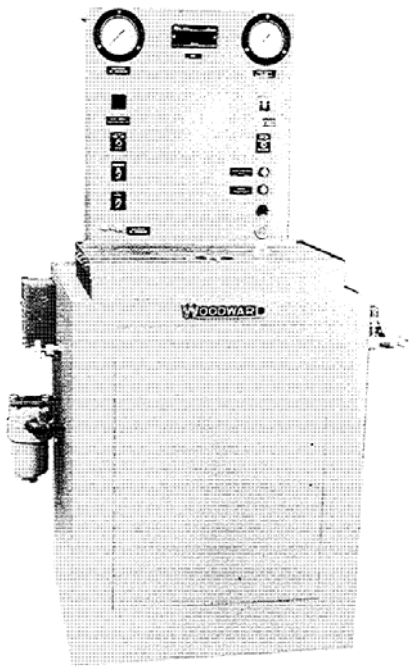
WOODWARD

Product Manual 25405
(Revision C)
Original Instructions



Electric Drive Test Stand

8909-094

Installation and Operation Manual

IMPORTANT

DEFINITIONS

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

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.

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.

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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.

NOTICE

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.

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*.

Contents

Illustrations and Tables

Chapter 1.
General Information

Introduction

This manual describes the Basic Electric Drive Test Stand, 8909-094, 60 Hz., and 8909-039, 50 Hz., for testing of most Woodward governors and actuators.

Only the basic test stand is described in this manual. Chapter 4 includes information for the most common accessories, but does not include complete information on the maintenance or use of these accessories.

Description

The Electric Drive Test Stand is a self-contained unit built to provide hydraulic 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 or actuator being tested.

All controls on the stand are conveniently located to permit efficient one-person operation. Pneumatic pressure is not included in the stand. If air-pressure devices on the governor are to be tested, a separate air-pressure source must be provided. The 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. The hydraulic circuit can be damaged by excessive pressure. The bleed valve must be open when starting the test stand.

IMPORTANT **The test stand is not built to test the PG-200, PG-300, PG-500 or larger governors, or Woodward hydraulic amplifiers.**

Test Stand Features

The basic test stand features a 3 hp, 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 US gallon oil sump, an oil pump, and oil heaters. All electrical controls are solid-state design, using semiconductor devices.

The basic stand will test Woodward UG-8, PG governors with standard PG or UG bases, and 3161 governors. Auxiliary kits (see Chapter 4) are required to test SG, PG, UG-32, UG-40, PSG, EGB-2 through EGB-58, LSG-10, PG-PH, EG-3, EG-10, TG-13, and PG-EG governors and actuators. The stand also will test many governors which have not been manufactured by Woodward.

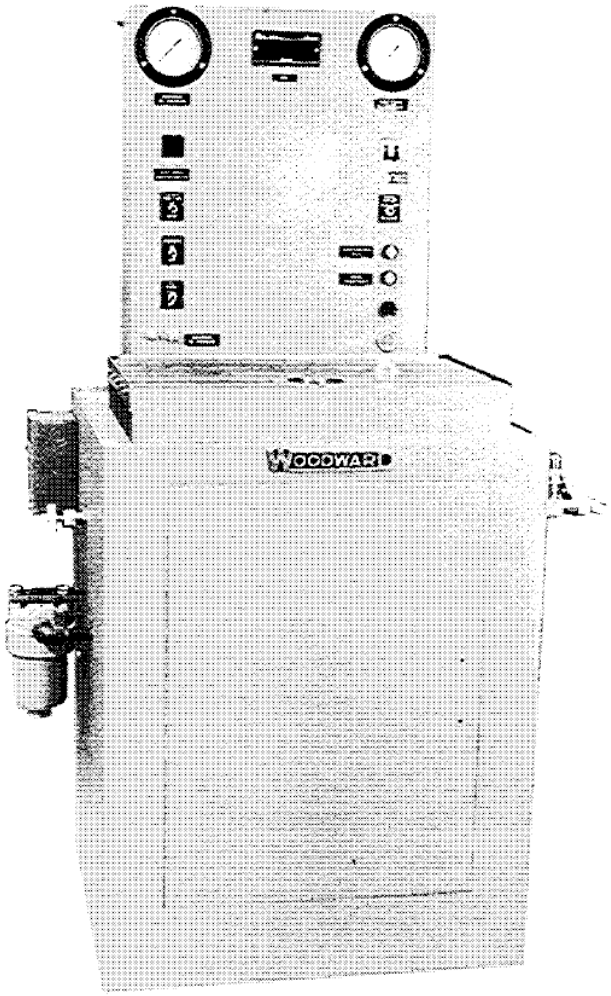

Figure 1-1. Basic Electric Drive Test Stand

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 Woodward test stand will let 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 normal 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. However, the stand will provide a facility to confirm governor response to known criteria.

The electric motor drive is relatively smooth and can provide a governor with completely different attributes than are found when the same governor is placed on an engine or turbine.

When testing a governor on a Woodward test stand, the technician or operator should keep in mind that the governor is being set up to the drive variables of the test stand, not the variables of the engine drive. Woodward test procedures are all designed within the drive characteristics of the test stand. In most cases a governor setup 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 will permit the following checks and 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 in distance or degrees;
- Governor stability as it is reflected by the test-stand drive;
- A check for major leaks, and
- A general check on governor assembly and operation. (The reliability of this test will be greatly influenced by the expertise of the technician.)

Governor response time can be adjusted on the test stand, but it must be remembered that the response is to the governor drive, not to an engine or turbine 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 or makeup 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 safer 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 an obvious fault or binding in the linkage or fault in the governor drive, then contact someone familiar with engine-governor problems for advice.

Woodward does not consider the test stand to be a simulator of a specific engine or turbine. Instead, 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.

Chapter 2. Installation

Shipping

The basic Electric Drive Test Stand is shipped from the factory bolted to a wooden shipping platform. A plywood shipping box or wooden crate 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 as necessary. The basic test stand will weigh about 1000 pounds when shipped. The stand and shipping platform may be moved by nearly all types of forklift equipment. Lift eyes are not provided and should a hoist have to be used, a sling must be constructed.

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 protected 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 the 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 6 months), Woodward publication 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*, should be followed.

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. Five gallons, or more, of oil could be pumped out of the test stand by accident. It is recommended that this possibility be taken into consideration when locating the test stand.

A minimum 4-foot by 4-foot area will be 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 in planning the test-stand location.

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.

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, the jam nuts should be tightened.

Properly ground the stand according to local electrical code or prudent use. The stand will be wired for 208–240 Vac single-phase current and proper grounding is necessary for the safety of the operator.

The test stand requires a supply of 208–240 V, 50 or 60 Hz, with 5.5 kVA. Connecting wiring should be flexible, if allowed by local code, to permit tipping the test stand during occasional maintenance and cleaning operations. Flexible or solid conduit wiring can be used.

Accessories

Vacuum accessories, when ordered, are contained within the test stand. Air-pressure accessories, when specified, must be connected to an air pressure source as necessary during installation. Most air pressure accessories require a minimum of 100 psi air pressure.

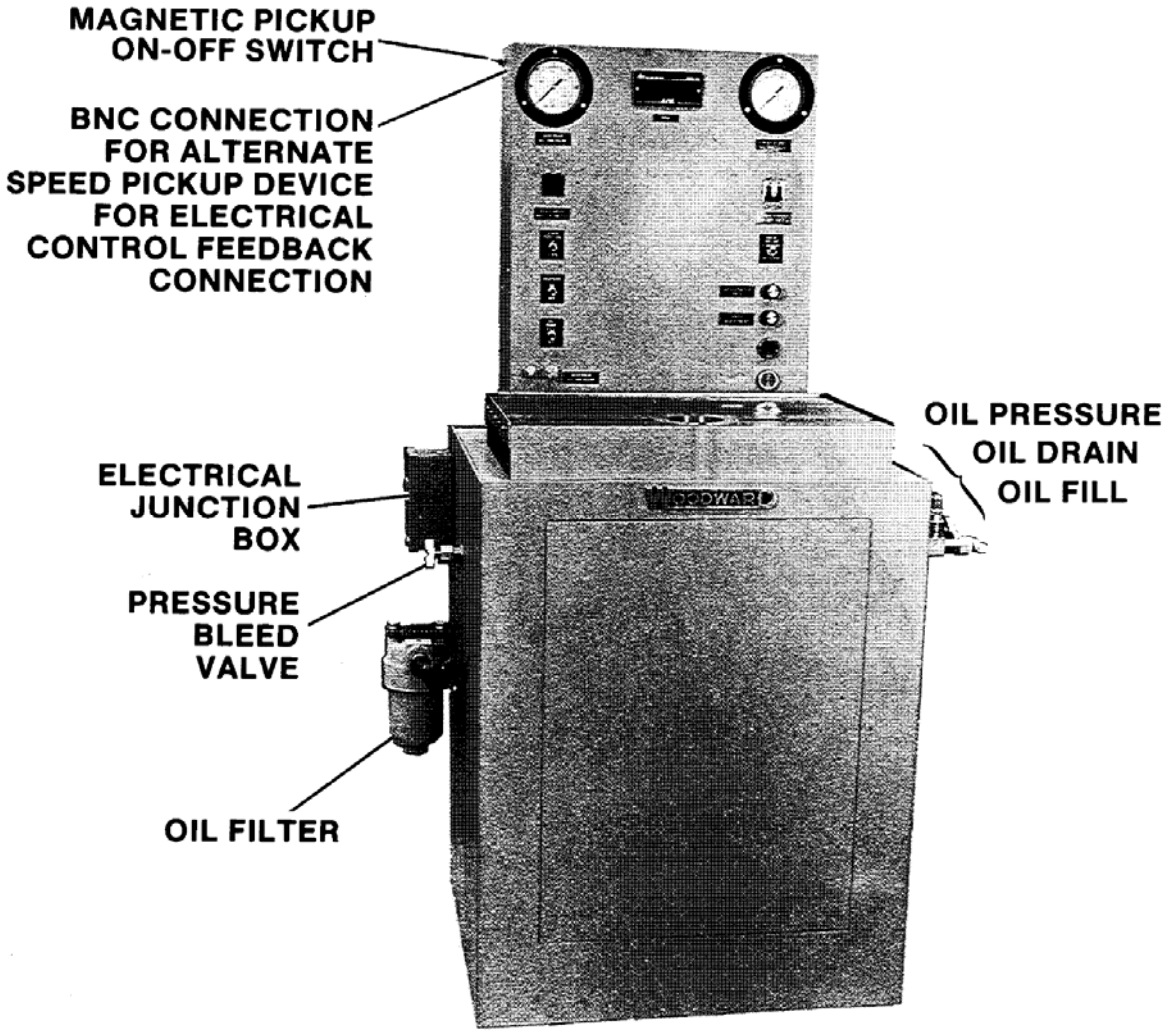

Figure 2-1. Basic Electric Drive Test Stand

Chapter 3. Operation

Control Panel

The top back panel of the 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. The larger connection should be fitted to the pump pressure test port in the governor. The small connection, labeled “Eng Lub or Diaph” will go 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.

