WOODWARD

Product Manual 54054
(Revision NEW)
Original Instructions

PGA Governor

Installation 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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

www.woodward.com/publications

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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, 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 Out-of-date translations are marked with ⚠.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.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Warnings and Notices

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

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.

PGA Governor Installation

General

Use care while handling and installing the PGA 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.

IMPORTANT **Throughout this manual, the words PRIME MOVER refer to engine(s) or turbine(s).**

Before beginning the installation, follow these instructions:

If the governor is factory set for one direction of rotation only, be sure the governor drive shaft rotation is correct for the governor. 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. The governor speed setting and the control air pressure are stamped on the governor data plate.

⚠WARNING **A misaligned drive shaft could break and could cause an overspeed condition or runaway engine.**

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. Use the correct length of coupling. This coupling also must allow for thermal expansion without end loading the drive shaft.

Do not pound the drive coupling onto the governor drive shaft, or force the governor into position.

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

Place a gasket between the base of the governor and the engine mounting pad to allow for surface imperfections. Mount the governor squarely on its mounting pad and in line with the drive.

Refer to the engine manufacturer's specifications for torque limits when tightening the four governor mounting bolts. Torque the mounting bolts evenly. There must be no movement or rocking of the governor on the engine mounting pad.

The PGA governor comes equipped with one of the five most common base assemblies:

- PG Standard
- PG-UG8 standard
- PG-UG8-90 (base rotated 90° with respect to PG-UG8 standard)
- PG-UG40
- PG extended square

The differences among bases is the base configuration and the type of drive shaft used.

The PG standard base uses a serrated or a special drive shaft; the PG-UG8, PG-UG8-90, and PG-UG-40 may use either a serrated or keyed drive shaft; and the PG extended square base uses only a keyed drive shaft.

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.

The terminal shaft connection for the 12 or the 58 ft-lb rotary servo is a 1-48 inch serration. Pin size for the rod end is 1/2 inch. Correct locking methods must be used on the linkage connections.

See Figure 2 for recommended output shaft travel adjustment.

⚠WARNING

Be sure to allow sufficient overtravel at each end of output shaft overtravel. Insufficient overtravel can prevent the governor from shutting down the prime mover and also from giving maximum fuel when required.

Many governors include a feature commonly referred to as "compensation cut-off." Due to the location cut-off in the power cylinder wall, it is necessary that the governor-to-fuel-control linkage be adjusted so that at idle no-load the output shaft of the governor is at least 15% of its travel from minimum position.

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

The manual speed setting knob must be set at minimum to assure that the pneumatic signal range is correct. The manual speed-setting knob allows manual operation when the air pressure signal is not available, and it also raises the pneumatic speed setting.

Make the electrical connections as shown in Figure 3. If the wiring schematic does not correspond to your particular governor, contact Woodward or your authorized dealer/distributor.

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.

