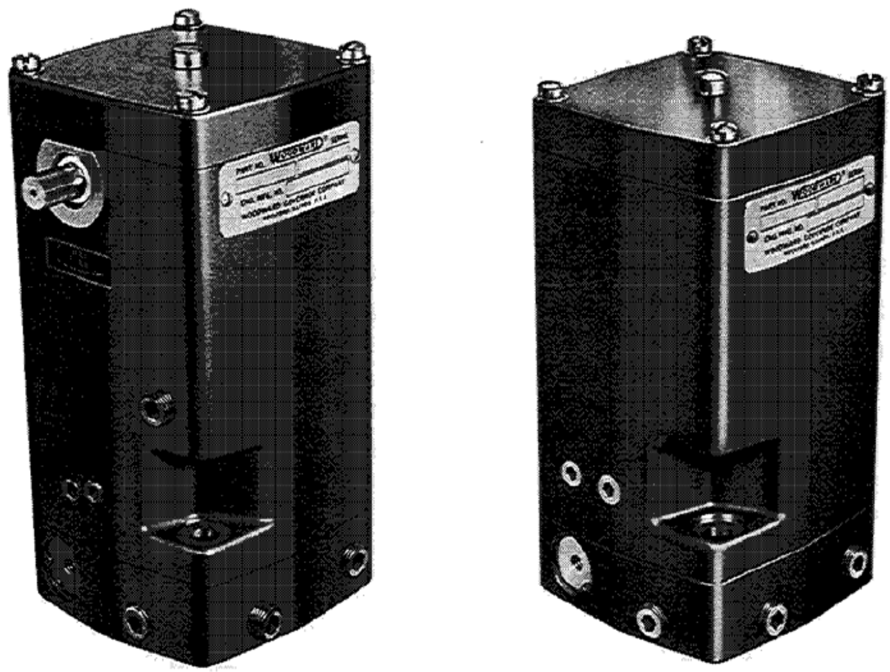
WOODWARD

Product Manual 37710
(Revision K)
Original Instructions



EG-3C and EG-R Actuators

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 Out-of-date translations are marked with ⚠.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

Contents

Illustrations and Tables

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.

Chapter 1.
General Information

EG Governors

The governors included in the Woodward EG Series are of the electric type. They are designed to control the speed of diesel, gas, and dual fuel engines or steam and industrial-commercial gas turbines driving alternators, dc generators, pump, compressors, or paper mill machinery.

The EG governor can be operated as an isochronous governor or as a speed droop governor. As an isochronous governor installed on an engine or turbine operating alone, it will maintain a constant speed for all loads within the capacity of the engine or turbine except momentarily at the time a load change occurs. Paralleled with other EG governors on units driving alternators, it will render proportional load division with isochronous control. Paralleled with dissimilar governors or with an infinite bus (commercial power), the EG governor can be operated as a conventional speed droop governor, and the load carried by the engine or turbine will be a function of governor speed setting and speed droop setting.

The EG governor consists essentially of three separate assemblies: a control box, a speed adjusting potentiometer, and a hydraulic actuator. Depending on the control box and the type of service in which it is used, a load signal box and a resistor box may also be required. The resistor box, if needed, can be obtained from Woodward or supplied by others.

The output signal of the EG control box serves as the input signal to the EG hydraulic actuator. The actuator in turn controls the flow of energy medium to the engine or turbine.

The flexibility of the EG governor system makes it adaptable to many special as well as standard arrangements. We will be glad so offer our recommendations for the operating scheme you propose.

As is the case with any governor of any type, the engine should be equipped with a separate overspeed device to prevent runaway in the event of any failure which may render the governor inoperative.

EG Actuators

The hydraulic actuator of the EG governor adjusts the engine or turbine fuel supply as dictated by the output signal of the EG control box. Several different actuators are available for this purpose, The exact assembly used depends upon (1) the work required to move the fuel control and (2) whether or not a centrifugal flyweight head assembly is desired. The work required is the product of the distance through which the fuel control muss be moved and the force required to move it at the point of greatest resistance. An actuator with a centrifugal flyweight head assembly will limit maximum engine or turbine speed if the control box signal is interrupted or if it fails in such a fashion as to call for maximum fuel. Should this occur, the speed setting of the flyweight head assembly can then be lowered to permit complete control of the engine or turbine at its normal speed. (Should the control box fail in such a way as to emit a continuous signal calling for a decrease in fuel, the unit would shut down.)

The essential element of each actuator is an electro-hydraulic transducer which directs oil to and from the power piston, which actuates the fuel or steam control mechanism. The transducer consists of a polarized magnet to which is attached the pilot valve plunger controlling oil flow to and from the power piston. The solenoid responds to the push-pull output of the control box and, in so doing, moves the pilot valve plunger up or down. Through connecting linkage, the power piston moves the terminal (output) shaft of the actuator. The engine or turbine fuel linkage attaches to the actuator.

⚠WARNING

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

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

While strict linearity of terminal shaft travel versus load is not required, the linkage should be arranged to give the same degree of linearity afforded conventional speed-sensing governors.

Each actuator has its own oil pump to develop the hydraulic pressure needed to move the power piston, Some of the actuators use oil from the engine lube oil system or some other external source.

Two basic types of EG hydraulic actuators are available. One type has incorporated within it a conventional centrifugal speed-sensing flyweight head assembly which provides control during starting, and permits the actuator to serve as a 'back-up" governor in case the electrical signal is interrupted. The other type of actuator does not include a centrifugal flyweight head assembly; such units require that the engine or turbine be controlled manually or by other means during starting.

Actuators without the centrifugal head assembly have a stalled work capacity of 4.5, 20, or 40 ft-lb (6.1, 27, or 54 J). Actuators with the centrifugal head assembly are available with stalled work capacities of 1.7, 2.5, 10, 35, or 50 ft-lb (2.3, 3.4, 14, 47, or 68 J). The useful work capacity of an actuator is approximately 2/3 of the stalled work capacity.

This manual describes the EG-3C and EG-R actuators. Separate manuals describe the EG control boxes and other types of hydraulic actuators.

⚠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.

EG-3C and EG-R Hydraulic Actuators

EG-3C Actuator

The EG-3C hydraulic actuator (Figure 1-1) has a stalled work capacity of 4.5 ft-lb (6.1 J), a useful work capacity of 3 ft-lb (4 J), and its stalled torque rating is 60 lb-ft (81 N·m) transmitted through an output shaft of 42°.

Figure 1-1. EG-3C Actuator

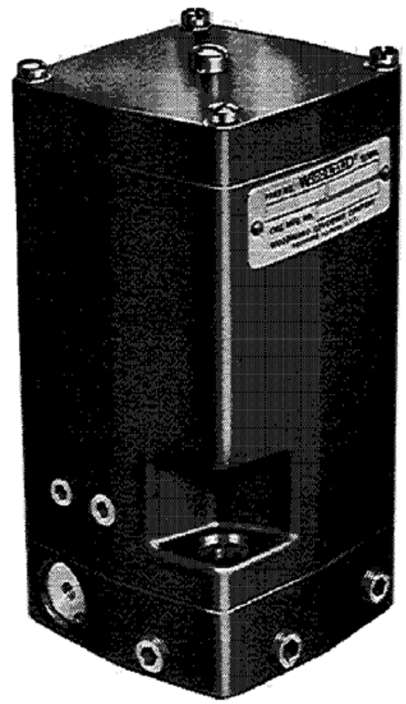


Figure 1-2. EG-R Actuator

The terminal shaft of the standard EG-3C actuator extends from both sides of the actuator case. An outline drawing of the EG-3C actuator is shown in Figure 1-6.

EG-R Actuator

The EG-R hydraulic actuator (Figure 1-2) may be used with remote servos having a stalled work capacity of 20 ft-lb (27 J) [servo force of 120 lb (534 N) and 2" (51 mm) stroke or force of 240 lb (1068 N) and 1" (25 mm) stroke]. It is recommended that linkage be designed to require a maximum of 2/3 of the servo force to move the fuel or steam valve, fuel racks, etc., at the point of greatest resistance. An outline drawing of the EG-R actuator is shown in Figure 1-7.

The remote servos designed for use with the EG-R actuator are differential servos in separate housings. Tubing connects the hydraulic circuits of the actuator to those in the remote servo. Figure 1-3 shows a typical remote servo assembly.

Oil for the EG-3C or EG-R actuator is taken from the engine lubricating oil system or from a separate sump (not furnished by Woodward). The actuator does not have a self-contained sump.

EG-3C and EG-R actuators provide hydraulic-mechanical fuel setting control in response to appropriate electric control signals. The actuators may be adjusted to move toward either minimum or maximum fuel in the absence of an electric control signal.

⚠WARNING	**Actuators designed to go to maximum fuel in the absence of a control signal will also go to maximum fuel in case of an accidental loss of control signal. This can cause a dangerous overspeed situation.**

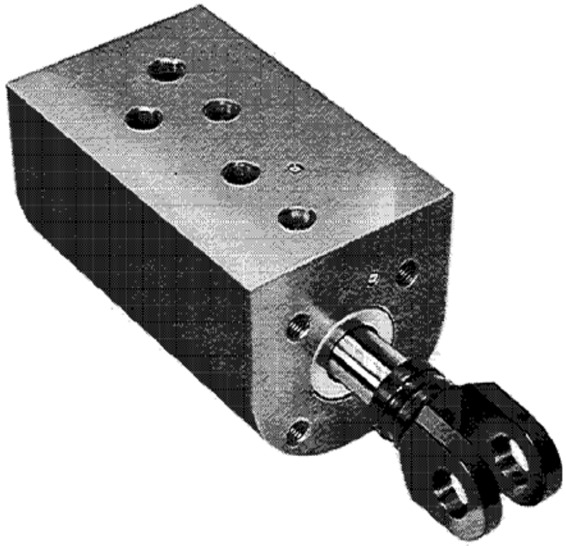


Figure 1-3. Remote Servo

Drive

Since neither the EG-3C nor the EG-R hydraulic actuator has a mechanical speed sensing flyweight head assembly, neither requires that its drive shaft be driven directly by the engine. The drive shaft is rotated—either by the engine or another source—only to turn the actuator pump gears, and to provide relative rotation between the non-rotating pilot valve plunger and its bushing. (The drive shaft is an integral part of the pilot valve bushing.) Both actuators require 1/3 hp (249 W) to turn the drive shaft at normal operating temperatures. The oil pump of the EG-3C and EG-R hydraulic actuators is designed for rotation by the drive shaft in one direction only, as determined by oil passages plugged in the actuator base and case. A relief valve is incorporated within the actuator to maintain the operating oil pressure at approximately 375 psi (2586 kPa) plus supply pressure.

