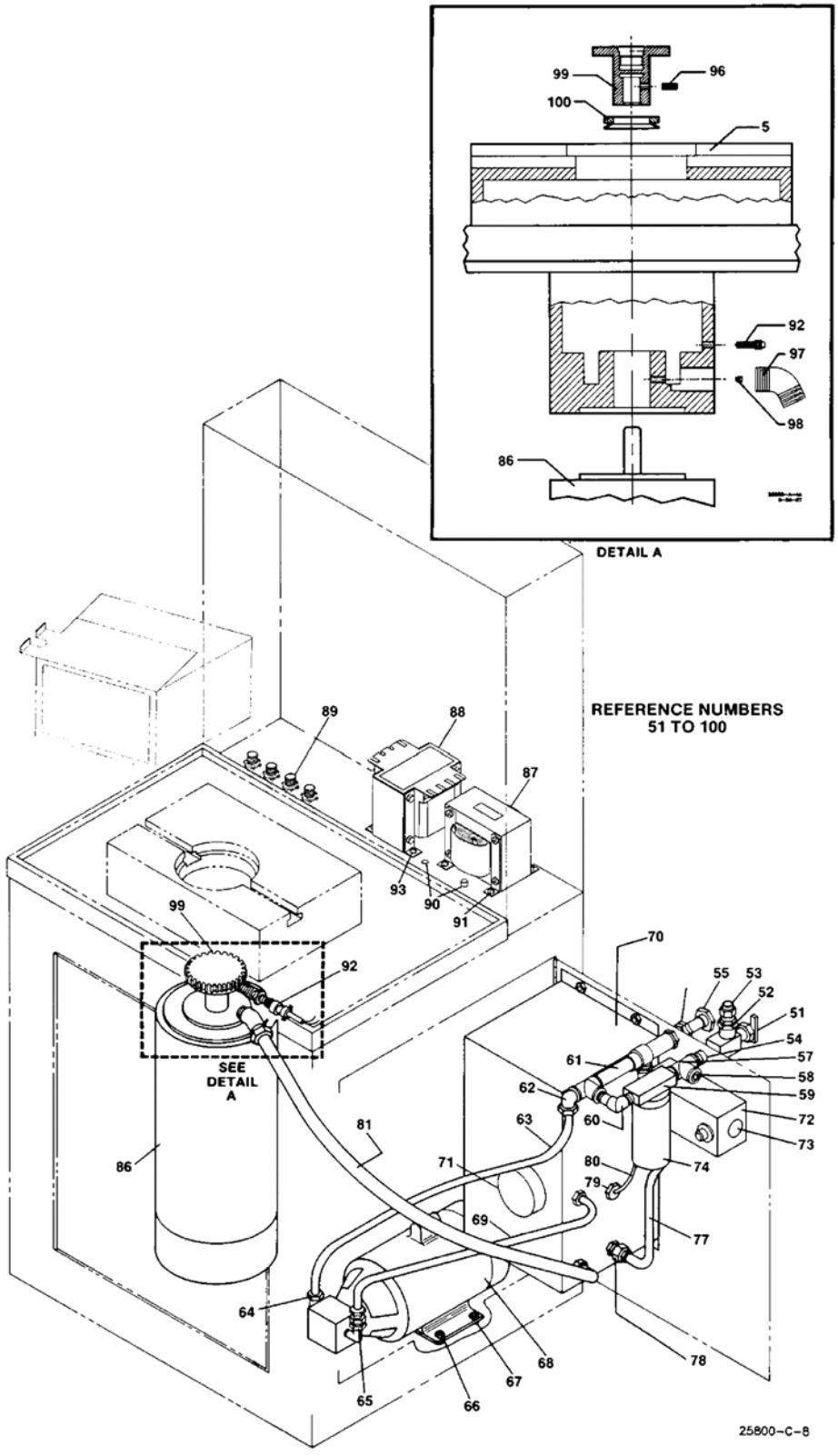

Figure 7-2. Test Stand Drive and Hydraulic System

Parts List for Figure 7-3

Ref. No.	Part Name	Quantity
25805-101	Screw, .250-20 X .500	4
25805-102	Plug, .500 Diam. Nylon	3
25805-103	Screw, 6-32 X .375	2
25805-104	Receptacle, 15A/125V Single	1
25805-105	Connector, Strain Relief	1
25805-106	Lock, 1.000 Conduit	1
25805-107	Bushing, Strain Relief	1
25805-108	Plug or Bushing for Switch Kit Wiring	1

