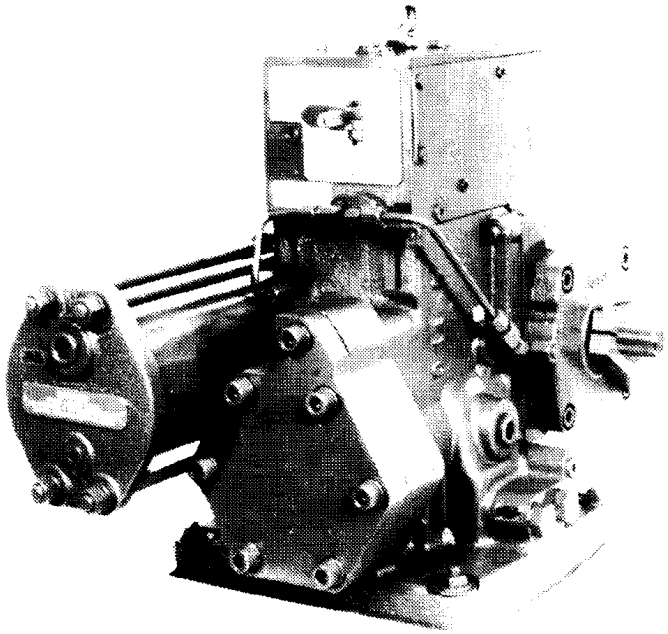
WOODWARD

# Product Manual 82328
# (Revision A)
**Original Instructions**



# PGTM-200 Actuator

## 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:**

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**Proper Use**

**Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.**

**Translated Publications**

**If the cover of this publication states "Translation of the Original Instructions" please note:**

**The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

# 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

## Description

The PGTM-200 Actuator is a hydraulic actuator suitable for control of fuel racks on diesel engines and fuel or steam valves on turbines. The actuator provides control activities by converting an electric signal into rotary mechanical motion.

The PGTM actuator is designed to operate in conjunction with a Woodward proportional electronic governing systems (2301, 43027 and 2500). The actuator provides 200 ft-lb (271 J) of work.

The output shaft of the actuator takes a position which is proportional to an electric control signal of 20 to 160 milliamps of dc current.

The manual fuel positioner may be used to position the fuel rack or fuel valve should the electric control signal be interrupted. The manual feature provides no speed control of the engine or turbine. It provides only a hydraulic assisted means of positioning the output shaft.

**⚠WARNING**

**The manual positioner shaft will set the position of the terminal shaft only when actuator oil pressure is available. The manual positioner shaft does not set a speed reference for the prime mover.**

## Accessories

Optional accessories for use with the PGTM actuator include a remote heat exchanger and a booster servomotor.

### Remote Heat Exchanger

The heat exchanger may be used to lower actuator oil temperature when the actuator operates in high ambient temperatures. It should be used whenever the actuator will go above 200 °F (93 °C) maximum operating temperature. A heat exchanger can be added without change or conversion of the actuator (see manual 36641, *Governor Oil Heat Exchanger, Remote and Integral Types*).

### Booster Servomotor

The booster servomotor may be used with the actuator to help the prime mover start quickly by moving the actuator output toward the maximum fuel position at startup (see manual 36684, *Booster Servomotor*).

## References

The product literature listed contains additional information for parts associated with the PGTM Actuator.

| | |
|---|---|
| Manual 25071 | Oils for Hydraulic Controls |
| Manual 36618 | PG-200/300 Case, Accumulator, & Power Cylinder |

# Chapter 2.
# Installation

## Introduction

See the outline drawing (Figure 2-2) for dimensions and connection details of the PGTM.

**⚠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.**

Be careful when handling and installing the actuator. Do not hit the drive shaft or output shaft. Rough handling can cause damage to seals, parts, and adjustments. Keep protective covers on electrical connections to avoid damage to threads and sockets during installation of the actuator on the mounting pad or during storage.

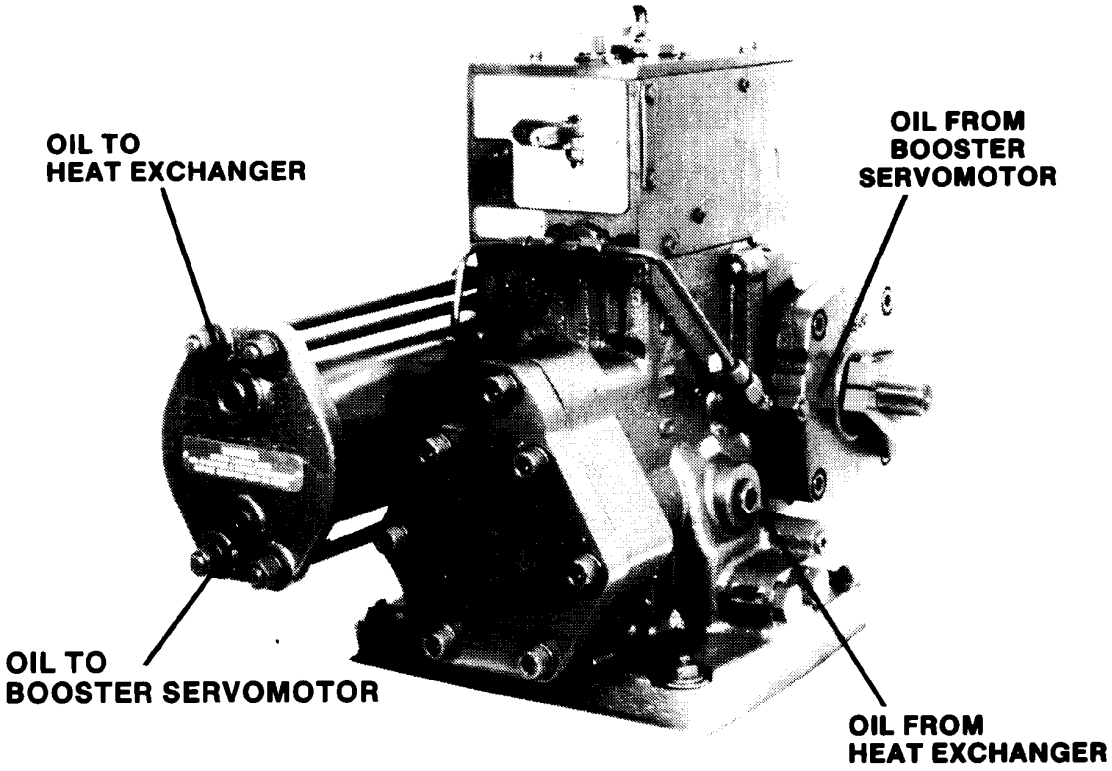


Figure 2-1. PGTM-200 as Shipped from the Factory

## Receiving

The PGTM actuator is shipped from the factory in a vertical position, bolted to a wood platform. The actuator has been calibrated at the factory to exact specifications, then drained of oil. A light film of oil covers the internal parts to help prevent rust. Calibration or internal cleaning is not needed before installation and operation. The drive shaft and output shafts are covered with a light film of oil. A soft seal preservative, if used, is removed before installation with a cloth and mineral spirits.

## Storage

If the PGTM actuator is to be in storage for a period of time, see Woodward manual 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*.

## Installation Requirement

See Figure 2-2 for:

- Overall dimensions
- Location of installation holes
- Manual fuel position shaft
- Output and drive shaft locations and dimensions
- Adjustment locations

Enough clearance must be given for installation, removal, and servicing of the actuator. The actuator case drain should be easily accessible. Be sure there is adequate space above the unit to allow access to the combined oil-level dipstick and oil-fill cap.

## Installation

Install the PGTM on the engine accessory-drive pad. A gasket may be used between the governor and the installation pad to absorb possible imperfections in the mounting surfaces and to provide insulation from engine temperature. If a gasket is too thick, it can cause unnecessary wear to the actuator. A gasket is not necessary.

The drive shaft must slip into the accessory drive or mating coupling without force. Be careful not to push the drive shaft into the actuator, improper alignment or too tight a fit between any of the parts can result in wear or seizure.

The actuator must be located in a nearly vertical attitude in reference to the base.

**NOTICE**

**Damage to the drive shaft, drive-shaft seal, or other parts of the actuator may occur if the actuator is dropped or set on the drive shaft.**

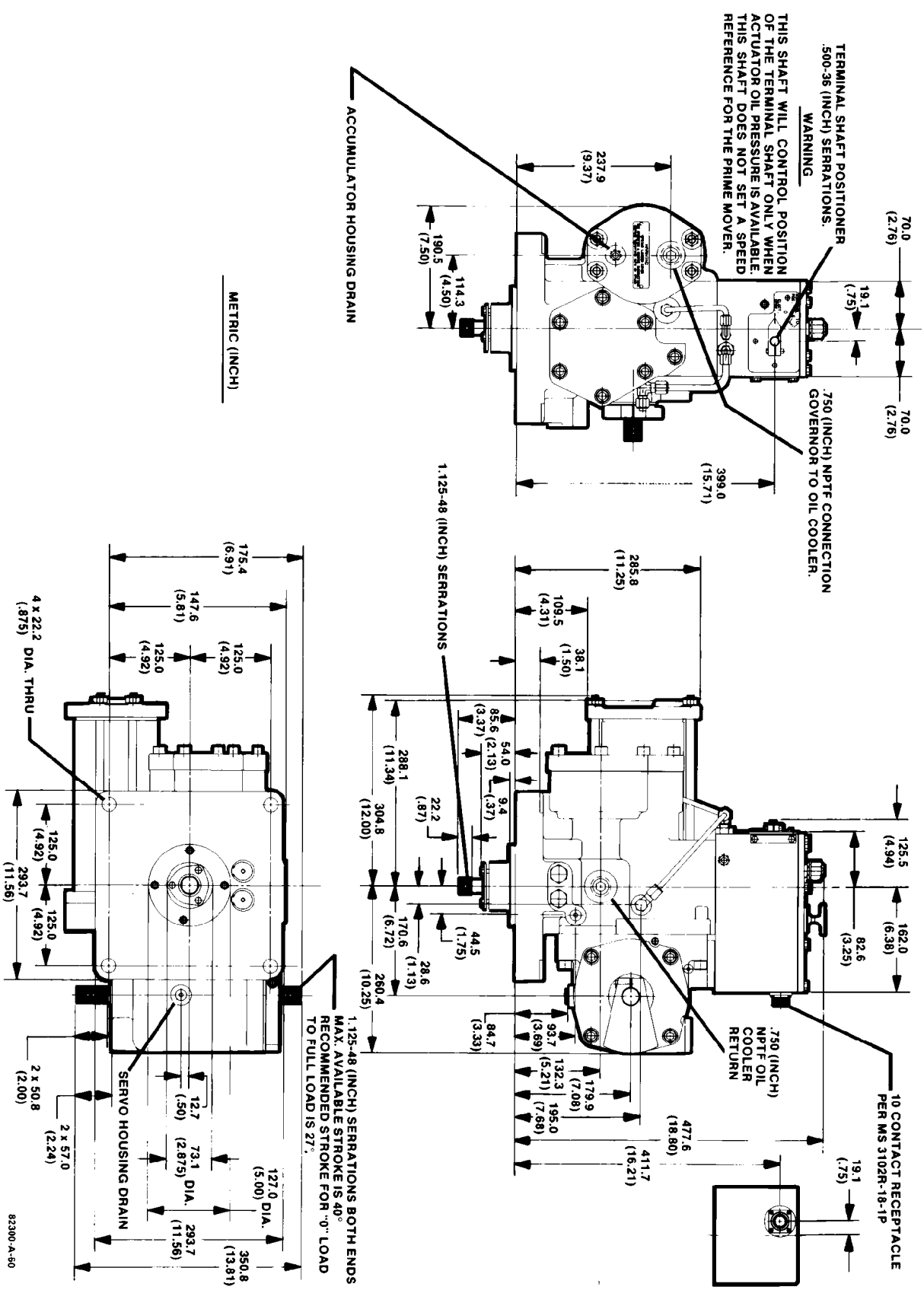


Figure 2-2. PGTM-200 Outline Drawing

## Drive Requirements

The PGTM actuator requires a drive with a minimum rotation of 250 rpm. 1000 rpm rotation is recommended. Drives in excess of 1200 rpm can cause unacceptable heating of the hydraulic oils and possible wear of precise actuator parts.

