



**Replacing the ST-125™ Engine Control with
an L-Series Speed Controller 8404-5003**



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

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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

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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 Out-of-date translations are marked with .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.

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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.

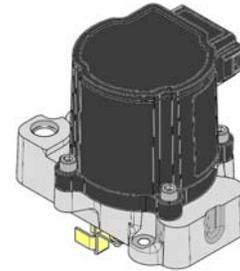
1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control 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.

Replacing the ST-125™ Engine Control with an L-Series Speed Controller 8404-5003

Introduction

Woodward's L-Series Speed Controller can be used as a functional replacement for the ST-125™ Speed Control. The L-Series 8404-5003 speed control was designed with many new features and functions that are not built into the ST-125.

The Woodward L-Series combines the L-Series electric actuator with integrated speed control software to control the speed of a diesel engine. The L-Series utilizes a microprocessor-based control that is incorporated into the actuator, creating a single, integrated package. This eliminates the need for an additional driver box and speed control box.



Refer to Woodward manual 26250 for details on the L-Series additional features, operation, adjustment, and troubleshooting.

Required Items to Complete Replacement

Installation Kit 8923-1253 (includes the following):

- 8404-5003 L-Series Speed Control with pump cover
- 1870-1022 Mounting Kit (Gasket and Screws)
- 02-0004-135 Bore Plug (2 each)
- 02-0004-136 O-Ring (2 each)
- 02-0004-137 Plastic Spacer (2 each)
- 02-0004-138 Clip (2 each)
- 5404-1049 Electrical Harness

Additional Items Needed:

- **Programming Harness 8923-1061** (used for configuring and tuning the L-Series)
- **9-Pin Straight-through Serial Cable** (not provided)
- **L-Series Service Tool Software 9927-1222** (free download from www.woodward.com)
- **L-Series Speed Control Manual 26250** (free download from www.woodward.com)

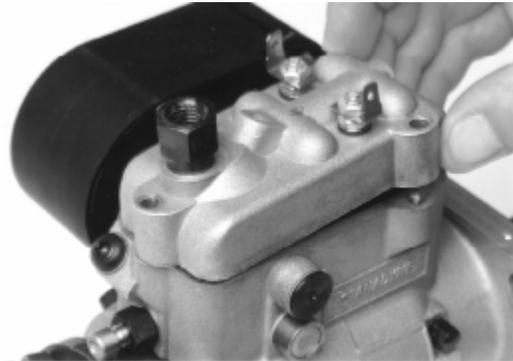
Overview

The following pages describe the ST-125 replacement in detail. The general replacement requires the removal of the ST-125 actuator and shutoff cam from the injection pump, then plugging the two holes in the sides of the pump housing. The L-Series is mounted on top of the Stanadyne pump, replacing the existing cover. The L-Series electrical harness can be installed using the existing wiring for the ST-125 speed control. A programming harness and a laptop computer are necessary to configure the control for the proper speed signal (number of teeth when using an MPU or number of cylinders when using ignition), speed set points (including the overspeed set point), tuning, and any necessary options. The default PID speed dynamics should be sufficient for the initial start-up. Once the engine is running, you can use the service tool software to adjust the speed dynamics for best performance in your application.