Switches

See Figure 3-1 of the back panel to identify the controls and switches. The switch locations on the back panel are not necessarily as illustrated because design improvements may change some locations. Functions of switches have not changed.

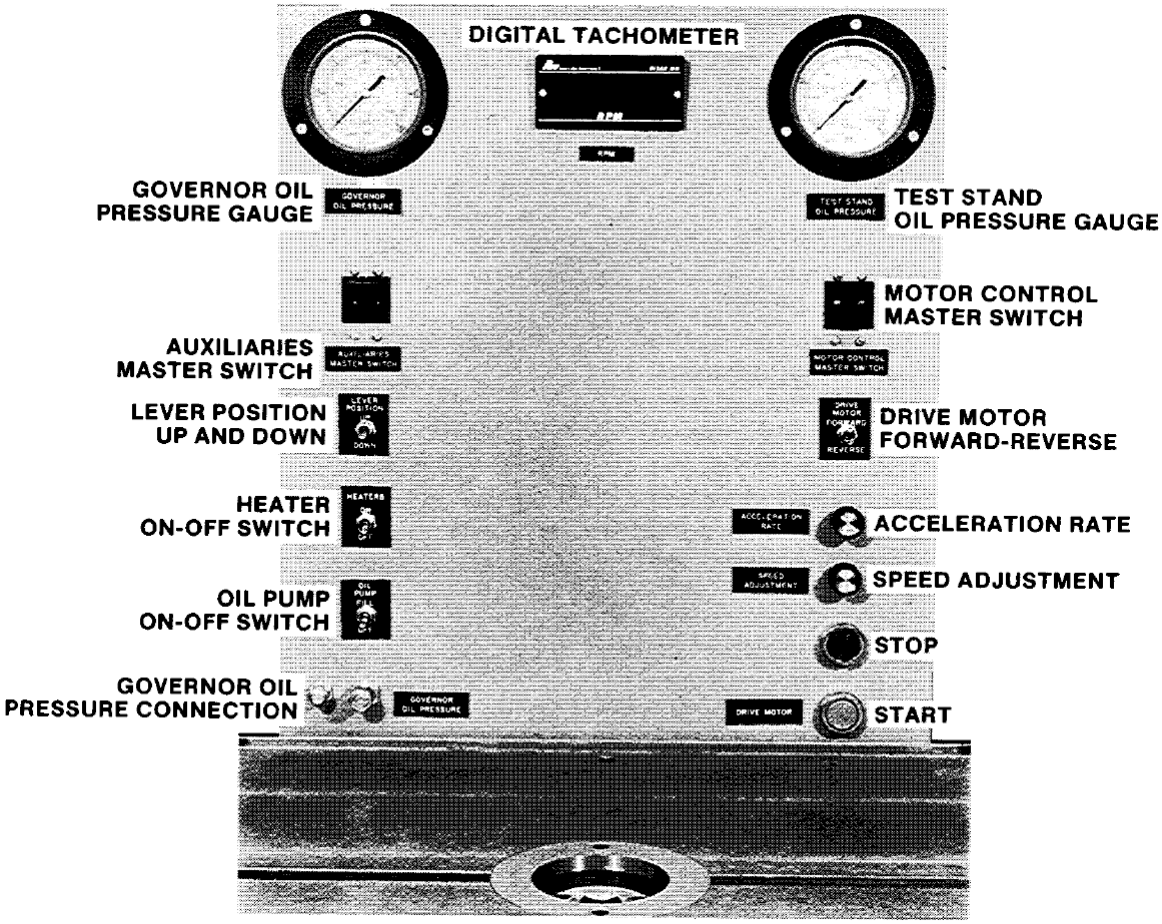

Figure 3-1. Test Stand Back Panel

Auxiliaries Master Switch

This switch activates the pump, or pumps, in the test stand and such electrical accessories that are operated from the stand. The switch must be on before the drive motor will operate.

Lever Position Switch

This switch is up when the output shaft of the governor being calibrated turns clockwise or extends to increase fuel. Counterclockwise rotation or retraction will call for the lever position switch to be in a down position. The pulley on the feedback potentiometer must turn counterclockwise to increase when the lever position switch is up and clockwise to increase when the switch is down. Increased fuel will pull line from the pulley. When the lever switch is down the pulley will take up line on increased fuel.

Heaters

This switch turns the oil heaters on and off. The thermostat for the oil heaters is located in the base of the test stand and should normally be set at 210 degrees F. Under normal conditions this switch is always left on so the heaters are in operation when the governor auxiliaries switch is on.

NOTICE

The oil pump should always be on when the heater switch is on so circulating oil will protect the heating elements from damage.

⚠WARNING

Normal thermostat setting of the oil heater is 210 °F, hot enough to cause personal injury if accidentally spilled. The heaters can be set for even hotter oil which can be extremely dangerous if improperly handled.

Oil Pump

The oil-pump switch activates the test stand oil pump to provide control oil for the lube-oil shutdown connection, if needed, and to transfer test-stand oil in and out of the governor. The pump also provides oil circulation needed by the oil heaters. The valve at the back of the oil reservoir must be open when the test stand is operating.

Motor Control Master Switch

This double switch activates the motor circuits and must be on before the governor-drive motor will operate. The master switch does not start motor rotation.

Drive Motor (Forward/Reverse)

When this two-position switch is “Up” (forward) the drive shaft will turn clockwise. When this switch is “Down” (reverse) the drive shaft will turn counterclockwise. If this switch is changed it will cause the motor circuit to open. The speed-adjustment potentiometer will then have to be moved to zero-speed setting before the motor can be restarted.

Acceleration Rate Potentiometer

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 drive rotation is set at the desired speed the Acceleration Potentiometer should be turned clockwise until the governor being tested losses 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 acceleration 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.

Speed-Adjusting Potentiometer

This potentiometer sets the test-stand speed. 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 will activate the drive circuit.

Drive Motor Buttons

(Green 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 Speed Adjusting potentiometer is turned counterclockwise to “0.” The START button likewise does not start the drive motor as this must be done by advancing the speed-setting 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.”

Main Magnetic Pickup Switch and Auxiliary Speed Signal (BNC Connector)

These two features are on the left-hand side of the upper cabinet (see Figure 2-1). When the switch is “On” it feeds the speed-related voltage from either the magnetic pickup or the voltage generator (whichever is used) to the panel-mounted tachometer and the BNC connector. Control boxes which require a speed reference are then connected to the BNC.

If an auxiliary magnetic pickup is used, as is the case with multiplier tables, it is connected to the BNC and the switch is turned to off, removing the main magnetic pickup or speed generator from the circuit. The auxiliary magnetic pickup voltage is then running the tachometer. Should a different tachometer be used with the auxiliary magnetic pickup, it may be run with a “T” connector at the BNC, the auxiliary then driving both the panel-mounted tachometer and the other device.

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 and by the Pressure Bleed Valve on the left-hand side of the test stand.

NOTICE

A closed bleed 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 Bleed Valve always should be open when the test stand is started to prevent possible damage to the pressure gauge. After the oil pump has been started, the operator should open the Pressure Regulator Valve on the right-hand side of the stand, then the Pressure Bleed Valve should be closed. The Pressure Regulator Valve may then be closed until the desired pressure in the stand has been attained. 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.

IMPORTANT

Opening the Pressure Bleed Valve before shutting down the stand is a good practice. The Bleed Valve must be open when starting the stand to avoid possible gauge damage. A valve at the back of the oil reservoir must be open when the pump is in operation.

Governor 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.

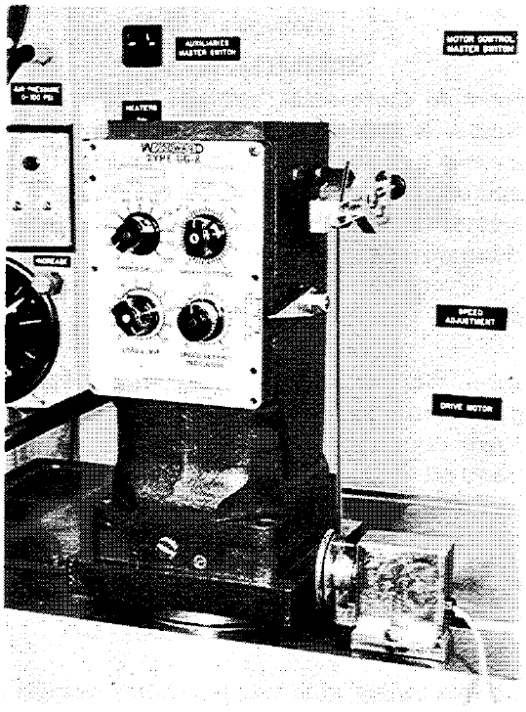

Figure 3-2. Typical Rotary Output Connected to Feedback

Early models had other feedback designs. These earlier designs may be replaced with this improved feedback system.