109-124 Not Used

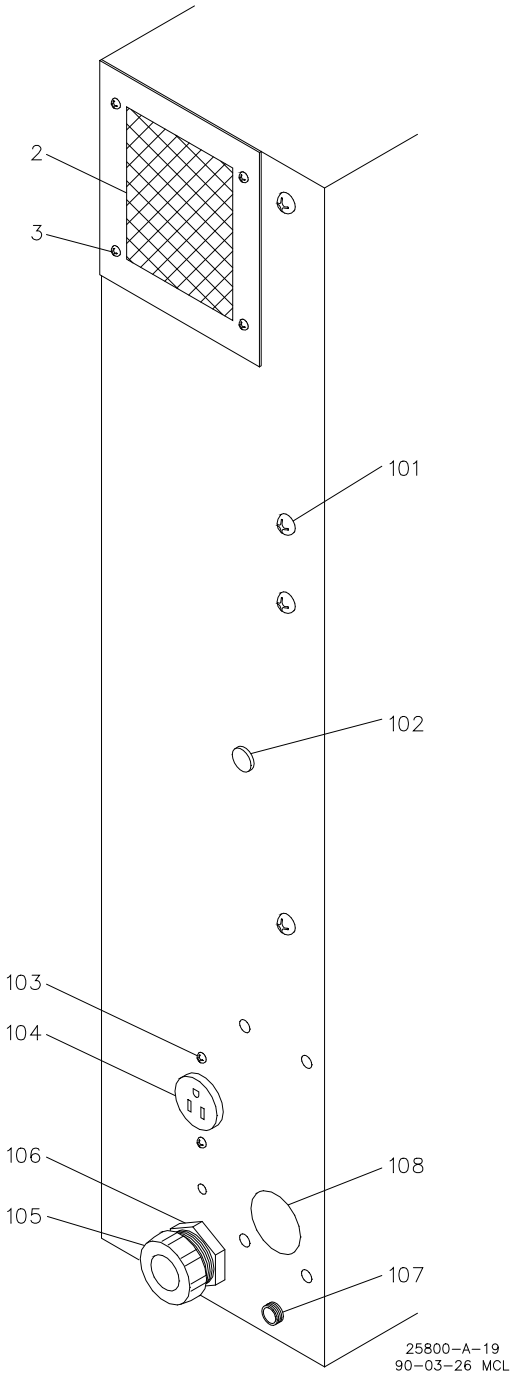

Figure 7-3. Upper Cabinet Connections

Parts List for Figure 7-4

Ref. No.	Part Name	Quantity
25805-125	Feedback Amplifier	1
	Nut, 6-32 Elastic Hex	4
	Jumper, 2-Section Terminal Block	1
25805-126	Block, 6 Pole Terminal	1
	Jumper, 2 Section Term Block	4
	Nut, 6-32 Elastic Hex	2
25805-127	Module, Motor Direction Control	1
	Screw, 8-32 x .500	4
25805-128	Module, Motor Speed Control	1
	Nut, 10-32 Elastic Hex	4
	Screw, 10-32 x .500	2
25805-129	Relay, 240 Volt, DPDT	1
	Socket, 8 pin, Surface Mount.	1
	Screw, 6-32 x .500	2
25805-130	Capacitor, 2500 uF 350 WVdc	1
	Screw, 10-32 x .312	2
	Lock Washer, #10	2
	Hanger, No. 6 Conduit	1
	Nut, .250-20 Elastic Hex	1

