CATERPILLAR® Service Information System Shutdown SIS

Previous Screen

Product: NO EQUIPMENT SELECTED
Model: NO EQUIPMENT SELECTED
Configuration: NO EQUIPMENT SELECTED

Troubleshooting
ETR ELECTRICAL PROTECTION SYSTEM
Media Number -SENR4617-01 **Publication Date -01/04/1990** **Date Updated -05/08/2002**

Service Procedures

Introduction

The information in this section is a supplement to the troubleshooting methods of the previous section. This material is much more descriptive and detailed for the user who is less familiar with these components. The Troubleshooting Section makes constant references to this section when more detailed information is necessary to complete a diagnosis, or to calibrate or test a component.

Service Procedure List

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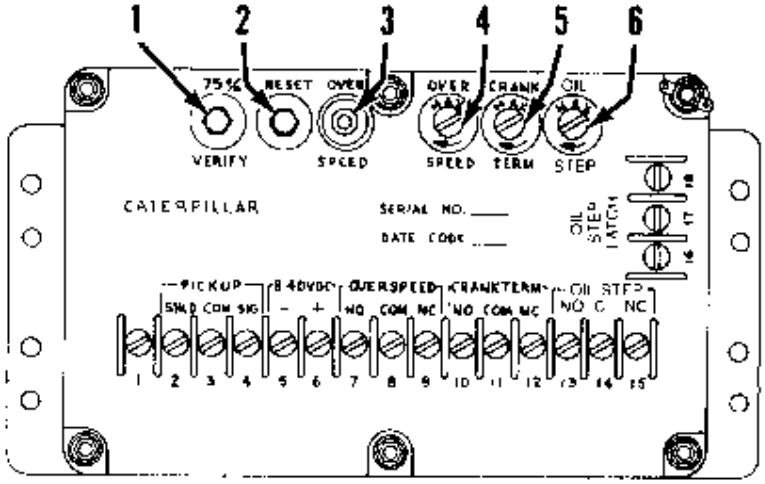
Service Procedure A



C18168P2

7W2743 Electronic Speed Switch (ESS)
(1) Verify button. (2) Reset button. (3) "LED" overspeed light. (4) Seal screw plug (overspeed). (5) Seal screw plug (crank terminate). (6) Seal screw plug (oil step).

Overspeed Verify Test

1. Run the engine at rated speed and push verify button (1) in for a moment. This will cause the speed switch to activate and cause engine shutdown.

NOTE: Any time the engine speed is 75% or more of the overspeed setting, engine shutdown will occur if the verify button is pushed.

Example: For an engine with a rated speed of 1200 rpm, the overspeed setting is 1416 rpm (see 3500 SI SPEED SPECIFICATION CHART and Note A). The overspeed verify test will cause shutdown of the engine at 75% (± 25 rpm) of the overspeed setting of 1416 rpm. In this example, 75% of 1416 rpm is approximately 1062 rpm. If the verify button is pushed at an engine speed of approximately 1062 rpm or above, engine shutdown will occur.

The "LED" overspeed light (3) will come on and stay on until the reset button is pushed after an overspeed switch shutdown. Before restarting the engine, push in reset button (2) for a moment. This will reset the speed switch, and the "LED" overspeed light (3) will go off. The emergency stop switch (ES) must now be manually reset before the engine can be started again

NOTE A: The engine overspeed setting rpm is 118% of rated engine rpm.

NOTE B: To verify overspeed shutdown system operation, push in the VERIFY button for a moment. The engine must shut down at 75% or more of overspeed setting.

NOTE C: The magnetic pickup frequency (Hz) is calculated as follows:

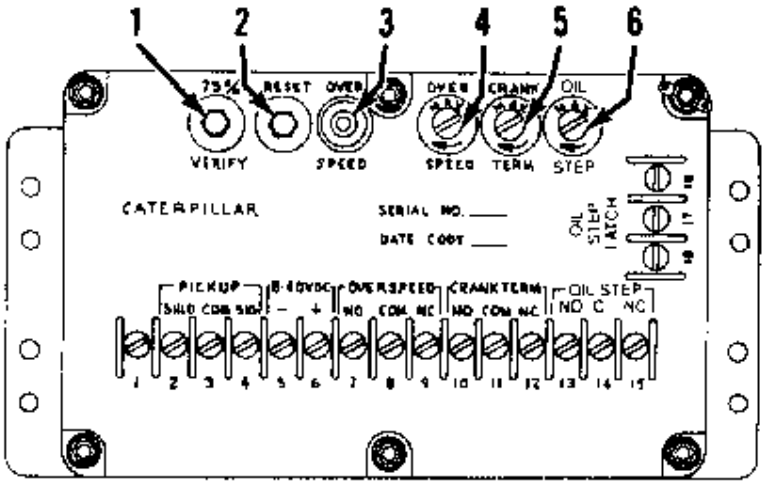
$$\frac{\text{\# of flywheel teeth} \times \text{rpm}}{60} = \text{Frequency (Hz)}$$

NOTE D: Input Voltage: Maximum 40 VDC; Minimum 8 VDC.