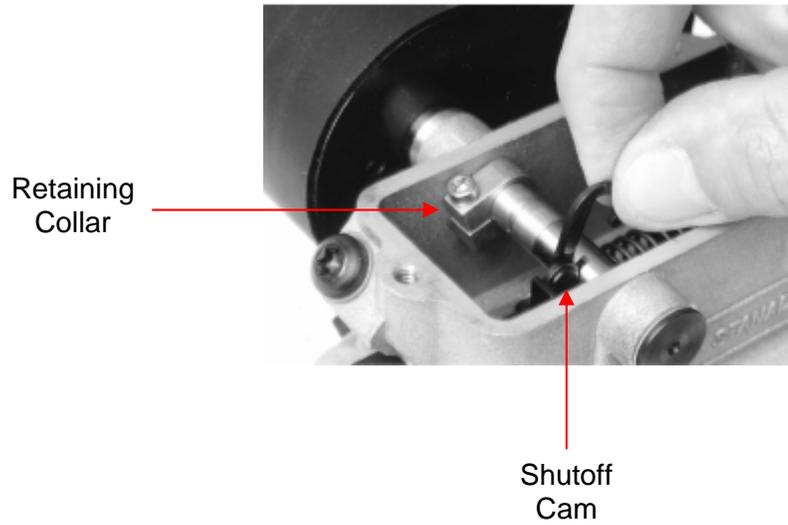
Mechanical Installation

Do not expose the control to sources of radiant heat such as exhaust manifolds or turbochargers. The L-Series control is designed to operate within an ambient temperature range of -40 to $+105$ °C (-40 to $+221$ °F). In spark-ignited applications, make sure the L-Series is located away from the ignition coil, and that harness wires are not routed next to the spark plug wires.

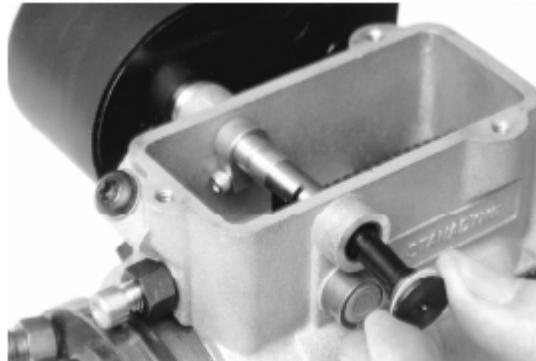
1. Remove the fuel return line from the pump return line connector assembly. Use two wrenches to loosen. Loosen the three cover screws and remove the governor control assembly from the pump.



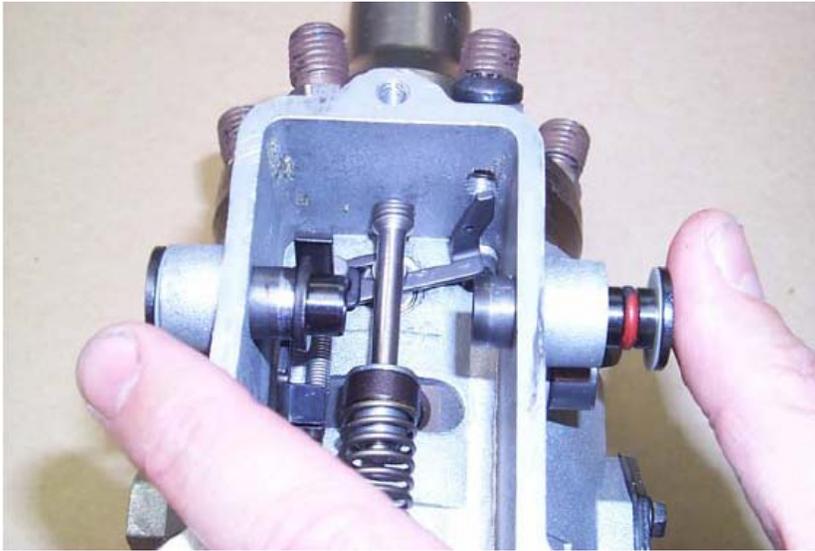
2. Remove the shut-off cam (roller-type) from the slot on the ST-125 actuator shaft. Loosen the retaining collar and remove the actuator from the pump housing. Be careful not to drop the retaining collar inside the pump.