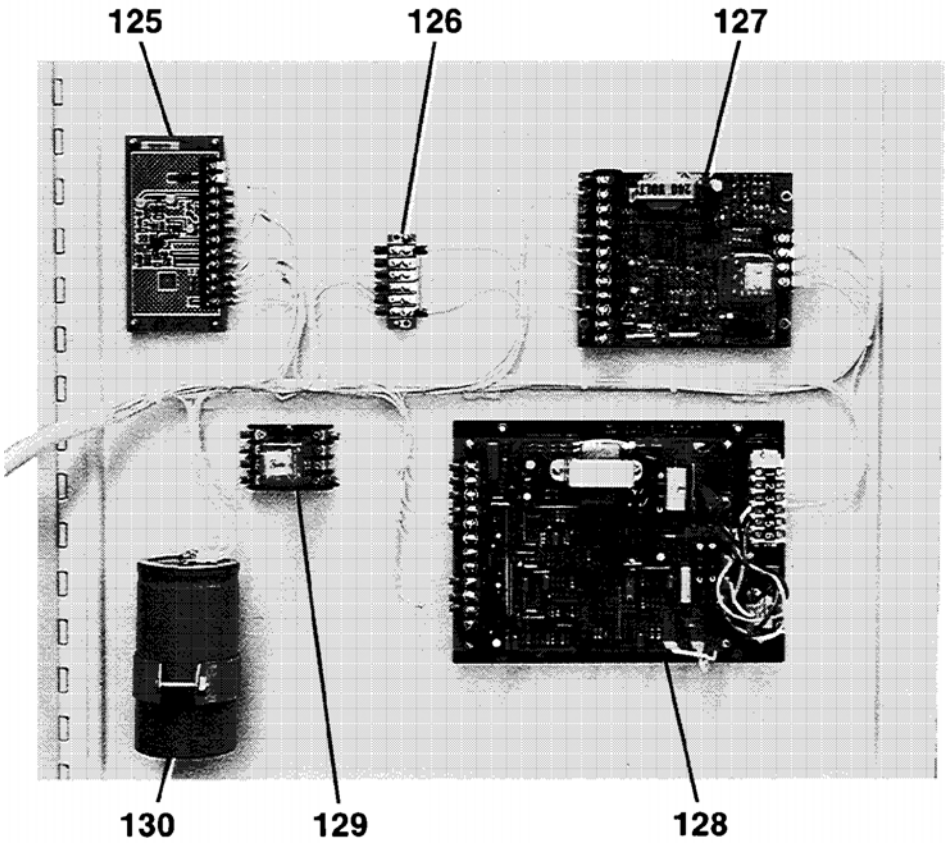

Figure 7-4. Inside 3 HP Upper Cabinet Door

Parts List for Figure 7-5

Ref. No.	Part Name	Quantity
25805-151	Plate, Switch Kit Cover	1
25805-152	Screw, 8-32 X .250	4
25805-153	Not Used	
25805-154	Plug, 1.375 Diam. Steel	1
25805-155	Not Used	
25805-156	Switch, Push button Start	1
	Nameplate, Start	1
25805-157	Panel, Operator Module	1
25805-158	Knob, .995 OD Knurled	2
25805-159	Potentiometer, 10K, 2W 10T	1
25805-160	Switch, Push button Stop	1
	Nameplate, Stop	1
25805-161	Switch, SPDT Push Button Blk	1
25805-162	Potentiometer, 200K, 2W 10T	1
25805-163	Dial, 15 Turn .875 Diam	1
25805-164	Potentiometer, 10K, 2 W, 1T	1
25805-165	Switch, DPDT Toggle	2
25805-166	Screw, 8-32 X .250	4