Figures 3-2, 3-3, and 3-4 show methods connecting the improved feedback system various governor outputs

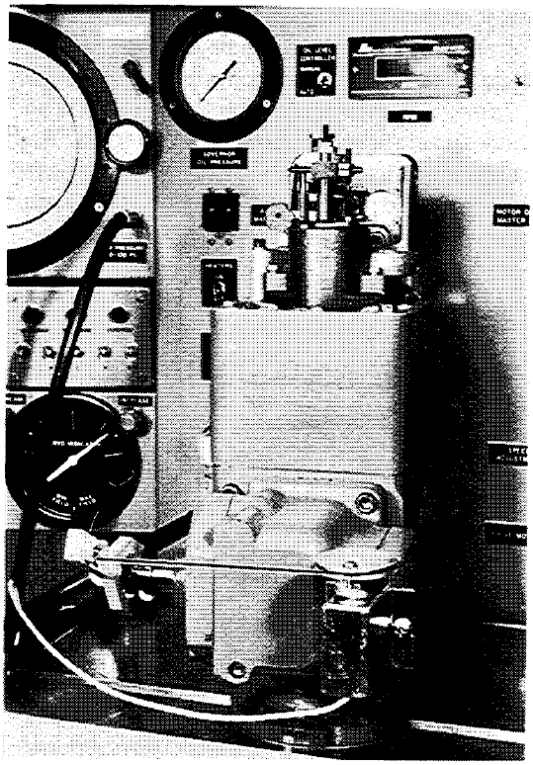

Figure 3-3. Linear Output Connected to Feedback

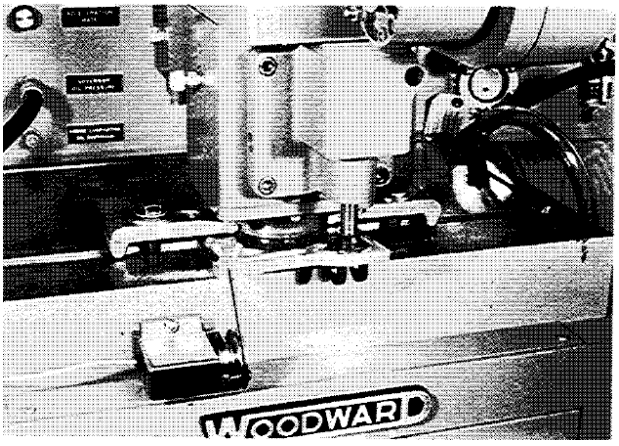

Figure 3-4. Downstroke Output Connected to Feedback

To Calibrate a Governor

Select the proper drive adapter for the test-stand motor (a 1.5 inch hex adapter with the proper serration or keyway for the governor drive shaft). Select the proper 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.

Attach the applicable oil lines between the governor and the test stand. The two valves on the right-hand side of the test stand are the oil-line connections. The front valve is the pressure line and the back valve is the drain line. Governors with self-contained sumps may be filled with oil from the pressure line without attaching a drain line. The drain line is used to circulate hot oil through a governor without a self-contained sump. An oil-level-control kit is recommended when governors with self-contained sumps are being tested. The test-stand oil heaters should be used whenever possible as most governors are sensitive to temperature. Most governors will reach operating temperature in about 30 minutes on the test stand.

IMPORTANT **To protect the oil heaters from damage, always use the test stand oil pump while using the oil heaters.**

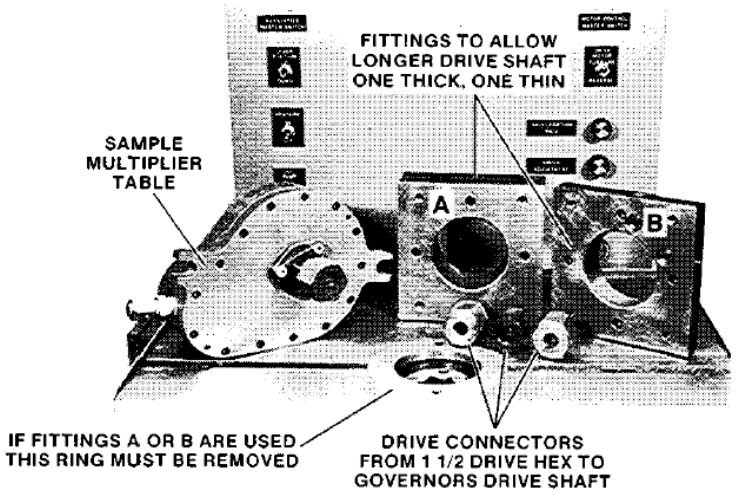

Figure 3-5. Test Stand Adaptors

Turn on the test-stand switch and the Auxiliary and Motor Control Master Switches. Be sure the oil-heat thermostat, inside the lower door of the stand, is set at the desired temperature (usually 210 °F.). 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 correct attitude. 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 Acceleration Rate and Speed Adjustment potentiometers on the control panel full counterclockwise. Push the green START button momentarily, then slowly turn up the Speed Adjustment 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 TSP. The drive motor will not start when the green button is pushed. The Speed Adjustment setting starts the drive motor as it is moved from the full counterclockwise position.

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

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

Load Switch

A box on the side of the test-stand base contains the Load Switch. The control contains a potentiometer which can be set to momentarily raise or lower the test-stand speed from the operation of the regular Speed Adjustment setting. A momentary (pushbutton) switch at the top of the box then includes this setting in the test-stand-drive circuit, 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 will show little effect on drive speed. Turning the control clockwise will allow the simulation of a reduction in load. Turning the control counterclockwise will simulate an increase in load when 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 motor after the STOP button is pushed, the Speed Adjustment potentiometer must be turned to full counter-clockwise, the START button pushed, and the Speed Adjustment potentiometer turned slowly clockwise.**
- **If motor direction is changed, the drive will stop, 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 linkage between the governor output and the feedback potentiometer. (Remove the potentiometer from the output shaft on some installations and remove the connecting linkage between the output and the potentiometer in other instances.)

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 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 either the electrical drive of the stand, by the electrical supply current 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 make certain 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 will often 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.

3. Check the concentricity between the motor drive and the circular mounting hole in the test stand table. The drive must be concentric within .010 of an inch total indicator reading (tir). Factory specifications call for concentricity within 0.005 tir. Check the mounting surface for distortions caused by burrs, dirt, or other imperfections.

⚠WARNING **HIGH VOLTAGE—Remove the test stand from electrical supply prior to checking or working on any of the drive components. Life threatening voltages are present throughout the drive circuits.**

4. Check the filter capacitor on the output of the Hampton Drive PCB (located in the box on the left outside of the test stand) for an open circuit. The capacitor is rated at 2500 µF at 350 Vdc (working).

5. 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.

6. 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 and the entire stand will pull much more than this, especially if the oil heaters and other options are operating at the same time as the 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, and do cause problems with test stand operation.

Hampton Drive Boards

The two Hampton Products drive boards cannot be checked with normally available test equipment. Contact Hampton Products in Rockford, IL, or Woodward, 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. Prior to 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.

Drive Motor Maintenance

The drive motor should have maintenance every 1000 to 1500 hours of operation.

To service the motor, remove the blue plastic brush covers on each side of the motor. Push in on the brush-keeper spring and remove the keeper-spring unit. The brush then may be removed from the motor.

The cover on the bottom of the motor may be removed to facilitate cleaning the brush area of the motor.

Brushes should have a minimum length of .750 inches. Replace with Hampton Products part number 3013, available from Hampton Products, Rockford, IL 61125. While the brushes are out, the commutator area should be blown out with compressed air or otherwise serviced according to the shop standard for motor service. The commutator should be rebuilt or resurfaced after five brush changes. Do not attempt to remove the motor from the test stand, unless absolutely necessary, as it must be replaced in nearly absolute concentricity with the mounting circle in the test stand table.

Do not attempt to disassemble the dc drive motor unless thoroughly familiar with dc motor maintenance. Extensive damage to the motor is possible if disassembled by inexperienced persons. Damage caused in this manner will not be covered by warranty.

Chapter 4. Accessories

Introduction

A number of 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.

In addition to the accessories listed in this chapter, Woodward engineering support groups are prepared to provide fittings and accessories needed to adapt the test stand to any governor which can be driven by the 3 horsepower, electric test stand.

Universal Accessories

EG Actuator Tester

The EG Actuator Tester is used to test EG Proportional Actuators and EG Compensated Actuator. It is used with the speed readout on the test stand. In addition, the tester is used to center the pilot-valve plunger to the pilot-valve port. The tester box connects to the actuator being tested and to the BNC connector on the side of the test stand. If the auxiliary speed-sensing potentiometer is used, the magnetic pickup switch on the side of the control panel must be turned to “OFF.”

Transformer Assembly (5435-045)

This transformer will convert 460 volt supply to 230 volt supply needed by the test stand. Isolation transformer from General Electric Company, indoor/outdoor type QM, is included in the transformer kit. The general purpose transformer converts 480 volt source to 240 volts, and 240 volt source to 120 volts 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 so the transformer is always open.

Multiplication Drive Assemblies

The governor-drive motor is capable of operating at 2000 rpm. The addition of drive-multiplication assemblies will increase the upper-speed limit. The multiplication drives fit 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-10PC, 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. The drive assembly will permit base oil feed or drain. An alternate magnetic pickup is included with the multiplication drive assembly.

Figure 4-1. Multiplication Drive Assembly

Right-Angle Drive Box

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 will permit base oil feed and drain of the governor or actuator.

