WOODWARD

Product Manual 89015
(Revision G, 10/2013)
Original Instructions

Hydraulic Amplifier (Electrical Input)

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 Out-of-date translations are marked with ⚠.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

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

Manual 89015

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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.

Regulatory Compliance

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking.

ATEX–Potentially Explosive Atmospheres Directive:	Declared to 94/9/EEC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. LCIE 06 ATEX 6109 X Zone 1, Category 2, Group IIG Ex e II T6 Or Zone 2, Category 3, Group IIG EEx nC IIC T3

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

Machinery Directive:	Compliance as a component with 98/37/EC COUNCIL DIRECTIVE of 23 July 1998 on the approximation of the laws of the Member States relating to machinery.
Pressure Equipment Directive:	Compliant as “SEP” per Article 3.3 to Pressure Equipment Directive 97/23/EC of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.

North American Compliance:

UL:	UL Listed for Class I, Division 2, Groups B, C, D, T3. For use in the United States. UL File E158654

Special Conditiions for Safe Use

⚠WARNING	**The risk of electrostatic discharge is reduced by permanent installation of the valve, proper connection of the equipotential ground lugs, and care when cleaning. The valve should not be cleaned unless the area is known to be non-hazardous.**

Wiring must be in accordance with North American Class I, Division 2 or European Zone 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Field Wiring must be suitable for at least 90 °C.

Connect ground terminal to earth ground.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division 2 ou Zone 2.

Chapter 1.
General Information

Description

The electrically controlled hydraulic amplifier is a linear, pilot-valve-operated servo actuator. It is used when a large force is needed to operate power control mechanisms such as turbine steam valves and fuel control linkages of large engines. An EG-3P proportional actuator is used to electrically control the hydraulic amplifier.

The EG-3P proportional actuator is installed under the cover of the hydraulic amplifier. The EG-3P actuator changes a low-level electrical input signal to a rotary mechanical output. This output, through mechanical linkage, controls the movement of the amplifier pilot valve plunger. The amplifier pilot valve sends high-pressure control oil from the prime mover lubricating system or an external pump to the increase side of a differential servo cylinder. Some amplifiers have a single-acting servo cylinder with a spring return. The servo piston is moved in the decrease direction by oil at supply pressure and the return spring pushing on the bottom side of the servo piston. The piston is connected to the power control mechanism of the prime mover.

Pressure oil against the top side of the piston opens the fuel or steam control valve. A return spring applies pressure on the bottom side of the piston to balance the force of pressure oil. This gives a balanced system with a linear response through the full stroke of the amplifier.

The return spring returns the servo piston to the closed position on loss of oil pressure. It also keeps the control valve in the closed position when the amplifier is not in use. In other applications, the return spring gives only a low force biasing load. Return springs for the 7-1/4” (184 mm) amplifier are available from 50 to 2000 lbs (222 to 8896 N) compression. Return springs for the 5-1/4” (133 mm) amplifier are available from 50 to 400 lbs (222 to 1779 N) compression.

Two models of electrically controlled hydraulic amplifiers are described in this manual. The work output of either model is proportional to the oil pressure and length of the output stroke used. The basic difference in the two models is the diameter of the servo cylinder. The work output of the 7-1/4” (184 mm) diameter servo cylinder (large model) can be up to 3000 ft-lb (4068 J) at the maximum stroke of 3” (76 mm) at 500 psi (3448 kPa) oil pressure (maximum). It develops a stalled force of approximately 12 000 pounds. The work output of the 5-1/4” (133 mm) diameter servo cylinder (small model) can be up to 1000 ft-lb (1356 J) at the maximum stroke of 2-1/2” (64 mm) at 500 psi (3448 kPa) oil pressure (maximum). It develops a stalled force of approximately 4700 pounds.

Extend to Increase Models

Extend-to-increase models are available. These units reverse the wiring on the EG-3 actuator (– to A and + to B). If a return spring is used, the actuator will cause the valve to open on loss of oil pressure. In most instances, the return spring is left out of the amplifier and an external return spring is provided by the user.

Start oil cannot be used in the extend-to-increase models.

Optional Features

There are several options available with the hydraulic amplifier, designed to meet varying requirements. These are included in the amplifier assembly at the customer's request.

The amplifier has an internal oil transfer passage designed to receive either a sleeve (Figure 3-1), an oil plug (Figure 3-2), or a transfer valve (also called a pressure sensing valve; Figure 3-3). The sleeve is installed for single-acting operation to provide increased work capacity in the increase direction. The plug is used to provide differential operation.

When supply oil pressure at start-up is low, a transfer valve is installed. Initially, low pressure supply oil is insufficient to move the servo to increase fuel. The transfer valve temporarily converts the differential amplifier to a single-acting amplifier by blocking the flow of supply oil to the bottom side of the servo piston and opening that area to drain. This allows low pressure supply oil to move the servo to increase. As supply oil reaches normal operating pressure, the transfer valve unseats and re-establishes differential operation.

A port for starting oil provides a means of opening the fuel or steam valve prior to start-up. Starting oil is used to raise the pilot valve plunger and direct supply oil to move the servo to increase. When the customer specifies starting oil, a yield-type pilot valve plunger is installed in place of the standard solid plunger. In all applications where starting oil is required, a three-way valve (not supplied by the Woodward) must be connected to the starting oil port. For starting, the valve is turned to allow starting oil under the pilot valve plunger. The valve must be turned back to drain after start-up. Trapped oil under the plunger will render the amplifier inoperative.

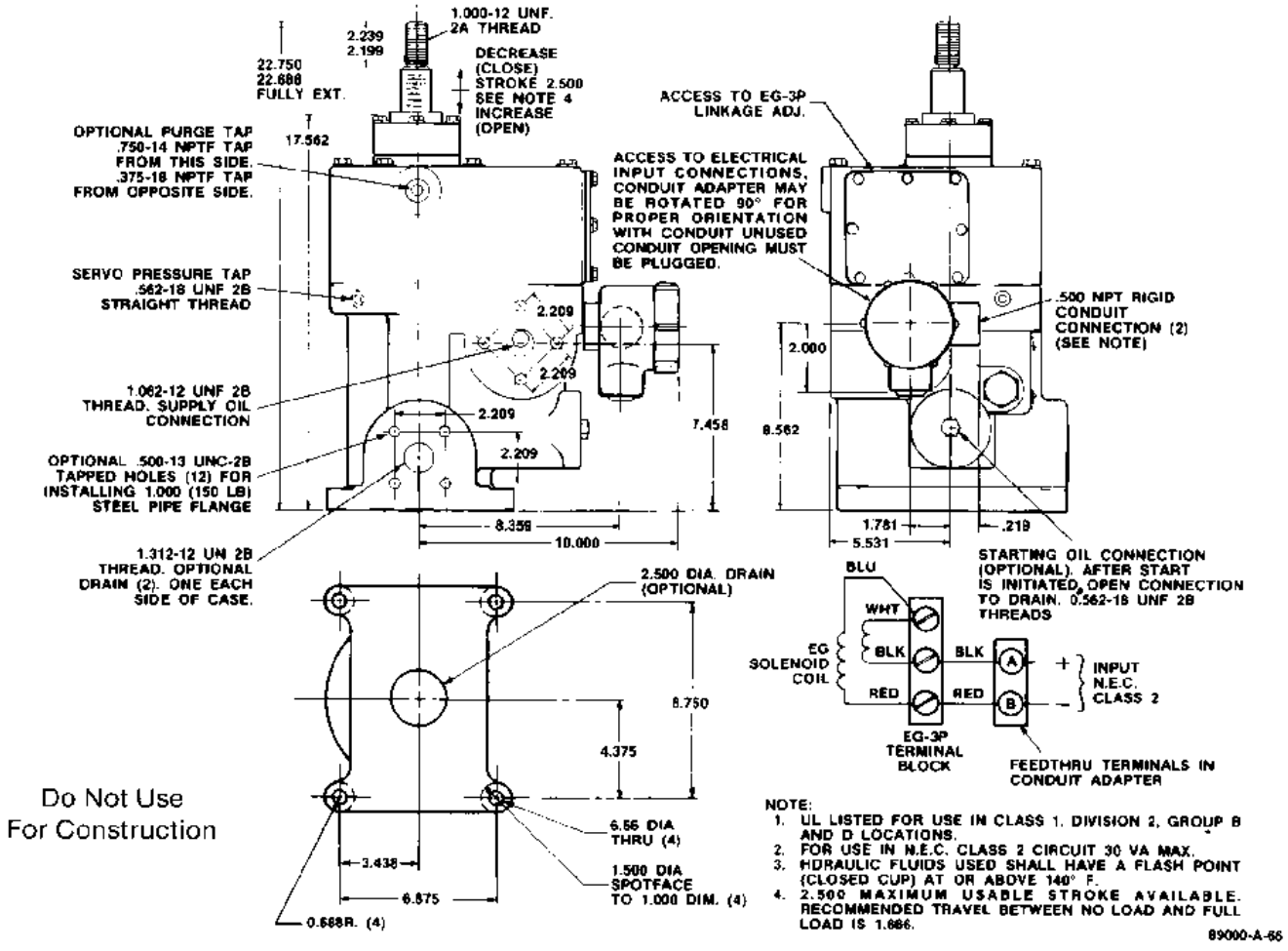
The maximum work capacity of the 7-1/4" (184 mm) amplifier in the opening direction is increased to approximately 4500 ft-lb (6102 J) at 500 psi (3448 kPa). It has a stalled force of approximately 18 000 pounds.