167-175 Not Used

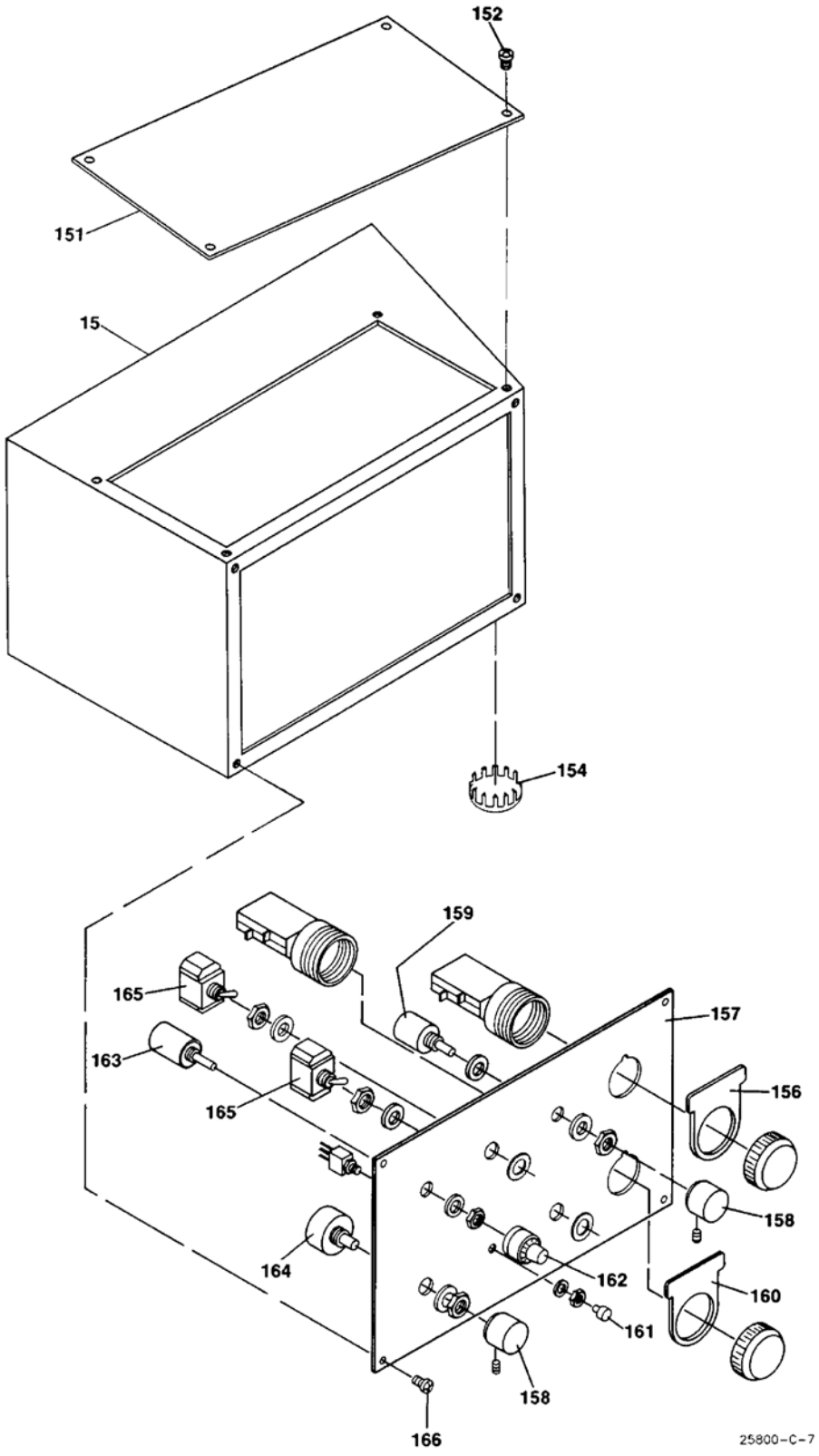

Figure 7-5. Operator Control Panel

Parts List for Figure 7-6

Ref. No.	Part Name	Quantity
25805-176	Elbow, .250 Tube/.250 Female NPT	2
25805-177	Tube, .250 OD Copper	AR
25805-178	Elbow, .250 Tube/.125 Male NPT	1
25805-179	Tee, .250 Tube/.125 Male PTF	1
25805-180	Tubing, .250 OD Flex. Nylon	AR
25805-181	3-Fuse Block, 1 or 2	AR
25805-182	8 Pin Surface Mount Socket	2
25805-183	22 Pole Terminal Block	1
25805-184	DC Power Supply for PGE Switch Kit	1

