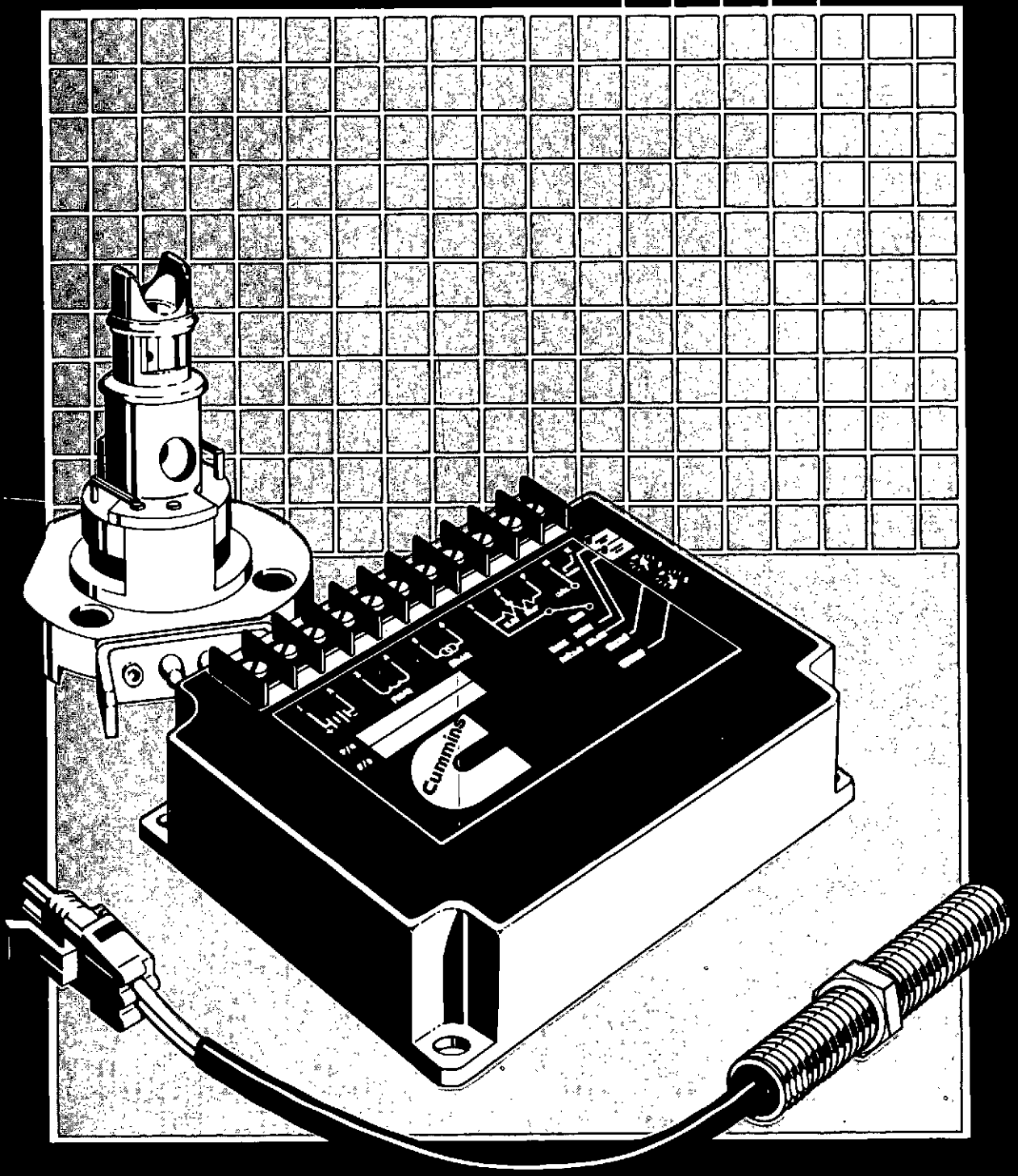
Electric Fuel Control Governor



Electric Fuel Control Governor

Cummins Diesel Engine

Bulletin No. 3379231-03, Printed 9-86

Foreword

The Electric Fuel Control (EFC) governor is used on the PT (type G) fuel system. The governor can be adjusted for isochronous or droop governing applications. The governor is available with normally open (fail to the open position) or normally closed (fail to the closed position) system.

This publication contains the instructions for the installation, adjustment, and troubleshooting of the Cummins EFC governor on a generator set or a generator drive application.

Contents

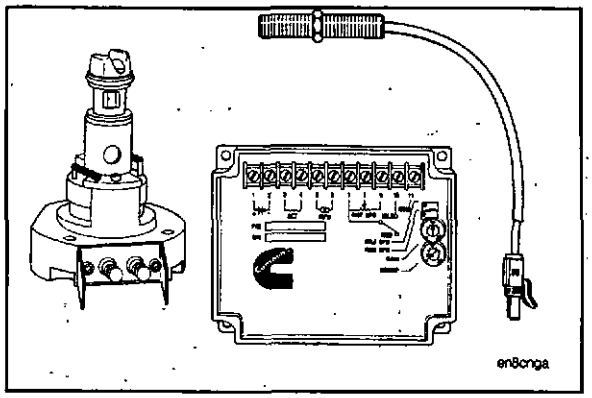
Service Tools (or Equivalent) Required

Tool Number	Tool Name
ST-752	Mechanics Hand Tool Set
3377462	Digital Tachometer
3376898	Electrical Multitester
3376613	Potentiometer Screwdriver
3376897	Cycle (Frequency) Meter
	24 Volt DC Batteries

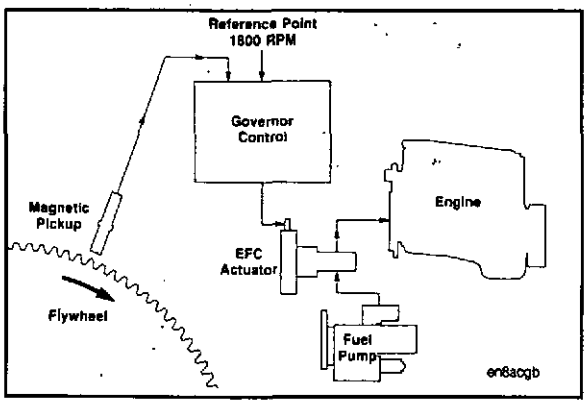
Electric Fuel Control Governor

Governor Description

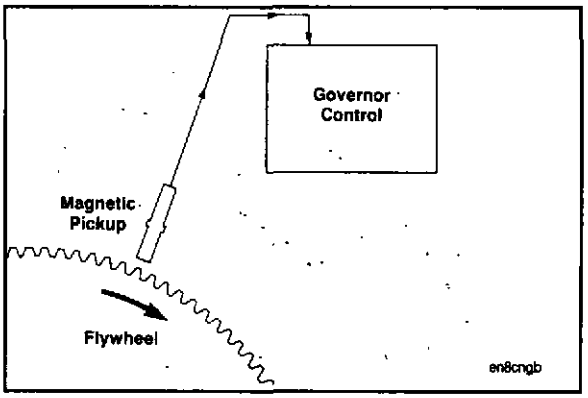
The governor contains a magnetic pickup, a governor control, an actuator and the mounting parts.



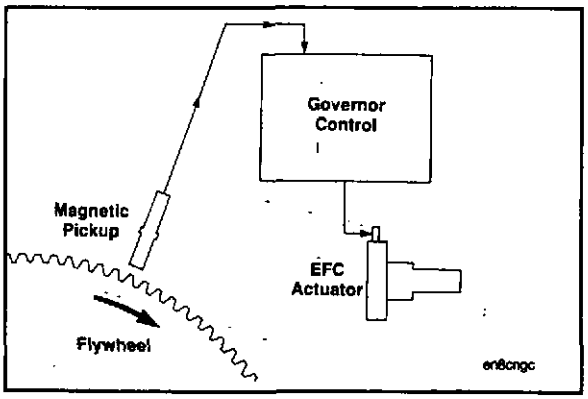
The governor is available with normally open or normally closed governor systems.

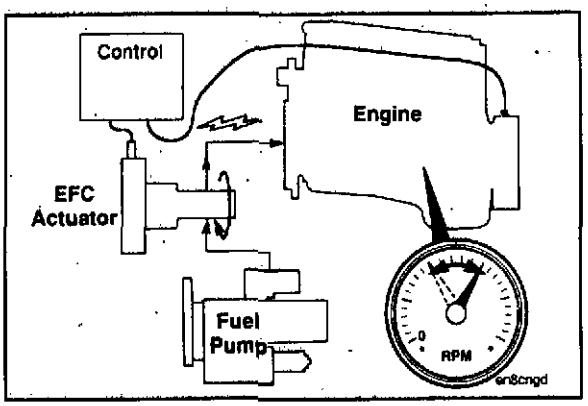


The magnetic pickup senses engine speed at the flywheel ring gear and sends an alternating current (A.C.) electrical signal to the governor control.

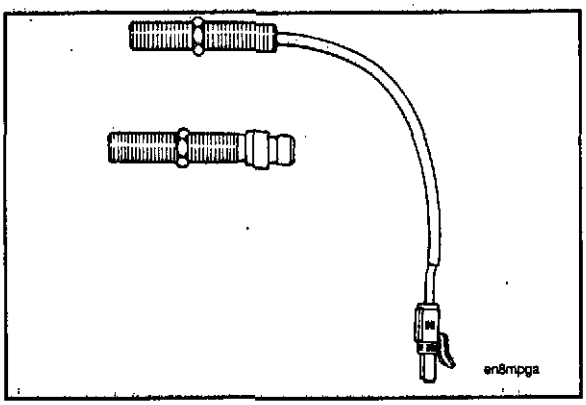


The governor control compares the electrical signal from the magnetic pickup with a preset reference point. If there is a difference in the two signals, the control will change the current to the actuator.



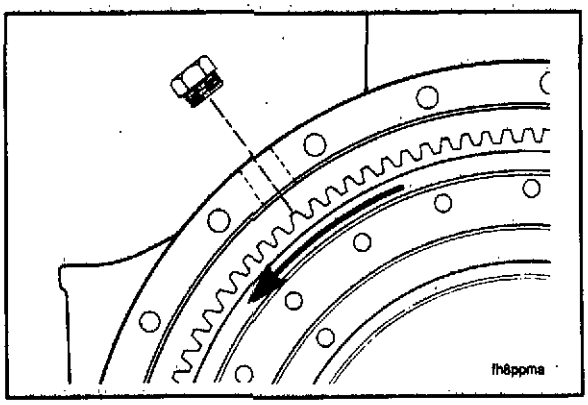


The change in current in the actuator coil will make the actuator shaft rotate. The fuel flow, and engine speed or power will change when the actuator shaft rotates.

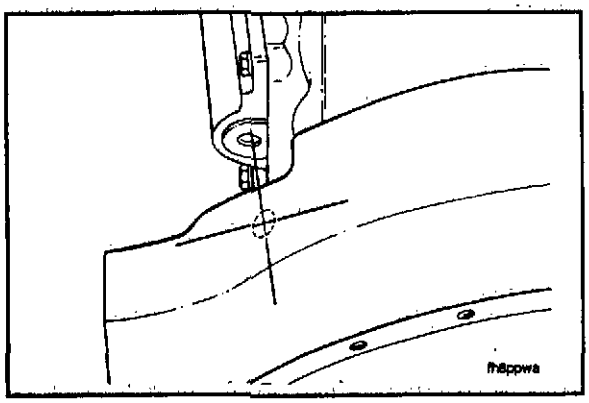


Magnetic Pickup Installation

The magnetic pickup is an electromagnetic device. The pickup is mounted in the flywheel housing. There are two types of magnetic pickups.



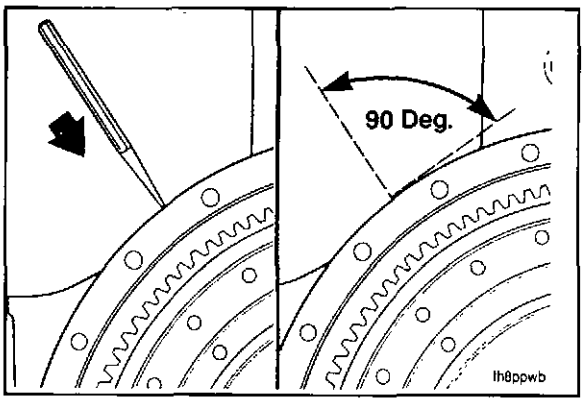
Remove a pipe plug from the flywheel housing that aligns with the flywheel gear teeth. Rotate the flywheel to center a gear tooth below the magnetic pickup hole, if necessary.



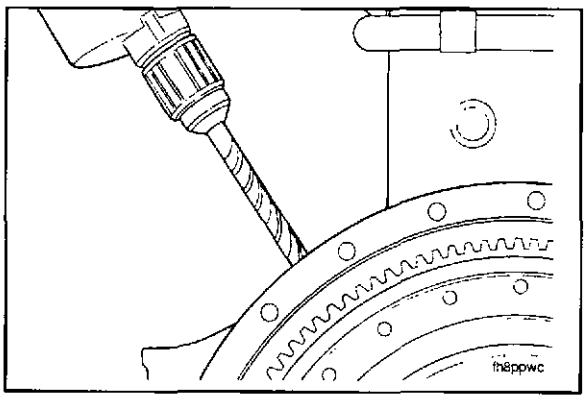
If the flywheel housing does not have a pipe plug that aligns with the flywheel gear teeth, drill and tap a hole in the housing.

NOTE: The drill chips must be removed from the flywheel housing. The main generator must be removed to clean the chips out of the housing.

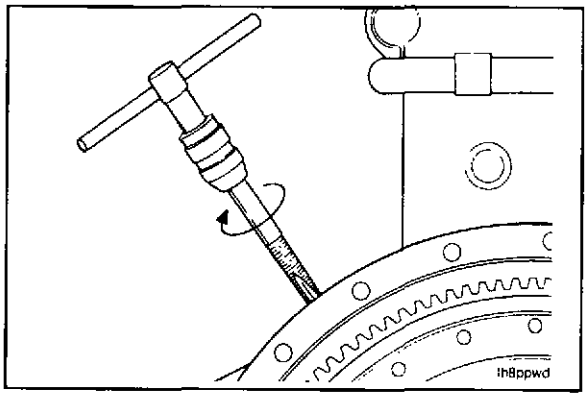
1. The hole must be perpendicular to the gear teeth. The hole can be over any part of the gear teeth.



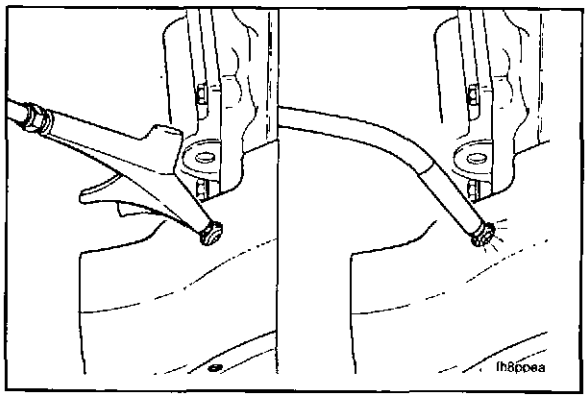
2. Drill a 37/64 inch [14.7 mm] hole in the housing.

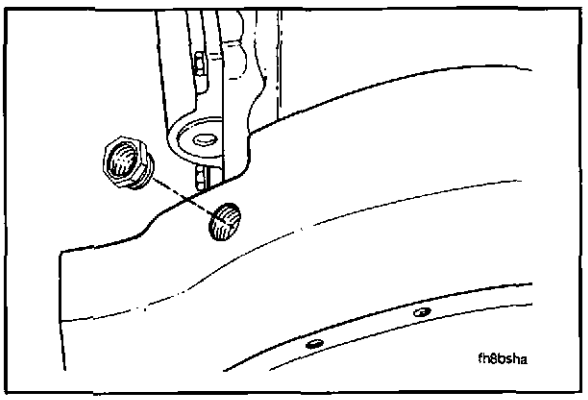


3. Tap the hole with a 5/8-18 UNF-2A size tap.

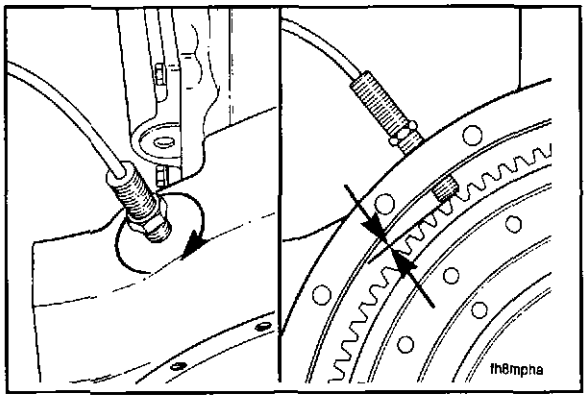


4. Remove the chips with a magnet if the housing is cast iron.
5. Remove the chips with compressed air if the housing is aluminum.



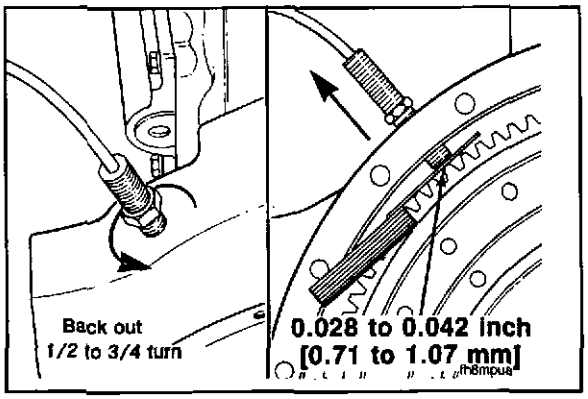


If the housing has a 3/4-16 UNF hole, install a bushing in the hole to reduce the threads to 5/8-18 UNF-2A.



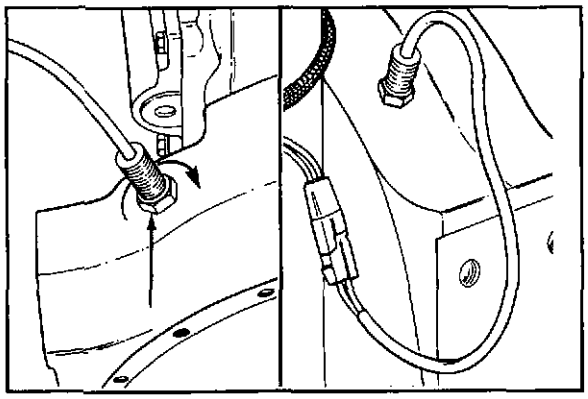
Screw the magnetic pickup all of the way down until it contacts a flywheel gear tooth. The pickup will screw in very easy, do not use excessive pressure to install the pickup.

NOTE: If the pickup does not screw in with finger pressure, check the hole and the pickup threads. Tap the hole again, if required. Refer to the previous page for the chip removal procedure.



Back the pickup out 1/2 to 3/4 of a turn.

If you can get a feeler gauge between the magnetic pickup and the flywheel gear tooth, back the pickup out 0.028 to 0.042 inch [0.71 to 1.07 mm] from the flywheel gear tooth.