The work capacity of the 5-1/4" (133 mm) amplifier in the opening direction is increased to approximately 1900 ft-lb (2576 J) at 500 psi (3448 kPa). It has a stalled force of approximately 9100 pounds.

The hazardous location versions of the amplifiers have an ingress protection rating of IP54 as defined in IEC 60529.

Reference Publications

89007	*Electrically Controlled Hydraulic Amplifier* product specification
82516	*EG-3P/6P/10P Actuator* product specification
82560	*EG-3P Actuator* manual
25071	*Oils for Hydraulic Controls* manual



Do Not Use For Construction

Figure 1-1. 5-1/4” Hydraulic Amplifier with Optional Connector and Optional Output Shaft Scale

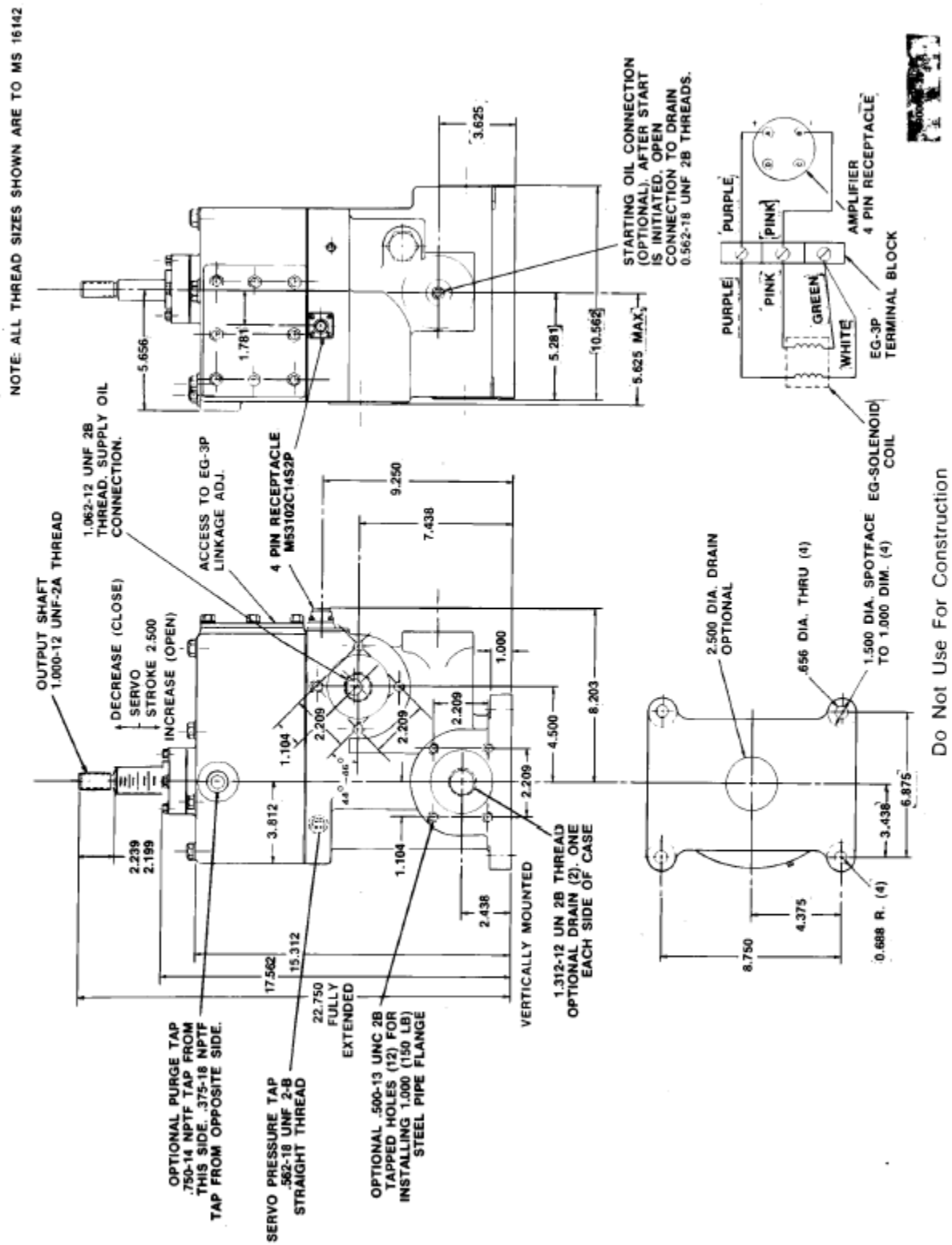


Figure 1-2. 5-1/4” Hydraulic Amplifier Dimensions

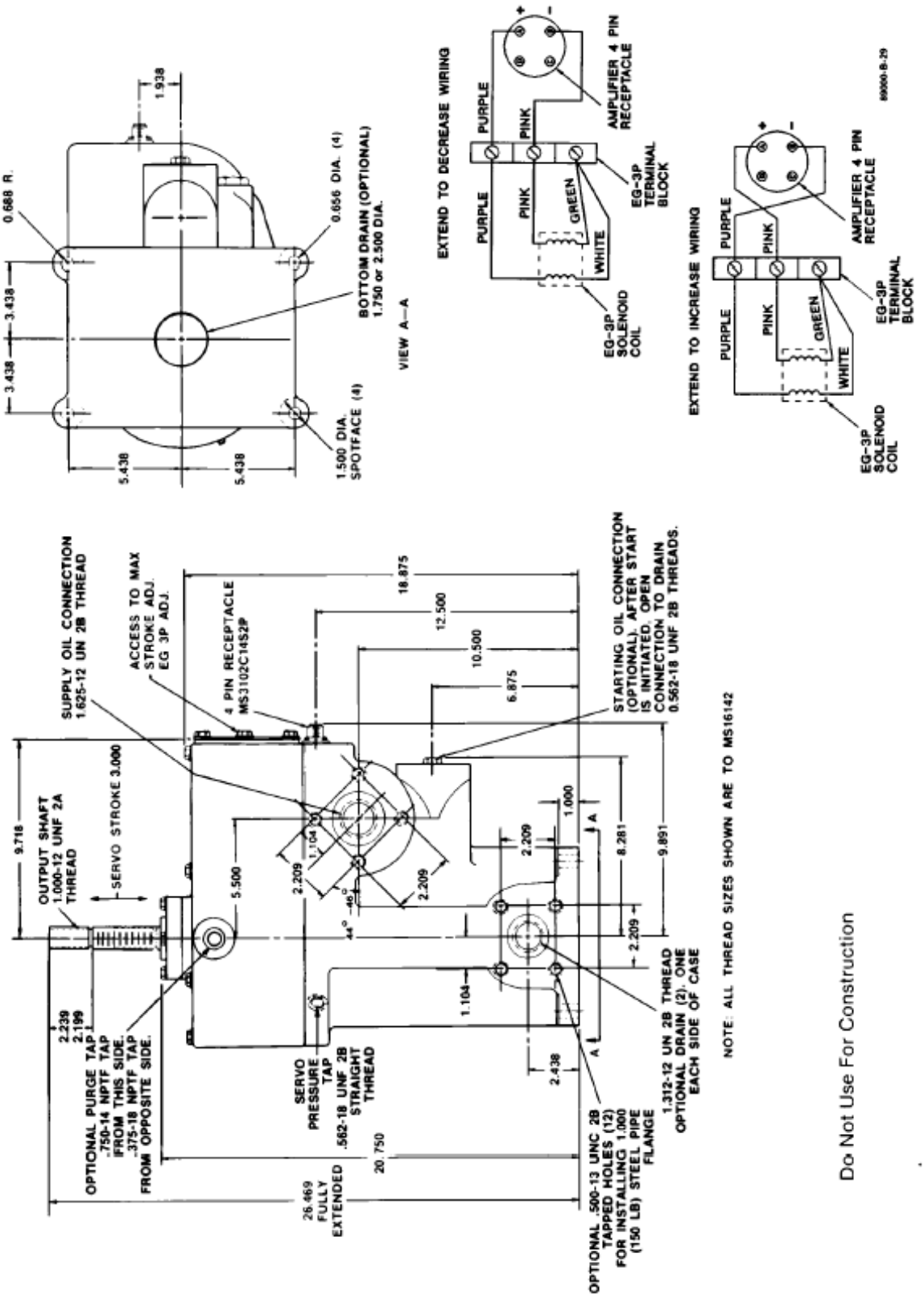


Figure 1-3. 7-1/4” Hydraulic Amplifier Dimensions

Chapter 2.
Installation

Installation

⚠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.

⚠WARNING

Explosion Hazard—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.

⚠WARNING

Explosion Hazard—The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere.

⚠WARNING

Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

⚠CAUTION

Do not lift or handle the hydraulic amplifier by any conduit or connector. Lift or handle the amplifier using appropriate lifting equipment.

⚠CAUTION

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the EG-3P Hydraulic Amplifier.

⚠CAUTION

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.

NOTICE

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system. Make all required electrical connections based on the wiring diagrams (Figures 1-1, 1-2, and 1-3).