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

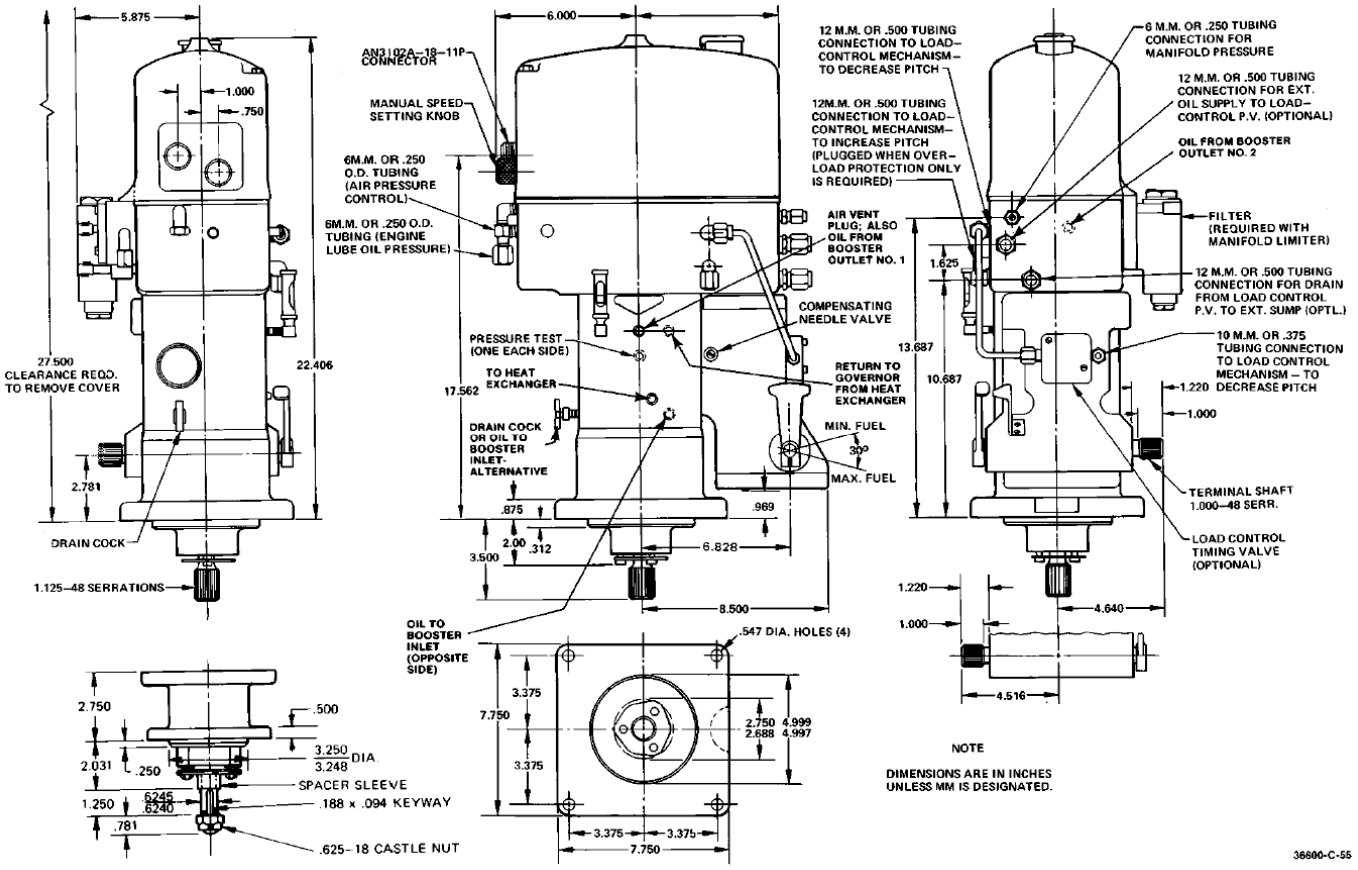
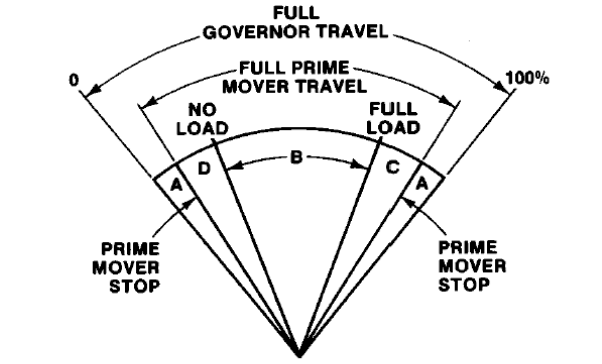


Figure 1. Outline Drawing of PGA Governor with 58 ft-lb Rotary Output, UG40 Base, and Load Control