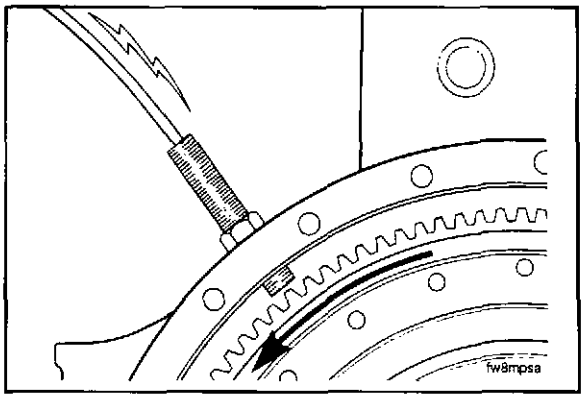


Tighten the locknut down on the flywheel housing.

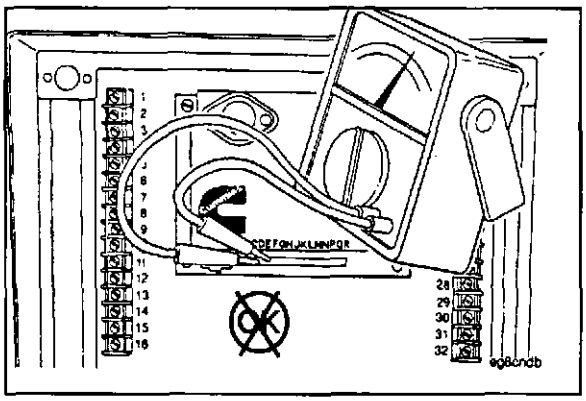
Plug the electrical connection into the pickup, when required.

Install the main generator, if it was removed.

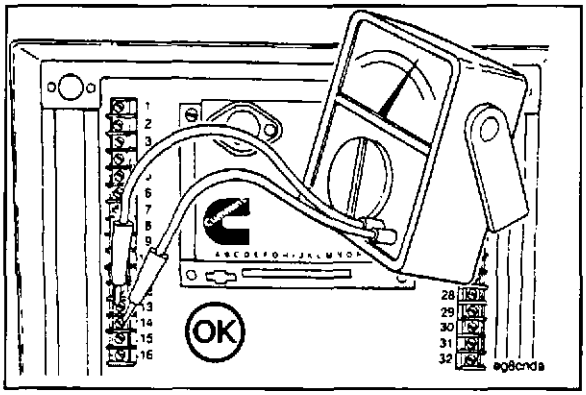
When the flywheel gear teeth pass the pickup, an A.C. voltage is induced. One cycle is induced for each gear tooth.



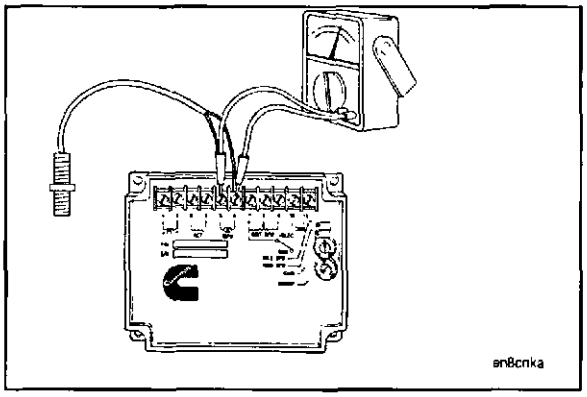
Caution: Measure the voltage of the panel mounted governor control on the engine control terminal strip. Do not measure the voltage on the control terminal strip. If two terminals on the panel mounted governor control terminal strip are shorted, it can damage the control unit.

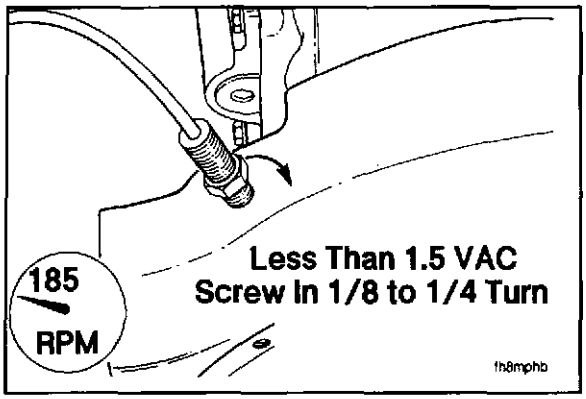


Check the magnetic pickup voltage on terminals 13 and 14 on the engine control terminal strip inside the engine mounted instrument panel.

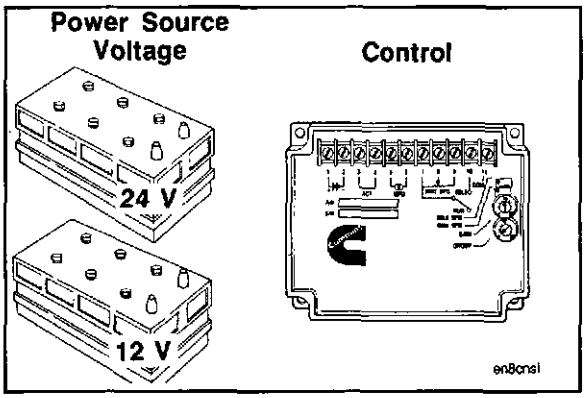


If a remote mounted control is in use, check the magnetic pickup voltage on terminals 5 and 6.





If the pickup signal is less than 1.5 volts AC when cranking the engine, screw the pickup in 1/8 to 1/4 turn.

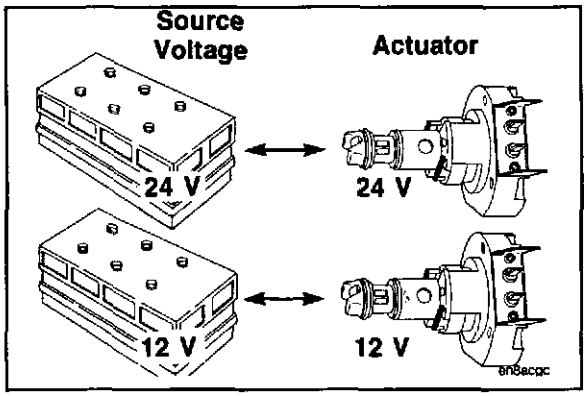


Power Source

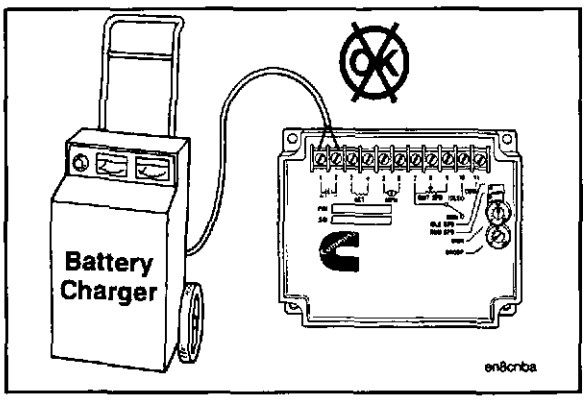
The governor control can operate on either 12 or 24 volts D.C.

A normally closed control must be used with a normally closed actuator.

A normally open control must be used with a normally open actuator.



The actuators can have a rating of 12V. or 24 V.-D.C. The source (battery) voltage at the control must be the same as the voltage rating of the actuator.

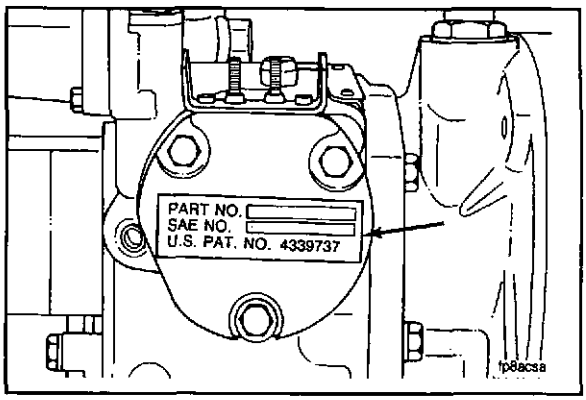


Caution: Do not connect the governor control to a battery charger. Due to the circuitry and method of operation of the chargers, the governor will not function *properly. Connect the battery charger to the battery.*

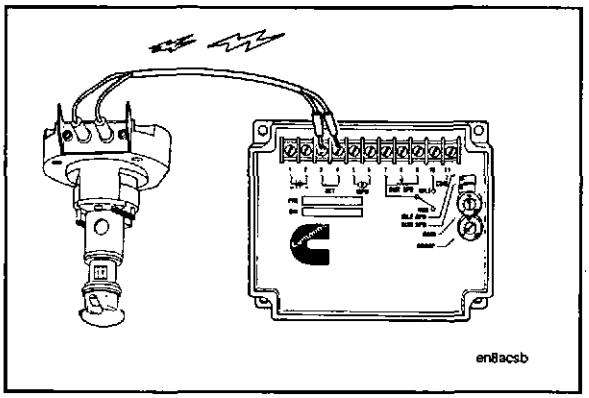
NOTE: See the panel mounted and remote governor control wiring diagrams for the specific wiring. See page 30 and 31.

Actuator Description

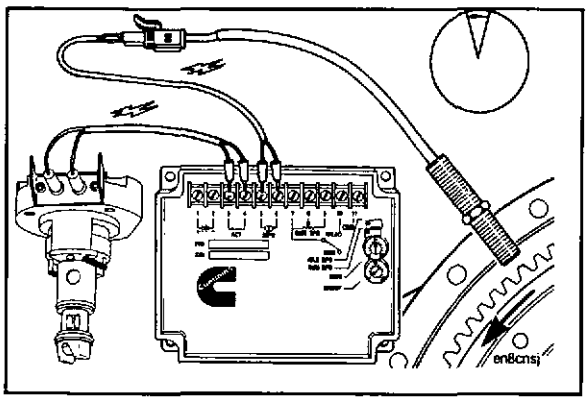
The actuator is an electromagnetic rotary solenoid valve. The actuator is installed in the EFC cavity of the PT fuel pump. The actuator controls the engine speed and horsepower by controlling the fuel flow to the injectors.



The actuator shaft will turn when the current from the governor control changes.

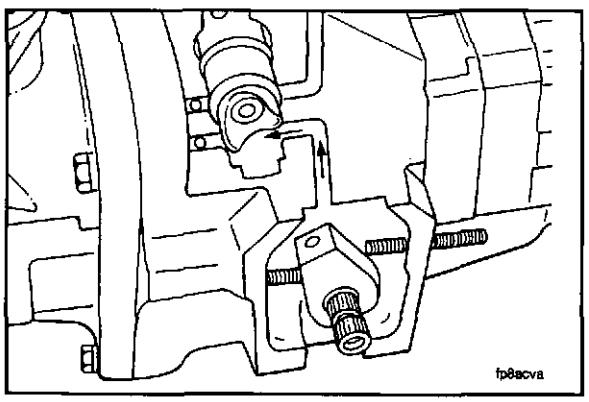


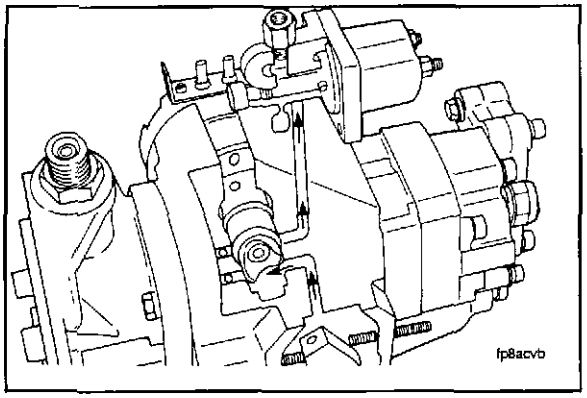
The current from the governor control will change when the magnetic pickup senses a change in the engine speed.



Fuel Flow Through the Fuel Pump

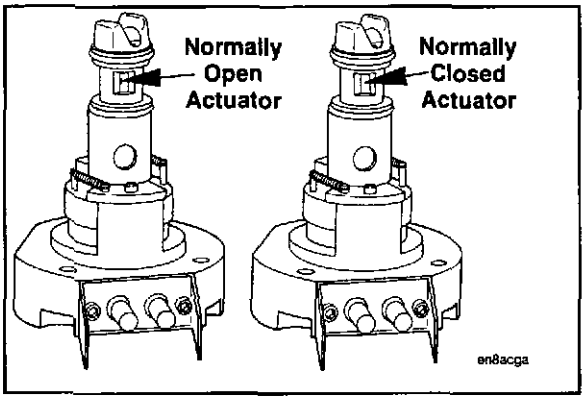
The throttle shaft is set in the full open position. The fuel flows through the fuel pump to the actuator (EFC) cavity.





The actuator controls the fuel flow to the injectors.

The fuel flows through the actuator to the shutoff valve.

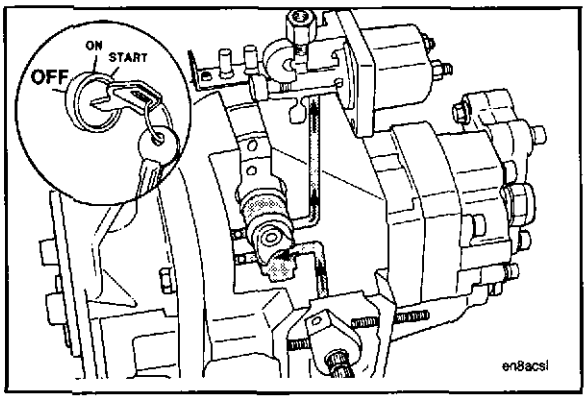


Actuator Identification

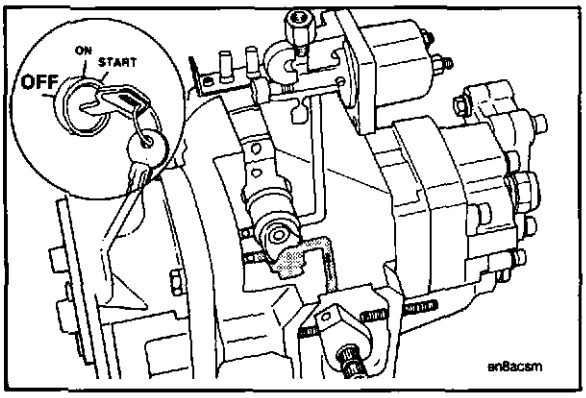
Two styles of the actuator are now available.

a. *Normally open*

b. Normally closed

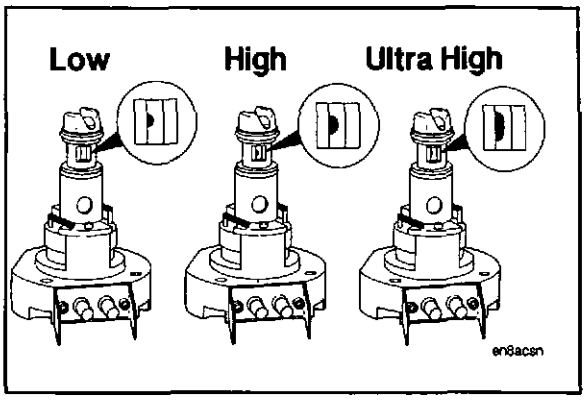


The normally open actuator is in the full fuel position when the electrical system is turned off.



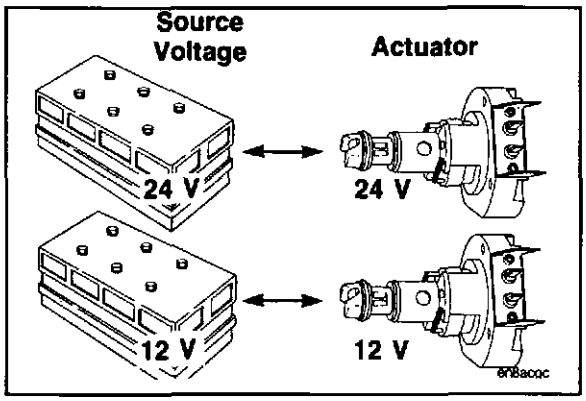
The normally closed actuator will stop the fuel flow when the electrical system is turned off.

The actuators are available in low, high, and ultra high flow.



The actuators are rated at 12 or 24 volts D.C.

Make sure the governor control voltage is the same as the actuator voltage rating.



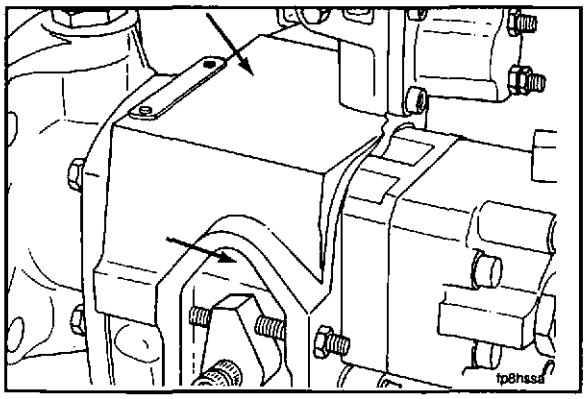
EFC Fuel Pump Housing

When a new EFC fuel pump is built at Cummins, the pump will have an EFC housing.

The EFC fuel pump housing can be identified in the following areas:

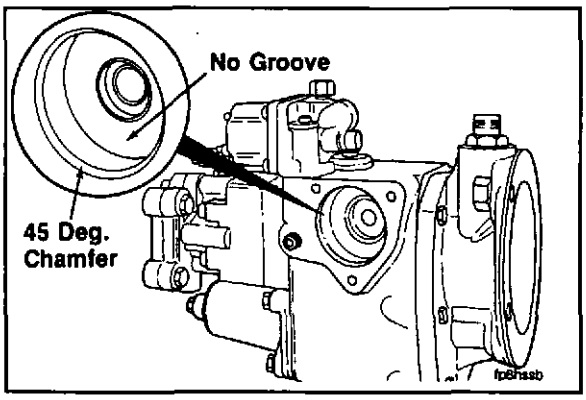
The AFC no-air adjusting screw hole has been omitted.

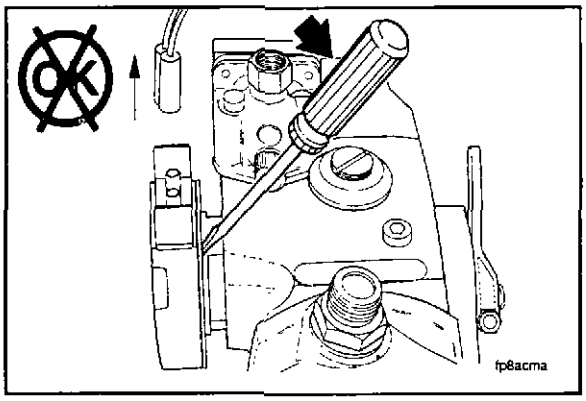
The ASA or AFC vent hole, in the top of the housing has been omitted.



The AFC spring seat groove is not machined.

A 45° chamfer is at the EFC actuator mounting surface.