The drive may be in either clockwise or counterclockwise direction.

## Fuel-System Linkage

Align and install the linkage between the fuel system and the actuator correctly and carefully. The linkage must move freely and not have excessive backlash. Use about 2/3 of the 42 degrees of actuator output travel between idle and full fuel (28 degrees). Permit enough overtravel so the governor can cause complete shutdown and still give full fuel at full load. The actuator output travel between shutdown position and idle speed should never be less than five degrees.

The linkage between the actuator and the engine should be nearly linear (movement of the lever on the actuator output shaft will produce the same amount of movement of the fuel rack or valve.) The linkage may be spring loaded but must not distort during maximum transients.

The indicator on the output shaft may be located on either side of the actuator.

## Oil Supply

The actuator will need about 8 L (8.5 qt) of oil to operate. Initially put about 5.5 L (5.8 qt) of new, clean oil in the actuator. Then add the amount necessary to bring the oil into the proper location on the dipstick after the actuator is running (about 2.5 L/2.6 qt).

**IMPORTANT**

**The working elements in the PGTM column run submerged in oil. The volume of oil in the 200 ft-lb power unit will cause a considerable difference in the level of oil between cold start-up and running at operating temperature. Check the oil level at operating temperature and with the engine running in a steady state condition. Add as necessary to meet the dipstick level.**

## Oil Condition

Extreme caution is necessary when filling the PGTM actuator with oil so dirt and/or contamination is not added to the actuator. Because of the torque-motor, pressure-regulating system within the actuator, a completely clean oil supply is necessary. Use clean containers, new clean oil, and extra care when filling the actuator with oil.

# Oils For Hydraulic Controls

This information is provided as a guide in the selection of lubricating hydraulic oil for actuator use. Oil selection is based on viscosity change over the temperature range of the actuator. The information also provides an aid in recognizing and correcting common problems associated with oil used in governors and actuators. It is not intended to suggest the selection of lubrication oil for the engine, turbine, or other type of prime mover being controlled.

Governor oil lubricates and provides hydraulic power. The oil must have a viscosity index that allows it to perform over the operating temperature range, and it must have the proper blending of additives to cause it to remain stable and predictable over this range. Actuator fluid must be compatible with seal materials, (nitrile, polyacrylic, and fluorocarbon). Many automotive and gas-engine oils, industrial-lubricating oils, and other oils of mineral or synthetic origin meet these requirements. Woodward actuators are designed to give stable control with most oils, if the fluid viscosity at the operating temperature span is within a 50 to 3000 SUS (Saybolt Universal Seconds) range. At the normal operating temperature, viscosity should be between 100 and 300 SUS. Poor actuator response or instability may be an indication that the oil is outside of this range.

Excessive component wear or seizure in an actuator indicates the possibility of:

- Insufficient lubrication caused by:
  - An oil that flows slowly, either when it is cold or during start up
  - No oil in the actuator or actuator oil level too low
- Contaminated oil caused by:
  - Dirty oil containers
  - An actuator exposed to heating and cooling cycles, creating condensation of water in the oil
- Oil not suitable for the operating conditions, or
- An improper oil level which creates foamy, aerated oil.

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

## Oil Replacement

Replace the governor oil if it is contaminated, or if it is suspected of contributing to actuator instability. Drain the oil while hot and agitated, flush the governor with a clean solvent having some lubricity (number 1 diesel oil or kerosene) before refilling with new oil. If drain time is insufficient for the solvent to completely drain or evaporate, flush the actuator with the same oil it is to be refilled with to avoid dilution and possible contamination of the new oil. To avoid contamination replacement oil must be free of dirt, water and other foreign material. USE CLEAN CONTAINERS TO STORE AND TRANSFER OIL.

Oil that has been carefully selected to match the operating conditions and is compatible with actuator components should give long service between oil changes. Under ideal conditions (minimum exposure to dust and water and within the temperature limits of the oil) changes may be extended. A regularly scheduled oil analysis is helpful in determining the frequency of oil changes.

Any persistent or recurring oil problems should be referred to a qualified oil specialist for solution.

The recommended continuous operating temperature of the oil is 140 to 200 °F (60 to 93 °C). Measure the temperature of the actuator on the outside lower part of the case. The actual oil temperature will be warmer by about 10 degrees F (6 degrees C).

## Recommended Oils

Specific oil viscosity recommendations are given in the chart, Figure 2-3. Select a readily available, good brand of oil, either mineral or synthetic, and continue using it. Do not mix different classes of oils. Oil that meets the API (American Petroleum Institute) engine service classification or either group S or C, starting with SA and CA through SF and CD is suitable for actuator use. Oils meeting performance requirement of the following specifications are also suitable for use in the actuator: MIL-L-2104A, MIL-L-2104B, MIL-L-2104C, MIL-L-46152, MIL-L-41652A, MIL-L-46152B, and MIL-L-45199B.

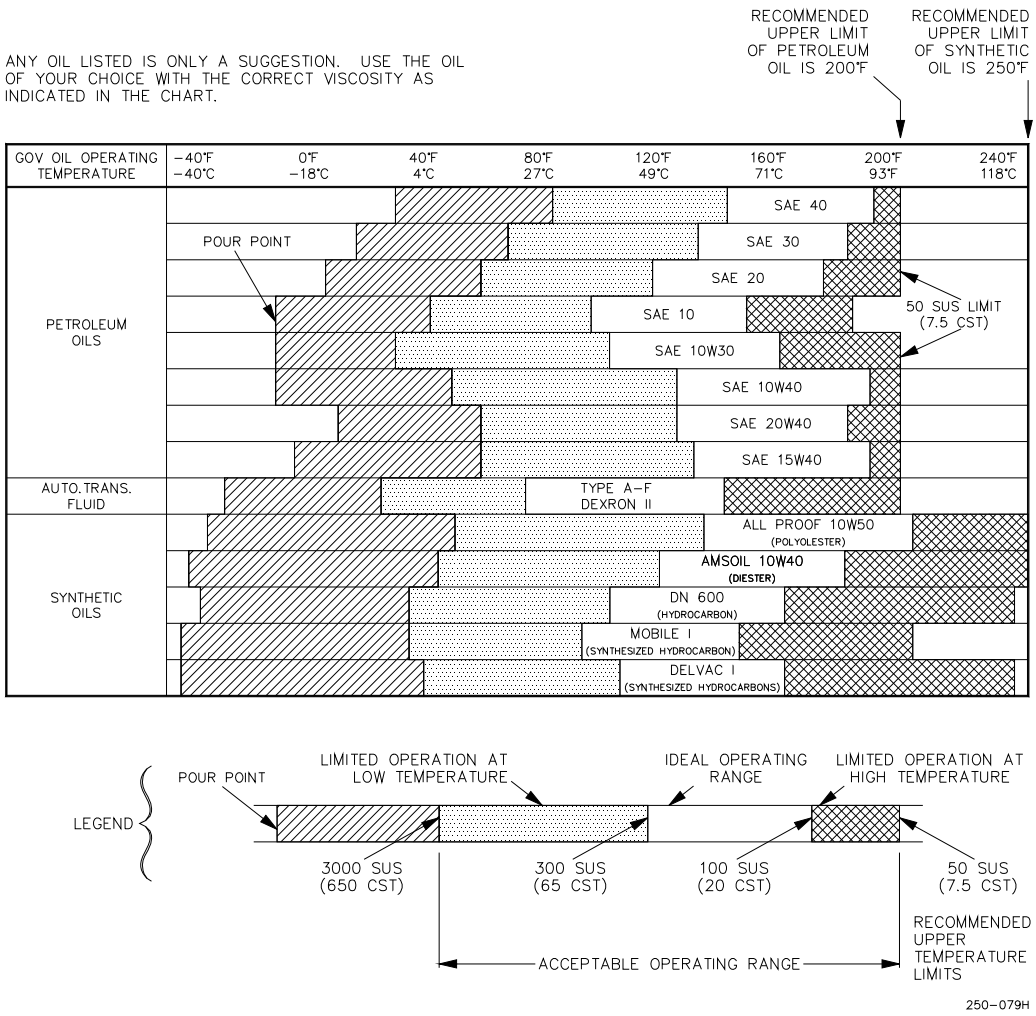


Figure 2-3. Viscosity and Operating Temperature of Oils

| VISCOSITY COMPARISONS | | | | |
|---|---|---|---|---|
| CENTISTOKES (CST, CS, OR CTS) | SAYBOLT UNIVERSAL SECONDS (SUS) NOMINAL AT 100 DEGREES F | SAE MOTOR (APPROXIMATE) | SAE GEAR (APPROXIMATE) | ISO |
| 15 | 80 | 5W | | 15 |
| 22 | 106 | 5W | | 22 |
| 32 | 151 | 10W | 75 | 32 |
| 46 | 214 | 10 | 75 | 46 |
| 68 | 310 | 20 | 80 | 68 |
| 100 | 463 | 30 | 80 | 100 |
| 150 | 696 | 40 | 85 | 150 |
| 220 | 1020 | 50 | 90 | 220 |
| 320 | 1483 | 60 | 115 | 320 |
| 460 | 2133 | 70 | 140 | 460 |

250−087
97−11−04 skw

Figure 2-4. Equivalent Viscosities for Lubricating Oils

# Chapter 3.
# Operation and Adjustment

## Initial Operation

**⚠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.**

When a new actuator is placed in service, it can present unstable operation until all air is bled from the hydraulic system. Originally, the oil will appear milky and may have numerous small air bubbles. There are no special bleed valves in the system, and the air must be worked out during operation. All air should be out of a new actuator within 5 minutes of start-up.

**IMPORTANT**

**The actuator is adjusted to exact specifications prior to shipment from the factory. Do not attempt the following adjustments until all other sources of possible control problems have been checked. The adjustments should not change unless effected by a change in linkage, failure within the actuator, or replacement of parts in the actuator.**

## Adjustments

There are three adjustments available to the operator of the PGTM actuator: Range Adjustment, Level Adjustment, and Manual Fuel Control position adjustment.

All of the adjustments are reached by removing the actuator cover.

### Range Adjustment

(see Figure 3-1)

The range adjustment is made by pivoting the adjustable arm which rests on the feedback-spring seat. The adjustment changes the effective length of the feedback lever. Rotating the adjustable arm spring-seat point toward the torque motor (lengthening the feedback lever) will decrease the amount of output shaft movement for a given electric signal. Moving the adjustable arm spring-seat point away from the torque motor (shortening the feedback lever) will increase the amount of output shaft movement for a given electric signal. The adjustment changes the amount of terminal shaft movement in response to a given change in the electrical control signal.

### Level Adjustment

(see Figure 3-2)

The level adjustment consists of a 0.250-28 socket-head set screw located in the center of the cam-lever assembly. Turning the screw into the lever increases the spring tension on top of the pilot valve, causing the terminal shaft to go to increase fuel. Backing out the screw moves the terminal shaft toward minimum fuel at a given electrical-control signal.

