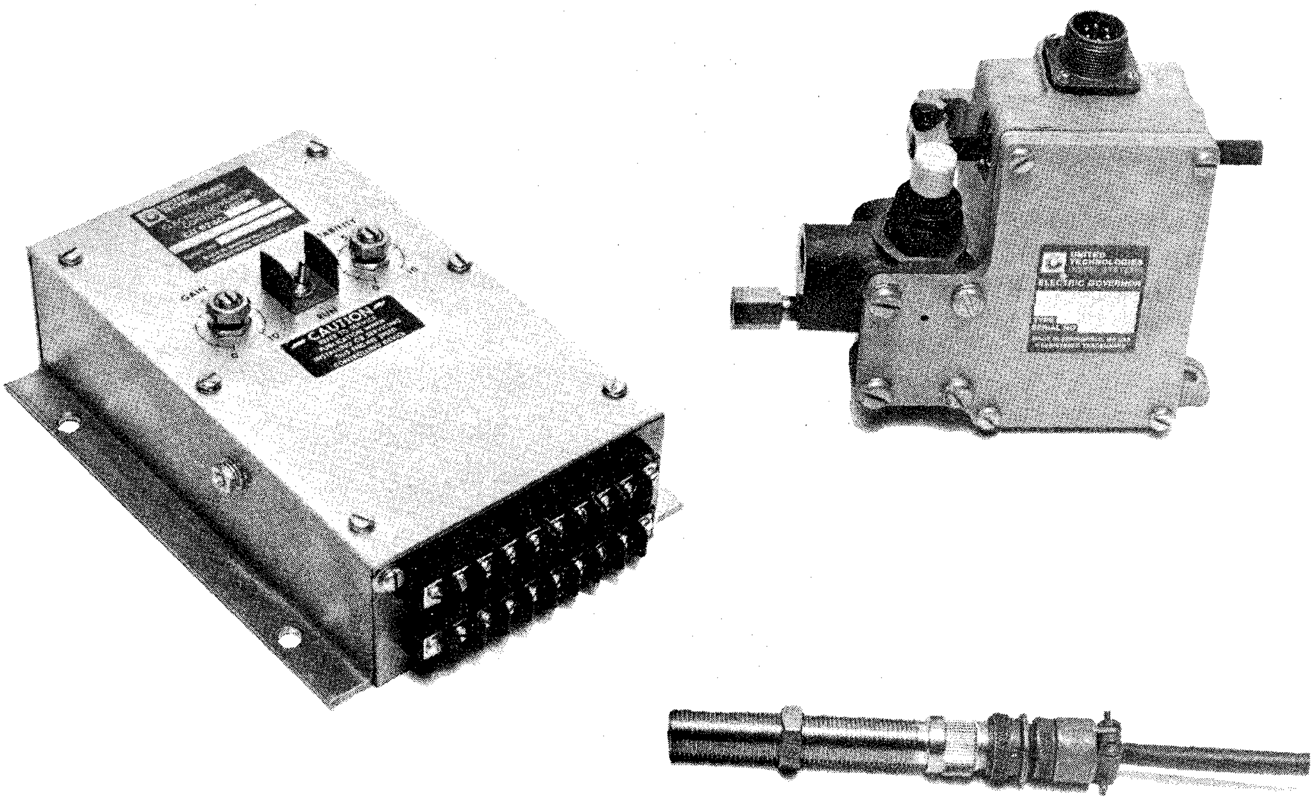
CU 673C-23 SINGLE ENGINE OPERATION FOR CUMMINS ENGINES



SYSTEM INTRODUCTION

The United Technologies Engine Governing system is an electrical sensing system that will maintain precise control of engine speed, at any selected point, and provide rapid transient response with changes in load. It is all electric and requires no engine drive nor hydraulic fluid, and is ruggedly built to resist vibration and physical damage. The engine governing system is designed to provide stady state stability of plus or minus ¼%, generally referred to as isochronous regulation.

The basic system consists of three (3) components: a speed control unit, an actuator, and a magnetic speed sensor. Various accessories may be added at anytime to provide special functions such as precise load sharting, speed droop, automatic paralleling, load anticipation, variable speed, and finite speed trim.

SPEED CONTROL UNIT (CU 673C-23)

The speed control unit contains all solid state electronic curcuits which sense speed from a magnetic speed sensor or other suitable signal source. A controlled output current is provided by the speed control unit to a proportional electric actuator for throttle control. The performance is isochronous.

Three integral adjustments are provided to achieve the desired performance. A "Frequency Adjust" which can adjust the speed control range by 30:1 and "Gain" control to increase or decrease governor response sensitivity and a "Stability" control to match the time constant of the governor to that of the engine. All adjustments are accessible from the top of the speed control unit (see Figure 1).

In addition, an Idle/Run feature has been built-into the speed control unit to provide engine warm-up or maintenance at engine idle.

The CU 673C-23 speed control unit is adaptable to a wide variety of diesel, carbureted gas and gasoline engines, gas turbines, and practically any rotating device that must be speed controlled.

ACTUATOR (AGD 130)

The actuator is a linear electro-magnetic fuel metering device. It meters fuel quantities up to 1700 lbs. per hr. according to the amount of current flowing from the speed control unit through the actuator.

MAGNETIC SPEED SENSOR

The magnetic speed sensor responds to the number of ring gear teeth, or other types of ferrous projections, which pass the tip of the speed sensor, by inducing an electrical pulse within the coil. The pulses are then sent into the speed control unit. In effect, the magnetic speed sensor signals the number of teeth per second which pass the tip. This signal is directly proportional to engine speed.

SPECIFICATIONS

CU 673C SERIES SPEED CONTROL UNIT PERFORMANCE CHARACTERISTICS

- Isochronous .... ±0.25% regulation or better
- Droop .... 0-5% regulation
- Steady-state Stability .... ±0.25% or better
- Frequency Range .... 300-10K Hz continuous
- Speed Drift With Temperature .... ±1% maximum
- Speed Trim Range .... ±200 Hz.