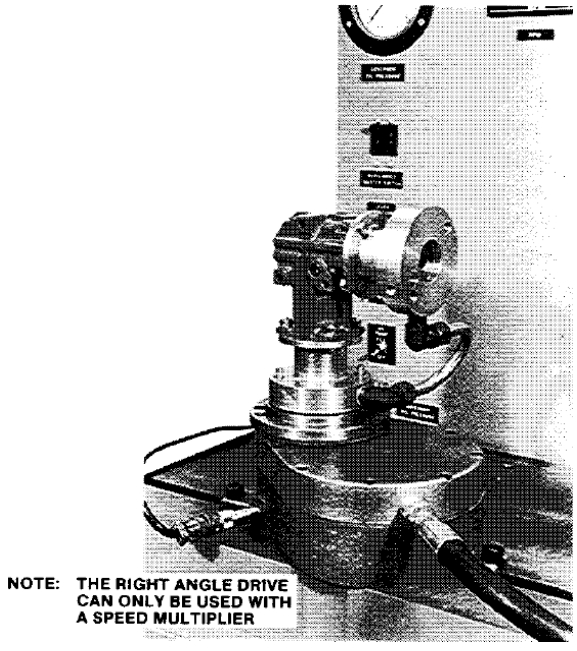

Figure 4-2. Right Angle Drive

Oil-Level Control Kit

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 solenoid valve in the oil supply line beneath the test-stand table and a level monitor in the drain line. The level monitor controls the flow of heated oil through the governor.

General Purpose

Surface Thermometer (1823-104)

The surface thermometer holds to the test governor magnetically and provides a continuing check on the actual temperature of the governor case.

Variable DC Power Supply (5439-076)

The variable power supply provides 0 to 140 volts of dc power to permit testing electric speed setting and solenoid devices used on many governors. The device may also be used to test the mechanical side of EGB units. The device operates on 110 volt ac power.

Pressure Gauges

Special pressure gauges are available which convert test pressures to nearly all conventional terms. A partial list of the special gauges follows:

0–120 Inch Pressure Gauge Kit (8959-033)—This gauge measures air pressure used in connection with, but not part of, the test stand. Wallace Tiernan or similar-quality gauge is included in the kit. Used to test PG-PL, PGA, PG-EV and other governors with air pressure speed setting, shutdown devices, or fuel limiters.

0–77 kPa Pressure Gauge Kit (8959-034)—Graduations on the dial of 0–100 psi and 0–700 kPa. Needed for automatic reading in kPa units. Wallace Tiernan or similar-quality gauge is included in the kit.

0–7 kg/cm² Pressure Gauge Kit (8959-066)—Air-pressure gauge is calibrated 0-7 kg/cm2. Wallace Tiernan or similar-quality gauge is included in the kit.

0–6.8 Bars Pressure Gauge Kit (8959-046)—Measures air pressure with Wallace Tiernan or similar-quality gauge.

0–100 PSI Gauge (8939-022)—Wallace Tiernan or similar-quality gauge to test lube-oil shutdown on certain PG governors.

0–85 PSI Gauge Kit (8909-022)—Kit includes air-pressure regulator and auxiliary instrument panel to simulate air, oil, or water shutdown during governor calibration. Wallace Tiernan or similar-quality gauge calibrated 0–85 psi and 0–600 kPa.

Cords and Electrical Connectors

When required, the test stand can be equipped with a 12-pin cord to provide either control current or to check safety features on the governor being calibrated. The cord is usually accompanied with special test equipment or switch boards which may or may not be attached to the test stand. The following cords permit making specific attachments to the governor electronic-control system.

PGE and PGR (5400-512)—16-inch-long cord to fit Bendix pygmy 6 pin at one end and 12-pole cord end on the test stand. Red and blue pins are removed from the 12-pin end.

GE-PG (5400-51 3)—16-inch-long cord to fit Bendix connector on one end and 12-pole test stand. Red, green, orange, and are removed from both ends of the pygmy 16-pin cord end on the blue connectors cord.

Certain PG and PG Rail (5400-514)—16-inch-long cord to fit between 8-pin governor socket (females) and 12 pin-male cord end on the test stand. Red, green, orange, and blue conductors are removed from both ends of the cord.

Some PG Rail and Some PGE (5400-511)—16-inch-long cord to fit from GE or Alco governors to the 12-pole cord end on the test stand. 12-pole Pyle National sockets at both ends. Red conductors are removed from each end.

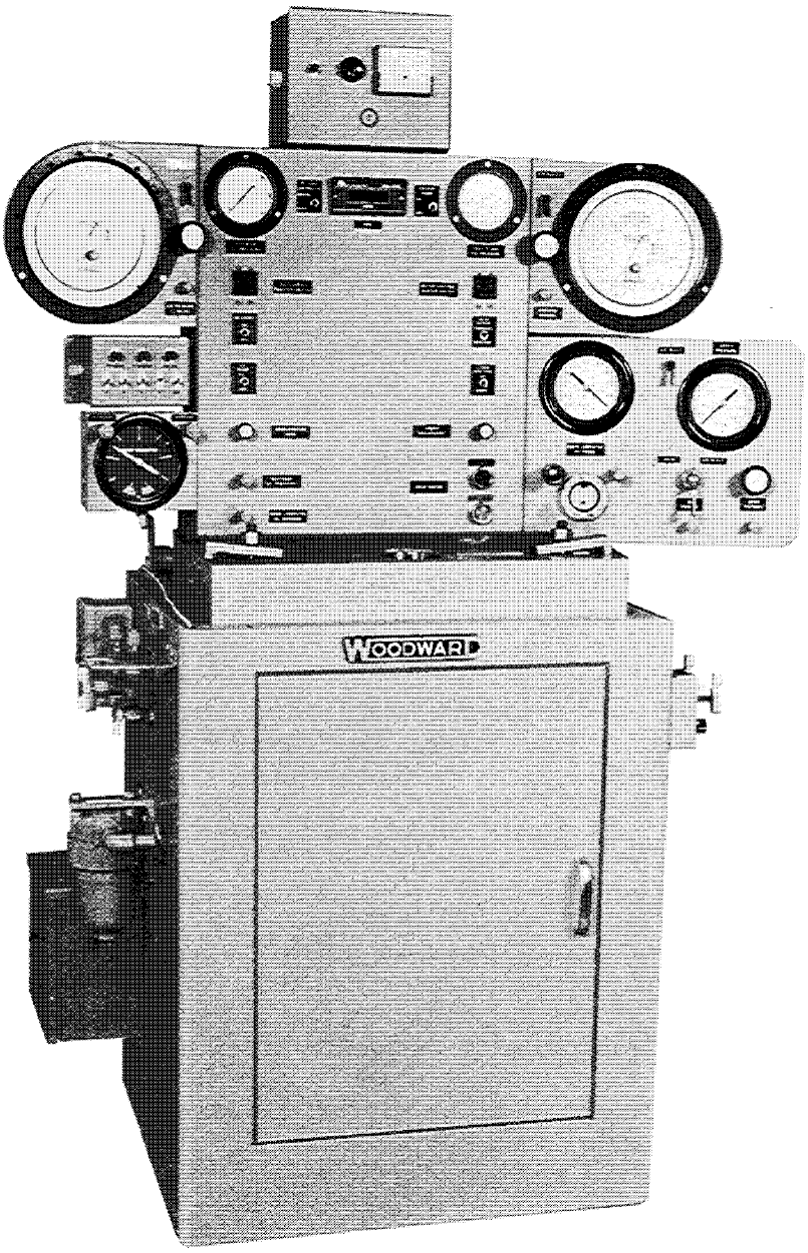

Figure 4-3. Test Stand Equipped with Many Options

Chapter 5.
Governor Connection Instructions

The seven pages of drawings that follow contain locations for various electrical, pneumatic, and hydraulic connections available on governors and actuators manufactured by Woodward. Consult the appropriate drawing to determine connections for the governor to be tested and calibrated on the test stand.