EG-3C Actuator Operation

A schematic arrangement of the EG-3C actuator is shown in Figure 1-4.

Oil from the external source enters the suction side of the oil pump. The pump gears carry the oil to the pressure side of the pump, first filling the oil passages and then increasing the hydraulic pressure. When the pressure becomes great enough to overcome the relief valve spring force and push the relief valve plunger down to uncover the bypass hole, the oil recirculates through the pump. The movement of two opposing pistons rotates the actuator terminal shaft. The engine or turbine fuel (or steam) linkage is attached to the terminal shaft. Pressure oil from the pump is supplied directly to one end of the buffer piston; the other end of the buffer piston connects directly to the underside of the loading piston. Pressure in this hydraulic circuit always tends to turn the terminal shaft in the “decrease fuel” direction. However, the loading piston cannot move up unless the power piston moves down; the power piston can move down only when the oil trapped under it escapes to sump.

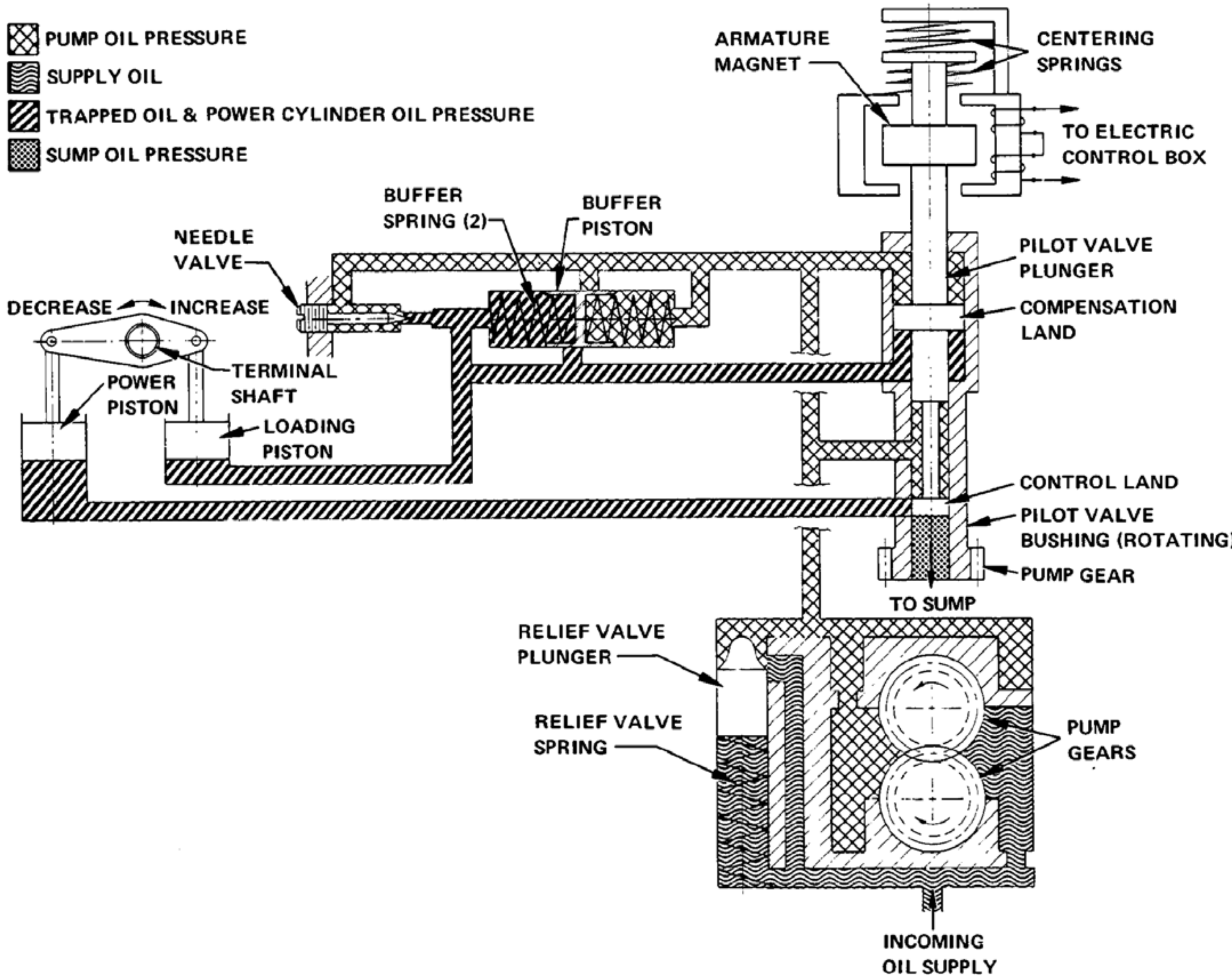


Figure 1-4. Schematic Diagram of EG-3C Actuator

The pilot valve plunger controls the flow of oil to and from the power piston. The pilot valve plunger is connected to an armature magnet which is spring-suspended in the field of a two-coil solenoid. The output signal from the electric control box is applied to the current in the coil, which moves the armature magnet—and pilot valve plunger—up or down. The pilot valve plunger is raised as a result of a decrease in load or a decrease in speed setting of the control box. It is lowered as a result of an increase in load or an increase in speed setting. The centering springs return the armature magnet and pilot valve plunger to their steady-state centered positions when the electric control signal fades to its on-speed voltage value. The pilot valve plunger is "centered" when its control land exactly covers the control port in the pilot valve bushing.

(The "on-speed" output signal from the electric control box depends on the scheme of operation specified by the engine manufacturer to occur if the signal to the actuator is interrupted. The centering springs can be set so that, if the signal is lost, the armature and pilot valve plunger will be moved either (1) below center, causing the actuator to call for full fuel, or (2) above center, causing the unit to shut down. While theoretically possible to center the pilot valve plunger when the input signal is interrupted, it in not practical to do so.)

With the pilot valve plunger centered, no oil flows to or from the power piston. If the pilot valve plunger is raised due to a decrease in load (causing an increase in speed), the oil trapped under the power piston is free to escape to sump. Pressure oil, moving through the buffer piston and needle valve system, and going to the underside of the servo piston, causes the servo piston to move up in the decrease fuel direction. Engine speed begins decreasing.

Stability of a system controlled by the electric governor section is enhanced by the use of a temporary negative feedback signal which biases the speed and load signal to the pilot valve plunger, The temporary feedback signal is in the form of a pressure differential applied across the compensating land of the pilot valve plunger. The pressure differential is derived from the buffer system, and is allowed to fade away as the engine returns to speed.

Movement of the buffer piston to the left partially relieves the compression of the right-hand buffer spring and increases the compression of the left-hand buffer spring. The force of the left-hand buffer spring tending to twist this movement results in a slightly higher oil pressure on the right side of the buffer piston than is transmitted to the underside of the compensation land of the pilot valve plunger. The pressure on the right of the buffer piston is fed to the upper side of the compensation land, The difference in pressures on the two sides of the compensation land produces a force which acts to push the pilot valve plunger back to its centered position.

When the terminal shaft has been rotated far enough to satisfy the new fuel requirement, the force of the pressure differential on the compensation land will have re-centered the pilot valve plunger, even though engine speed is not yet completely back to normal. The power piston—and terminal shaft—movement is thereby stopped. The continued decrease of speed to normal results in a continued decrease in upward force on the pilot valve plunger as the control box signal returns to its on-speed voltage value. At the same time, the pressure differential on the two sides of the buffer piston (and on the upper and lower side of the compensating land) is being dissipated by flow of oil through the needle valve orifice. As this occurs, the buffer springs return the buffer piston to its normal, central position. The decrease in electrical signal to its on-speed value and the dissipation of differential pressure on the two sides of the compensation land occur at the same rate (and the pilot valve remains centered) until the engine is again at the on-speed condition at the decreased load.

Now, consider the operation when the engine load increases and engine speed decreases, The pilot valve plunger is lowered, and pressure oil flows to the power piston. Although the loading piston and power piston are the same in diameter, the power piston acts on a lever on the terminal shaft at a greater radius than the loading piston; therefore the power piston moves up, rotating the terminal shaft in the "increase fuel" direction, and engine speed begins increasing. The loading piston is forced down. The oil displaced by the loading piston moves the buffer piston to the right, thus causing a pressure differential on the upper and lower sides of the compensation land so that the pilot-valve plunger is re-centered before engine speed returns to normal. This pressure differential dissipates through the needle valve orifice an the same rate that the electrical signal is reduced to its on-speed voltage value as the engine speed returns to normal. The engine thus returns to its steady-state condition, with the terminal shaft at the new fuel position required for the increase in engine load.

EG-R Actuator Operation

A schematic arrangement of the EG-R actuator is shown in Figure 1-5.