Lubricating oil used for the prime mover is generally acceptable for use in the hydraulic amplifier. The oil supply to the amplifier can be supplied directly from the prime mover lubricating oil system or from an independent auxiliary pump.

Provide the amplifier with an adequate supply of oil. Steady state leakage is less than 4 US gal/min (15 L/min) at 150 psi (1034 kPa), 60 SSU.

Transient flow rates of 330 in³/s (85 US gal/min or 320 L/min) are needed when using the 5-1/4” (133 mm) amplifier. The 7-1/4” (184 mm) amplifier needs a flow of 780 in³/s (200 US gal/min or 760 L/min). Use accumulators with a 2.5 US gal (9.5 L) capacity to supply necessary flow rates.

Install the hydraulic amplifier vertically or horizontally with the electrical connector or junction box up. Make all connecting lines as large, short, and straight as possible. The amplifier can be drained from either side of the case. If the drain through the bottom of the case will be used, the amplifier will be shipped without the drain seal plug. See Figures 1-1, 1-2, or 1-3 for installation data.

If the amplifier is set up for starting oil, connect the starting oil port to drain for normal operation. Use a 3-way valve in the oil line to the pilot valve plunger when starting oil is used. If the starting oil port is closed during operation, normal leakage results and hydraulically locks the pilot valve. As a result, the amplifier will not work. If the amplifier is ordered without starting oil, the area under the pilot valve plunger is drained inside.

Make sure that the linkage connecting the amplifier to the fuel or steam control operates freely and has minimum backlash. Lower the amplifier piston rod 1/4” to 1/3” (6 to 8 mm) and adjust the connecting turn buckle until the fuel or steam control is in the desired position.

Chapter 3.
Theory of Operation

Introduction

Refer to Figures 3-1 through 3-4 for the operation of the hydraulic amplifier and EG-3P actuator. Figure 3-1 is a schematic of the amplifier with a solid pilot valve plunger and sleeve for single acting operation. Figure 3-3 shows the pilot valve with a yield plunger and transfer valve in the open position. Figure 3-4 shows a 3-way valve in the starting oil line in addition to the transfer valve in the closed position. Figure 3-4 also shows the yield plunger in the pilot valve plunger.

Operation

EG-3P Actuator

The EG-3P actuator is an electro-hydraulic transducer. It controls oil flow to and from a power piston through the action of a two-coil polarized solenoid, a permanent magnet, a centering spring, and a pilot valve plunger.

The magnet is fastened to the pilot valve plunger. It is held within the magnetic field of the solenoid by the centering spring and the restoring spring. The centering spring forces the magnet and pilot valve plunger in the decrease fuel direction. When the solenoid is energized, the restoring spring and the magnet forces the pilot valve plunger in the increase fuel direction.

Movement of two opposing pistons rotates the actuator output (terminal) shaft. Pressure oil from supply to the amplifier is directed to one side of a loading piston. This hydraulic circuit maintains a constant load on the actuator linkage and always tries to rotate the output shaft in a decrease direction. The loading piston cannot move unless movement of the power piston occurs in the opposite direction. Oil flow to and from the power piston is controlled by the position of the actuator's pilot valve plunger. When the control land on the pilot valve plunger is centered over the control port in the pilot valve bushing, oil flow to and from the power piston stops, except to compensate for leakage, and no movement of the output shaft occurs.

During steady-state operation, the combination of restoring spring force and magnetic attraction at any current level trying to move the magnet and pilot valve plunger in a direction to increase power, is balanced by the centering spring force.

Any change in the current level of the input signal causes a comparable change in the magnetic attraction of the solenoid. A decrease in current level decreases the magnetic attraction, which causes a decrease in the force opposing the centering spring. The centering spring moves the magnet and plunger in the decrease direction, opening the control port to the power piston and permitting oil to drain. The supply pressure on the loading piston then causes the output shaft to rotate in a decrease direction.

As the output shaft rotates, its movement is followed by the feedback linkage which increases the restoring spring compression at a rate proportional to the movement of the output shaft.

The magnet and pilot valve plunger centers when the output shaft reaches its new position as called for by the electronic control. This is in response to the change in prime mover speed setting or load. Overshoot following a correction for a decrease in speed or load is thus minimized.

An increase in current level, increases the magnetic attraction of the solenoid. This causes an increase in the force opposing the centering spring. Since the restoring spring force and magnetic field is now greater than the centering spring force, the magnet (and plunger) moves in the increase power direction. This uncovers the control port and lets oil at supply pressure (less the pressure drop occurring across the pilot valve) into the power piston chamber.

The power piston and loading piston have the same area, but the power piston has a greater mechanical advantage due to a longer lever arm. Therefore, a lower control pressure in the power piston chamber generates enough force to move the output shaft in an increase direction, raising the amplifier pilot valve plunger. As the output shaft rotates, the feedback linkage decreases the restoring spring compression, which permits the magnet (and plunger) to re-center when the output shaft reaches its new position.

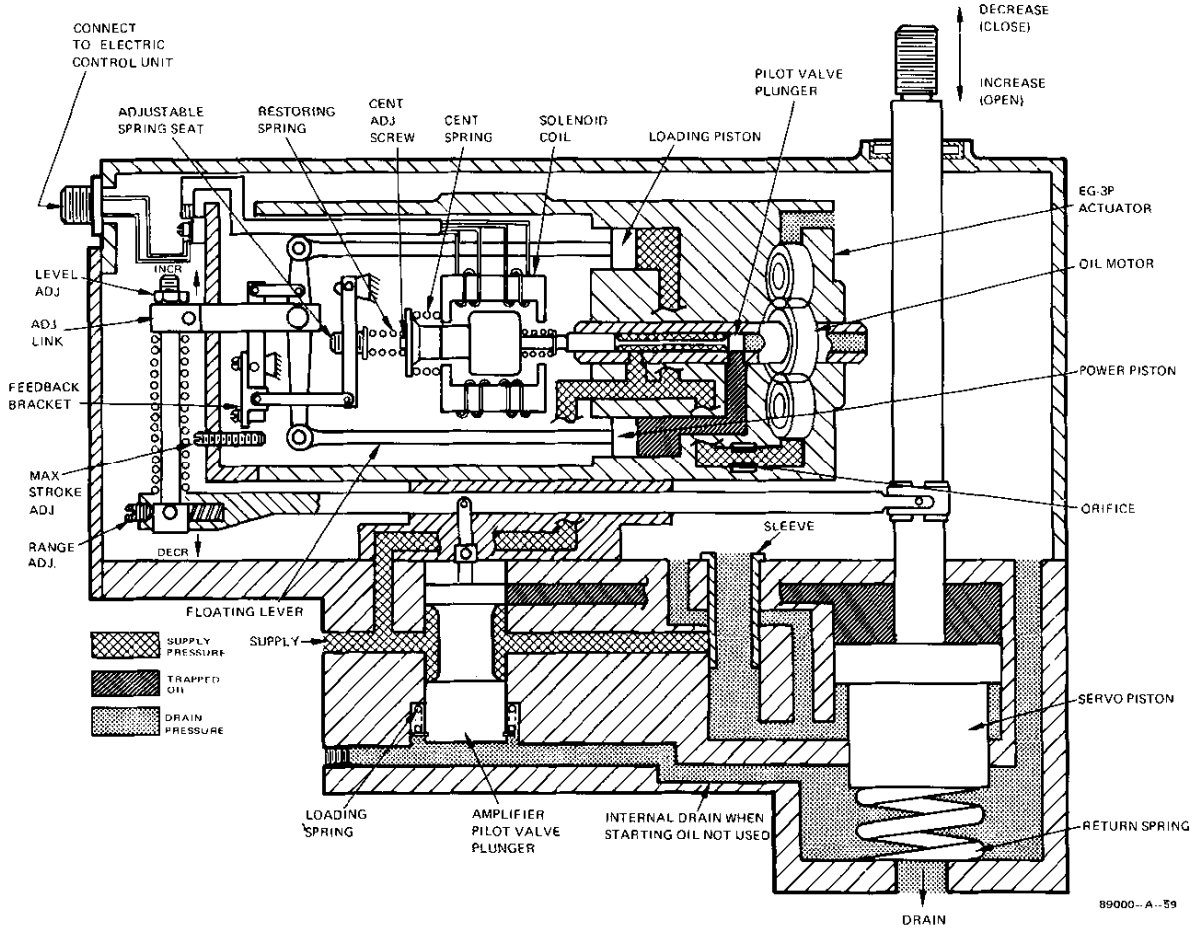


Figure 3-1. Schematic of Hydraulic Amplifier

Hydraulic Amplifier

(See Figure 3-1 through 3-4.) The output shaft of the EG-3P actuator is fastened to the amplifier connecting lever by an output shaft and an adjustable link. Any change in position of the EG.-3P output shaft is transmitted to the amplifier pilot valve plunger which controls the flow of oil to and from the servo cylinder.

Pressure oil from an outside supply is directed to the EG-3P actuator, to the pilot valve, and to the bottom (decrease) side of the servo piston.