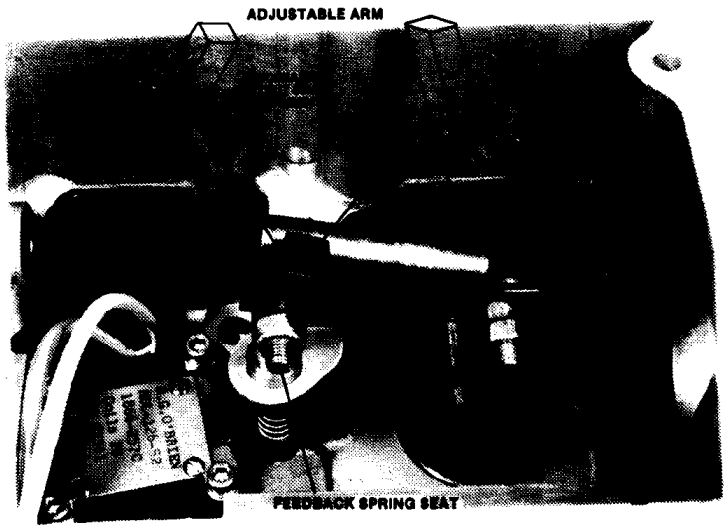


Figure 3-1. Range Adjustment Location

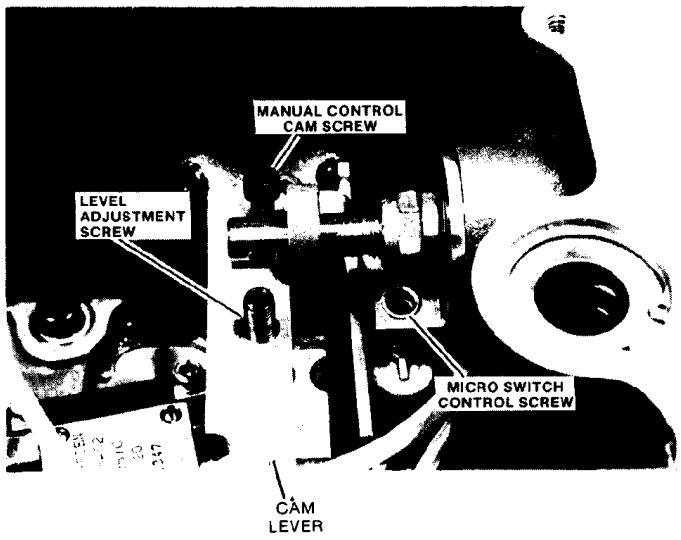


Figure 3-2. Level and Manual Fuel Location Adjustments

## Manual Fuel Control

(see Figure 3-2)

The manual fuel control position has three possible adjustments for the operator of the PGTM.

**⚠WARNING**

**The manual fuel lever removes the engine or turbine from governor control and physically sets the fuel rack or fuel valve in a positive position. Should the load change, a dangerous overspeed condition could occur, threatening property and life. DO NOT USE THE MANUAL CONTROL IF THE OVERSPEED TRIP IS NOT WORKING.**

**To Adjust The Manual Fuel Control:**

1. Remove the cover from the top of the column.

2. Move the manual speed-setting shaft clockwise until the screw just touches the cam-lever assembly.

3. Set the indicator on the front of the governor to the “0” position.

4. Rotate the manual shaft until the pointer is at 10. The servo should increase to 40. if not, adjust the socket-head-cap screw (see Figure 3-2, manual-fuel control cam screw). The pointer may have to be reset at 0 after readjusting the cap screw.

5. Set the maximum-stop screw at the 10 location and the minimum-stop screw at “Electrical Operation”.

6. The microswitch should operate midway between 0 and “Electrical Operation”. If not, readjust the microswitch screw (see Figure 3-2).

**⚠WARNING**

**DO NOT OPERATE UNDER MANUAL FUEL CONTROL UNLESS:**

1. **The overspeed protection has been checked and is working properly. The overspeed protection must not use the actuator to cause shutdown.**
2. **The unit being fueled by the actuator has a positive, non-shifting load which allows for an ungoverned operation.**

**THE MANUAL FUEL SETTING POSITION PERMITS OVERSPEED. USE ONLY WITH EXTREME CAUTION.**

Another level adjustment is included in the actuator, but should NEVER require field adjustment unless the pilot-valve assembly is removed from the power unit. The adjustment consists of a set screw which pushes down on the top of the pilot-valve bushing. The bushing is located on a spring washer, and tightening this set screw will lower the bushing. This adjustment is factory set and should not have to be moved during normal maintenance.

# Chapter 4.
# Principles of Operation

## Introduction

The schematic drawing (Figure 4-1) shows the working relationship of the various parts.

## Actuator Section

The PGTM actuator has been designed for basic control of the fuel settings as ordered by a signal from an electric governor. The actuator takes the electrical signal and, through the torque motor located in the column, changes this signal to a rotary-mechanical position of the terminal shaft. An increased electrical signal causes the torque motor to lower one end of a lever toward the nozzle, reducing the flow of oil from the nozzle.

The reduction of flow increases the oil pressure above the pilot-valve plunger, causing the plunger to move down in the pilot-valve bushing, directing pressure oil toward the lower side of the relay-servo piston. This increased flow of pressure oil will cause the relay-servo piston to rise (toward increase fuel),. raising the connecting link and allowing the feedback lever to pivot. The feedback lever increases the feedback spring tension on the torque-motor lever, causing the lever to return to a central position against the increased electrical signal. The flow of oil through the nozzle is thus restored, allowing the pressure above the pilot-valve plunger to decrease and cause the loading spring to return the plunger to a central position.

A decrease in electrical signal to the torque motor will cause the opposite effect, allowing more oil to come from the nozzle. The loading spring will cause the pilot-valve plunger to rise, venting oil from under the relay-servo piston, allowing pressure oil above the cylinder to drive the piston down (toward decrease fuel), lowering the connecting link and allowing the feedback lever to pivot. This reduces the feedback-spring force on the torque-motor lever, allowing it to return to a central position, reducing the flow of oil from the nozzle and thus re-centering the pilot-valve plunger.

Control pressures in the pilot-valve system are created by the use of an orifice between the low-pressure accumulator and the pilot-valve bushing. The orifice allows the same volume of oil flow as is allowed through the nozzle under the torque-motor-control lever at the steady-state condition. This combination of restrictions permits a variable pressure to determine the position of the plunger in the bushing.

A 140 µm strainer-filter is included in the oil line between the high-pressure and low-pressure accumulators to help protect the orifice and nozzle from dirt. The strainer-filter may be removed for periodic cleaning.

The pilot-valve plunger is rotated in the stationary bushing by a drive in the top of the drive shaft. The rotation is maintained to reduce friction between the plunger and the bushing, thus providing more responsive actuator movement.

## Operating Pressures

The PGTM-200 oil pump and accumulator produce a reservoir of 200 psi (1379 kPa) pressure oil. This pressure is reduced 100 psi (690 kPa) in the relay pilot-valve and servo-piston area of the actuator. The control pressure in the pilot valve at the orifice is held at 200 psi (1379 kPa).

The additional accumulator in the PGTM column provides pressure oil to the pilot valve during start-up and during transients which may empty the regular accumulator. The low-pressure accumulator fills with oil at about 70 psi (483 kPa). The accumulator assures that the actuator will maintain control pressures at the pilot valve, even if transients should drain the main accumulator and cause a temporary loss of pressure in the power section of the unit.

During normal operation, the low-pressure accumulator will be at the top of its stroke and have no effect on actuator operation.

## Manual Operation

When the manual position lever is used, it first deactivates the microswitch and removes the actuator from the electric control circuit. As the lever is moved further, the cam screw adds pressure to the level spring, which forces the torque motor lever to move and restricts the flow of pressure oil through the nozzle, resulting in a movement of the pilot valve and servo piston. The servo piston movement changes the pressure on the torque-motor lever through the feedback lever, and the actuator stops the output shaft at a fuel position. The operation of the pilot valve, servo piston, relay valve, and power piston-terminal shaft is the same as under electrical governor operation.

**⚠WARNING**

**The manual setting does not control the speed of the engine or turbine, but instead provides for a hydraulic setting of the fuel racks or valve. Should engine load be reduced while the fuel setting is set by the manual control, engine speed will increase since no change will occur in the fuel setting.**

## Oil Pump

The actuator-drive shaft drives the gear-rotor oil pump. Check valves in the pump area allow actuator drive in either direction. The oil from the pump goes to an accumulator where it moves a piston against a spring until a bypass port is uncovered. This provides a constant 200 psi (1379 kPa) supply of oil to service the actuator.

## Rotary Output Section

Actuator output is initiated by movement of the servo piston which controls a relay valve directing pressure oil to, or from, the power cylinder. Feedback from the rotary-output shaft changes the fulcrum point of the relay valve and causes the flow of oil to the power cylinder to be shut off when the new location is reached.

## Power Cylinder

The power cylinder consists of a differential piston connected to the relay piston and the rotary output shaft. Pressure oil is constantly directed to the side of the power piston with the least surface area, urging the unit toward decreased fuel. The relay-valve system controls the flow of pressure oil to, and from, the side of the piston which has the most surface area. If the relay valve allows pressure oil to flow to the larger side of the piston, the piston will move the terminal shaft toward increased fuel. If the relay-valve plunger drops, it releases oil from the large area of the piston to sump and the pressure oil on the other side of the piston will move the terminal shaft toward minimum fuel.

## Rotary Variable Differential Transducer (RVDT)

An optional RVDT is available with the PGTM actuator. This device provides a variable feedback voltage to the electric governor to allow indication of exact terminal shaft location. See Figure 5-2 for wiring of the transducer.