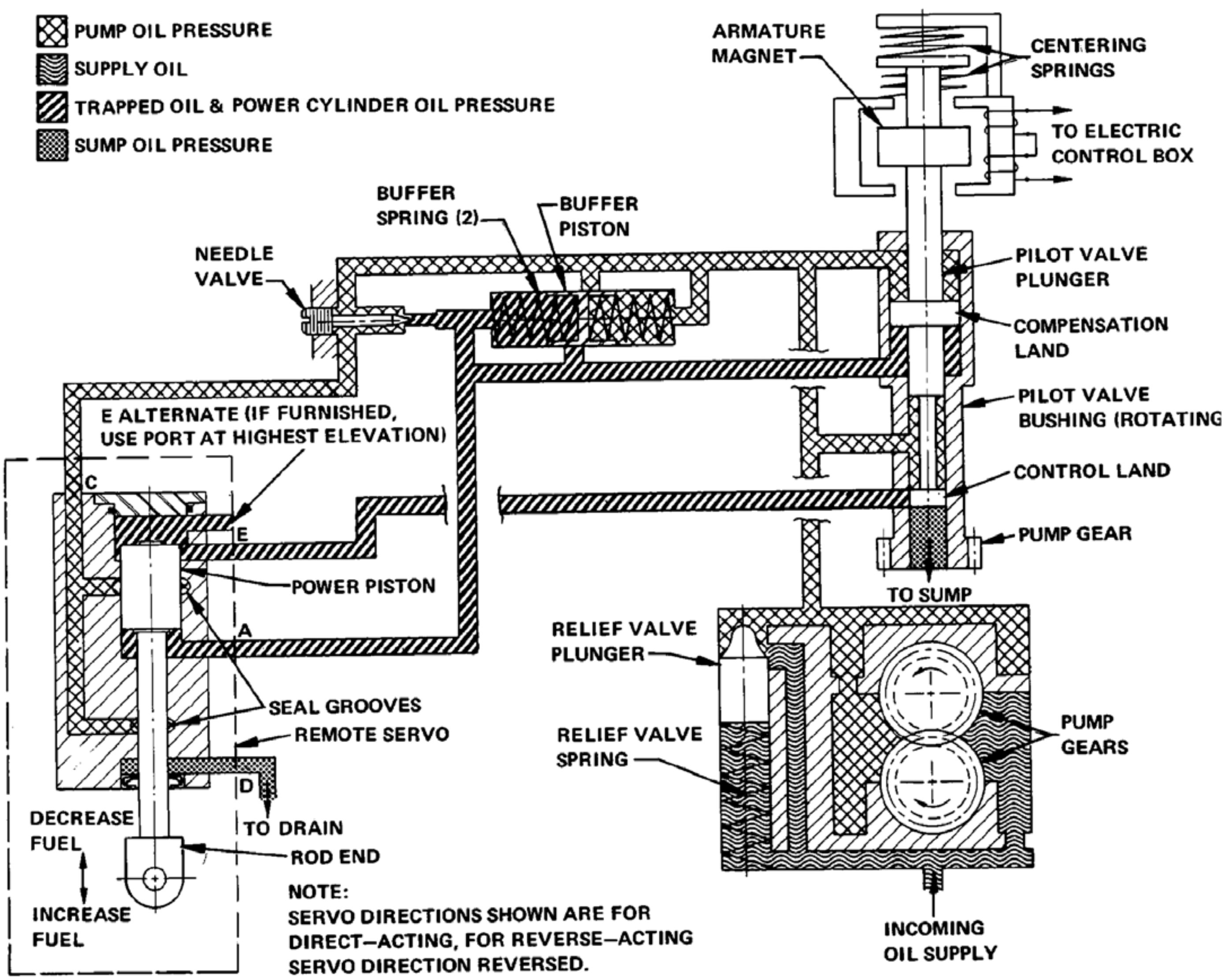


Figure 1-5. Schematic Diagram for EG-R Actuator

Oil from the external source enters the suction side of the oil pump. The pump gears carry the oil to the pressure side of the pump, first filling the oil passages and then increasing the hydraulic pressure. When the pressure becomes great enough no overcome the relief valve spring force and push the relief valve plunger down to uncover the bypass hole, the oil recirculates through the pump.

The linear movement of the power piston of the remote servo, used in conjunction with the EG-R actuator, moves the engine or turbine fuel (or steam) linkage. The EG-R actuator controls the flow of oil to and from the servo piston. Pressure oil from the pump is supplied directly to one end of the buffer piston; the other end of the buffer piston connects to the underside of the servo piston. Pressure in this hydraulic circuit always tends to move the piston up in the “decrease fuel” direction. However, the piston cannot move up unless the oil trapped between the upper side of the piston and the pilot valve plunger can escape to sump.

The pilot valve plunger controls the flow of oil to and from the upper side of the power piston in the remote servo. The pilot valve plunger is connected to an armature magnet which its spring-suspended in the field of a two-coil solenoid. The output signal from the electric control box is applied to the solenoid coils, and produces a force, proportional to the current in the coil, which moves the armature magnet—and pilot valve plunger—up or down. The pilot valve plunger is raised as a result of a decrease in load or a decrease in speed setting of the control box; it is lowered as a result of an increase in load or an increase in speed setting. The centering springs return the armature magnet and pilot valve plunger to their steady-state, centered positions when the electric control signal fades to its on-speed voltage value. The pilot valve plunger is “centered” when its control land exactly covers the control port in the pilot valve bushing.

(The “on-speed” output signal from the electric control box depends on the scheme of operation specified by the engine manufacturer to occur if the signal to the actuator is interrupted. The centering springs can be set so that, if the signal is lost, the armature and pilot valve plunger will be moved either (1) below center, causing the actuator to call for full fuel, or (2) above center, causing the unit to shut down. While theoretically possible to center the pilot valve plunger when the input signal is interrupted, it is not practical to do so.)

With the pilot valve plunger centered, no oil flows to or from the upper side of the power piston. If the pilot valve plunger is raised due to a decrease in load (causing an increase in speed), the oil trapped on the upper side of the piston is free to escape to sump. Pressure oil. moving through the buffer piston and needle valve system, and going to the underside of the servo piston, causes the servo piston to move up in the decrease fuel direction.

Stability of a system controlled by the electric governor section is enhanced by the use of a temporary negative feedback signal which biases the speed and load signal to the pilot valve plunger. The temporary feedback signal is in the form of a pressure differential applied across the compensating land of the pilot valve plunger. The pressure differential is derived from the buffer system, and is allowed to fade away as the engine returns to speed.

Movement of the buffer piston to the left partially relieves the compression of the right-hand buffer spring and increases the compression of the left-hand buffer spring. The force of the left-hand buffer spring tending to resist this movement results in a slightly higher oil pressure on the right side of the buffer piston than on the left. The pressure on the left of the buffer piston is transmitted to the underside of the compensation land of the pilot valve plunger; the pressure on the right of the buffer piston is fed to the upper side of the compensation land. The difference in pressures on the two sides of the compensation land produces a force which acts to push the pilot valve plunger back to its centered position.

When the servo piston has been moved far enough to satisfy the new fuel requirement, the force of the pressure differential on the compensation land will have re-centered the pilot valve plunger, even though engine speed is not yet completely back to normal. The servo piston movement is thereby stopped. The continued decrease of speed to normal results in a continued decrease in upward force on the pilot valve plunger as the control box signal returns to its on-speed voltage value. At the same time, the pressure differential on the two sides of the buffer piston (and on the upper and lower side of the compensating land) is being dissipated by flow of oil through the needle valve orifice. As this occurs, the buffer springs return the buffer piston to its normal, central position. The decrease in electrical signal to its on-speed value and the dissipation of differential pressure on the two sides of the compensation land occur at the same rate (and the pilot valve remains centered) until the engine is again at the on-speed condition at the decreased load.

Now consider the operation when the engine load increases and engine speed decreases. The pilot valve plunger is lowered, and pressure oil flows to the upper side of the servo piston. Because the area against which the oil pressure acts on the upper side of the piston is greater than the area against which the oil on the lower side of the piston acts, the net force moves the piston in the “increase fuel” direction. The oil displaced on the left side of the piston moves the buffer piston to the right, thus causing a pressure differential on the upper and lower sides of the compensation land so that the pilot valve plunger is re-centered before engine speed returns to normal. This pressure differential dissipates through the needle valve orifice at the same rate that the electrical signal is reduced to its on-speed voltage value as the engine speed returns to normal. The engine thus returns to its steady-state condition, with the remote servo piston at the new fuel position required for the increase in engine load.

Surrounding the power piston and its piston rod are grooves connected to the pump output pressure. These seal grooves have nothing to do with operation of the actuator, but are used to ensure that any leakage of pressure oil from the servo comes from a part of the hydraulic circuit where it will do no harm.

