



Product Manual 36404
(Revision C)
Original Instructions

Analysis and Correction of PG Governing Troubles

Troubleshooting 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

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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 Out-of-date translations are marked with ⚠.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.

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.

Analysis and Correction of PG Governing Troubles

General

It is impossible to anticipate every kind of trouble that is encountered in the field. This manual covers the most common troubles experienced. Poor governing may be due to faulty governor performance, or it may be due to the governor attempting to correct for faulty operation of the engine or turbine auxiliary equipment. The effect of any auxiliary equipment on the overall control required of the governor must also be considered.

Approximately 95% of all trouble may be corrected by following these instructions. The other 5% may be of a nature requiring the services of a governor engineering specialist.

Governor Oil Level

Governor oil level must be kept between the lines on the oil level gauge glass with the unit operating. The correct level is at the joint line of the power case and column (the upper line on the gauge glass) and no higher. Instructions given on decals near the oil gauge should be strictly adhered to.

For oil gauges with only one line, fill the governor with oil until oil covers the line in the oil gauge. After the governor and oil have warmed up to operating temperature refill the governor with oil until the oil again covers the line in the oil gauge.

For more complete information on oils to use, and when to change the governor oil, see Woodward manual 25071, *Oils for Hydraulic Controls*.

Dirty oil causes approximately 50% of all governor troubles.

Use clean new or filtered oil. Containers used to fill governors from bulk containers should be perfectly clean. Oil contaminated with water causes foaming, breaks down rapidly and corrodes internal governor parts.

Compensating Adjustments

Adjust the compensating needle valve with the governor controlling the engine or turbine, even though the compensation may have been previously adjusted at the factory or on governor test equipment. Although the governor may appear to be operating satisfactorily because the unit runs at constant speed without load, the governor may require adjustment.

High overspeeds and low underspeeds, or slow return to speed, after load change or speed setting change, are some of the results of an incorrect setting of the compensating needle valve.

Manuals applicable to the various types of PG governors contain detailed instructions for adjusting the compensation.

Analysis and Correction of Governing Troubles

The chart on the following pages may be used to determine the probable causes of faulty operation, and to correct these troubles.

Terms used in the chart are defined as follows:

Hunt—A rhythmic variation of speed which is eliminated by blocking governor operation manually, but which recurs when returned to governor control.

Surge—A rhythmic variation of speed, always of large magnitude, which is eliminated by blocking governor action manually and which will not recur when returned to governor control, unless speed adjustment is changed or the load changes.

Jiggle—A high frequency vibration of the governor fuel rod end (or terminal shaft) and fuel linkage. Do not confuse this with normal controlling action of the governor.

Trouble	Cause	Correction
1. Engine hunts or surges.	A. Needle valve adjustment incorrect.	Adjust needle valve as described in governor manual.
	B. Buffer springs too light. This may occur on a new installation, or on an old installation by reason of deterioration of engine or fuel linkage, or as a radical change in load conditions.	Install heavier buffer springs (consult governor manufacturer).
	C. Fuel linkage incorrectly set This might occur if the governor has been changed or removed and replaced. Relationship of governor travel to power output of engine should be linear.	Rework or reset the linkage from governor to unit to obtain the linear relationship.
	D. Engine gas valve is not properly shaped to give linear relationship between governor travel and horsepower output of the engine. Engine may hunt with light loads and be stable with heavy load.	Re-shape gas valve, or (if possible) adjust linkage from governor to gas valve to obtain linear relationship between governor travel and engine output.
	E. Lost motion in engine linkage, fuel pumps, or gas valve.	Repair linkage, fuel pumps, or gas valve.
	F. Binding in engine linkage, fuel pumps, or gas valve.	Repair and realign linkage, fuel pumps or gas valve.
	G. Governor stroke too short. This may occur on a new installation.	Redesign or rework the fuel linkage to require more governor stroke. (Consult manufacturer of engine and governor).
	H. Low oil level. No harm is done if top of oil is still visible in gauge glass.	Add oil (slowly) to the correct level in gauge.
	I. Dirty oil or foaming oil in governor.	Drain governor oil, flush governor to clean, and refill with proper clean oil. See manual 25071. Bleed air and adjust the needle valve as described in governor manual.

