



**ST-125™
Control
System**



**8405-307 Control
8405-309 and 8405-315 Actuator
for Stanadyne DB-4 Series Pumps**

CE Compliant

Installation and Adjustment Manual

WOODWARD GOVERNOR COMPANY



WARNING

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.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.



CAUTION

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.



CAUTION

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.

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Chapter 1

General Information

This manual covers ST-125™ part numbers:

8405-307 ST-125 Control
8405-309 and 8405-315 Actuator

The ST-125 Control System consists of a separate actuator and control. The actuator is a bi-directional actuator designed specifically for the Stanadyne DB-4 Series diesel fuel injection pumps. The control can be mounted in a cabinet or to the skid, but, in either case, the control must be protected from water and excessive dirt. The ST-125 Speed Control is designed for applications where a constant speed must be maintained.

Features of the ST-125 Control system include:

- Capability for both 12 volt and 24 volt operation
- Start Fuel Limiting
- Retention of the Stanadyne shutdown solenoid
- Precise engine control using actuator position feedback
- Capability of covering a wide range of magnetic pickup (MPU) frequencies through the use of a four-position switch

The Start Fuel Limiting allows a setting for the maximum fuel in the Stanadyne pump on initial start-up to reduce “black smoke” starts. This maximum position remains in effect until the engine reaches rated speed. This limit can be disabled if desired.

Since the ST-125 Actuator mounts in the same location as the throttle lever and shaft assembly, the original shutdown solenoid is retained.

The ST-125 Actuator incorporates position feedback that provides accurate and quick response.

There are two methods of engine shutdown provided with the ST-125 system. Along with the above mentioned retention of the shutdown solenoid, a second method is provided by means of the Run/Stop feature. A user-supplied switch connected to the Run/Stop wire is an effective means to drive the Stanadyne pump to minimum fuel and provide an immediate shutdown, but it should not be used as an emergency method for shutdown.

Declaration of Incorporation

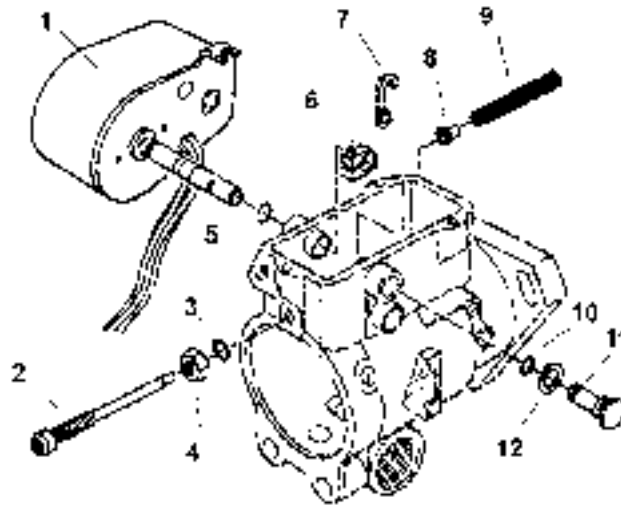
In accordance with the EMC Directive 89/336/EEC and its amendments, this controlling device manufactured by the Woodward Governor Company, is applied solely as a component to be incorporated into an engine prime mover system. Woodward Governor declares that this controlling device complies with the requirements of EN50081-2 and EN 50082-2 when put into service per the installation and operating instructions outlines in the product manual.

Notice: In order to be EMC Directive compliant, this controlling device is intended to be put into service only upon incorporation into an engine prime mover system that itself has met the requirements of the above Directive and bears the CE mark.

Chapter 2

Preparation of Stanadyne Fuel Pump

Parts Diagram



Parts List

- | | |
|--------------------------|----------------------------|
| 1. Actuator | 7. Roller-Type Shutoff Cam |
| 2. Adjustable Guide Stud | 8. Idle Spring Retainer |
| 3. Seal - Black | 9. Governor Spring |
| 4. Locknut | 10. Seal - Red |
| 5. Seal - Brown | 11. Retaining Shaft |
| 6. Gear Clamp | 12. Spacer Washer |

Removing Existing Governor Control Cover

1. Remove the fuel return line from the pump return line connector assembly. Use two wrenches to loosen.



NOTE

Clean the outside of the pump with solvent and dry with compressed air before removing the Stanadyne governor control cover. A suitable container should be placed under the fuel injection pump to catch any fuel that may spill when removing the cover.

