



Product Manual 36637
(Revision J, 7/2016)
Original Instructions

PG-EG
Integral EG Actuator for PG Governors

Installation and Operation Manual



General Precautions

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

Practice all plant and safety instructions and precautions.

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



Revisions

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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 **26455**, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with . Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

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

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Regulatory Compliance

Other European Compliance:

Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking:

Machinery Directive: Compliant as partly completed machinery with Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.

Special Conditions for Safe Use:

Field wiring must be suitable for at least 95 °C.

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

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.



**Overspeed /
Overtemperature /
Overpressure**

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

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

! WARNING**Personal Protective Equipment**

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

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

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

! WARNING**Start-up**

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

! WARNING**Automotive Applications**

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

NOTICE**Battery Charging Device**

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

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

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

Follow these precautions when working with or near the control.

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

Chapter 1.

General Information

Introduction

This manual contains information about the Woodward Integral EG Actuator for PG governors as an add-on unit:

- to form the PG-EG actuator (no ballhead) or
- to create a ballhead backup governor (PGA-EG or PGG-EG) from the PGA or PGG governor.

In this manual, PG-EG refers to any of these three governor types.

This manual covers the EG, governor components affected by the EG, and information pertaining to the PG-EG. For more general governor information, refer to the PGA governor manual (36604) or the PGG governor manual (36627).

Description

The EG is an electro-hydraulically controlled actuator that accepts a (0 to 200) mA signal, and outputs on a standard PG servo proportional to the mA signal.

Reverse or Direct Acting

The actuator is available for use with either direct- or reverse-acting electronic controls. Direct-acting units assume an increasing fuel as the current level increases. Reverse-acting units assume a decreasing fuel position as the current level increases.

Reverse-acting EG actuators are normally used on ballhead governors to provide an automatic ballhead back-up in case the electrical control signal is lost or interrupted.

Direct-acting EG actuators will cause shutdown if the electrical current to the actuator is lost or interrupted.

	Direct-Acting	Reverse-Acting
Fuel Rack Position	(0.050 to 0.950) inches TR	(0.050 to 0.950) inches TR
Control Current	(20 to 160) mA	(160 to 20) mA

Vibration Resistance

The EG actuator is in itself resistant against vibration due to the torque motor beam being mass-stabilized in all three axes. As a consequence, vibrations have minimal influence on the position of the beam.

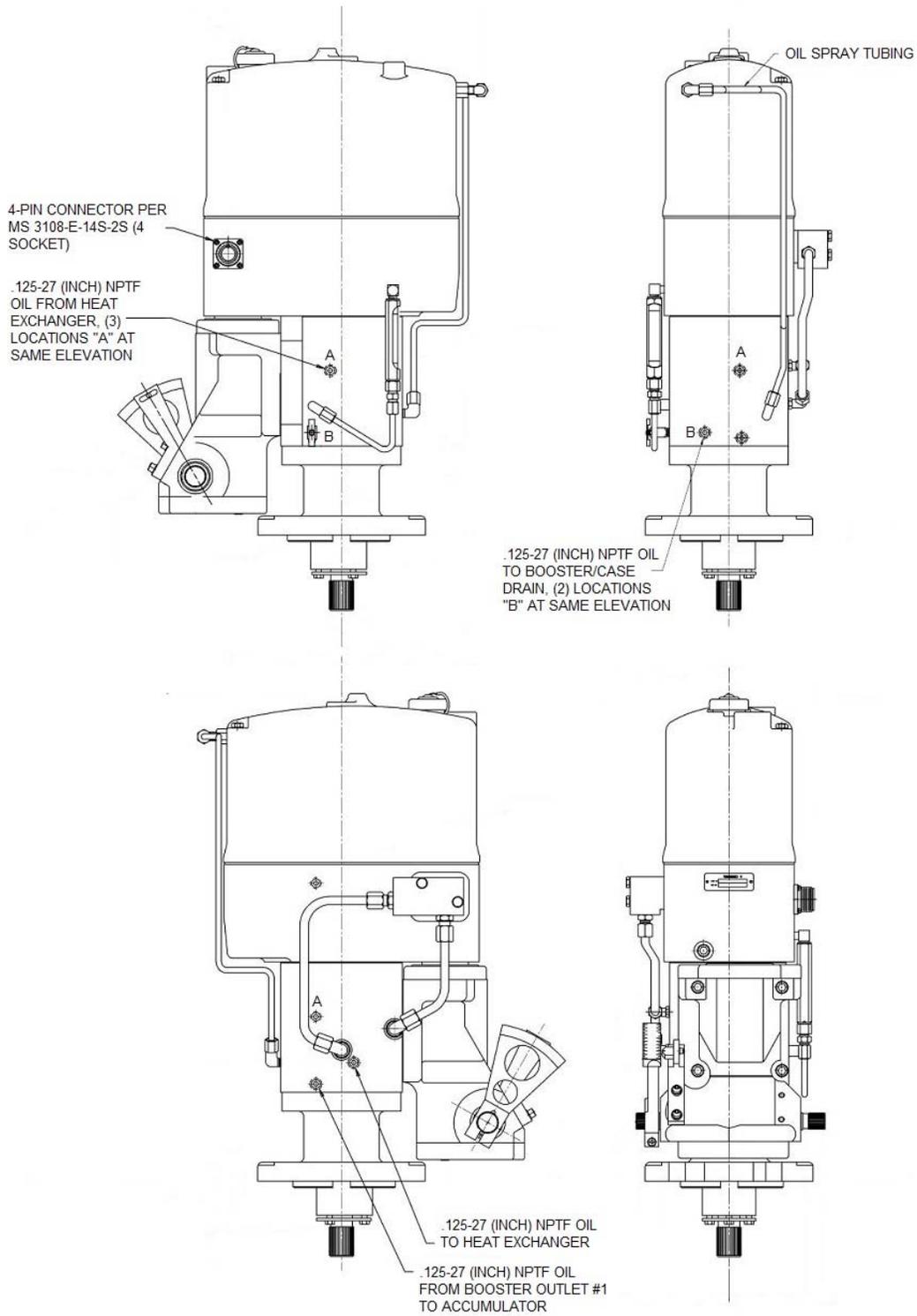


Figure 1-1. PG-EG Actuator Connections

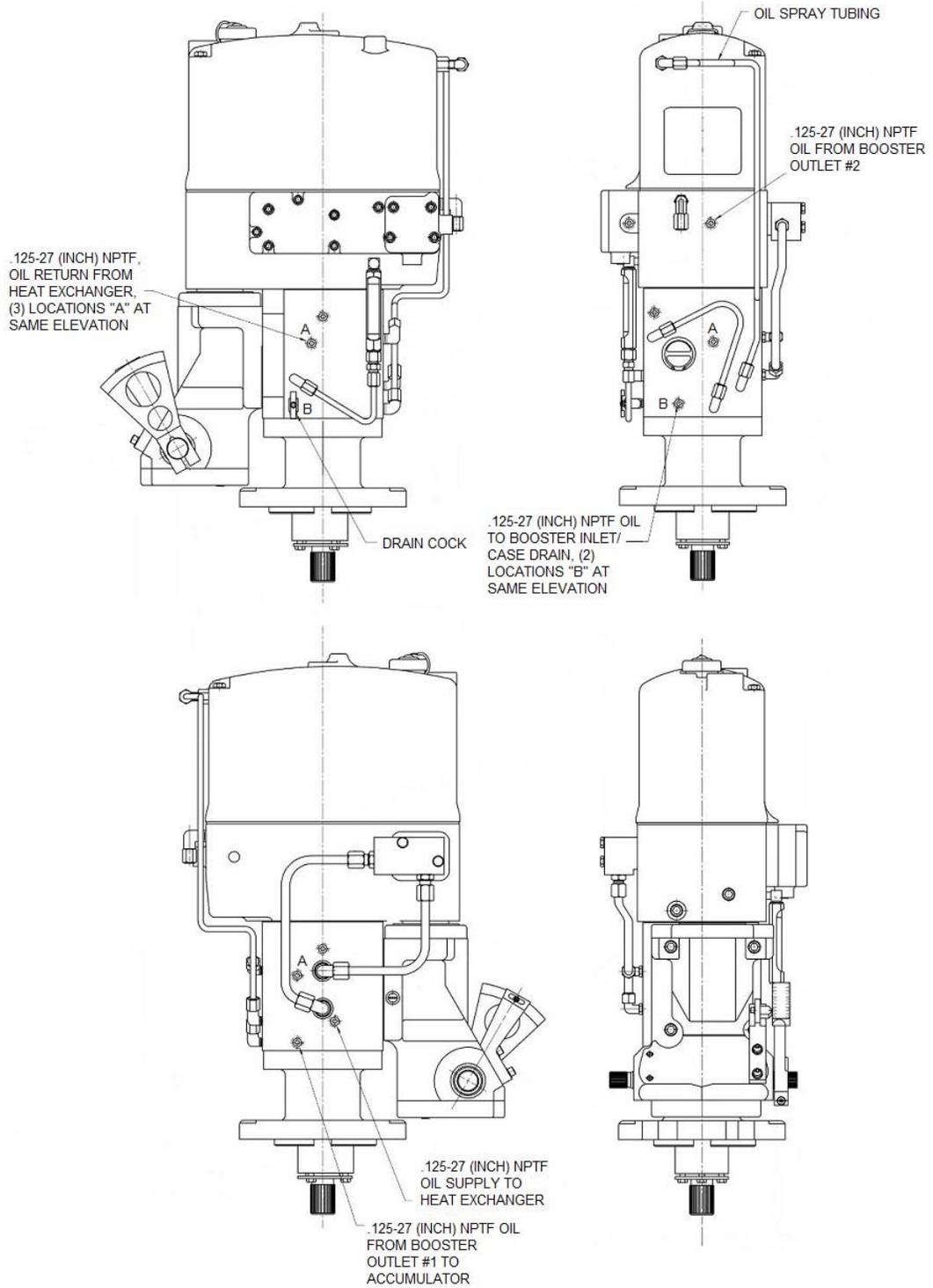


Figure 1-2. PG/PGG-EG Governor Connections (Without Mode Select Block)