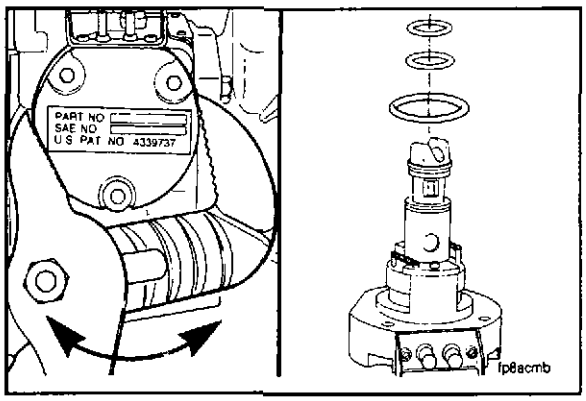


Actuator Removal From an EFC Fuel Pump Housing

Remove the actuator wires and capscrews.

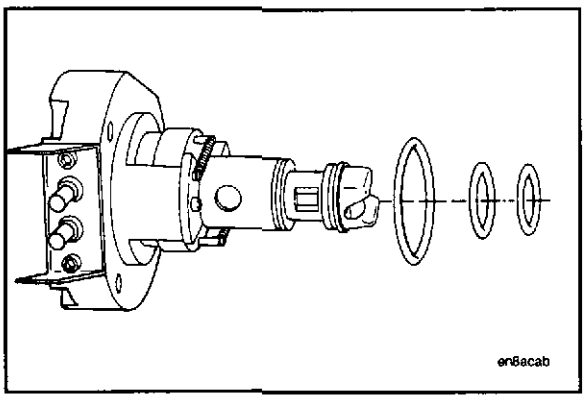
Caution: Do not pry the actuator from the housing.

This can damage the actuator shaft and make it stick.



Twist the actuator and pull it from the housing.

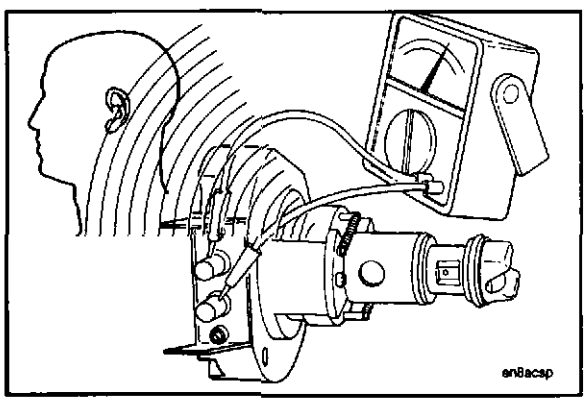
Remove the three O-rings from the actuator.



Actuator Installation in an EFC Fuel Pump Housing

Install a new O-ring on the 50 mm [2 in.] diameter of the actuator.

Install two new O-rings on the actuator barrel.

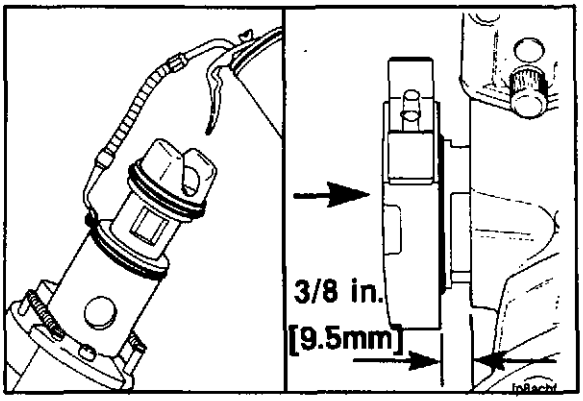


Apply the actuator rated battery voltage across the two terminals on the actuator to test the solenoid and to observe actuator operation. The actuator will make a loud click when the actuator shaft hits the internal stop. Removing the voltage from the actuator terminals will allow the force of the springs to return the actuator shaft to its original position. A click must be heard when the voltage is removed.

NOTE: The EFC housing does not require the EFC plug in the bottom of the EFC housing bore.

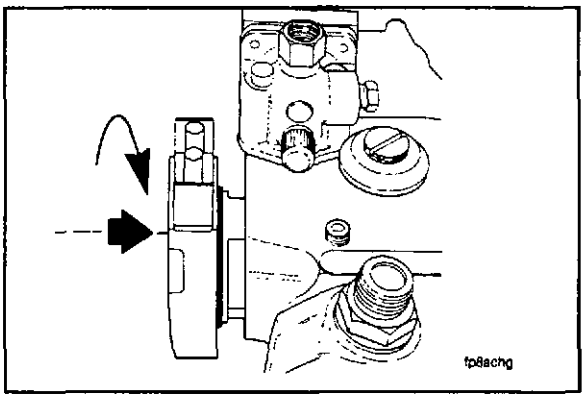
Lubricate the two barrel O-rings with clean engine oil.

Insert the actuator in the fuel pump housing. The actuator flange will be approximately 3/8 inch [9.5 mm] from the fuel pump housing.

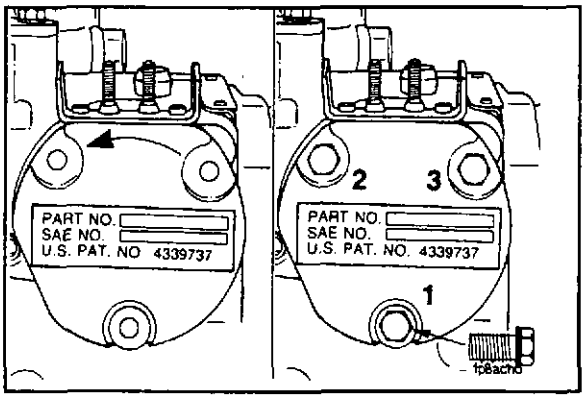


Use the palm of the hand. Firmly push and rotate the actuator approximately 30 degrees until the actuator flange contacts the fuel pump housing.

Rotate the actuator until the mounting holes are aligned.

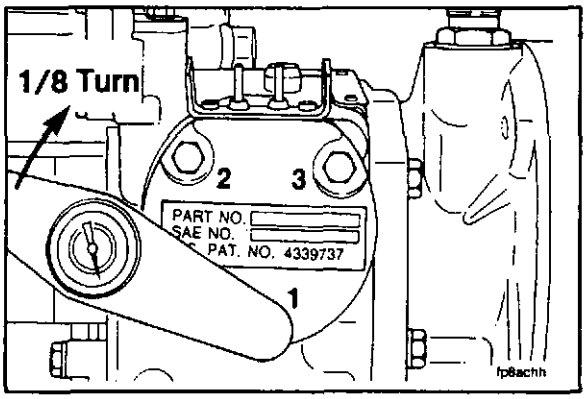


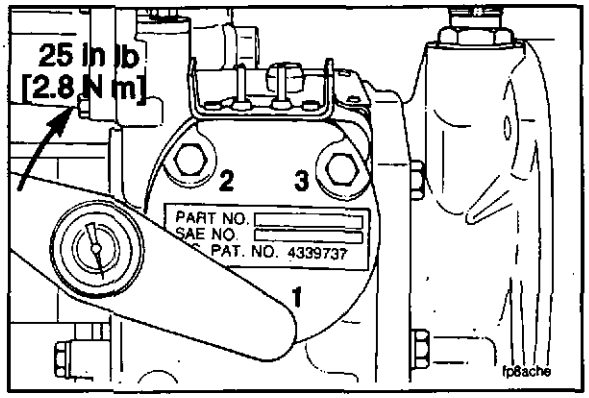
Install the three 1/4-20 x 1 1/4 inch hex head capscrews. These capscrews have captive spring washers and do not require lockwashers. Tighten the capscrews until they are finger tight.



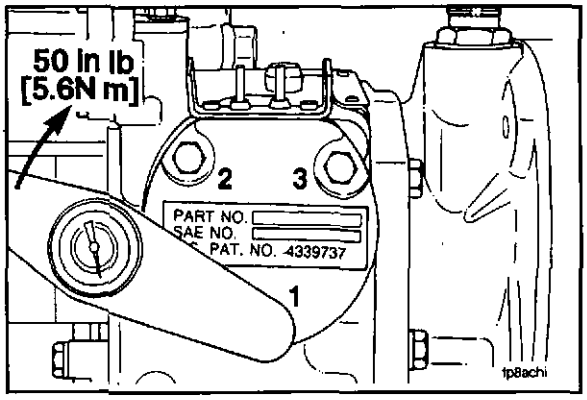
The actuator capscrews must be tightened in the following sequence:

1. Tighten the mounting capscrews 1/8 of a turn, in the sequence shown in the figure, until they are seated.

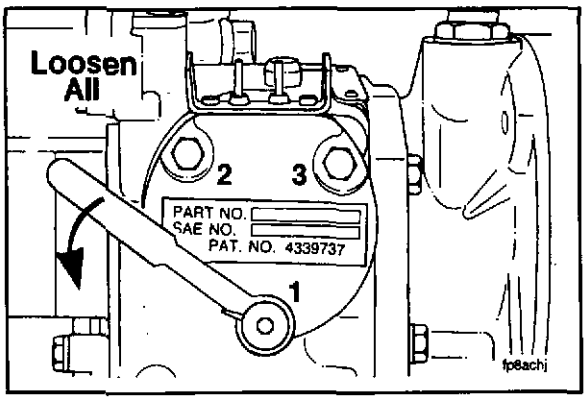




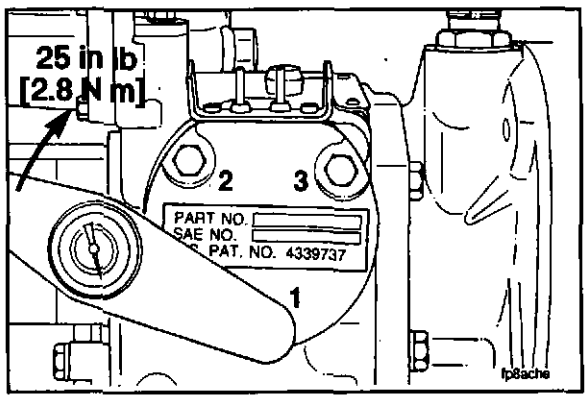
2. Tighten the capscrews in sequence to 25 in-lb [2.8 N•m] torque.



3. Tighten the capscrews in sequence to a torque of 50 in-lb. [5.6 N•m].

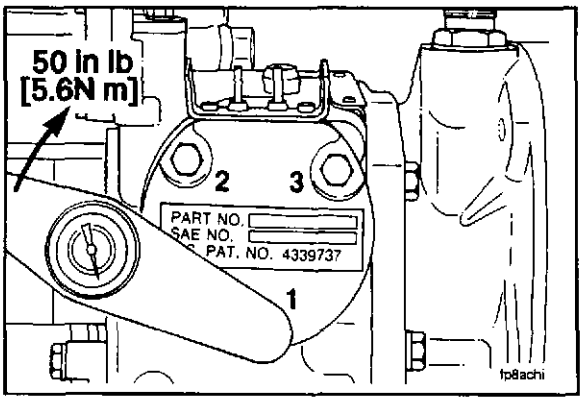


4. *Loosen all three capscrews completely.*



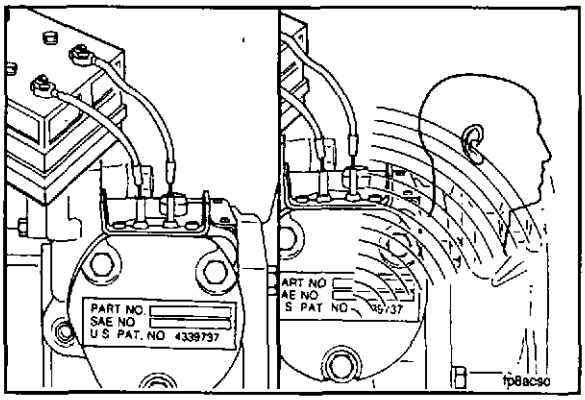
5. Tighten the capscrews again in sequence to 25 in.lb. [2.8 N•m] torque.

6. Tighten the capscrews again in sequence to 50 in.lb. [5.6 N•m] torque.
7. This procedure will make sure that the actuator is properly installed and is not binding.



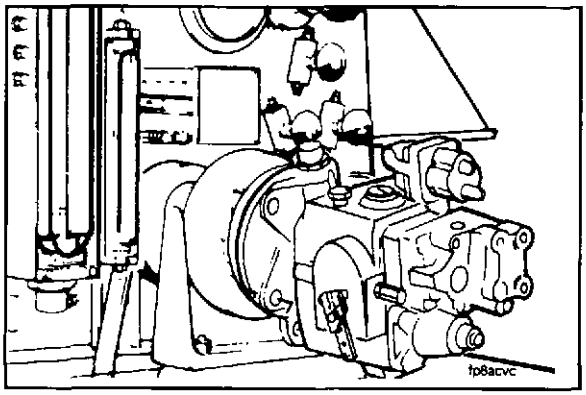
A final check is to apply and remove battery voltage across the two actuator terminals. The operation of the actuator must have a similar sound as it did before installing in the fuel pump housing. If the actuator does not click, as if it is not operating, or operating slower than before, loosen all of the capscrews and tighten them again as described in the previous procedure.

Caution: This test will only verify that the actuator will go from the full open to the full closed position. A slight binding of the actuator shaft can cause a governor stability complaint. This test may not detect a slight binding.

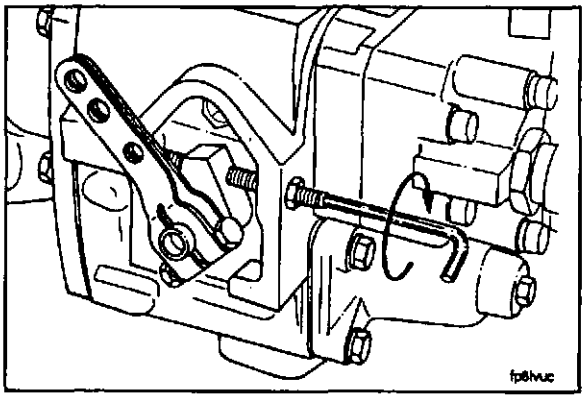


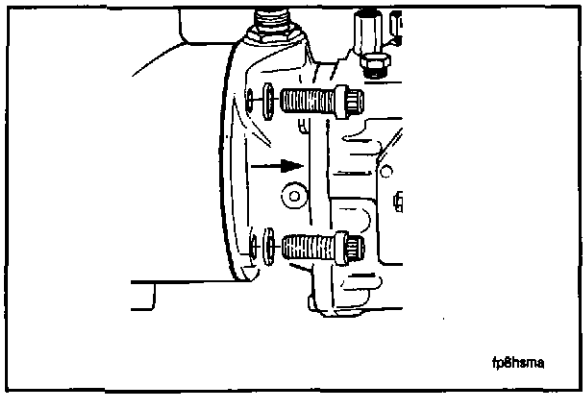
The fuel pump can now be calibrated (Refer to the Fuel Pump Calibration Manuals or the monthly Cumulative Supplement Update).

NOTE: Apply the actuator rated battery voltage to the normally closed actuator when the fuel pump is calibrated.



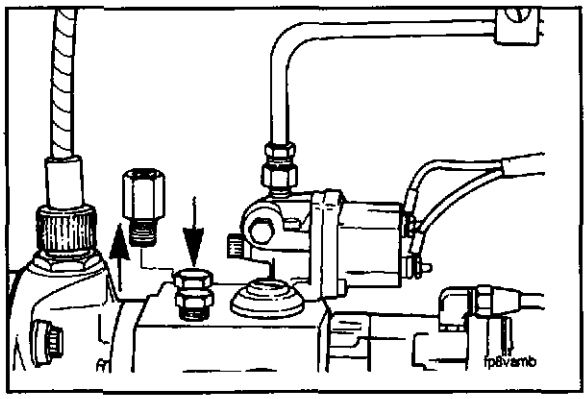
The throttle shaft must be locked in the full open position. After the calibration, the fuel pump can be mounted on the engine.



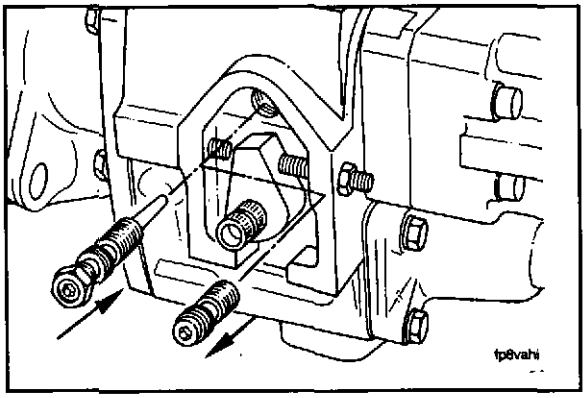


Actuator Installation in an AFC Fuel Pump Housing

Remove the fuel pump if it is on the engine.

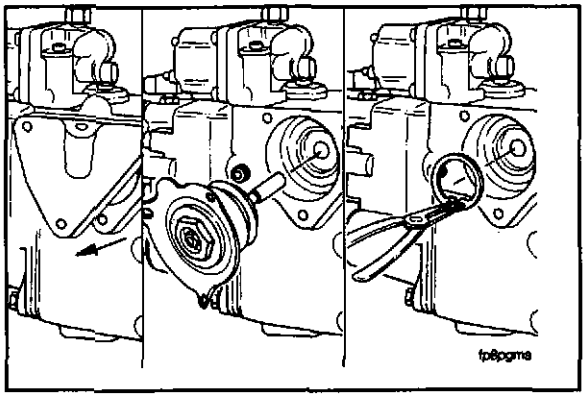


Remove the ASA, if required, and the AFC fuel drain tube. Install a plug in the housing. Install a plug in the fuel drain tube connection.



Remove the AFC no-air plug, if the fuel pump does not have an AFC. Replace it with the no-air needle valve. The AFC no-air plug is located directly above the throttle shaft.

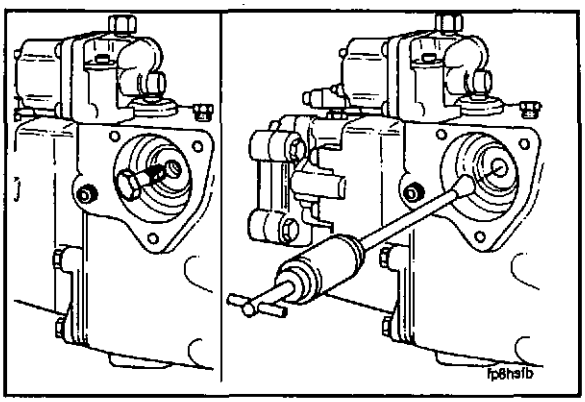
Tighten the AFC no-air needle valve in the housing to 25 in. lb. [2.8 N•m]. Tighten the jam nut.



Remove the AFC cover plate. Remove the AFC bellows/plunger assembly, if required. Use a pair of snap ring pliers to remove the barrel or barrel plug snap ring.

Thread one of the previously removed 1/4-20 capscrews into the AFC barrel plug. Pull out the barrel plug with a pair of pliers. Discard the three original AFC cover plate capscrews.