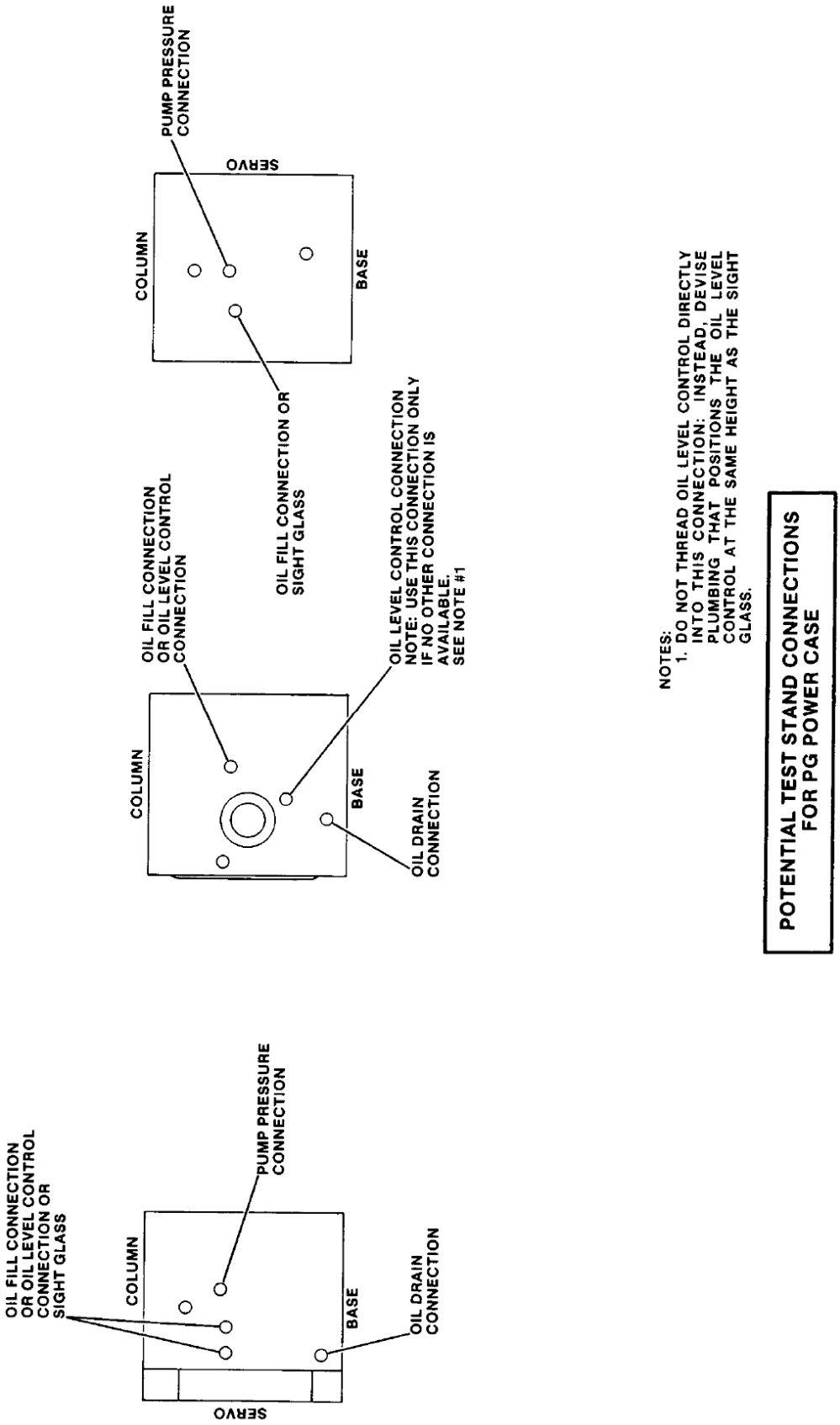

Figure 5-1. PG Power Case Connections, PG-PL Connections

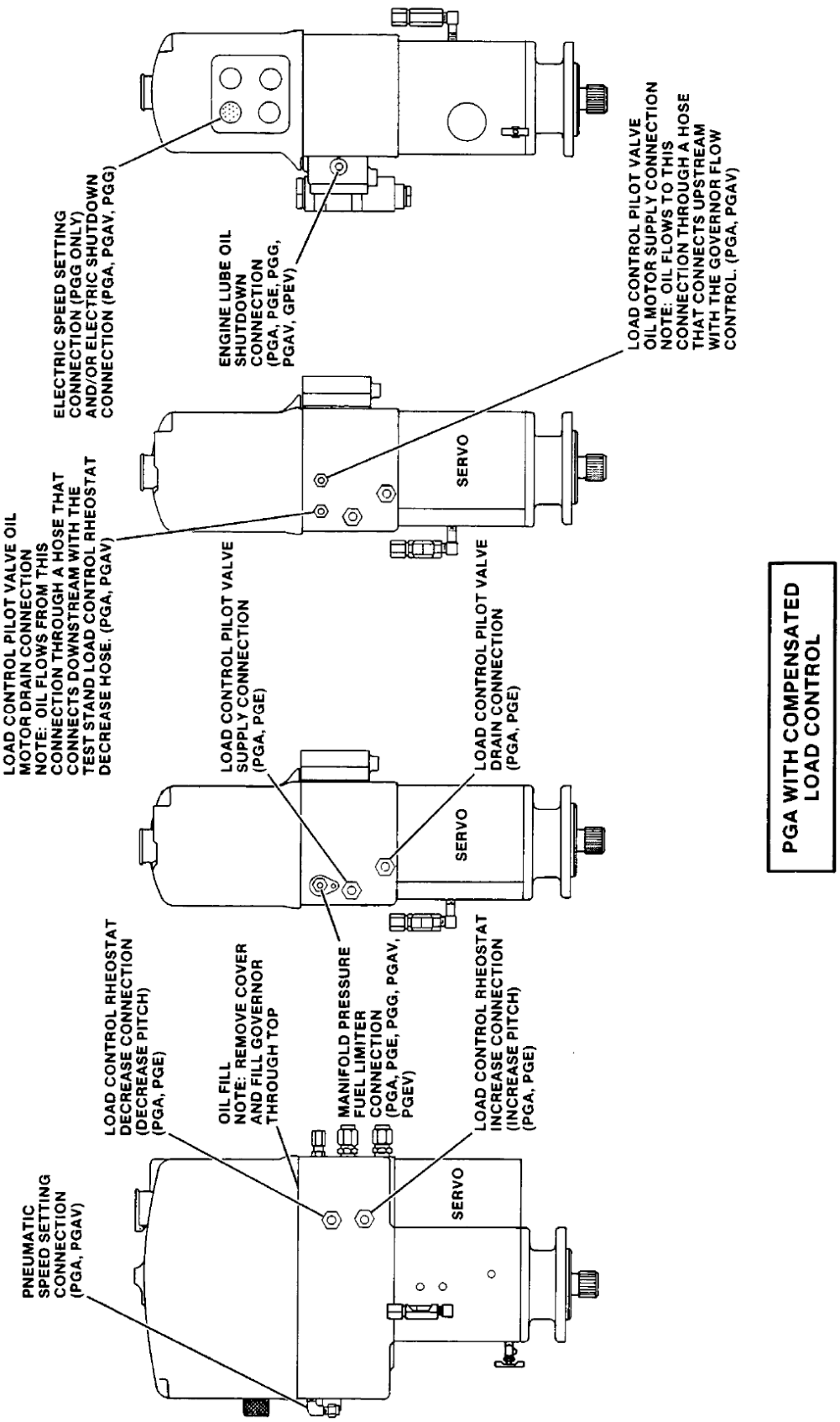

Figure 5-2. PGA Connections

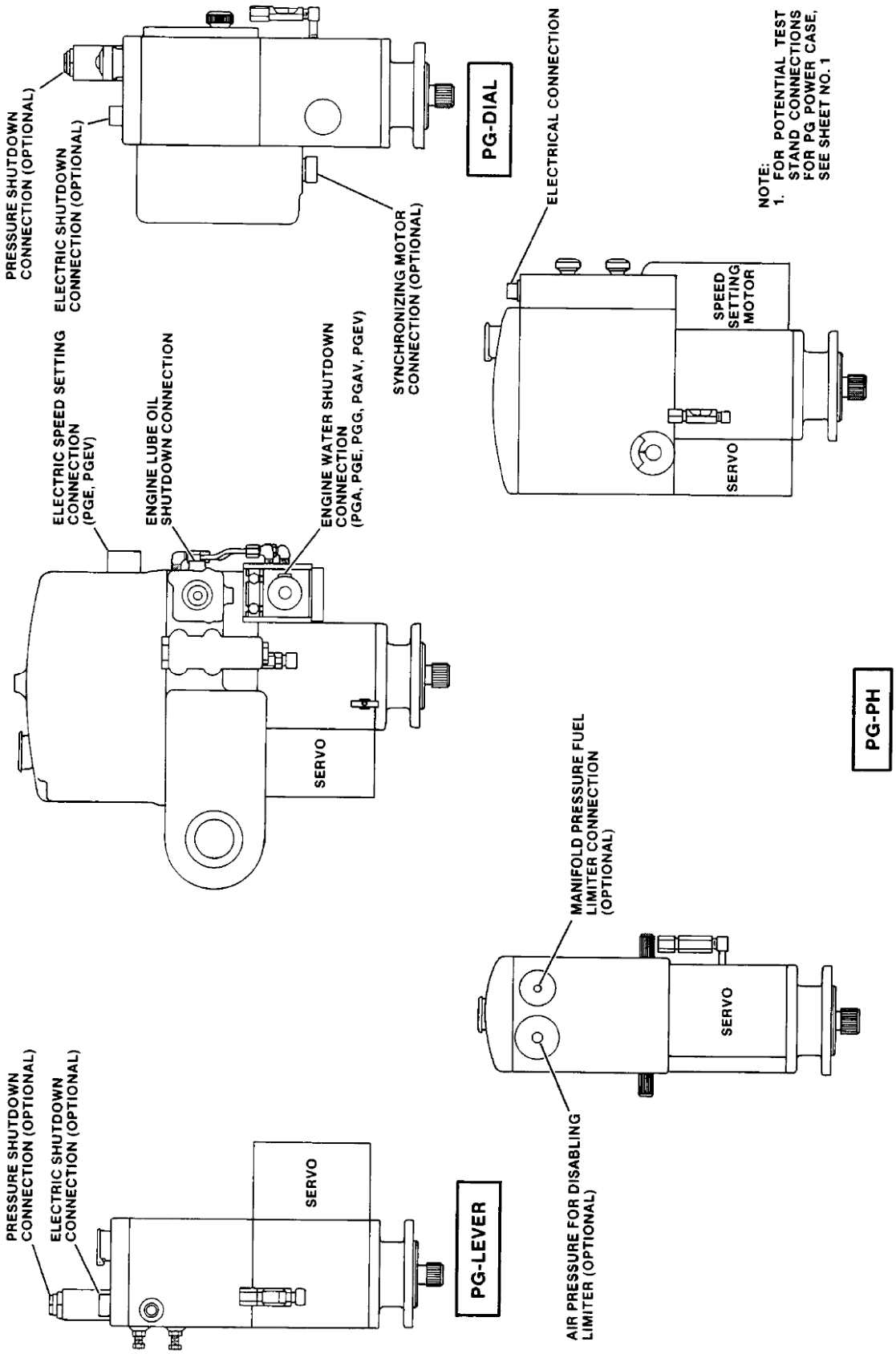

Figure 5-3. PG Lever, PG Dial, PG-PH Connections

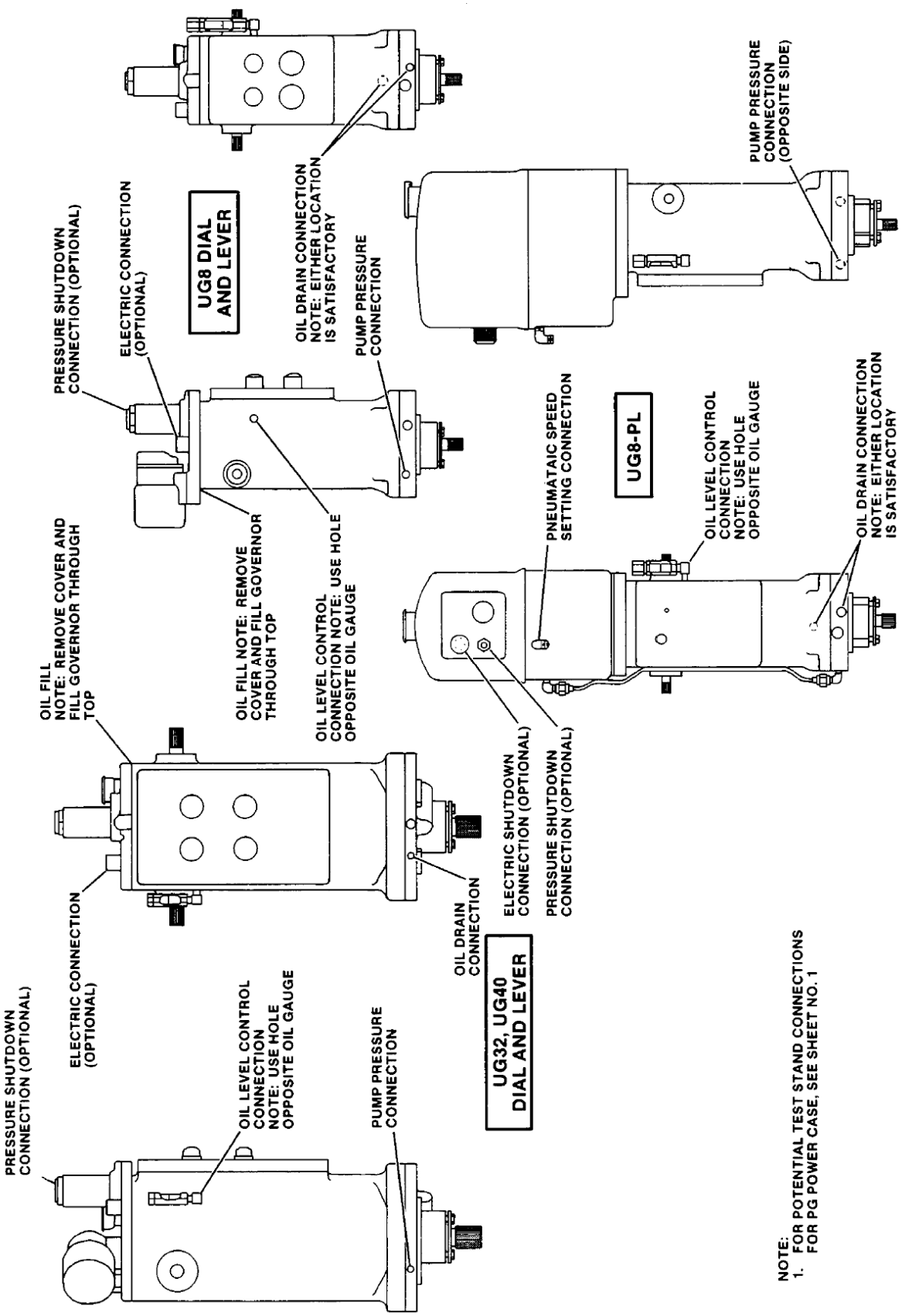

Figure 5-4. Test Stand Connections for UG Governors

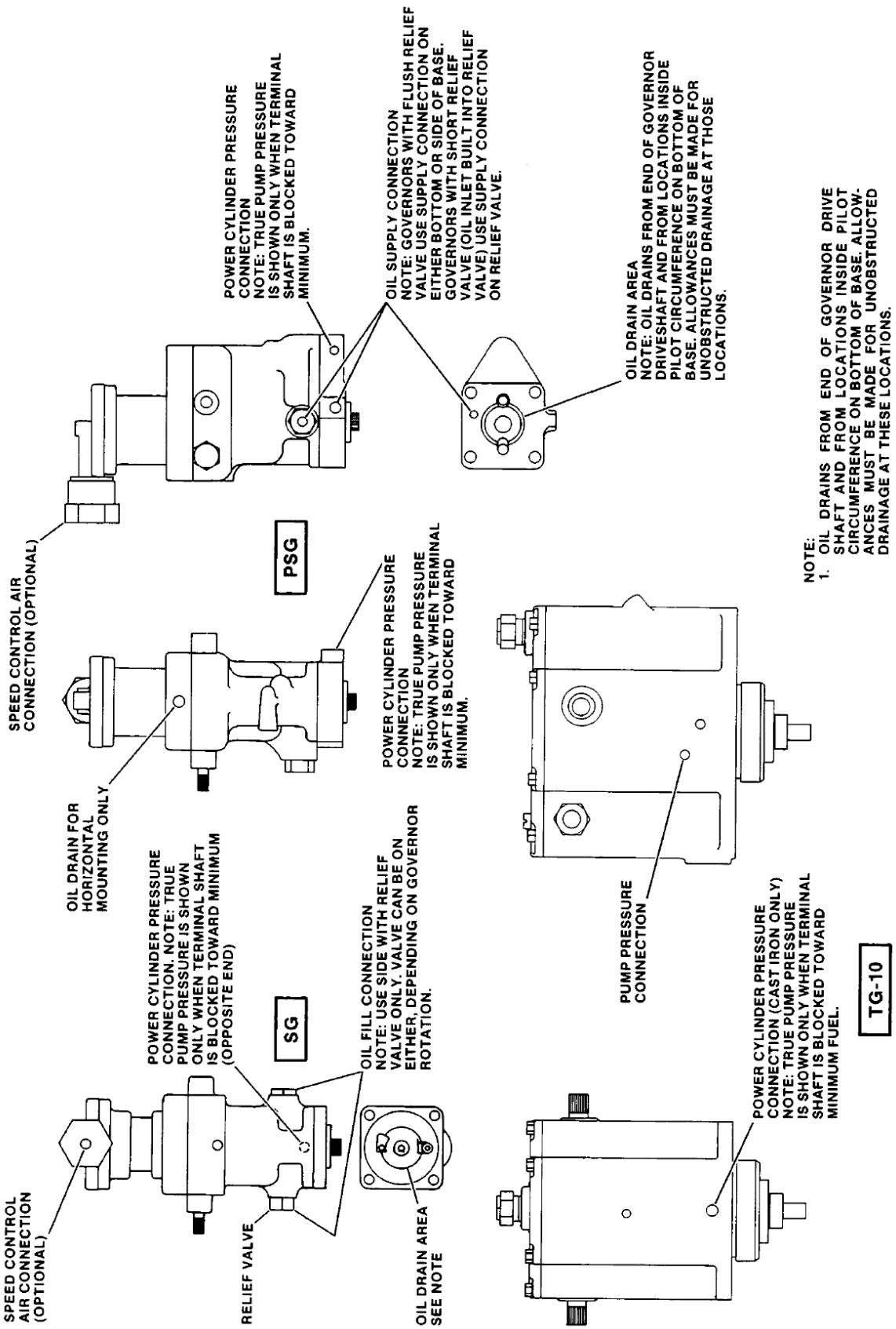

Figure 5-5. Test Stand Connections for SG, PSG, and TG Governors

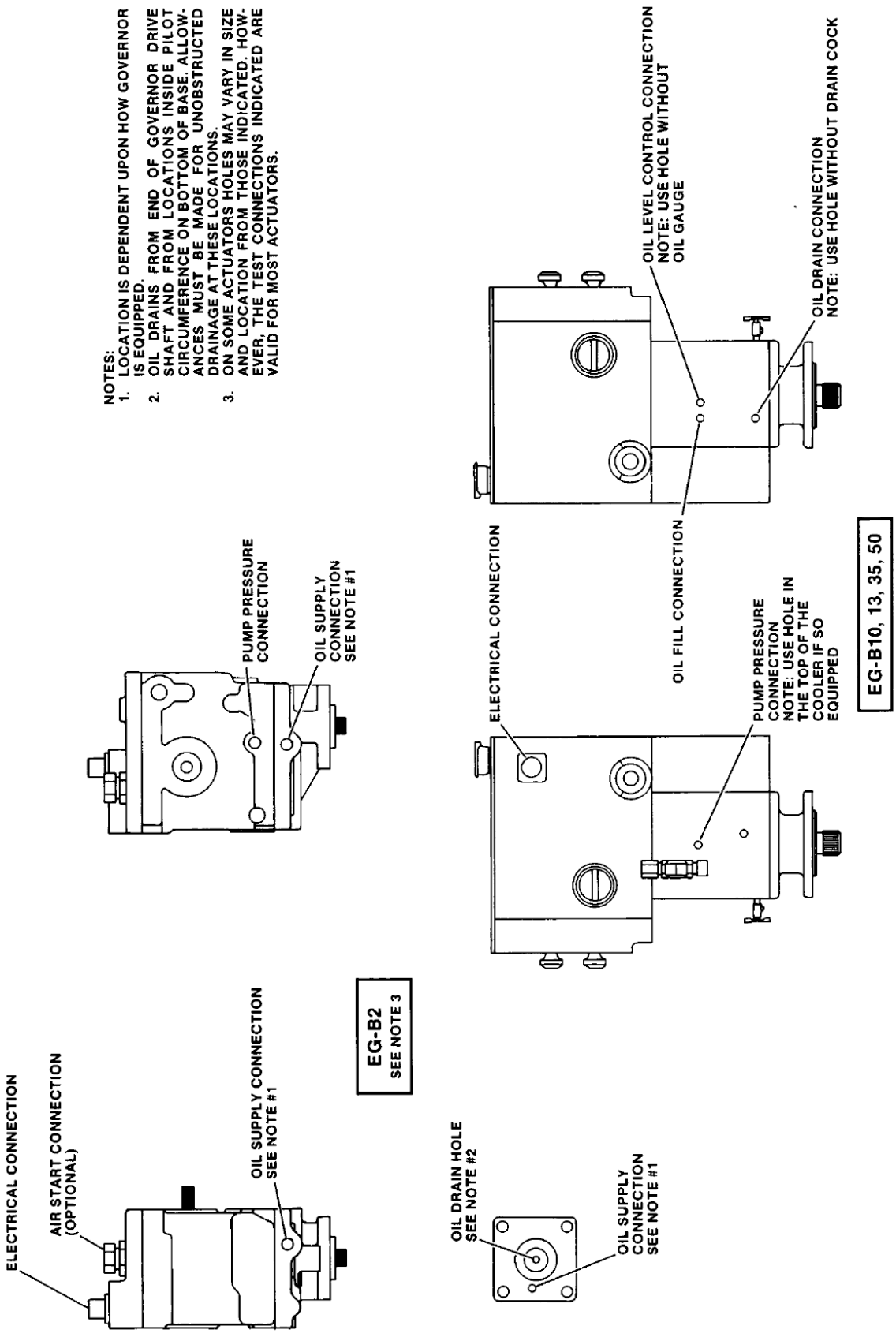

Figure 5-6. Test Stand Connections for EGB Governors

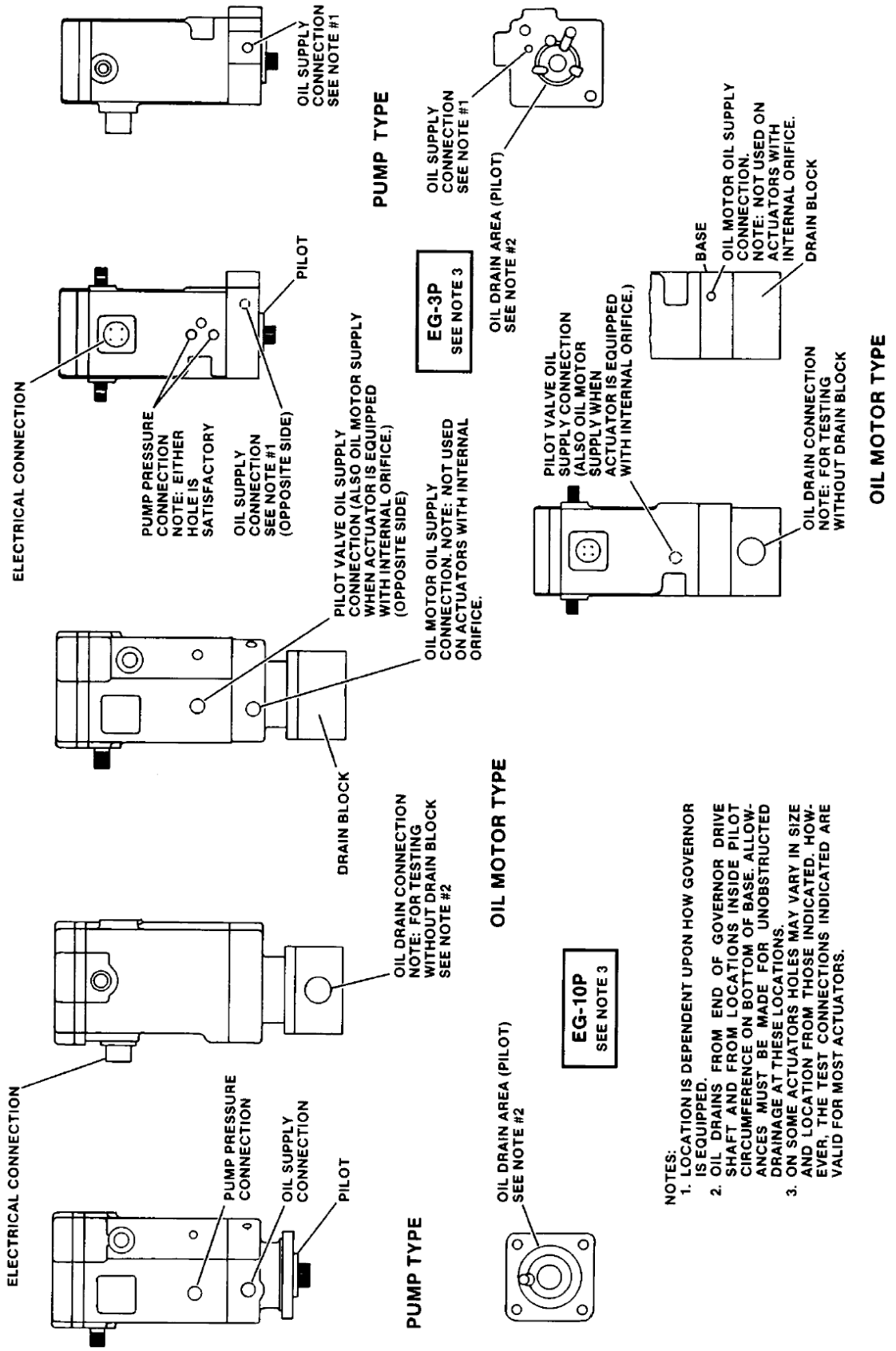

Figure 5-7. Test Stand Connections for EG Actuators

Chapter 6.
Maintenance and Troubleshooting

Oil Strainer

The oil strainer on the left-hand side of the base of the test stand is manufactured by Marvel Engineering; model M-3458. The 40 µm filter element is Marvel No. 529206-5140. 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 additionally important not to contaminate the governor being tested.

IMPORTANT

Removal of the filter requires 6.375 inches of clearance beneath the filter housing.

To change the oil in the test stand, either drain the oil from the back of the reservoir or use the oil pump to pump the oil out of the system through the valve on the side of the test stand. Should the pump be used to clear the stand of dirty oil, an additional amount of clean oil should be flushed through to thoroughly purge the stand.