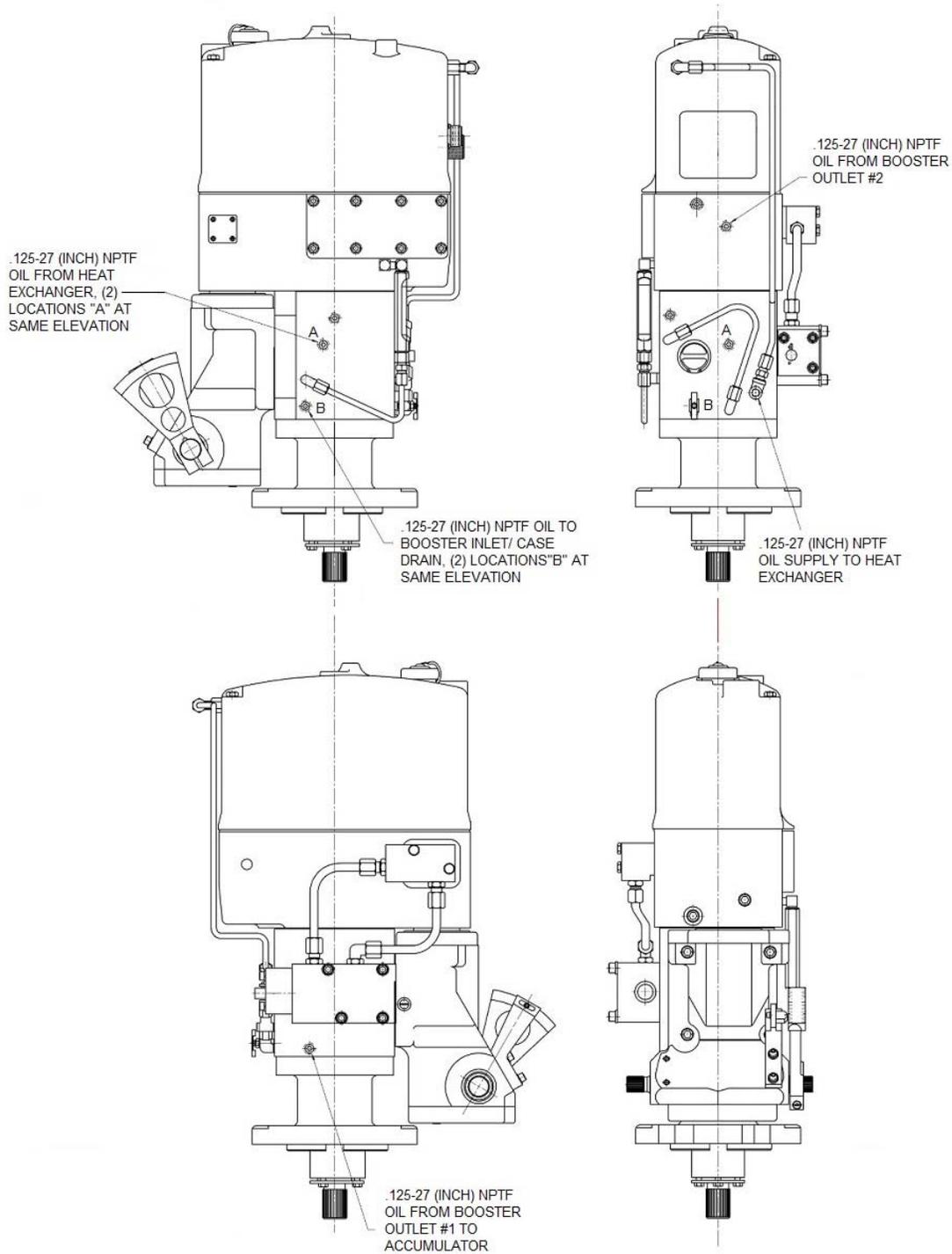


Figure 1-3. PGA/PGG-EG Governor Connections (With Mode Select Block)