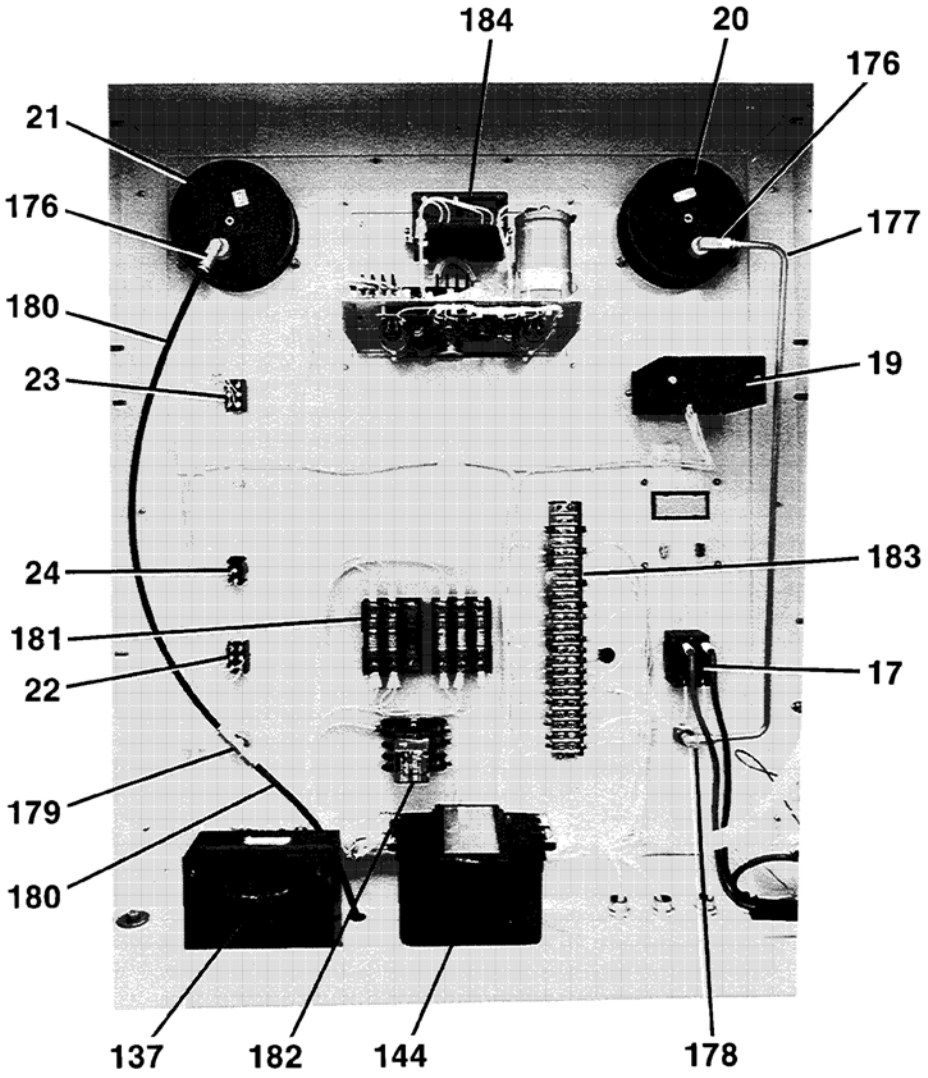

Figure 7-6. Back of Upper Panel

Parts List for Figure 7-7

Ref. No.	Part Name	Quantity
25805-251	Instrument Panel	1
25805-252	Knob, .995 OD, Knurled	1
25805-253	Potentiometer, 10K, 2 Watt, 1 Turn	1
25805-254	Switch Locking Ring	6
25805-255	Switch Indicating Plate	6
25805-256	Switch, DPDT, Toggle	1
25805-257	Switch, SPDT, Toggle	5
25805-258	Jack, Black Test, .175 ID	3
25805-259	Fuse Holder, 3 AG	1
25805-260	Fuse, 1.5 Amp, 3 AG, Slo-Blo	1
25805-261	Screw, 6-32 x .500	2
25805-262	Elastic Lock Nut, 6-32	2
25805-263	4-Pin Socket and 4-Pin Plug	1
25805-264	Lens, Lamp	3
25805-265	Lamp, 120V, Slide Base	3
25805-266	Lamp Holder	3
25805-267	Screw, 8-32 x .250	4

Not Shown: Cable Assembly and DC Power Supply which are supplied with the switch kit.