3500 SI SPEED SPECIFICATION CHART						
No. Of Flywheel Teeth	Rated Engine RPM[1]	Magnetic Pickup Frequency[1] (±25 Hz) Note C	Overspeed Setting[2] (±25 RPM) Note A	75% Overspeed Verify[2] (±25 RPM) Note B	Crank Termination Setting[2] (RPM)	Oil Step Setting[2] (RPM)
183	1000 1200 1500	3050 3660 4575	1180 1416 1770	885 1062 1328	400	800

[1] Typical Rated Engine Speeds
[2] Electronic Speed Switch Functions

Service Procedure B



C18158P2

7W2743 Electronic Speed Switch (ESS)
(1) Verify button. (2) Reset button. (3) "LED" overspeed light. (4) Seal screw plug (overspeed). (5) Seal screw plug (crank terminate). (6) Seal screw plug (oil step).

Overspeed Calibration

1. Remove lockwire and seal from seal screw plugs (4), (5) and (6). Remove seal screw plug (4) from access hole for overspeed adjustment screw.

2. Use a small screwdriver and lightly turn overspeed adjustment potentiometer twenty turns in direction Of "MAX ARROW" (clockwise).

NOTE: The overspeed adjustment screw is made so that it cannot cause damage to the potentiometer, or be removed, if the adjustment screw is turned too many turns in either direction.

3. Run the engine at 75% of desired overspeed setting rpm. Make reference to the 3500 SI SPEED SPECIFICATION CHART (in Service Procedure A).

4. With engine at 75% of overspeed setting rpm, push VERIFY button (1) and hold in. Turn overspeed adjustment potentiometer in the direction opposite of "MAX ARROW" (counterclockwise) slowly until

"LED" overspeed light (3) comes ON. Engine will shut down if speed switch is connected to the Gas Shutoff Valve (GSOV).

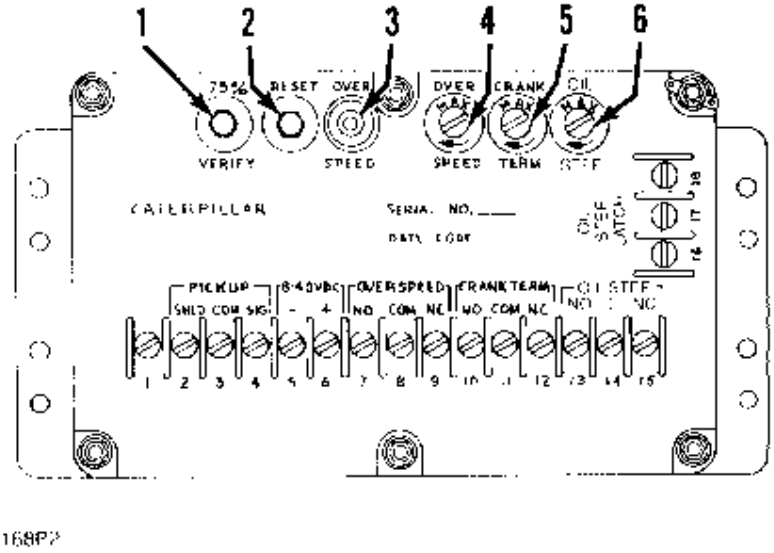
5. To reset speed switch, push in reset button (2).

6. Slowly turn overspeed adjustment potentiometer approximately one turn clockwise and do Steps 3, 4 and 5 again.

NOTE: More adjustment may be needed to get the correct setting. Turn adjustment potentiometer clockwise to increase speed setting, and counterclockwise to decrease speed setting. Turn adjustment potentiometer very slowly only a small amount at a time until adjustment is correct.

7. When the speed setting is correct, install seal screw plug (4) in overspeed adjustment access hole. Tighten screw to a torque of 0.20 ± 0.03 N·m (2 ± .3 lb in). Install the lockwire and seal (if crank termination and oil step adjustments are complete).