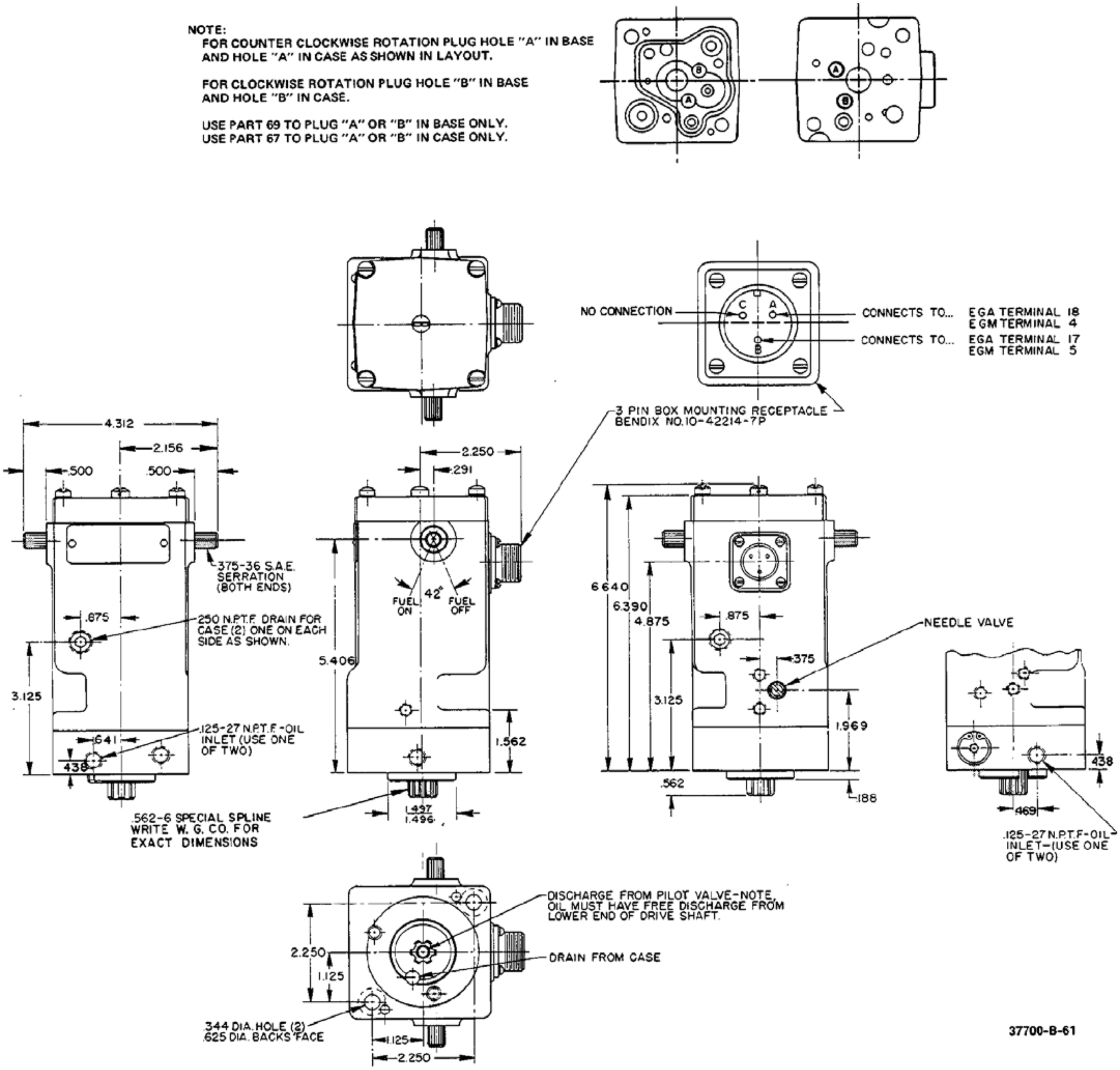


Figure 1-6. EG-3C Outline Drawing

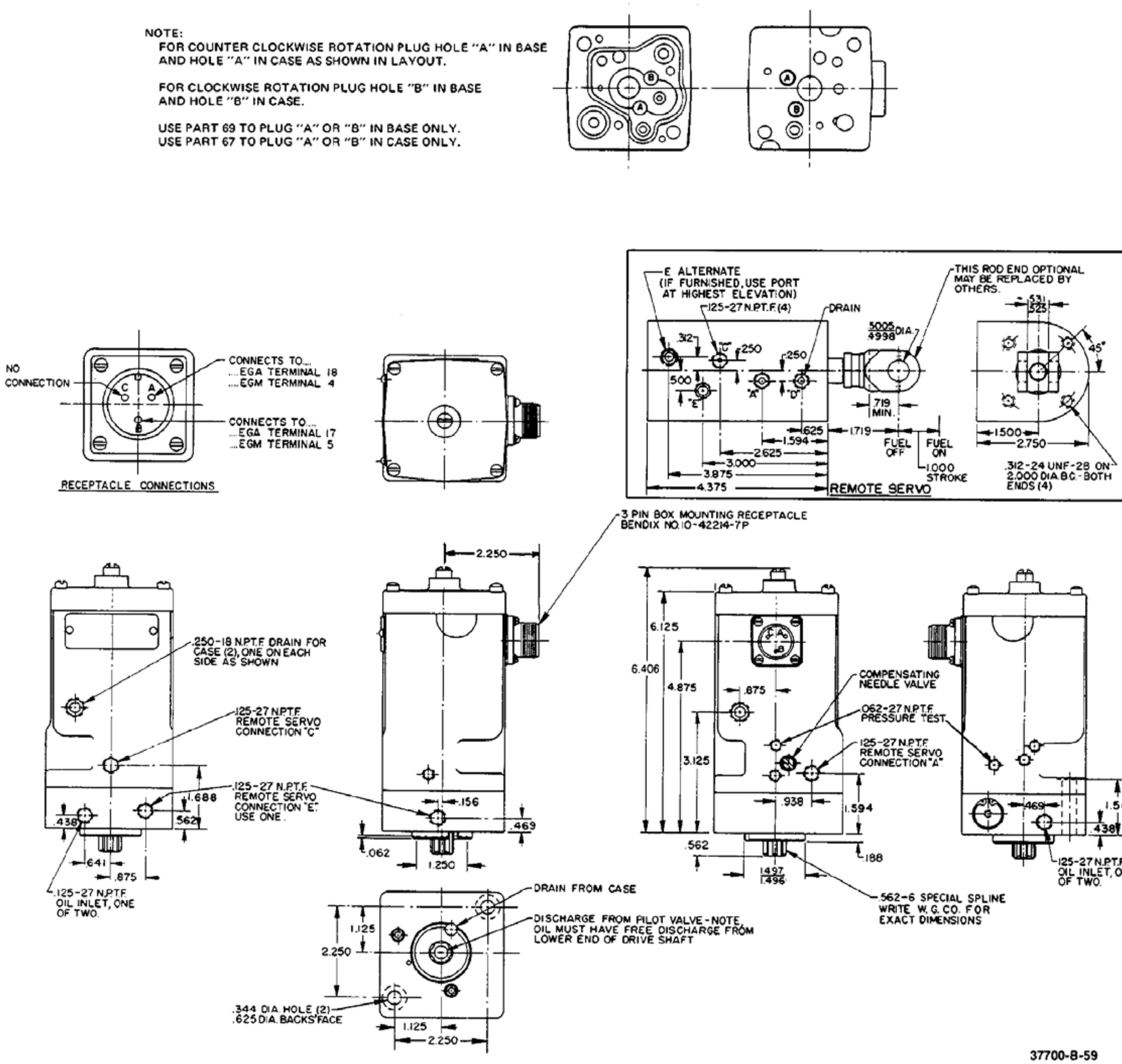


Figure 1-7. EG-R Outline Drawing

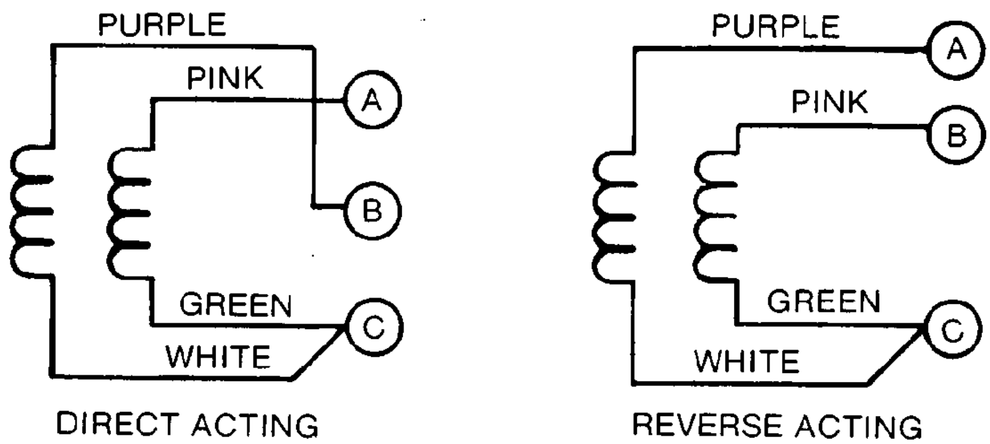


Figure 1-8. EG-3C and EG-R Wiring Diagrams

Chapter 2. Installation and Adjustments

Installation

Take particular care to mount the actuator square with the engine linkage and in line with the drive to the actuator. A gasket should be placed between the base of the actuator and the base mounting pad. The gasket must not block the two drain holes adjacent to the centering pilot of the base. Oil draining through the drive shaft bore must flow freely to sump. The splined drive shaft must fit into the drive with a free, slip fit—no tightness is permitted. The actuator must drop onto the mounting pad of its own weight without any force being applied.

The linkage should be designed to use at least 2/3 of the total available angular travel of the actuator terminal shaft (42°) or 2/3 of the total available servo stroke (1”/25 mm or 2”/51 mm) from no-load to full-load positions.

Adjustment of the linkage must provide for control of fuel from “OFF” to “FULL FUEL” within the limits of governor output shaft or servo travel.

The engine linkage must be free of binding but without excessive backlash. If there is a collapsible member in the linkage, be sure it does not yield each time the actuator moves the linkage rapidly.

⚠WARNING **Be sure to allow sufficient overtravel at each end so the governor can create a shutdown and also give maximum fuel when required.**

Oil Supply

A 3/8” (9.5 mm) OD tubing oil fine must be connected from the oil supply to either of the two 1/8” (3.2 mm) pipe tapped inlet holes of the actuator (see Figure 1-6 or 1-7). A minimum of 5 psi (34 kPa) oil pressure is required at the actuator end of the line. If a separate sump is used (rather than engine lubricating oil), the lift head should not exceed 12” (30 cm), and a foot valve should be used.

Oil from the engine lubricating system can be used in the actuator. If this oil is used, a 2 US gal/min (7.6 L/min), 20 to 25 µm filter should be installed in the oil supply line.

The remote servo used with the EG-R actuator must be mounted lower than the actuator. All hydraulic lines must slope downward continuously, If these instructions are not followed, air may become trapped in the servo or the lines and prevent proper operation of the governor systems. The ports in the EG-R actuator and the corresponding ports in the remote servo are shown in Figure 1-7. Use 3/8” (9.5 mm) OD tubing for the connections between the actuator and the remote servo.

Adjustments

Starting the Prime Mover for the First Time

Before starting the prime mover for the first time, disconnect the potential input terminals as indicated:

EG-A Control Box

- Disconnect terminals 1 through 10 at the control box (Figure 2-1).

EG-M Control

- Disconnect terminals 1, 2, and 3 at the control box (Figure 2-2).
- Disconnect terminals 1 through l0 at the load signal box, if used (Figure 2-3).

