



## Installation Manual



## PG-PL Governor Installation

Manual 54052 (Revision B)

## IMPORTANT



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.

## DEFINITIONS

- **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*.

Revisions—Text changes are indicated by a black line alongside the text.

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# PG-PL Governor Installation

## Governor Installation

Use care while handling and installing the PG-PL governor. Be particularly careful to avoid striking the drive shaft or output shaft.

Do not set the governor on its drive shaft. Abuse can damage seals, internal parts, and factory adjustments.

### **WARNING**

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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.

### **IMPORTANT**

Throughout this manual, the words “prime mover” refer to either engine(s), turbine(s), or other types of prime movers.

Before beginning the Installation, read the following instructions:

The conventional PG-PL can be rotated either clockwise or counterclockwise. If the governor is factory set for one direction of rotation only, be sure the governor drive shaft rotation is correct. Incorrect direction of rotation can cause seizure of rotating parts. Make sure that the governor speed setting and control air pressure are correct for your installation.

### **IMPORTANT**

The governor speed setting and the control air pressure are stamped on the governor data plate.

The prime-mover-to-governor coupling must provide a close but free fit. Make sure that no side loads are applied to the governor drive shaft. This coupling also must allow for thermal expansion without end loading the drive shaft.

### **WARNING**

A misaligned drive shaft could break and could cause an overspeed condition.

Do not pound the drive coupling onto the governor drive shaft, or force the governor into position. A common drive shaft diameter is the 1-1/8 inch (~29 mm) serrated shaft. Other drive shaft diameters also are used on the PG-PL governor.

If an optional keyed drive is used, take care to avoid rough gear teeth and incorrect backlash when installing the governor. Refer to the prime mover manufacturer's specifications for the correct amount of backlash and for the adjustment procedure.

Place a gasket between the base of the governor and the engine mounting pad. Mount the governor squarely on its mounting pad and in line with the drive. Torque the mounting bolts evenly. There must be no movement or rocking of the governor on the engine mounting pad.

**IMPORTANT**

Refer to the engine manufacturer's specifications for torque limits when tightening the four governor mounting bolts.

## Linkage Attachments

Refer to the prime-mover manufacturer's manual for the correct linkage selection, installation, and adjustment. Be sure there is no lost motion or binding in the linkage.

A common terminal shaft connection for the rotary servo is a 3/4 inch (~19 mm) serration for the 12 ft-lb (16 J) servo, and a 1 inch (~25 mm) serration for the 24 ft-lb (33 J) servo. Several different types of linear servos also are used. Correct locking methods must be used on the linkage connections.

For diesel engine applications, use a linear linkage (see Figure 1). For applications involving a butterfly valve, such as on a gas engine, use a non-linear linkage (see Figure 2).

Linear servo travel is 1.0 inch (25 mm) maximum, and rotary servo travel is 30 degrees maximum. See Figure 3 for recommended output shaft travel adjustment.

**WARNING**

Be sure to allow sufficient overtravel at each end of the output shaft travel so the governor can shut down the prime mover and also give maximum fuel when required.

When installing non-linear linkage, be sure the two following conditions are attained when the linkage is in the zero governor travel position:

- The lever which is attached to the governor and the connecting link is in line with the governor output shaft and the point of attachment of the connecting link to the butterfly lever.
- When the butterfly valve is closed, the butterfly valve lever must be at 90 degrees with the connecting link.

After the governor has been correctly mounted and the correct linkage connections completed, make the pneumatic connections to the manual or automatic pneumatic controller.

The manual speed-setting knob allows manual operation when the air pressure signal is not available, and it also raises the pneumatic speed setting.

## Oil Supply

Use Table 1 as a guide in the selection of a suitable lubricating/hydraulic oil. Oil grade selection is based on the operating temperature range of the governor.

This guide is NOT Intended to be used in the selection of the prime mover lubricating oil.