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 is of the interior of the base with the door in the front of the test stand open.

The loop of wire on the left-hand side of the picture goes through a hole in the top of the base to the feedback potentiometer. The 3 horsepower, reversible, dc motor is supplied by Hampton Products Company of Rockford, Illinois, as are the various electronic control boards in the control portion of the test stand.

The oil pump and motor supplied by Delta Power Hydraulic Company of Rockford, Illinois, is visible at the bottom of Figure 6-1.

Oil Reservoir

A valve is located at the back of the oil reservoir, between the tank and the pump. This valve should be checked to be sure the pump is not drawing from a reservoir which has been shut off.

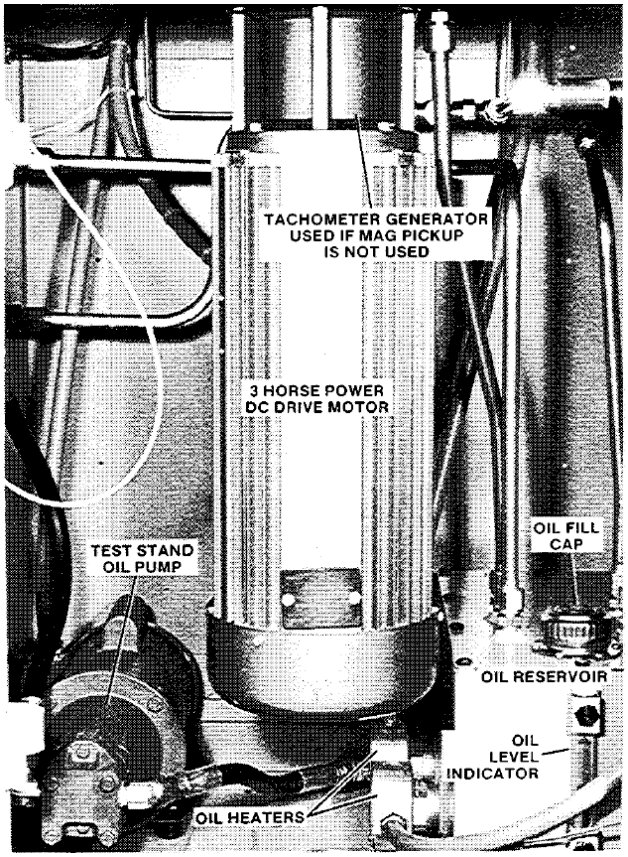

Figure 6-1. Interior of Base

Two 1000 watt oil heaters, shown in Figure 6-1, are on the bottom of the reservoir. The heaters are built by the E.L. Wiegand Division of Emerson Electric, Pittsburgh, Pennsylvania, model MTO-XX, Chromalox. The heaters are of emersion type, 240 Vac, single phase. They are wired in parallel. The reservoir must be drained before the heaters can be replaced. The heaters extend from 4-inch junction boxes into the reservoir. 1.250-11.5 NPT threads connect the heaters to the reservoir. The elements must have a heat exchanger plate.