When the electronic control senses an underspeed condition and signals for an increase in speed (power), the actuator output shaft rotates in the increase direction. This raises one end of lever (33) in Figure 5-1A, which lifts the pilot valve plunger. Oil is admitted at supply pressure (less the pressure drop occurring across the pilot valve) to the top (increase) side of the servo piston. Although the oil pressure on the top side of the piston is lower than on the bottom side, it acts over twice the surface area and causes the piston to move in the increase power direction. As the piston moves, the end of lever (33) connected to the piston rod also moves, in the same direction. This lowers the pilot valve plunger until its land is centered over the oil control port, and servo piston movement stops.

During a steady state condition, the actuator output shaft is kept in a given position by the electronic control. The amplifier pilot valve plunger is centered over the control port. With flow to the top side of the servo piston closed, except to compensate for leakage, the servo piston keeps its position as set by the electronic control and load on the prime mover.

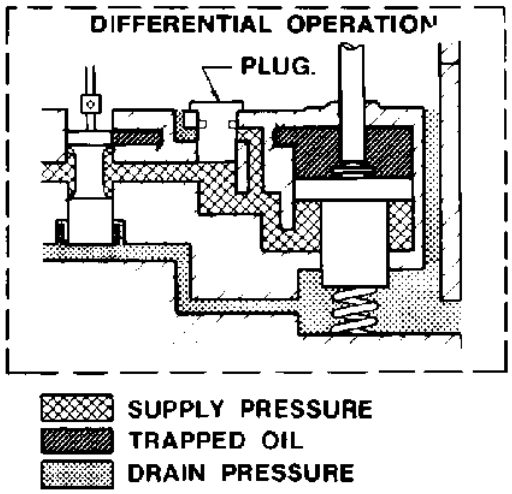


Figure 3-2. Schematic of Hydraulic Amplifier (plug, solid pilot valve plunger)

When the electronic control senses an overspeed condition and signals for a decrease in speed (power), the actuator output shaft rotates in the decrease direction. This lowers the left end of lever (33) and pushes the pilot valve plunger down, allowing oil to drain from the top side of the servo piston. The oil pressure on the bottom side of the servo piston, along with the return spring force, causes the servo piston to move in the decrease power direction. Movement of the piston continues until the pilot valve plunger is again centered by the floating lever.

In applications that need the steam or fuel control opened before the prime mover can be started, and where an electrical signal to the amplifier is not available, the following starting method is used.

Pressure oil is supplied by an auxiliary oil pump through a starting oil port in the amplifier case. Make the connection using a 3-way valve with one port connected to drain (see Figure 3-3).

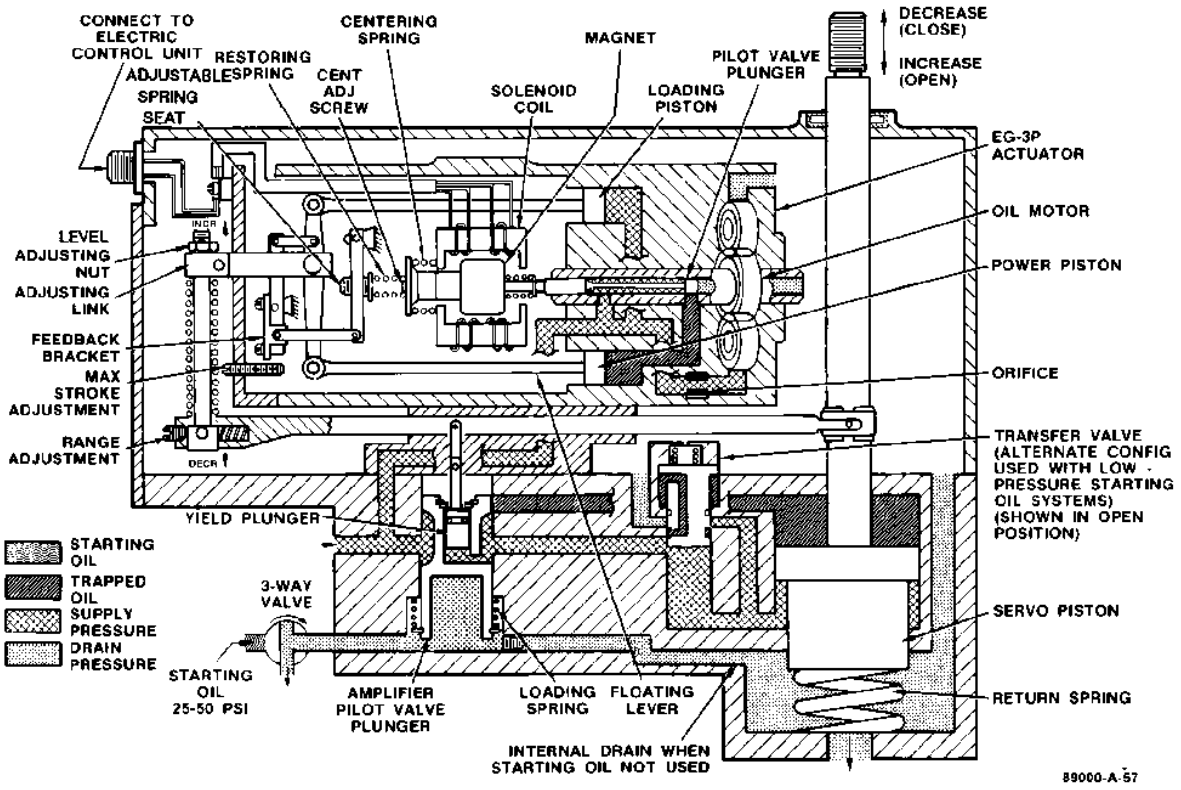


Figure 3-3. Schematic of Hydraulic Amplifier
(transfer valve, yield plunger, 3-way valve)

Starting oil is directed through a 3-way valve to the starting oil port and then under the pilot valve plunger. The yield plunger inside the pilot valve plunger lets the plunger move up. When the plunger moves up, supply oil flows to the top of the servo piston, pushing the servo piston down and opening the fuel or steam control.

Turn the 3-way valve to drain after starting, or oil will be trapped under the pilot valve plunger and cause the amplifier to stop operating.

If the oil supply comes from the prime mover and an auxiliary supply of low pressure oil must be used for starting (such as from a hand pump), a transfer valve is used. It is used to minimize the force acting on the bottom side of the servo piston.

Oil pressures in the range of 30–57 psi (207–393 kPa) normally cannot generate enough force on the top side of the piston to overcome the forces of starting oil pressure and spring compression on the bottom side of the piston. In the starting position, the transfer valve stops the flow of oil to the bottom side of the servo piston and at the same time opens the area to drain. When the prime mover starts, the normal supply pressure flows into the area under the head of the plunger and lifts the plunger against the opposing spring force. When the pressure of the normal oil supply reaches 45–65 psi (310–448 kPa), the plunger snaps to the open position, closing the drain port and opening the control port, which admits supply oil to the bottom side of the servo piston. The starting valve remains in the open position during normal operation. At shutdown, the spring returns the plunger to the closed position.

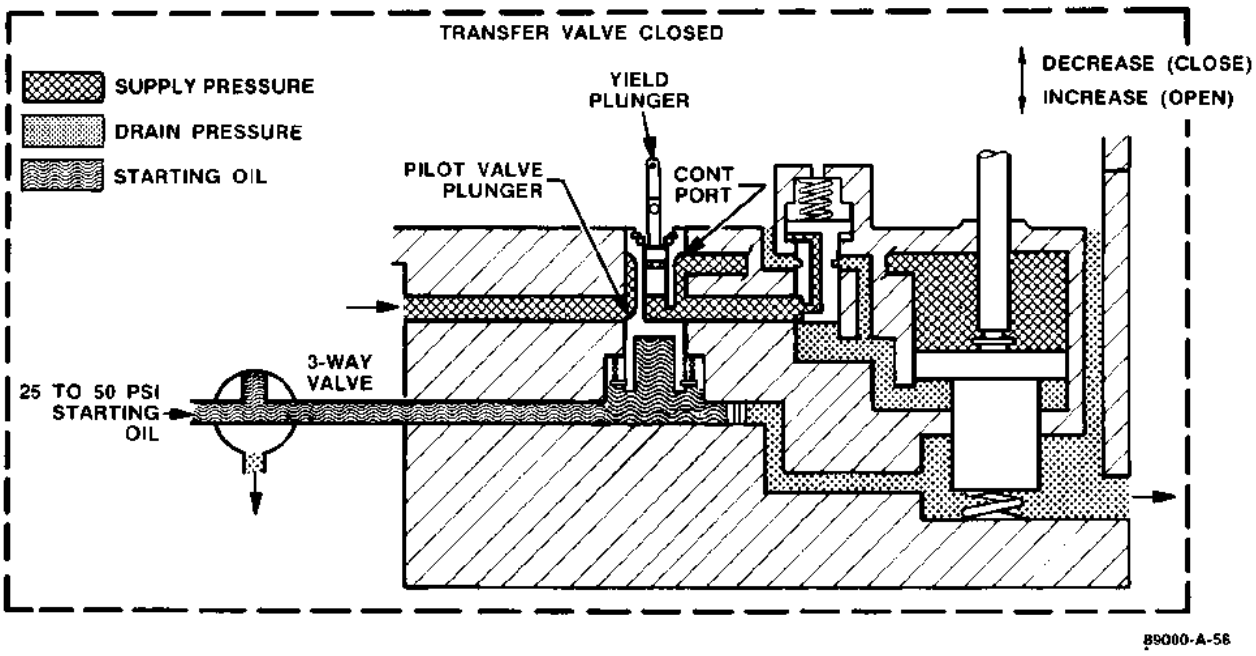


Figure 3-4. Schematic of Hydraulic Amplifier
(yield plunger, transfer valve in closed position)

Chapter 4. Troubleshooting

Introduction

Use Table 4-1 to find possible causes and corrections for problems which can occur. Some problems can be caused by a malfunction of other equipment used with the amplifier or by the oil supply.