2. Disconnect the electric shutoff (ESO) solenoid wire from the governor control cover.
3. Loosen the three cover screws and remove the governor control assembly from the pump. Save all the screws and the cover for later installation.



Preparing Stanadyne Fuel Pump

4. Remove and discard the throttle shaft linkage snap clip (or shut-off cam, if external lever). Use Stanadyne tool #20992 or needle nose pliers.



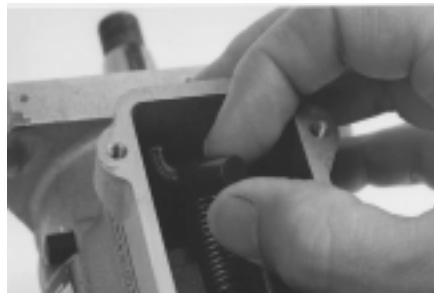
5. Remove the shutoff shaft assembly. Remove the o-ring seal and spacer washer from the shaft and discard.



6. Remove the throttle lever and shaft assembly and the throttle lever fork and spacer.



7. If the pump is equipped with a damper assembly, slide the damper barrel off the damper piston.



8. While holding the control rod guide with a 5/8 inch (16 mm) wrench, use a 9/16 inch (15 mm) wrench to loosen and remove the droop control locking cap.



9. Twist and pull to remove the slotted adjusting cap assembly.



10. Use diagonal cutting pliers to remove the control spring pin from the control rod.



11. Loosen and remove the control rod guide.



12. Disengage the governor spring from the governor arm. Depress the metering valve and remove the control rod and spring assembly.



13. Install the new spring and guide stud assembly (Woodward kit 8934-636).



- a. The wire that crosses the center of the spring should be placed between the fingers on the lever. Install the spring seat into the open end of the spring.
- b. Thread the locknut and o-ring onto the guide stud slightly so only two or three threads are exposed behind the nut. This is to provide clearance for the nut and stud during installation into the pump.
- c. Install the guide stud by turning it into the pump until only one to two threads are exposed between the locknut and the head of the guide stud. Tighten the locknut against the side of the fuel pump to prevent fuel leakage.

Installation of ST-125™ Actuator

14. Install the ST-125™ Actuator using the following procedure.



- a. Lubricate the actuator o-ring (#5/brown) with silicone or petroleum based lubricant prior to assembly.
- b. Partially insert the ST-125 actuator into the pump bushing. Place the retaining collar over the shaft with the clamping screw boss on the cam slot side of the shaft. Slide the actuator and collar into place.

c. Hold the actuator solidly against the pump housing bushing by squeezing the actuator and collar together to remove end play. Press directly behind the bushing—not on the free end of the actuator. A maximum of 0.05 mm (0.002 inch) axial end play is allowed, but zero end play is preferred. Torque the 6-32 screw to 1.0 to 1.4 N·m (9 to 13 lb-in). DO NOT OVERTIGHTEN.



Following assembly, check that the actuator shaft rotates freely.

15. With the actuator fully inserted, insert the grooved o-ring (#10/red o-ring) plug (from kit 8934-636) into the shutdown shaft bushing.



16. Insert the shutoff cam (from kit 8934-636) into the slot on the actuator shaft, making sure it engages the groove on the grooved o-ring plug, and that the roller engages the metering valve linkage. Check for free operation of the metering valve linkage and actuator shaft.



17. Reassemble the pump cover by rotating the actuator so the cover clears the actuator mounting tang, then rotate the actuator back so the tang sits on top of the mounting hole.

**NOTE**

Press the shutdown lever back during assembly to assure it correctly engages the metering valve linkage.

Use a new cover gasket, cover screws, and both lock and flat washers.

**NOTE**

Do not load the end of the actuator against the pump when tightening the cover screw. This will cause the actuator shaft to bind.

Tighten the screws to 2.8 to 3.9 N·m (25 to 35 lb-in).



18. Wiring and connectors between the actuator and the speed control are customer supplied. Match the wire colors from the actuator to the speed control.