Service Procedure C



C 31688P2

7W2743 Electronic Speed Switch (ESS)
(1) Verify button. (2) Reset button. (3) "LED" overspeed light. (4) Seal screw plug (overspeed). (5) Seal screw plug (crank terminate). (6) Seal screw plug (oil step).

Crank Terminate Speed Calibration

1. Remove lockwire and seal from seal screw plugs (4), (5) and (6). Remove seal screw plug (5) from access hole for crank terminate adjustment screw.

2. Use a small screwdriver and lightly turn overspeed adjustment potentiometer twenty turns in direction of "MAX ARROW" (clockwise).

NOTE: The crank terminate screw is made so that it cannot cause damage to the potentiometer, or be removed, if the adjustment screw is turned too many turns in either direction.

3. Turn the crank terminate adjustment potentiometer twelve turns in a direction opposite of "MAX ARROW" (counterclockwise) for an approximate crank terminate setting.

4. Connect a voltmeter (6V7070 Multimeter or a voltmeter of same accuracy) with the positive lead at ESS-12 and the negative lead at ESS-5. Start the engine and make a note of the speed at which the system voltage is canceled (this is the speed at which the DC starter system disengages). See the 3500 SI SPEED SPECIFICATION CHART (in Service Procedure A) for the correct crank terminate speed.

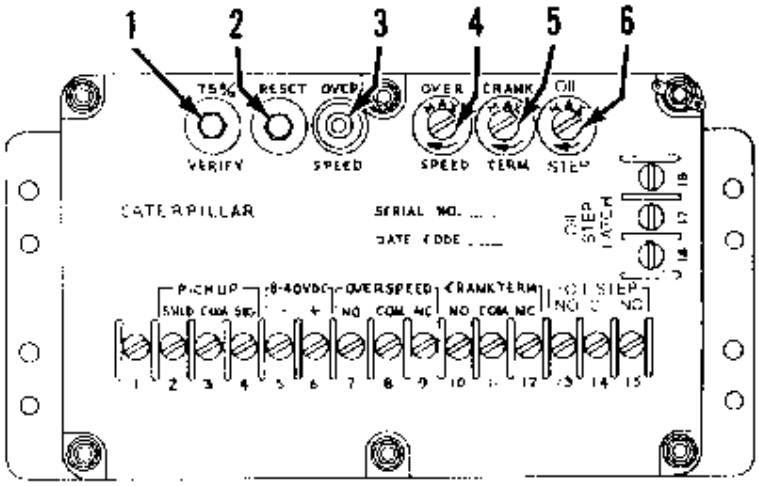
NOTE: If this setting is not correct, do Steps 5, 6 and 7. If the setting was correct, go to Step 7.

5. Stop the engine and turn the crank terminate adjustment potentiometer one full turn in the correct direction (clockwise to increase and counterclockwise to decrease).

6. With the voltmeter still connected as in Step 4, start the engine and make a note of the speed at which the system voltage is canceled (this is the speed at which the DC starter system disengages). If needed, make more small adjustments until the crank terminate speed is correct.

7. Install seal screw plug (5) in crank terminate adjustment access hole. Tighten to a torque of 0.20 ± 0.03 N·m (2 ± .3 lb in). Install the lockwire and seal (if overspeed and oil step adjustments are complete).

Service Procedure D



C16168P2

7W2743 Electronic Speed Switch (ESS)
(1) Verify button. (2) Reset button. (3) "LED" overspeed light. (4) Seal screw plug (overspeed). (5) Seal screw plug (crank terminate). (6) Seal screw plug (oil step).

Oil Step Speed Calibration

1. Remove lockwire and seal from seal screw plugs (4), (5) and (6). Remove seal screw plug (6) from access hole for oil step adjustment screw.

2. Use a small screwdriver and lightly turn oil step adjustment potentiometer twenty turns in the direction of "MAX ARROW" (counterclockwise). This will lower the oil step speed setting to its lowest value.

NOTE: The oil step adjustment screw is made so it cannot cause damage to the potentiometer, or be removed, if the adjustment screw is turned too many turns in either direction.

3. Use a 6V7070 Multimeter (or a voltmeter of same accuracy) to check for positive (+) voltage at terminal ESS-13 [negative (-) voltage is at terminal ESS-5].

4. Make reference to 3500 SI SPEED SPECIFICATION CHART (in Service Procedure A). For a particular engine rating, find the specified rpm in column for Oil Step Speed Setting. Run the engine at this specified rpm.