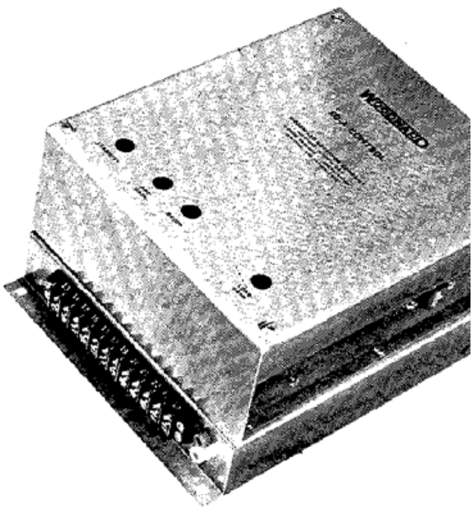


Figure 2-1. EG-A Control

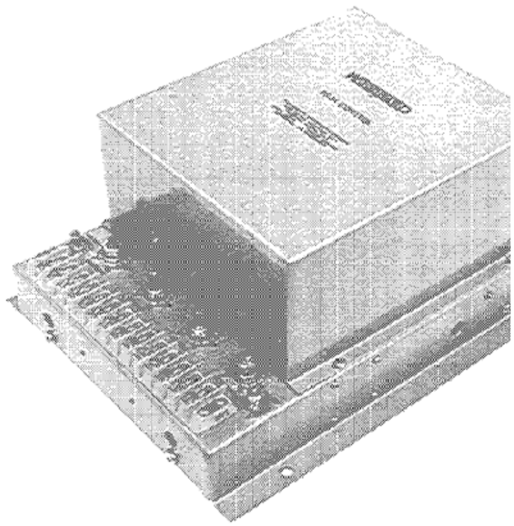


Figure 2-2. EG-M Control

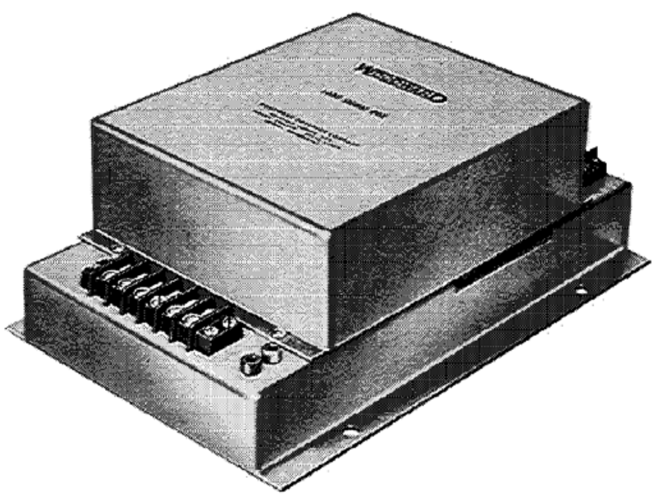


Figure 2-3. Load Signal Box

Be sure to mark the wires so that they can be correctly reconnected later, Fasten the disconnected wires to a spare terminal block for later electrical checks, or, if a spare terminal block is not available, separate and tape the wires to a wooden board or a piece of cardboard.

With the wiring disconnected, the electro-hydraulic transducer of the EG-3C or EG-R actuator is inoperative. The actuator output (terminal) shaft or remote servo piston will normally move to the “maximum fuel” (or steam) position when the actuator oil pump begins turning to build up pressure for the first time or after the unit has been shut down for a short period after running, If the output shaft or piston remains in this position after normal operating pressure is reached, the centering springs above the transducer are adjusted to cause the actuator to go to “maximum fuel” (or steam) if the electrical input signal to the actuator is lost. If the output shaft or piston moves to the opposite end of its stroke when normal operating pressure is reached, the centering springs are adjusted to cause the output shaft or piston to go to “minimum fuel” (or steam) if the control signal is lost.

The actuator can be—and may already be if it were so ordered—adjusted to go to “minimum fuel” when the actuator pump begins to build up oil pressure. Such units will stay at “minimum fuel” until an electrical input signal moves the pilot valve plunger sufficiently to cause the output shaft or piston to move in the opposite direction, Units adjusted to go to “minimum fuel” when the actuator pump begins building up pressure will also go to the “minimum fuel” position when the electrical input signal is lost.

Should it be necessary to change the direction of initial movement of the output shaft or piston, contact Woodward for complete instructions for changes to be made in the control system.

Start the engine or turbine and control it manually or by other means.

With the unit running without load and at approximately normal speed under manual control, make these electrical checks before reconnecting wires to terminals 1, 2, and 3 or the control box and (if used) the load signal box:

A jumper across terminals 23 and 24 of the EGA box should be present for 60 Hz, operation and removed for 50 Hz. operation.

EG-A Control Box

1. The voltage between the wires normally connected to terminals 1 and 2, 2 and 3, and 1 and 3 should be approximately 120, 208, or 240 V as marked on the control box nameplate.
2. There should be no voltage at no-load between the wires to terminals 5 and 6, 7 and 8, and 9 and 10 of the control box.

EG-M Control Box—AC Power Supply Single Phase

1. The voltage between wires to terminals 1 and 2 should be 120 V.

2. When the indicated readings are obtained, the unit should be shut down and the wires again connected to the terminal blocks.

Before restarting the engine, recheck to be sure that all electrical connections to the control box, the load signal box (if used), and the hydraulic actuator are made in accordance with the wiring diagram furnished for the installation. Then set the control box adjustments as follows:

EG-A Control Box
AMPLIFIER GAIN ADJUSTMENT—Turn to extreme CCW (counterclockwise) position.
STABILITY ADJUSTMENT—Turn to extreme CW (clockwise) position.
DROOP ADJUSTMENT—Set in mid-position.
LOAD PULSE ADJUSTMENT (if the box is equipped with this adjustment)—Turn to extreme CCW position; then turn CW 1/4 turn.
LOAD GAIN ADJUSTMENT—Set in mid-position.

EG-M Control Box with Load Signal Box
Control Box
AMPLIFIER GAIN ADJUSTMENT—Turn no extreme clockwise position.
STABILITY ADJUSTMENT—Turn to extreme clockwise position

Load Signal Box
DROOP ADJUSTMENT—Set in mid-position.
LOAD PULSE ADJUSTMENT—Turn to extreme CCW position; then turn CW 1/4 turn.
LOAD GA1N ADJUSTMENT—Set in mid. position.

EG-M Control Box without Load Signal Box
AMPLIFIER GAIN ADJUSTMENT—Turn to extreme CCW position.
STABILITY ADJUSTMENT—Turn so extreme clockwise position.

Running the Engine under Control of the Electric Governor for the First Time

With the electric control box adjusted as outlined above and before starting the engine, set the electric governor needle valve (Figure 2-4) 1/8 turn open.

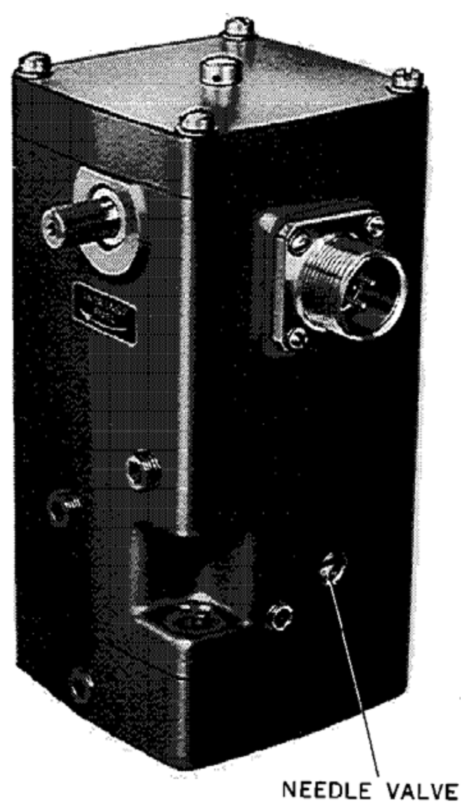


Figure 2-4. EG-3C Actuator Needle Valve

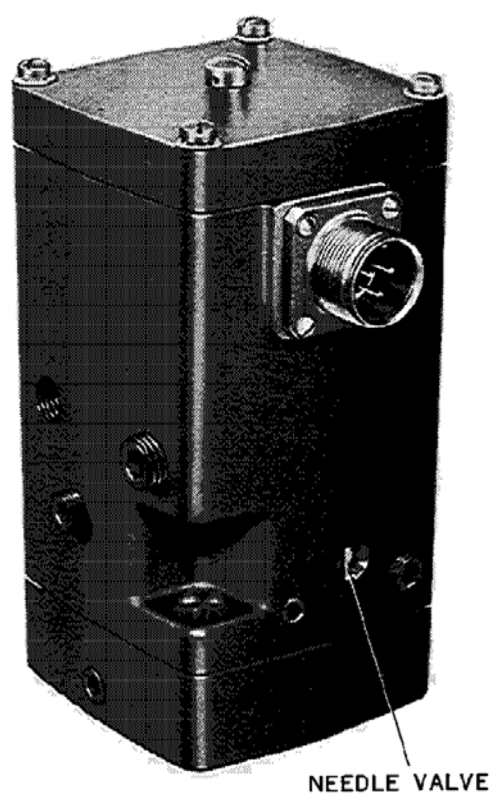


Figure 2-5. EG-R Actuator Needle Valve

Start the engine in accordance with the engine manufacturer's instructions, using manual or another means of control.

When the engine speed approaches its rated speed and the generator is excited, the electric control box wilt receive input signals and the EG governor will control the engine.

Use the speed setting potentiometer to adjust engine speed to normal.

Further adjustments of the control box should now be made, The objective of this procedure is to set the AMPLIFIER GAIN adjustment as far in the clockwise direction as possible while at the same time opening the electric governor needle valve as far as possible. A recording frequency meter is a valuable aid in judging the effect of the various adjustments. If a recording frequency meter is not available, a voltmeter across terminals 17 and 18 on an EG-A control box or across terminals 4 and 5 on the EG-M control box will be useful in judging the effect of the adjustments.