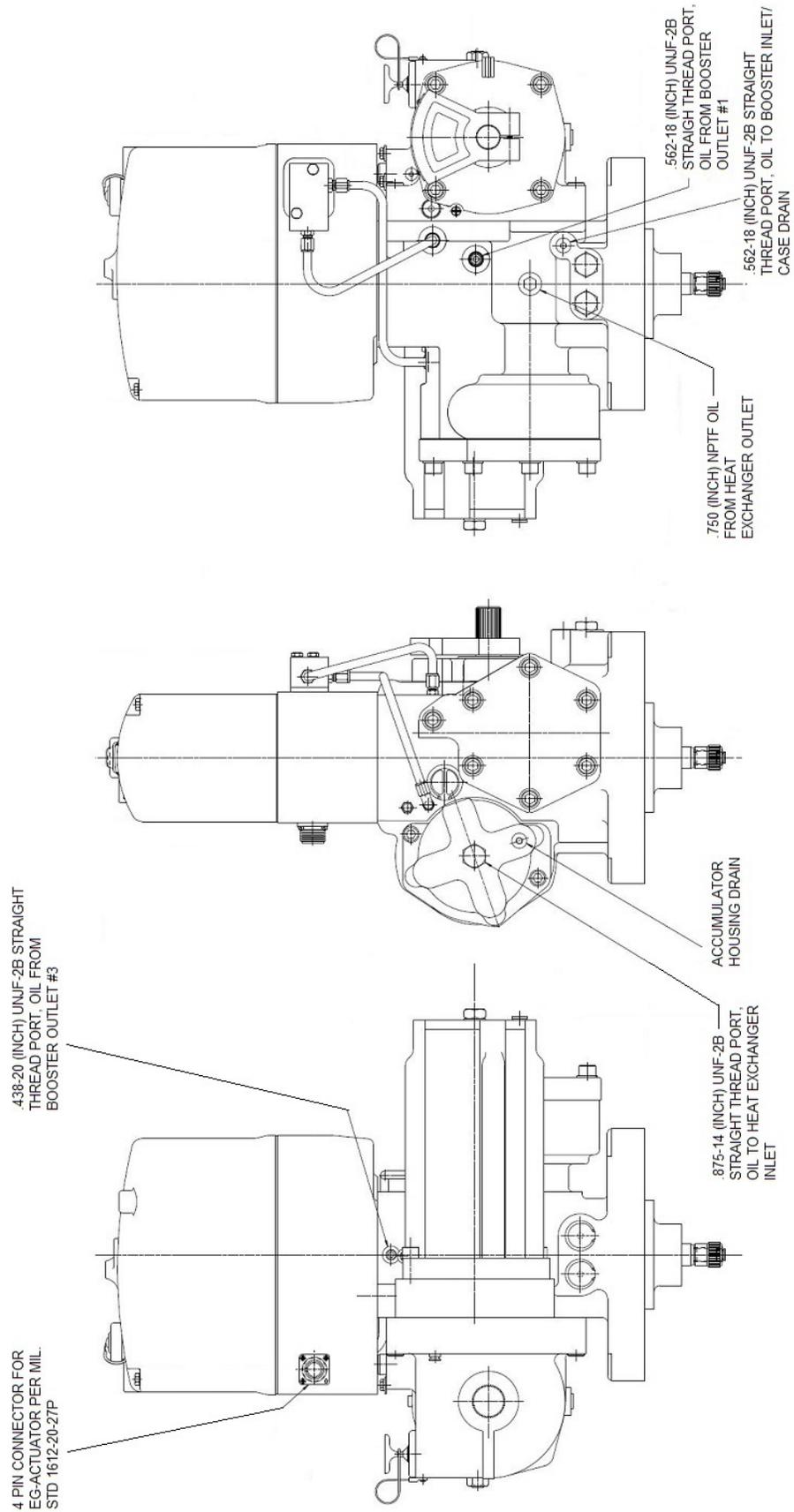


Figure 1-4. PG-EG 200 Actuator Connections

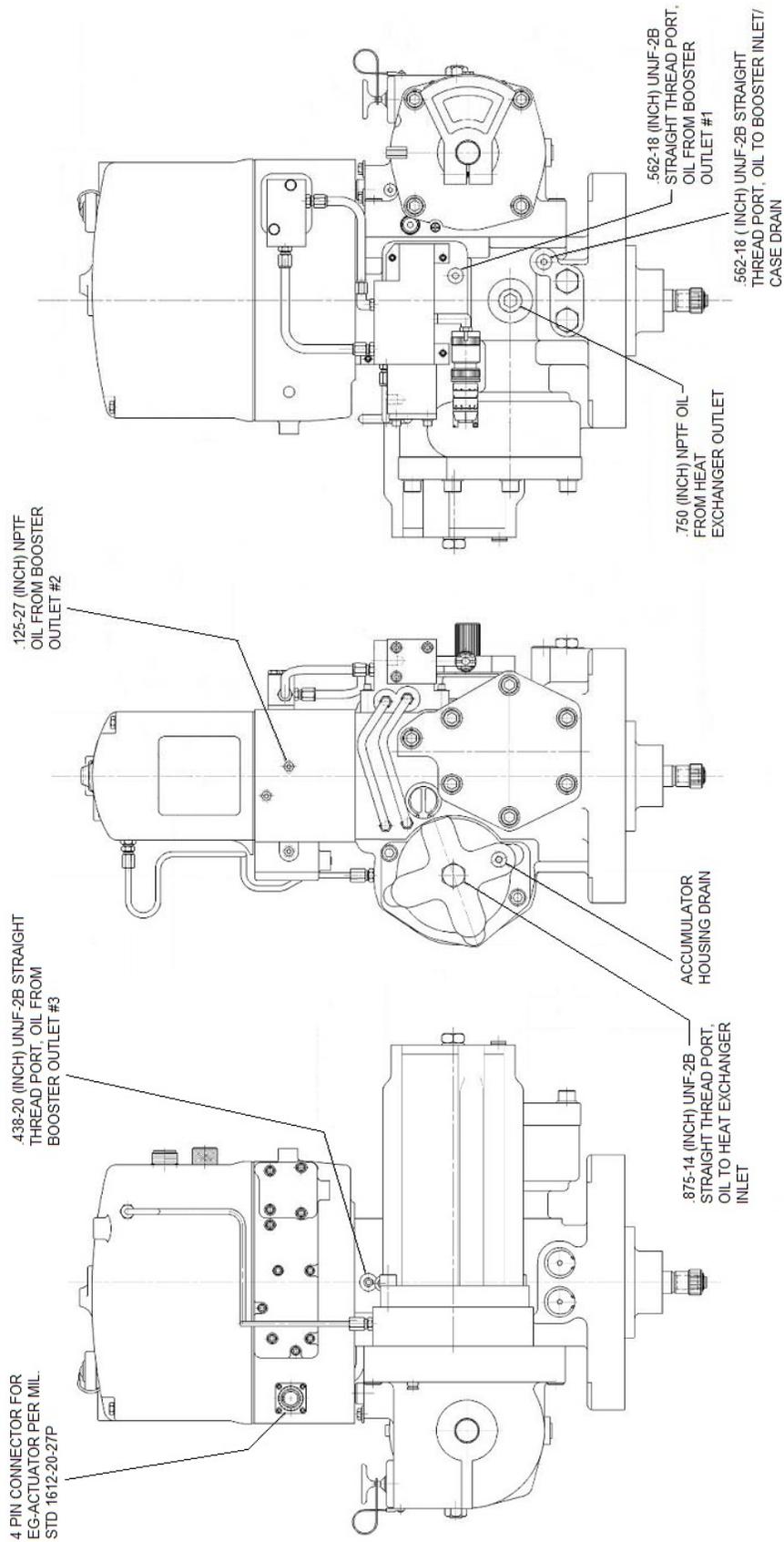


Figure 1-5. PGA-EG/PGG-EG 200 With and Without Mode Select Block

Chapter 2. Installation

Introduction

This chapter describes receiving, storage, and installation requirements for the actuator.

! WARNING

Due to typical noise levels in turbine or engine environments, hearing protection should be worn when working on or around the actuator.

! WARNING

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

! WARNING

Use of a predicted minimum fuel shutdown procedure is highly recommended. Failure to comply with this recommendation can cause personal injury and/or property damage.

NOTICE

Use care while handling and installing the actuator. Be particularly careful to avoid striking the drive shaft, terminal shaft, or the electrical connector. Abuse can damage seals, internal parts, and factory adjustments. Do not set the actuator on its drive shaft.

! WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

Initial Operation

! WARNING

Before initial operation of the engine equipped with this actuator, read all of this installation chapter. Make sure that all installation steps have been correctly accomplished and all linkages are secured and properly attached. Carefully review the direction of rotation for the actuator oil pump.

Receiving

Your PG governor is shipped from the factory bolted to a wooden platform in a vertical position. After being tested at the factory, the governor is drained of oil. This leaves a light film of oil covering the internal parts, preventing rust. No internal cleaning is required.

NOTICE

Use care in handling the governor. Be particularly careful to avoid striking the drive shaft. Do not drop or rest the governor on its drive shaft. Such treatment could damage the gears and bearings in the governor oil pump.

Most PG governors lift from an eye-bolt threaded into a 0.375-16 (inch) hole in the center of the cover. PG-200, PG-300, and PG-500 governors must be lifted with a sling. Some PG governors have split covers which need to be lifted with a sling as well.

Storage

The governor may be stored for up to a year as received from the factory. Store the governor in a vertical position. Fill completely with oil if extended storage is necessary.

Mounting Requirements

A gasket must be used between the governor and the accessory mounting pad. A 0.81 mm (0.032 inch) thick gasket is recommended for this purpose. The gasket is used to absorb imperfections between the governor base and the mounting pad, and to avoid oil leakage between the governor and the drive portion of the engine.

Install the governor square on the accessory pad, using the correct length of coupling between the governor and the drive. Make sure the driveshaft does not bind, and that there is no excessive side load on the driveshaft assembly. Make sure the coupling is tight, and do not use force when installing the drive shaft into the coupling. The governor must be installed in a vertical position.

A rough or non-concentric drive can prevent smooth governor operation and shorten governor life. The drive should be as smooth as possible. Poor drive dynamics can damage governor seals and bearings.

NOTICE

Rotation direction is factory set for some governors. Damage will result if the governor is installed on a drive which rotates in the wrong direction. Specifications for individual governors indicate if the unit has been plugged to limit rotation to one direction only. Many PG governors are equipped with check valves in the pump, allowing rotation in both clockwise and counterclockwise directions.

Linkage

Align the linkage from the governor to the fuel pumps or valves to eliminate binding and excessive backlash. The relationship of governor/terminal shaft angular position to the fuel control position must be adjusted in accordance with the engine manufacturer's specifications. The linkage must not limit the governor's ability to call for maximum fuel or to shut down the engine.

Linkage must not give during major transients and must not be so heavy that it hinders accurate governor response. Linkage must be designed to resist wear.

Linkage is responsible for many apparent "governor problems", and proper design and installation of the linkage between the governor output and the engine is extremely important.

The fuel-control linkage must be adjusted so at least 15 % of the governor travel (output) from minimum position has been used when the fuel control is at idle no-load (A and D; see Figure 2-1). This minimum setting is required due to the location of the compensation cut-off port (if so equipped).

Use as much of the governor output travel as possible. Stability is greatly improved with the use of maximum governor travel. Design linkage so governor output and resultant power output of the engine are nearly linear.

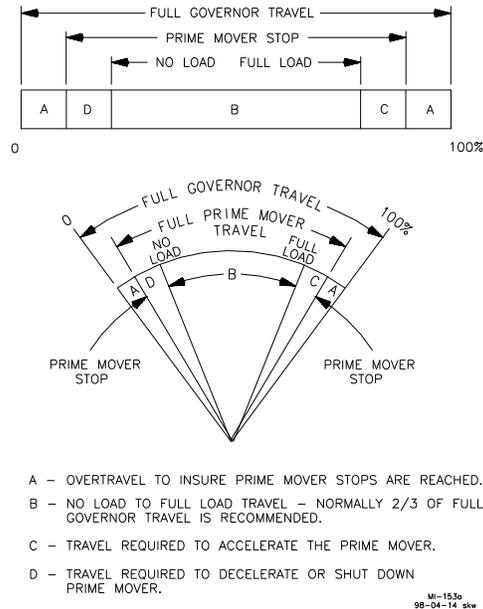


Figure 2-1. Governor Travel

Electrical and Hydraulic Connections

Make the pneumatic (if applicable), hydraulic, and electrical connections required for the particular governor. Refer to Figures 1-1 through 1-3 for the PG-EG 58 governor and Figures 1-4 and 1-5 for the PG-EG 200 governor.

Most governors are equipped with an oil spray to reduce or prevent vibration-induced damage to the torque-motor assembly.

All governors have hydraulic connections for a booster. For information regarding selecting the correct booster type, refer to Manual 36684.

When connecting a start booster to the governor, at least two lines are required:

- Oil to booster inlet, which takes oil from the governor sump to the booster inlet
- Oil from booster outlet #1, which takes oil from the booster outlet #1 to the accumulator system of the governor. By supplying oil under pressure during starting from the booster into the accumulator, the governor should distribute the oil internally without any delay.

In most cases there should be no need to connect other lines between the booster and the actuator or governor.

On a PG-EG 58 actuator no other connections are possible. On the PG-EG 200 actuator and PGA-EG/PGG-EG 200 governors, it is possible to connect a second

line (oil from booster outlet #3) to the first stage relay piston to assist opening up the output servo of the governor.

On PGA-EG/PGG-EG 58 governors and PGA-EG/PGG-EG 200 governors, there is also an option to connect a line (oil from booster outlet #2) to the speed setting servo. Again, under most conditions, the speed setting will be receiving oil under pressure directly from the accumulators. Under some conditions a better starting performance may be obtained by connecting this line.

Table 1-1. Overview of Available Connections

MODEL	FIGURE	OIL TO BOOSTER INLET	OIL FROM BOOSTER OUTLET #1	OIL FROM BOOSTER OUTLET #2	OIL FROM BOOSTER OUTLET #3
PG-EG 58	1-1	Always	Always	Not present	Not present
PGA-EG 58 no MSB	1-2	Always	Always	Optional	Not present
PGG-EG 58 no MSB					
PGA-EG 58 w/MSB	1-3	Always	Always	Optional	Not present
PGG-EG 58 w/MSB					
PG-EG 200	1-4	Always	Always	Not present	Optional
PGA-EG 200 no MSB	1-5	Always	Always	Optional	Optional
PGG-EG 200 no MSB					
PGA-EG 200 w/MSB					
PGG-EG 200 w/MSB					

All governors have hydraulic connections for a heat exchanger which allows oil to be circulated to an external cooler to ensure that the governor oil temperature remains between 71 °C and 93 °C (160 °F and 200 °F) under all operating conditions. In case a heat exchanger is used on a governor also equipped with an oil spray, extra attention is required. Since the spray tube is located at the same height as the oil-to-cooler connection on the governor’s power case, these two connections are hydraulically linked. This means that the oil spray will no longer function when combined with a cooler, since the oil will follow the path with the least resistance. In order to prevent this, we recommend adding an orifice to the oil-to-cooler line exactly where it leaves the power case to ensure enough flow of oil is going to the oil spray.

Standard electrical connections are made to the four-pin connector on the side of the column (see figures). Optionally, the EG actuator may be wired to the connector on the receiver bracket through an internal mounting bracket.

Instead of a connector, the governor may be equipped with a flying lead, leaving the governor on the side of the column. This option is used mostly on governors in a high-vibration environment.

Clearances

Leave adequate clearance to connect the linkage, to fill the governor with oil, and to remove the cover (if necessary).

Governor Oil

Governor oil must have lubricating and hydraulic properties. The oil must have a viscosity index that allows it to perform over the operating temperature range of the governor. The oil must have additives that allow it to remain stable and predictable over the operating temperature range of the governor. The oil used in the governor must be compatible with the nitrile, polyacrylic, and fluorocarbon seals used in the governor.