When troubleshooting malfunctions of the hydraulic amplifier, check the performance of the:

- electronic control
- oil supply system
- prime mover power control mechanism

Amplifier problems such as erratic operation can be caused by dirty oil. To flush the unit with fuel oil or kerosene, run the amplifier through a cycle using the test circuit in Figure 4-1. After flushing, remove the base from the EG-3P and clean the orifice thoroughly. Replace the base, being sure that the base seal is in the correct position and the base is aligned properly. The oil motor must turn freely.

NOTICE **Oil seals and gaskets can be damaged if solvent is used to flush the amplifier.**

If there is a problem in the governing system, connect the test circuit shown in Figure 4-1 to the amplifier. This will locate the problem in the electric control unit or the hydraulic amplifier. Set the switch to NORMAL and operate the amplifier by changing the potentiometer setting. If the amplifier operation is within specifications, check the electronic control. See the correct manual for troubleshooting the electronic control.

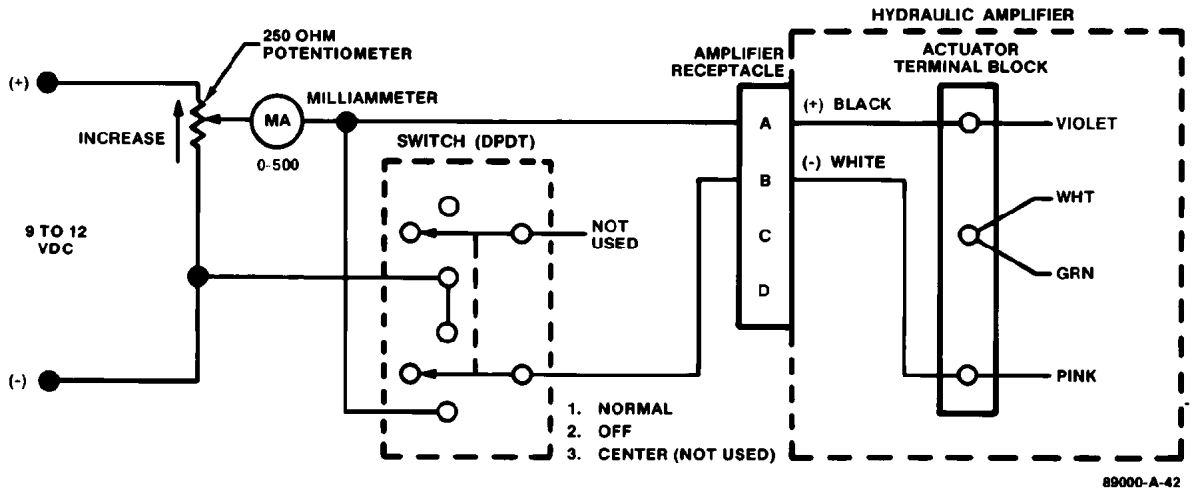


Figure 4-1. Test Circuit for the Hydraulic Amplifier

If the malfunction is in the EG-3P actuator or the hydraulic amplifier:

1. SHUT OFF the amplifier supply oil.
2. Remove cover from the amplifier.
3. Disconnect the actuator output arm from the adjustable link. See Figure 5-1a.

Do not change the setting of the adjustable link, or remove the lever from the actuator shaft.

The pilot valve plunger on some amplifiers is designed to go to maximum fuel on shutdown. Use a micarta rod (Figure 4-2) to hold the plunger down. If the plunger is loaded to minimum, it will stay open.

NOTICE

If the pilot valve plunger Is not held open, a large quantity of oil will be discharged from the P.V. bushing when the oil supply is turned on.

Connect the test circuit (Figure 4-3) to the EG-3P actuator and turn on the oil supply. Rotate the test circuit potentiometer to various positions while looking at the movement of the actuator output shaft. The output shaft must rotate smoothly from one position to another. It must take the same position for a specific potentiometer setting when rotated from the increase or decrease direction. If the actuator has a malfunction, see the section of the troubleshooting chart covering the EG-3P actuator, and find the description for that problem.

If the EG-3P actuator is operating correctly, see the troubleshooting section for the hydraulic amplifier.

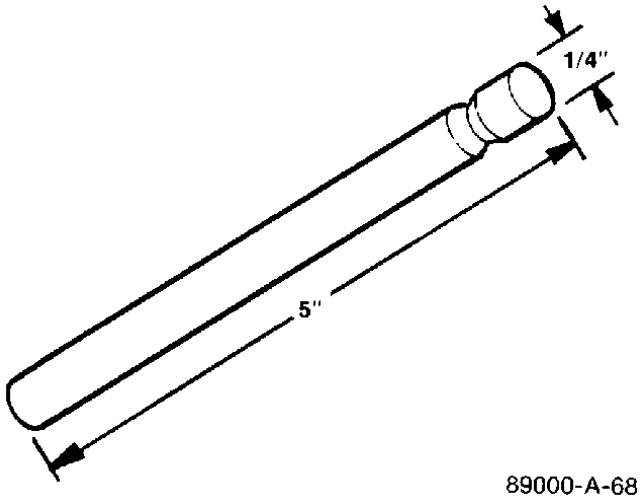


Figure 4-2. Micarta Block for Holding Pilot Valve Plunger Open

Extend to Increase Test

Amplifiers which extend to increase must have the polarity indicated in the test hookup in Figure 4-3 reversed.

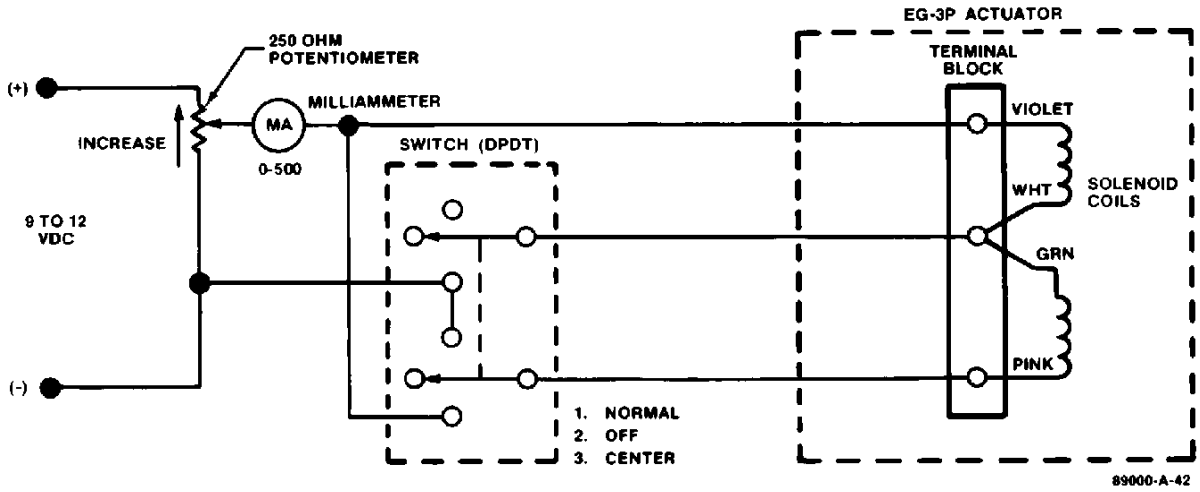


Figure 4-3. Test Hookup for Checkout and Adjustment of the EG-3P Actuator

Table 4-1. Troubleshooting Chart for EG-3P Actuator

Problem	Probable Cause	Correction
No actuator response to input signal at any level from 0 to 9 volts.	Low or no oil pressure to amplifier..	Check prime mover lubricating oil or outside oil supply system for proper operation.
	Dirt in oil supply. Loading or power piston sticking. Oil motor orifice stopped up causing pilot valve plunger to stick.	Flush amplifier with clean fuel oil or kerosene while cycling with test circuit. To clean a plugged oil motor orifice, the base of the EG-3P actuator must be removed.
	Open circuit or high resistance in solenoid coil.	Replace coil if open or resistance is not 28–35 Ω at 700 °F (371 °C).
	Actuator internal linkage damaged or disconnected.	Replace damaged parts or make connections as needed.
Bad response.	Low oil pressure or varying oil pressures.	Check prime mover lubricating oil or other oil supply system for correct operation.
Will not repeat.	Dirt in oil supply. Loading or power piston sticking. Oil motor orifice plugged up allowing pilot valve plunger to stick.	Flush amplifier with clean fuel oil or kerosene at 300 psi (2068 kPa) while cycling with test circuit. To clean a plugged oil motor orifice, the base of the EG-3P actuator must be removed.
	Linkage does not move freely.	Replace worn or damaged parts as needed.
	Intermittent open or high resistance in wiring or electrical connector.	Repair or replace bad wiring or electrical connector.
	Magnet spring broken or missing.	Replace spring.