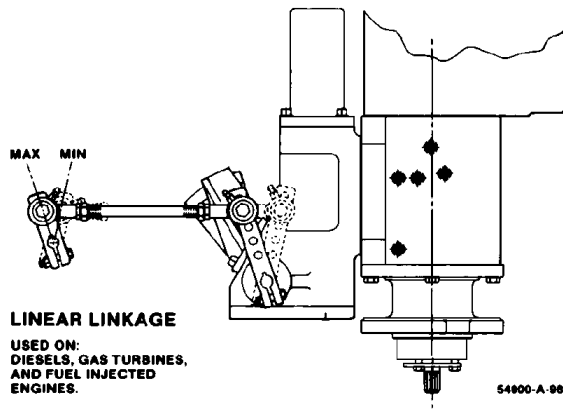


Figure 1. Linear Linkage Arrangement

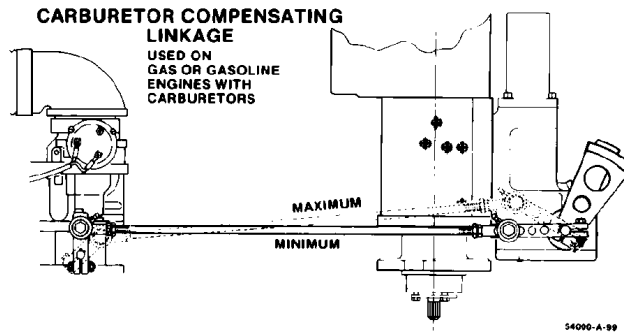


Figure 2. Non-linear Linkage Arrangement

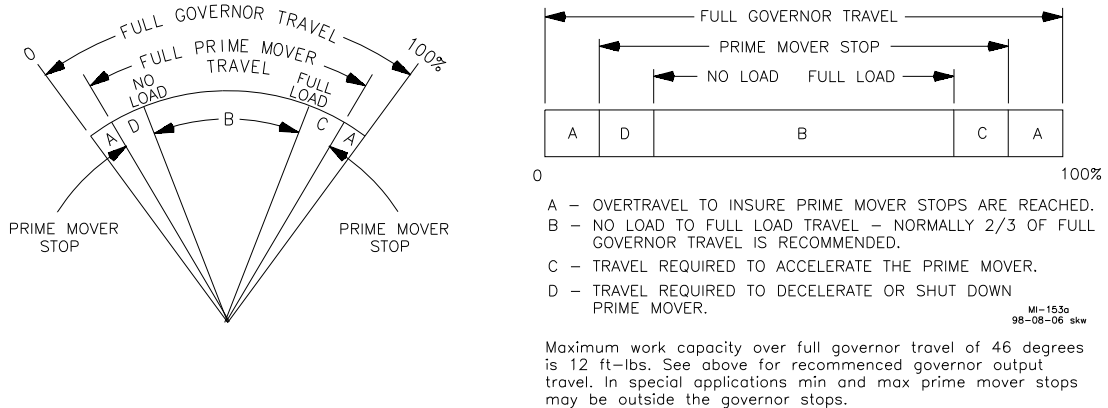


Figure 3. Recommended Governor Output Shaft Travel

Be sure to use only clean oil. The source of most troubles in any hydraulic governor is dirty, contaminated, or oxidized oil.

Governor oil viscosity at operating temperature must stay within the 50 to 3000 SUS (Saybolt Universal Seconds) range. Ideal oil viscosity at operating temperature is between 100 and 300 SUS.



**A loss of stable governor control and possible engine overspeed may result if the viscosity is not within the 50 to 3000 SUS range.**

Governor oil must be compatible with seal materials such as nitrite, polyacrylic, and fluorocarbon. If in doubt, contact Woodward.

The recommended continuous operating temperature of the oil is 140 to 200 °F (60 to 98 °C). The ambient temperature limits are -20 to +200 °F (-29 to +93 °C).

Measure the temperature of the governor on the outside lower part of the case. The actual oil temperature will be slightly warmer, approximately 10 degrees F (6 degrees C).

The oil capacity of the governor is 1.6 quarts (1.5 L) for the 29 ft-lb (39 J) rotary servo governor. The total capacity depends on the type of servo. Servos with smaller work ratings require slightly less oil.

Before starting the engine, fill the governor with the selected oil to the mark on the oil sight glass with the engine at the lowest speed setting. If the oil sight glass has two marks, fill governor with oil to a level visible between the two marks with the engine at the lowest speed setting. Oil must be visible in the glass at all times.