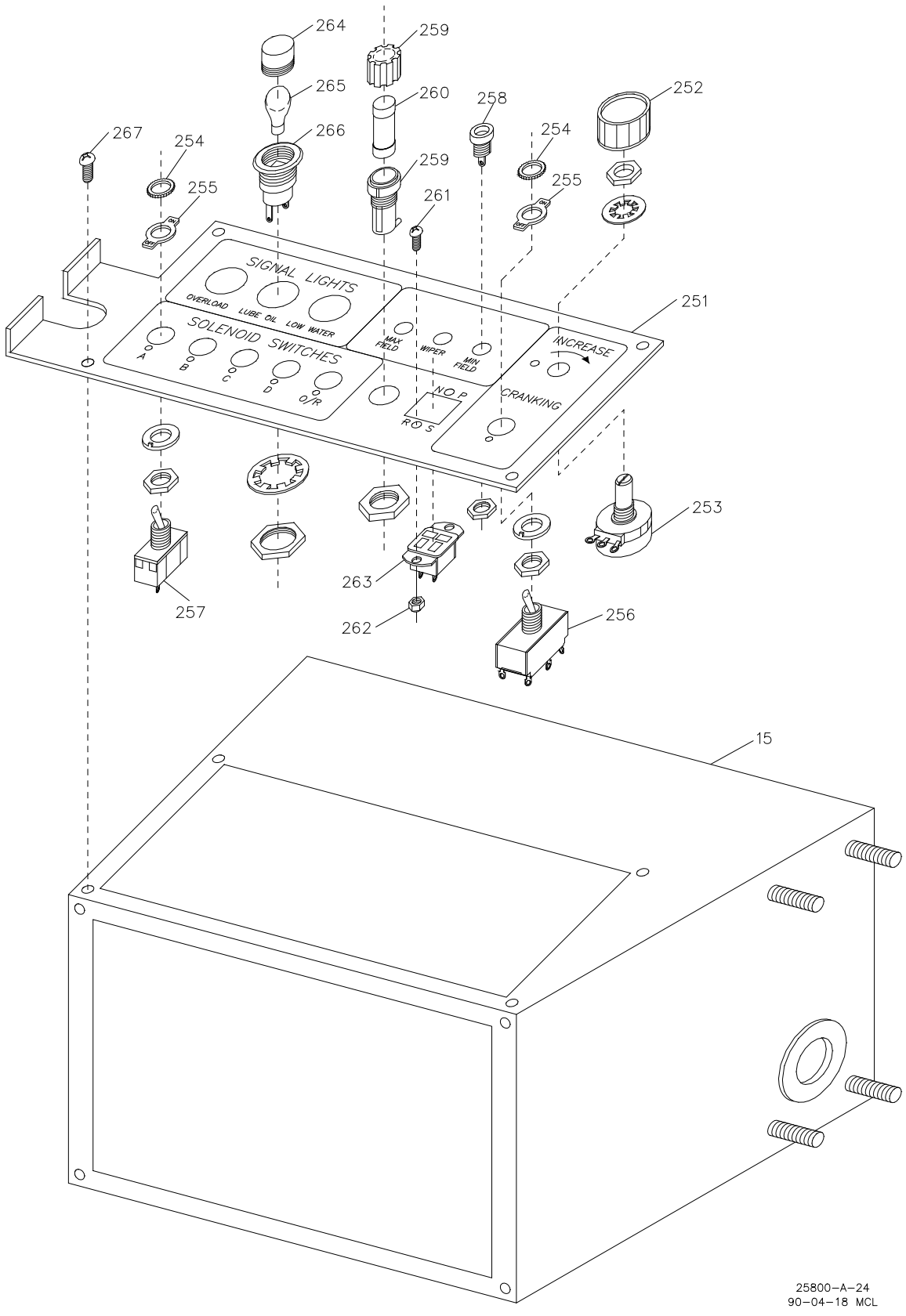

Figure 7-7. PGE Governor Switch Kit

Parts List for Figure 7-8

Ref. No.	Part Name	Quantity
25805-201	12 Volt Power Supply	1
	Screw, 4-40 x .250	4
25805-202	12 Volt Relay	1
	8-Pin, Surface Mount Socket	1
	Screw, 6-32 x .500	2
25805-203	Feedback Amp Board Assembly	1
	Nut, 6-32 Elastic Hex	4
	Jumper, 2 Section, Terminal Block	1