Many oils and synthetic lubricating fluids used in the engines controlled by PG governors meet these specifications. When possible use the same grade and weight of oil used in the engine. Information in this manual is intended to be used only in the selection of the governor lubricating oil, not for selecting engine lube oil. **USE ONLY NEW, CLEAN OIL. DO NOT USE USED ENGINE OIL IN THE GOVERNOR.**

Woodward governors and actuators are designed to give stable operation with oils which provide 50 to 3000 SUS (Saybolt Universal Seconds) of viscosity throughout the operating temperature range. Ideally the viscosity at the normal operating temperature should be between 100 and 300 SUS. Poor governor response or instability is often an indication that the oil being used is too thick or too thin.

For more detailed information on the choice of governor oil, refer to manual 25071, *Oils for Hydraulic Controls*.

The recommended oil temperature for continuous governor operation is (60 to 93) °C / (140 to 200) °F. Measure the oil temperature of the governor or actuator on the outside lower part of the power case. The actual oil temperature will be about 6 °C (10 °F) higher. The governor is designed to operate in ambient temperatures of (29 to 93) °C / (20 to 200) °F.

Oil Problems

A filter is located between the oil pump and the control pilot valve of the EG actuator. Should this filter become clogged, it can seriously hinder the ability of the actuator to control, even on the mechanical ballhead side. Take extra care with the PG to be sure that oil is clean and that it does not deteriorate due to heat.

Excessive component wear or seizure in a governor indicates the possibility of insufficient lubrication caused by:

- An oil that flows slowly when it's cold or at start-up;
- High or low governor oil level;
- Restrictions in oil lines to boosters or heat exchangers;
- Contaminated oil (usually caused by dirty oil containers used when transferring oil to the governor);
- A governor exposed to heating and cooling cycles, creating condensation of water in the oil;
- Oil not suitable for the operating conditions.

Operating a governor continuously beyond the high-limit temperature of the oil will result in oil oxidation. This is identified by varnish or sludge deposits on governor parts. To reduce oil oxidation, lower the oil operating temperature with a heat exchanger or other means, or change to an oil more oxidation resistant at the operating temperature.

PG-governors operating with internal oil-pressures in excess of 1655 kPa (240 psi) often require a heat exchanger to protect the oil from damage.

IMPORTANT

Many governor problems are the result of improper selection or improper maintenance of governor oil. The governor should be serviced on a routine schedule. Develop the schedule with consideration to the governor operating temperature and the cleanliness of the atmosphere in which the governor operates.

**WARNING**

A loss of stable governor control and possible engine overspeed may result if oil viscosity exceeds the 50 to 3000 SUS range.

Governor Oil Service

Replace the governor oil if it is contaminated or if it is suspected of causing governor problems. Drain the oil while it is still hot and agitated. Flush the governor with kerosene or an equivalent solvent. If drain time is insufficient for the solvent to completely drain or evaporate, flush with the same grade and weight of oil which will be used to refill the governor. Discard the oil used to flush out the solvent.

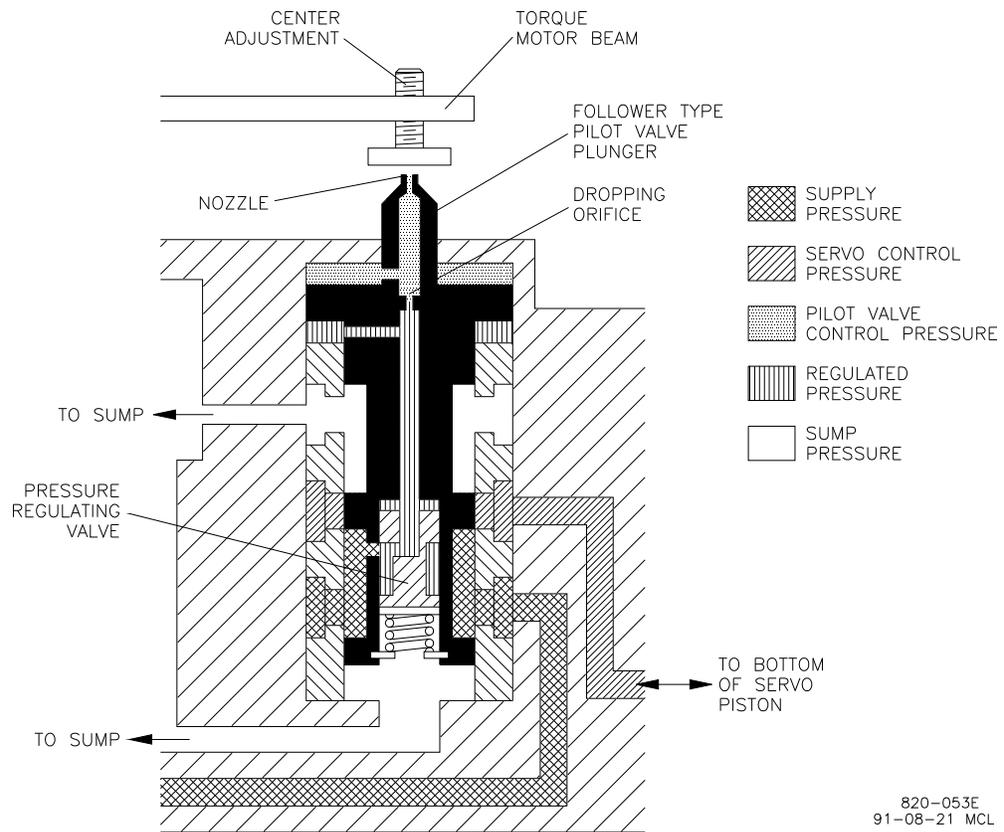
To avoid contamination of the governor, the replacement oil must be free of dirt, water, or other foreign material. Use clean containers to store and transfer oil. Refer persistent or recurring oil problems to an oil specialist.

After the oil is selected, fill the governor with new, clean oil, in the volumes listed here: Type 12/29/58 (1.4 L / 1.5 qt), Type 200/300 (6.2 L / 6.5 qt), Type 500 (6.6 L / 7.0 qt).

While the engine is *not* running, fill the governor to the maximum level indication. During normal operation, this level should not drop below the minimum level. Do not add oil when operating the governor.

PG-EG 200, 300, and 500 cases must be filled in two stages. Fill with about 4 liters/quarts before starting, then add the amount needed to bring the oil up to operating levels after start-up. On these governors, there is an oil level dipstick inside the fill port cap. On newer types, a small sight gauge glass has been added onto the terminal shaft housing. Always use the dipstick for accurate oil level readings. All other PG-EGs have an oil filler cup in the cover and a special long oil gauge glass on the power case.

To prevent contamination of the flapper nozzle system, an oil filter has been fitted to the oil feed line going to the EG actuator. Check this filter every time the oil is changed, and clean if necessary.



820-053E
91-08-21 MCL

Figure 3-1. Schematic of Pilot Valve and Pressure Regulator Section

Cleaning the PG-EG Actuator Oil Filter

Clean the filter after it has been dis-assembled from the manifold block on the side of the actuator.

Use white spirit or another oil-based cleaning fluid to wash backward, against the normal flow direction onto a filter cloth or similar. Do not use sharp tools to probe into the filter. Debris content should come out leading a flow of cleaning fluid thru the filter. Use a soft brush to help the particles get loose from the mesh surface. Inspect the content of the filter. Normal wear of the PG-EG actuator should produce very few particles, so if you find a lot of debris you should investigate its origin. Make sure the cans used to add oil are clean (no dust, no water, no other oil remains).

If a filter is very dirty and cannot be cleaned it should be replaced by a new filter: Woodward number 3005-533.

If, over time, filters continue to be very dirty, consider reducing the time between cleaning. Clogged filter can seriously reduce the flow of oil to the EG-actuator, thus making it very difficult to maintain its dynamic behavior.

Chapter 3.

Principles of Operation

Flapper Nozzle System

The flapper nozzle system is basically a hydraulic amplifier which converts the torque motor beam position through the pilot valve into a servo position. Pump pressure oil is supplied to the interior of the pilot valve and lowered by the pressure regulating valve into the regulated pressure at 690 kPa (100 psi). This flow of 690 kPa oil is then directed onto the bottom of the control land and through a dropping orifice (giving the pilot valve control pressure) to the top of the same control land but with a larger surface. At the same time, pilot valve control pressure oil is directed through a nozzle and sprays onto the bottom of the torque motor beam (acting as the flapper).

The balance of these hydraulic pressures and forces positions the pilot valve in the bushing and causes the pilot valve to follow the position of the torque motor beam. To center the pilot valve in the bushing in steady state, the gap between the flapper (the torque motor beam) and the nozzle is adjustable by means of the center adjustment.

The control land of the pilot valve, balanced between the regulated pressure below and the pilot valve control pressure above, provides a hydraulic amplification of the position of the torque-motor beam. This permits accurate positioning of the plunger in the bushing without having the bushing rotate to eliminate static friction as is necessary in the mechanical pilot valve system.

Torque-motor System

The torque-motor system consists of an electromagnetic coil and a beam. On top of the beam, an armature is mounted which is placed into the electromagnetic field of the coil. The beam itself is suspended by a torsion spring, allowing a small degree of rotation of the beam around the center of the torsion spring but no translations.

The torque-motor beam is balanced between the restoring spring, the level-adjust spring, and the torque from the torque-motor. With the system in steady state, the pilot valve of the flapper nozzle system is centered and the servo is stationary.

By changing the current to the coil, the amount of torque on the armature changes, and thus the torque on the torque-motor beam. This will change the gap between the beam and the pilot valve, cause the pilot valve to follow the movement of the beam, and allow oil to flow to or from the servo. The resultant change in servo position causes the restoring lever to load or unload the restoring spring, and thus restores the equilibrium of the torque-motor beam at the new current level. The torque motor beam resumes its original position, and the gap between the beam and the pilot valve will be restored to its original size with the pilot valve centered.