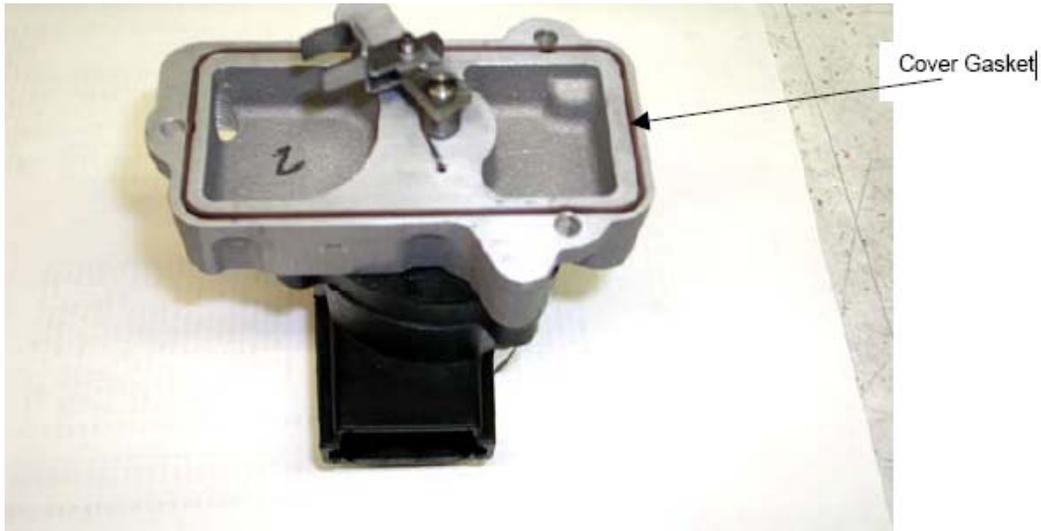
3. Remove the sealing plug; it will be replaced with a new bore plug, O-ring, and plastic spacer.



- Slide the plastic spacers (p/n 02-0004-137) on the bore plugs (p/n 02-0004-135). Lubricate the red O-rings (p/n 02-0004-136) with silicon or petroleum-based lubricant before installing them on the bore plugs. Insert the bore plugs into the housing and secure with the clips (p/n 02-0004-138). (If using pliers or another tool to press the clip into place, make sure the top surface of the pump housing is not damaged where the O-ring will seal.) Manually spin the bore plugs to be sure the clips do not interfere with the linkage hook.



- Install the new cover gasket into the groove on the L-Series (8404-5003). Install the L-Series assembly, with the linkage oriented as shown in the following photo. Do not force the cover into place—if the linkage is properly aligned, it will fit without being forced. The fork should engage the pump linkage. Tighten the three cover screws, torque to 4.0–5.1 N·m (35–45 lb-in).



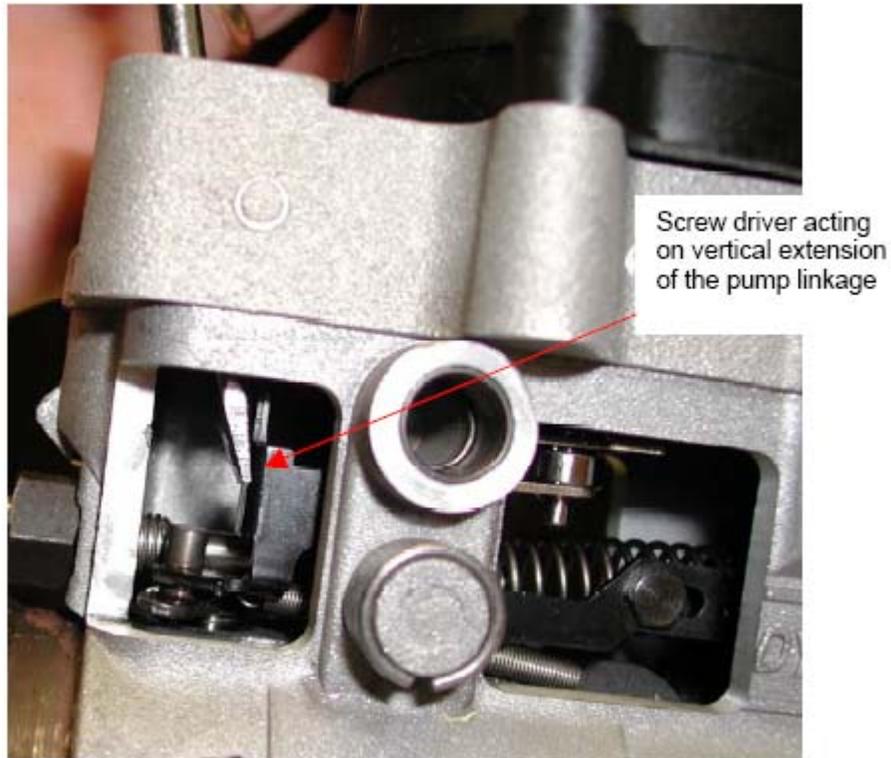
6. Because this is a “blind assembly”, the following photos are included to demonstrate how free movement of the internal pump linkage must be verified after installation of the cover assembly. Moving the pump linkage with a small screwdriver does this. The screwdriver can access the internal pump linkage through the fuel inlet fitting port as shown. The screwdriver acts against the pump linkage as shown in the cutaway view of the pump. Use the screwdriver to deflect the internal pump linkage away from the injector side of the pump. Release and assure that the pump linkage returns to the minimum fuel position. Also verify that the internal pump linkage is fully seated in the minimum fuel direction.