Turning the amplifier gain adjustments clockwise results in a decrease in speed which is corrected by resetting the speed setting potentiometer.

Proceed in this manner:

A. If the unit is stable—

1. Turn the AMPLIFIER GAIN adjustment CW until the unit begins to hunt. Now turn the STABILITY adjustment CCW to stabilize the unit.

   If the unit cannot be stabilized by turning the STABILITY adjustment, reset the STABILITY adjustment to its maximum CW position, and turn the AMPLIFIER GAIN adjustment CCW until the unit becomes stable.

   Reset the speed setting potentiometer to obtain rated speed.

   When the unit is stable, disturb the system by changing the load on the engine, by making a quick speed setting change, or by moving the engine fuel racks or control valve. Observe the speed change.

2. Now open the electric governor needle valve in 1/8 turn increments until the unit again begins to hunt. Next turn the STABILITY adjustment to achieve stability.

   If the unit will not settle down, reset the STABILITY adjustment to its maximum CW position and close the electric governor needle valve 1/8 turn. Use the STABILITY adjustment (if necessary) so stabilize unit.

   Repeat the process of opening the electric governor needle valve until a slight hunt develops and then turning the STABILITY adjustment to stop the hunting until no further improvement in transient response can be achieved. (As noted previously, use of a recording frequency meter is recommended when making these adjustments.) Do not open the needle more than 1-1/2 to 2 turns.

   Typical final settings are: AMPLIFIER GAIN mid-position to maximum CW; STABILITY mid-position to maximum CW; needle valve, 3/4 to 1 turn open.

B. If the unit is unstable—

1. Close the needle valve until the unit becomes stable.

   a. When the unit becomes stable, follow the adjustment procedure outlined in “A” above.
   b. If the unit does not become stable, the cause of the problem likely lies outside of the control box and actuator.

   Check to see that—
   - The linkage is arranged to use at least 60% of the available output of the actuator.
   - The linkage is not sloppy or binding.
   - The oil supply to the governor is not filled with air bubbles.
   - The unit voltage regulator is functioning properly.
   - The voltage supply Is correct.
   - The speed signal supplied to an EG-M control box is correct.

The AMPLIFIER GAIN, STABILITY, and electric governor needle valve should not require further adjustment.

Additional checks should be made as listed below on units equipped with an EG-A control box or an EG-M control box with a load signal box:

EG-A Control Box

There are two types of boxes in service. One box has red and black test jacks and full load voltage is 6 V. The other type has red and white test jacks and full load voltage is 9 V. The difference is because of the point in the circuitry at which the test jacks are connected.

Insert a dc voltmeter into the test jacks on the control box. (The red jack is positive.) The voltmeter should have a minimum rating of10 000 Ω/V. Load the unit as near to 100% as possible. The phase loading should be balanced within 10%. At 100% load, the load voltage should be adjustable from ±0.5 to 6 or 9 V, depending on which type box is used, and at 50% load it should be adjustable to 50% of full load voltage, etc. If polarity is reversed but the voltage amplitude is correct, each of the three pairs of current inputs at control box terminals 5 and 6, 7 and 8, and 9 and 10 must be reversed. This will give the correct polarity. For proper load sharing, EG-A control boxes to be paralleled must be set at the same proportional voltage at the same percentage of full load based on 6 or 9 V at full load.

⚠WARNING

HIGH VOLTAGE—Don’t disconnect any wires at the resistor box. The current transformer can develop a dangerously high voltage when open-circuited.

If the above voltages cannot be obtained, check the phase relationships. Proceed in this manner:

1. Disconnect the load signal resistor leads at the control box, terminals 5 through 10. (Observe the warning note above).

2. Set the LOAD GAIN adjustment on the control box to the maximum CW position.

3. If there is a LOAD PULSE adjustment on the control box, set it fully CCW.

4. Load the unit to rated load or as much load as is available. The load must be at a power factor greater than 0.9. The loads on all phases must be equal within 5%.

5. Measure the ac voltage across the load resistors at the control box end of the leads. These voltages must be equal within 10%, and at 100% load should be from 0.75 V to a little over 2 V. These voltages are directly proportional to the phase loads. For example, at 50% load the range will be half as much. The load must be kept constant during the phase checking procedure.

6. Touch the pair of wires from one of the load resistors to terminals 7 and 8 on the control box and observe the dc voltage at the test jacks. If the polarity is reversed, reverse the wires and observe voltage.

7. Repeat step 6 with the pairs of wires from each of the other load resistors; observe the dc voltage at the test jacks.

8. Of the three load resistors, one will yield a dc voltage larger than the other two. Connect this resistor to terminals 7 and 8 permanently. The correct polarity must be maintained.

9. Touch the wires from a second load resistor to terminals 5 and 6 and then to 9 and 10. Connect these wires to the terminals that yield the highest dc voltage.

10. Connect the remaining two wires to the remaining terminals to give the maximum dc voltage across the test jacks.

11. The LOAD GAIN should now be adjustable from ±0.5 to full load voltage or more at full load. If it is, proceed to step 14; if it is not, proceed with step 12.

12. In step 9, the difference in voltage between touching the resistor leads to terminals 5 & 6 and 9 & 10 is always small. Because of this small difference, the pairs of wires to terminals 5 & 6 and 9 & 10 may be connected to the wrong terminals. If they are not connected correctly, the voltages in step 11 cannot be obtained.

    Return the LOAD GAIN adjustment to maximum, and the procedure outlined in the next step will correct the wiring.

13. Reconnect the wires from terminals 9 & 10 to terminals 5 & 6; reconnect the wires from terminals 5 & 6 to terminals 9 & 10. In each case, the connections should be made to give the maximum dc voltage across the test jacks.

14. The load gain will now be adjustable from ±0.5 to full load voltage or more at full load, and the proper setting may now be made.

    To set Actuator Compensation or De-droop control (if on your unit), check prime mover rpm or alternator frequency at no load. Load the alternator to as near full load as possible (do not put on an infinite bus) and recheck speed or frequency. If it has changed, advance the control and recheck until adjusted for no frequency or speed change from no load to lull load.

EG-M Control Box with Load Signal Box

Insert a dc voltmeter into the test jacks on the load signal box. (The red jack is positive.) The voltmeter used should have a rating of 10 000 Ω/V or more. Load the unit as near to 100% load as possible. The phase loading should be balanced within 10%. At 100% load, the load voltage should be adjustable from 0 to 9 V, and at 50% load, it should be adjustable to 4.5 V, etc. If polarity is reversed, but the voltage amplitude is correct, each of the three pairs of current inputs at control box terminals 5 and 6, 7 and B, and 9 and 10 must be reversed. This will give the correct polarity.

For proper load sharing, EG-M load signal boxes to be paralleled must be set at the same voltage at the same percentage of full load based on 9 V at full load.

IMPORTANT **When paralleling a unit equipped with an EG-A control box to a unit having an EG-M control box and load signal box, the load voltage on the EG-A control box is set at a value based on the full load voltage for the particular type box at full load, while load voltage on the load signal box used with the EG-M control box is set at a value based on 9 V at full load.**

⚠WARNING **HIGH VOLTAGE—Don't disconnect any wires at the resistor box. The current transformer can develop a dangerously high voltage when open-circuited.**

If the above voltages cannot be obtained, check the phase relationships. Proceed in this manner:

1. Disconnect the load-signal resistor leads at the load signal box, terminals 5 through 10. (Observe warning note above.)

2. Set the LOAD GAIN adjustment on the load signal box to maximum CW position.

3. Il there is a LOAD PULSE adjustment on the load signal box, set it fully CCW.

4. Load the unit to rated load or as much load as is available. The load must be at a power factor greater than 0.9. The loads on all phases must be equal within 5%.

5. Measure the ac voltage across the load resistors at the load signal box end of the leads. These voltages must be equal within 10%, and at 100% load should be from 0.75 V to a little over 2 V. These voltages are directly proportional to the phase loads. For example, at 50% load the range will be half as much. The load must be kept constant during the phase checking procedure.

6. Touch the pair of wires from one of the load resistors to terminals 5 and 6 on the load signal box and observe the dc voltage at the test jacks. If the polarity is reversed, reverse the wires and observe voltage.

7. With the same pair of wires, repeat step 6 on terminals 7 and 8 and on 9 and 10.

8. Of the three pairs of terminals, one pair will yield a larger dc voltage than the other two. Connect the wires to this pair.

9. Touch the pair of wires from a second load resistor to each of the two pairs of terminals remaining. Connect no the pair yielding the largest dc voltage.

10. Connect the remaining pair of wires to the remaining terminals to give the maximum dc voltage across the test jacks.

11. The load gain will now be adjustable from 0 to at least 9 V at full load, and the proper setting may now be made.

Operating Adjustments

The LOAD GAIN, AMPLIFIER GAIN, and STABILITY settings should not require adjustments other than these made during initial start-up.

The LOAD PULSE adjustment can usually be left at the setting made before the unit was started. This adjustment controls the load pulse decay time, and can be used to improve transient performance. It is necessary to use a recorder to establish the optimum setting of this adjustment. It can be set only after the LOAD GAIN adjustment has been made.

The DROOP adjustment is used when the unit is paralleled with an infinite bus or with dissimilar units. The DROOP switch (see plant wiring diagram or typical wiring diagram shown in an EG control box manual) must be in the correct position to complete the droop circuit in the control box. When operating in parallel, turn the SPEED SETTING adjustment clockwise (increase speed direction) to increase the load on the unit. Turning the DROOP adjustment clockwise increases droop, thereby improving paralleled stability.

Chapter 3.
Maintenance

General

When requesting information concerning governor operation and maintenance, or when ordering parts, it is essential that the following information be Included:

- Serial number of the control box or hydraulic actuator—whichever is involved.
- Manual number.
- Part reference number and name or description of part.