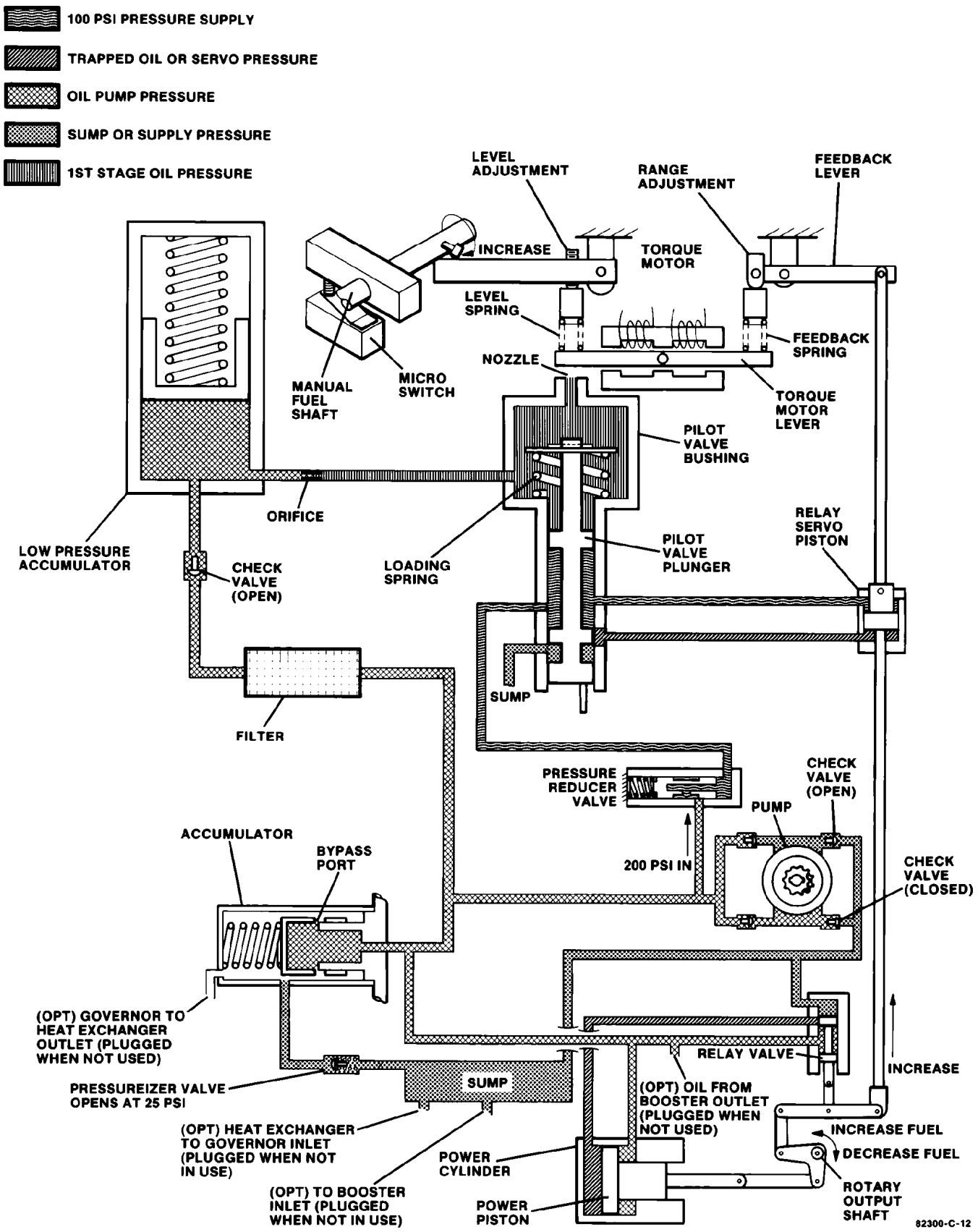


Figure 4-1. Schematic of PGTM-200

# Chapter 5. Maintenance

## Oil Condition

Oil condition within the PGTM actuator should be the first concern in both preventive and corrective maintenance. Relatively small pressure changes within the pilot-valve system are responsible for the control characteristics of the actuator, and these pressures will be adversely affected by dirty or contaminated oil.

Since the actuator has a self-contained sump, there is little chance of contamination from within the actuator except from heat and related oxidation, sludge, and varnish formations. Care must be taken to avoid any contamination when changing oil, servicing the actuator, or adding oil. The life of oil in the actuator will be directly determined by the amount of heat the oil is exposed to and the selection of oil type and weight.

In many cases, the lubricating oil used in the engine being controlled will be acceptable for the actuator. Because of availability, this grade and type of oil should be used if possible. Under no circumstance should used oil be placed in the actuator, as it will cause unnecessary wear to precision parts and may plug small diameter oil flow channels.

Whenever actuator control problems are encountered, the first corrective step should be to carefully check the oil condition and oil level. If the oil is not in new and perfect condition, drain the actuator while hot and refill with the proper grade and type of oil. After operating about 30 minutes, drain the unit again and refill with more new oil of the proper grade and type.

**IMPORTANT**

**Most problems which appear to be caused by the electrical actuator are traced to either oil condition or linkage from the unit to the engine or turbine being controlled. Prior to disassembly, the oil should be checked carefully and changed if any doubt exists on the condition. The linkage to the engine or turbine should be carefully inspected for binding or looseness.**

## Electrical System

To check the torque motor in the PGTM actuator, remove the conduit connector from the electronic control. The resistance between posts A and B should measure 38 Ω (±5 Ω). Resistance between the posts and the case should be 100 kΩ or more. The torque motor is rated with a 12 to 14 Ω resistance, and a 25 Ω resistor is included with the interior wiring. An open reading through the circuit could indicate failure of either the resistor or the torque motor.

The manual fuel setting feature of the actuator must close the microswitch when the indicator on the front of the actuator shows electrical control. The switch, when open, will interrupt the flow of electrical control current.

# Actuator Repair

Should repair be necessary, the actuator may be disassembled in the field by qualified mechanical-repair personnel. The most likely cause of trouble is dirt in the hydraulic-oil system. Under certain conditions, the actuator may have to be disassembled to clean dirt from the system.

A 140 µm filter-screen is located in the front of the actuator case, behind the external oil line. This filter may be removed by disconnecting the oil pressure lines. If removed, the filter-screen should be carefully backflushed in a commercial solvent. Should this filter become clogged or dirty, it will cause erratic or unacceptable actuator operation.

The lands of the pilot-valve plunger must be sharp and free of any nicks or other damage. Should the lands be damaged or worn, the plunger must be replaced. The thrust bearing at the top of the plunger should be replaced if any wear is observed. The upper thrust-bearing race may be turned over should wear be observed.

## Microswitch

The microswitch is not repairable. To replace:

1. Remove the cover from the top of the actuator. Remove the three screws from the cover on the front of the actuator. Do not remove the pointer from the shaft which would allow the complete removal of the front cover.

2. Remove the manual fuel control cam screw from the end of the shaft.

3. Loosen the elastic stop nut from the manual fuel-control shaft.

4. Mark the location of the microswitch cam on the shaft. The cam will be replaced in the same radial location in relation to the shaft-limit dog.

5. Hold down on the manual control lever and back the shaft and attached cover and shaft-limit dog partially out of the column. Do not back the shaft out any further than necessary to clear the microswitch. The elastic nut, spring washer, spacer, and microswitch cam will have to be removed from the shaft while the shaft is being backed from the column. Do not drop any of the parts into the column.

**NOTICE**

**With the shaft removed, the manual control lever will lift up against the return spring, and the return spring could drop into the top of the actuator case. Take care that no parts drop into the case or complete disassembly could be required.**

6. With the shaft backed out, but not removed from the actuator case, remove the three screws that hold the switch bracket in the case. Lift the bracket and switch from the case.

7. Replace the switch on the bracket and replace the bracket in the case with the three screws. Replace the wires on the same terminals.

8. Reassemble the manual-control shaft and reset the length of the cam screw. Set the microswitch-operating screw, if necessary, to open and close when the indicator on the front of the case is half way between manual and electric control.

9. Reinstall the indicator cover on the front of the casting.

10. Replace the cover on top of the actuator.

## 200/300 Case, Accumulator, and Power Cylinder

Information on maintenance, operation, and repair of the power case, accumulator, and power cylinder portions of the PGTM-200/300 are provided in manual 36618, *PG-200/300 Case, Accumulator, and Power Cylinder*. Parts for the assembly are provided in this manual. No adjustments are included in the assembly, and routine maintenance should not be necessary.

**⚠WARNING**

**The accumulator spring (605 in Figure 6-6) is compressed and held in the accumulator assembly. Injury to person or damage to the equipment can result from careless disassembly of this unit. Place the accumulator assembly in an arbor press to permit a controlled rate of spring expansion.**

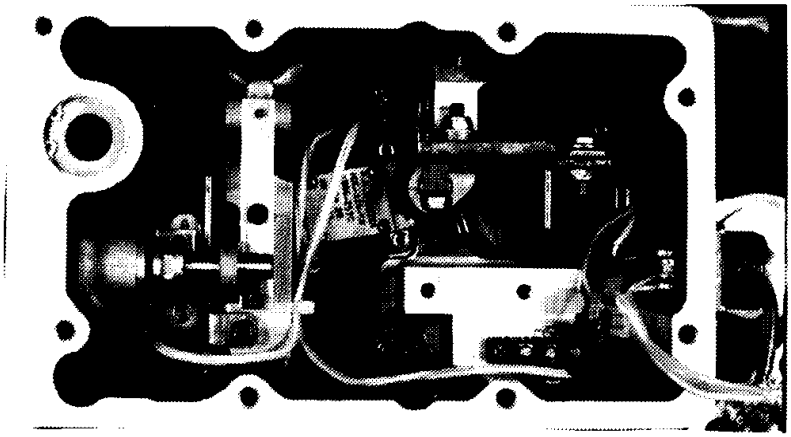

Figure 5-1. PGTM Column without RVDT

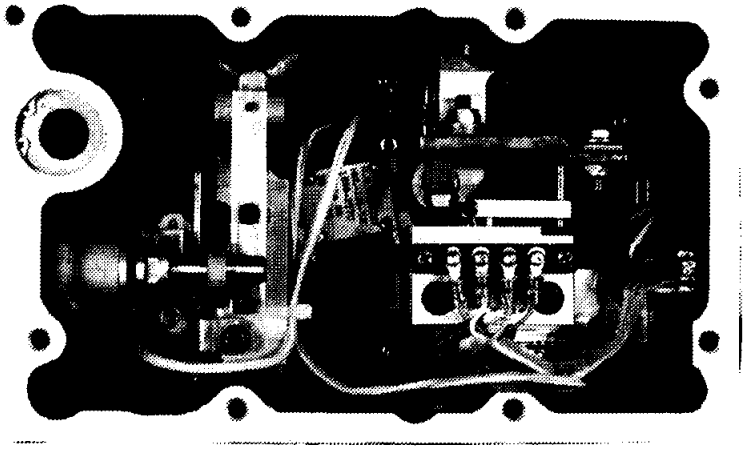

Figure 5-2. PGTM Column with RVDT Option

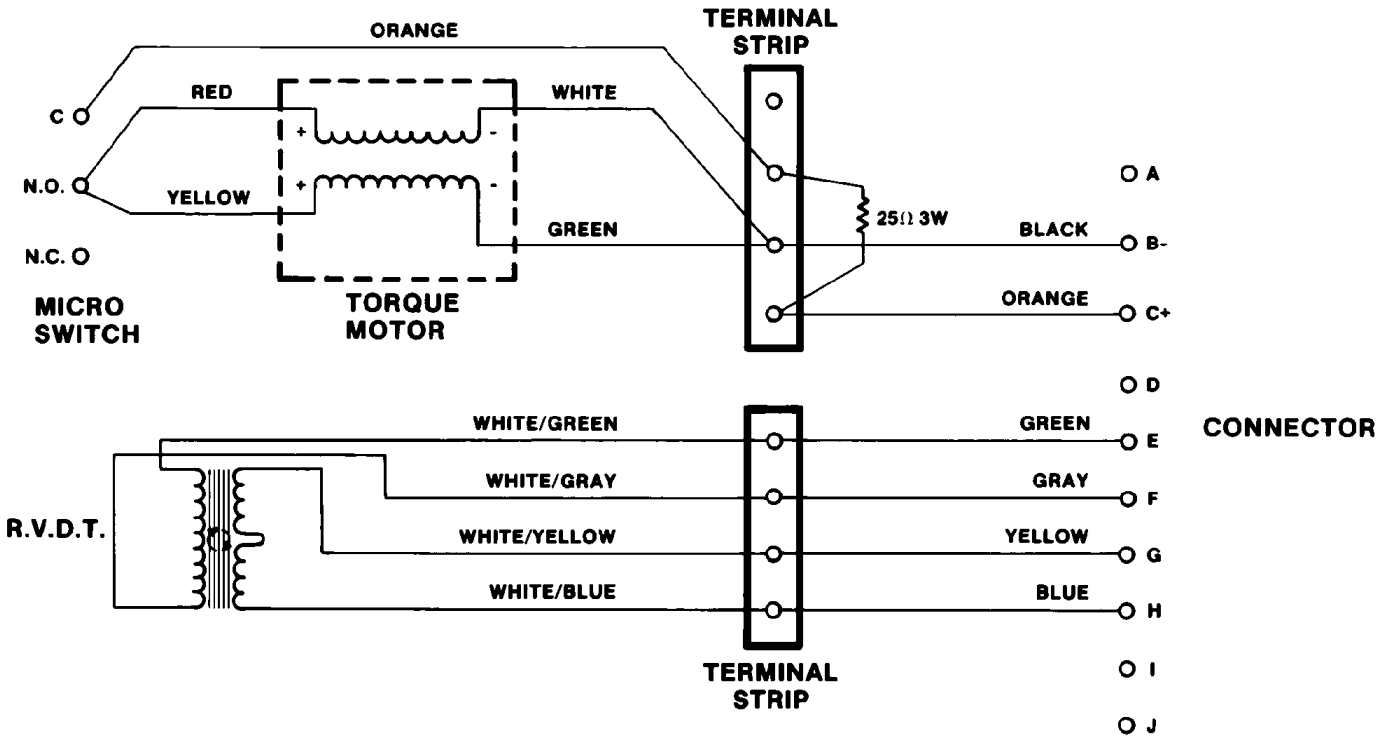


Figure 5-3. Wiring Diagram for PGTM-200

# Chapter 6.
# Replacement Parts

When ordering replacement parts, include the following information:

- Actuator serial number and part shown on the nameplate
- Manual number (this is manual 82328)
- Parts reference number and part name from the parts list

**WARNING** **Injury may result if compressed springs are released suddenly. Use the proper equipment to remove springs and spring covers.**

## Parts List for Figure 6-1

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-101 | Oil Filler-Dip Stick | 1 |
| 82328-102 | Dip Stick Retaining Screw | 1 |
| 82328-103 | Aluminum Cover | 1 |
| 82328-104 | Breather Cap | 1 |
| 82328-105 | Screw, 0.250-20 x 1 | 8 |
| 82328-106 | Gasket, Cover | 1 |
| 82328-107 | Column | 1 |
| 82328-108 | Link, Power Piston | 1 |
| 82328-109 | Bolt, 0.250-20 x 0.750, Hex Head | 1 |
| 82328-110 | Sleeve, Clamping | 1 |
| 82328-111 | Lever Assembly, Feedback | 1 |
| 82328-112 | Nut, 0.250-28 Elastic | 1 |
| 82328-113 | Feedback Adjustment Lever | 1 |
| 82328-114 | Nut, 0.250-28, Elastic | 1 |
| 82328-115 | Spring Seat | 2 |
| 82328-116 | Bushing, Spring Seat | 2 |
| 82328-117 | Feedback Spring | 2 |
| 82328-118 | Spring Seat, Torque Motor | 2 |
| 82328-119 | Washer, 0.112 Spring Lock | 2 |
| 82328-120 | Screw, 4-40 x 0.500 | 2 |
| 82328-121 | Cam Lever Assembly | 1 |
| 82328-122 | Screw, 0.250-28 x 0.500 | 1 |
| 82328-123 | Cotter Pin | 1 |
| 82328-124 | Pin, Pivot | 1 |
| 82328-125 | Screw, 8-32 x 1.500 | 4 |
| 82328-126 | Washer, Spring Lock | 4 |
| 82328-127 | Torque Motor | 1 |
| 82328-127A | Spring, Lever Loading | 1 |
| 82328-128 | Screw, 4-40 x 0.375 | 4 |
| 82328-129 | Washer, Spring Lock | 4 |
| 82328-130 | Receptacle, 10-pin | 1 |
| 82328-131 | Gasket | 1 |
| 82328-132 | Screw, 6-32 x 0.562 | 2 |
| 82328-133 | Washer, #6 | 2 |
| 82328-134 | Terminal Strip | 1 |
| 82328-135 | Tag, Identification | 1 |
| 82328-136 | Drive Screw | 2 |
| 82328-137 | Stop Screw Cover | 1 |
| 82328-138 | Screw, 0.250-20 x 0.625 | 1 |
| 82328-139 | Stop Screw | 2 |
| 82328-140 | Plug | 3 |
| 82328-141 | O-Ring | 3 |
| 82328-142 | Check Valve | 1 |
| 82328-143 | Snap Ring, Internal Retaining | 1 |
| 82328-144 | Valve, Nozzle | 1 |
| 82328-145 | O-Ring | 1 |
| 82328-146 | Race, Upper, Thrust Bearing | 1 |
| 82328-147 | Bearing, Needle Thrust | 1 |
| 82328-148 | Race, Lower, Thrust Bearing | 1 |
| 82328-149 | Spring, Pilot Valve | 1 |
| 82328-150 | Cotter Pin | 1 |
| 82328-151 | Pilot-Valve Plunger | 1 |
| 82328-152 | Roll Pin | 1 |
| 82328-153 | Pilot-Valve Bushing | 1 |
| 82328-154 | Spring Washer | 1 |
| 82328-155 | Nut. Elastic Stop | 1 |
| 82328-156 | Washer, 0.265 x 0.500 x 0.032 | 1 |
| 82328-157 | Screw, 0.250-20 x 1.250 | 1 |
| 82328-158 | Indicator. Position | 1 |
| 82328-159 | Shaft Assembly, Manual Fuel | 1 |
| 82328-160 | Screw, Cam Operating | 1 |
| 82328-161 | Cover, Front | 1 |
| 82328-162 | Screw, 0.500-20 x 0.625 | 3 |
| 82328-163 | Screw, 0.250-28 x 0.750 | 1 |
| 82328-164 | Washer, 0.250, Split Lock | 1 |
| 82328-165 | Stop, Min.-Max. | 1 |
| 82328-166 | Snap Ring, Retaining | 1 |
| 82328-167 | Spacer, Shaft | 1 |
| 82328-168 | Oil Seal | 1 |
| 82328-169 | Bearing | 1 |
| 82328-170 | Spline Nut | 2 |
| 82328-171 | Orifice, Cup | 1 |
| 82328-172 | Washer, Seal | 1 |
| 82328-173 | Oil Filter Assembly | 1 |
| 82328-174 | O-Ring | 1 |
| 82328-175 | Actuator Assembly | 1 |
| 82328-176 | Set Screw, 10-32 x 0.500 | 1 |
| 82328-177 | Washer, Conical Spring | 1 |
| 82328-178 | Spacer, Shaft | 1 |
| 82328-179 | Nut, Elastic-Hex | 1 |
| 82328-180 | Bearing | 1 |
| 82328-181 | Bracket, Switch | 1 |
| 82328-182 | Microswitch | 1 |
| 82328-183 | Washer, Flat | 2 |
| 82328-184 | Washer, Split Lock | 2 |
| 82328-185 | Screw, 6-32 x 0.875 | 2 |
| 82328-186 | Piston, Accumulator | 1 |
| 82328-187 | Spring, Accumulator | 1 |
| 82328-188 | Washer, Spring-Seat | 1 |
| 82328-189 | Ring, Retaining | 1 |
| 82328-190 | Screw, 0.250-20 x 0.500 | 3 |
| 82328-191 | Washer, Split-Lock | 3 |
| 82328-192 | Screw, 0.500-28 x 0.500 Oval-Pt. Set | 1 |
| 82328-193 | Nut | 1 |

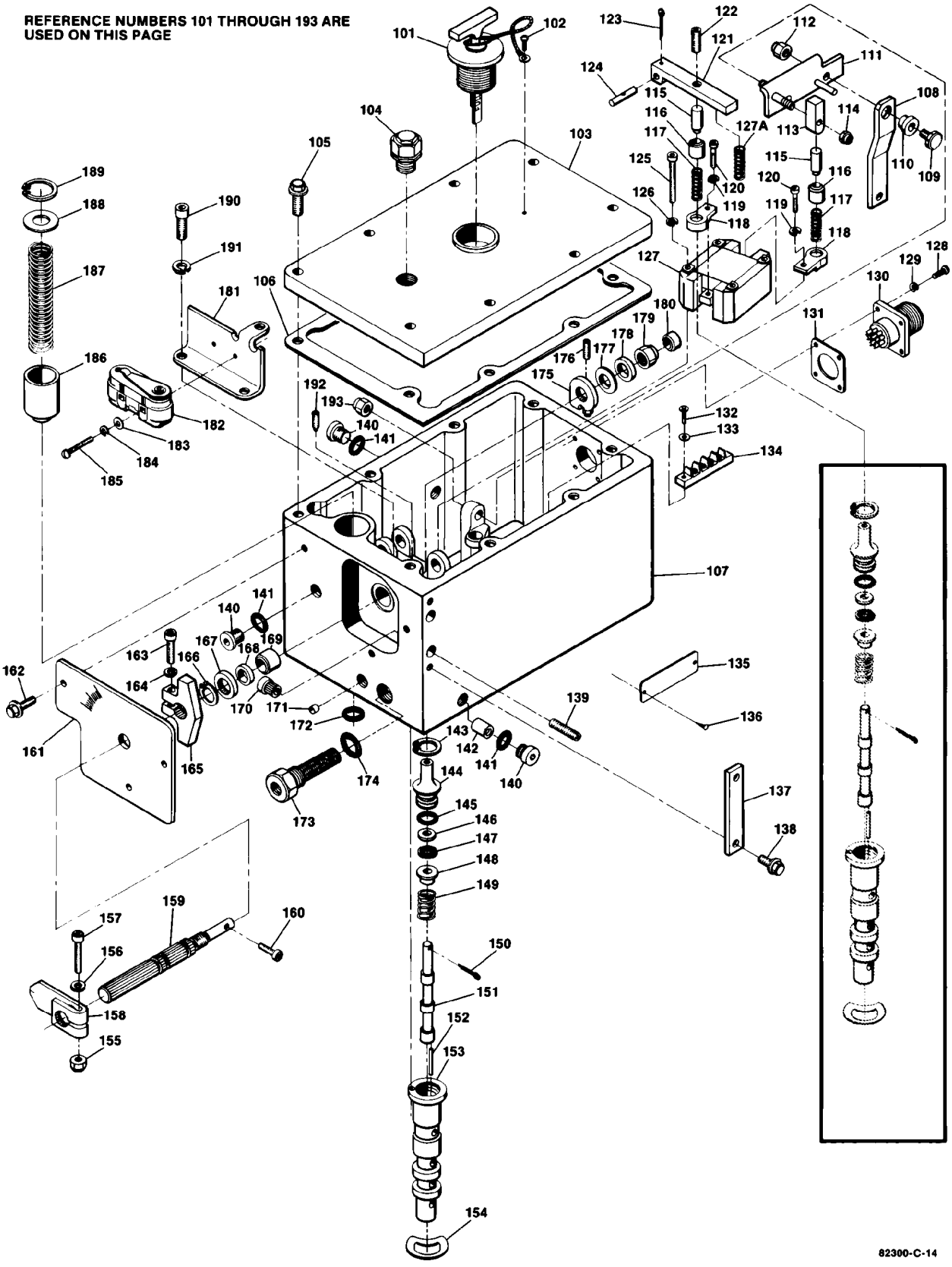


Figure 6-1. PGTM-200 Control Column

## Parts List For Figure 6-2

Reference numbers 201 through 208 are used on this page.