Direct and Reverse Acting

The same set of springs may be set for either a direct- or reverse-acting actuator. The only difference is the level to which the level-adjust spring is set, and the wires to the torque-motor which are reversed.

PG-EG WITHOUT MODE SELECT VALVE

- SHOWN AT STEADY STATE CONTROLLING ON E.G.
- BALLHEAD PILOT-VALVE OPENED

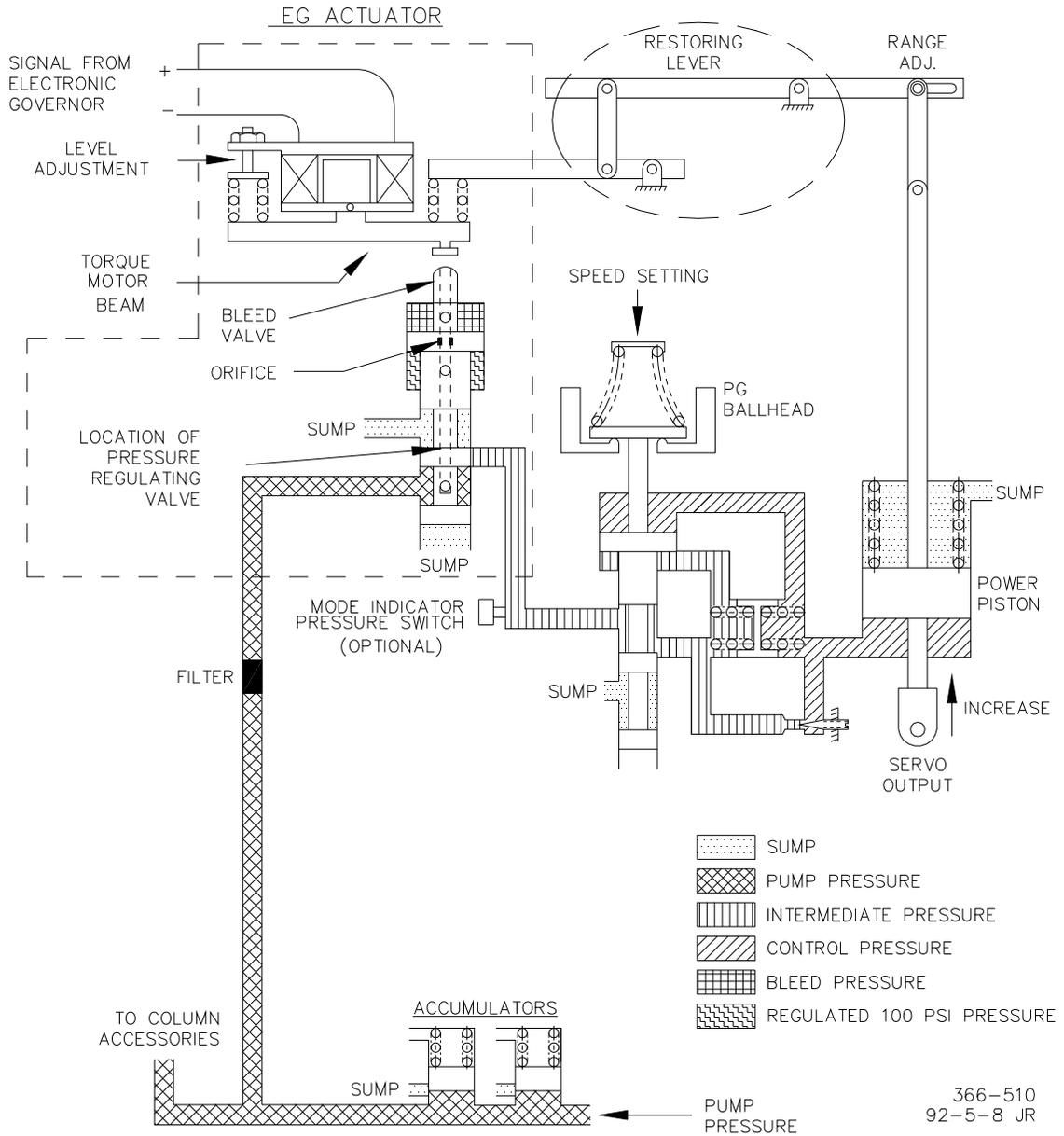


Figure 3-2. PG-EG Schematic, without Mode Select Valve

PG-EG WITH MODE SELECT VALVE

● SHOWN AT STEADY STATE CONTROLLING ON PG (BALLHEAD)