POWER INPUT

- Magnetic Speed Sensor Signal .... 0.25-30 volts rms
- Supply .... 11-40 VDC (transient and reverse voltage protected)
- Polarity .... Negative Ground (Case isolated)
- Power Consumption .... 60mA (continuous) plus actuator current

ENVIRONMENTAL

- Temperature Range .... −55° to +85°C (−65° to +185°F)
- Relative Humidity .... up to 100%
- Case .... Fungus proof and corrosion resistant

PHYSICAL

- Dimensions .... See Figure 1
- Weight .... 1.13 kgs (2.5 lbs)
- Mounting .... Any position (See Installation Page 9)

RELIABILITY

- Tested 100%
- Vibration .... All printed circuit boards are conformally coated on both sides

MATING CONNECTOR

- Actuator to Speed Control Unit .... CB 6712A
- Magnetic Speed Sensor .... CB 6713A

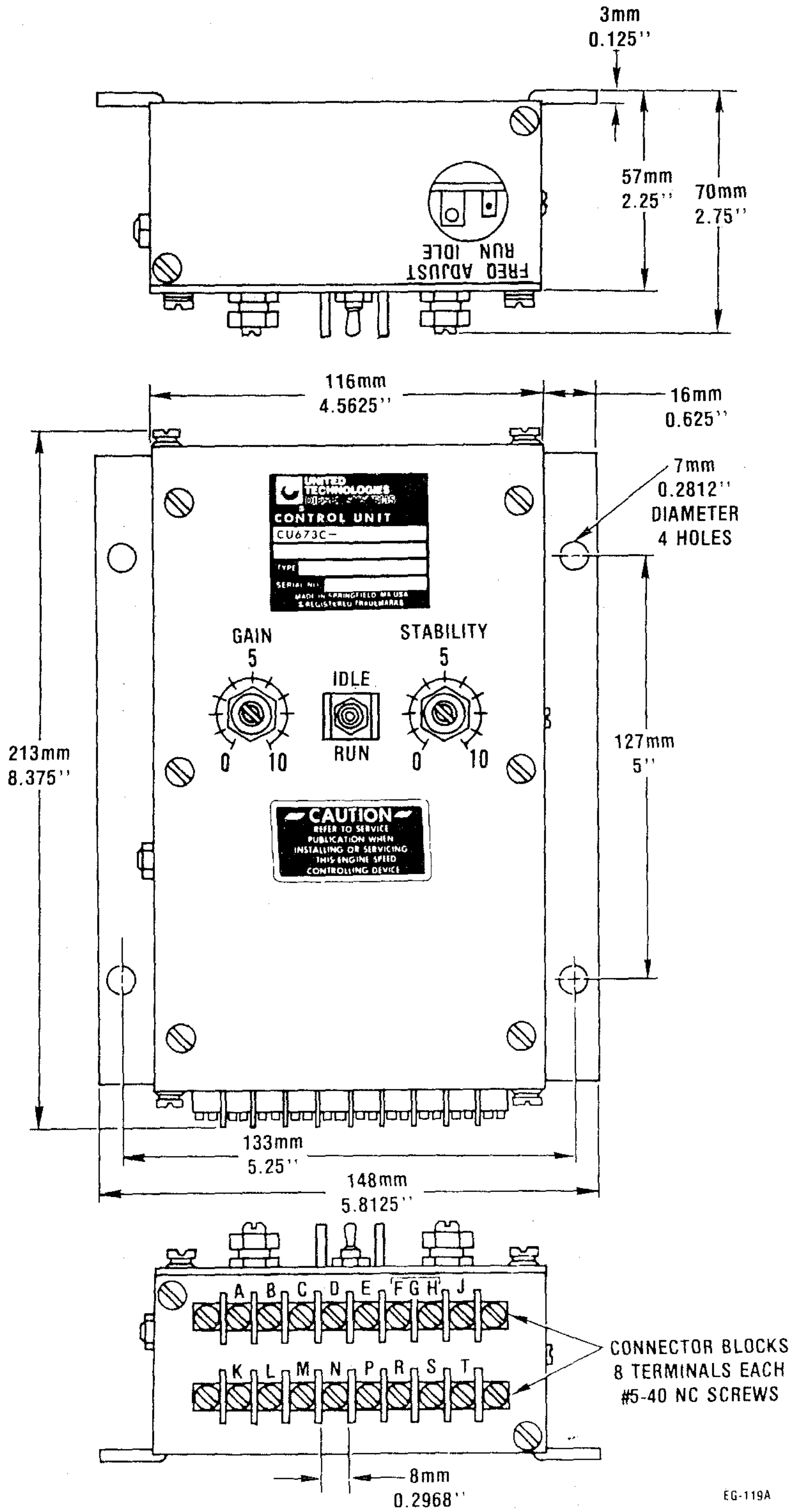


Figure 1. CU 673C speed control unit dimensions

SPECIFICATIONS

AGD-130 ACTUATOR PERFORMANCE

- Maximum Flow Rate (Diesel #2) .... 771 kg/hr (14.4 litre/min)
  1700 lbs/hr (3.80 gpm)

POWER INPUT

- Operating Voltage .... 12, 24, or 32 VDC
- Normal Operating Current .... 2A at 12 VDC
  1.5A at 24 or 32 VDC
- Maximum Current (Instantaneous) .... 6A at 12 VDC
  3A at 24 or 32 VDC

ENVIRONMENTAL

- Temperature Range .... −54° to +93 °C (−65° to +200 °F)
- Relative Humidity .... up to 100%
- Case .... Fungus proof and corrosion resistant

PHYSICAL

- Dimensions .... See Figure 2
- Weight .... 1.75 kgs (3.85 lbs)
- Mounting .... Any position (See Installation Page 9)

RELIABILITY

- Tested 100%

MATING CONNECTOR

- Use .... EC1249-2 (6 pins)/MS3106R14S-6S
- Wiring harness (includes both connectors prewired) CB679
- Actuator to Speed Control Unit CB6712A

VARIATIONS

- AGD 130 E4 .... With temperature probe and standard fuel metering valve
- AGD 130 E5 .... High temperature coil and standard fuel metering valve −54° to +107 °C (−65° to +225 °F)
- AGD 130 F2 .... High temperature electro-mechanical section with a low fuel limiting valve (prevents engine shutdown)
- AGD 130 G4 .... Reverse acting with fuel metering valve (Use CU 673C-9 speed control unit)

REBUILD KITS

- KT 6723 .... For all AGD 130 Series Actuators
  - contains .... Fuel Metering Valve, Actuator Lever Assembly, Dust Boot
- KT 6724 .... For VA 671A and VA 673A valves
  - contains .... Valve Plunger Assembly, Actuator Lever Assembly, Dust Boot "O" Ring Gasket,(2) Aluminum Gaskets
- KT 6726 .... For AGD 100A1 and AGD 130D1 actuator
  - contains .... Fuel Metering Valve, Actuator Lever Assembly, Dust Boot Spacer Plate, (4) Screws, Gasket
- KT 6732 .... For AGD 130 E4/F1 (High Temperature Coils)
  - contains .... Housing Assembly, Plate - Ident, Gasket