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-201 | Elbow | 1 |
| 82328-202 | 0.250 Stainless Oil Line | 1 |
| 82328-203 | Straight Fitting | 1 |
| 82328-204 | Elbow | 1 |
| 82328-205 | 0.250 Stainless Oil Line | 1 |
| 82328-206 | Fitting | 1 |
| 82328-207 | O-ring | 1 |
| 82328-208 | T-Fitting Assembly | 1 |
| 82328-209 | O-rings (not shown) | 3 |

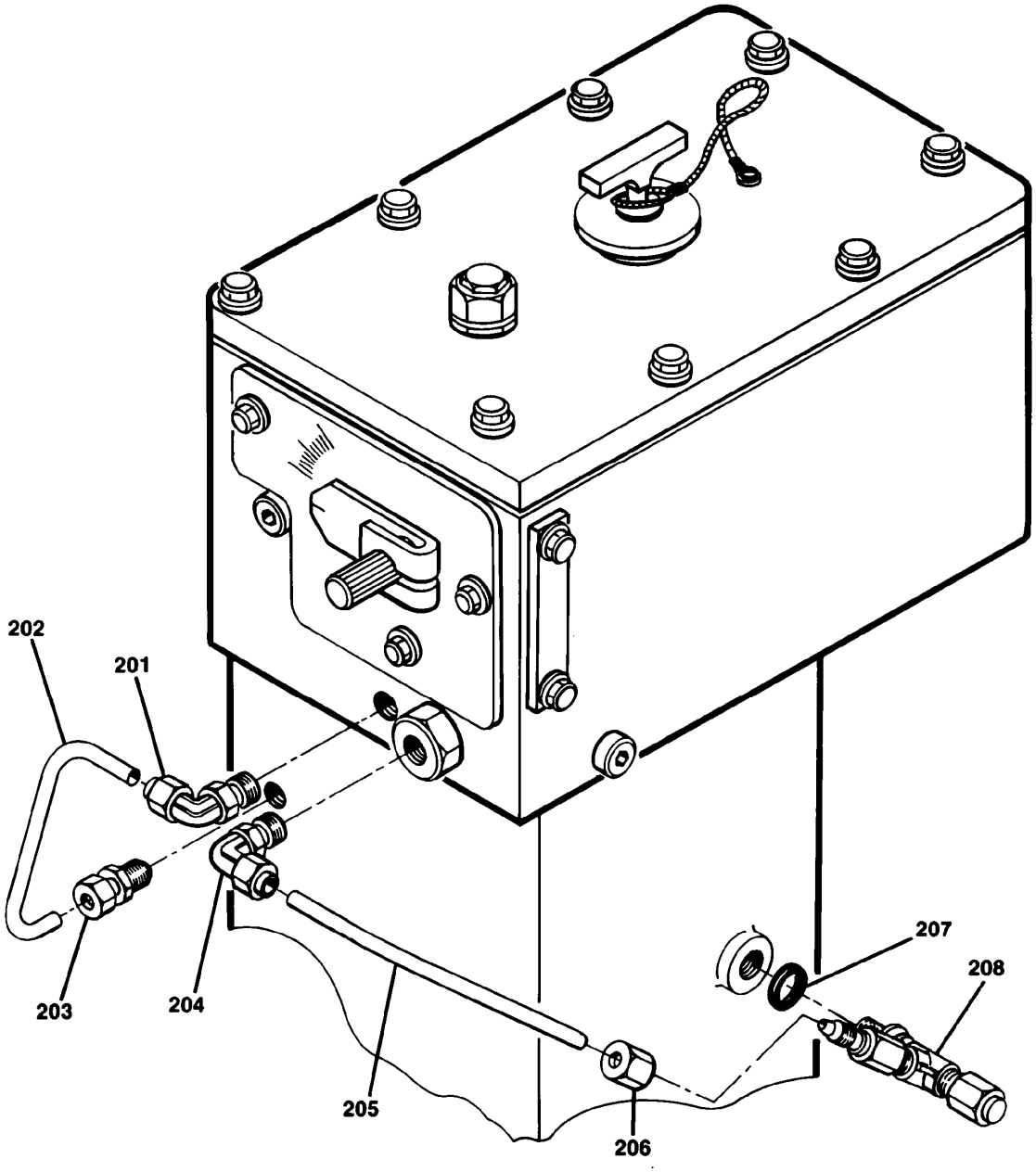


Figure 6-2. PGTM-200 Auxiliary Oil Lines

## Parts List For Figure 6-3

Reference numbers 301 through 308 are used on this page.

| Ref. No. | Part Name ..... Quantity |
|---|---|
| 82328-301 | Screw, 6-32 x 0.375 ..... |
| 82328-302 | Lever, RVDT Feedback..... |
| 82328-303 | Transformer, Pickering RVDT ..... |
| 82328-304 | Block, RVDT Clamping..... |
| 82328-305 | Screw, 0.250-20 x 1.500 ..... |
| 82328-306 | Terminal Block, 4 Pin ..... |
| 82328-307 | Washer, flat..... |
| 82328-308 | Screw, 6-32 x 0.500 ..... |

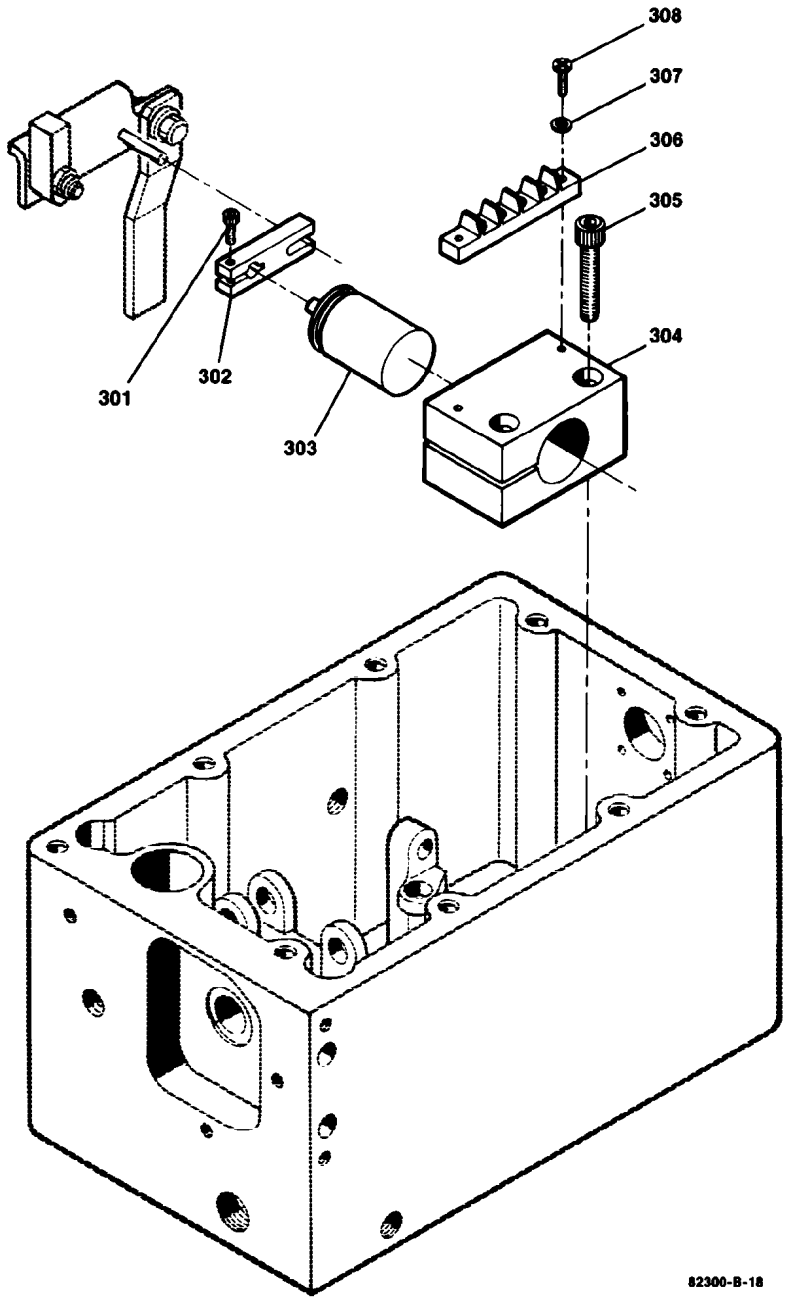


Figure 6-3. PGTM-200 Optional RVDT

## Parts List for Figure 6-4

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-401 | Relief Valve Plunger | 1 |
| 82328-402 | Relief Valve Spring | 1 |
| 82328-403 | O-ring, 0.801 x 0.070 | 1 |
| 82328-404 | Relief Valve Plug | 1 |
| 82328-405 | Retaining Ring, 1.111 Dia. | 1 |
| 82328-406 | Washer, 0.500 ID | 4 |
| 82328-407 | Screw, 0.500-13 x 2.500 | 4 |
| 82328-408 | Not Used | |
| 82328-409 | O-ring, 0.351 ID x 0.072 | 4 |
| 82328-410 | Plug, 0.438-20 UNF-2A | 4 |
| 82328-411 | Screw, 0.500-13 x 2.000 | 2 |
| 82328-412 | Washer, 0.500 ID Split Lock | 2 |
| 82328-413 | Washer, 0.515 x 0.875 x 0.064 | 2 |
| 82328-414 | O-ring, 0.468 x 0.078 | 1 |
| 82328-415 | Plug, 0.562-18, UNF-2A | 1 |
| 82328-416 | Pin, 0.3742 Dia. x 0.625 | 2 |
| 82328-417 | Connecting Rod | 1 |
| 82328-418 | Gasket | 1 |
| 82328-419 | Case | 1 |
| 82328-420 | O-ring, 0.468 ID x 0.070 | 1 |
| 82328-421 | Plug, 0.562-18 UNF-2A | 1 |
| 82328-422 | Pipe Plug, 0.750 | 1 |
| 82328-423 | Plug, 0.875-14 UNF-2A | 2 |
| 82328-424 | O-ring, 0.755 ID x .097 | 2 |
| 82328-425 | Pin, 3.188 x 0.875 | 1 |
| 82328-426 | Washer, 0.500 ID | 7 |
| 82328-427 | Screw, 0.500-13 x 2.000 | 7 |
| 82328-428 | Servo Cover | 1 |
| 82328-429 | Gasket | 1 |
| 82328-430 | Servo Piston | 1 |
| 82328-431 | Plug, 0.250 | 1 |
| 82328-432 | Not Used | |
| 82328-433 | Pin | 2 |
| 82328-434 | Washer, Split Lock | 4 |
| 82328-435 | Screw, 0.312-24 x 0.500 | 4 |
| 82328-436 | Terminal Shaft Housing | 1 |
| 82328-437 | Screw | 1 |
| 82328-438 | Top of Plug | 1 |
| 82328-439 | O-ring | 1 |
| 82328-440 | Bottom of Plug | 1 |