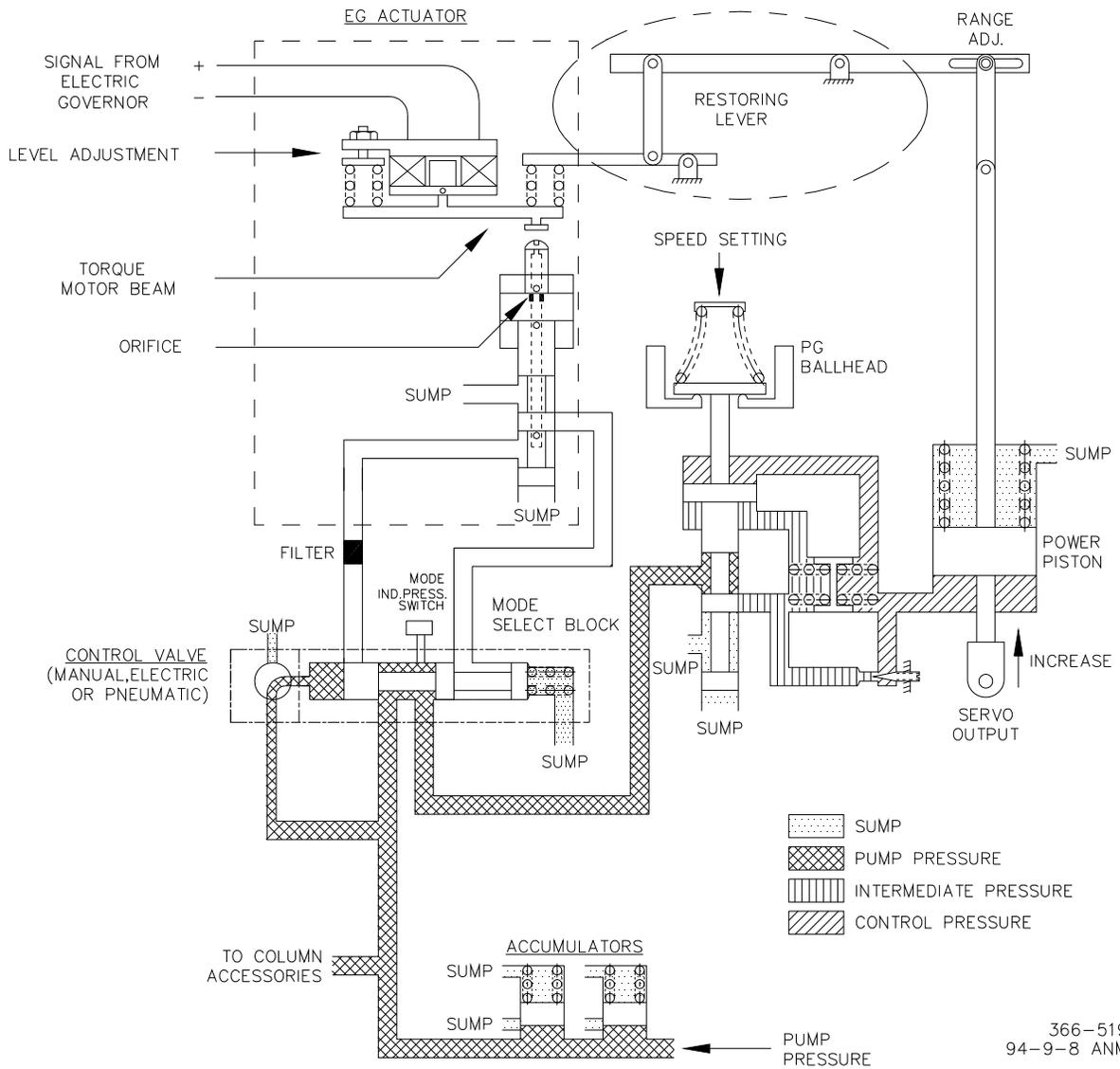


Figure 3-3. PG-EG Schematic, with Mode Select Valve, Controlling on PG

PG-EG WITH MODE SELECT VALVE

- SHOWN AT STEADY STATE CONTROLLING ON EG.
- BALLHEAD PILOT-VALVE OPENED

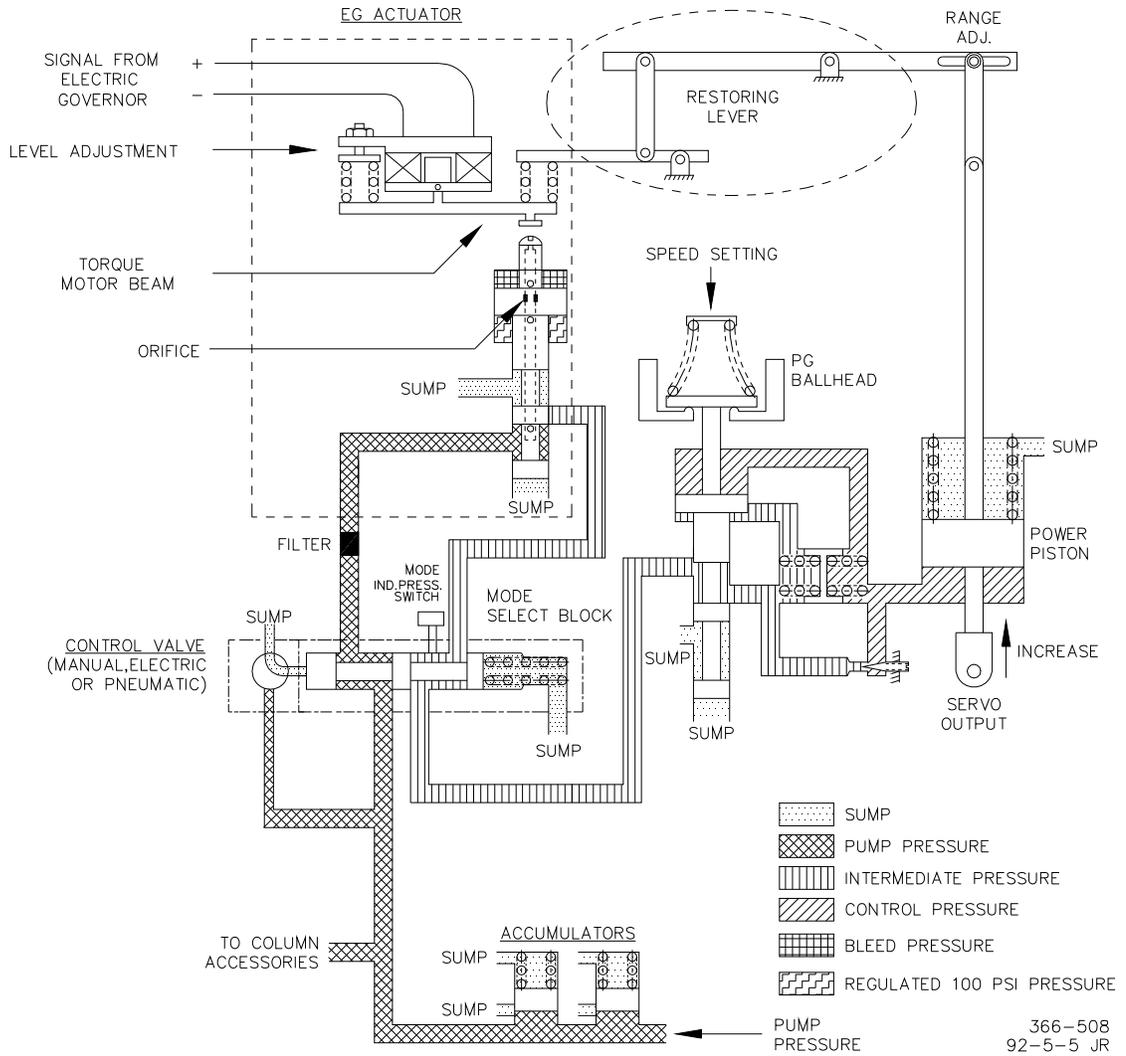


Figure 3-4. PG-EG Schematic, with Mode Select Valve, Controlling on EG

ACTUATOR VERSION

● NO BALLHEAD BACK-UP

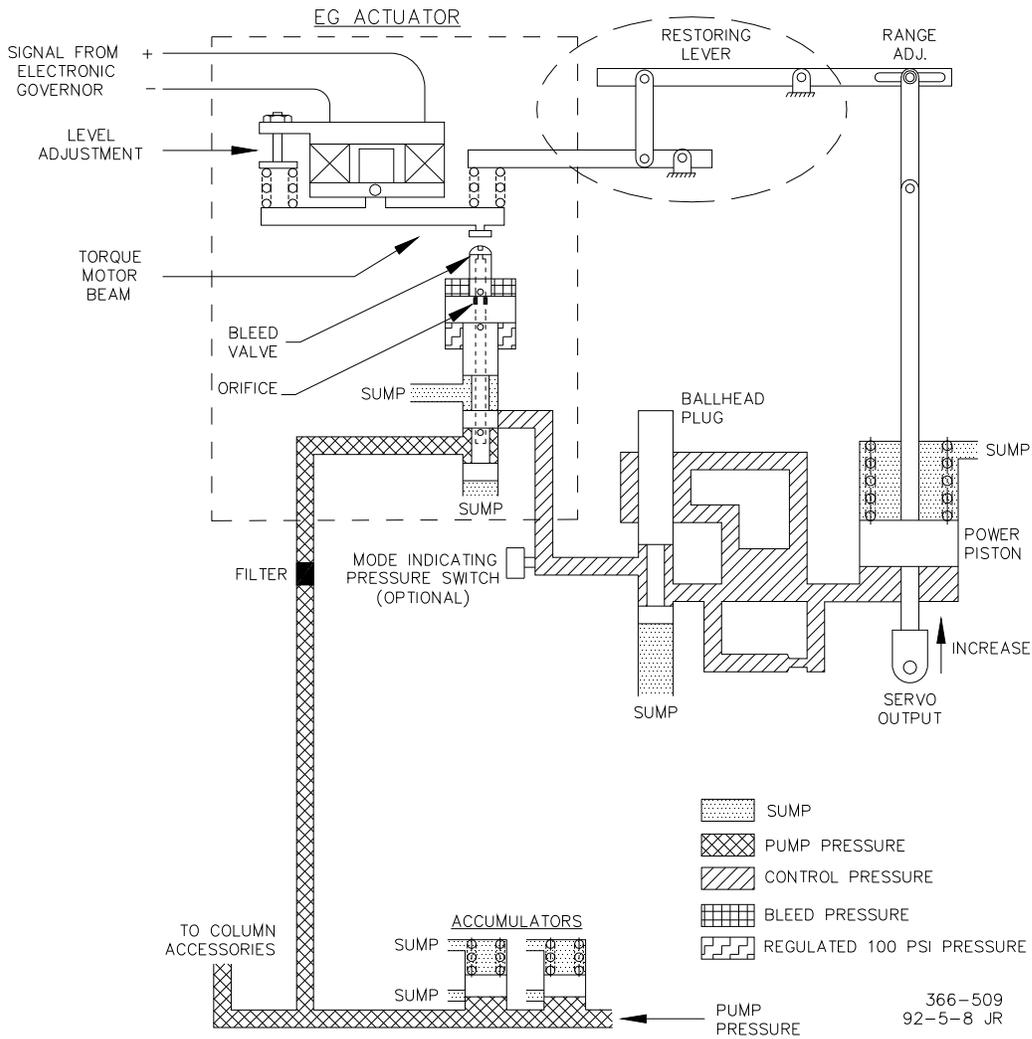


Figure 3-5. EG Actuator Schematic, No Ballhead Backup

Chapter 4. Operation and Adjustments

Introduction

Because the PGA-EG and PGG-EG are each a combination of an electric actuator and a ballhead governor, routine start-up adjustments can be more complex than on other governors.

When installing or adjusting a PGA-EG/PGG-EG which has been taken off an engine or has been repaired, make sure to understand if the governor is running under control of the electronics or on the ballhead. Be sure of electronic control when setting the dynamics of the electronic control system.

Centering Adjustment

NOTICE

The torque-motor/pilot valve relationship in the electric actuator is calibrated at the factory and should not need readjustment unless the torque motor, the pilot valve plunger, or the pilot valve bushing is replaced. The adjustment is extremely sensitive and will change all other adjustments.

WARNING

DO NOT TOUCH any of the calibration adjustments unless thoroughly familiar with the electrical portions of the control. Complete calibration of the actuator should not be attempted on the engine as overspeeding or other dangers may occur during the calibration process.

It is absolutely vital that the armature/torque motor beam combination is correctly centered between the magnets of the torque motor. If the tools to assist this action are not available, do not attempt to do this.

If a torque motor has been disassembled, it may be necessary to re-magnetize the magnets to ensure the torque motor will have enough power to allow all settings to be made. Since measuring the amount of magnetism present is very difficult, do not disassemble the magnet unless you are able to re-magnetize it afterwards.

NOTICE

Use of the proper tools for the centering adjustment is essential to proper control operation. These tools are available only in specially-equipped workshops.

IMPORTANT

DO NOT DISASSEMBLE any part of the torque motor outside a Woodward plant.

Adjustment of the Anti-rotation Device

On the PG-EG actuator with no ballhead, to prevent the feedback lever between the tailrod and the actuator from becoming dislodged by vibration, an anti-rotation device has been added. It consists of a steel plate mounted on the cover of the torque motor which guides a pin protruding from the tailrod. Because of the tolerance of the slot in which the pin moves up and down, and the thickness of the plate, it is important that pin and plate are perpendicular to each other. To adjust this, the mounting screws of the plate run through two slots, allowing the plate to be positioned correctly.

If the guiding plate has been removed, assemble as follows.

1. Install the guiding plate and mount the screws by hand. Do not tighten the screws but allow small adjustments.
2. First check visually if the plate is set perpendicular to the pin. Adjust this by moving the plate in its slots until it is.
3. Now run the tailrod up and down. This will set the plate in the correct position and ensure the slot and the tailrod are exactly parallel. Now tighten the screws to a torque of (0.7 to 0.8) N·m / (6 to 7) lb-in.

Mode Select Valve and Mode Indicating Switch

Mode Indicating Pressure Switch

To show the mode the governor is working in, a mode indicating pressure switch is available.

Two switches are available:

- one for use with (690 to 896) kPa / (100 to 130) psi pump pressure governors, with a switch point of 586 kPa / 85 psi;
- one for use with 1379 kPa / 200 psi pump pressure governors, with a switch point of 1276 kPa / 185 psi.

The switch is mounted in one of two locations, depending on whether or not the governor is equipped with a mode select valve.

No Mode Select Block

When the governor is not equipped with a mode select block, use the switch mounting position available on the mode select block. For both 690 kPa / 100 psi and 1379 kPa / 200 psi pump pressures, the resultant signals are:

- pins A-C closed = pins A-B open = EG-mode;
- pins A-B closed = pins A-C open = PG-mode.