Fuel Inlet
Fitting

**NOTICE**

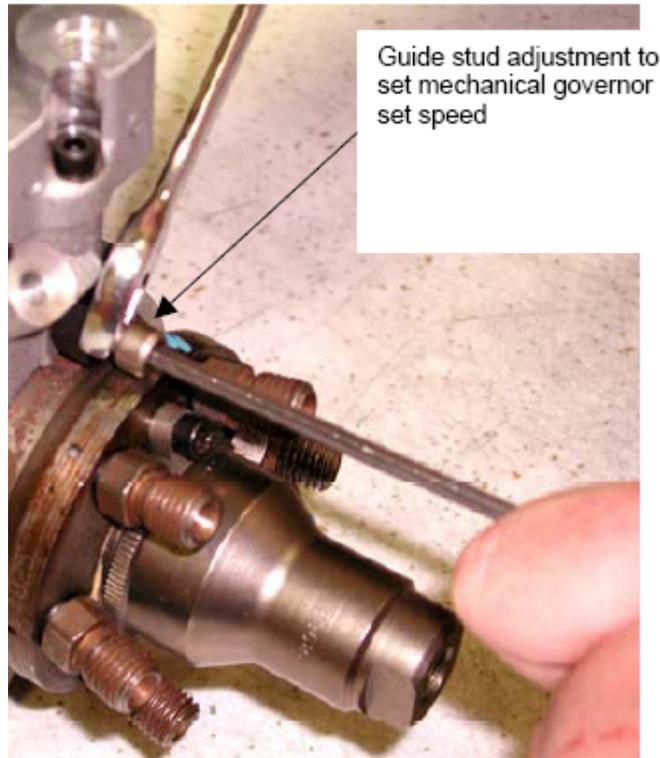
The pump cover must be removed, inspected, and re-installed if free movement to minimum fuel position is not verified as directed above.

CUTAWAY VIEW



7. Re-install the pressure regulator fitting from original pump cover. Replace the O-ring with item 1355-197. Lubricate the O-ring before installing it on the fitting and tighten it into the cover with 10.2–12.4 N·m (90–110 lb-in) of torque. Re-attach the fuel return line to the pressure regulator/fuel return fitting. The fitting position of the fuel return line is only slightly different from before, so the fuel return line should not require any changes other than slight adjustments. Tighten the fuel return line fitting to Stanadyne recommendations. The ESO solenoid is NOT used with this cover design. Be sure that the ESO wire leads are properly tied off, insulated, and secured. Refer to the appropriate engine/fuel pump documentation to ensure that the system functions properly without the ESO.

8. The mechanical governor inside the pump should already be adjusted for use with the ST-125. If not, the following step can be used to make the adjustment. To ensure that the mechanical governor does not interfere with L-Series operation and can control speed in the unlikely event of control failure, adjust the mechanical speed set point: If the electrical harness is already installed, do not connect it to the L-Series control until the mechanical governor setting is complete. Start the engine on the mechanical governor and adjust the guide stud until the mechanical governor's target speed is 5% to 10% higher than the intended L-Series control's target speed. Tighten the guide stud nut to 6.8–7.9 N·m (60–70 lb-in) and shut down the engine.