Problem	Probable Cause	Correction
Output shaft fully clockwise—will not rotate in counterclockwise direction.	Centering spring weak or broken (part of coil cover assembly).	Replace coil cover assembly.
Output shaft fully counterclockwise —will not rotate in clockwise direction	Restoring spring weak or broken (part of coil cover assembly). Pilot valve plunger not centered.	Replace coil cover assembly. Center pilot valve plunger as instructed in Adjustments section.

Table 4-2. Troubleshooting Chart for Hydraulic Amplifier

Problem	Probable Cause	Correction
Fuel control or steam valve will not open.	Low oil supply pressure. Fuel control or steam valve does not move freely.	Check prime mover lubricating oil or other oil supply system for correct operation. Disconnect linkage and check operation of fuel control or steam valve. Check steam valve unbalance forces.
Lagging servo response.	Changing oil supply pressure or cavity in the oil. Fuel control or steam valve does not move freely. Pilot valve plunger does not move freely. Oil supply is dirty. Pilot valve plunger loading spring broken or missing.	Check prime mover lubricating oil or outside oil supply system for correct operation. Disconnect linkage and check operation of fuel control or steam valve. Check steam valve forces in both directions. Disassemble and clean amplifier. Drain, flush, and refill oil supply system. Replace filters. Replace loading spring.
Fuel control or steam valve will not close or closes too slowly.	Fuel control or steam valve does not move freely. Starting oil port not connected to drain or internal drain passages plugged. Starting valve plunger does not move freely in closed position. Bottom of servo piston open to drain. Weak or broken servo piston return spring—too much leakage past servo piston. Particle wedged between land on pilot valve plunger and sleeve causing sleeve to move down with plunger—servo piston may go to full increase with decreasing input signal.	Disconnect linkage and check operation of fuel control or steam valve. Make proper connections to drain. Disassemble amplifier and clean drain passages. Disassemble and clean amplifier. Check oil supply for dirt. Disassembly of the amplifier to replace the return spring or servo piston is not recommended in the field unless absolutely necessary. Cycle amplifier to full increase and attempt to remove particle by flushing. If condition continues, disassemble and clean amplifier. Replace plunger and/or sleeve if sharp edges have been damaged.

Problem	Probable Cause	Correction
Fuel control or steam valve will not open for starting (low-starting-oil pressure systems).	Fuel control or steam valve does not move freely. Starting valve plunger held in open position. Plunger spring broken or missing. Starting oil pressure too low.	Disconnect linkage and check operation and force needs of fuel control or steam valve. Disassemble and clean amplifier. Check oil supply for dirt. Replace plunger spring. Increase starting oil pressure to a minimum of 20 psi (138 kPa). Do not exceed 25 psi (172 kPa).
Servo piston will not hold position. The servo piston will move full stroke either direction with small change in input signal to the actuator.	Yield spring broken or missing. Piston rod ring not correctly fastened.	Replace yield spring and/or retaining rings as needed.

Chapter 5.
Replacement Parts

When ordering replacement parts, include the following information:

- Amplifier serial number and part number shown on nameplate.
- Manual number 89015.
- Parts reference number in parts list and description of part or part name.

Parts List for Figure 5-1a

Ref No.	Part Name	Quantity
89015-1	Wiper scraper seal	1
89015-2	Vee seal	1
89015-3	Seal plate	1
89015-4	Hex hd. cap screw, 0.250-20 x 2.000	4
89015-5	Helical spring lock washer, 0.250	7
89015-6	Ring gasket	1
89015-7	Hex hd. cap screw, 0.250-28 x 5.750	8
89015-8	Seal - .250 ID stato	8
89015-9	Hydraulic amplifier cover	1
89015-10	Side plate gasket	1
89015-11	Side plate	1
89015-12	Washer, 0.375 OD x 0.195 I.D. x 0.031	10
89015-13	Spring lock washer, #10	12
89015-14	Hex hd. cap screw 10-24 x 0.625	1
89015-15	Hex kaylock nut 0.250-28	1
89015-16	Washer	4
89015-17	Adjustable link slider	1
89015-18	Adjustable link spring	1
89015-19	Adjustable link	2
89015-20	Cotter pin, 0.062 x 0.500	2
89015-21	Lever	1
89015-22	Soc. hd. cap screw, 10-32 x 0.625	8
89015-23	Soc hd. cap screw, 0.250-28 x 0.750	3
89015-24	Block	1
89015-25	Soc. hd. cap screw, 10-32 x 0.750	3
89015-26	Shaft	1
89015-27	Nylok soc. hd. set screw, 0.375-24	1
89015-28	Cotter pin, 0.062 x 0.750	3
89015-29	Pin	1
89015-30	Elastic hex (thin) nut, 0.250-28	1
89015-31	NOT USED	
89015-32	Lever adjusting spring	1
89015-33	Lever	1
89015-34	Cylinder cover	1
89015-35	Springlock washer, 0.500 I.D.	8
89015-36	Hex hd. cap screw, 0.500-13 x 1.250	8
89015-37	S.S. external retaining ring, 1.272 free dia.	1
89015-38	Straight pin	2
89015-39	Piston rod ring	1
89015-40	S.S. external retaining ring (bowed), 1.272 dia	1
89015-41	O-ring, 4.984 I.D. x 0.139	1
89015-42	Servo piston	1
89015-43	Spring	1
89015-44	Hydraulic amplifier case	1
89015-45	Connector gasket	1
89015-46	Hydraulic amplifier electrical connector	1
89015-47	Splitlock washer, #6	4
89015-48	Screw, 6-32 x 0.312	4
89015-49	Case to cover gasket	1

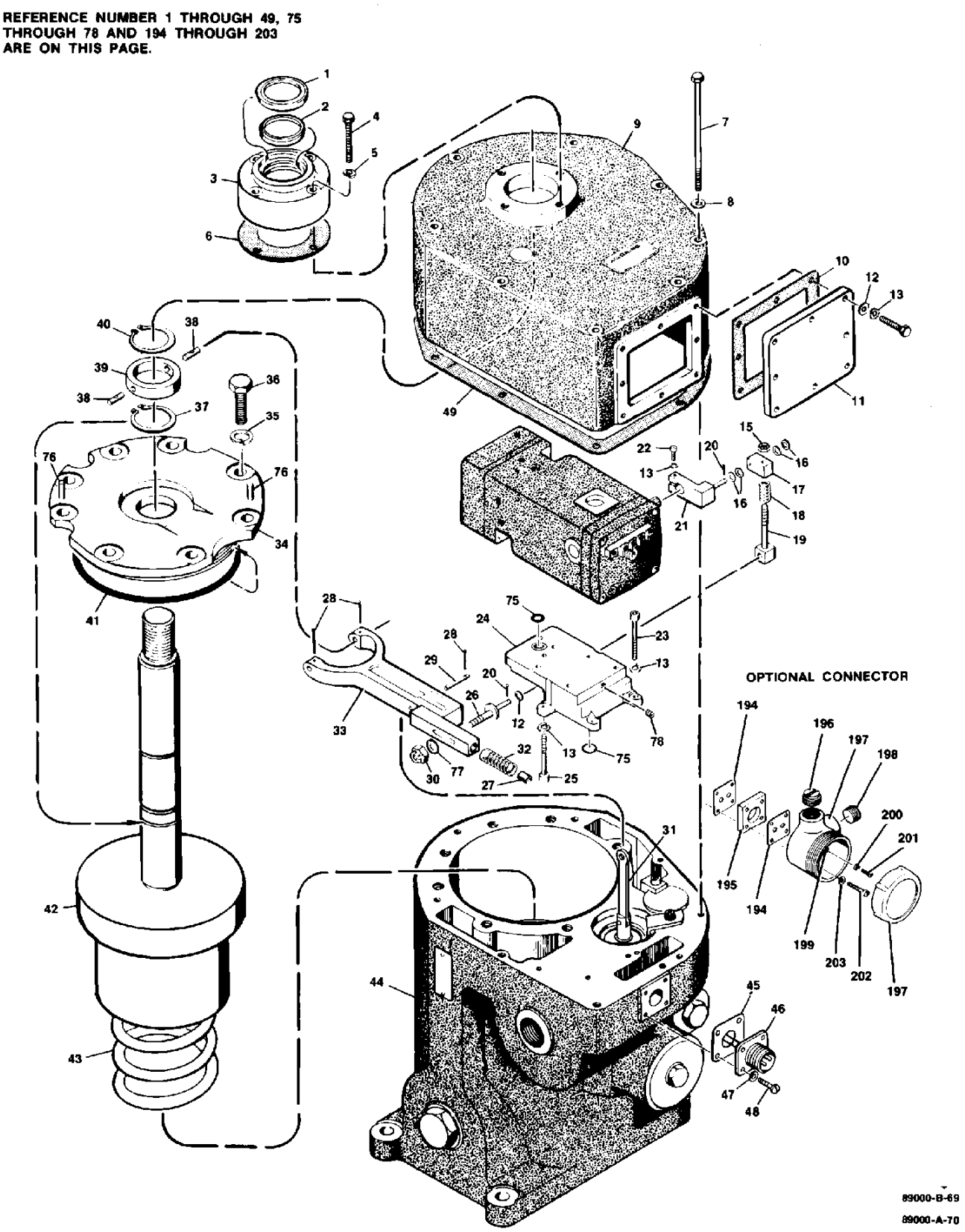


Figure 5-1a. Parts for Electrically Controlled Hydraulic Amplifier (sheet 1)