IMPORTANT

Always use the pump when the heaters are on. Circulating oil is necessary to protect the heaters and the oil supply from becoming too hot.

The reservoir thermostat is at the bottom left of Figure 6-2. The plate on the unit is graduated into degrees and the knob should be turned to the proper setting (usually 210 °F). The control is manufactured by Athena Control, Inc., Model 86-10D-03F. It includes a solid-state electronic board and a single-turn potentiometer. The Type JH thermocouple is installed in the oil reservoir, thread size is 500 NPT. The thermocouple extends 2 inches into the reservoir. The thermocouple is manufactured by Durex International Corp., model GU-102-0-7-24-188-U, 2 inch, type J.

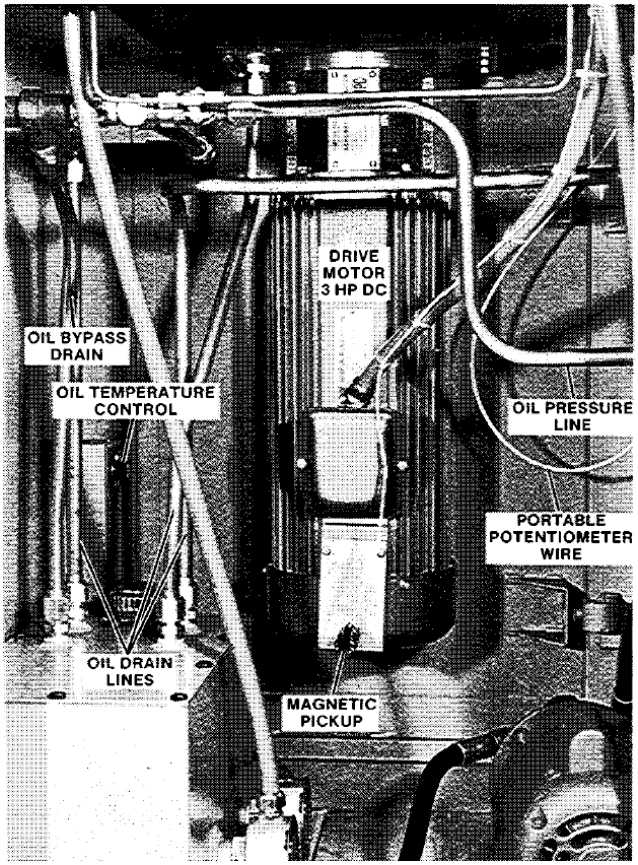

Figure 6-2. Interior of Base from Back

Drive Motor Speed Reference

The magnetic pickup used in many stands to produce the reference speed is located on the back side and bottom of the drive motor (see Figure 6-2). The motor is attached to the test-stand table with a tach generator. The generator output is used in test stands which do not have a magnetic pickup on the bottom of the drive motor.