The oil must never be above the line where the case and column castings meet. Oil above this level will be churned into foam by the rotation of the flyweight head.

NOTICE

**Always check the governor oil level with the engine idling once the governor has reached normal operating temperature, Oil must be visible in the glass under all operating conditions. Add oil, if necessary, to the required level.**

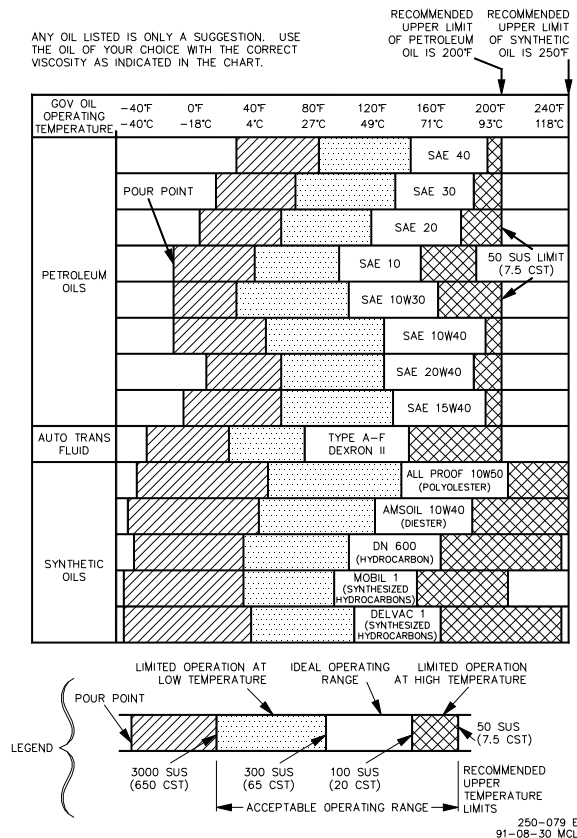


Table 1. Oil Chart

A governor oil cooler is required if operating temperatures exceed 200 °F (93 °C), and speeds exceed 1200 rpm on an engine application or 1100 rpm on a steam turbine.

It also may be necessary to use an oil cooler at lower governor drive shaft speeds if the governor is mounted close to steam valves or lines which result in high ambient temperatures.

## Initial Operation

Before initial operation of the PG-PL equipped prime mover, be sure that all installation steps are successfully accomplished.



### WARNING

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.

Normally, the only requirements for putting a new governor into service are to:

1. Fill the governor with oil (see Oil Supply).
2. Adjust the compensation needle valve to obtain maximum stability (see Compensation Needle Valve Adjustment below).
3. Set the speed adjusting knob on the governor to give low speed at initial start-up (see Before Starting the Engine).
4. Connect all auxiliary devices, if any (see Auxiliary Devices).

All other operating adjustments are accomplished during factory testing according to engine manufacturer specifications and should not require further adjustments.

### NOTICE

Do not attempt internal adjustment of the governor unless thoroughly familiar with the proper procedure.

Before starting the engine, be sure the PG-PL governor is set to give low speed at initial start-up by following these Instructions:

#### For Direct-Acting Governors

For starting and operating a direct-acting governor on pneumatic speed setting, turn the speed adjusting knob to its minimum speed setting (counterclockwise) position (low speed).

If pneumatic pressure is not used, be sure the manual speed setting is at its minimum speed setting (counterclockwise) position (low speed).

#### Reverse-Acting Governors

**For Starting**—Always start a reverse-acting governor with either maximum air pressure speed signal (low speed) or, if pneumatic pressure is not used, be sure the manual speed setting is at the full counterclockwise position (low speed).

**For Normal Operation**—When operating a reverse-acting governor on pneumatic speed setting, turn the speed adjusting knob clockwise to its maximum position (high speed).

Start the prime mover as instructed by the prime mover manufacturer, and allow the governor to reach its normal operating temperature.

## Compensation Needle Valve Adjustment

Make the following compensation adjustments on the governor with the prime mover operating at lowest speed setting to provide stable governor operation:

1. Open the compensation needle valve several turns to cause the prime mover to hunt.

If opening the needle valve alone does not cause the prime mover to hunt, manually disturb the governor speed setting to induce the governor to become unstable.

Allow the governor to hunt for several minutes to remove trapped air through the governor oil passages.