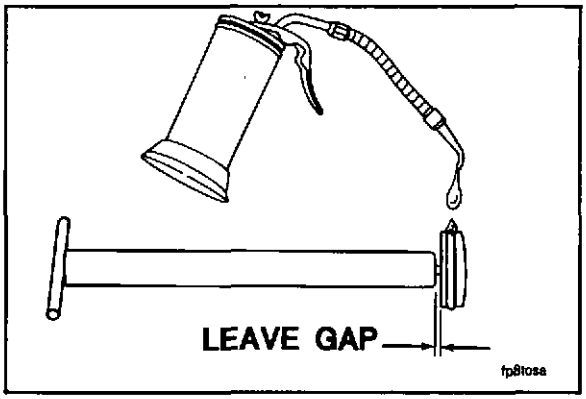
If the fuel pump has a functional AFC, use the AFC barrel puller, Service Tool 3375599 to remove the barrel. The AFC cannot be used with an EFC governor. The AFC cavity is now ready for the installation of the EFC governor actuator.



Install the O-ring plug on the Governor Plug Tool, Part No. 3376457, approximately three turns. Install the O-ring on the plug.

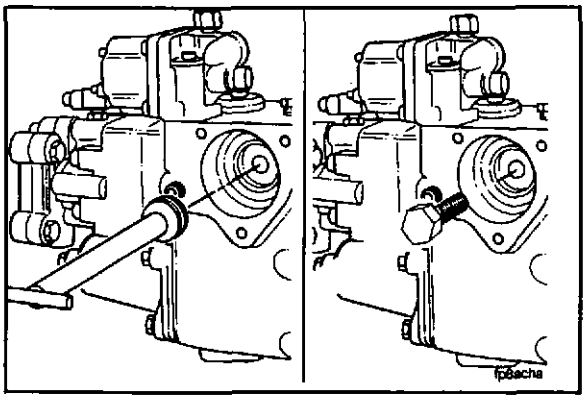
Caution: : Do not tighten the O-ring plug to the plug tool or the tool can not be removed after the plug is inserted in the pump AFC cavity.

Lubricate the O-ring with clean engine oil.



Press firmly until the O-ring plug is seated in the pump housing.

Carefully unscrew the plug tool.

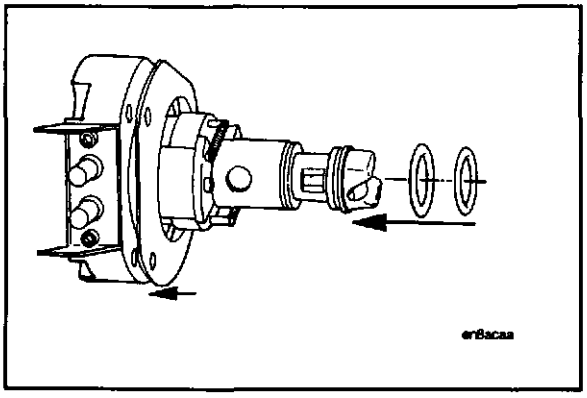


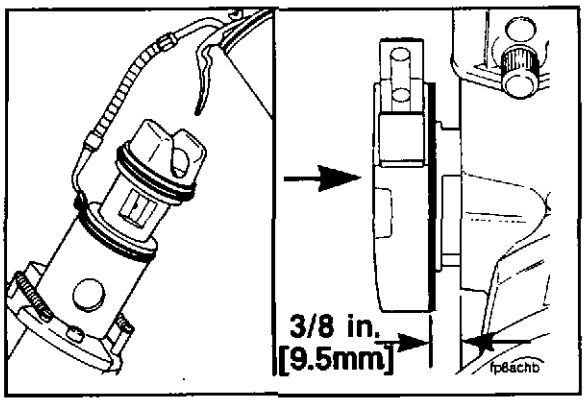
Install the EFC gasket on the actuator. The gasket will fit only one way. The fuel pump side goes against the fuel pump.

Caution: Do not use any gasket adhesive or sealant on this gasket.

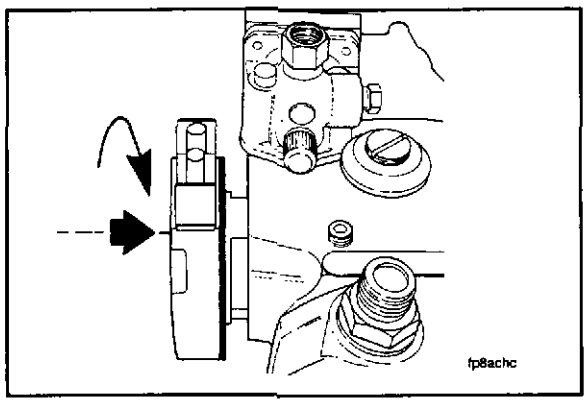
Check that all of the mounting holes can be aligned.

Install the O-rings on the shaft.

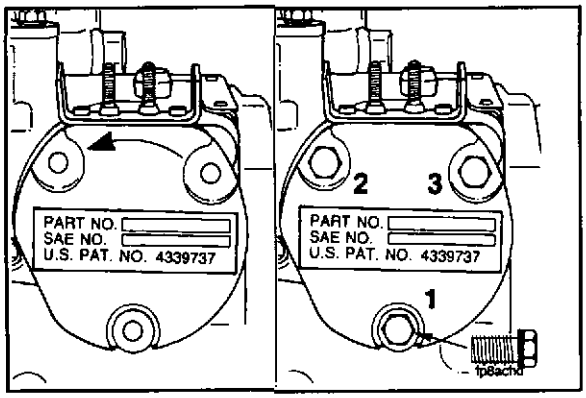




Lubricate the actuator O-rings with clean engine oil. Insert the actuator in the EFC cavity of the fuel pump housing. The actuator flange will be approximately 3/8 inch [9.5 mm] from the fuel pump housing.

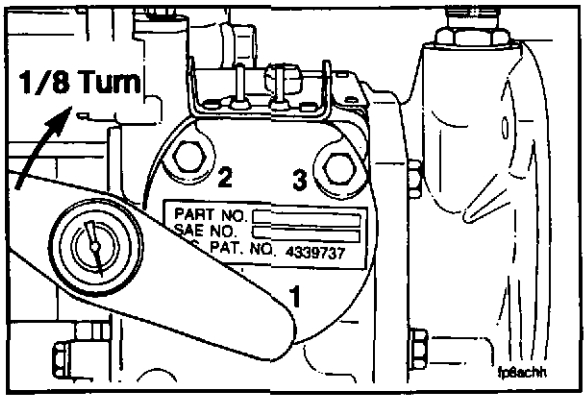


Use the palm of the hand. Firmly push and rotate the actuator approximately 30 degrees until the actuator flange contacts the fuel pump housing.



Rotate the actuator until the mounting holes are aligned.

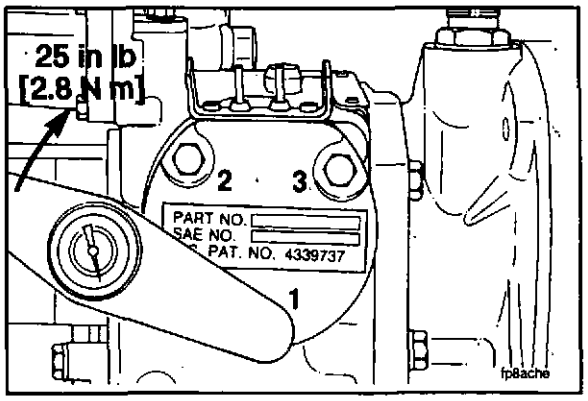
Install the three 1/4-20 X 1 1/4 inch hex head capscrews. These capscrews have captive spring washers and do not require lockwashers. Tighten the capscrews until they are finger tight.



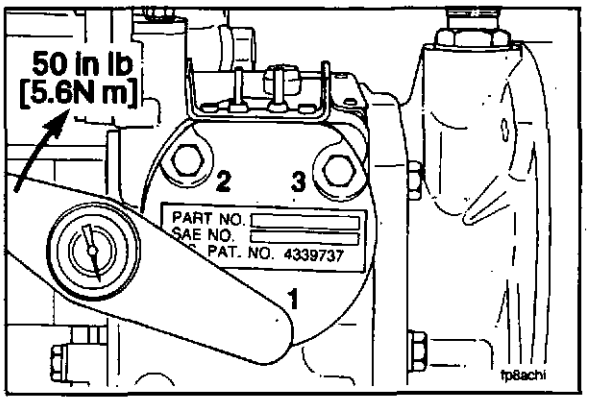
The actuator capscrews must be tightened in the following procedure:

1. Tighten the mounting capscrews 1/8 of a turn, in the sequence shown in the figure until they are seated.

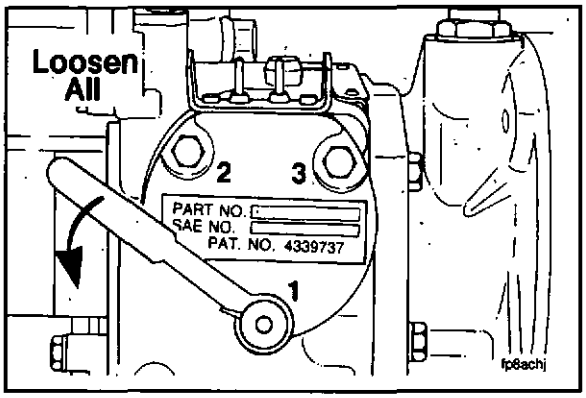
2. Tighten the capscrews in sequence to 25 in-lb [2.8 N•m] torque.



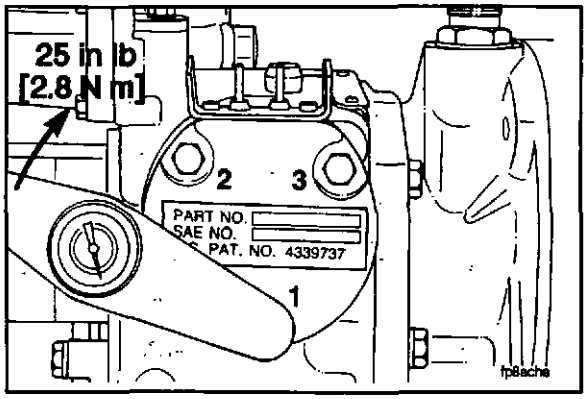
3. Tighten the capscrews in sequence to a torque of 50 in-lb. [5.6 N•m].

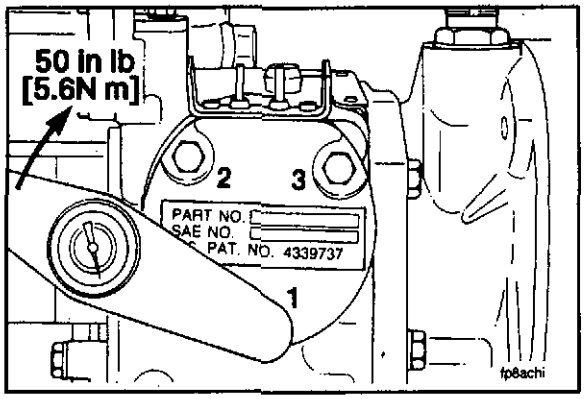


4. Loosen all three capscrews completely.

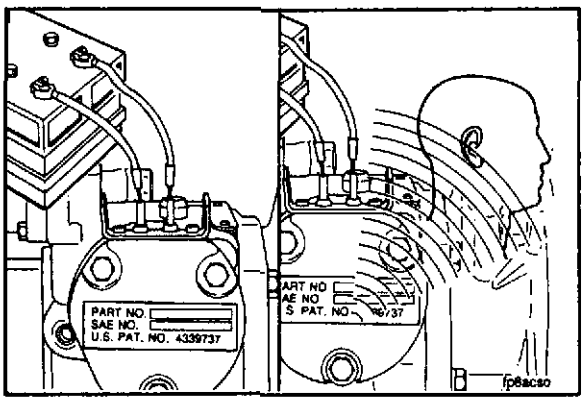


5. Tighten the capscrews again in sequence to 25 in-lb [2.8 N•m] torque.



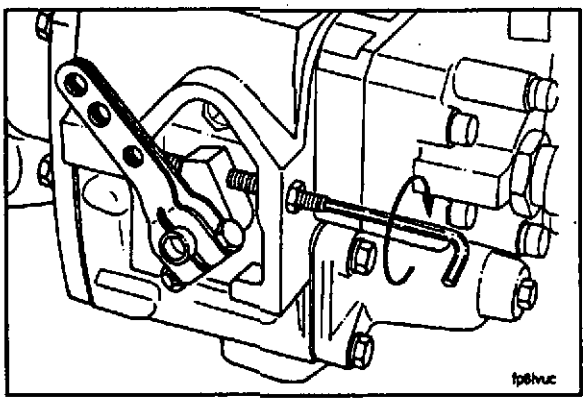


6. Tighten the capscrews again in sequence to 50 in-lb [5.6 N•m] torque.
7. This procedure will make sure that the actuator is properly installed and is not binding.



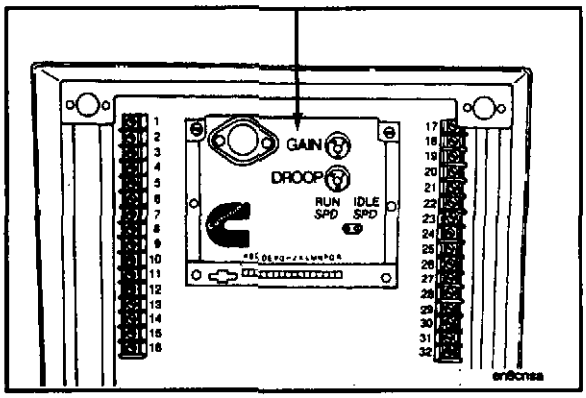
A final check is to apply and remove battery voltage across the two actuator terminals. If the actuator does not click, as if it is not operating, or operating slow , loosen all of the capscrews and tighten them again as described in the previous procedure.

Caution: This test will only verify that the actuator will go from the full open to the full closed position. A slight binding of the actuator shaft can cause a governor stability complaint. This test will not detect a slight binding.



The fuel pump can now be calibrated (Refer to the Fuel Pump Calibration Manuals or the monthly Cumulative Supplement Update). The throttle shaft must be locked in the full open position. After the calibration, the fuel pump can be mounted on the engine.

NOTE: Apply the actuator rated battery voltage to the normally closed actuator when the fuel pump is calibrated.

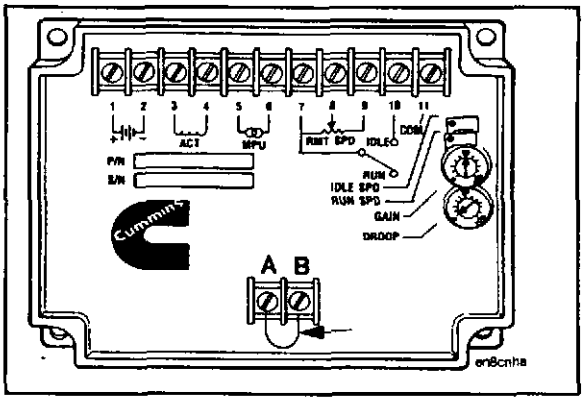


System Adjustments - Single Unit Governor

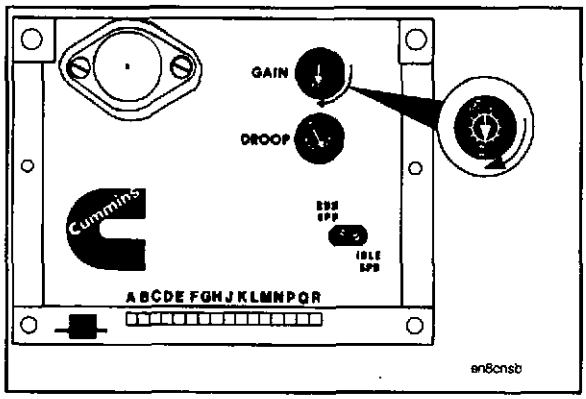
Panel Mounted Governor Control Adjustments

The panel mounted governor control has four potentiometers for making system adjustments. These components are mounted on the control which is located inside the engine instrument panel or generator control panel.

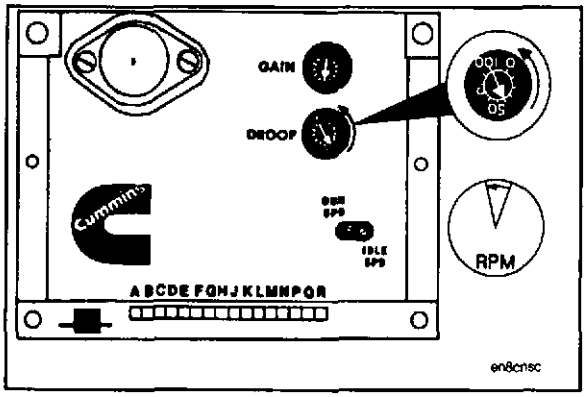
NOTE: When a two bearing generator or a single bearing generator with a flexible drive between the flex discs and shaft (eg. Kohler 4T10 generators, Models 230ROZ, 250 ROZ and 275 ROZ) is installed, use a remote mounted control. If the engine is not stabile after the gain adjustment is made, install a jumper wire between terminals A and B.



The **gain** control is a one-turn potentiometer. It is used to adjust the sensitivity of the governor. A clockwise rotation of the potentiometer dial will shorten the response time of the governor to load changes. Refer to the glossary for the gain description.



The **droop** control is a one-turn potentiometer. It is adjustable for zero % (isochronous) to five % speed droop. Counterclockwise rotation will decrease the speed droop.