5. With the engine running, look into the oil step adjustment access hole. A red "LED" (light emitting diode) light will be ON. A positive (+) voltage will be seen at terminal ESS-13, 9 seconds after "LED" light comes ON. Now turn the oil step adjustment potentiometer clockwise until the red light in the oil step access hole goes OFF. When the light goes OFF, this indicates that the oil step rpm setting is above the present running rpm of the engine. Slowly turn the adjustment potentiometer counterclockwise until the light comes back ON. After a 9 second delay, positive (+) voltage will again be seen at terminal ESS-13.

6. When the oil step speed setting is correct, install seal screw plug (6) into the adjustment access hole for the oil step function. Tighten plug to a torque of 0.20 ± 0.03 N·m (2 ± .3 lb in). If all other adjustments are complete (overspeed and crank terminate), install lockwire and seal.

Service Procedure E

Magnetic Pickup Check

1. Connect a 6V7070 Multimeter (or a voltmeter of same accuracy) to electronic speed switch common terminal (ESS-3) and signal terminal (ESS-4). Set the meter voltage scale to a scale greater than 1.5 VAC. Start the engine and run at idle rpm or 600 rpm (whichever is greater).

If the measured voltage is 1.5 VAC **or more**, the operation of the magnetic pickup is correct. If measured voltage is **less than** 1.5 VAC, go to Step 2.

NOTICE

The magnetic pickup is an important part of the ETR Shutoff Protection System. It is required for crank terminate, overspeed and governing. Be ready to take action when the magnetic pickup is disconnected.

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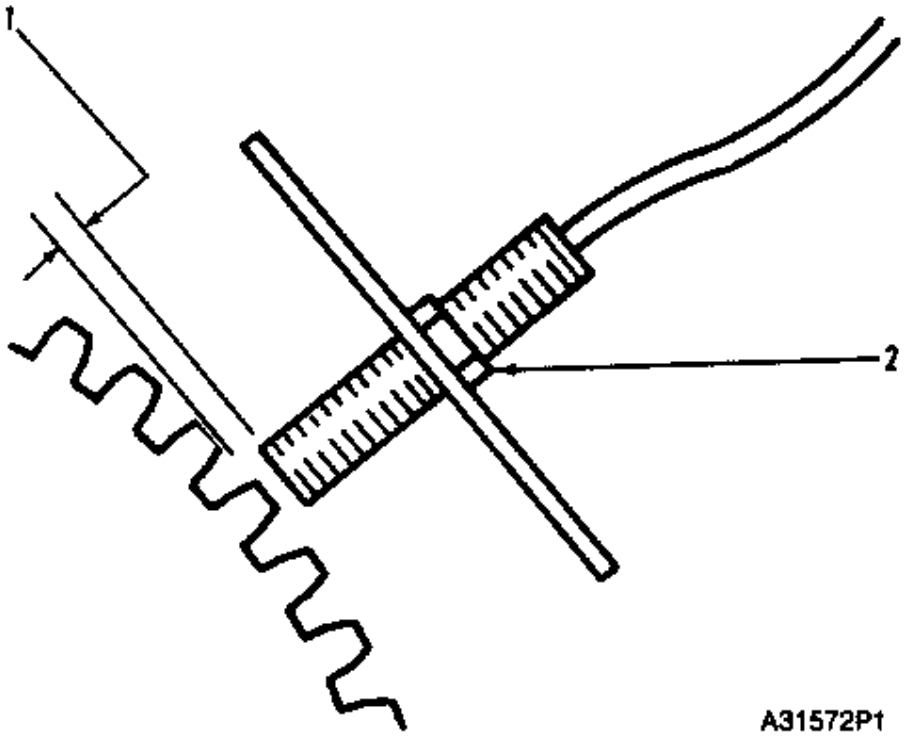
2. Stop the engine. Disconnect the wiring from the magnetic pickup at the plug-in connector and connect the voltmeter to magnetic pickup connector terminals. Start the engine and run at idle rpm or 600 rpm (whichever is greater).

If the measured voltage is 1.5 VAC **or more,**repair or replace the wiring between the magnetic pickup and the electronic speed switch. If the measured voltage is **less than** 1.5 VAC, go to Step 3.



Magnetic Pickup
(1) Clearance dimension. (2) Locknut.

3. Remove the magnetic pickup from the engine flywheel housing and turn the flywheel until a gear tooth is directly in the center of the threaded opening for the magnetic pickup. Install the magnetic pickup again in the threads of the flywheel housing.