19. Re-connect the ESO wires removed in step 2.



Chapter 3

ST-125™ Installation and Calibration

The ST-125™ Actuator is equipped with a Deutsch DT-series connector and accepts mating connector:

6-socket connector	part number DT06-6S-EP04
locking wedge	part number W6S
contact pin	part number 1062-16-0122
(0.5–1.5 mm ² [20–16 AWG])	

The ST-125 Control is equipped with a Deutsch DT-series connector and accepts mating connector:

6-pin connector	part number DT04-6P-EP04
locking wedge	part number W6P
contact pin	part number 1060-16-0122
(0.5–1.5 mm ² [20–16 AWG])	

Mount the control on the skid or to a control panel that is enclosed so that the control is protected from the weather. Cable lengths between the ST-125 actuator and control, and the distance between the control and battery, should not exceed 6 m (20 feet). Mount the control in a location allowing space for potentiometer adjustment. Do not expose the control to sources of radiant heat such as exhaust manifolds or turbochargers. The speed control is designed to operate within a temperature range of –40 to +70 °C (–40 to +158 °F). Also, choose a protected location so the control will not be damaged when moving the engine/generator set or when equipment is moving nearby.

All wires from the actuator must be terminated to the control with their respective matching color codes (see the wiring diagram, Figure 3-2).

If the Run/Stop option is not used, tie pin 11 (green wire) to the battery (+). The control is in the Run mode when pin 11 is connected to the battery (+). If the Run/Stop feature is used, the control drives the actuator and respective fuel pump to minimum fuel when pin 11 is disconnected from the battery (+) or connected to the battery (–). After six to ten seconds, the power to the actuator is shut off (allowing pump to go to max fuel) to prevent unnecessary power drain while the engine is off.

Install the magnetic pickup (MPU) through a housing or rigid bracket. Make sure the sensed gear is of a magnetically soft material (a typical non-stainless steel). The gap between the pickup and the outside diameter of the gear should be set between 0.25 and 1.00 mm (0.010 and 0.040 inch) at the closest point (allow for radial runout).

Pre-Start Potentiometer Settings

- Speed Trim fully counterclockwise (minimum)
- Start Fuel fully clockwise (maximum)
- Stability at mid-position
- Gain at mid-position

Using the desired rated engine rpm and the number of teeth on the flywheel, calculate the rated MPU frequency in hertz:

$$\text{Rated MPU Frequency (Hz)} = \frac{(\text{rpm})(\# \text{ of Teeth on Gear})}{60}$$

With this calculated MPU frequency, find the speed range in the table that includes this MPU frequency.

Set the four position DIP switch on the control to the switch combination that matches the speed range that includes the calculated MPU frequency. (The switch is closed when the switch is depressed with a pen or pencil on the side closest to the control's outer edge.)

Speed Range (Hz)		Sw1	Sw2	Sw3	Sw4
Low	High				
1429	1590	Open	Open	Closed	Open
1591	1915	Open	Open	Closed	Closed
1916	2305	Open	Closed	Open	Open
2306	2749	Open	Closed	Open	Closed
2750	3399	Open	Closed	Closed	Open
3400	4049	Open	Closed	Closed	Closed
4050	5002	Closed	Open	Open	Open
5003	5505	Closed	Open	Open	Closed
5506	5868	Closed	Open	Closed	Open
5869	6425	Closed	Closed	Open	Open
6426	6922	Closed	Open	Closed	Closed
6923	7315	Closed	Closed	Closed	Open
7316	8025	Closed	Closed	Open	Closed
8026	8740	Closed	Closed	Closed	Closed

Startup and Adjustment

Starting the Engine

Start the engine using the manufacturer's instructions.



WARNING

TO PROTECT AGAINST POSSIBLE PERSONAL INJURY, LOSS OF LIFE, AND/OR PROPERTY DAMAGE WHEN STARTING THE ENGINE, BE PREPARED TO MAKE AN EMERGENCY SHUTDOWN to protect against runaway or overspeed should the electric control, the actuator, or the fuel control fail.