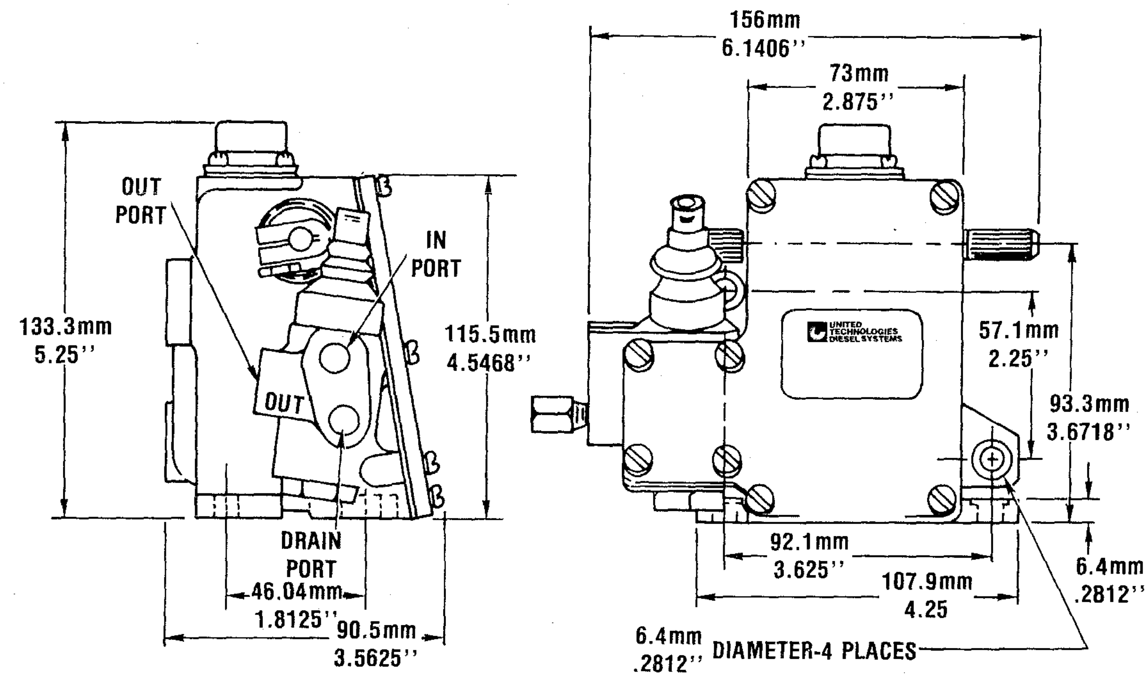


Figure 2. AGD 130 actuator dimensions

SPECIFICATIONS

MAGNETIC SPEED SENSOR

- Dimensions (Shielded) .... See Figure 3 and Table A
- Thread Size .... 5/8 - 18 UNF-2A
- Tap Drill Size .... 37/64"
- Proximity to Gear Teeth .... 0.75mm (0.030 in.)
- Temperature Range .... −55° to +105°C (−65° to +225°F)
- Output .... 0.50 to 30 volts RMS is recommended to input to the speed control unit
- Resistance .... 50 to 500 ohms

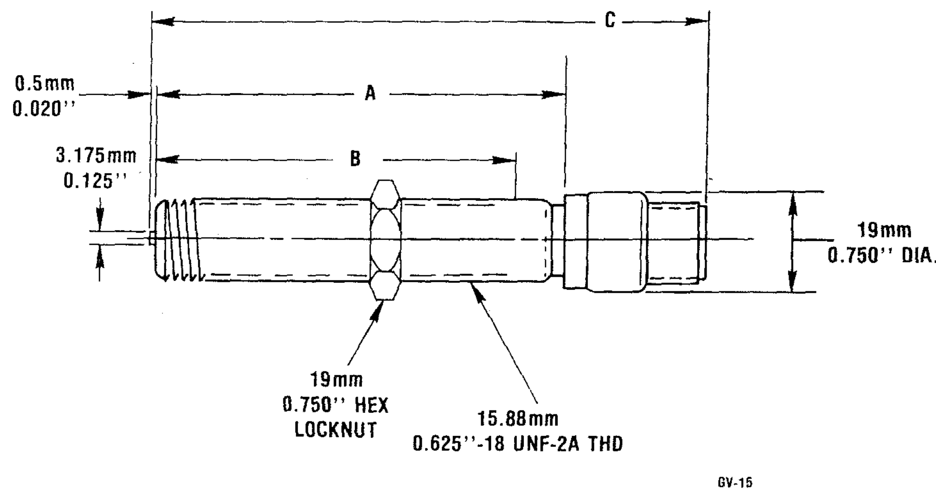


Figure 3. Shielded magnetic speed sensor dimensions

SHIELDED MAGNETIC PICKUP CAT. NO.	DIMENSION A	DIMENSION B MAX. USABLE THD LENGTH	DIMENSION C PICKUP LENGTH	ADDED LENGTH OF CONNECTOR AND CABLE CLAMP
MP 677*	76mm 3 inches	67mm 2-5/8 inches	102mm 4 inches	
MP 678*	127mm 5 inches	118mm 4-5/8 inches	152mm 6 inches	
MP 679**	76mm 3 inches	67mm 2-5/8 inches	102mm 4 inches	60.325mm 2.375 inches
MP 6710A**	127mm 5 inches	118mm 4-5/8 inches	152mm 6 inches	60.325mm 2.375 inches

*Magnetic speed sensors are without connector and clamp.

**Magnetic speed sensors are complete with connector (EC 1267-1) and cable clamp (AD 673). A 2 wire-shielded cable cut to the desired length is required. Slide the cable clamps on to the cable and solder each wire to the connector plug.

Table A
Shielded magnetic speed sensor dimensions

SYSTEM DESCRIPTION

SPEED CONTROL UNIT

The speed control unit is designed to operate on 12, 24 or 32 VDC systems. For 12 volt operation, one jumper connection is added externally. For 12 volt operation, the speed control unit will operate from 11 to 18 volts. In the 24 - 32 volt connections, the speed control unit will operate from 13 to 40 volts.

The speed control unit compares the engine high frequency speed signal with the frequency of the reference oscillator signal. The speed control unit supplies the proper current to the electric actuator which, in turn, controls the engine power to minimize the difference between the frequency of the two signals. (See Figure 4).

Pickup Signal and Amplifier

The engine speed signal is usually obtained from a magnetic speed sensor mounted in close proximity to the teeth of a ferrous gear that is driven by the engine. The frequency of the speed sensor signal is proportional to engine speed. The flywheel ring gear is normally used because of the ease of speed sensor installation and because of the high frequency speed sensor signal.