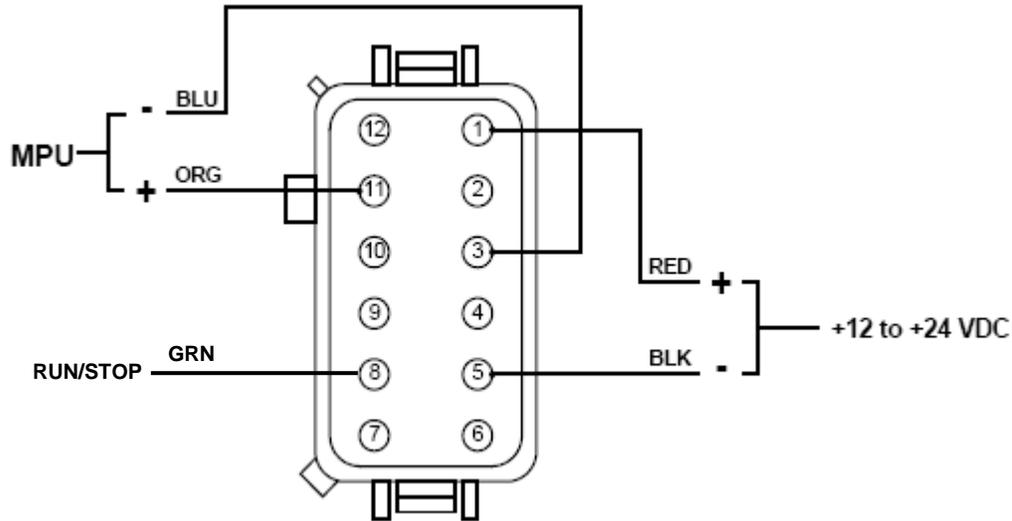
This completes the mechanical installation. Now the electrical harness will need to be installed on the engine.

Electrical Installation

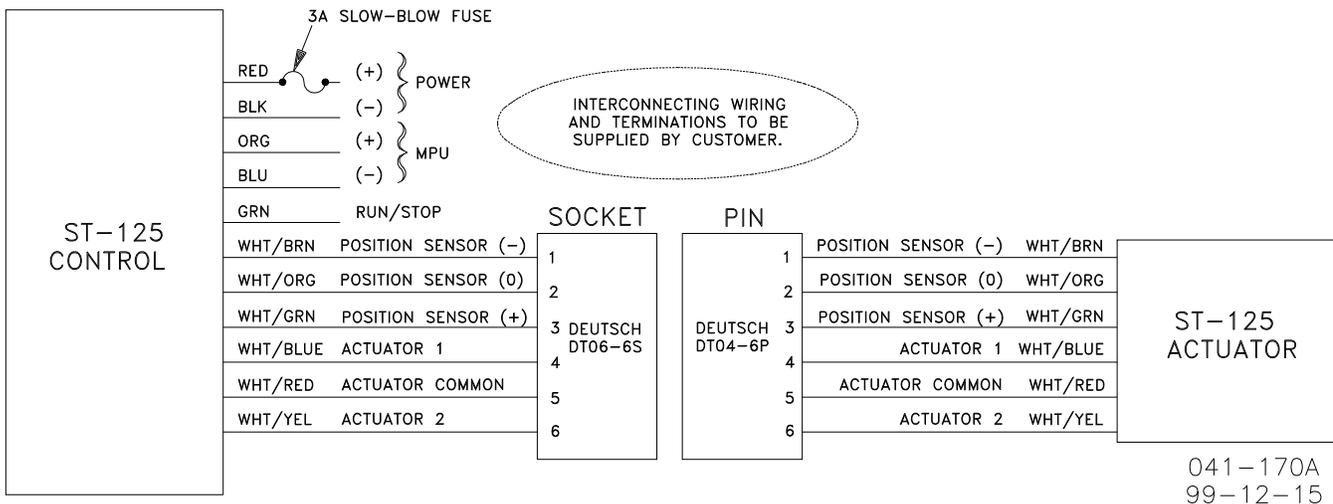
A wiring pinout of the L-Series control is shown as viewed by looking into the control's connector. The control system should be protected with a 6 A fuse in the voltage supply lines. Typical max average current is 2.1 A, or max 25 W at 12 V. The application should be configured to turn on power to the actuator when the engine is first cranked. Cable with individually shielded, twisted pairs should be used with the speed signal input.

Using the harness provided in the installation kit (8923-1253), replace the ST-125 connector by wiring in the L-Series harness into the ST-125 portion of the engine harness as shown in the diagrams.