A - OVERTRAVEL TO INSURE PRIME MOVER STOPS ARE REACHED

B - NO LOAD TO FULL LOAD TRAVEL — NORMALLY 2/3 OF FULL GOVERNOR TRAVEL IS RECOMMENDED

C - TRAVEL REQUIRED TO ACCELERATE THE PRIME MOVER

D - TRAVEL REQUIRED TO DECELERATE OR SHUT DOWN PRIME MOVER

Figure 2. Recommended Governor Output Shaft Travel Adjustment

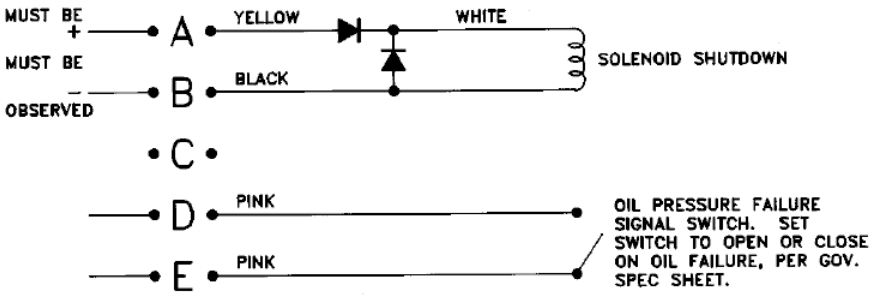


Figure 3. Wiring Schematic

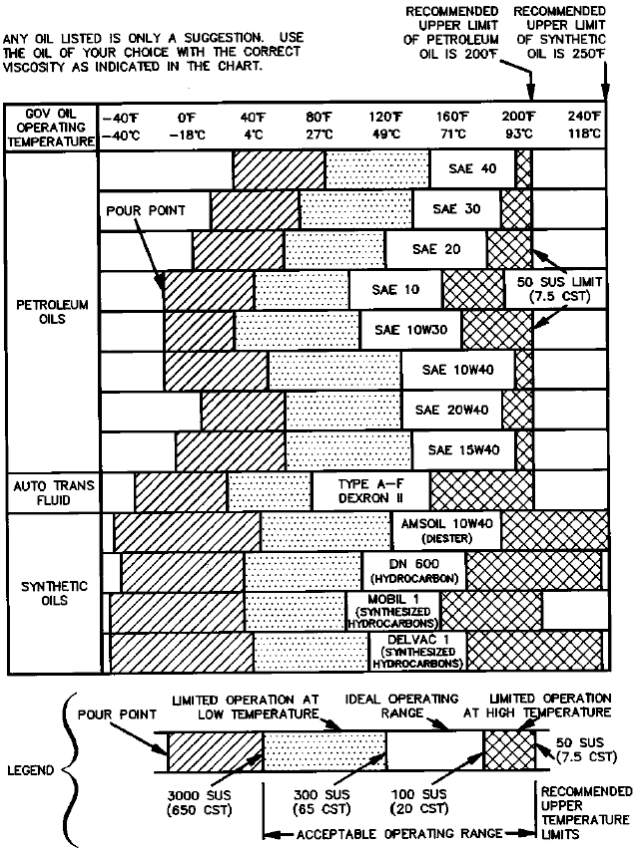


Table 1. Oil Chart

Governor oil viscosity at operating temperature must stay within the 50 to 3000 SUS (Saybolt Universal Seconds). Ideal oil viscosity at operating temperature is between 100 and 300 SUS. Hydraulic fluid pour point must be below lowest expected starting temperature.

⚠WARNING

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 nitrile, polyacrylic, and fluorocarbon. If in doubt, contact Woodward or your authorized dealer/distributor.

The recommended continuous operating temperature of the oil is 140 to 200 °F (60 to 93 °C). The ambient temperature limits are –20 to _200 °F (–30 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 by approximately 10 °F (6 °C).

The oil capacity of the governor is approximately 1.5 quarts (1.4 liters). The total capacity depends upon the size of the servo; servos with larger work ratings than 12 ft-lb require more oil.

Before starting the engine, fill the governor with the selected oil to the mark on the oil sight glass. If the oil sight glass has two marks, fill the governor with oil to a level visible between the two marks.

Always check governor oil level with 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 mark on the oil sight glass. However, the oil must never be above the line where the case and column castings meet.

NOTICE

Do NOT overfill. Oil above this level will be churned into foam by the rotation of the flyweight head. This will result in a loss of stable governor control.

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

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

Initial Operation

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

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

1. Make the hydraulic, pneumatic, and electrical connections required for the particular governor.
2. Fill the governor with oil (see Oil Supply).
3. Connect all auxiliary devices, if any (see Auxiliary Devices).
4. Set the speed adjusting knob on the governor to give low-speed at initial start-up.
5. Select LOW Speed at initial start-up on the engine speed control.
6. Adjust the compensation needle valve to obtain maximum stability. See Compensation Needle Valve Adjustment below.

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 PGA Governor is set to give low speed at initial start-up.

⚠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.

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

The objective of the compensation needle valve adjustment is to obtain maximum stability in governor operation. This adjustment depends upon the individual characteristics of the prime mover.

Make the following compensation adjustments with the prime mover operating at lowest speed setting;

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 hunt.

   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 2 turns 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.

IMPORTANT

If normal troubleshooting procedures (see below) fail to eliminate hunting, contact Woodward or your authorized dealer/distributor for possible use of preloaded buffer springs.

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.

WARNING

The air vent plug is under oil pressure. Do not remove while operating the governor. If removed, a stream of hot oil will squirt out of the vent hole under a pressure of 50 to 100 psi (345 to 690 kPa) depending upon the governor oil operating pressure.

Loosen the air vent plug on the side of the governor case enough to establish an oil leak.

Bleed until air bubbles stop.

4. Tighten the air vent plug and refill the governor with oil to the mark on the oil sight glass. Check the air vent plug for leaks after tightening.

5. Repeat steps 1 through 3 until the prime mover returns to speed with only a slight overshoot or undershoot.

With preloaded buffer springs (see Auxiliary Devices below), the needle valve should not be more than 1/16 turn open for smooth operation. The needle valve must never be closed tight, as the governor cannot operate satisfactorily with the needle valve closed.

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 and properly calibrated.

   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 on 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, contaminated, or oxidized 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 “freeze” in their bores. Be sure to use only clean oil.

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.

8. Make sure buffer springs are not too light. This may occur on a new installation. Consult Woodward or your authorized dealer/distributor if heavier buffer springs should be installed.

9. For additional troubleshooting information, see manual 36604, PGA Governor.

Auxiliary Devices

Many auxiliary devices are available for use, either singly or in combination, for the PGA governor. Some auxiliary devices may be supplied as original equipment only, and some may be installed in the field. Contact Woodward or your authorized dealer/distributor for information (address information on the Woodward website, www.woodward.com).

Solenoid Operated Shutdown Devices, manual 36650

⚠WARNING **The shutdown solenoid must not be used as an overspeed protection device. Any failure of the governor-to-engine linkage, or the governor drive shaft, or any mechanical failure which would render the governor inoperative, could result in an overspeed condition or runaway engine. Overspeed protection must come from a unit completely separate from the PGA governor.**

Overspeed Trip Test Device, manual 36605
PG Manifold Gauge Pressure Fuel Limiter, manual 36661
PG Speed Setting Fuel Limiter, manual 36660
Basic Load Control System, manual 36630
Booster Servomotor, manual 36684
Extensible Tailrod, manual 36640
Governor Oil Heat Exchanger, manual 36641

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 54054.

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