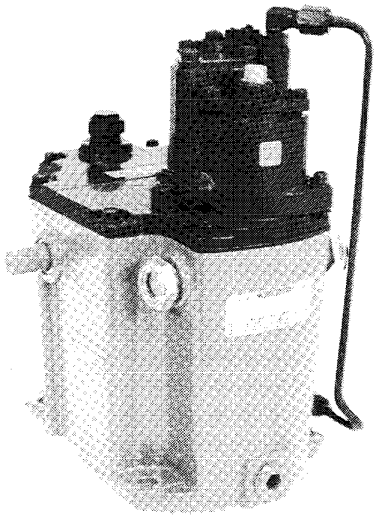
WOODWARD

Product Manual 04047
(Revision C)
Original Instructions



Pneumatic Speed Setting Device for the TG-13/17 Governor

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 Out-of-date translations are marked with ⚠.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

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

Contents

Illustrations and Tables

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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.

Chapter 1.
General Information

Introduction

This manual describes the installation, operation, and repair of the TG-13/17 governor pneumatic speed-setting device as welt as the retrofitting of the TG-13/17 governor with the pneumatic speed setting device. This device is normally installed and calibrated at the factory, but it can be calibrated in the field or at a shop that has a test stand (see Chapter 3).

IMPORTANT **In this manual, "prime mover" refers to engines, turbines, or other types of prime movers as applicable.**

The pneumatic speed setting device is used to change the speed setting of the TG governor by means of a control air pressure signal. A regulated air pressure signal from a pneumatic controller or from a pressure regulator is required to operate the device. Pneumatic speed setting devices are currently available for use with an air pressure signal range of 21 kPa/3 psi (minimum speed setting) to 103 kPa/15 psi (maximum speed setting).

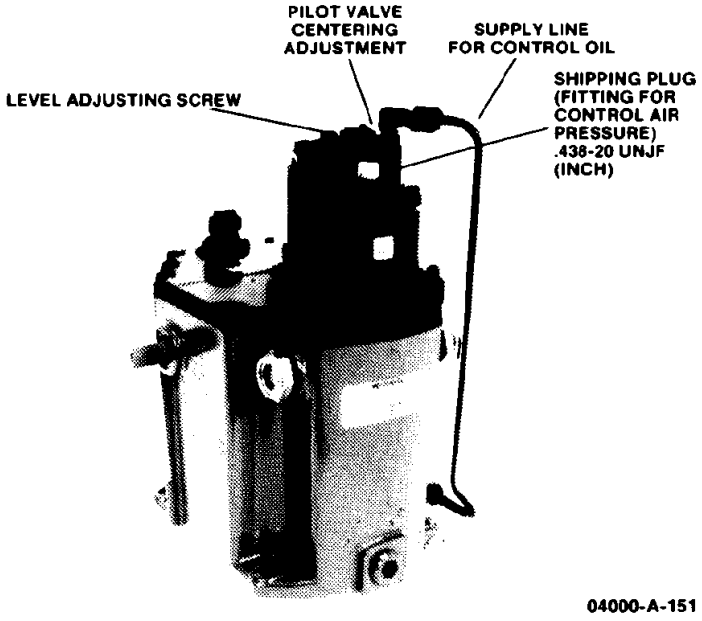


Figure 1-1. Pneumatic Speed Setting Device for the TG-13/17 Governor

In addition to the air pressure signal, supply oil from the TG-13/17 governor is also required to operate the device. The pneumatic speed setting TG-13/17 governors are available for the following three standard speed ranges:

- 1100 to 2400 rpm
- 2400 to 4000 rpm
- 4000 to 6000 rpm

A TG governor with one of the above speed ranges is commonly referred to as a 2000, 4000, or 6000 rpm TG governor, respectively.

Each speed range has either a 500 or a 1000 rpm nominal speed band width which can be widened or shortened (see Calibration Procedures, step 29) to suit the customer's requirements.

The nominal speed band width is selected by the customer at the time of purchase. If it is not known, please call Woodward with the governor designation number (shown on the governor nameplate) to determine which speed band width spring is installed in the governor.

References

04042	*TG-13/-17 and TG611-13/-17 Governors Installation and Operation*

Chapter 2.
Installation

Introduction

If the TG-13/17 governor is factory equipped with the pneumatic speed setting device, it has been set to standard factory specifications unless it was ordered to meet specific customer specifications. If it was not set to customer specifications, it may be necessary to make some adjustments when installed. It should be noted that the 500 or 1000 rpm nominal speed band width can easily be widened or shortened to suit the installation. See Calibration Procedure, step 29 for range adjustment procedures. This adjustment is made after the governor is installed on the prime mover. Please refer to manual 04042 for TG-13/17 installation instructions.

After installing the TG governor (factory equipped with the pneumatic speed setting device) on the prime mover, make sure to attach the air supply line to the pneumatic speed setting device housing. The air supply line must be capable of supplying a regulated air pressure from 21 to 103 kPa (3 to 15 psi). Control air pressure port is a 0.438-20 UNJF -2B tap straight thread port (see Figure 5-4).

Initial Operation

Before initial operation of the TG-13/17 equipped turbine, be sure that all previous installation steps are successfully accomplished as explained in manual 04042.

Normally, the only requirement for putting a new governor into service is to fill the governor with oil (see manual 04042). When shipped from the factory, the TG-13/17 is adjusted to the low speed setting and most likely will need to be adjusted to suit the specific requirements of the particular installation. Make sure that the control air pressure is adjusted to give low speed at initial start-up.

⚠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.

Start the turbine, following the turbine manufacturer's instructions.

Open the steam valve slowly until the governor controls. Continue to open the steam valve fully. Speed will not increase beyond the governor setting. Slowly increase control air pressure, keeping track of turbine speed. If speed is not at the desired speed level at 103 kPa (15 psi), adjust the speed setting.

Make sure the terminal-shaft linkage to the valve is correctly adjusted to allow maximum and minimum steam-flow requirement.

Check the governor for stable operation by manually disturbing the terminal shaft linkage or speed setting. Governor stability is satisfactory when the governor returns to speed with only a slight overshoot or undershoot. Instability indicates the need for adjustment of droop on the TG governor (see droop adjustment in Calibration Procedure, Chapter 3, step 16).

Chapter 3.
Retrofitting the TG-13/17 Governor with the Pneumatic Speed Setting Device

Introduction

TG-13/17 governors with a die-cast aluminum case can be retrofitted with the pneumatic speed setting device in the field. However, It is recommended that retrofitting be accomplished at a facility equipped with a test stand and by qualified personnel only.

If these facilities are not available, contact Woodward for a governor replacement exchange or for the retrofitting to be done at the factory.

The following procedure applies to the screw-speed-setting type TG governor, If it is desired to retrofit the lever-speed-setting type TG governor, please contact Woodward for information.

Part reference numbers used in this chapter refer to Figures 3-2 and 3-3.