If the engine does not start, check to assure that the control is receiving the proper battery voltage, that the Run/Stop wire (green wire) has battery voltage applied to it, and that the magnetic pickup is putting out at least 1.0 Vrms. Also, check that the engine is cranking at a minimum of 5% of rated speed, that the engine is receiving proper fuel, and that the shutdown solenoid is in the run condition.

If the engine is unstable after startup, slowly turn the gain pot counterclockwise until it is stable. If the engine is stable, turn the gain slowly clockwise until the engine is unstable and then turn the gain slightly counterclockwise until the engine is stable again.

Speed Trim Adjustment

After the engine is stable, adjust the Speed Trim clockwise until the correct rated engine speed is obtained. If the rated engine speed cannot be obtained or if the engine speed is already above rated speed, the four-position DIP switch is not in the correct setting. If it is necessary to readjust the speed setting switch, the engine must be shut down during this procedure.



WARNING

The engine must always be shut down during speed switch adjustments to prevent the possibility of engine overspeed during this process.

Stability and Gain Settings

The Stability and Gain can now be adjusted to obtain the type of engine response desired. The stability and gain adjustments allow you to change the way the engine responds to load steps and speed changes. With a high stability setting, the engine will start up at a controlled rate with little or no speed overshoot. Load steps will produce relatively little speed overshoot when the engine returns to rated speed. This “soft” engine response will occur at the expense of longer recovery times. A low stability setting will produce a “fast” engine response with short times to accelerate to rated speed and quick recovery times from load steps. This will occur at the expense of overshoots or underdamped oscillations (ringing) on speed and load transients. A Stability setting of mid-position is a good compromise between a “fast” engine response and a “soft engine response, and it is usually quite acceptable for most installations and applications.

When either the Gain or Stability is increased, the other adjustment will have to be decreased to maintain a stable engine. It is desirable to have as high a Gain setting as possible at the selected Stability setting in order to reduce the amount of engine speed variations. Check the response of the engine after each adjustment by load stepping the engine. If it is not possible to load step the engine, the engine stability can be checked by quickly disconnecting, then connecting the Run/Stop switch or wire. Repeat the following tuning procedure until the engine responds as desired.

NOTE



Too high a gain setting may result in stable operation at normal temperatures but could cause oscillation when the engine is cold. Readjustment may be required for satisfactory cold-start operation.

Start Fuel Limiting

The purpose of Start Fuel Limiting is to limit the fuel that the fuel pump can deliver to the engine on startup. When adjusted properly, the Start Fuel Limiting supplies the engine with just enough fuel to start but not so much as to produce black smoke during startups. After the engine reaches rated speed, this fuel limiting feature is disabled and the fuel pump is free to go to the maximum fuel condition. If the Start Fuel Limiting feature is not desired, adjust the pot to a full clockwise position. Otherwise, adjust the Start Fuel Limit pot to mid-position and re-attempt to start the engine. If the engine starts but produces black smoke, readjust the Start Fuel Limit pot counterclockwise slightly. If the engine did not start, turn the Start Fuel Limit pot clockwise slightly and repeat start attempt.