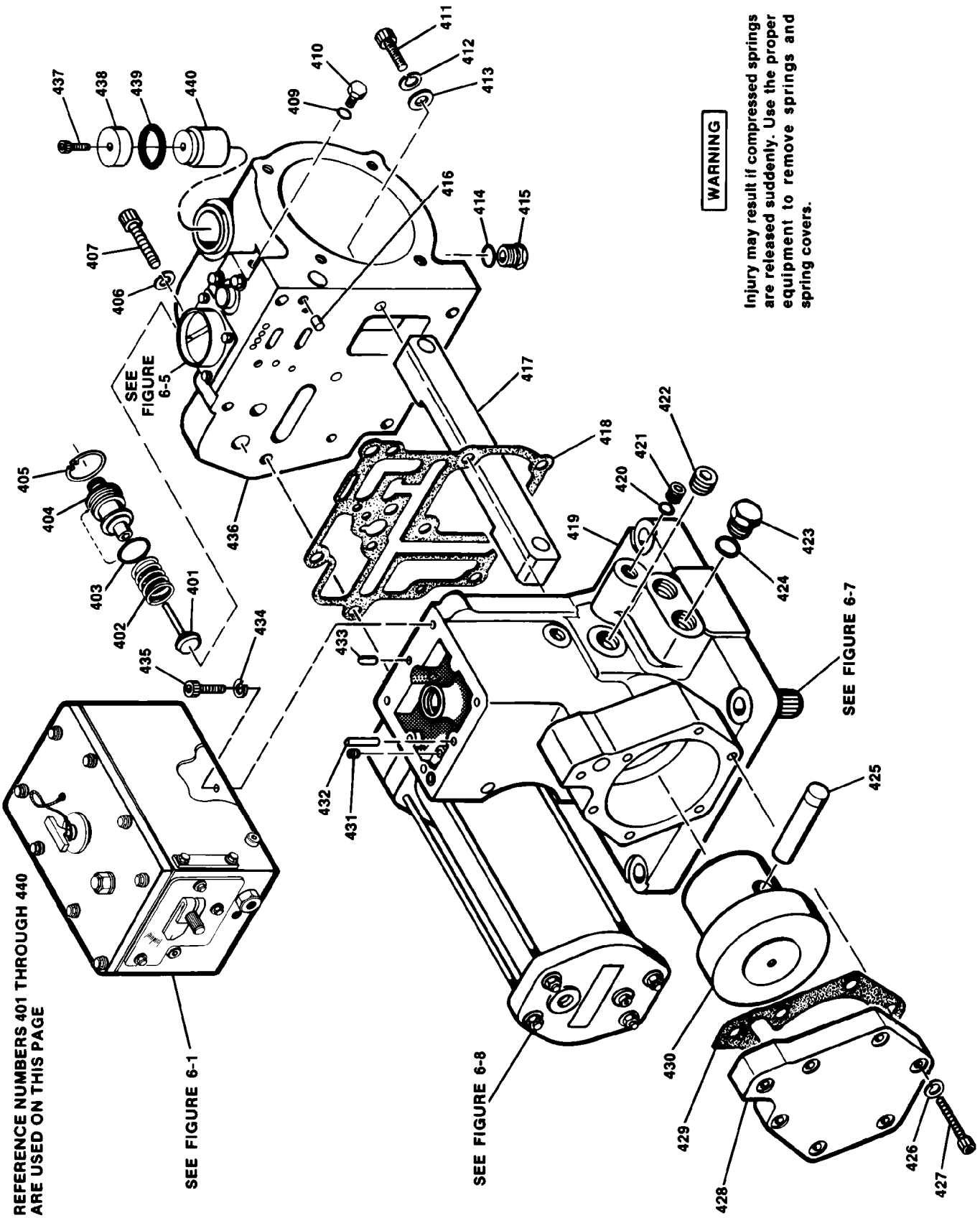


Figure 6-4. PGTM-200 Major Actuator Parts

## Parts List For Figure 6-5

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-472 | Cotter Pin | 2 |
| 82328-473 | Drilled Pin | 1 |
| 82328-474 | Lever | 1 |
| 82328-475 | Pin, 0.187 dia. x 0.531 | 1 |
| 82328-476 | Piston | 1 |
| 82328-477 | O-ring, 1.864 ID x 0.070 | 1 |
| 82328-478 | Piston Stop | 1 |
| 82328-479 | O-ring, 1.989 ID x 0.750 | 3 |
| 82328-480 | Plate | 1 |
| 82328-481 | Washer, 0.250 | 4 |
| 82328-482 | Screw, 0.250-28 x.0 750 | 4 |
| 82328-483 | Screw, 0.250-28 x 0.500 | 2 |
| 82328-484 | Washer, 0.250 | 2 |
| 82328-485 | Washer, 0.750 | 2 |
| 82328-486 | Spring Cover | 1 |
| 82328-487 | O-ring, 1.239 x 0.070 | 1 |
| 82328-488 | Loading Spring | 1 |
| 82328-489 | Spring Seat | 1 |
| 82328-490 | Pilot Valve Sleeve | 1 |
| 82328-491 | Plunger Adjuster | 1 |
| 82328-492 | Spring Seat | 1 |
| 82328-493 | Pilot Valve Plunger | 1 |
| 82328-494 | Pilot Valve Spring | 1 |
| 82328-495 | Retaining Pin | 1 |
| 82328-496 | Snap Ring | 1 |

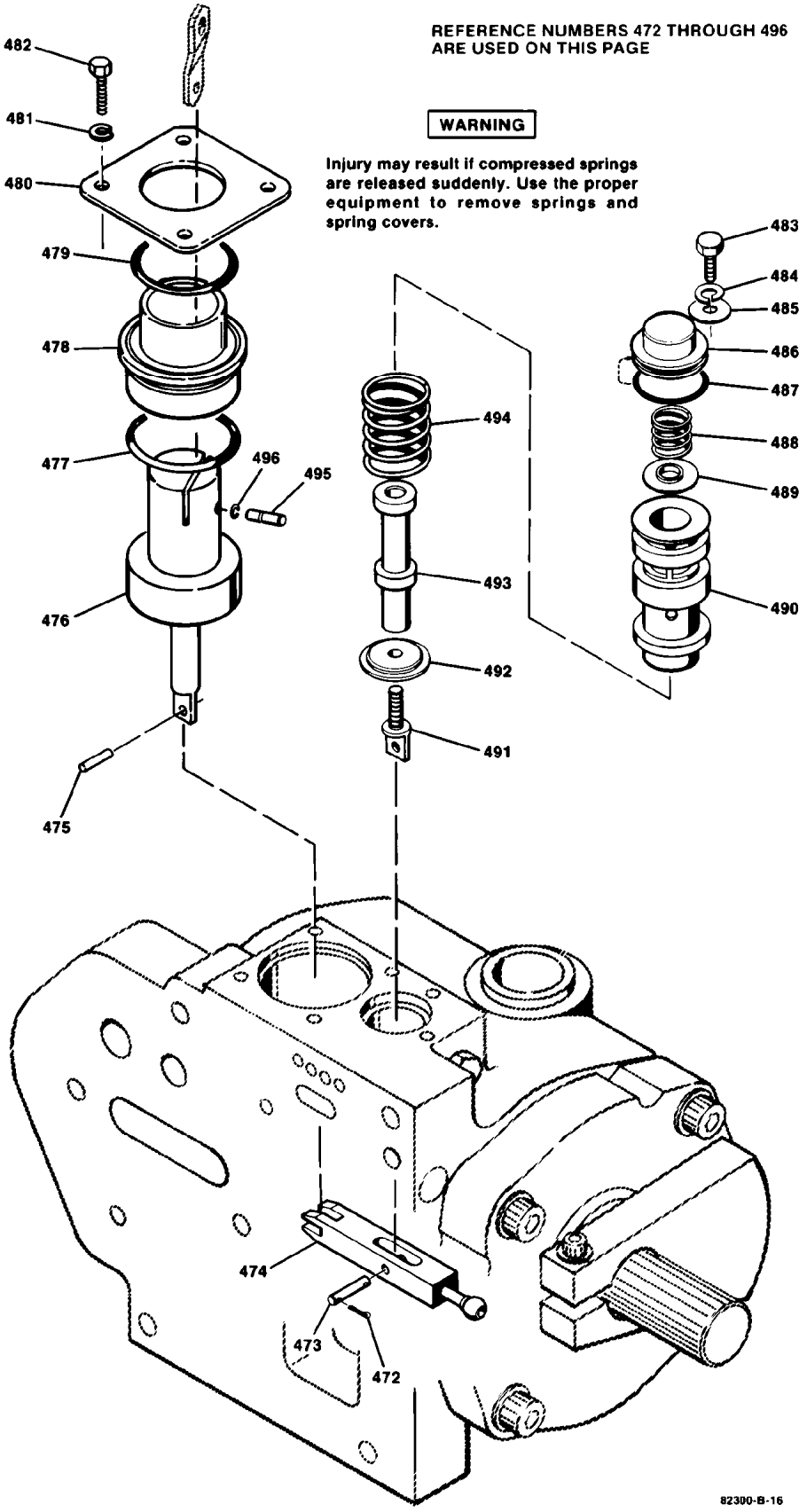


Figure 6-5. PGTM-200 Relay Valve Parts

## Parts List For Figure 6-6

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-500 | Oil Seal, 1.125 x 1.562 | |
| 82328-501 | Needle Bearing | |
| 82328-502 | Gasket | |
| 82328-503 | Screw, 0.500-13 x 2.500 | |
| 82328-504 | Washer, 0.500 ID | |
| 82328-505 | Terminal Lever | |
| 82328-506 | Output Shaft | |
| 82328-507 | Cover | |
| 82328-508 | Screw, 0.312-18 x 1.500 | |
| 82328-509 | Washer. 0.312 ID | |
| 82328-510 | Drive Screw | |
| 82328-511 | Scale | |
| 82328-512 | Indicator | |
| 82328-513 | Screw, 0.500-13 x 1.250 | |
| 82328-514 | Washer, 0.500 ID | |
| 82328-515 | Lock Ring, Internal | |
| 82328-516 | Pin, 3.750 x 0.874 | |
| 82328-517 | Retaining Ring. 0.971 Dia | |
| 82328-518 | Plug | |
| 82328-519 | O-ring, 0.614 ID x 0.070 | |
| 82328-520 | Retaining Ring, 0.620 Dia | |
| 82328-521 | Spring Seat | |
| 82328-522 | Spring | |
| 82328-523 | Retaining Ring, 0.207 ID | |
| 82328-524 | Plunger | |
| 82328-525 | Valve Sleeve | |