Follow this procedure to retrofit the TG governor with the pneumatic speed setting kit:

1. SHUT DOWN the prime mover.

2. With the prime mover shut down, remove the TG governor from the prime mover and drain oil from the governor.

3. An oil hole must be drilled in the governor case to connect oil line (25) to the governor case with elbow (29), as shown in Figure 6-1. For correct oil hole location, see Figure 3-1.

   Completely disassemble the case before drilling the oil hole. See manual 56101 for disassembly and assembly instructions.

NOTICE **Carefully remove all metal filings from the drilled hole and back flush governor with pressure oil until all metal filings are removed.**

4. Install the governor on a test stand or on a bench.

5. Remove snap ring (1) from speed-setting screw assembly (3) and remove the governor cover.

6. Remove O-ring (2), speed-setting-screw assembly (3), washer (4), and loading spring (5) from inside guide (6).

7. Remove pivot (9) and stop washers (8).

8. Remove spring clip (10) and feedback lever (13).

9. Remove all other parts until the governor case is completely disassembled.

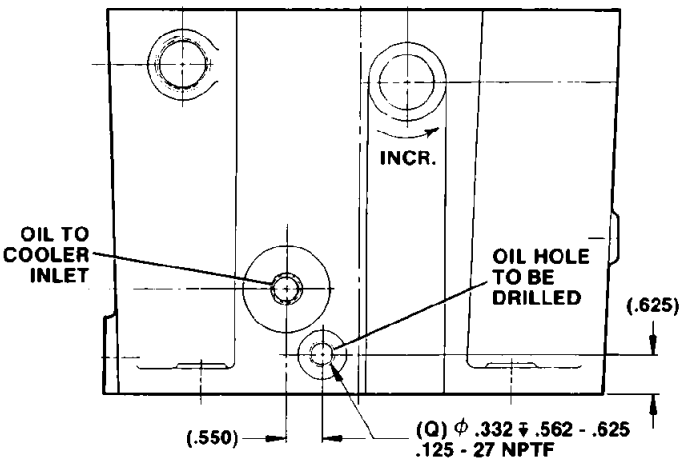


Figure 3-1. Correct Location of Oil Hole

10. Use a drill bench and drill a 0.332” diameter 0.562–0.625” deep hole in the governor case, and taper ream and thread for 0.125-27 NPTF. Carefully remove alt metal filings in the tapered hole and back flush the governor with pressure oil until ALL metal filings are removed.

11. Install the new feedback lever assembly (39, 40, and 41) found in the conversion kit, and use spring clip (10) to attach the new feedback lever (40) to speed setting nut (15). Make sure that feedback lever (40) is sitting under droop slider (12), Also make sure that end of spring clip (10) is resting above pivot pin (9).

12. In order to retain approximately the original maximum speed setting, make the following maximum speed setting correction:

    Adjust the distance from the top of the speed-setting screw (16) to the flat of the screw to the following dimensions:

- 2000 rpm governor 4.19 mm (0.165 inch)
- 4000 rpm governor 4.95 mm (0.195 inch)
- 6000 rpm governor 3.76 mm (0.148 inch)

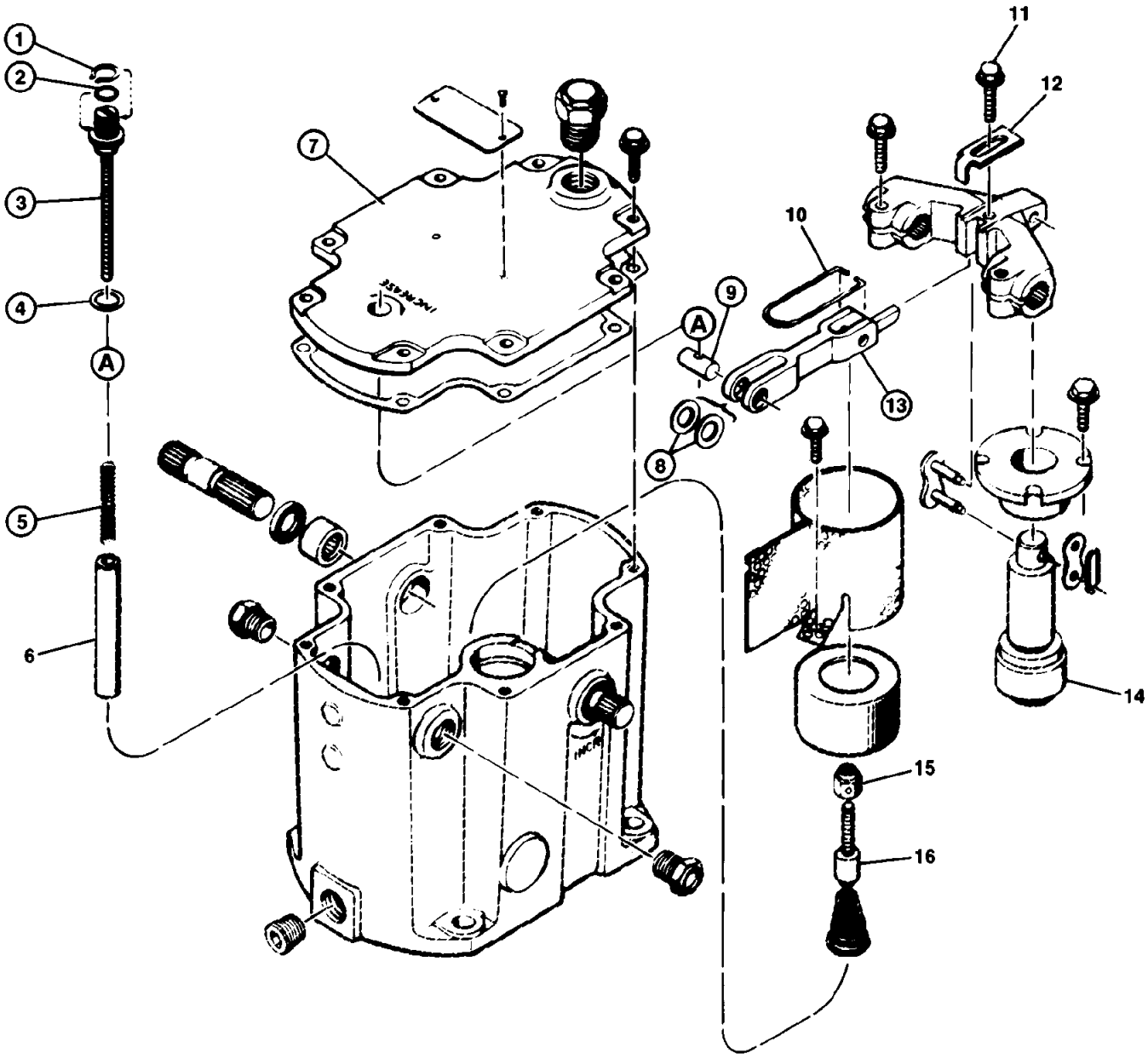
13. In order to retain approximately the original droop setting, make the following droop correction:

    Mark the point of contact of droop slider (12) with new feedback lever (40). Loosen socket-head screw (11) on the droop slider just enough to allow the droop slider to be moved. Move the droop slider towards the power piston (14) by the following amount:

- 2000 rpm governor 0.38 mm (0.015 inch)
- 4000 rpm governor 0.66 mm (0.026 inch)
- 6000 rpm governor 0.86 mm (0.034 inch)

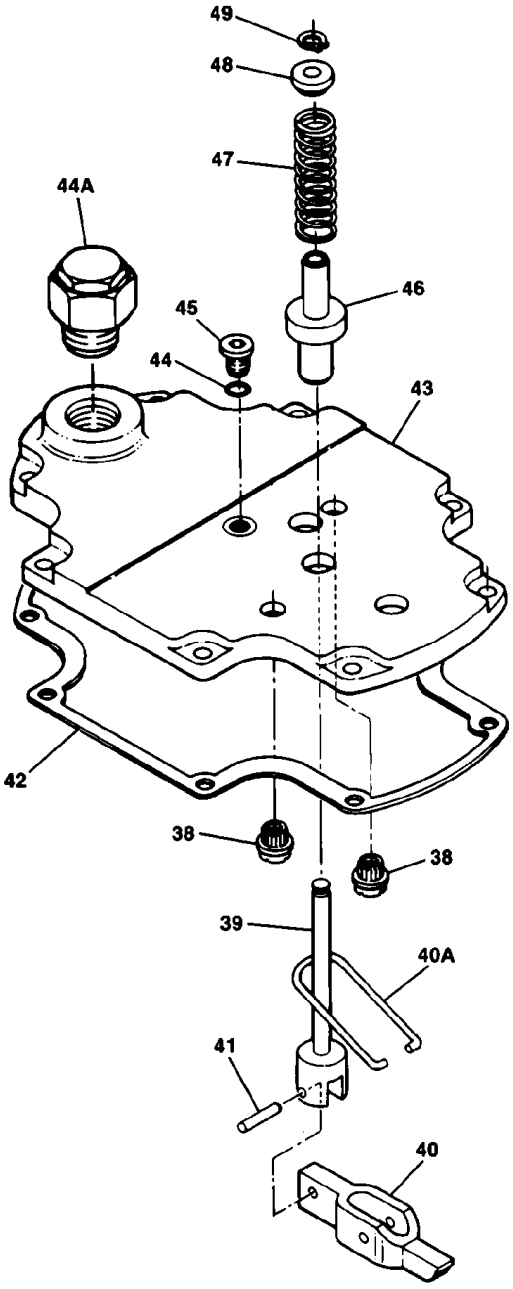
    Tighten again socket-head screw (11) on the droop slider.

14. Slide the speed-setting output rod (39) through the guide (46) on the governor test cover.



Ref. No.	Part Name	Ref. No.	Part Name
1	Retaining ring	9	Pivot
2	Preformed packing	10	Spring clip
3	Speed setting screw assembly	11	Droop slider screw
4	Washer	12	Droop adjusting lever
5	Loading spring	13	Feedback lever
6	Speed setting screw guide	14	Servo piston
7	Cover	15	Speed setting nut
8	Stop washer	16	Speeder screw assembly

Figure 3-2. Parts to be Removed
(shown with a circle)



Ref. No.	Part Name	Ref. No.	Part Name
40	Speed setting feedback lever	44A	Breather/Filler cap
40A	Spring clip	45	Plug
41	Pin	46	Speed setting rod guide
42	Gasket	47	Speed setting return spring
43	Cover	48	Speed setting spring seat
44	O-ring	49	Retaining ring

Figure 3-3. Retrofit Parts to be Installed
(in addition to the pneumatic speed setting device)

15. Fasten the test cover to the governor.

16. Attach oil line (25) to the governor case with elbow (29) (see Figure 6-1).

17. Go now to CALIBRATION PROCEDURES ON GOVERNOR TEST STAND. Follow the procedures to calibrate the governor, but OMIT steps 1, 5, and 13.

18. Continue with steps 14 through 32.

19. Retrofitting is now completed.

Calibration Procedures on Governor Test Stand

Calibration requires a special test cover (see Figure 3-4), which can be purchased from Woodward. A protractor (Figure 3-5), a magnetic tool base with pointer, a 1/8 inch ball-end hex driver, and a torque wrench also will be needed for governor calibration.

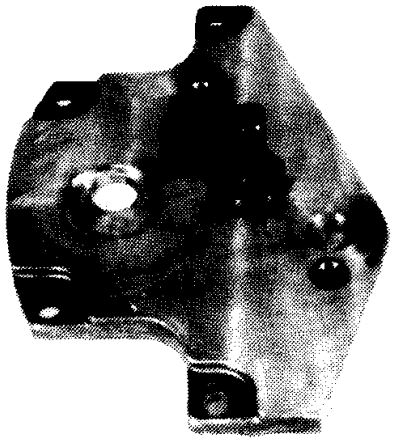


Figure 3-4. Test Cover

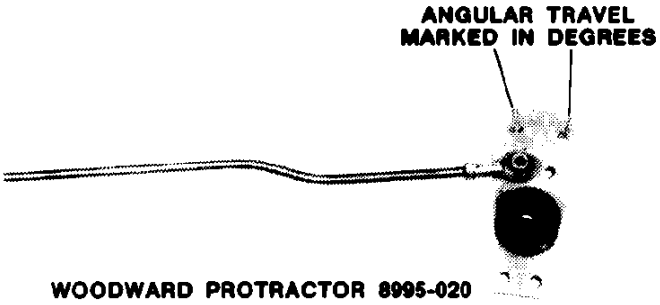


Figure 3-5. Woodward Protractor 8995-020

Part reference numbers used in this calibration procedure refer to Figure 6-1 except when noted otherwise.

1. Install the governor on a test stand and remove the governor cover.

2. Fill the governor to within 50 mm (2 inches) of the top with clean oil with a viscosity of 100 to 300 SUS at 16 to 92 °C (60 to 180 °F).

3. Install the protractor to the governor terminal shaft, and connect the protractor to the test stand.

4. Place the magnetic tool base on the governor test stand with the pointer close to the protractor. Rotate the terminal shaft fully clockwise, placing the power piston in its lowest position. Align the pointer to the “0” mark on the protractor.

5. Fasten the test cover to the governor.

6. Install spring (47), spring seat (48), and retaining ring (49) on plunger (39). Make sure that the end of the spring clip (40A) is resting above pivot pin (41) on feedback lever (40).

7. Install the pneumatic head onto the test cover.

8. Attach the air supply lines on the speed-setting housing. The air supply line must be attached to a regulated air pressure signal from a pneumatic controller or from a pressure regulator.