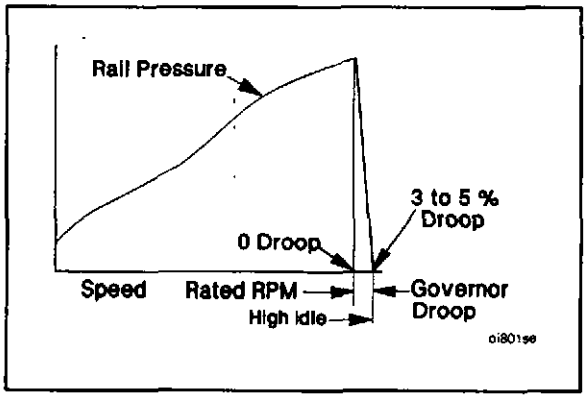


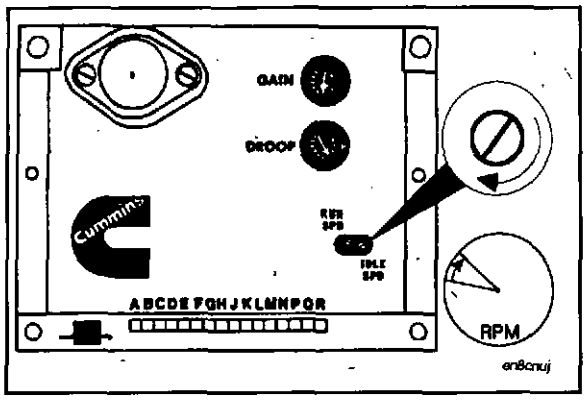
Refer to the glossary for the droop description.

$$\frac{\text{High Idle Speed - Rated Speed}}{\text{Rated Speed}} \times 100\% = \text{Governor Droop}$$

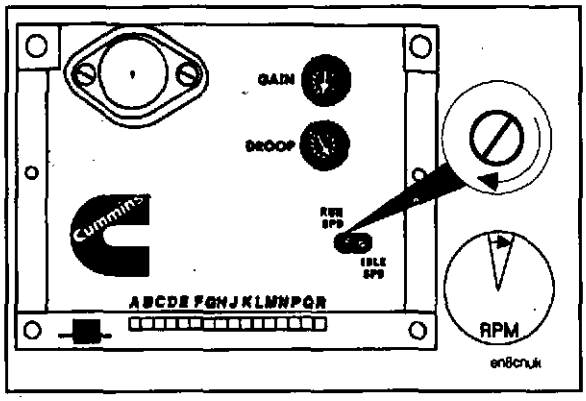
$$\frac{1890-1800}{1800} \times 100 = 5\%$$

$$\frac{1800-1800}{1800} \times 100 = 0\% \text{ (Isochronous)}$$

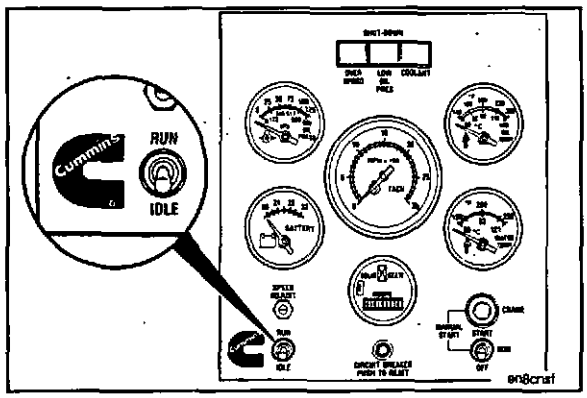




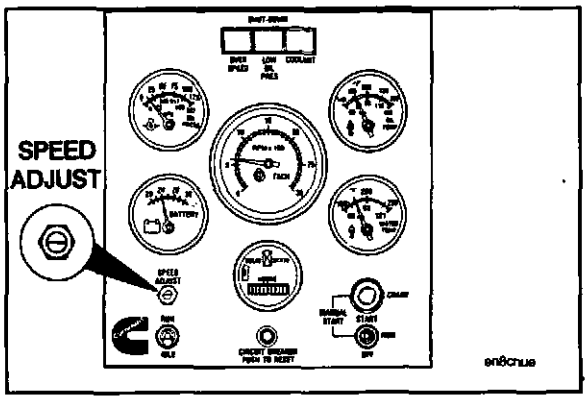
The **idle speed** control is a 20-turn potentiometer for adjusting the idle speed. A clockwise rotation will increase the idle speed.



The **run speed** control is a 20 turn potentiometer for setting the desired no-load governed speed. A clockwise rotation will increase the run speed.

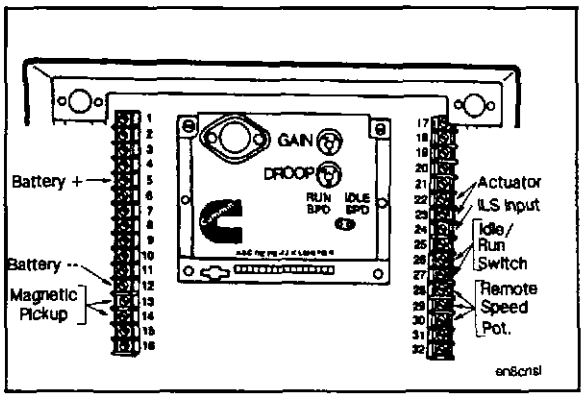


An **idle-run** switch, located on the engine instrument panel, allows the selection of the idle or run mode.

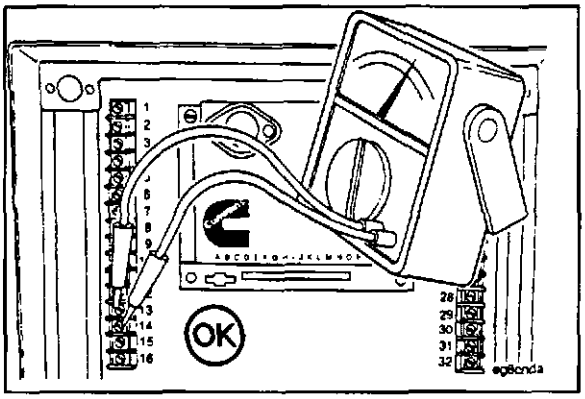


Also located on the engine instrument panel is the **Speed Adjust** potentiometer which is used for fine speed adjustment after **Run Speed, Droop,** and **Gain** have been set.

The panel mounted governor control wiring.



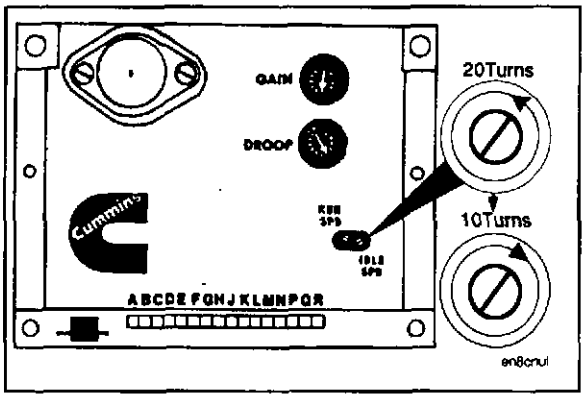
Caution: Measure the voltage on the engine control circuit board terminal strip and not on the control terminal strip. If two terminals on the control terminal strip are shorted, it can damage the control unit.



Preliminary Adjustments

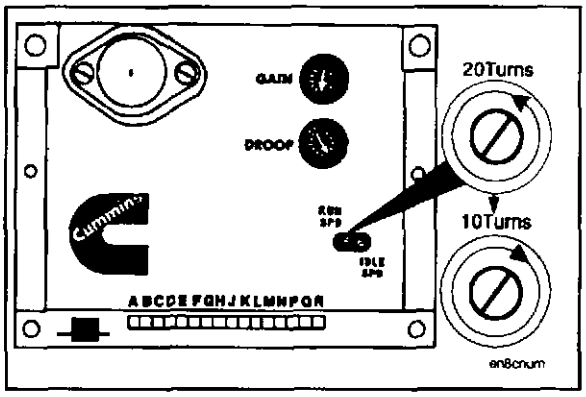
The idle speed potentiometer adjustment.

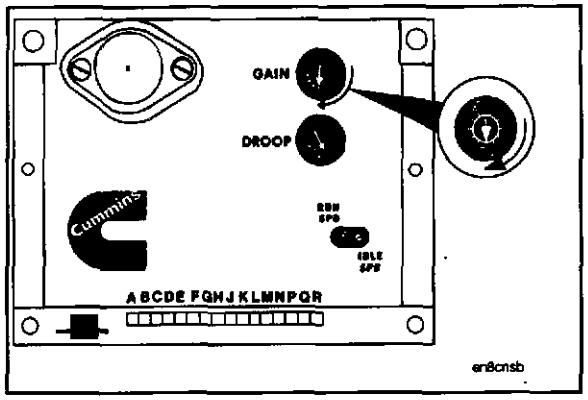
1. Turn the screw counterclockwise 20 turns.
2. Turn the screw clockwise 10 turns.
3. This will set the idle speed potentiometer to its mid position.



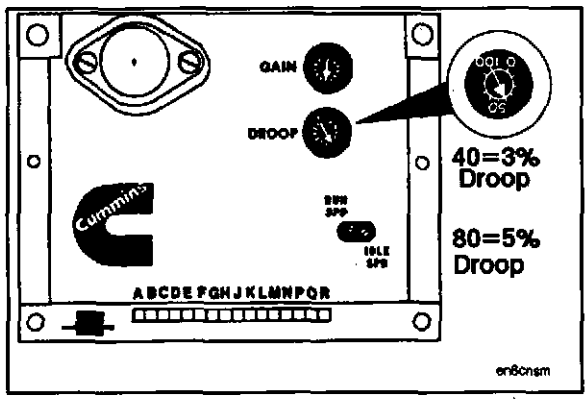
The run speed potentiometer adjustment.

1. Turn the screw counterclockwise 20 turns.
2. Turn the screw clockwise 10 turns.
3. This will set the run speed potentiometer to its mid position.





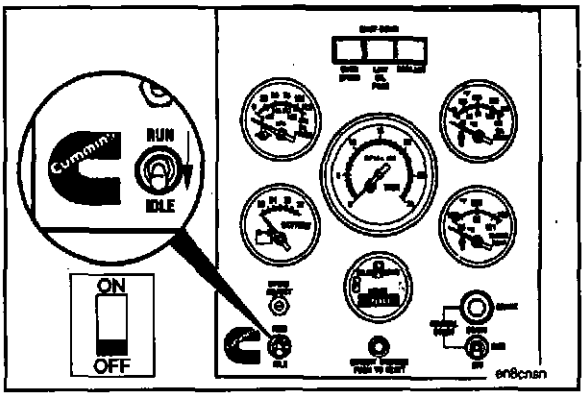
Turn the gain potentiometer adjustment to midposition or 50.



The droop potentiometer adjustment.

1. Turn the potentiometer fully counterclockwise for isochronous operation.
2. Turn the potentiometer to approximately 40 for 3 percent droop.
3. Turn the potentiometer to approximately 80 for 5 percent droop.

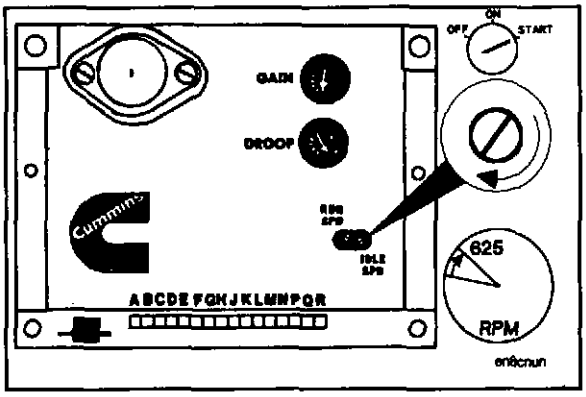
Adjust any remote speed potentiometers to the center of their adjustment range.



Governed Speed Adjustment

Place the idle-run switch on the engine instrument panel in the idle position.

NOTE: Open the main line circuit breaker while the engine is at idle.



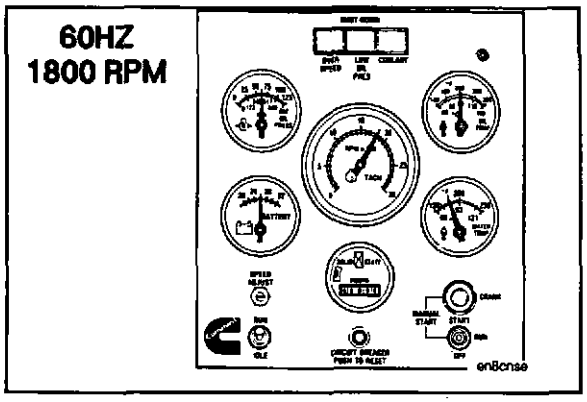
Start the engine. Adjust the idle speed potentiometer on the governor control until the engine is running at 600 to 650 RPM.

Generators which are to operate at 60 Hz full load, must have the engine no load governed speed adjusted to:

60.0 Hz (1800 RPM) for isochronous operation

61.8 Hz (1854 RPM) for 3% speed droop

63.0 Hz (1890 RPM) for 5% speed droop



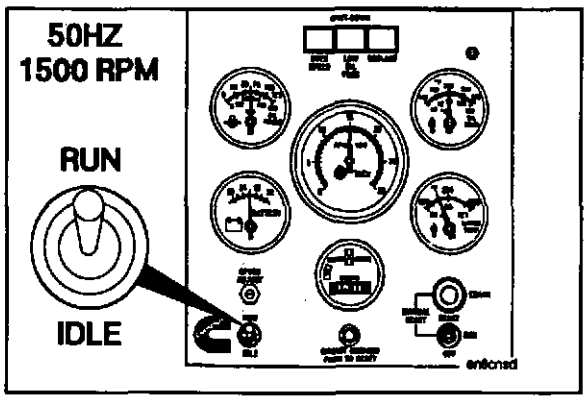
For generators which are to operate at 50 Hz full load, the engine no-load governed speed must be adjusted to:

50.0 Hz (1500 RPM) for isochronous operation

51.5 Hz (1545 RPM) for 3% speed droop

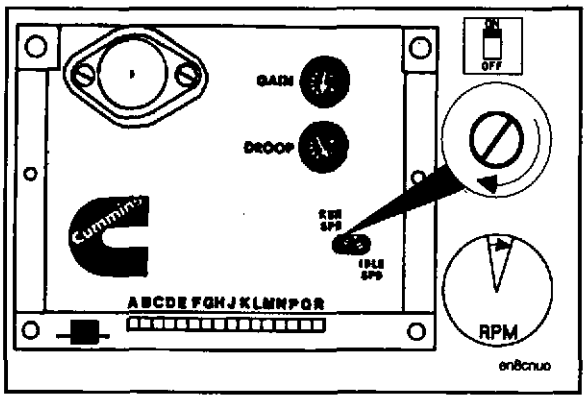
52.5 Hz (1575 RPM) for 5% speed droop

Move the idle run switch to the "Run" position



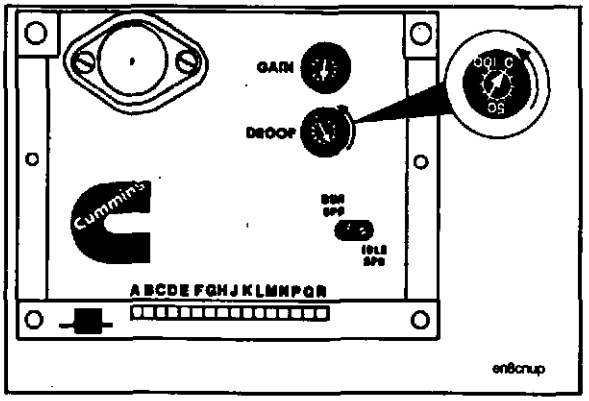
Adjust the run speed potentiometer on the governor control until the no load speed is correct.

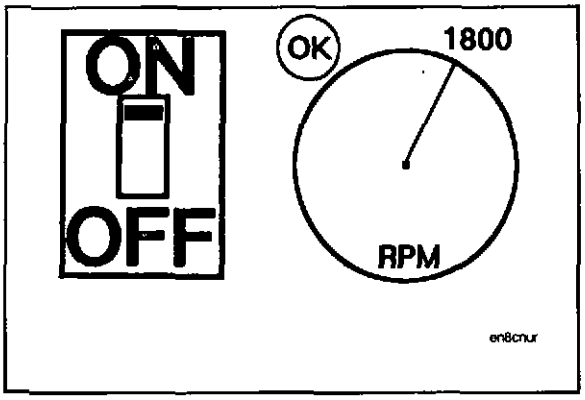
NOTE: Close the main line circuit breaker.



Droop Adjustment - Isochronous Operation

For isochronous operation, the droop potentiometer must be turned fully counterclockwise and will not require any further adjustment.

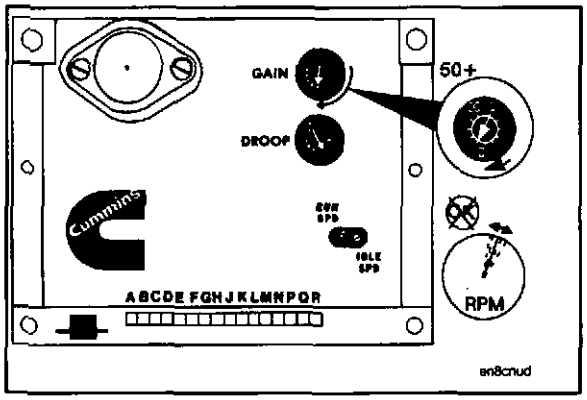




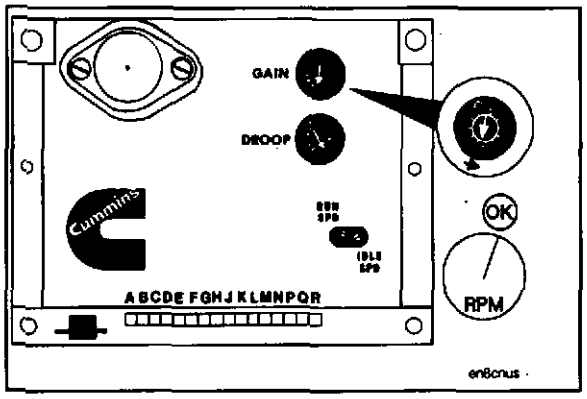
Gain Adjustment

Close the main line circuit breaker and apply approximately 1/4 of the rated load.

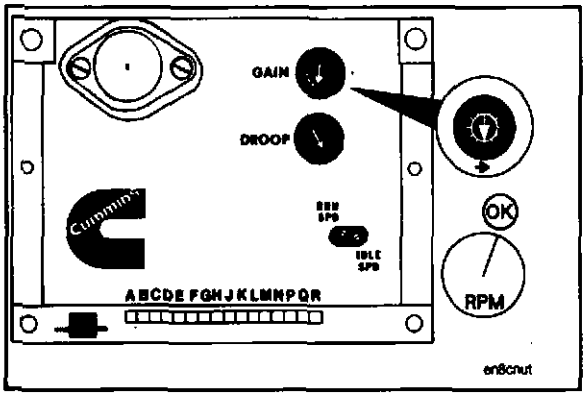
Make sure the engine speed is constant.



If the engine speed is constant, turn the GAIN potentiometer clockwise slowly until the engine speed is not constant.



1. Slowly turn the potentiometer counterclockwise until a constant speed is achieved.

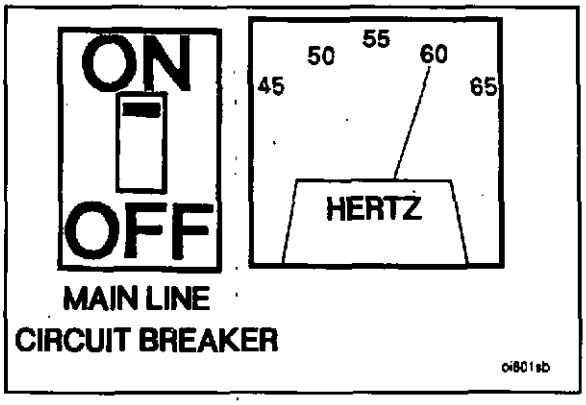


2. Turn the potentiometer counterclockwise an additional 1/2 division.

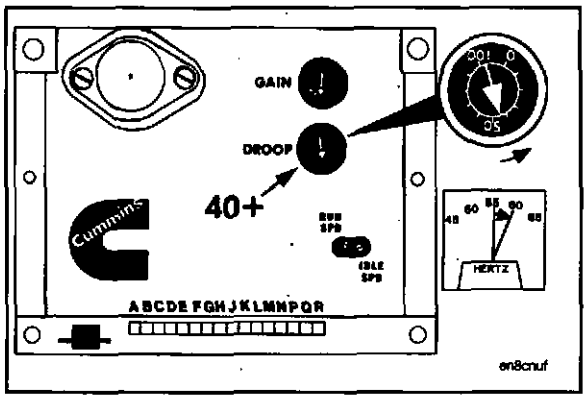
Droop Operation

Close the main line circuit breaker and apply the rated KW load.