The magnetic pickup generates an electrical frequency proportional to the speed of the motor rotation. There are no moving parts and should problems be suspected, they will normally be found either in the distance between the pickup and the motor fan, in the wiring from the pickup to the tachometer, or in the tachometer. To set the distance for the magnetic pickup, loosen the locknut and thread in until the tip of the pickup just touches the motor fan, then back Out one-half turn. Reset the locknut. Do not have the pickup too close or too far from the fan on the motor. The magnetic pickup wire can pick up interference from the motor-supply current cable and this relationship should be inspected if problems are suspected.

All test-stand oil plumbing is built from 5/8 inch copper tubing with steel fittings. Internal wiring in the base is twisted copper in flexible cables.

Figures 6-1 and 6-2 are of the simplest test stand. Many test stands have a vacuum system in the base as well as other auxiliary items.

Electrical Circuits

Figure 6-4 is a schematic of the test-stand control and drive circuits. Circuits are in the back of the control panel on the back of the test stand. Figure 6-3 shows the control circuits viewed with the test stand back cover removed. Callouts on Figure 6-3 are for reference only. We suggest that control circuit problems be referred to the manufacturer. Hampton Products of Rockford, Illinois.

All circuits in the back 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 control panel. These additional gauges are seldom connected to the drive boards shown in Figures 6-3 and 6-4.

Replacement potentiometers, switches, and circuit breakers may be obtained from Woodward at any of the addresses on the back of this manual. 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.

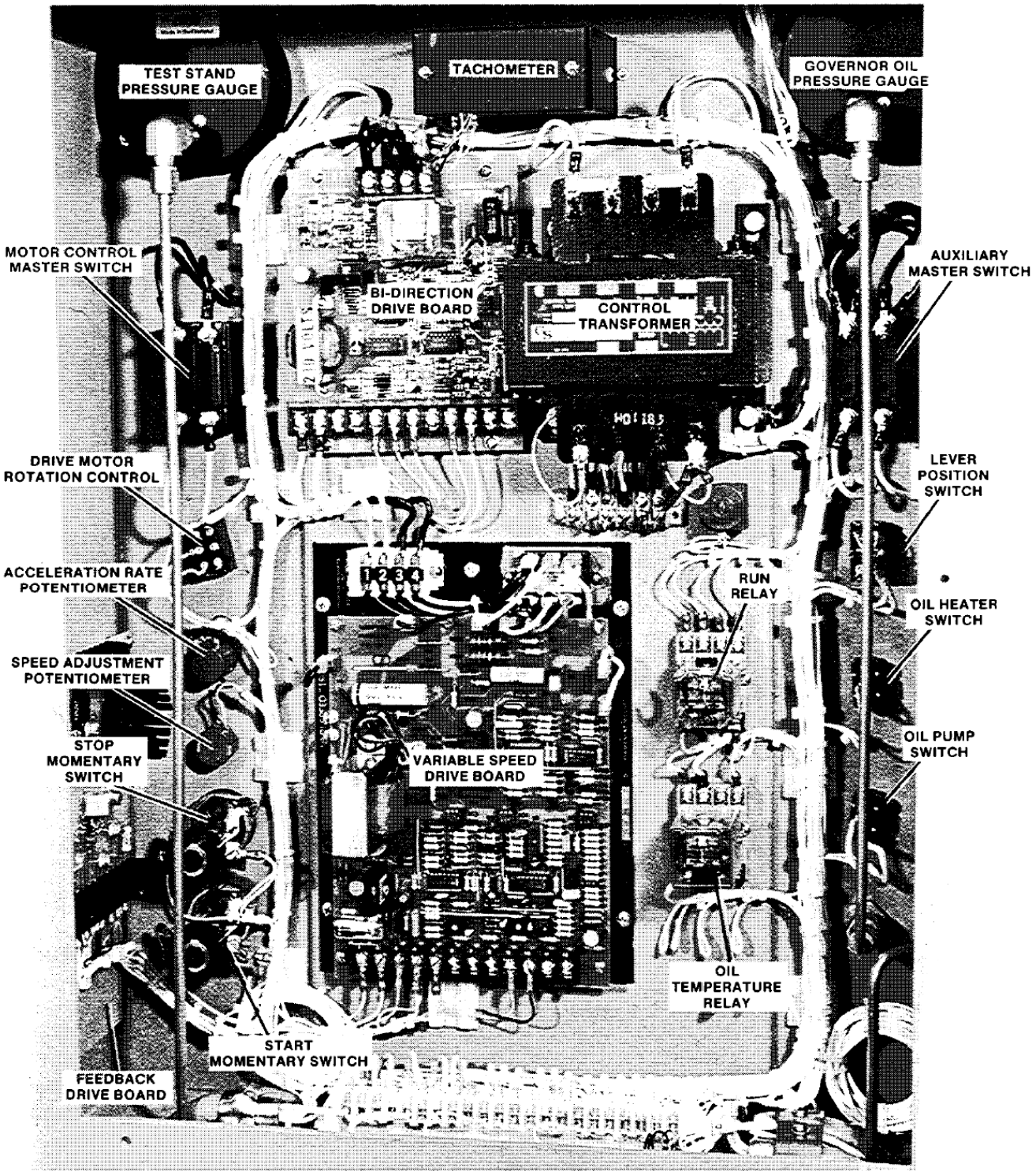

Figure 6-3. Interior of Control Panel

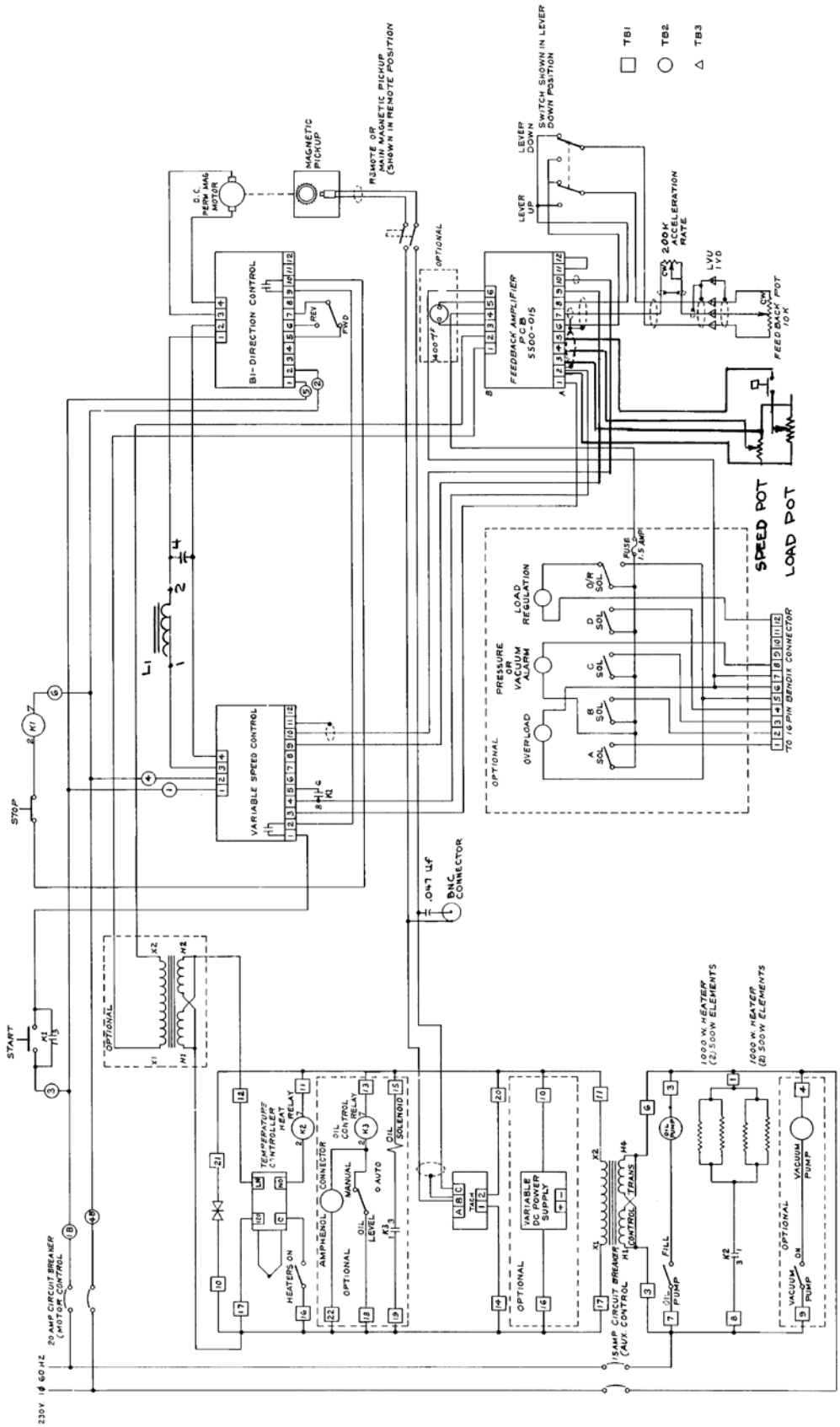

Figure 6-4. Test Stand Electrical Schematic

Chapter 7.
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 25405C.

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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.

2012/9/Colorado