9. Attach oil line (25) to the speed setting device with elbow (21).

10. Check the speed setting bellows range adjustment for proper mark orientation as shown in Figure 3-6.

IMPORTANT

Find the orientation mark on the top edge of the bellows. Turn this mark to a position as shown in Figure 3-6. This is approximately midrange. Turning this mark clockwise (cw) increases the amount of speed change for a given air pressure change. Turning the mark counterclockwise (ccw) decreases the amount of speed change for a given air pressure.

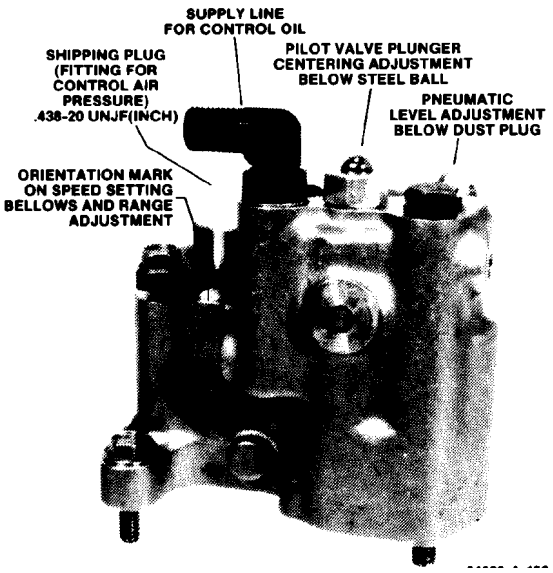


Figure 3-6. Pneumatic Speed-Setting Device

11. Rotate the governor drive shaft at 2000 rpm in the proper direction.

    A decal on the side of the governor case indicates direction of rotation when shipped from the factory. Governor direction of rotation, as viewed from the top of the governor, is also stamped on the governor name plate.

NOTICE

Be sure test stand drive and governor drive rotation are the same when viewed from the top of the governor. Incorrect drive rotation may cause governor damage.

12. Remove dust plug (9) and turn level adjusting screw (37) in the pneumatic head ccw until speed-setting rod (39) is fully extended. The speed setting rod (39) can be seen by looking under the test cover and at full extension should be approximately 13 mm (0.5 inch) below speed setting rod guide (46).

13. Follow this procedure to center the pilot valve in the pneumatic head: Adjust screw (20) above pilot valve (23) in the pneumatic head cw until speed setting rod (39) moves up. Then turn the screw one turn ccw, which again should extend speed setting rod (39).

14. Follow this procedure to make the maximum speed adjustment: Adjust the speeder spring screw (16) (Figure 3-2) using a 1/8 inch ball-end hex driver to obtain the following speed at 2 degrees terminal-shaft position:

- 2900 ±20 rpm for the 2000 rpm governor
- 4400 ±20 rpm for the 4000 rpm governor
- 6600 ±20 rpm for the 6000 rpm governor

15. Follow this procedure to make the level adjustment:

Drive the governor at the following speed:

- 1800 rpm for the 2000 rpm governor
- 3600 rpm for the 4000 rpm governor
- 5400 rpm for the 6000 rpm governor.

    Adjust level adjusting screw (37) to obtain 38 degrees terminal-shaft position.

16. Follow this procedure to check the droop setting: Increase governor speed to obtain 2 degrees terminal-shaft position. Speed should be:

- 2010 ±20 rpm for the 2000 rpm governor
- 403S ±20 rpm for the 4000 rpm governor
- 6000 ±20 rpm for the 6000 rpm governor

    It may be necessary to readjust the droop slider to obtain this speed. If the customer desires droop other than what is described here, adjust as necessary.

    Moving the droop slider away or towards the terminal-shaft center line increases or decreases droop, respectively. Do not move the droop slider past the point of zero droop (the center line of the terminal shaft), as this will result in unstable operation.

17. If the droop setting is changed, repeat steps 15 and 16 until correct droop is obtained.

18. Place a torque wrench on the terminal shaft, Torque required to rotate the terminal shaft to maximum fuel should be 23 N·m (200 lb-in) minimum for the TG-13 and 30 N·m (267 lb-in) for the TG-17.

19. Remove the oil line, air supply line, pneumatic head, retainer ring, spring seat, spring, and test cover from the governor.

20. Before installing the full governor cover, make sure that the end of the spring clip (40A) is resting above pivot pin (41) on feedback lever (40).

21. Install the full cover. During the installation of the full cover, make sure that the speed-setting lever is kept under the droop slider.

22. Torque the cover screws to 10 N·m (90 lb-in). Connect oil and sir pressure lines.

23. Install spring (47), spring seat (48), retaining ring (49), and the pneumatic head on the governor.

24. Remove plug (45) from the cover.

25. Turn level adjusting screw (37) in the pneumatic head ccw six turns.

26. Speed-setting lever (34) is now fully depressed. Enter through hole in cover where plug (45) goes and turn speeder spring screw (16) (Figure 3-2) using a 1/8 inch ball-end hex driver to obtain the following speed at 2 degrees terminal shaft position:

- 2900 ±20 rpm for the 2000 rpm governor
- 4400 ±20 rpm for the 4000 rpm governor
- 6600 ±20 rpm for the 6000 rpm governor

27. Apply 103 kPa (15 psi) air pressure to the pneumatic head. Turn level adjusting screw (37) cw so that governor is controlling at 38 degrees terminal shaft or full fuel position at desired high speed.

28. Adjust the air pressure to 21 kPa (3 psi) and check for desired low speed at 2 degrees terminal-shaft position, or other terminal-shaft position specified by the customer.

29. Follow this procedure to make the range adjustment: If the speed at 3 psi is too high, move the mark (see Figure 3-6) on the bellows seat cw when viewing the pneumatic housing as in Figure 3-6. If the speed is too low, move the mark on the bellows seat ccw.

    Repeat steps 27 and 28 until desired speed at 103 kPa (15 psi) and 21 kPa (3 psi) are achieved. Four different feedback springs (14) are available to match the speed range with the speed range of various governors. If the speed range cannot be achieved, it may be necessary to acquire a different feedback spring.

30. Slowly increase and then decrease the control air pressure. Governor speed must increase and decrease smoothly with no hysteresis.

31. Install the governor cover, plug (45), and slotted plug (9).

32. Press steel ball (17) in.

Chapter 4.
Theory of Operation

Introduction

This chapter describes the theory of operation of the pneumatic speed setting device used on the TG governor. See Figure 4-1 for a schematic of the pneumatic speed setting device.

Operation

The pneumatic speed setting device uses external air pressure and governor oil pressure to set governor speed.