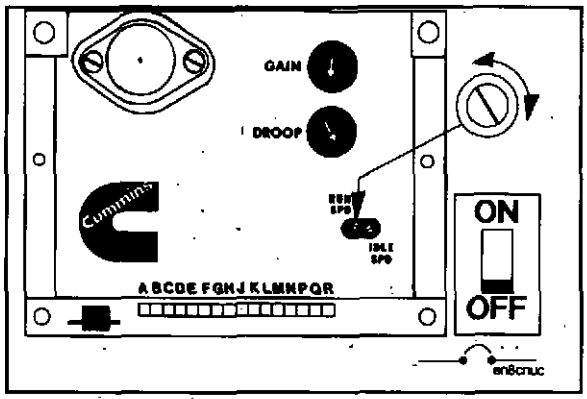
Check the frequency meter to make sure the full load governed speed is correctly set at 60 Hz or 50 Hz.



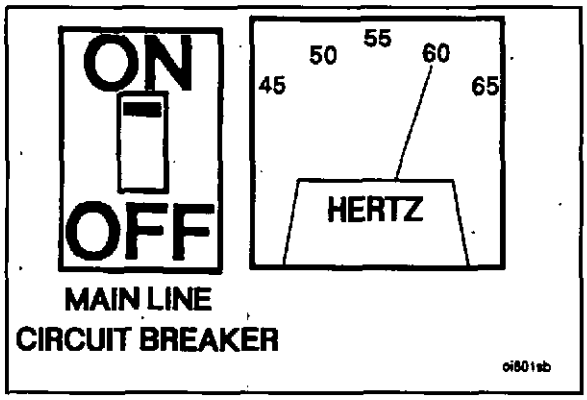
1. If the frequency meter is less than 60 Hz or 50 Hz, more droop is present than desired.
2. Turn the droop potentiometer counterclockwise slowly until it is 60 Hz or 50 Hz.



3. Open the main line circuit breaker and adjust the no load governed speed again to the correct setting.



4. Close the main line circuit breaker and apply the load. The frequency meter must read 60 Hz or 50 Hz.
5. If the frequency meter is not 60 Hz or 50 Hz, repeat the procedure. It will usually take two or three successive adjustments to obtain the correct frequency.



$$S_{al} = S_{nl} - \left[\left(\frac{\text{Available KW Load}}{\text{Rated KW}}\right) \times \left(S_{nl} - S_{fl}\right)\right]$$

Where
S_{al} = Speed at Available KW Load
S_{fl} = Speed at Full KW Load
S_{nl} = Speed at No Load

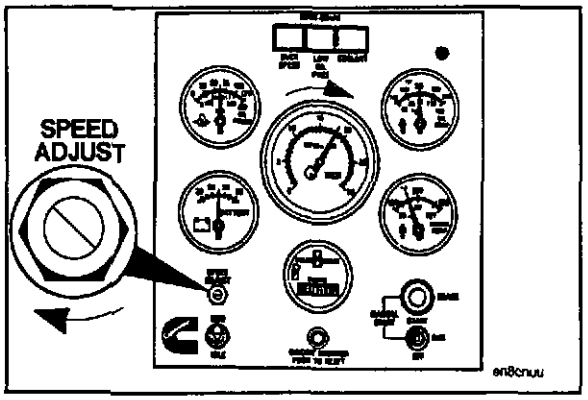
Example
Available KW Load = 400
Rated KW = 500
Speed at Full KW Load = 1800
Speed at No Load = 1854

$$S_{al} = 1854 - \left[\left(\frac{400}{500}\right) \times (1854 - 1800)\right]$$

S_{al} = 1811 RPM

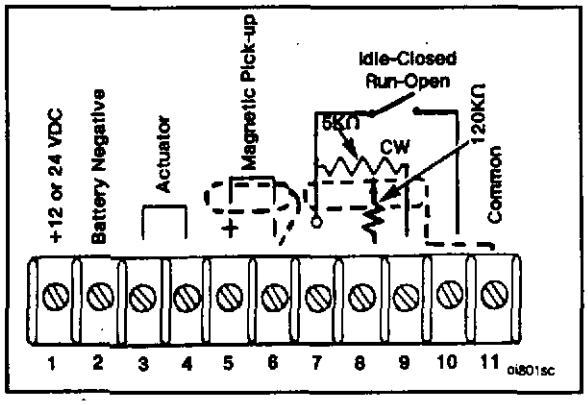
6. To calculate the operating (governed) speed under the available load for droop operation, when the full KW load is not available, use this formula.

NOTE: The engine speed in RPM is equal to 30 times the frequency (Hz). At 60.0 Hz, the engine speed = 30 X 60 = 1800 RPM.



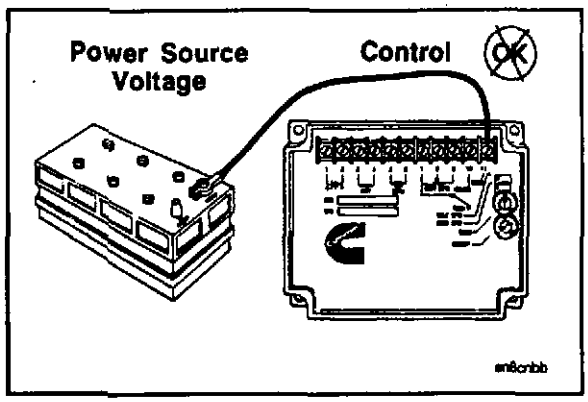
Fine Speed Adjustment

After the gain adjustment is made, the full load governed engine speed may require a minor adjustment to equal the desired speed (i.e. 60 Hz, 1800 RPM or 50 Hz, 1500 RPM). Use the SPEED ADJUST potentiometer on the *engine instrument panel* for fine speed adjustments of less than ±100 RPM.



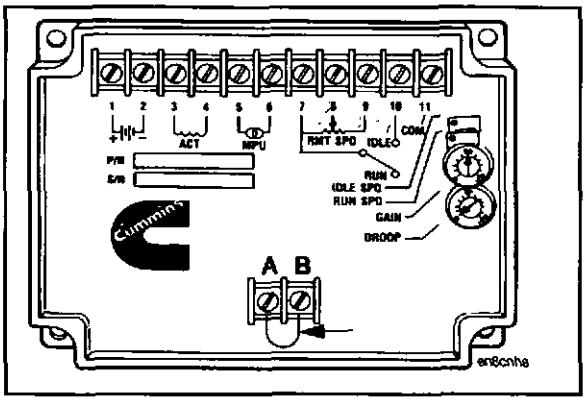
System Adjustment Remote Mounted Governor Control

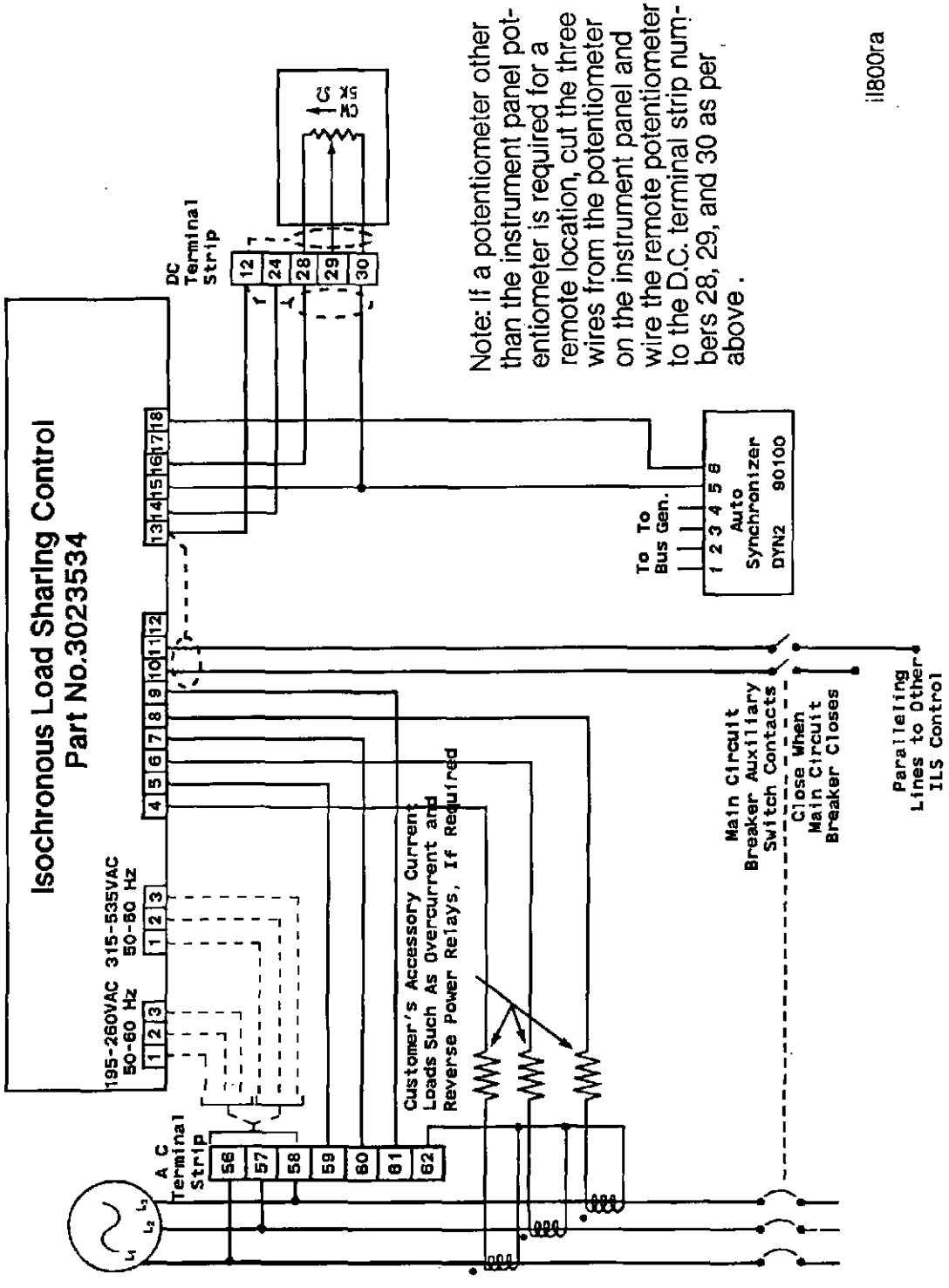
Follow the panel mounted governor control instructions for setting the governed speed, idle, droop and gain on the remote mounted control. The wiring for the remote mounted control is shown.



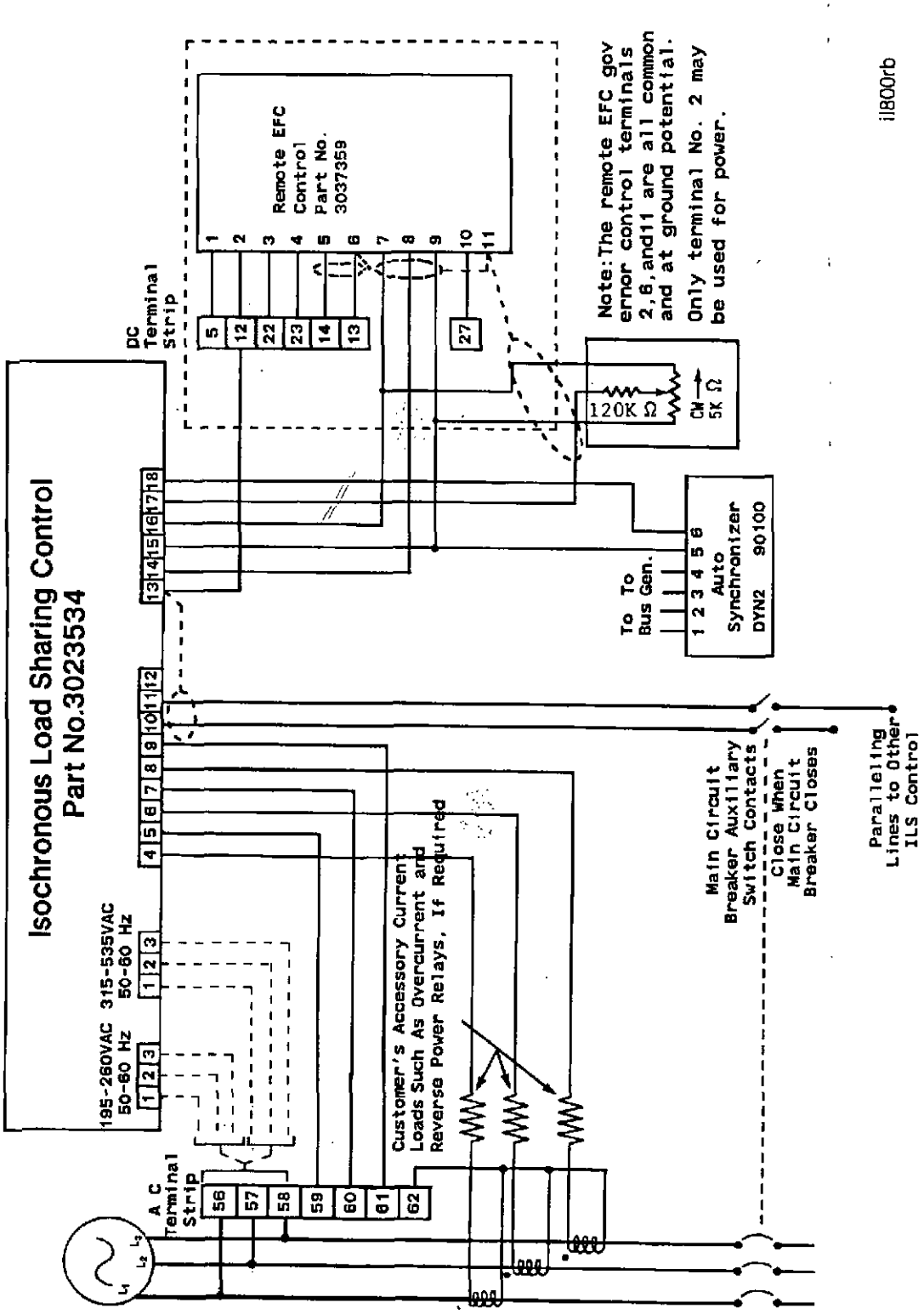
Caution: Do not attach the battery negative to Terminal Number 11. The control circuitry will be damaged.

NOTE: When a two bearing generator or a single bearing generator with a flexible drive between the flex discs and shaft (eg. Kohler 4T10 generators, Models 230 ROZ, 250 ROZ and 275 ROZ) is used, install a jumper between terminals A and B. This jumper provides additional stability in the governor control. The oscillation frequency of the coupling between the engine and the generator can cause the governor control to react to this oscillation in addition to a change in engine speed.





The load sharing control with a panel mounted plug in control and a remote speed adjusting potentiometer for use with an auto synchronizer and an isochronous load sharing control.



The load sharing control with a remote control and a remote speed adjusting potentiometer for use with an auto synchronizer and an isochronous load sharing control.

Wiring Of Generator Sets (Refer To The Diagram On The Next Page)

Caution: Measure the voltage of the panel mounted governor control on the printed circuit board terminal strip. Do not measure the voltage on the control terminal strip.

Notes For Auto-Synchronizer

1. The "Gain Range" is changed by adding a jumper between Terminals 6 and 14.

   No jumper 6 to 14: Auto-Synchronizer is set for fast responding engines.

   With jumper 6 to 14: Auto-Synchronizer is set for slow responding engines.

2.

   a. Closing a contact or jumpering 11 to 12 allows the Auto-Synchronizer to perform as a sync check relay only, with circuit breaker contact output but no control on the incoming generator.

   b. Closing a contact between 12 to 13 allows the Auto-Synchronizer to perform as a speed matching unit. The speed and phase of the incoming generator are controlled and contact is closed to drive circuit breaker. Once the circuit breaker is closed, the contact between 12 and 13 should be opened. (See the diagram for an example of how one would most likely wire Terminals 11, 12 and 13.)

   c. Open contacts or no jumper 11 to 12 or 12 to 13 allows the Auto-Synchronizer to still sense any error but it does not provide any control or contact closures.

3. Phasing of voltage potential to the Auto-Syncrhonizer is necessary to keep each signal in its correct phase relationship. If the generator voltage is not the same as the voltage rating of the Auto-Synchronier, step-down transformers are required. Correct phasing of the transformer leads is necessary. Step-down transformers require a nominal 10 VA/PHASE for the GEN. input to the Auto-Synchronizer and 7 VA/PHASE for the BUS input to the Auto-Synchronizer.

Notes For Isochronous Load Sharing

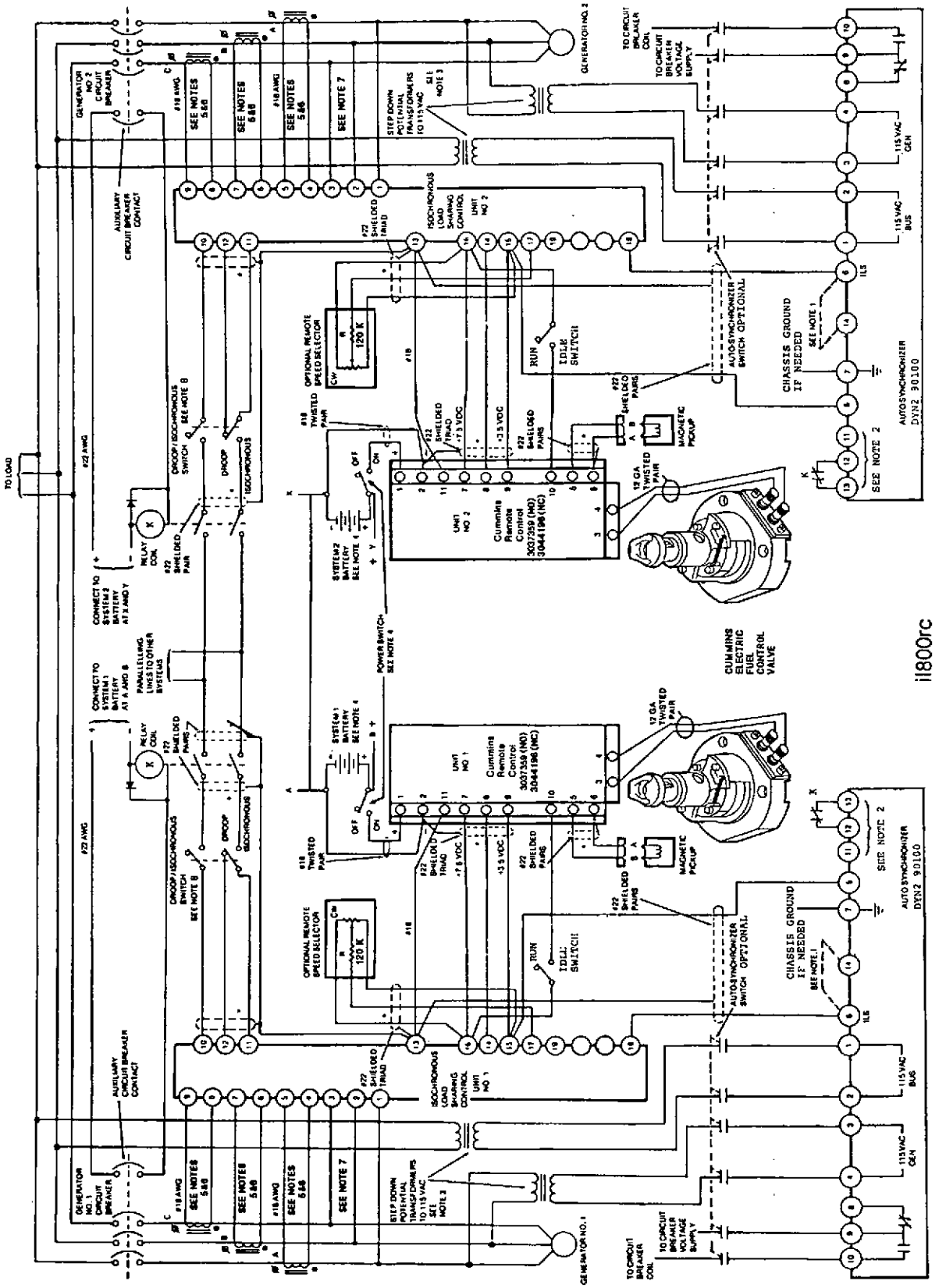
4. Systems battery supply. If more than one engine is started using the same battery supply, use separate battery supply for the DYNA System. Twist power leads as shown. Use shielded leads as shown. Use a single pole, single throw 4 ampere switch.