Other signals may be used for a speed signal instead of the output of the flywheel. The governor will accept any signal if the frequency is proportional to engine speed, and in the frequency range of the governor (300 to 10K Hertz). The signal strength must also be within the range of the input amplifier (.25 volts rms to 30 volts rms for approximately sinusoidal signals). The input amplifier is very tolerant to signal wave form. It is required only that a non-sinusoidal signal have a minimum of 0.8 volts peak-to-peak and a maximum of 30 volts rms at all engine speeds from cranking to maximum. The speed control unit has an input impedence of 5000 ohms between terminal "S" and terminal "T". Terminal "T" is connected internally to the battery negative.

The input amplifier protects the system if the input signal is not strong enough. In the absence of any signal from the magnetic speed sensor, the speed sensor amplifier goes into a local oscillation of about 12K Hertz. Since this frequency is above the maximum reference frequency, the phase detector considers the engine in "overspeed" and the actuator moves to the fuel shutoff position. This provides inherent fail safe protection against loss of speed sensor signal.

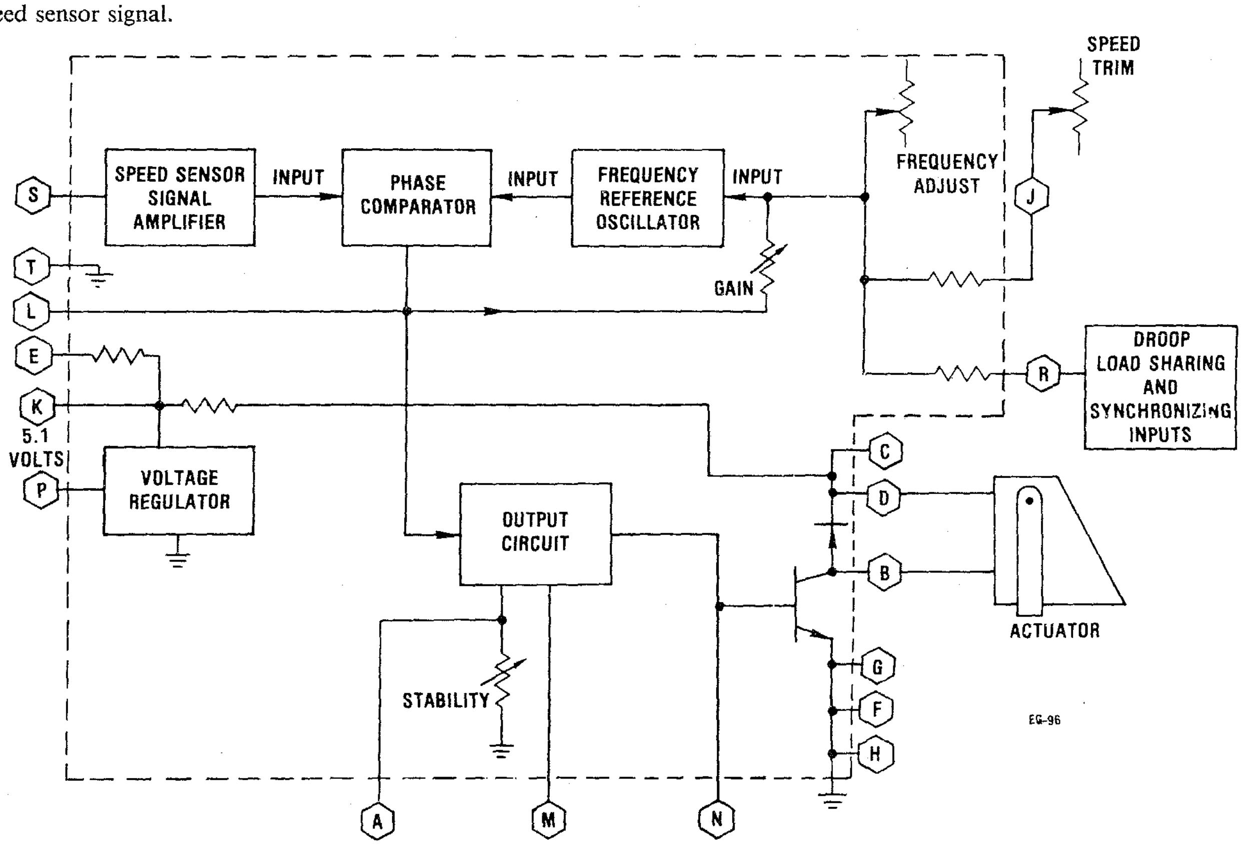


Figure 4. Functional schematic

Since there is no speed sensor signal with the engine stopped, the oscillation of the speed sensor signal amplifier keeps the actuator in the fuel shut-off position until the engine is cranked. After a few teeth have passed the magnetic speed sensor, enough signal is provided to block the input amplifier oscillation. At this time, the actuator moves to the full fuel position and remains there during starting and acceleration of the engine.

Frequency Reference Oscillator

A wide range, temperature compensated, voltage controlled oscillator is used as the speed reference for the speed control system. The frequency setting is adjusted by applying 0 to 10 volts at the frequency reference oscillator input. Zero volts represents a frequency of 10K Hz. while 10 volts represents a frequency of 300 Hz. The internal frequency adjust provides this voltage setting. If an external remote speed control is desired, a reconnection of internal jumpers can be made. (Refer to Section EG 70-7 for detailed instructions.)

Two other external inputs are available to adjust the frequency reference oscillator. Terminal "J" is the input from the speed trim control which provides minor trimming of engine speed. Terminal "R" is the input from accessories such as load sharing, droop, or automatic synchronizing. When the speed control unit is controlling an engine, the reference oscillator does not maintain a constant frequency but deviates from its nominal RPM which occurs during load changes. The reference oscillator is forced by the phase comparator to track the engine speed sensor input, described below. Thus, the voltage representing speed error is the amount of voltage required to drive the reference oscillator off frequency as far as the engine is off speed at that moment.

Phase Comparator Circuit

This circuit is used to force the reference oscillator to track the engine speed sensor signal. The phase comparator circuit detects the phase difference between the input signal through the input amplifier and the signal from the reference oscillator. When the engine changes speed, the signal from the input amplifier changes frequency. The phase comparator circuit measures the amount the engine signal is ahead or behind the reference oscillator signal. Its voltage output is used to force the reference oscillator to the the same frequency as the signal from the engine. In this way, the phase comparator output is proportional to the speed error. (When used in this way, the phase comparator and the reference oscillator make up a "Phase Lock Loop"). The gain control is used to couple the phase comparator output to the reference oscillator. By increasing the coupling, for example, a small voltage deviation from the phase comparator corresponds to a large frequency deviation, and vice versa. (See Figure 5.)