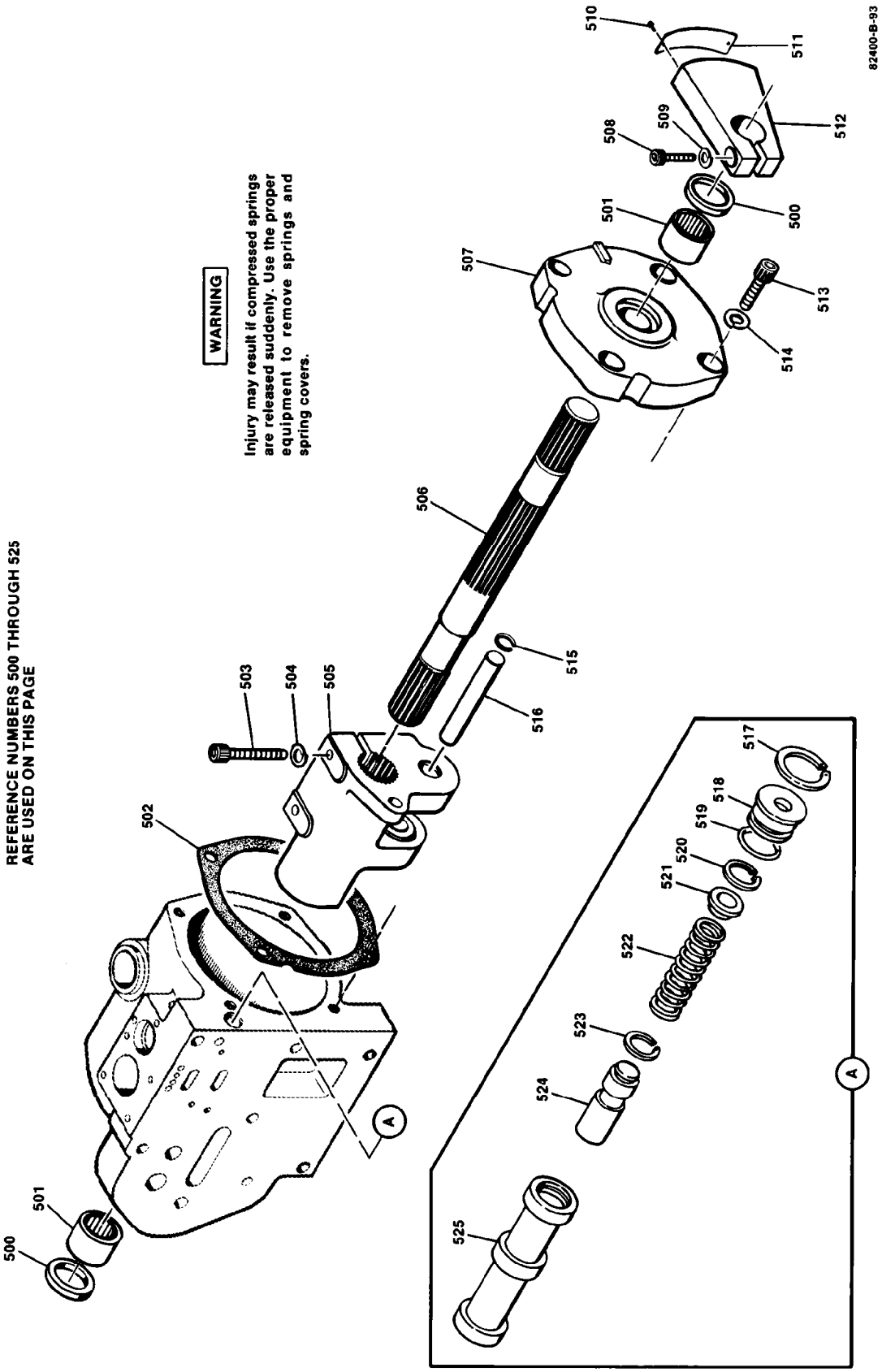


Figure 6-6. PGTM-200 Terminal Shaft Parts

## Parts List For Figure 6-7

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-540 | O-ring, 1.114 ID x 0.070 | 4 |
| 82328-541 | Check Valve | 4 |
| 82328-542 | Retaining Ring | 4 |
| 82328-543 | Magnetic Plug | 1 |
| 82328-544 | Needle Bearing, 1.000 ID | 1 |
| 82328-545 | 0-Ring, 3.489 ID x 0.070 | 1 |
| 82328-546 | Base Pilot | 1 |
| 82328-547 | Oil Seal | 1 |
| 82328-548 | Gasket | 1 |
| 82328-549 | Oil Seal Retainer | 1 |
| 82328-550 | Retaining Ring, 0.621 Dia | 1 |
| 82328-551 | Bearing | 1 |
| 82328-552 | Drive Shaft | 1 |
| 82328-553 | Bearing Retainer | 1 |
| 82328-554 | Screw, 0.250-28 x 0.625 | 3 |
| 82328-555 | Screw, 0.312-24 x 1.000 | 4 |
| 82328-556 | Washer, 0.312 | 4 |
| 82328-557 | Retaining Ring | 2 |
| 82328-558 | Pump Element | 1 |
| 82328-559 | Key, 1875 | 1 |
| 82328-560 | Solid Drive Shaft | 1 |
| 82328-561 | Roll Pin | 1 |

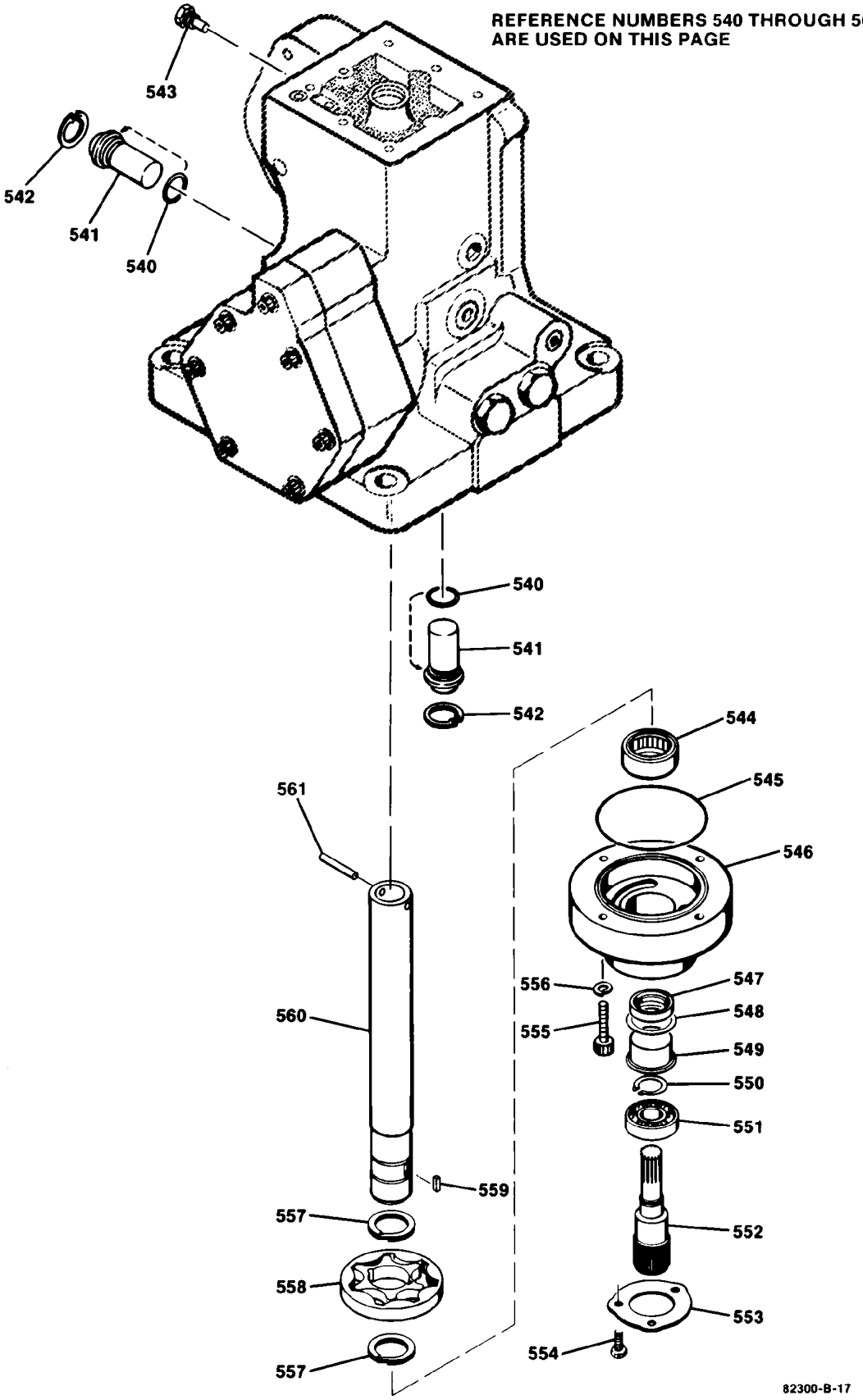


Figure 6-7. PGTM-200 Drive Shaft and Pump

## Parts List For Figure 6-8

| Ref. No. | Part Name | Quantity |
|---|---|---|
| 82328-601 | O-ring, 1.114 ID x 0.070 | 2 |
| 82328-602 | Accumulator Plate | 1 |
| 82328-603 | Stud, 0.500 Dia. x 13” Long | 2 |
| 82328-604 | Accumulator | 1 |
| 82328-805 | Accumulator Spring | 1 |
| 82328-606 | Accumulator Tube | 1 |
| 82328-607 | O-ring | 2 |
| 82328-608 | Accumulator End | 1 |
| 82328-609 | Washer, 0.500 ID | 2 |
| 82328-610 | Nut | 4 |
| 82328-611 | Plug, 0.562-18 UNF-2A | 2 |
| 82328-612 | Warning Plate | 1 |
| 82328-813 | Drive Screw | 2 |
| 82328-614 | Plug, 0.750 | 1 |
| 82328-815 | O-ring, 0.468 ID x 0.078 | 2 |
| 82328-616 | Stud, 0.500 Dia. x 14” Long | 2 |

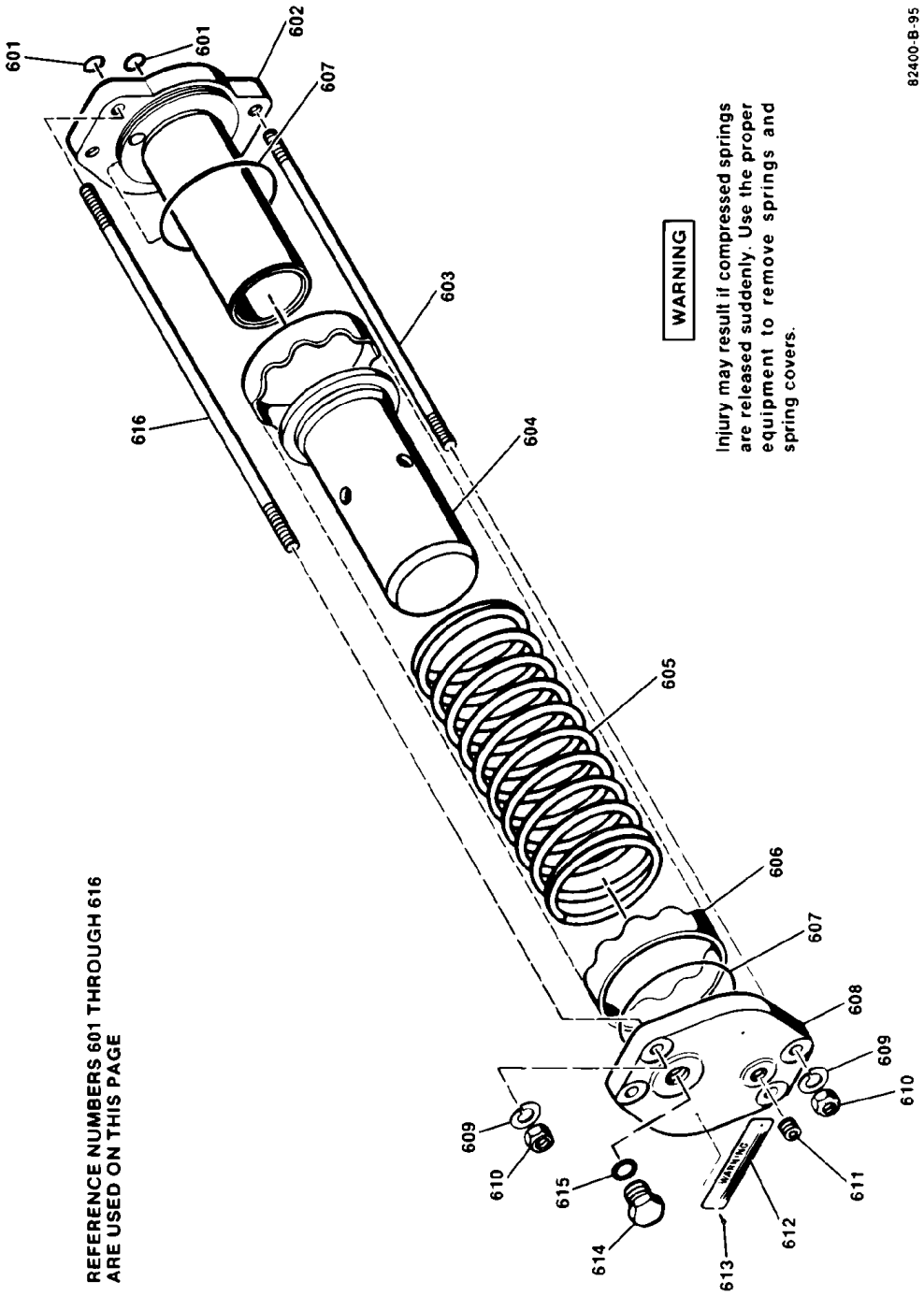


Figure 6-8. PGTM-200 High Pressure Accumulator

# Chapter 7.
# 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 82328A.**

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**Email and Website—www.woodward.com**

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

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

2012/11/Colorado