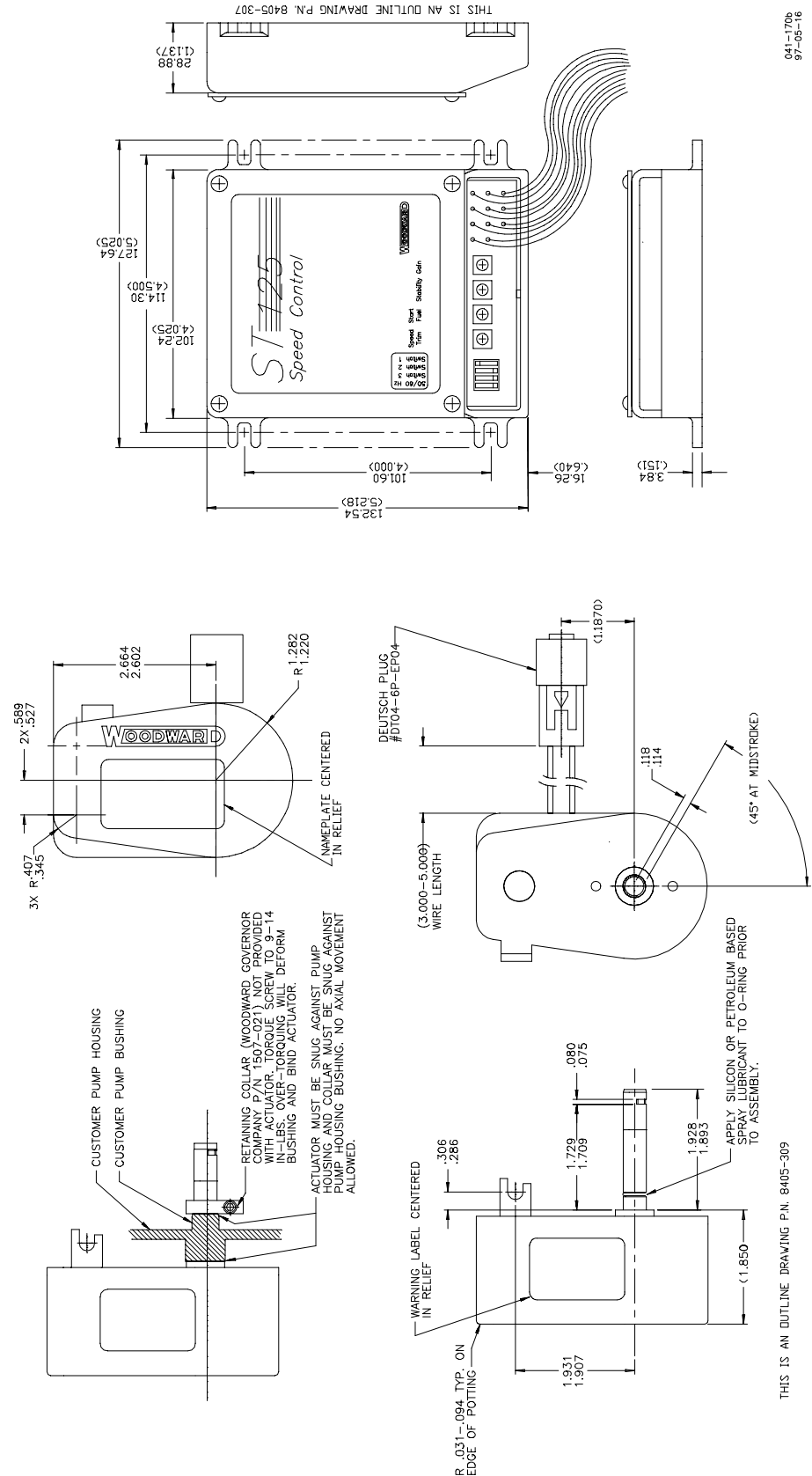


Figure 3-1. Control Outline Drawing

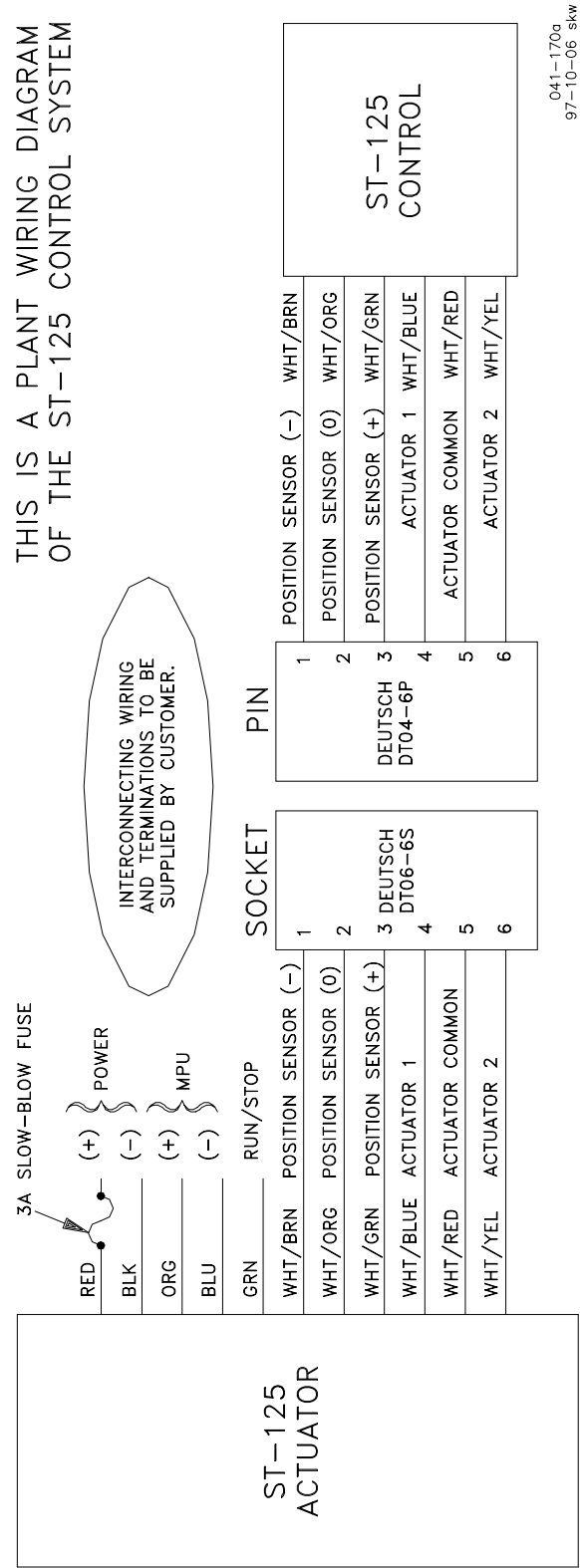


Figure 3-2. Control Wiring

Chapter 4

Repair and Replacement

Introduction

Identification

If any part of the electronic control is to be returned to Woodward Governor Company for repair, attach a tag to the part with the following information:

- name and location where the control is installed;
- complete Woodward Governor Company part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.



CAUTION

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

Packing a Complete Control

Use the following materials when returning a complete control:

- 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.

Additional Instructions

When returning equipment to Woodward, please telephone and ask for the Customer Service Department. They will help expedite the processing of your order through our distributors or local service facility.

Replacement Parts Information

When ordering replacement parts for electronic controls, include the following information:

- the part number(s) (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

How to Contact Woodward

Use the following address when shipping or corresponding:

Woodward Governor Company
Industrial Controls Group
PO Box 3800
3800 North Wilson Ave
Loveland CO 80539-3800

TELEPHONE: (970) 663-3900 (24 hours a day)
FAX: (970) 962-7050

There is also information and e-mail addresses on Woodward's Internet (World Wide Web) home page:
<http://www.woodward.com>

Other Service Facilities