An increase in air pressure expands the speed setting bellows (6). The bellows pushes down on the end of speed setting-lever (34) at the left of the pivot point, raising the right end of the speed-setting lever. Supply oil flows through the orifice of the speed-setting pilot-valve plunger (23) into a cavity below the pilot valve plunger. When oil flow from nozzle (28) is restricted, the oil pressure is raised, raising the pilot valve plunger. This allows high pressure oil to flow through a port to the speed setting piston (15), moving it downward to increase governor speed. As the speed setting piston moves down, feedback spring (14) is compressed and pushes the speed-setting lever away from the nozzle. Oil leaves the cavity below the speed-setting pilot valve plunger, and pilot-valve loading spring (22) returns the speed-setting pilot-valve plunger to a “null” position. The speed-setting piston takes a position that is proportional to the air pressure supplied to the speed-setting bellows.

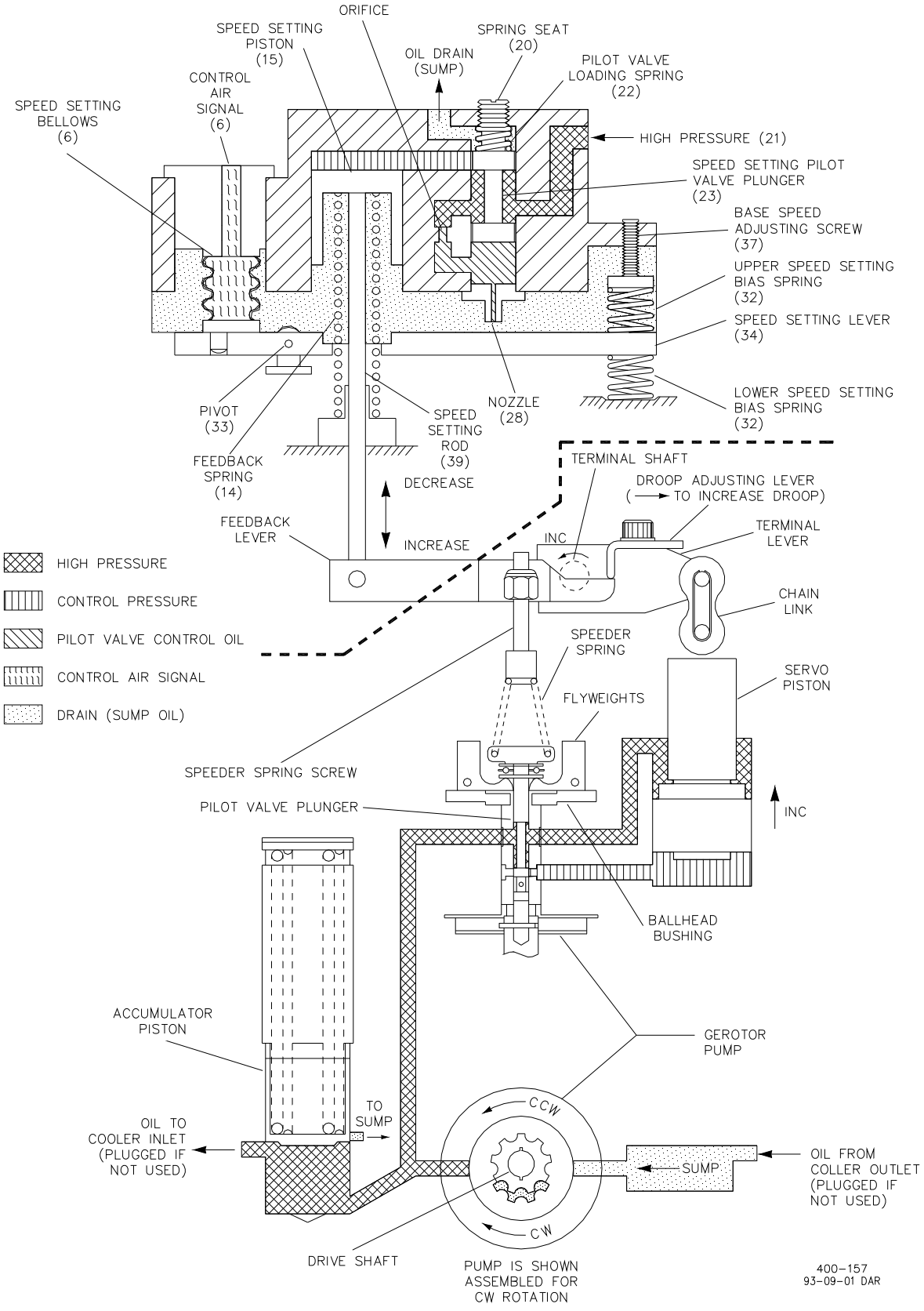


Figure 4-1. Schematic of the TG-13/17 Governor with Pneumatic Speed Setting Device

Chapter 5. Troubleshooting, Disassembly, and Assembly

Introduction

This chapter provides instruction for troubleshooting, repair, and calibration of the pneumatic speed setting device.

Troubleshooting

Use the following guide to help troubleshoot the pneumatic speed setting device.

If any part of the pneumatic speed setting device is disassembled, it will require calibration before being returned to service on the prime mover. See the Calibration Procedure at the end of this chapter.

⚠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.

Table 5-1. Troubleshooting Chart

Symptoms	Cause	Correction
Speed does not increase when air pressure (as specified by the engine manufacturer) to the speed-setting bellows is increased.	Binding of external linkage attached to the terminal shaft. Air leak in the speed-setting bellows and/or air lines. Control pilot-valve plunger incorrectly adjusted. Speed-setting range or level incorrectly adjusted. Speed-setting pans within the TG governor may be sticking or binding.	Realign linkage as necessary. Locate and stop the air leak. Refer to the calibration procedures, item 5, for adjustment procedure. Speed-setting range or level may be out of calibration. Refer to the calibration procedures for adjustment procedure. Refer to manual 56101, Section 3A or 38, Governor Repair, for disassembly, repair and assembly of the TG speed setting parts.
Speed does not decrease when the air pressure is removed from the speed-setting bellows.	Binding of external linkage attached to the terminal shaft. Control pilot-valve plunger incorrectly adjusted. Speed-setting range or level may be incorrectly adjusted. Speed-setting parts within the TG Governor may be sticking or binding,	Realign linkage as necessary. Refer to Calibration Procedures in Chapter 3 for adjustment procedure. Refer to the calibration procedures for adjustment procedure. Refer to manual 56101, Section 3A or 3B, Governor Repair, for disassembly, repair, and assembly of the speed-setting parts.

Disassembly

Remove the governor from the prime mover.

NOTICE

This governor is a precision device and should be treated as such. Set the governor upright on wooden blocks to protect the drive shaft. Do not drop or set the governor on the drive shaft as this may cause damage to the drive shaft, bearings, seals, or other parts inside the governor.

Do not disassemble the device any further than necessary. All disassembly and repair should be done by personnel experienced in repair and calibration of precision controls. In all repair work, it is essential that tools, the work area, and parts be kept clean.

⚠WARNING

Wear approved eye protection to prevent possible eye injury during disassembly, cleaning, and assembly of parts.