Parts List for Figure 5-1b

Ref No.	Part Name	Quantity
89015-50	Sealing cup	1
89015-51	Bleeder plug	2
89015-52	O-ring, 1.171 I.D. x 0.116	2
89015-53	Nameplate	1
89015-54	Drive screw	2
89015-55	Pilot valve sleeve	1
89015-56	P.V. loading spring	1
89015-57	NOT USED	
89015-58	P.V. plunger assembly	1
89015-59	External retaining ring	1
89015-60	P.V. sleeve spring	1
89015-61	Plug	1
89015-62	Soc. hd. cap screw, 0.250-28 x 0.750	1
89015-63	Splitlock washer, 0.250	1
89015-64	Sensing valve clamp	1
89015-65	Sensing valve plug	1
89015-66	O-ring, 1.049 I.D. x .103	1
89015-67	Soc. hd. cap screw 5/16-18 x 1	1
89015-68	Spring lock washer, 0.312 I.D.	1
89015-69	Pilot valve stop block	1
89015-70	Soc. hd. pipe plug, .250	1
89015-71	O-ring .924 I.D. x 0.103	1
89015-72	Plug 1.062-12	1
89015-73	O-ring, 0.468 I.D. x 0.078	2
89015-74	Plug	2
89015-75	O-ring, 0.489 I.D. x 0.070	2
89015-76	Dowel pin	2
89015-77	Washer, 0.500 0.D. x 0.261 I.D. x 0.032	1
89015-78	Plug	1
89015-79	Sleeve (optional)	1
89015-80	Transfer valve	1
89015-81	Teflon tubing, #6 AWG	1 ft (30 cm)
89015-82	PV Sleeve spring	1
89015-83	Pipe plug	1
89015-84	External retaining ring	1
89015-85	Pilot valve plunger	1
89015-86	O-ring .426 ID	1
89015-87	Plunger	1
89015-88	Pin	1
89015-89	Retainer	1
89015-90	Retaining ring	1
89015-91	Spring	1
89015-92	Pilot valve sleeve	1
89015-93	Link	1
89015-94	O-ring - 1.614 ID x .070	1
89015-95	Bottom drain plug through 100	1

89015-96 through 100 NOT USED

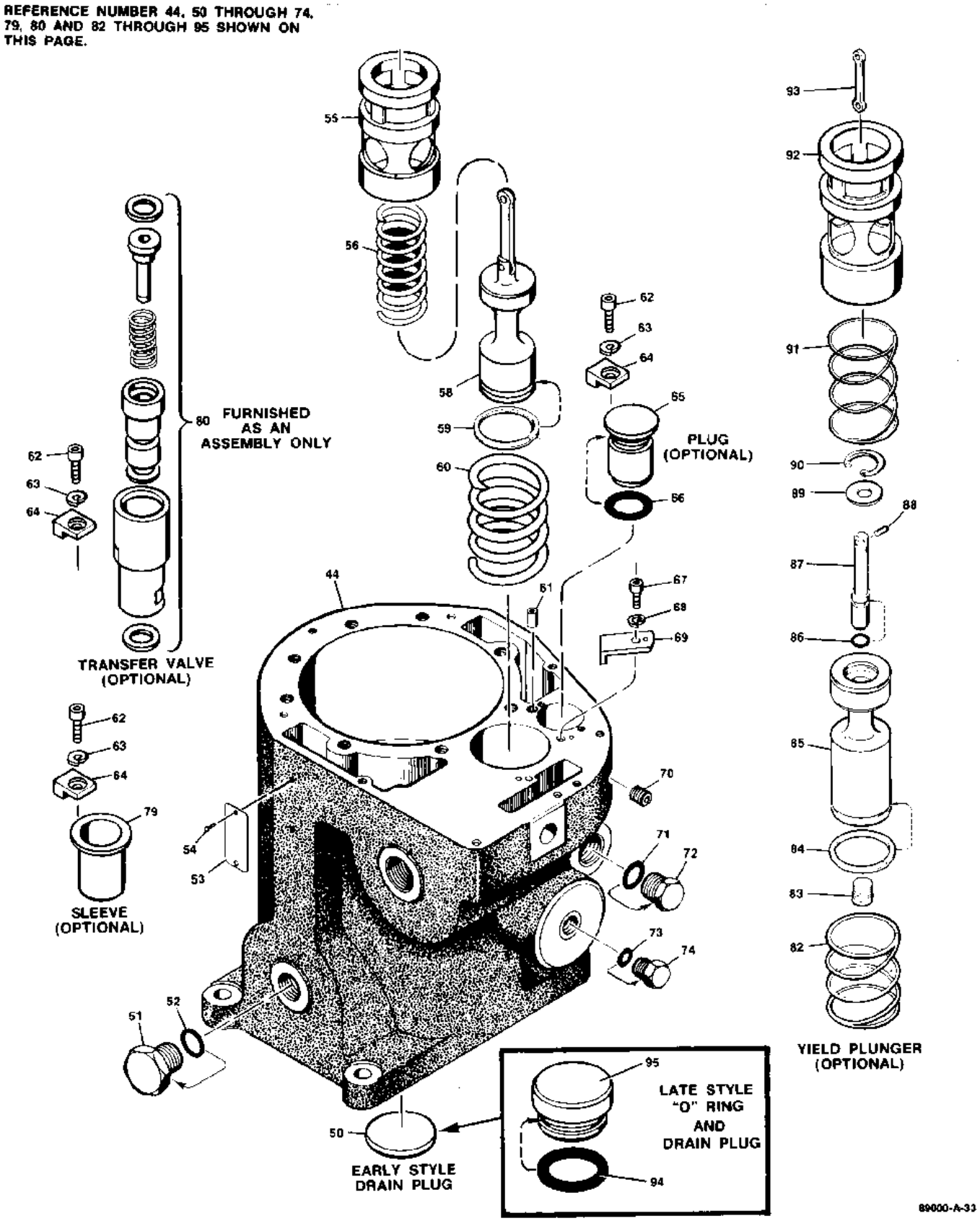


Figure 5-1b. Parts for Electrically Controlled Hydraulic Amplifier (sheet 2)

Parts List for Figure 5-2

Ref No.	Part Name	Quantity
89015-101	Phillips screw 5-40 x .438	2
89015-102	Spring lockwasher, #5 x .125 D.D.	2
89015-103	Insulated lug terminal, #6	4
89015-104	Teflon tubing, #6 AWG	1 ft (30 cm)
89015-105	3 pole terminal, #6	4
89015-106	Hex hd. cap screw, 0.250-28 x 0.375	1
89015-107	Washer, 0.266 x 0.500	1
89015-108	Cover	1
89015-109	Drilled screw, 10-24 x 1.250	4
89015-110	Internal shake proof washer, #10	4
89015-111	Washer, 0.375 O.D. x 0.195 E.D.	4
89015-112	Slotted hd. set screw	2
89015-113	Cover gasket	2
89015-114	Dowel pin	2
89015-115	Sub cap	1
89015-116	Needle bearing	2
89015-117	Case	1
89015-118	Drive Screw, #2 x 0.125	2
89015-119	Nameplate	4
89015-120	Plug, 0.062-27	4
89015-121	Plug, 0.125-27	4
89015-122	Pilot valve bushing	1
89015-123	O-ring, 2.614 I.D. x 0.070	1
89015-124	Power piston	2
89015-125	Gear stud	2
89015-126	Gear assembly	2
89015-127	O-ring, 0.239 I.D. x 0.070	2
89015-128	Directional flow plug	1
89015-129	Orifice plug, 0.047 dia	1
89015-130	Tapered dowel pin, #2 x 1.250	2
89015-131	Soc. hd. cap screw, 10-24 x 1.000	2
89015-132	Spring lockwasher, #10 x 0.190 I.D.	1
89015-133	Oil motor base	1
89015-134	O-ring, 0.676 ID. 0.070	1
89015-135	Servo loading piston stop	1
89015-136	Pilot valve plunger	1
89015-137	Compensation bushing	1
89015-138	Internal retaining ring, 0.498 dia	1
89015-139	Magnet spring	1
89015-140	Transducer assembly	1
89015-141	Washer, 0.223 ID.	1
89015-142	Magnet	1
89015-143	Centering spring assembly	1
89015-144	Washer	1
89015-145	Soc. hd. nylok screw, 6-32 x 0.375	1
89015-146	Adjustable spring set	1
89015-147	Cotter pin, 0.062 x 0.500 long	3
89015-148	Clamp brackets	1
89015-149	Straight drilled pin	1
89015-150	Drilled screw, 10-24 x 2.000	2
89015-151	Washer, 0.296 0.0	2
89015-152	Restoring spring link	1
89015-153	Restoring spring lever	1
89015-154	Drilled headed pin	1
89015-155	Push rod assembly	2
89015-156	Feedback link	1
89015-157	Feedback link pin	1
89015-158	Output Shaft	1
89015-159	Long lever	1
89015-160	Straight drilled pin	1
89015-161	Roll pin, 0.062 dia. x 0.438 S.S.	2