The phase comparator output is measured at terminal "L". This is an important terminal, it is used to monitor governor performance and function. The voltage on terminal "L" can be measured with a voltmeter. A reading of 5.1 VDC indicates the engine is on governed speed. A reading in excess of 5.1 VDC indicates an under-speed condition while readings of less than 5.1 VDC indicate overspeed conditions.

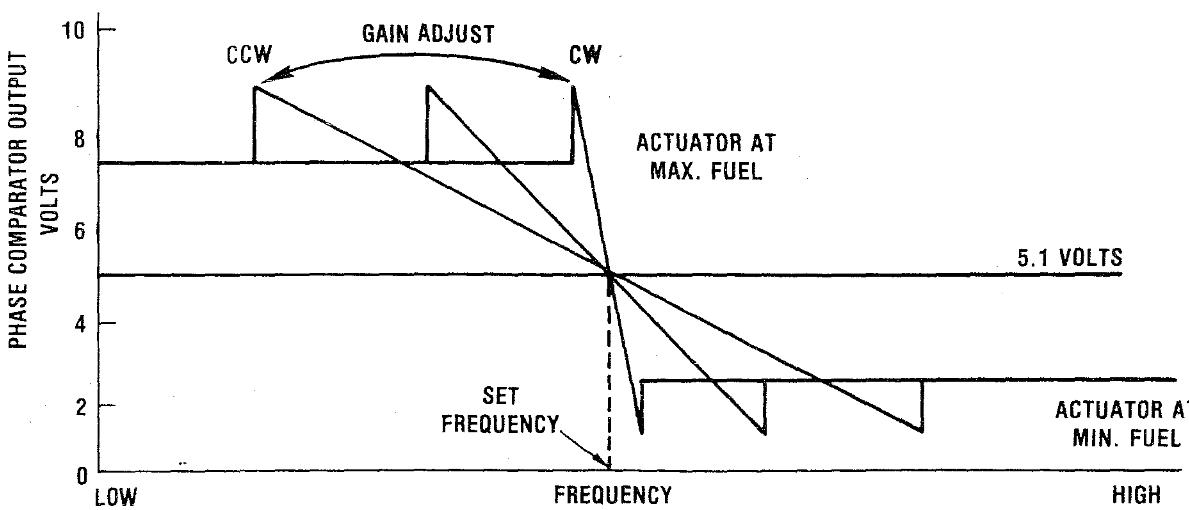


Figure 5. Phase comparator output versus frequency

Figure 5 indicates voltage at terminal "L" with different gain settings. As indicated by the curve, the gain should be turned CW as far as possible without causing instability.

Dynamic Control and Output Circuit

This circuit allows isochronous governing by introducing temporary droop during a load change for stability purposes. It provides an adjustable means to control the magnitude and time constant of the temporary droop to match the dynamic characteristics of the engine.

The output current switching portion of the circuit provides current to drive the actuator. The output transistor is alternately switched off and on at a frequency of 200 Hz which is well beyond the natural frequency of the actuator.

The actuator responds to the average current from the transistor and moves in proportion to this average current to position the engine throttle. The output transistor is switched to reduce power dissipation. The output of the circuit provides up to 15 amps at voltages up to 40 VDC.

A large insulated nut, holding an internal diode, is located at the side of the speed control unit housing. From the nut to ground is the voltage across the output transistor. Shorting this nut to ground **momentarily** will apply full voltage across the actuator and will force the actuator to the full fuel position. Measuring the voltage from terminals "B" to "D" indicates the voltage across the actuator.

ACTUATOR

An AC frequency signal (proportional to speed), generated by a magnetic speed sensor is constantly fed into the speed control unit and compared with a preset frequency. If the frequencies do not remain identical, a change in current from the speed control unit changes the magnetic force in the actuator which causes angular rotation of the actuator shaft and, in turn, linear movement of the metering valve. Fuel metering is proportional to the amount of current flowing through the actuator and is counterbalanced by an internal spring. The valve is used to meter fuel quantities up to (1700 lbs. per hour) 771 kg per hour, which is ample for all Cummins engines. The actuator housing is sealed against engine environment with gaskets at all openings so steam or other water based cleaning will not affect the system's operation. **No maintenance is necessary.**

SYSTEM INSTALLATION

SPEED CONTROL UNIT

The speed control unit is rugged enough for mounting in the control cabinet or engine mounted enclosure. Care should be taken to insure that the speed control unit is not subjected to extreme heat, as the life of electronic devices is always related to heat. If it is expected that water or mist will come in contact with the speed control unit, mount it vertically so the condensation will not accumulate in the speed control unit.

Wiring to the speed control unit should as shown in Figure 6.

The leads from the battery to the speed control unit and from the speed control unit to the actuator should be #16 or larger. These are the leads that are connected to terminals B, C, D, E and G of the speed control unit.

ACTUATOR

The actuator should be mounted as closely as possible to the outlet of the fuel injection pump. The actuator may be mounted in any position. However, the preferred mounting position is with the electrical connector at the top. The actuator should be located in an air stream if possible. No adjustment of the valve linkage is necessary.

Actuator bracket, BK 6726 may be used to facilitate preferred mounting on all Cummins engines. The fuel valve is connected into the fuel line to the injectors. The valve inlet (marked "in") on the actuator is connected to the outlet of the PT fuel pump. The valve outlet (marked "out") is connected to the rail leading to the injectors. Steel tubing or single wire braided rubber hose may be used for all fuel lines. Use 5/16" I.D. tubing for all engines except the 12 and 16 cylinder units which required 3/8" I.D. lines. The valve ports are 1/4" NPTF.

The drain port (marked drain) is 1/8" NPTF. It should be connected to the injector fuel return line. A normal back pressure on the drain of 2-4 PSI is acceptable. Higher back pressures may cause external fuel leakage. Additionally, all fuel valve fittings should be hand tightened and then wrench tightened 1 to 1-1/2 turns. If sealant is used it should be liquid type and not tape.

Right angle bends in fuel lines and fittings should be avoided near the fuel pump and actuator; use 30° or 45° fittings, or tubing with gradual sloping bends.