Disassemble the device according to the following instructions. Reference numbers in parentheses are assigned to each part in the exploded view, Figure 6-1.

1. Remove oil supply tube (25) and the air supply line from the speed-setting housing. Remove screws (13, 16, and 27) and lift the speed-setting device from the governor cover.

2. Remove lower speed-setting bias spring (32) and gasket (36) from the governor cover.

3. Remove three screws (1) and servo cover (2). Use screw (1) to pull plug (3) from housing (26). Remove piston (15) and spring (14).

4. Remove plug (9). DO NOT remove speed adjusting screw (37) unless replacement of the screw is necessary.

5. Remove plug (18), spring seat (20), spring (22), and pilot-valve plunger (23).

IMPORTANT

DO NOT remove spring seat (20) and ball (17) from plug (18), unless it is necessary to replace parts (26, 23, or 22).

For disassembly, refer to Figure 5-1.

Clamp spring seat (20) in a vise. Turn plug (18) counterclockwise to remove the plug from the spring seat. Turn the plug over and with a 1/8-inch punch and an arbor press, press ball (17) from the plug. (Ball (17) will be reinstalled after the unit has been calibrated).

6. Remove two screws (1) and strap (5).

7. Remove bellows (6) from housing (26).

8. Turn housing (26) upside down. Remove screw (35). Lift up on speed-setting lever (7) and remove upper speed-setting bias spring (32), spring seat (31), and steel ball (30).

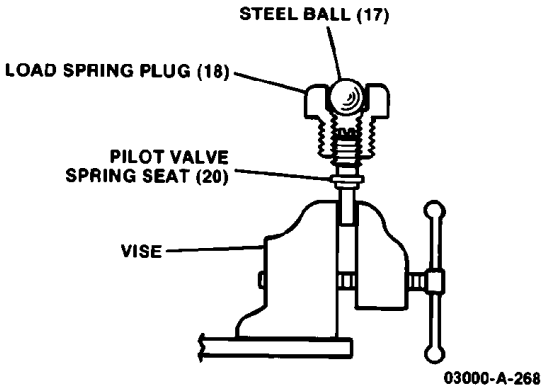


Figure 5-1. Removing Pilot Valve Spring Seat (20) and Steel Ball (17) from Loading Spring Plug (18)

9. Remove plug (9) and pin (11). Remove speed-setting lever (34).

10. Do not remove nozzle (28) unless damage is apparent.

Cleaning

Clean parts with solvent and a stiff brush to remove foreign particles.

Dry parts with clean tint-free wipes, or blow dry with clean dry air.

⚠CAUTION

Observe solvent manufacturer's instructions or restrictions regarding the use of solvents. If no instructions are available, handle with care. Use the cleaning solvent in a well-ventilated area away from tires or sparks.

Handle parts that have been machined to a close tolerance carefully, to prevent damage caused by contact with other parts or objects.

Part Inspection

(Refer to Figure 6-1.)

Springs (14, 22, 32, 47)

Inspect springs for rust and corrosion and replace if any damage is found.

Bearings (33)

Inspect bearings for dirt and worn areas. Replace them if they do not run smooth.

Speed Setting Lever (34)

Inspect the lever in the area of contact with nozzle (28).

Nozzle (28)

Inspect the nozzle for damage caused by speed setting lever (34). Replace if damaged.

Pin (11)

Inspect pin in the area of contact with bearings (33). and replace if any wear is visible.

Housing (26)

Inspect for wear in the bore caused by speed-setting piston (15). Also check for wear in the pilot-valve plunger bushing caused by pilot-valve plunger (23).

Speed Setting Piston (15)

Inspect the piston for uneven wear, nicks and scratches. Polish the piston carefully with a fine grit paper to remove any burrs from the edges.

Pilot Valve Plunger (23)

Inspect sharp corners for nicks and scratches. Replace the plunger it any damage is found.

Speed Setting Bellows (6)

Inspect the bellows for dirt and damage.

Assembly

Lay the parts on a clean, dry work surface.

Lubricate all O-rings with Vaseline to facilitate assembly.

Use only new O-rings, seals, and gaskets. Careful and precise assembly methods will save time, and help to ensure correct calibration and operation of the device.

Torque all 1/4-20 screws to 10 ±1 N·m (90 ±10 lb-in).

Assembly Procedures

(Refer to Figures 5-2, 5-3, and 6-1.)

1. If removed during disassembly, press nozzle (28) in place using a tool as shown in Figure 5-2. Be careful not to damage the nozzle or housing (26).

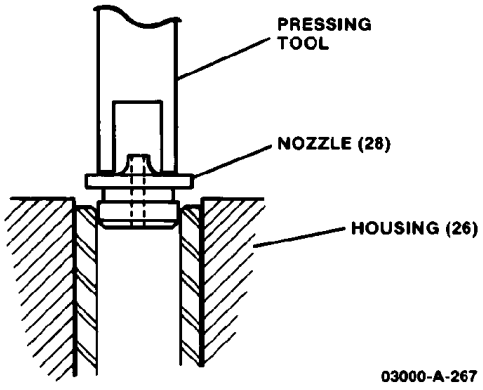


Figure 5-2. Method of Pressing Nozzle (28) into Housing (26)

2. Place pilot-valve plunger (23) in housing (26) with the spring seat up.

IMPORTANT

Remove spring seat (20) and ball (17) from loading spring plug (18) if pilot-valve plunger (23), loading spring (22), or housing (26) was replaced.

For disassembly, refer to Figure 5-1.

3. Turn spring seat (20) counterclockwise 3 or 5 turns, up through the bottom of plug (12). Put O-ring (13) on plug (12).

4. Install spring (22) on spring seat (20). Place plug (18), with seat (20) and spring (22), in housing (26).

5. Use a 1/8 inch Allen wrench to turn set screw (37) up through the bottom of housing (26). Turn the screw counterclockwise until it is halfway into the housing.

6. Install O-ring (10) on plug (9). Screw the plug into housing (26).

7. Fill spring seat (31) with white petroleum jelly to hold steel ball (30) in place during installation.

8. Use white petroleum jelly to stick spring seat (31) to upper bias spring (32) for installation into housing (26). Raise fever (34) and install spring, spring seat, and ball on set screw (37).

9. Place bearings (33) in speed-setting lever (34). Start pin (11) into housing (26). Place lever (34) in the housing and push pin (11) through bearings (33) and lever (34).

10. Install O-ring (10) on plug (9) and place in housing (26).

11. Install screw (35) through lever (34) into housing (26). If the nozzle has been replaced, it must be reseated. To seat nozzle, press down on the speed-setting lever near the adjusting screw (35) to remove the slack between nozzle (28) and nozzle plug and lightly tap the nozzle plug twice with a blunted center punch. Turn the adjusting screw (35) in until the nozzle plug lightly contacts the nozzle (28), then back it out one full turn. See Figure 5-3 for location of the nozzle plug.