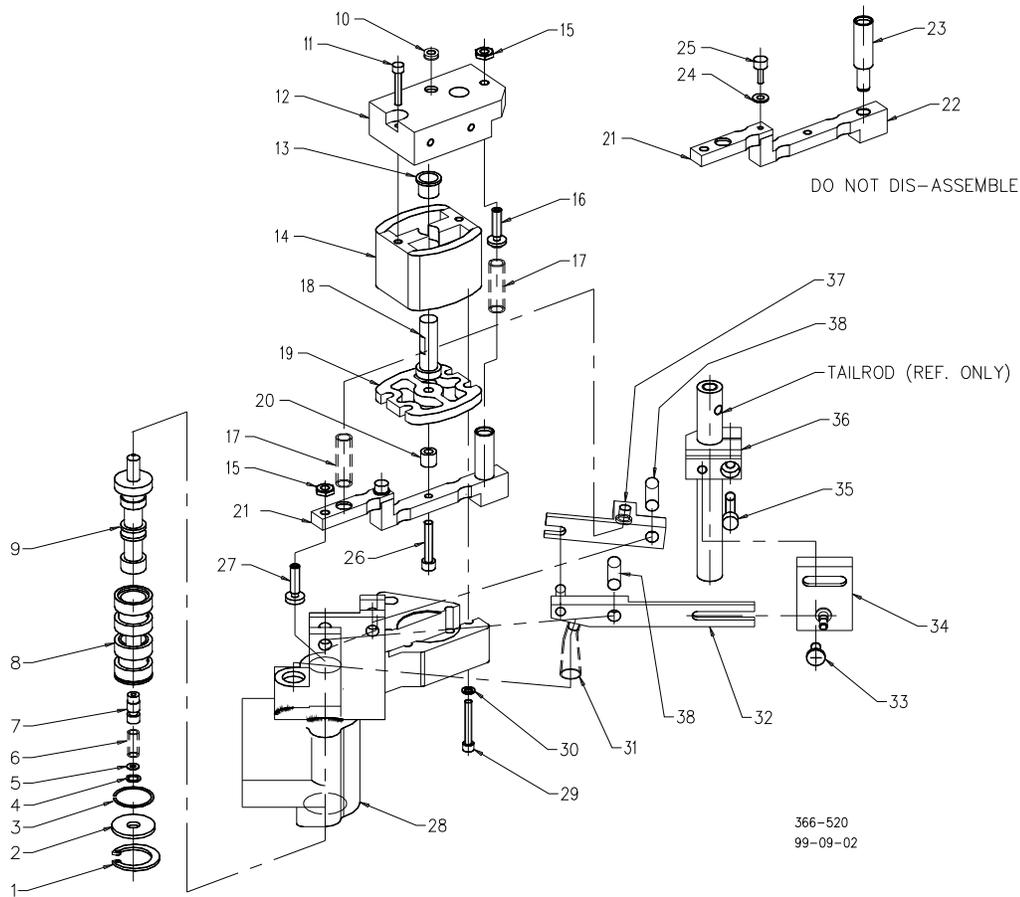


Figure 4-1. Torque Motor Exploded View

Parts List for Figure 4-1

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
36637-1	internal retaining ring	1	36637-20	flapper spacer	1
36637-2	bi-metal washer	1	36637-21	torque motor beam	1
36637-3	internal retaining ring	1	36637-22	not used	
	internal retaining ring	1	36637-23	not used	
36637-5	flat washer	1	36637-24	not used	
36637-6	regulator spring	1	36637-25	not used	
36637-7	regulator	1	36637-26	screw 8-32 x .750	1
36637-8	bushing	1	36637-27	control adjuster	1
36637-9	actuator plunger	1	36637-28	torque motor house	1
36637-10	grommet	1	36637-29	screw 6-32 x 1.000	4
36637-11	screw 6-32 x .750	2	36637-30	washer	4
36637-12	torque motor cover	1	36637-31	buffer spring	1
36637-13	armature stop	1	36637-32	primary feedback lever	1
36637-14	torque motor magnet	1	36637-33	screw 10-32 x .375	1
36637-15	reduced nut	2	36637-34	range adjustment strap	1
36637-16	spring adjuster	1	36637-35	screw 10-32 x 1.000	1
36637-17	trim spring	2	36637-36	tailrod clamp	1
36637-18	armature	1	36637-37	secondary feedback lever	1
36637-19	torsion spring	1	36637-38	pivot pin	2

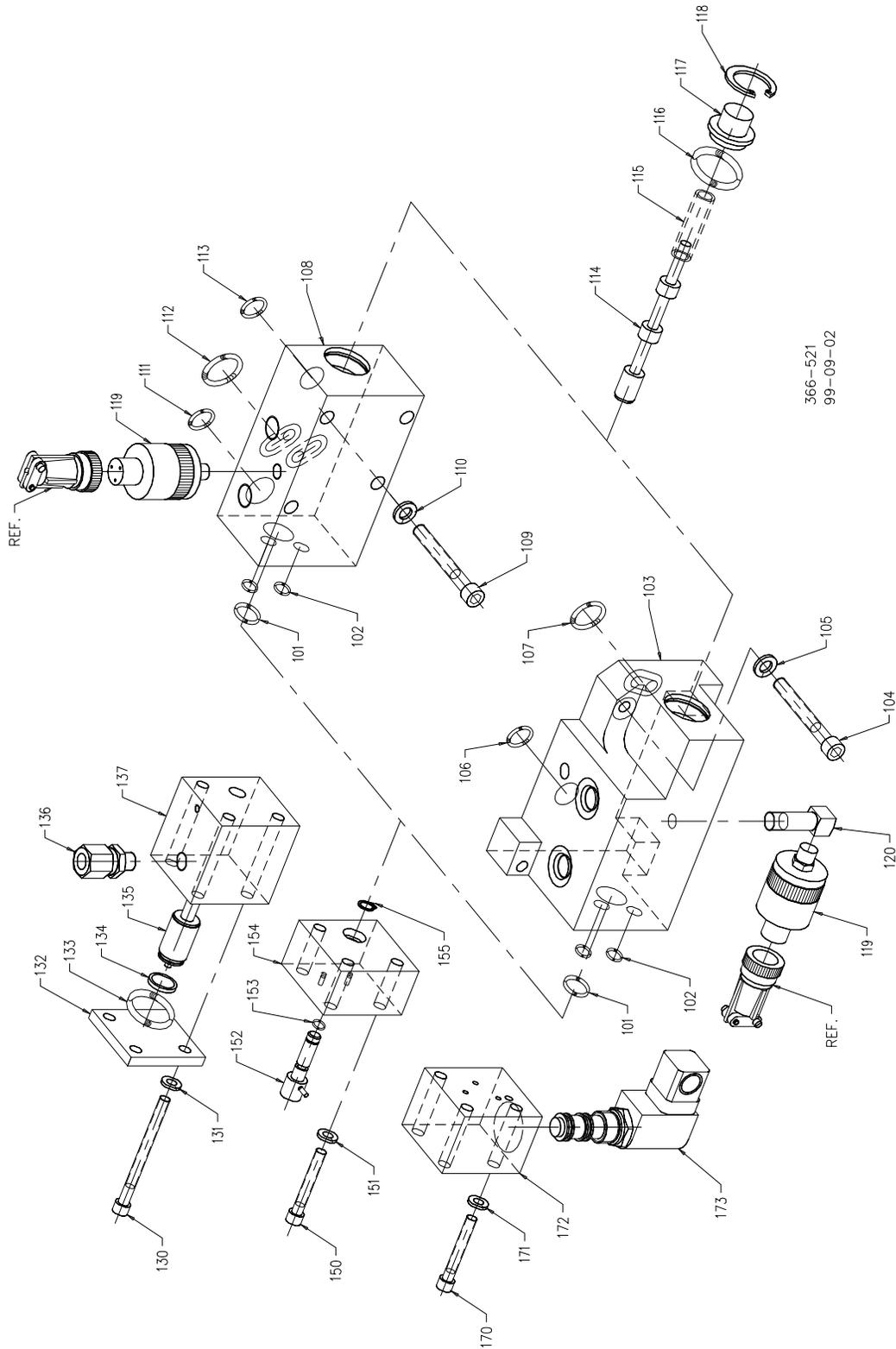


Figure 4-2. Mode Select Block Exploded View

Parts List for Figure 4-2

Ref. No.	Part Name	Quantity
36637-101	O-ring	1
36637-102	O-ring	2
36637-103	block- PG-200	1
36637-104	screw- .250-20 x 1.50	4
36637-105	washer	4
36637-106	O-ring	2
36637-107	O-ring	1
36637-108	block- PG-58	1
36637-109	screw- .312-18 x 2.50	4
36637-110	washer	4
36637-111	O-ring	1
36637-112	O-ring	2
36637-113	O-ring	1
36637-114	pilot valve	1
36637-115	spring	1
36637-116	O-ring	1
36637-117	plug	1
36637-118	retaining ring	1
36637-119	pressure switch	1
36637-120	elbow.....	1
numbers 121 to 129 not used		
36637-130	screw- .250-20 x 3.00.....	3
36637-131	washer	3
36637-132	plate- cover	1
36637-133	O-ring	1
36637-134	seal	1
36637-135	plunger- driver.....	1
36637-136	connector	1
36637-137	block- pneumatic mode select.....	1
36637-138	decals—PG-EG mode select	1
numbers 139 to 149 not used		
36637-150	screw- .250-20 x 1.75.....	3
36637-151	washer	3
36637-152	knob	1
36637-153	O-ring	1
36637-154	block- manual mode select.....	1
36637-155	retaining ring	1
36637-156	decals- manual mode select	1
numbers 157 to 169 not used		
36637-170	screw- .250-20 x 2.00.....	3
36637-171	washer	3
36637-172	block- electric mode select.....	1
36637-173	valve 3 way-solenoid.....	1
36637-174	decals- electric mode select.....	1

Mode Select Block

When the governor is equipped with a mode select block, use only the position available on the mode select block. Do not use the switch mounting position on the connecting block in this case. For both 690 kPa / 100 psi and 1379 kPa / 200 psi pump pressures, the resultant signals are:

- pins A-C closed = pins A-B open = EG-mode;
- pins A-B closed = pins A-C open = PG-mode.

Mode Select Valve

A mode select valve allows the operator to choose and influence the mode the governor is controlling in. This can be done by means of either a manual, electrical, or pneumatic signal to the mode select valve.

The valve has two modes:

- **Mechanical Control (or PG mode):** The oil from the accumulator is routed through the mode select valve to the ballhead pilot valve/compensation system and into the servo.
- **Electrical Control (or EG mode):** The oil from the accumulator is routed through the mode select valve to the actuator pilot valve, back to the mode select valve, and through the ballhead pilot valve/compensation system into the servo.