On original installations made at the factory, the fuel pumps have been calibrated to compensate for a small pressure drop across the actuator valve. On installations

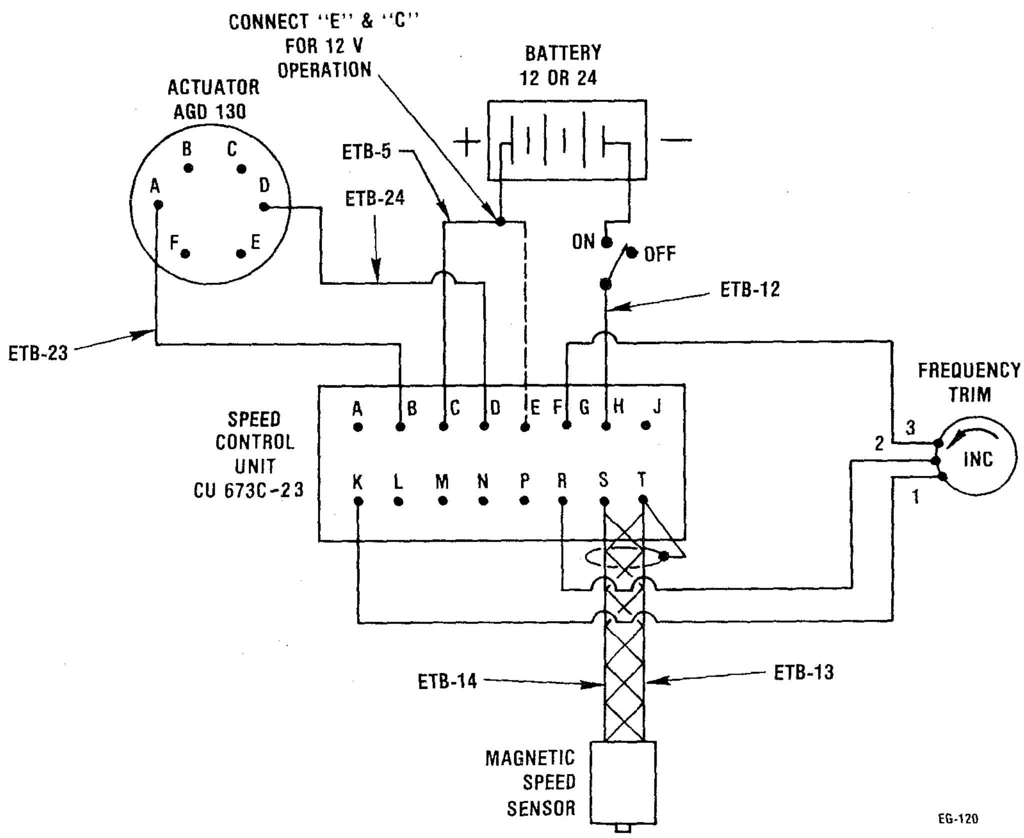


Figure 6. Wiring to CU 673C series speed control unit

made in the field, it will be necessary to re-adjust the throttle stop as required to obtain rated h.p. However, on engines where the h.p. is marginal for the load at the outset, it will be necessary to compensate for the pressure drop by adding shims to the PTR pumps. On AFC pumps, it will be necessary to replace the throttle shaft, and turn in the adjusting screw until the required rail pressure is obtained. The pressure drop should be measured only at rated speed. This adjustment is necessary only for engines that have no reserve power.

AFC fuel pumps with turbo-charger fuel limiting will limit the transient response of the engine.

The leads used for actuator connections should be at least #18 wire for 24 volt and 32 volt operation and #16 wire for 12 volt operation.

MAGNETIC SPEED SENSOR

The speed sensor is mounted in the gear case or flywheel bell housing. The speed sensor can be screwed in (with the engine stopped) until the tip strikes the top of the gear tooth, then backed out ¼ of a turn and secure it by the locknut. The threaded hole should be relatively perpendicular to the centerline of the crankshaft and a spot face should be provided for a flat surface to anchor the locknut securely. Any ferrous gear may be used as long as the frequency and amplitude meet the speed control unit specification.

The wire leads from the speed sensor should be twisted for their entire length up to the speed control unit. The speed sensor leads may need to be shielded if they are exceptionally long 3 meters (10 ft.) or if external interference from spark ignited engines or external equipment is encountered.

Do not ground either of the speed sensor leads. Only the shielded wire is to be grounded, fused, to one specific terminal on the speed control unit. One of the speed sensor input terminals on the speed control unit is commonly connected to ground and should be utilized for the shield connection. The shield should not be connected at the speed sensor end.

SYSTEM ADJUSTMENTS

1. PRELIMINARY

The speed control unit has been adjusted at the factory for starting conditions and will control the engine at approximately 450 RPM. If it is desirable to reset the control unit, turn the "Freq. Adjust." at the rear cover 22 turns CCW. Then turn CW 4 turns. This will provide control of the engine at about 800 RPM. The following adjustments or checks should also be made.

a) Set the gain and stability controls at midrange (5) on the scale.

b) Set the speed trim control (if used) to midrange position.

> CAUTION:
> DO NOT CONNECT THE SPEED CONTROL UNIT TO A BATTERY CHARGER

c) Apply DC power to the engine governing system the wiring system by closing a switch in the battery circuit.

d) Momentarily ground the insulated nut on the side of the speed control unit with a jumper wire. The actuator valve should go into the full fuel position (the valve actuator link moves down). If not, check for proper wiring of the 6 pin actuator connector. Remove the cable and check between pins A and B and between C and D on the actuator. Each coil should have about 4 ohms resistance. If not replace the actuator.

2. STARTING THE ENGINE INITIALLY

> CAUTION:
> THE ENGINE SHOULD BE EQUIPPED WITH AN INDEPENDENT OVERSPEED SHUTDOWN MECHANISM TO PREVENT RUNAWAY WHICH CAN CAUSE EQUIPMENT DAMAGE OR PERSONNEL INJURY.

The throttle lever on the PT pump should be held in the full fuel position. However, it may be used to manually control the engine during the first startup. Set the toggle switch on the speed control unit to the run position. DC power should be applied through the wiring harness to the engine governing system by closing a switch in the battery circuit. Starting the engine may now proceed normally. During cranking, but before the engine starts, the actuator will push its valve open. Once started, the engine will be controlled at low idle by the speed control unit. The throttle lever on the PT pump should be held wide open at this time if it hasn't been earlier. If the engine is under the control of the governing system, raise the speed as required by turning the "Freq. Adjust." control at the rear cover of the speed control unit, in a CW direction, usually about four turns. (See Figure 1.) Final precise speed adjustment can be made by using the speed trim control, if used. If at any time the system becomes unstable, turn the gain and stability controls CCW until the engine becomes stable.