2. Close the compensation needle valve gradually until hunting is just eliminated. However, keep the needle valve open as far as possible to prevent sluggishness in the governor response.

The needle valve setting normally varies from 1/16 to 1 turn open, depending upon the particular prime mover. Never close the needle valve tight; the governor cannot operate satisfactorily with the needle valve closed.

3. Check engine stability by manually disturbing the governor speed setting.

The compensation adjustment is satisfactory when the engine returns to speed with only a slight overshoot or undershoot.

Once the needle valve adjustment is correct, it is not necessary to change the setting except for large permanent changes in temperature which affect governor oil viscosity.

### **IMPORTANT**

Remote servo applications may require venting to remove air in addition to the needle valve adjustments outlined above.

4. Loosen the vent plug (see **CAUTION** below) on the side of the governor case (see Figure 4) enough to establish an oil leak.

### **NOTICE**

The vent plug is under pressure. Do not remove while operating the governor.

5. Bleed until air bubbles stop.
6. Tighten the vent plug and refill the governor with oil to the mark on the oil sight glass. Check the vent plug for teaks after tightening.
7. Repeat steps 1 through 3.

### **IMPORTANT**

If normal troubleshooting procedures (see below) fail to eliminate hunting, contact Woodward for possible use of preloaded buffer springs.



With preloaded butter springs (see Auxiliary Devices), a needle valve opening of 1/16 to 1/8 turn usually gives best performance. The needle valve must never be closed tight as the governor cannot operate satisfactorily with the needle valve closed.

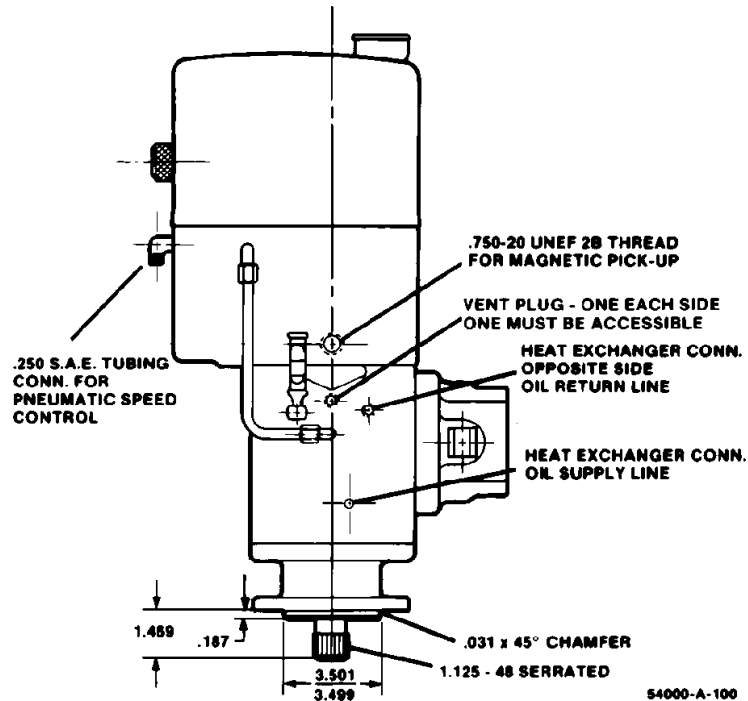


Figure 4. Outline Drawing of PG-PL Governor (shown with 12 ft-lb linear servo-horizontal)

## Troubleshooting Procedures

Normal troubleshooting procedures consist of the following checks:

1. Make sure that the speed changes observed are not the result of load changes beyond the capacity of the engine or turbine.
2. If the governor is on an engine, make sure that all cylinders are firing properly and that the injectors are in good operating condition.  
  
If the governor is on a turbine, make sure that the steam valves are operating correctly.
3. Make sure there is no binding or lost motion in the operating linkage between the governor and the engine or turbine.
4. Be sure that there are no steam or fuel gas pressure changes.
5. Check the compensation needle valve for correct adjustment.
6. Be sure that the air controller output pressure is as specified. If neither load nor engine or turbine irregularities are found to be the cause of the speed variation, the cause may be either in the governor or in the engine or turbine drive to the governor.