25805-204	Motor Speed Control Module	1
	Washer, Flat, .250 Inch	4
	Nut, .250-20 Elastic Hex	4

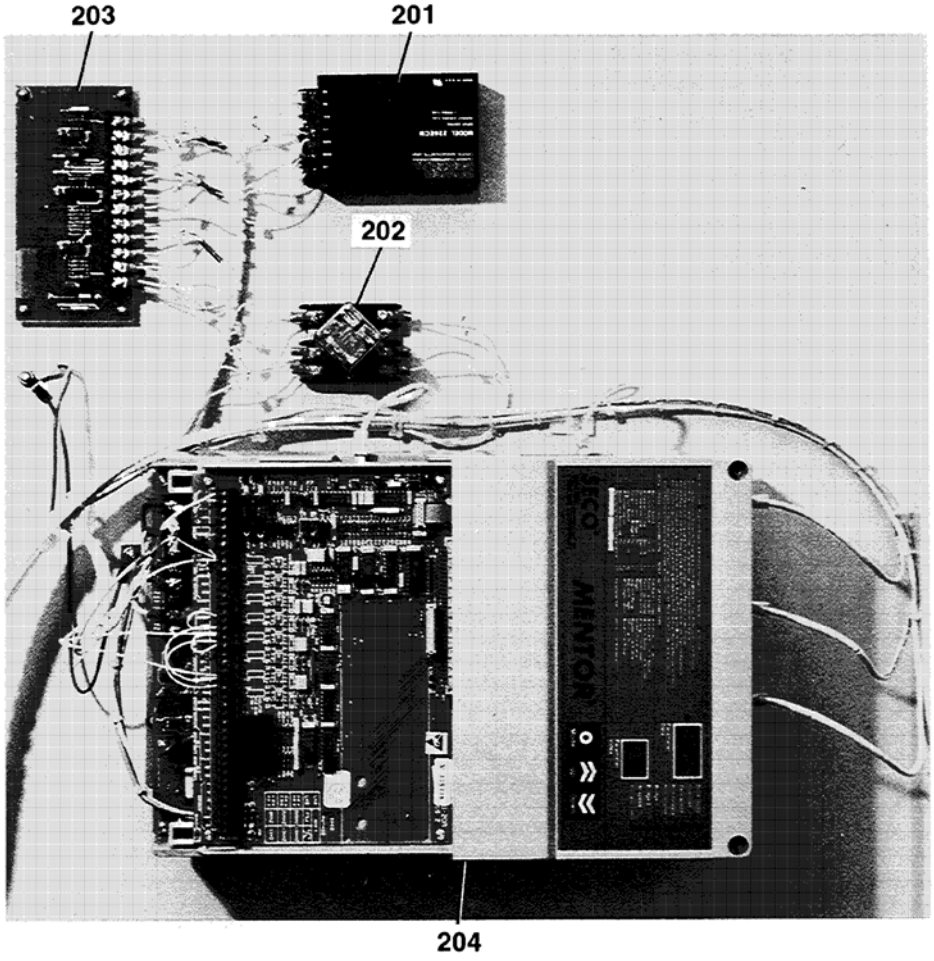

Figure 7-8. Upper Cabinet Door for 5 HP Stand

Chapter 8.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 25805D.

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**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.