IMPORTANT

In electrical mode, the actuator pilot valve and the ballhead pilot valve are placed in series. In order for the governor to operate in this mode, it is necessary to raise the mechanical speed setting over the electrical speed setting, since this offset will open the ballhead pilot valve and keep it “out of the way.” This speed difference should amount to 5 % to 10 % of the maximum speed.

NOTICE

Under EG mode, the ballhead will still control if the PG speed setting is lower than the EG.

The mode select valve consists of a pilot valve located in a block which is mounted onto the side of the governor power case. Internal governor hydraulics are routed through the block. When the pilot valve is driven against a return spring, the valve will switch. When the driving force is removed, the spring returns the pilot valve and the valve switches back. Two pilot valves are available: a direct-acting one and a reverse-acting one.

Five different methods are available to drive the mode select valve:

Manual—Turning a knob clockwise directs pressure oil against the end of the valve plunger and forces the plunger against the return spring to switch into PG mode. Turning the manual knob counterclockwise connects the operating end of the mode select valve plunger to drain, allowing the return spring to move the plunger and switch to EG mode.

Direct Electrical—A 24 V (dc) signal moves a solenoid valve to direct pressure oil against the end of the direct-acting valve plunger and forces it against the return spring to switch into PG mode. Removal of the electrical signal connects the operating end of the valve plunger to drain, allowing the return spring to move the plunger and switch to EG mode.

Reverse Electrical—A 24 V (dc) signal moves a solenoid valve to direct pressure oil against the end of the reverse-acting valve plunger and forces it against the return spring to switch into EG mode. Loss or removal of the signal connects the operating end of the valve plunger to drain, allowing the return spring to move the plunger and switch to PG mode.

Direct Pneumatic—Air pressure drives a plunger which shuttles the direct-acting mode select valve plunger against the return spring to switch into PG mode. Removal or loss of air pressure will cause the return spring to move the plunger back and switch to EG mode.

Reverse Pneumatic—Air pressure drives a plunger which shuttles the reverse-acting mode select valve plunger against the return spring to switch into EG mode. Removal or loss of air pressure will cause the return spring to move the plunger back and switch to PG mode.

Maintenance

The mode select valve should require minimal or no maintenance. O-rings should be replaced to eliminate possible oil leaks. The pneumatic, electric, or manual actuator which sets the position of the pilot valve may be removed from the housing for cleaning or repair.

NOTICE

Do not attempt to disassemble any portion of the mode select valve with the governor running. Pressure oil circulates in all parts of the valve, and the governor will quit operating, and oil will be pumped out of the governor should any part of the valve be loosened or removed while the governor is running.

Applications

The ballhead governor and the electric-input actuator operate continually, with each having its own desired fuel-output position. PGA-EG hydraulics select the lesser of the two fuel outputs for the actual fuel output.

Setting up for reverse-acting means that the electronics in the control are programmed for reverse-acting; the actuator must be calibrated to accept this reverse signal. Loss of electrical signal to the actuator causes the actuator to call for increased fuel, moving the output to increase until the ballhead takes over control (remember that for correct actuator use, the mechanical speed setting must be raised by 5 % to 10 %). This means that the reverse-acting setup of control and governor results in automatic switching from electrical control to ballhead control should electronic failure occur, although at a higher speed.

When control and actuator are set up for direct-acting, loss of electronic signal to the actuator means that the actuator goes to minimum fuel. Since the ballhead is set to a speed 5 % to 10 % above the electronic maximum speed, it cannot take over control.

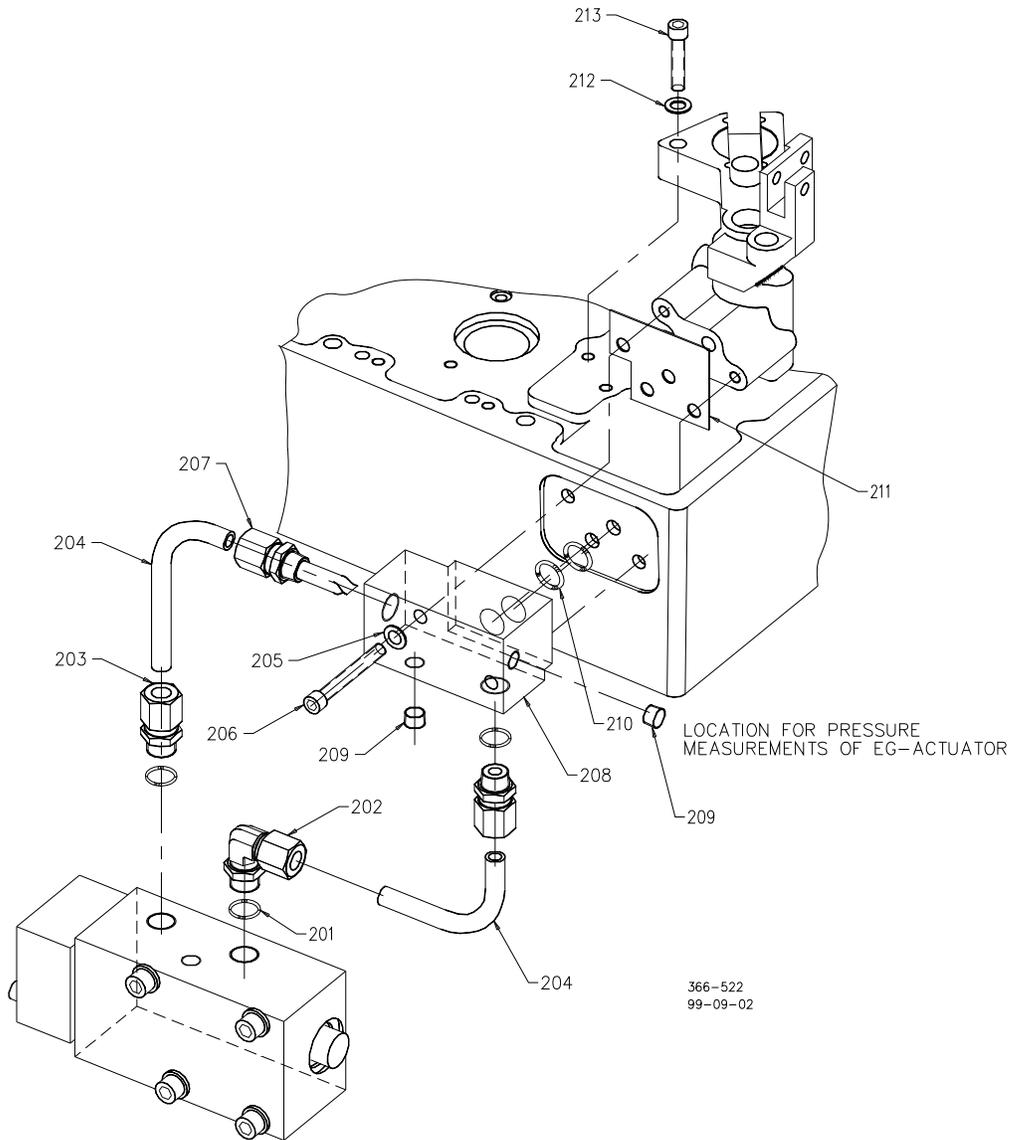


Figure 4-3. Assembly and Tubing Exploded View

Parts List for Figure 4-3

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
36637-201	O-ring	3	36637-208	manifold block	1
36637-202	connector- elbow	1	36637-209	plug .125 NPTF	2
36637-203	connector- straight	2	36637-210	O-ring	2
36637-204	tubing .375 OD	AR	36637-211	gasket	1
36637-205	washer	2	36637-212	washer	1
36637-206	screw .250-28 x 2.50	2	36637-213	screw .250-28 x 1.25	1
36637-207	filter	1			

Chapter 5.

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 at www.woodward.com/directory, which also contains the most current product support and contact information.

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		Products Used in Engine Systems		Products Used in Industrial Turbomachinery Systems	
Facility	Phone Number	Facility	Phone Number	Facility	Phone Number
Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727	China	+86 (512) 6762 6727	China	+86 (512) 6762 6727
Germany:		Germany	+49 (711) 78954-510	India	+91 (124) 4399500
Kempen	+49 (0) 21 52 14 51	India	+91 (124) 4399500	Japan	+81 (43) 213-2191
Stuttgart	+49 (711) 78954-510	Japan	+81 (43) 213-2191	Korea	+82 (51) 636-7080
India	+91 (124) 4399500	Korea	+82 (51) 636-7080	The Netherlands	+31 (23) 5661111
Japan	+81 (43) 213-2191	The Netherlands	+31 (23) 5661111	Poland	+48 12 295 13 00
Korea	+82 (51) 636-7080	United States	+1 (970) 482-5811	United States	+1 (970) 482-5811
Poland	+48 12 295 13 00				
United States	+1 (970) 482-5811				

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.

Revision History

Changes in Revision J—

- Updated Figures 1-1 through 1-5

Changes in Revision H—

- Added filter cleaning instructions

Changes in Revision G—

- Updated Declaration of Incorporation

Changes in Revision F—

- Added Regulatory Compliance information
- Added installation information and warnings to Chapter 2
- Added Declarations

Changes in Revision E—

- Chapter 2—Added paragraph advising how to use an external cooler with actuators that have oil spray

Declarations

**DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC**

Manufacturer's Name: WOODWARD, INC

Manufacturer's Address: Building A ,Ditiantai Industrial Park, Huaihedao, Beichen High-Tech Industrial Park, Tianjin, China

Model Names: PG58/PG200/PG300

This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

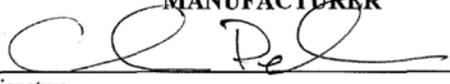
The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director at Woodward Poland Sp. z o.o
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER



Signature

Christopher Perkins
Full Name

Engineering Manager
Position

WGC, Fort Collins, CO, USA
Place

07 - Aug - 2014
Date

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We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **36637J**.



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Email and Website—www.woodward.com

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

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