7. Make sure governor operating oil pressure is 100 psi (690 kPa). This value, however, may vary between governors, depending upon the required output work capacity of the power cylinder.

With the engine shut down, remove the plug from the pressure port on the governor power case and install a pressure gauge rated above specified operating oil pressure.

The source of most troubles in any governor is dirty oil. The moving parts within the governor are continually lubricated by the oil within the governor. Grit and other impurities will cause excessive wear of valves, pistons, and plungers, and can cause these parts to stick and even to “freeze” in their bores.

In many instances, erratic operation and poor repeatability can be corrected by flushing the unit with fuel oil or kerosene while cycling the governor. The use of commercial solvents is not recommended as they may damage seals or gaskets.

## Auxiliary Devices

Many auxiliary devices are available for use, either singly or in combination, for the PG-PL governor. Some auxiliary equipment may be supplied as original equipment only, and some may be installed in the field. Contact Woodward for information ([www.woodward.com](http://www.woodward.com)).

The following paragraphs give brief description of some of the auxiliary equipment available from Woodward, and list the manuals where detailed information may be obtained.

Manual No.	Title
36600	PG Governor Basic Elements
36602	Basic Elements, PG Governor with Differential Servomotor
36605	Overspeed Trip Test Device
36618	PG-200/300 Case, Accumulator and Power Cylinder
36641	Governor Oil Heat Exchanger, Remote and Integral Types
36650	Solenoid Operated Shutdown Assembly
36651	Pressure Actuated Shutdown Assembly
36680	Buffer Springs
36684	Booster Servomotor
36692	PG Power Cylinder Assemblies
36693	PG Base Assemblies
36694	PG-PL Governor

### Governor Oil Cooler

A governor oil cooler is required if operating temperatures exceed 200 °F (93 °C), and speeds exceed 1200 rpm on an engine application or 1100 rpm on a steam turbine.

It also may be necessary to use an oil cooler at lower governor drive shaft speeds if the governor is mounted close to valves or steam lines which result in high ambient temperatures.

Two basic models of oil cooler are available, the integral (bolt-on) and the remote type. If it is desired to add an oil cooler to a governor already in service, the remote oil cooler can be installed in the field. If the integral type cooler is desired, the governor must be returned to the factory for conversion.

## Shutdown Devices

A shutdown device can be incorporated in the PG-PL governor to stop fuel to the prime mover if equipment fails.

- An air, oil, or water shutdown device is available to shut down the prime mover on either high or low signal pressure. These devices are generally supplied where electrical devices cannot be used.
- A solenoid shutdown device can be arranged to energize or de-energize to shutdown. Solenoid coils are available to accommodate most common ac and dc voltages.



**The shutdown solenoid must not be used as an overspeed protection device. Overspeed protection must come from a unit completely separate from the PG-PL governor.**

## Preloaded Buffer Springs

Preloading allows the governor to minimize fuel linkage movements resulting from changes in speed due to engine misfiring or pump instability.

The use of preloaded buffer springs does not change the capability of the governor to recognize and respond to speed changes.

Preloaded buffer springs do retard the rate at which the governor output piston (or shaft) moves when responding to small or momentary off-speeds. The output piston (or shaft) moves at the normal rate for large speed changes.

Preloaded buffer springs are often installed in PG-PL governors used on two-cycle spark ignition engines and on some engines driving reciprocating pumps.

## Booster Servomotor

This device allows the engine to start quickly by supplying oil under pressure to the governor at the instant air is supplied to the engine. This enables the governor to move the engine linkage to the fuel-on position immediately.

## PG Base and Power Cylinder Assemblies

A number of different base and power cylinder arrangements are available to conform to engine or turbine manufacturer's specifications. These are factory installed.

The base assembly can be furnished with either a serrated or keyed drive shaft (refer to manual 36693). Power cylinder work capacities are available from 12 ft-lb (16 J) to 200 ft-lb (271 J). Manual 36692 explains the various power cylinders, while manual 36618 explains the PG-200/300 Case, Accumulator, and Power Cylinder.

If problems are encountered with the installation or operation of this governor, contact Woodward.

We appreciate your comments about the content of our publications.

Send comments to: [icinfo@woodward.com](mailto:icinfo@woodward.com)

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