Ref No.	Part Name	Quantity
89015-162	Retainer ring	2
89015-163	Short lever	1
89015-164	Feedback lever	1
89015-165	Washer, 0.174 x 0.375 x 0.032 thick	2
89015-166	Spring lockwasher, #8 - 164 I.D.	2
89015-167	Slotted screw, 8-32 x 0.438	2
89015-168	Feedback adjustment bracket	1
89015-169	Roll pin, 0.062 dia. x 0.312 S.S.	1
89015-170	O-ring 0.301 I.D. x 0.070	1
89015-171	Plug	1
89015-172	Socket hd. pipe plug, 0.500	1
89015-173	Screw 8-32 x 0.4375	2
89015-174	Lockwasher	2
89015-175	Washer .174 ID	2
89015-176	Feedback lever assembly	1
89015-177	Roll pin	2
89015-178	Roll pin .062 dia. x 0.438	2
89015-179	Lever short	1
89015-180	Rod assembly	2
89015-181	Feedback link	1
89015-182	Feedback link pin	1
89015-183	Output shaft	1
89015-184	Lever long	1
89015-185	Pin drilled	1
89015-186	Roll pin 0.062 dia. x 0.312	1
89015-187	Feedback bracket assembly	1
89015-188	Cotter pin 0.0625 dia. x .500	1
89015-189	Needle bearing	1
89015-190	Retaining ring – external	1
89015-191	Centering spring assembly	1
89015-192	Retainer	1
89015-193	Transducer assembly	1
89015-194	Gasket	2
89015-195	Spacer	1
89015-196	Plug - .500-14	1
89015-197	Adapter	1
89015-198	Plug .500-14	1
89015-199	Terminal	2
89015-200	Terminal cup Washer	2
89015-201	Screw 6-32 x .250	2
89015-202	Screw 10-32 x .875	4
89015-203	Washer	4

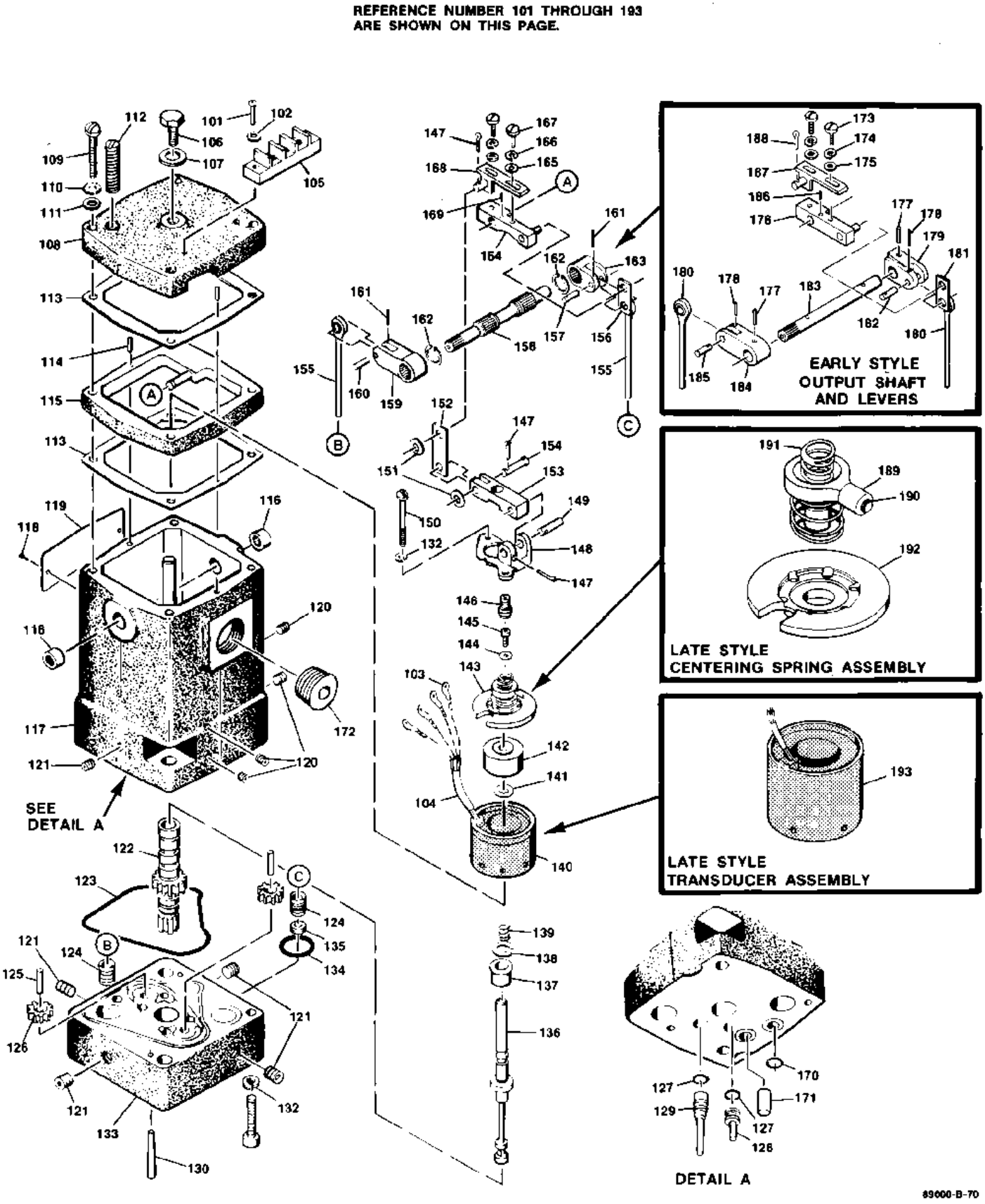


Figure 5-2. Parts for EG-3P Actuator

Chapter 6.
Service Options

Product Service Options

⚠WARNING	**Explosion Hazard—The external ground lugs shown on the installation drawing must be properly connected to ensure equipotential bonding. This will reduce the risk of electrostatic discharge in an explosive atmosphere.**

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and 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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- 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 is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

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.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard 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. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

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 and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). 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 authorization 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 offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- 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. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our 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 many of our worldwide locations or 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 us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
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

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

Turbine 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

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
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	

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 G—

- Added electrostatic discharge warnings (pages v, 6, 25)

Changes in Revision F—

- Increased amplifier piston rod adjustment range (page 7)

Declarations

DECLARATION OF CONFORMITY

Manufacturer's Name:	WOODWARD GOVERNOR COMPANY (WGC) Industrial Controls Group
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	5.25 inch Hydraulic Amplifiers / 9907-580 and similar
Conformance to Directive(s):	94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
Marking(s):	Category 2, Group II G, Ex e II T6
Applicable Standards:	EN 60079-0: 2004 Electrical Apparatus for Explosive Gas Atmospheres Part 0 : General Requirements EN 60079-7: 2003 Electrical Apparatus for Explosive Gas Atmospheres Part 7 : Increased Safety "E"
Third Party Certification Information	LCIE 06 ATEX 6109 X LCIE - Siège Social : 33, Avenue du Général Leclerc F92260 Fontenay-aux-Roses, France
Conformity Assessment:	ATEX Production Quality Assessment, ITS05ATEXQ4211
Notified Body For ATEX:	Intertek (0359) Intertek House, Cleeve Road Leatherhead, Surrey, KT22 7SB UK

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Joseph Driscoll

Full Name

Engineering Manager

Position

WGC, Fort Collins, CO, USA

Place

8/30/07

Date

5-09-1183 Rev 13, 1-May-07

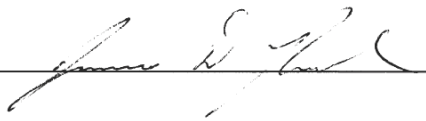
00126-04-EU-02-03.doc

DECLARATION OF CONFORMITY
According to EN 45014

Manufacturer's Name:	WOODWARD GOVERNOR COMPANY (WGC) Industrial Controls Group
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	5.25 inch Hydraulic Amplifiers / 9907-414 and similar 7.25 inch Hydraulic Amplifiers/ 9907-410 and similar
Conformance to Directive(s):	94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
Applicable Standards:	EN50021, 1999: Electrical apparatus for potentially explosive atmospheres - Type of protection 'n' EN60529, 1991: Degrees of protection provided by enclosures (IP code)

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

James D. Rudolph

Full Name

Engineering Manager

Position

WGC, Fort Collins, CO, USA

Place

5/5/04

Date

5-09-1183 Rev 8, 2-May-2003 00126-04-EU-02-01

Declaration of Incorporation

Woodward Governor Company
1000 E. Drake Road
Fort Collins, Colorado 80525
United States of America

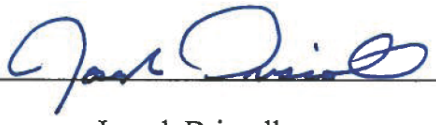
Product: 5.25" and 7.25" Hydraulic Amplifiers
Part Numbers: 9907-410, 9907-414, 9907-580, and similar

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 the following EU Directives as they apply to a component:

98/37/EC (Machinery)

This product is intended to be put into service only upon incorporation into an apparatus/system that itself will meet the requirements of the above Directives and bears the CE mark.

MANUFACTURER



Signature

Joseph Driscoll
Full Name

Engineering Manager
Position

WGC, Fort Collins, CO, USA
Place

8/30/07
Date

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Please reference publication 89015G.

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