3. FINAL ADJUSTMENTS

Once the engine is at operating speed, the optimum stability and gain adjustments can be made as follows.

a) Turn the gain control CW until instability results. Then back-off slightly CCW (one major division) beyond the point where stability returns.

b) Turn the stability control CW until instability results. Then back-off slightly CCW (one major division) beyond the point where stability returns.

c) Load may now be applied to the engine. If necessary, repeat (a) and (b) above until optimum performance is obtained. Normally, the critical point for gain and stability adjustment is at no load.

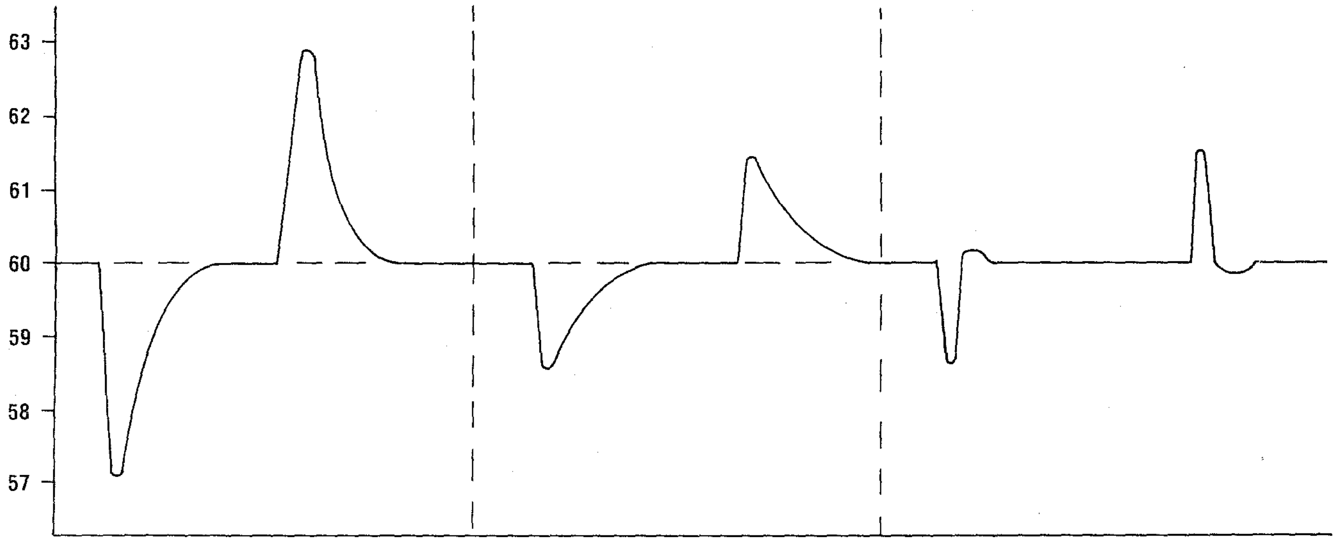
CW adjustment of the **gain** control **increases** the governor system response after a load change. CCW adjustment causes more sluggish action.

CW adjustment of the **stability** control **decreases** the recovery time constant after a load change. CCW adjustment lengthens the recovery time constant.

Excellent performance should result from these adjustments. Trimming of all adjustments, i.e. gain stability and frequency, can be made under various load conditions and load changes to get exactly the desired governing characteristics.

If a load bank and a recorder are available, use them to make traces per Figure 7.

d) Once the engine is running set the toggle switch on the speed control unit to the idle position. Set the idle speed by adjusting the control located at the rear cover to the desired RPM.



INITIAL GAIN AND STABILITY CONTROL ADJUSTMENTS GIVE A TRACE INDICATING, FROM THE EXCURSION OF THE TRANSIENT, THE GAIN SHOULD BE INCREASED BY TURNING THE GAIN CONTROL CW. NOTE: TIME IS CONSTANT FOR ALL CONDITIONS.

INCREASED GAIN RESULTED IN A NEW TRANSIENT WITH REDUCED EXCURSION. IT IS APPARENT FROM THE LONG TAIL ON THE TRANSIENT THAT THE STABILITY CONTROL MUST BE TURNED CW.

READJUSTING BOTH GAIN AND STABILITY CONTROLS GIVES A TRACE, INDICATING GOOD TRANSIENT AT FULL LOAD AND GOOD STABILITY. THE SPEED CONTROL UNIT IS NOW PROPERLY ADJUSTED AND THE LOCKNUTS CAN BE TIGHTENED.

EG-10

Figure 7. Typical performance chart

TROUBLE SHOOTING

If the governor does not operate, measuring, in sequence, voltage between the various speed control unit terminals and ground (Terminals F, G, H and T are ground) will indicate the possible fault. Should all 5 voltage tests indicate normal values, the defect must be in the actuator or in the wiring to the actuator. (See Section on Defective Actuators on page 14).

TERMINALS	NORMAL VALUE	PROBABLE CAUSE OF NON-NORMAL READING
S	1.0 VAC - RMS minimum while cranking.	1. Defective magnetic speed sensor. 2. Gap too large between speed sensor and gear teeth. 3. Improper or defective wiring to the speed sensor.
K	10.1 ± 0.20 VDC while energized (Internal regulated DC supply)	1. DC power not connected or low battery voltage. 2. Speed trim control shorted, ground or miswired. 3. Wiring error. 4. Defective speed control unit.
L	Above 5.1 VDC while cranking. (Inverse speed error signal.) Above 5.1 volts is under speed signal. Below 5.1 volts is over speed signal. On speed will indicate a steady 5.1 volts.	1. Frequency adjust set too low. Turn CW. 2. Defective speed control unit.
N	8.5 to 9.5 VDC while cranking. (Proportional actuator voltage.)	1. Defective speed control unit. 2. Battery voltage may be too low while cranking.
B	2.5 VDC maximum while cranking. (Transistor voltage.)	1. Output transistor open (defective speed control unit). 2. Defective actuator (see page 14). 3. Error in wiring to actuator.

OTHER TROUBLE SHOOTING TESTS

SYMPTOM	TEST	PROBABLE TROUBLE
Engine overspeeds	Determine voltage on terminal "L". Should be less than 5.1 VDC.	1. Frequency set too high. Turn frequency adjust CCW. 2. Defective speed control unit.
Engine overspeeds	Measure the voltage across the insulated nut located on the side of the control unit. Should be more than 2.5 VDC.	1. Output transistor shorted. (Defective speed control unit.) 2. Wiring to actuator incorrect.
Throttle does not move	Measure battery voltage at the battery while cranking. Must be 8.0 VDC minimum.	1. Insufficient battery voltage. Put a momentary connection from terminal "B" on the control unit to negative ground while cranking (Terminal "G" is ground). 2. Replace with battery of higher amp hour rating.
Throttle does not move	Ground the insulated nut located on the side of the speed control unit, except on CU 673C-10 speed control units. Throttle should move to full open position.	1. Wiring to actuator or battery incorrect. 2. Actuator or linkage bound. 3. Defective actuator. (See page 14.)