Troubleshooting

Governor faults are usually revealed in speed variations of the engine, but it does not necessarily follow that all such speed variations indicate governor faults. Therefore, when improper speed variations appear, the following procedure should be carried out:

1. Check the load to be sure that the speed changes observed are not the transient result of continuing load changes.

2. On a diesel or gas engine, check the engine operation to be sure that all cylinders are firing properly, and that the injectors or spark plugs are in good operating condition.

3. See that the operating linkage between the hydraulic actuator and engine or turbine is free from binding or lost motion.

4. Check the voltage regulator to be sure it is functioning properly. If these checks do not reveal the cause of the speed variation, the cause may be in the governor.

5. With the unit set for isochronous operation and running “on-speed”, check the voltage input to the hydraulic actuator. This may be checked at terminals 17 and 18 of the EG-A control box or terminals 4 and 5 of the EG-M control box. The dc voltage reading should:

IMPORTANT	**The voltage levels and control adjustments in this procedure assume that the governor is in control of the engine and that the prime mover is on-speed. Results other than those indicated imply that a problem exists in that area.**

   A. Be between +0.7 and +0.90 or –0.90 and –0.7 V.
      1. It the voltage is within this range, proceed to step 5B below.

⚠WARNING	**The control P.V. plunger is directly under the null voltage screw. A downward pressure on the P.V. plunger could cause excessive increase in speed.**

2. If the voltage is not within this range, remove screw (2, Figure. 4-1; 102, Figure 4-2) in the actuator cover. Insert a 1/8” hex wrench into the null voltage screw (10, Figure 4-1; 110, Figure 4-2). Turn slowly to adjust the voltage across terminals 17 and 18 of the EG-A control box or terminals 4 and 5 of the EG-M control box to be between +0.7 and +0.9 V.

IMPORTANT

The positive meter lead must be connected to terminal 18 of the EG-A box or terminal 4 of the EG-M box if the governor is of the type adjusted to go to maximum fuel when the electric signal to the actuator is interrupted. Turn the null voltage screw (10 or 110) CCW—when viewed from above—to decrease voltage.

If the governor is of the type which is adjusted to shut down the engine when the electric signal to the actuator is interrupted, the positive meter should be connected to terminal 17 of the EG-A box or terminal 5 of the
EG-M. In this case, adjust the voltage across terminals 17 and 18 to be between +0.9 and +0.7 V. Turn the null voltage screw (10 or 110) CW—when viewed from above—to decrease voltage.

a. When the voltage has been adjusted as directed, go to step 5B below.
b. If the voltage cannot be adjusted to the value specified, the control box may be defective. See the applicable control box manual for further electrical checks or replace the entire box.

B. Not fluctuate more than ±0.25 V.
1. If it does not, proceed to step 6 below.
2. If it does, reset the AMPLIFIER GAIN and STABILITY adjustments as outlined in the EG Control Box section under the section entitled “Running the Engine under Control of the Electric Governor for the First Time” (page 16).
a. When the fluctuations are within the range specified, proceed to step 6 below.
b. If the fluctuations cannot be reduced to the range given, the control box may be defective. See the applicable control box manual for further electrical checks or replace the entire box.

6. Assuming that the trouble is reflected by a change in unit steady-state speed as load is changed, take two dc voltage readings (across terminals 17 and 18 of an EG-A control box or terminals 4 and 5 of an EG-M control box) under different load conditions.

A. If the voltage is the same at each of these readings, the control box may be defective. See the applicable control box manual for further electrical checks or replace the entire box.
B. If the voltage readings differ by more than 0.2 Vdc, the trouble lies within the actuator. Replace or repair the actuator.

EG Control Box

Properly installed, the EG control box will cause little, if any, trouble. The use of conservatively rated components, most of which are sealed in an encapsulated package. assures long life for this assembly. Should trouble develop within the control box, the simplest, cheapest, easiest, and quickest remedy is to replace the encapsulated unit, or, in rare instances, the chassis assembly.

Hydraulic Actuator

The source of most troubles in any hydraulic actuator or governor stems from dirty oil. Grit and other impurities can be introduced into the governor with the oil, or form when the oil begins to break down (oxidize) or become sludgy. The moving parts within the actuator are continually lubricated by the oil within the actuator.

Thus, grit and other impurities will cause excessive wear of valves, pistons, and plungers, and can cause these parts no stick and even “freeze” in their bores.

It is virtually impossible to re-center the armature magnet—and hence, pilot valve plunger—without the use of special equipment. Unless such equipment is available, we do not recommend that any attempt be made to disassemble and overhaul the hydraulic actuator.

Plants at which an unplanned shutdown would be costly often keep a complete spare actuator available. (Spare actuators should be kept filled with oil to prevent rusting.)

Those having a governor test stand can likely adapt their stand for testing and setting hydraulic actuators. Write to Woodward for complete information regarding the test stand adaptation and new auxiliary test equipment needed. We will also supply at that time the necessary instructions for properly centering the armature magnet and testing the actuator.

Chapter 4.
Replacement Parts

When ordering actuator replacement parts, it is essential that the following information be given:

- Actuator serial number (shown on nameplate); needed since the manual reference numbers do not identify the exact part required for any one actuator.
- Manual number (this is manual 37710).
- Part reference number, name of part, or description of part.

Parts list for Figure 4-1

Ref. No.	Part Name	Quantity
37710-1	Cover	1
37710-2	Vent Screw	1
37710-3	Fil. Hd. Screw (#10-24 x 7/8)	4
37710-4	Shakeproof Washer (#10)	4
37710-5	Cover Gasket	1
37710-6	Socket Hd. Screw (#10-32 x 2”)	2
37710-7	Split Lock Washer (#10)	4
37710-8	Pin	1
37710-9	Transducer Clamp Bracket Assem...	1
37710-10	Null Voltage Screw	1
37710-11	Centering Screw (#6-32 x 3/8”)	1
37710-12	Washer	1
37710-13	Coil Cover Assembly	1
37710-14	Magnet and Bushing Assembly	1
37710-15	Washer	1
37710-16	Transducer Assembly	1
37710-17	Transducer Support Ring	1
37710-18	Roll Pin	2
37710-19	Roll Pin	2
37710-20	Pin	2
37710-21	Lever (Long)	1
37710-22	Lever (Short)	1
37710-23	Rod Assembly (Long)	2
37710-24	Decal	1
37710-25	Needle Bearing	2
37710-26	Oil Seal	2
37710-27	Drive Screw	2
37710-28	Nameplate	1
37710-29	Actuator Case	1
37710-30	Decal	1
37710-31	Pipe Plug (1/16”)	4
37710-34	Rd. Hd. Screw (#4-40 x 5/16”)	4
37710-35	Split Lock Washer (#4)	4
37710-36	Receptacle	1
37710-37	Gasket	1
37710-38	Terminal Shaft	1
37710-39	Compensating Needle Valve	1
37710-40	O-ring	1
37710-41	1/4” Pipe Plug	2
37710-43	Spring	1
37710-44	Snap Ring	1
37710-45	Compensation Bushing	1
37710-46	Pilot Valve Plunger	1
37710-47	Pilot Valve Bushing/Drive Shaft	1
37710-48	Idler Gear Stud	1
37710-49	Idler Gear Assembly	1
37710-50	Seal Ring	1
37710-51	Dowel Pin	2
37710-52	Relief Valve Sleeve	1
37710-53	Relief Valve Plunger	1
37710-54	Relief Valve Spacer	1
37710-55	Relief Valve Spring	1
37710-56	Power Piston	2
37710-57	O-ring	1
37710-58	Base	1
37710-59	Socket Head Screw	2
37710-60	Shipping Plug — 1/8” Pipe	1
37710-61	Buffer Spring	2
37710-62	Buffer Piston	1
37710-63	O-ring	1
37710-64	Buffer Plug	1
37710-65	Snap Ring	1
37710-66	1/8”’ Pipe Plug	3
37710-67	Case plug	1
37710-68	O-ring	2
37710-69	Base Plug	1