5. Select current transformers to provide as close as possible 5.0 amps at full-rated load. Current transformers require 12.5 VA/PHASE at 5.0 amps.

6. Observe current transformer polarity markings when connecting.

7. Phasing of voltage potential to the Isochronous Load Sharing Control is necessary to keep each signal in its correct phase relationship. Cummins supplied ILS panels are capable of input voltage ranges from 195 to 260 VAC or 315-535 VAC. If the generator voltage is not the same as the voltage rating of Isochronous Load Sharing Control, step-down transformers are required. Correct phasing of the transformer leads is necessary. Step-down transformers require a nominal 6 VA/PHASE for the Isochronous Load Sharing Control.

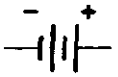
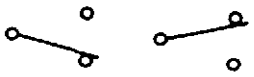
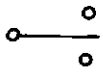
8. Droop/Isochronous switch is not required if units are always operated in the Isochronous mode.

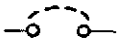
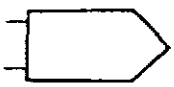


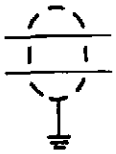
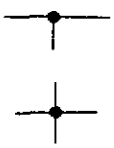
A typical wiring diagram for two generator sets with a load sharing control, governor control, EFC fuel control and auto-synchronizer.

Graphic Symbols

This table contains the symbols and their identification used in these drawings.

Name		Symbol
Battery		
Alternator (Frequency Source)		
Resistor		
Variable Resistor (Potentiometer)	3 Terminal Device	
	2 Terminal Device	
Terminal Strip		
Switches: (N.O.) Normally Open		
(N.C.) Normally Closed		
Transfer		
Transfer 3 Position		
Relay Contact (N.O.)		
(N.C.)		

Name	Symbol
Transfer	
Capacitor	
Fuse	
Circuit Breaker	
Jumper Wire	
Coil	
Magnetic Core	
Transformer	
Variable *Reluctance* Magnetic Pickup	
Female Contact	
Male Contact	

Name	Symbol
Shields: Shielded Wire	
Shielded Pair	
Crossing of Conductors (wires) not Connected	
Junction of Connected Conductors (wires)	
Ground Chassis or Frame Connection	
Conducting connection to a chassis or frame, or equivalent chassis connection of a printed wiring board. The chassis or frame (or equivalent chassis connection of a printed wiring board) may be at a different potential than the earth or structure in which this chassis or frame (or printed wiring board) is mounted.	

Name	Symbol
Direct Conducting Connection to Circuit Return	
Conducting connection to a structure that serves a function similar to that of an earth ground (that is, a structure such as a frame of an air, space, or land vehicle that is not conductively connected to earth).	
Earth Safety Ground	
** This symbol may be used in place of symbol for direct conducting connection to circuit return to indicate a ground connection having a specified protective function (e.g., for protection against electrical shock in case of a fault).	

* Electrical and Electronics Symbols and abbreviated name.

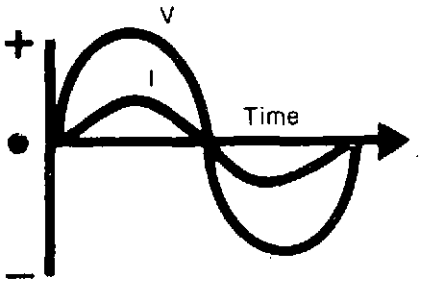
** Ref. Electrical and Electronics Graphic Symbols and abbreviated name.

*** ANSI/1EEEY32-E Reference clarification

Glossary of Power Generator Terms*

A.C. — See Alternating Current.

Alternating Current — Electrical current which repeatedly varies from zero to a positive maximum value to zero to a negative maximum value and back to zero at a periodic rate. Since the applied voltage continually reverses polarity, the resultant current flow alternates in direction within the circuit.



Alternating Current I
Applied Voltage V

AMP — An abbreviation for the term Ampere.

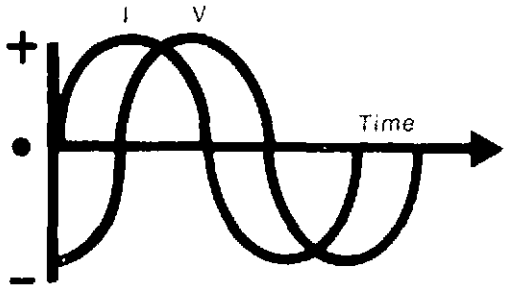
Ampere — The unit of measure of electrical current flow. One ampere of current will flow when one volt of electrical potential is applied across one ohm of resistance.

Auto-Transformer — A transformer of single coil construction in which both the primary and secondary connections are made on the same coil but at different taps.

B- — Symbol used to designate the negative polarity of a D.C. voltage supply.

B+ — Symbol used to designate the positive polarity of a D.C. voltage supply.

Capacitance — The property of a device which resists changes in voltage. In an A.C. circuit, a capacitive load will cause the voltage to lag behind the current flow. Stated more conventionally, the current leads the applied voltage. A capacitive load is therefore a leading power factor load (see Power Factor).



Alternating Current Leading Applied
Voltage Caused by Capacitive Load

Capacitor — A device possessing the property of capacitance. A typical capacitor consists of two conducting surfaces separated by an insulating material. A capacitor stores electrical energy, blocks trhe flow of D.C. and permits the flow of A.C. to a degree largely dependent on the capacitance and the frequency of the applied A.C.

Circuit — An electrical path through which an electric current may flow from a voltage supply to a load and return. A closed or complete circuit is one where current is flowing. An open circuit is one where the path has been disrupted, such as an open switch or circuit breaker, thus stopping current flow.

Circuit Breaker — A protective device for opening a circuit when current flow exceeds a predetermined value.

Circulating Current — Also called Cross Current. Current which flows between paralleled generators, most apparent with no external load on the paralleled generators. Circulating current is caused (1) by unequal excitation of the generators (reactive current, which may be reduced by changing the voltage regulator adjustment or connections); and (2) by unequal power from the engines that are driving the generators real current (and power) which can be eliminated by governor adjustments.

Conductor — A wire, cable, bus, or other device intended to distribute current from the supply to the load. Technically, a conductor is any device which will permit the flow of current.

Contactor — A device for opening and closing an electric circuit. Contactors are normally used in motor circuits where large amounts of current are controlled.

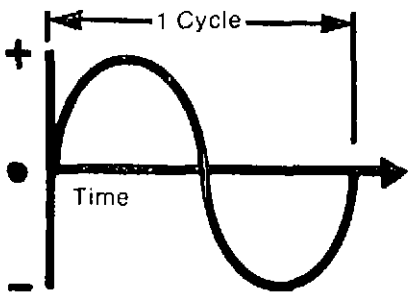
*Some of the terms defined and explained within this glossary apply particularly to current Cummins Generator Sets.

Cross Current — See Circulating Current.

Cross Current Compensation — A term, no longer approved, for a circuit arrangement that made paralleled generators share the reactive component of load current in proportion to the generator ratings. The circuit arrangement could also essentially eliminate the reactive component of circulating current flowing between paralleled generators. See Reactive Differential (Cross Current) Compensation And Reactive Droop Compensation.

Current--(Electrical, Symbol I) — The rate of transfer of electricity from one point to another. Current is usually a movement of electrons, but may also be a movement of positive ions, negative ions or holes. Current is usually measured in amperes.

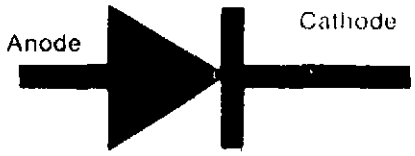
Cycle — A complete set of events before repetition occurs. In alternating current or voltage, a cycle starts at zero, continues to a maximum positive value returns to zero, continues to a maximum negative value, and is completed at zero.



Typical Alternating Current
or Voltage Cycle

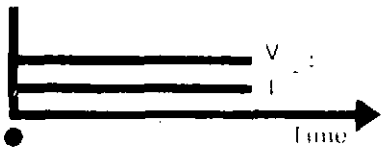
D.C. — See Direct Current.

Diode — A two terminal solid-state device which permits current to flow in one direction, but not in the other. In alternating current circuits, a diode will permit one half cycle to flow but will resist the flow of the opposite half cycle of current. Thus, alternating current is converted to direct current by a diode.



Diode

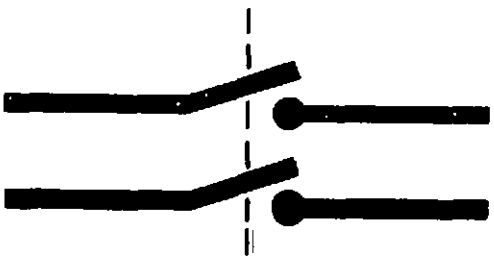
Direct Current--(Abbreviated dc) — An electric current that flows in one direction only. Conventional direct current is defined as flowing from positive to negative in the circuit outside the source (example: a battery or combination of diodes). Conventional current flows in the direction of the arrow through a diode. Electron flow and U.S. Navy designated current flow in the opposite direction.



Direct Current I
Applied Voltage V

Distribution Panel — A control panel containing circuit breakers, transfer switches, and other control devices which distribute the electrical power, such as from a generator set to the various loads.

Double Pole Switch — A switch which has two sets of contacts which operate on two independent circuits at the same time.



Typical Double Pole Switch Shown as a
Single Throw Type in the Off Position

Double Throw Switch — A switch which has a common pole that is closed to one contact and open to a second contact in one switch position. With switch operation, the first contact opens and the second contact closes to the common pole.

Typical Double Throw Switch Shown as a
Single Pole Type

E — Symbol used to represent electrical potential (voltage).

Earth Ground — An intentional connection made between the earth and the metallic frame of electrical equipment as a means to eliminate possible voltage hazards to personnel. Earth Ground also serves, in some cases, to reduce electrical interference in sensitive circuits such as television and radio equipment.

EFC Governor, Electric Fuel Control Governor — An isochronous (same speed no load and full load) or speed droop governor that consists of a magnetic pickup, a governor control, and an actuator. The actuator may be normally closed or normally open. The actuator is mounted within the fuel pump housing.

EMI — An abbreviation for the term electro-magnetic interference which is sometimes caused by SCR type devices and evident in radio and television operation.

Energy — The capability of performing work.

Frequency — The number of complete cycles of alternating current per unit of time. Typically, frequency is expressed in cycles as per second or Hertz (HZ).

Frequency Droop — A decrease in steady-state frequency output of a generator caused by an increase in load. This decrease in frequency from the no load frequency is expressed as a percentage of the full load frequency or:

$$\text{Percent Frequency Droop} = \frac{\text{(No Load Frequency-Full Load Frequency)} \times 100}{\text{Full Load Frequency}}$$

A three percent frequency droop may be used to provide governor stability and for load sharing between paralleled generator sets.

Frequency Meter — An instrument designed to measure the frequency of an alternating current system.

Gain — The increase in signal power that is produced by an amplifier, usually given as the ratio of output to input voltage, current or power. In generator set systems, a low gain setting on the electric governor or voltage regulator provides a relatively small signal to correct variations of frequency or voltage. The frequency and/or voltage may wander or be slow in recovering to stable conditions after a load change. A high gain setting provides a relatively large signal to correct variations of frequency and/or voltage. If the gain is set too high, the electric governor or voltage regulator may over-correct. This may produce unacceptable hunting of the frequency and/or voltage.

Gate — The third terminal of an SCR to which a voltage must be applied before the SCR will conduct.

Governor — A device which controls engine speed and thus the generator output frequency.

Ground — A connection, either accidental or intentional, between an electrical potential and the earth or some conducting body serving in place of the earth.

Heat Sink — A device which absorbs heat from electrical devices such as diodes and SCR's and dissipates the heat to the surrounding air.

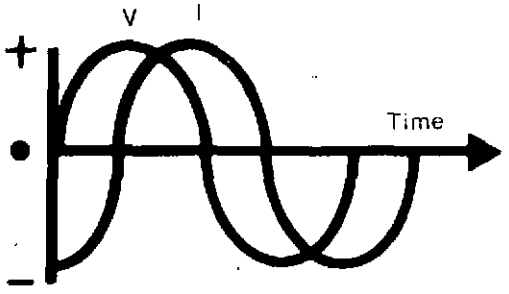
Hertz — A term equivalent to cycles per second (See Frequency).

Hunting — Oscillation in frequency or in voltage where steady-state conditions are not reached, particularly after a load transient change.

I — Symbol used to represent current.

Impedance — The opposition to the flow of alternating current.

Induced Voltage — The voltage which is produced by relative motion between a wire and a magnetic field.



Alternating Current Lagging Applied Voltage Caused by Inductive Load

Inductance — The property of a device which resists changes in current. In an A.C. circuit, an inductive load will cause the current lag behind the applied voltage. Stated more conventionally, the current lags the applied voltage. An inductive load is therefore a lagging power factor load. See Power Factor.

Inductor — A device possessing the property of inductance. An inductor stores electrical energy, passes DC, and opposes the flow of AC to a degree largely dependent on the inductance and the frequency of the applied AC. A typical inductor consists of a coil of wire.

In Phase — Alternating currents or voltages are in phase with respect to each other if they cross through zero and reach their positive and negative maximum values together.

Insulation — A non-conductive material such as rubber or plastic intended to prevent current from flowing. Technically, insulation is any material which stops the flow of current.

Isochronous — As it applies to engine governors, maintaining constant steady-state speed regardless of the load within the rating of the engine. Thus, a generator set is said to be isochronous if the frequency remains the same regardless of load.

Normally Closed–(Symbol N.C.) — As applied to a magnetically operated device such as a valve or the contacts of a relay, Normally Closed indicates that the valve or the relay contacts are closed when no power is supplied to the operating magnet.

Normally Open--(Symbol N.O.) — As applied to a magnetically operated device such as a valve or the contacts of a relay, Normally Open indicates that the valve or the relay contacts are open when no power is supplied to the operating magnet.

Ohm — The unit of measure of electrical resistance. One ohm of resistance will allow a current of one ampere to flow with an applied potential of one volt.

Ohmmeter — An instrument for measuring electricial resistance.

Ohm's Law — A fundamental law expressing the relationship between voltage, current and resistance in electrical circuits. The law states that E = IR or voltage is equal to current times resistance.

Open Circuit — 1) A circuit that does not provide a complete path for the flow of current.2) A condition of an electrical circuit caused by the breaking of continuity of one or more conductors of the circuit; often an undesired condition. 3) An arrangement of conductors and equipment that depends upon lack of continuity for operation, as open-circuit telegraphy; a circuit in which continuity is incomplete or interrupted.

Oscillogram — The permanent record produced by an oscillograph, or a photograph of the trace produced by an oscilloscope.

Oscillograph — A measurement device for determining waveform by recording the instantaneous values of a quantity such as voltage as a function of time.

Oscilloscope — An instrument primarily for making visible the instantaneous value of one or more rapidly varying electrical quantities as a function of time or of another electrical or mechanical quantity.

Oscilloscope, Dual Beam — An oscilloscope in which the cathode-ray tube produces two separate electron beams that may be individually or jointly controlled.

Parallel Connection — An electrical connection in which the input of one element is connected to the input of another element. The output connections are similarly connected together thus providing two or more paths for current to flow.

Parallel Connection

Parallel Operation — The method by which two or more generators having the same voltage and frequency characteristics are connected to a common load.

Permanent Magnet Generator — A generator which uses permanent magnets to create a magnetic field. As applied to Cummins Generators; a permanent magnet generator, within the main generator, supplies the power to the voltage regulator which in turn supplies power to the exciter field. The permanent magnet generator still supplies power during a short circuit of the main generator. This permits the main generator to sustain high short circuit currents. The output of the permanent magnet generator is electrically isolated from the main generator output and is not adversely affected by main generator output waveform distortion such as from SCR type loads.

PMG — See Permanent Magnet Generator.

Polarity — An electrical term which indicates the direction in which current flows in a conductor. In a direct current system, current flows in the same direction. In an alternating current system, current changes direction as the polarity of the A.C. voltage source changes.

Potential — Another term to indicate voltage.

Potential Difference — The difference in voltage between two points in a circuit.

Power — Defined as the rate of performing work. Mechanical power is measured in horsepower or kilowatts. Electrical power is measured in kilowatts.

Power Factor — The ratio of the true power (KW) requirements of a load to the apparent power (KVA) requirement of a load. The combined loads applied to a power source may have a resistive, capacitive, or inductive effect.

Resistive loads such as incandescent lighting or resistive heating elements cause no shift in the voltage/currentwaveforms and are therefore unity (1.0) power factor loads.

Inductive and capacitive loads, however, cause the voltage and current waveforms to shift with respect to one another. These types of loads are commonly called power factor loads (i.e., the power factor is less than 1.0).

See INDUCTANCE and CAPACITANCE for more information.

Power factor is ferquently multiplied by 100 and expressed as a percentage.

The formula for power factor is:

$$\text{Power Factor} = \frac{\text{True Power (KW)}}{\text{Apparent Power (KVA)}}$$

R — Symbol used to represent resistance.

Reactive Differential (Cross Current) Compensation — A circuit arrangement for operating generators in parallel with no generator voltage droop. Reactive Differential Compensation is accomplished by a differential interconnection of the secondaries of the generator current transformers used for Reactive Droop Compensation. This arrangement is not often used and is very difficult to set up when paralleling generators of different capacities.