L-Series 8404-5003



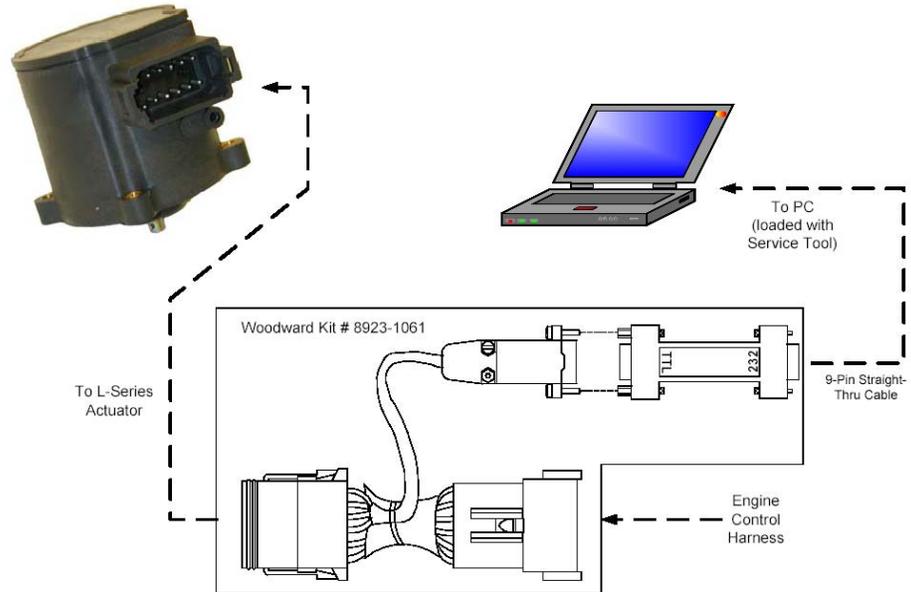
ST-125 Wiring



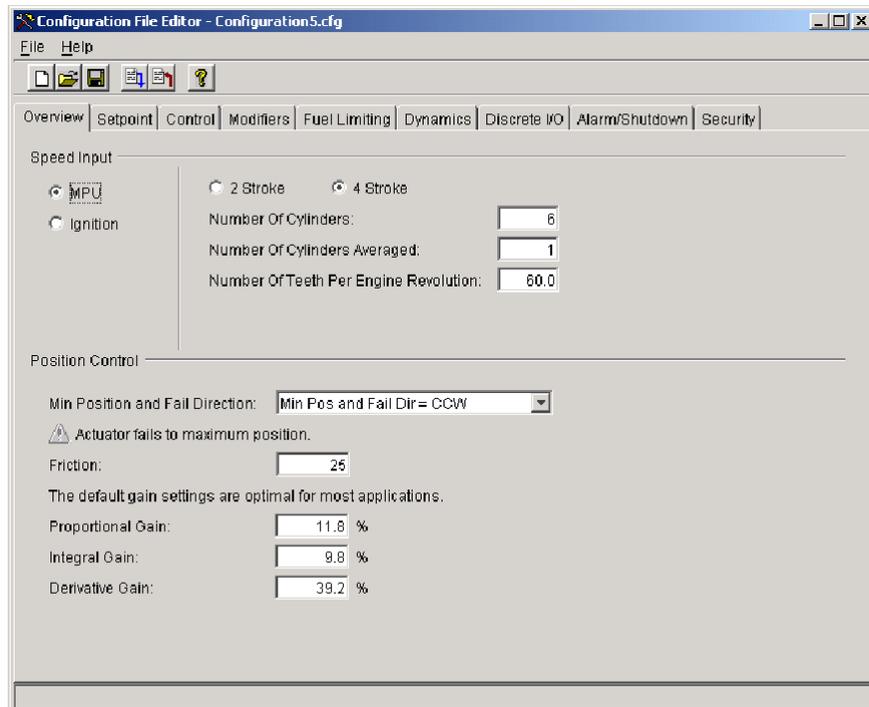
Configuring the L-Series

You must configure the L-Series using the Software Service Tool. Parameters such as Speed Input, Rated Set Point, and Overspeed Threshold need to be configured before starting the engine. Refer to L-series Speed Control manual 26250 for a complete description of all L-Series features and programming examples.

Connecting to the Control



Example Service Tool Screen



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