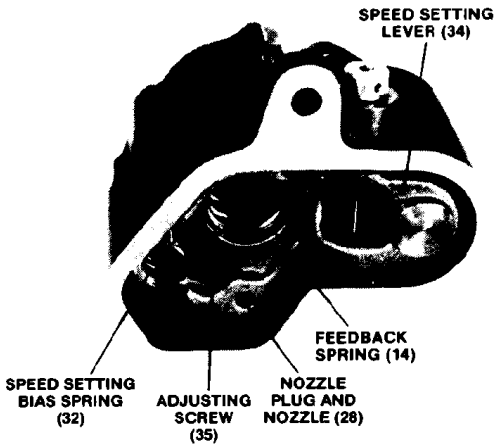


Figure 5-3. Seating Nozzle (28) with the Nozzle Plug

If the nozzle (28) has not been replaced, carefully run the screw in until the lever lightly contacts the nozzle, then back it out one full turn.

NOTICE

Reseating a nozzle that has already been seated, will damage the nozzle.

12. Place speed-setting spring (14) in housing (26) and seat it in lever (34). Place speed-setting piston over spring (14). Be sure the piston moves freely in housing (26).

13. Put O-ring (4) on plug (3). Place plug (3), with threaded hole up, in housing (26).

    Secure the plug with cover plate (2) and three screws (1).

14. Put O-ring (7) on speed-setting bellows (6). Install bellows (6) in housing (26) with the orientation mark on the top of the bellows turned as shown in Figure 3-6. Secure bellows in the housing with plate (5) and two screws (1).

NOTICE

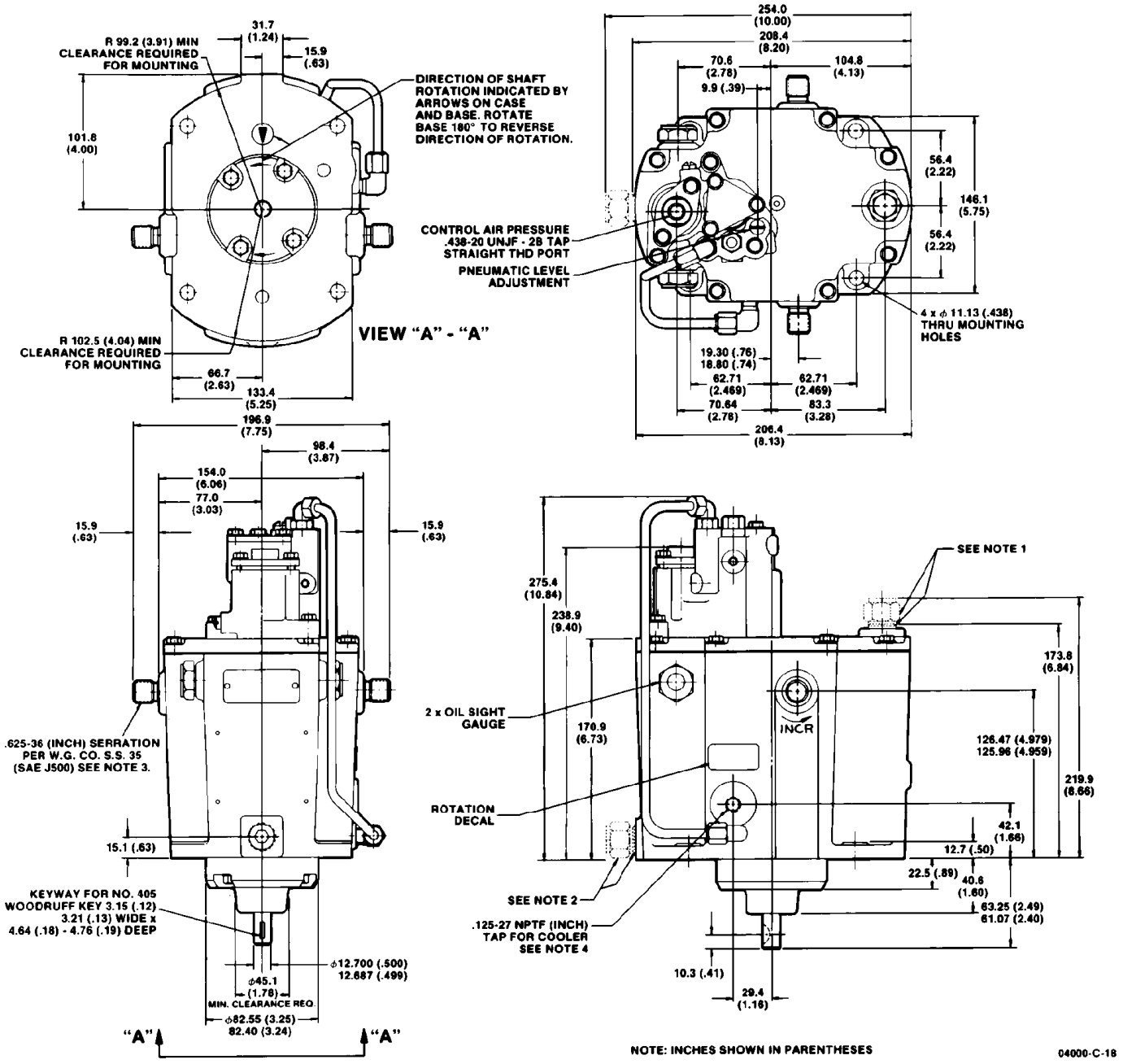
Turn screws (1) down together to prevent damage to bellows (6) and plate (5).

15. Place gasket (36) in place on the governor cover. Set lower bias spring (32) in place on the cover. Carefully place the device on the cover, being sure the lower bias spring (32) is seated in speed-setting lever (34).

16. Carefully place seal (8) on screw (16). Insert screw (16) through housing (26) and start it in the cover. Align gasket (36) with screw holes and install two screws (13 and 27). Torque screws (13, 27 and 16) to 10 ±1 N·m (90 ±10 lb-in).

17. Attach oil supply tube (25) to fitting (21) and the air supply line on the speed setting housing.

18. Tighten all air and oil line connections to prevent leakage.



NOTES:

1. OIL FILL PORT/BREATHER FILTER CAP LOCATION WHEN GOVERNOR DRIVE SHAFT IS MOUNTED VERTICALLY. OIL DRAIN PLUG LOCATION WHEN GOVERNOR DRIVE SHAFT IS MOUNTED HORIZONTALLY.
2. OIL FILL PORT/BREATHER FILTER CAP LOCATION WHEN GOVERNOR DRIVE SHAFT IS MOUNTED HORIZONTALLY. OIL DRAIN PLUG LOCATION WHEN GOVERNOR DRIVE SHAFT IS MOUNTED VERTICALLY.
3. TERMINAL OUTPUT SHAFT MAX AVAILABLE STROKE IS 40°. RECOMMENDED STROKE FROM NO LOAD TO FULL LOAD IS 25° - 30°.
4. COOLER TAP OUTPUT (USED ON 6000 RPM GOV.) COOLER RETURN TO BE CONNECTED TO GOVERNOR DRAIN.