ERRATIC OR UNSTABLE GOVERNING

A. INSUFFICIENT MAGNETIC PICKUP SIGNAL

Although the speed control unit will govern well on. 0.5 volts RMS signal if it is a clean sine wave, a signal from the magnetic speed sensor of 3 volts RMS at full speed will eliminate any possibility of missed or extra pulses. This signal is measured at terminals "S" and "T".

B. ELECTRICAL NOISE OR UNWANTED DROOP

If noisy electrical devices are present, such as magnetos, solid state ignition systems battery chargers or regulators which emit radio frequency interference (RFI), then unstable governing or droop may be noticed. The speed control unit has internal filters which provide some protection from radio frequency interference. Excessive levels of RFI must be treated separately. A metal shield placed around the emitting source will help. Placing the governor harness and speed control unit as far away as possible from the emitting source will help. Always twist the leads from the magnetic speed sensor all the way back to the speed control unit. Shield the speed sensor leads with the shield connected to terminal "T" of the speed control unit **only**. Raise the magnetic speed sensor voltage by reducing the gap between the speed sensor and the ring gear. A gap of 0.030" will provide a strong signal. If noise is still present, a capacitor (1,000 mfd, 12 - 20 volts) may be connected across the speed trim control, terminal K + to terminal F −. This will reduce external interference coming from the power supply. When extreme RFI is encountered, it may be necessary to shield all the leads to the speed control unit. The shield should be grounded at terminal "G" of the speed control unit.

C. DEFECTIVE ACTUATOR

Should the coils of the actuator become open or shorted, replace the actuator. If the coils are not open or shorted, the wiring or connectors are defective.

D. LOW SPEED SURGING OR PERIODIC INSTABILITY

Each engine has certain response characteristics to which the governor must be adjusted to match. The increase or decrease of speed, as load on the engine changes, can be reduced to a minimum by proper adjustment of the gain control. Turning the gain control CW will shorten the amount of speed change. Too much gain adjustment will result in rapid throttle movement, which is instability. The amount of time which the engine needs to completely regain the set speed, after a load change, can be reduced to a minimum by turning the stability control CW. Excess CW adjustment will cause instability, usually in the form of a low frequency surge.

The governor system can be properly adjusted by the following procedure. Under no load conditions, turn the gain control CW until instability occurs. Then back off (CCW) until stability is restored. Next, turn the stability control CW until instability occure. Then back off (CCW) until stability is restored. Once more, adjust the gain control as above. Apply various loads up to full load to insure that stability is fixed at all loads. If not, reset the gain and stability adjustments, as above, under whatever load condition indicates some instability.

If the gain control is nearly full CCW or the engine is unstable at any position of the gain and stability control, proceed as follows:

Note the frequency of instability. In the instance of slow speed surging of about 1-3 oscillations per second, modifying the speed control for added dead time compensation (derivitive) will improve performance and stabilize the system. Connect a jumper from terminals "M" to "H" (if serial number is less than 2R 6239, an external capacitor is required--see Service Letter EG-3 for details). Readjust the gain and stability as mentioned above. Some improvement must be noticed or the cause of instability lies elsewhere.

If the frequency of instability is very fast, such as 8-10 oscillations per second, then the dead time compensation can be reduced. Jumper "M" to "N". Readjust the gain and stability as above.

If the governor system allows for stable operation but speed overshoot is experienced because the gain control is almost fully CCW, a modification can be made to extend the gain control setting. Apply a 6.8K ohm resistor from terminal "L" to terminal "P". This will center the gain adjustment and improve its stability.

Fuel Metering Valve/Actuator Sticking

If the valve or the actuator is sticking, as determined by hand, this can cause erratic behavior. If the cause is dirt in the valve, the valve can be cleaned by removing the lower cap nut. Otherwise, replace the valve or actuator. Insufficient lubrication of the rod in the cap nut assembly can also cause binding and excessive wear. Assure drain connection has a slight positive pressure 1-5 PSI.

Fuel Metering Valve Leaking

If there is leaking at the pin on the valve, there is too great a pressure at the drain port (Max. 5 PSI). Temporarily disconnect the drain line. Plug the line coming from the injectors. Allow the drain fuel to flow externally. If the leakage does not stop, the check valve (VA 678) may be plugged. Remove, clean, and recheck the check valve operation.

Leakage at the upper cap nut is probably due to defective gaskets (GA 678) which should be replaced. Torque to 129 -150 lbs. in.

Actuator Test

The resistance between terminals A and B at the speed control unit connector should be about 8 ohms. If it is not, the coils in the actuator should be checked directly. Remove the wiring harness from the actuator and measure the resistance from A to B and C to D. They should read about 4 ohms. If not, replace the actuator. If the coils have the correct resistance, the wiring or connectors are defective.

Low Frequency Instability

For four and six cylinder engines which exhibit low frequency surging (about 1 Hz.), replacing the jumper next to the stability control (Figure 1) should eliminate this problem.

NOTE: Fuel system problems that may cause instability.

1. The AFC feature of the fuel pump must be modified by the Cummins Engine Co. for proper operation.
2. If air is suspected in the fuel line, use a sight glass to check for bubbles at the fuel pump inlet.

Readjustment of Linkage

If the linkage on the actuator is ever removed or replaced, follow these instructions for resetting. Roll the boot up over the plastic link on the lever. Place the actuator with its label flat down on a table. Rotate the lever on its shaft till all the play is just removed between the fuel valve ball and the plastic link. Tighten the lever holding nut and unroll the boot. No preload or play should exist on the valve stem for proper setting.

CUMMINS

TO

UNITED TECHNOLOGIES DIESEL SYSTEMS

Cummins	UTDS	Description
3014195	CU 673C-23	Speed Control Unit
3019635	AGD 130 E4	Actuator
213272	MP 677	Magnetic Speed Sensor (3 inches)
3003916	MP 6710A	Magnetic Speed Sensor (5 inches)
3015105	TP 672A	Speed Trim Control
3002770	BK 6726	Actuator Mounting Bracket
3005811	CB 6712A	Actuator Cable Harness
213273	CB 6713A	Actuator Cable Harness