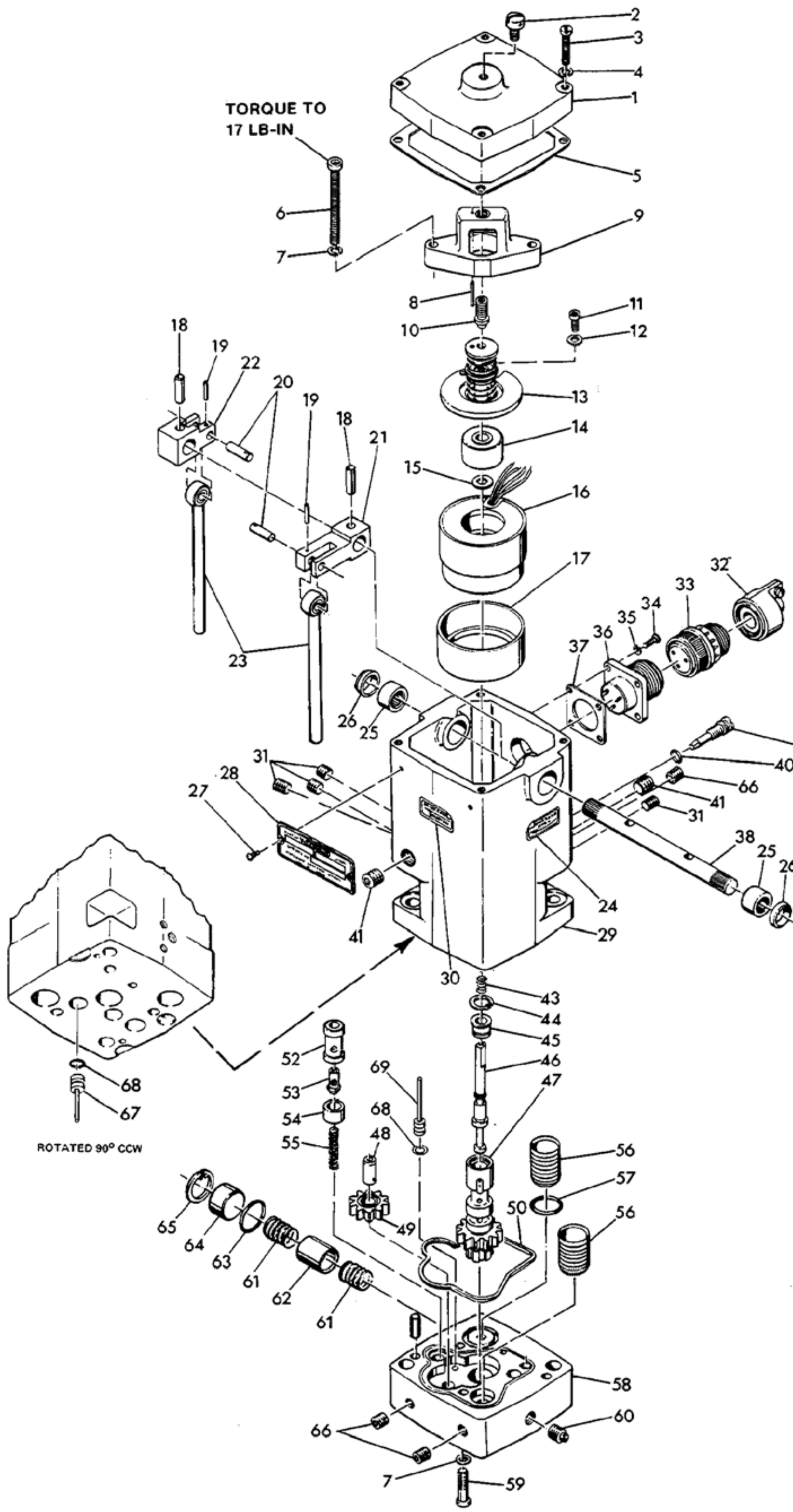


Figure 4-1. Exploded View, EG-3C Hydraulic Actuator

Parts list for Figure 4-2

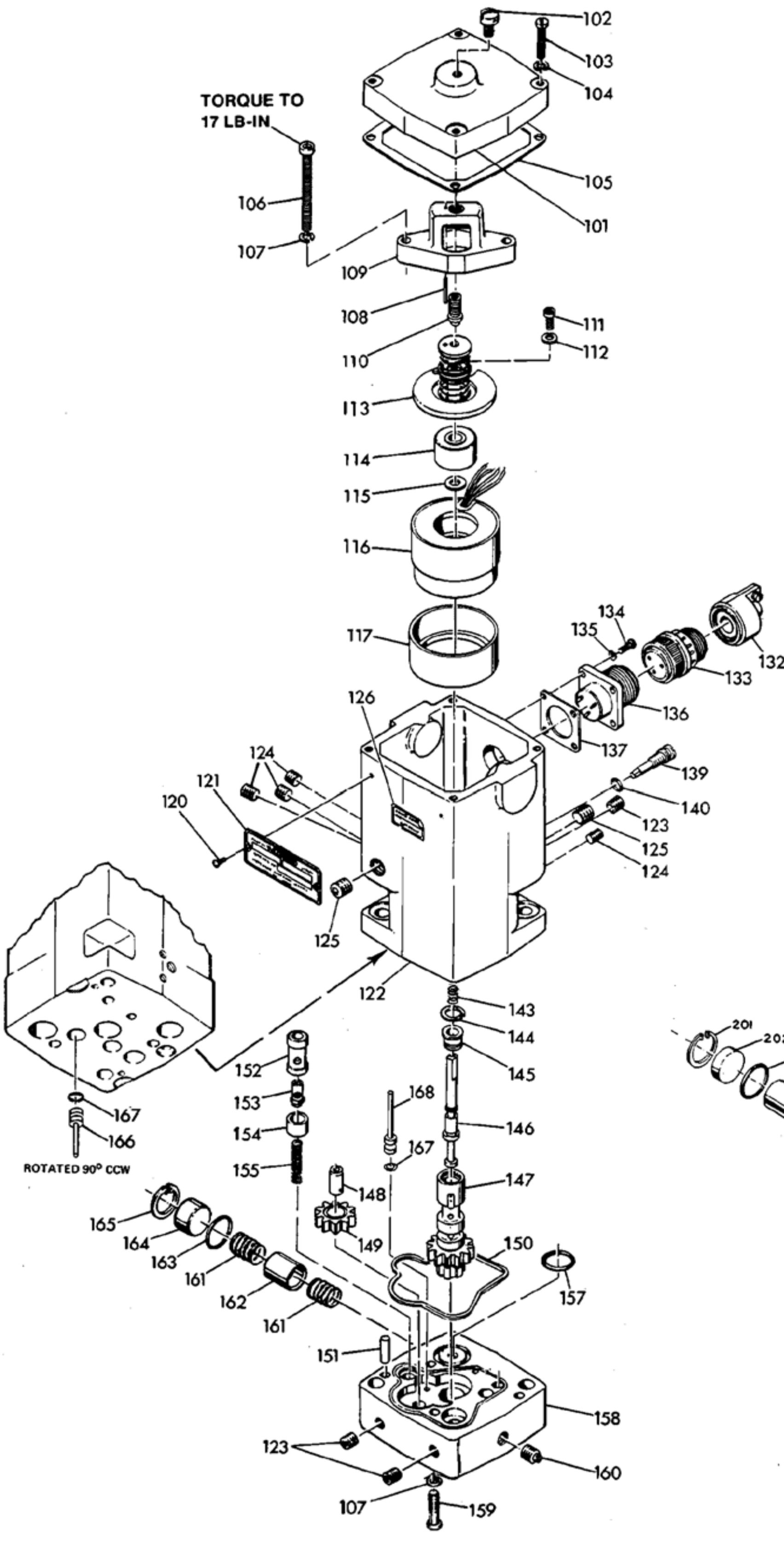
Ref. No.	Part Name	Quantity
37710-101	Cover	1
37710-102	Vent Screw	1
37710-103	Fill. Hd. Screw i#10-24 x 7/8”)	4
37710-104	Shakeproof Washer (#10)	4
37710-105	Cover Gasket	1
37710-106	Socket Hd. Screw (#10-32 x 2”)	2
37710-107	Split Lock Washer (#10)	4
37710-108	Pin	1
37710-109	Transducer Clamp Bracket Assem.	1
37710-110	Null Voltage Screw	1
37710-111	Centering Screw (#6-32 x 3/8)	1
37710-112	Washer	1
37710-113	Coil Cover Assembly	1
37710-114	Magnet and Bushing Assembly	1
37710-115	Washer	1
37710-116	Transducer Assembly	1
37710-117	Transducer Support Ring	1
37710-120	Drive Screw	2
37710-121	Nameplate	1
37710-122	Actuator Case	1
37710-123	Pipe Plug (1/8”)	3
37710-124	Pipe Plug (1/16”)	4
37710-125	Pipe Plug (1/4”)	2
37710-126	Decal	1
37710-134	Rd. Hd. Screw (#4-40 x 5/16)	4
37710-135	Split Lock Washer (#4)	4
37710-136	Receptacle	1
37710-137	Gasket	1

Ref. No.	Part Name	Quantity
37710-139	Compensating Needle Valve	1
37710-140	O-ring	1
37710-143	Spring	1
37710-144	Snap Ring	1
37710-145	Compensation Bushing	1
37710-146	Pilot Valve Plunger	1
37710-147	Pilot Valve Bushing/Drive Shaft	1
37710-148	Idler Gear Stud	1
37710-149	Idler Gear Assembly	1
37710-150	Seal Ring	1
37710-151	Dowel Pin	2
37710-152	Relief Valve Sleeve	1
37710-153	Relief Valve Plunger	1
37710-154	Relief Valve Spacer	1
37710-155	Relief Valve Spring	1
37710-157	O-ring	1
37710-158	Base	1
37710-159	Socket Heed Screw	2
37710-160	Shipping Plug — 1/8” Pipe	1
37710-161	Buffer Spring	2
37710-162	Buffer Piston	1
37710-163	O-ring	1
37710-164	Buffer Plug	1
37710-165	Snap Ring	1
37710-166	Case Plug	1
37710-167	O-ring	2
37710-168	Base Plug	1

Parts list for Figure 4-3

Ref. No.	Part Name	Quantity
37710-201	Snap Ring	1
37710-202	Servo Plug	1
37710-203	O-ring	1
37710-204	Servo Piston	1
37710-205	Servo Body	1
37710-206	Oil Seal	1

Ref. No.	Part Name	Quantity
37710-207	Rod End	1
37710-208	Cotter Pin 1/16” x 3/8”	1
37710-209	Taper Pin	1
37710-210	Drive Screw	2
37710-211	Nameplate	1



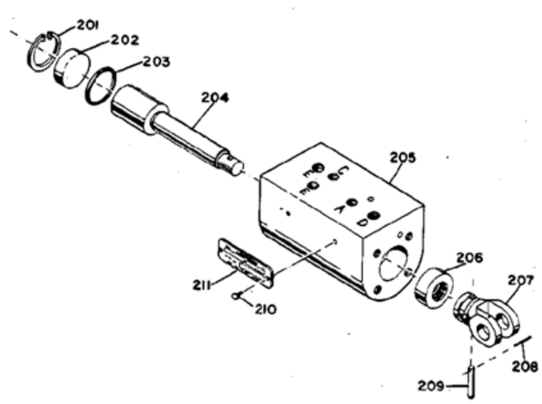


Figure 4-2. Exploded View, EG-R Hydraulic Actuator

Figure 4-3. Exploded View, Remote Serv

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 published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name ____________________

Site Location ____________________

Phone Number ____________________

Fax Number ____________________

Prime Mover Information

Manufacturer ____________________

Engine Model Number ____________________

Number of Cylinders ____________________

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) ____________________

Power Output Rating ____________________

Application (power generation, marine, etc.) ____________________

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Control/Governor #2

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Control/Governor #3

Woodward Part Number & Rev. Letter ____________________

Control Description or Governor Type ____________________

Serial Number ____________________

Symptoms

Description ____________________

____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 37710K.

B37710:K

WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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.

2012/11/Colorado