Figure 5-4. Outline Drawing of TG-13/17 Governor with Pneumatic Speed Setting Device

Chapter 6.
Replacement Parts

When ordering replacement parts, include the following information:
1. Manual number (this is manual 04047).
2. Governor serial number and part number shown on the nameplate.
3. Part reference number and part name from parts list.

Ref. No.	Part Name	Quantity
04047-1	Screw .250-20 x 1.0	5
04047-2	Cover plate	1
04047-3	Plug	1
04047-4	O-ring 1.114 ID x .070	1
04047-5	Plate	1
04047-6	Bellows assembly	1
04047-7	O-ring 1.176 ID x .070	1
04047-8	Stat-o-seal .250	2
04047-9	Plug .250-28 slotted	2
04047-10	O-ring .176 ID x .070	2
04047-11	Pin	1
04047-12	Washer .265 x .500 x .064 thick 55	2
04047-13	Screw .250-28 x .875 hex hd cap	1
04047-14	Feedback spring	1
04047-15	Speed setting piston	1
04047-16	Screw .250-28 x 3.750 hex hd	1
04047-17	Steel ball .3125	1
04047-18	Nut .250-28	1
04047-19	O-ring .351 ID X .072	1
04047-20	Pilot valve spring seat	1
04047-21	Elbow	1
04047-22	Pilot valve loading spring	1
04047-23	Plunger assembly	1
04047-24	Cup	1
04047-25	Tubing	1
04047-26	Housing	1
04047-27	Screw .250-20 x 1.250	1
04047-28	Nozzle	1
04047-29	Elbow ½ Pipe Thd to ¼ tube	1
04047-30	Steel ball .250	1
04047-31	Spring seat	1
04047-32	Speed setting bias spring	2
04047-33	Flanged bearing	2
04047-34	Speed setting lever	1
04047-35	Screw 10-32 x .750 soc hd cap	1
04047-36	Gasket	1
04047-37	Set screw .250-28	1
04047-38	Nut .250 x 28	2
04047-39	Speed setting rod	1
04047-40	Speed setting feedback lever	1
04047-40A	Spring clip	1
04047-41	Pin .1885 die x .875	1
04047-42	Gasket	1
04047-43	Cover	1
04047-44	O-ring .239 ID x .064	1
04047-44A	Breather/Filler cap	1
04047-45	Plug 312-24 hollow hex	1
04047-46	Speed setting rod guide	1
04047-47	Speed setting return spring	1
04047-48	Spring setting spring seat	1
04047-49	Retaining ring, ext .225 die	1
04047-50	Shipping plug .438-201	not shown

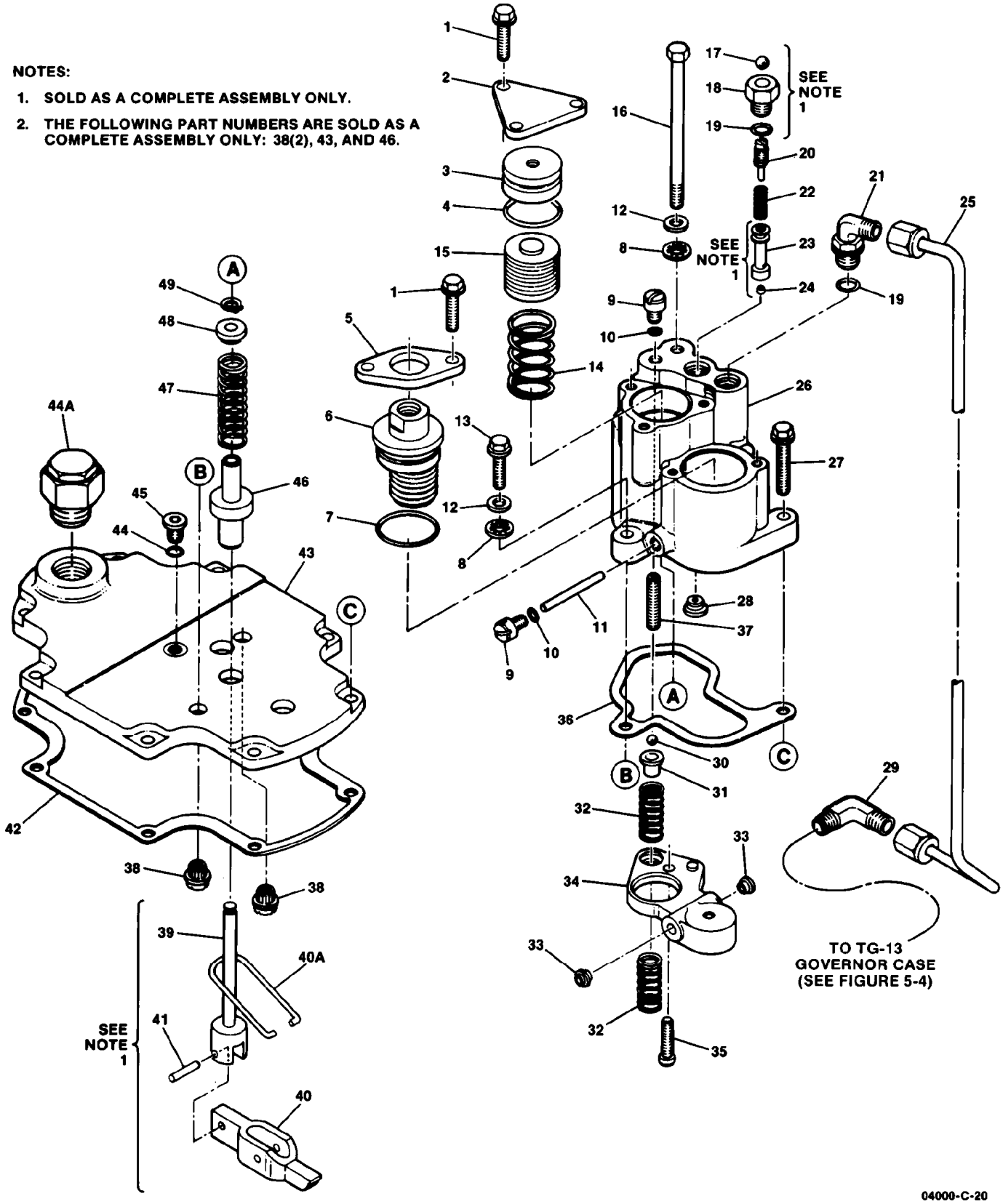


Figure 6-1. Parts for the TG-13/17 Pneumatic Speed Setting Device

Chapter 7.
Service Options

Product Service Options

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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 04047C.

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