Reactive Droop Compensation — A circuit arrangement that creates a droop in generator output voltage that is proportional to the reactive load current. This circuit arrangement makes paralleled generators share the reactive component of the load current in proportion to the generator ratings. It also can essentially eliminate the reactive component of circulating current which may flow between paralleled generators. The Reactive Droop Compensation arrangement is commonly called the Generator Paralleling Module.

Relay — An electro-mechanical device having a magnetic coil which, when energized, opens or closes several sets of contacts.

Resistance — Opposition to the flow of current.

Resistor--(Symbol R) — A device or component designed to have a definite amount of resistance. Resistors are used in circuits to limit current flow or to provide a voltage drop.

Resistor, Fixed — A component which is used to control voltage and current by introducing a constant resistance of known value into the circuit.

Resistor, Variable — Similar to a fixed resistor except the resistance value can be adjusted. The voltage adjust rheostat is a variable resistor.

Rheostat — A variable resistor.

Series Connection — An electrical connection in which the input of one element is connected to the output of another element providing only one path for current to flow.

Series Connection

Short Circuit — An abnormal connection (including an arc) of relatively low resistance, whether made accidentally or intentionally, between two points of different potential in a circuit. Equipment, not protected by fuses or circuit breakers, may be damaged by a short circuit.

Shunt Trip — An electro-mechanical device which, when energized, trips the main line circuit breaker.

Single Pole Switch — A switch which has only one set of contacts.

Typical Single Pole Switch Shown as a Single Throw Type in the On Position

Single Throw Switch - A switch which opens a set of contacts in one switch position and closes the contacts in the other position.

Typical Single Throw Switch Shown as a Single Pole Type in the Off Position

Speed Droop — A decrease in steady-state speed of an engine due to an increase in applied load. This decrease in speed from the no load speed is expressed as a percentage of full load speed or:

$$\text{Percent Speed Droop} = \frac{\text{(No Load Speed - Full Load Speed)} \times 100}{\text{Full Load Speed}}$$

Solenoid — An electro-mechanical device which, when energized, acts on a movable core or plunger in the center of the energizing coil to perform mechanical work.

Solid-State — A term which applies to electronic devices which are constructed using semiconductor material. Such devices include transistors, SCR's, and diodes.

Stability — Freedom from undesired variations or oscillation. In generator set systems, the generator set is stable if it can maintain or quickly re-establish steady state conditions of voltage and frequency after a sudden load change.

Surge Suppressor — A device capable of conducting current in either direction in the presence of high transient voltages thus protecting devices that could otherwise be damaged.

Synchronism — The condition where two or more generators are operating at the same frequency and output voltage and are in phase with one another.

Synchronizing — The procedure of matching the frequency, phase rotation, voltage and phase relationship of one generator to another for purposes of paralleling the units onto a common bus.

Synchronous — A generator whose output frequency is directly related (proportional) to the speed of the engine driving the generator.

Tachometer — An instrument for measuring the rate of rotation expressed in revolutions per minute.

Temperature Drift — A change in the value of a component caused by changes in operating temperature.

Terminal — A mechanical device for making electrical connections.

Transformer — Frequently, a device using a laminated iron core with a primary and secondary winding. A transformer changes some level of input (primary) voltage or current to a proportional output (secondary) voltage or current. See current transformer and potential transformer.

Transient — A temporary change from the steady-state conditions.

V — Symbol used to represent voltage.

Volt — The unit of measure of electrical potential (voltage). One volt of electrical potential will force a current of one ampere to flow through a resistance of one ohm.

Voltage — Electrical potential or pressure which forces current to flow through a circuit.

Voltage Dip — A temporary reduction in voltage generally resulting from an increase in load.

Voltage Droop — A decrease in steady-state voltage of a generator due to an increase in load applied. This decrease in voltage from the no load voltage is expressed as a percentage of the full load voltage or:

$$\text{Percentage Voltage Droop} = \frac{(\text{No Load Voltage} - \text{Full Load Voltage}) \times 100}{\text{Full Load Voltage}}$$

Voltage Droop Compensation — A system which permits paralleled generators to share the currents of a load in proportion to the generator set ratings.

Voltage Regulator — A device which controls the voltage output of a generator at a preset value regardless of the amount of load applied.

Voltmeter — An instrument designed to measure electrical potential or voltage.

Component Specifications

Actuator and Governor Control

Operation

Governing Mode	: Isochronous to 5% droop
Steady State Stability	: ±1/4%
Operating Input Frequency Range	: 1K to 5K Hz
Idle Frequency Range	: 200 to 2200 Hz
Response Time of Actuator	: 15 milliseconds

Power

Operating Voltage	: 12 Volts D.C. ±3 Volts or 24 Volts D.C. ±6 Volts Continuous
Ground Polarity	: Negative ground (case isolated)
Power Consumption (Maximum)	: 94 Watts (12 or 24 Volts D.C.)
Nominal Operating Current	: 1.3 amps at 24 volts
Nominal Operating Current	: 2.6 amps at 12 volts
Maximum Operating Current	: 3.9 amps at 24 volts
Maximum Operating Current	: 7.8 amps at 12 volts

Environmental

Ambient Operating Temp.	: -40° to 185°F [-40° to 85°C]
Maximum Temp. Drift	: ±1@ - 40° to 185°F [- 40° to 85°C]
Relative Humidity	: 0 to 100% non Condensing

Physical-Remote Control

Dimensions	: 5.75 in. x 4.44 in. x 2.15 in. (146mm x 113mm x 55mm)
Weight	: 2 lbs. [.9 kg]
Mounting	: Any position, typically in enclosure
Case Material	: Die cast aluminum

Panel Mounted Control

Dimensions	: 5.5 in. x 4.1 in. x 1.3 in. (140mm x 104mm x 33mm)
Weight	: 1 lb. [.45 kg]
Mounting	: 16 pin plug-in receptacle

Protection Features

High voltage protection (15 VDC for 12 volts or 32 VDC for 24 volts continuous)
Reverse of supply polarity
Surge protection (80 VDC, 10 msec transient)

Vibration Protection: (Remote Control) Entire printed circuit board sealed with Silicone filled Epoxy.

(Panel Mounted Control) Circuit board sealed with Silicone Epoxy.

Magnetic Pickup Specifications

Thread Size	: 5/8 - 18 UNF-2A
Tap Drill Size	: 37/64 inch
Proximity to Gear Teeth	: .028 in. min. - .042 in. max. (Approximately 1/2 to 3/4 turn)
Temperature Range	: - 67° to 220°F [- 55° to 105°C]
Output at Cranking Speed	: 1.5 volts AC minimum
Maximum Output	: 30 volts AC
Coil Resistance	: 300 ohms maximum

Remote Potentiometer Specifications

Resistance	: 5K Ohms ±5%
Linearity	: .25%
Travel	: 360° x 10
Power Rating	: 2 Watts @ 160°F [70°C]
Insulation Rating	: 1000 M Ohms @ 500 VDC
Dielectric Strength	: 100 V RMS
Operating Temperature Range	: +220°F to - 67°F [+105°C to - 55°C]

Wiper Resistor — For the Remote Mounted Control Fine Speed Adjustment Potentiometer

120K Ohms, 1/4 Watt

100 PPM Temperature Coefficient or Less Metal Film

Resistance Test of Actuator Coil

When the actuator leads are disconnected, the coil resistance must be 6.8 to 7.6 ohms for the 24 volt model or 2.0 to 2.3 ohms for the 12 volt model.

Table 1: Normally Open Electric Fuel Control Governor Parts

Part No.	Description
3052504	Actuator Low Flow-24V-For use on NT-855 and KTA-19 (KTA-1150) engines
3052505	Actuator High Flow-24V-For use on VTA-28 (VTA-1710), KTA-38 (KT(A)-2300) and KTA-50 (KTA-3067) engines
3052506	Actuator Ultra High Flow-24V-For use on KTTA-38 (KTTA-2300) and KTTA-50 (KTTA-3067) engines
3052507	Actuator Low Flow-12V-For use on NT-855 and KTA-19 (KTA-1150) engines
3052508	Actuator High Flow-12V-For use on VTA-28 (VTA-1710), KTA-38 (KT(A)-2300) and KTA-50 (KTA-3067)
3052509	Actuator Ultra High Flow-12V-For use on KTTA-38 (KTTA-2300) and KTTA-50 (KTTA-3067) engines
3037359	Control-12 or 24V (For Remote Mounting, Enclosed)
3032733	Control-12 or 24V (Plug-In type, for mounting in Cummins Engine Instrument Panel or Generator Control Panel Enclosure)

Table 2: Normally Closed Electric Fuel Control Governor Parts

Part No.	Description
3044189	Actuator, 24V, Normally Closed, Low Flow, for use on NT-855 and KTA-19 engines
3044190	Actuator, 24V, Normally Closed, High Flow, for use on VTA-28, KT(A)38, and KTA-50
3044191	Actuator, 24V, Normally Closed, Ultra-Hi Flow, for use on KTTA-38 and KTTA-50
3044192	Actuator, 12V, Normally Closed, Low Flow, for use on NT-855 and KTA-19 engines
3044193	Actuator, 12V, Normally Closed, High Flow, for use on VTA-28, KT(A)-38, and KTA-50
3044194	Actuator, 12V, Normally Closed, Ultra-Hi Flow, for use on KTTA-38 and KTTA-50
3044195	Control-12 or 24V, Plug-In-Type, for mounting in Cummins Engine Panel or Generator Control Panel Enclosure
3044196	Control-12 or 24V, Remote Mounting, Enclosed

Table 3: Parts Common for Both Systems

Part No.	Description
3034572	Magnetic Pickup (For SAE #1 or #0 Flywheel Hsg. with engine wiring)
3034573	Magnetic Pickup (For SAE #00 Flywheel Hsg. with engine wiring)
3015105	Remote Speed Potentiometer (See Remote Control)
104215	Idle-Run Toggle Switch
213272	Magnetic Pickup (For SAE #1 or #0 Flywheel Hsg. without engine wiring)
3003916	Magnetic Pickup (For SAE #00 Flywheel Hsg. without engine wiring)
213273	Wiring Harness for 213272 and 3003916 magnetic pickups

Table 4: Actuator Mounting Parts for an AFC Housing

Part No.	Description
193734	O-ring, Plug
145504	O-ring, Actuator
145505	O-ring, Actuator
3029854	Gasket
3029853	Spring, Return (Qty. 2)
3029300	Plug, O-ring
3017051	Capscrews, 1 1/4 inch (Qty. 3)

Table 5: Actuator Mounting Parts for an EFC Housing

Part No.	Description
3008248	O-ring, Shaft (Qty. 2)
3029853	Spring, Return (Qty. 2)
3048182	O-ring, Flange
3017051	Capscrews, 1 1/4 inch (Qty. 3)

Troubleshooting the EFC Governor

Symptom: Engine Cranks But Will Not Start

Cause	Correction
No Fuel in Tank or Tank Valve Closed	Add fuel to tank or open tank valve.
OK ⇩	
No Fuel to Cylinder Head	Loosen fuel line at cylinder head while cranking engine. Check fuel line check valves.
OK ⇩	
No Fuel Through Shutoff Valve	Manually open shutoff valve.
OK ⇩	
Shutoff Valve Electric Circuit	Check voltage from off/on switch. Reset circuit breaker. Reset overspeed stop switch. Check safety controls. Check shutoff valve coil voltage. Check wiring.
OK ⇩	
No Fuel to Shutoff Valve	Loosen pipe plug in shutoff valve and crank engine.
OK ⇩	
No Fuel Through Normally Closed Actuator	Check for power to the actuator. Check for power in and out of the control
OK ⇩	
Normally Open Actuator Normally Closed Control	Change actuator or control
OK ⇩	
Normally Closed Actuator Normally Open Control No Magnetic Pickup Signal	Identify cause of magnetic pickup signal loss and correct. Change actuator or control.

Troubleshooting the EFC Governor

Symptom: Engine Has Rough Performance Or Surge

Cause	Correction
Air in Fuel	Install sight glass and check for air in fuel.
OK ⬇	
Control Adjusted Incorrectly	Follow adjustment procedure. Reduce gain.
OK ⬇	
Actuator Sticking	Loosen all three capscrews and tighten again per procedure.
OK ⬇	
Actuator Return Springs Broken or Missing	Remove actuator and install new springs.
OK ⬇	
Actuator O-rings Defective	Remove Actuator and Replace O-rings.
OK ⬇	
Actuator (Normally Open)	Remove EFC control leads to actuator. *Connect battery to actuator. Start engine.* If engine operates at high idle, replace actuator.
OK ⬇	
Actuator (Normally Closed) *Defective*	Remove EFC control leads to actuator. Connect battery to actuator. Start engine. If engine operates at low idle, replace actuator.
OK ⬇	
Fuel Pump Housing Defective	Replace fuel pump housing.

Troubleshooting the EFC Governor

Symptom: Engine Has Rough Performance Or Surge (Continued)

Cause	Correction
System Voltage Below 19V for 24V System or 9.5V for 12V System	Charge batteries.
OK ⇩	
Battery Charger Not Connected Direct to Batteries	Connect battery charger directly to battery terminals.

Troubleshooting the EFC Governor

Symptom: Engine Operates At High Idle — Normally Open Actuator

Cause	Correction
Voltage Above 8V at Actuator on 12 Volt System or 16 Volts on 24 Volt System	Repair fuel pump. Replace actuator
OK ⬇	
Voltage Above 8V at Control Outlet to Actuator on 12V System or 16V on 24V System	Check wiring and connections.
OK ⬇	
Voltage Not Available at EFC Control	Check wiring and connections. Check battery voltage.
OK ⬇	
AFC No Air Needle Valve Loose or Not Installed	Tighten valve or replace AFC no air plug with needle valve.
OK ⬇	
Magnetic Pickup Voltage Below 1.5 VAC when Operating Engine	Check terminals 13 and 14 on the printed circuit board inside the engine mounted instrument panel or terminals 5 and 6 on the remote mounted control for magnetic pickup voltage.
OK ⬇	
EFC Control Failure	Replace EFC control.
OK ⬇	
Incorrect Normally Closed Control Installed and No Magnetic Pickup Signal	Identify cause of loss of magnetic pickup signal and correct. Install normally open control.

Troubleshooting the EFC Governor

Symptom: Engine Operates At High Idle — Normally Closed Actuator

Cause	Correction
Run Speed Adjusted Too High	Refer to adjustment procedure.
OK ⬇	
Wrong Controller (Normally Open Controller on Normally Closed Actuator)	Verify that you have a Normally Closed Controller.
OK ⬇	
Voltage Above 19-20V on Controller Actuator Output (9-10V on 12V Systems)	Check wiring. If wiring is okay, replace controller.
OK ⬇	
Voltage Above 19-20V on Actuator (9-10V on 12V Systems)	Check wiring. Replace actuator if necessary.
OK ⬇	
O-rings Defective on Actuator Shaft	Remove and inspect. Replace O-rings if necessary.

Troubleshooting the EFC Governor

Symptom: Engine Has Low Power — Normally Open Actuator

Cause	Correction
Engine Fuel Pressure Below the Specifications	Adjust to the specification. Check the fuel pump calibration.
OK ⬇	
Fuel Restriction Between Fuel Pump and Cylinder Head	Correct the restriction.
OK ⬇	
Injector Flow Not Adjusted Correctly	Check the injector flow.

Symptom: Engine Has Low Power — Normally Closed Actuator

Cause	Correction
Control Output Below 19-20V (9-10V on 12V Systems)	Replace Controller
OK ⬇	
Fuel Pump Calibration Not Correct	Remove and calibrate fuel pump
OK ⬇	
Fuel System Problem	Refer to fuel system manual.

Troubleshooting the EFC Governor

Symptom: Engine Operates Below Idle Speed	
Cause	**Correction**
Idle or Run Potentiometer Not Adjusted Correctly	Check the adjustment procedure.

Cummins Service Publications

The following Cummins Service Publications concerning the Cummins PT Fuel System can be purchased from any Cummins Distributor or Cummins Dealer.

Many publications have been translated into other languages. Cummins Distributors or Cummins Dealers have information on which publications are available in languages other than English.

For information about any Cummins publications, contact your local Cummins Distributor or Dealer.

Fuel Pump Calibration Information		
Bulletin Number		**Publication Description**
3379352		Codes 3600 and up - from Jan., 1981 to July of Year Printed
3379182		Codes 3200 to 3599 - from Jan., 1976 to Dec., 1980
3379068		Codes 2300 to 3199 - from Jan., 1970 to Dec., 1975
3379077		Codes issued between Oct., 1963 and Dec., 1969
983533		Codes issued before Oct., 1963 - No Flowmeter Method
3379101		PT (type R) Fuel Pump Calibration Manual
3379084		Fuel Pump Rebuild and Calibration Procedures
Injector Manuals		
3379071		*Injector Rebuild Manual*
3379664		Injector Parts, Flow and Cross Reference
Fuel System Wall Charts		
Full Size	Training Charts	
3379081	3379291	PT (type G) AFC Fuel Pump Cross Section and Flow
3379082	3379292	PT (type G) AFC - VS Fuel Pump Cross Section and Flow
3379080	3379237	PT 9 (type D) Top Stop Injector Fuel Injection Cycle
3379103	3379290	PT (type G) Fuel System Flow Diagram - All Injectors
3379131	3379293	PT (type G) Non AFC Fuel Pump Cross Section and Flow
3379485	3379295	PT (type G) AFC Fuel Pump Parts - July, 1979
3379172	3379294	PT (type H) AFC Fuel Pump Cross Section and Flow
983651		PT (type D) Injector In Line and Vee Series Engines
Miscellaneous Publications		
3379090		Guide to Troubleshooting
3379133		Control Parts List
3379022		Governors Used on Cummins Engines
3379144		Fuel Systems Publications Rack Program
3379209		Fuel Systems Publications Rack Update Subscription Service Cummins Training Aids Catalog

Cummins Service Publications (Continued)

Cummins Installation Recommendations	
952849	Automotive Fuel System
3382576	Marine Fuel System
3382409	Construction, Mining, Logging, Agriculture, Fire Pump, Generator Sets, and Stationary Power Fuel System
Film Recall Booklets (These publications have 33 mm slide training films available)	
3387049-OR	PT (type G) AFC Fuel Pump Calibration
985577-R	PT (type G) Fuel Pump Calibration
983601-R	Principles of PT Mechanical Governors
983602-R	PT (type G) Fuel Pump Operation and Adjustment
983603-R	PT (type R) Fuel Pump Operation and Adjustment
983604-R	PT (type B and C) Injectors
983608-R	Cummins PT Injectors
983609-R	Theory of Cummins PT Fuel System
983658-R	Cummins PT (type D) Injector
985576-R	Injector Calibration
985575-R	Injector Leakage Tester ST-990
983657-R	PT (type D) Injector Disassembly and Assembly
985605-R	Cummins Aneroids
985618-R	Troubleshooting PT Fuel System - Program 1
985620-R	Troubleshooting PT Fuel System - Program 2
985621-R	Troubleshooting PT Fuel System - Program 3
985622-R	Troubleshooting PT Fuel System - Program 4
3387050-R	PT (type G) AFC Fuel Pump Operation and Adjustments
3387066-R	PT (type G) AFC Fuel Pump Troubleshooting
3387137-R	Troubleshooting Driveability Complaints

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