Contact Woodward Governor Company, Customer Service Department for the name of your nearest Woodward distributor or service facility.

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:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Engine Information

Engine Model Number _____

Manufacturer _____

Number of Cylinders _____

Type of Fuel _____

Rating _____

Application _____

Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Governor Part Number and Revision Letter

Control Description or Governor Type

Serial Number _____

Woodward Governor Part Number and Revision Letter

Control Description or Governor Type

Serial Number _____

Woodward Governor Part Number and Revision 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.

ST-125™ Control Specifications

Woodward Part Numbers

8405-307	Control
8405-309 or 8405-315	Actuator

Compliance

CE Compliant

Environment

Operating Temperature

Actuator: -30 to +85 °C (-22 to +185 °F)

Control: -40 to +70 °C (-40 to +158 °F)

Storage Temperature

Actuator and Control: -40 to +85 °C (-40 to +185 °F)

EMI/RFI Susceptibility EN50081-2 and EN50082-2

Shock and Vibration US MIL-STD-810C, Curve J, 5 G from
5–2000 Hz in 3 axes

Typical Control Characteristics

Steady-State Speed Regulation

Rated speed ± 0.25 percent
(± 0.50 percent over the operating temperature)

Inputs

Speed Signal Input and Range

Magnetic Pickup Input:

1429–8740 Hz

30 Vac (rms) maximum

1 Vac (rms) minimum

Run/Stop Select Inputs:

8–32 Vdc, 4.0 mA maximum

Power Supply

8–32 Vdc (12/24 Vdc nominal), 2.7 A maximum
(3 A slow-blow fuse in line from battery required)

Power Consumption

23 W maximum