Trouble	Cause	Correction
1. Engine hunts or surges. (cont.)	J. Governor worn or not correctly adjusted.	Repair and adjust governor. See governor instruction manual: a. Check flyweight pins and bearings for wear. b. Check flyweight toes for wear and/or flat spots. c. Check flyweight head thrust bearing, also centering bearing. d. Pilot valve plunger may be sticking. Clean and polish if necessary. Do not break corners of control land. e. Check vertical adjustment of pilot valve plunger and correct if necessary. f. clean and polish all moving parts to ensure smooth and free operation.
	K. Power piston rod bent and/or power piston sticking in cylinder.	Repair if possible. If rod is bent, install new piston and rod assembly.
	L. Engine is misfiring. This applies principally to gas engines.	Check pyrometer readings of each cylinder, and take steps to eliminate misfiring, if possible. Installation of preloaded buffer springs may be desirable. (Consult governor manufacturer).
2. Fuel pump racks do not open quickly when cranking engine.	A. Low oil pressure in governor.	a. Check governor pump gears and gear pockets for excessive wear. No correction except to replace worn parts. b. Examine pump check valves. If not seating tight, install new ones.
	B. Cranking speed too low.	It may be necessary to use a booster servomotor (consult governor manufacturer).
	C. Booster servomotor (if used) not functioning properly.	Check action of automatic air starting valve.
3. Jiggle at governor rod end or terminal shaft.	A. Rough engine drive.	Inspect drive mechanism: a. Check alignment of gears. b. Inspect for rough gear teeth, eccentric gears, or excessive backlash in gear train. c. Check gear keys and nuts or set screws holding drive gears to shafts. d. Tighten chain between crankshaft and camshaft (if used). e. Check engine vibration dampener (if used).
	B. Failure of flexible drive in flyweight head.	Remove, disassemble and clean flyweight head parts. a. If rubber drive, install new rubber coupling. If more parts than the coupling need replacement, exchange the entire rotating sleeve and flyweight head assembly for a new assembly with spring drive and oil damping. (Consult governor manufacturer). b. If spring drive, check spring and install new spring coupling assembly if necessary. Center the coupling for equal travel in opposite directions.
	C. Governor not bolted down evenly on engine mounting pad.	Loosen bolts, realign governor correctly and tighten bolts.

Trouble	Cause	Correction
4. Load interchanges between connected units in parallel operation of an ac system. One unit on zero droop (to control system frequency), all other units on droop.	<p>Incorrect setting of the speed droop adjustment on one or more of the droop units.</p> <p>Note</p> <p>If droop is not provided, the governor is isochronous only, and cannot be used for parallel operation in an ac system except as the lead engine.</p>	<p>Increase droop on affected units until load remains steady on each droop unit. System load variations will be taken by the lead unit with zero droop.</p> <p>The droop units assist in correcting speed deviations on large disturbances, but return to their original loads after the load change has been absorbed by the zero droop unit.</p>
5. Load does not divide properly between connected units in parallel in a dc system (ship propulsion) or similar type installation. All units on droop.	<p>Droop setting incorrect on one or more units.</p> <p>Speed droop (in the governor) is usually not essential in a dc system, the equivalent of speed droop being obtained electrically. However, governors with speed droop are commonly used for dc service since the droop adjustment may be used to correct for inequalities of generator compounding.</p>	<p>Adjust droop on each unit until desired division of load is obtained.</p> <p>Increasing droop results in the unit taking a smaller share of load changes.</p> <p>Decreasing droop results in the unit taking a larger share of load changes.</p>
6. Engine is slow to recover from a speed deviation resulting from a change in load, or slow to respond to a change in speed setting.	A. Incorrect buffer springs in governor.	Install correct buffer springs (consult governor manufacturer).
	B. Governor oil pressure is low.	See Section 2A.
	C. Fuel supply restricted.	Clean fuel filters and fuel supply lines.
	D. Engine may be overloaded.	Reduce the load.
	E. Type PG governors with pneumatic-hydraulic speed control are designed to increase speed setting slowly. If this is objectionable, special parts can be supplied to obtain faster action.	Consult governor manufacturer. Changes in field may require services of a governor engineering specialist.
	F. Supercharger does not come to new speed quickly to supply sufficient air to burn the added fuel.	No simple field correction. Consult engine and governor manufacturer, or overhaul the supercharger.

Trouble	Cause	Correction
7. Engine will not pick up rated full load.	A. Fuel racks do not open far enough.	a. Check fuel pump stops and adjust as necessary. b. Check linkage between governor and fuel pumps and adjust if necessary. c. Certain special PG governors are equipped with a load limiting device, and the governor may be against the load limit. Adjustment may be made, if considered advisable. d. Oil pressure may be too low, see Section 2A. e. Oil in governor may be too light, change to next heavier grade (also see manual 25071).
	B. Fuel supply restricted.	See Section 6.
	C. Speed adjustment of the governor is limited when operating with speed droop and paralleled with an infinite bus.	a. Check and adjust maximum speed limit on a dial type PG governor.
		b. Check and adjust speed setting linkage on a lever type PG governor.
	D. Engine misfiring.	See Section 1L.
	E. Gas pressure too low.	Adjust pressure regulator in gas supply line.
	F. Supercharger does not supply sufficient air.	Overhaul supercharger.
	G. Slipping clutch (if used) between engine and driven load.	See Clutch Instruction Manual.
	H. Voltage regulator (if used) not functioning properly.	Readjust or repair voltage regulator.

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