4. Turn (by hand) in a clockwise direction until the end of the magnetic pickup just makes contact with the gear tooth. Now turn the magnetic pickup back out1/2 turn (180° in the counterclockwise direction) to get the correct air gap [clearance dimension (1)]. Now tighten locknut (2) to a torque of 45 ± 7 N·m (33 ± 5 lb ft).

NOTE: Do not let the magnetic pickup turn while locknut (2) is tightened.

Do Step 2 again. If voltage is still **less than** 1.5 VAC, replace the magnetic pickup.

Service Procedure F

Diode Test

Use the 6V7070 or the 6V7800 Multimeter for this test, and turn the multimeter dial to the Diode position, Disconnect the diode from its circuit.

1. Connect the positive probe of the multimeter to one end of the diode and the negative probe to the other end of the diode. Make a note of the multimeter reading.

2. Now reverse the multimeter connections on the diode. Make a note of these readings.

If the reading was high in one test and low in the other test, the diode is good. If the readings were the same in both tests (either high or low), the diode is bad and needs to be replaced.

Service Procedure G

Pressure Switch Test

Use the 1U5470 Engine Pressure Group and a continuity check for this test. If an access hole to the same pressure is not close or not available, remove the switch and install a tee at this location. Install the pressure switch in one side of the tee and connect the correct pressure gauge (from the 1U5470 Engine Pressure Group) to the other side of the tee.

NOTE: This test can also be performed on bench by using air pressure if the correct fittings are available.

With the wires disconnected from the pressure switch, check continuity of the switch terminals with the engine stopped and also with the engine running at the correct speed. Make a note of the pressure gauge reading when the continuity of the switch terminals changes. Compare this pressure reading with the correct specifications for the switch.

NOTE: If the pressure switch has 3 terminals, first check the continuity of both the N.O. and N.C. terminals to the common terminal with the engine stopped. Now use the N.O. terminal (had no continuity when the engine was stopped) for the test with the engine running. This will make sure that, when the switch breaks contact across the N.C. terminal, it moves all the way to close across the N.O. set of contacts at the other terminal.

Service Procedure H

Slave Relay Test

Remove the relay(s) from the junction box. Connect the negative lead of a 24 volt source to terminal 5 of the relay and connect the positive lead to terminal 1. Use a voltmeter to check the relay as follows:

1. Touch the negative probe of the voltmeter to terminal 5 and the positive probe to terminal 2. Voltage reading should be 24 volts.

2. With negative probe of voltmeter still at terminal 5, touch positive probe to terminal 3. Voltage reading should be zero.

Now put a jumper across terminal 1 and terminal 4.

3. Touch negative probe of voltmeter to terminal 5 and touch the positive probe to terminal 2. Voltage reading should be zero.

4. With negative probe still at terminal 5, touch positive probe to terminal 3. Voltage reading should be 24 volts.

If any of the readings from the above tests are incorrect or opposite from those shown, the relay is bad and should be replaced.

Service Procedure J

Water Temperature Switch

Use the 8T0470 Thermistor Thermometer Group and the 8T0500 Continuity Testing Light for this test. Install a probe from the thermometer group into the water manifold as close as possible to the temperature switch. Unplug the electrical connector from the temperature switch.

NOTE: DO NOT attempt to test the temperature switch off the engine. The switch uses water flow and temperature both to activate the switch at the correct temperature.

With the wires disconnected from the temperature switch, check the continuity of both the N.O. and the N.C. terminals to the common terminal with the engine stopped. Now use the N.O. terminal (had not continuity when the engine was stopped) for the test with the engine running. This will make sure that, when the switch breaks contact across the N.C. terminal, it moves all the way to close across the N.O. set of contacts at the other terminal.

Start the engine and with the engine under load, restrict the radiator or heat exchanger flow to bring up the engine temperature. When engine temperature reaches the activation point of the temperature switch, the N.O. terminal should close. The switch is okay. If the N.O. terminal does not close, the switch is defective.

Immediately reduce the load and reduce the jacket water temperature. Allow the engine to run at idle until the temperature returns to normal before stopping the engine. Replace the switch if necessary and reconnect wiring before starting the engine.

Service Procedure K

Protection System Battery Drain

There are two components used in the electric protection system that continue to draw small amounts of current from the battery when the engine is not running. These components are the electronic speed switch (ESS) and the charging alternator.

For a system that uses only one of these components, an engine can remain shut down for months without discharging the battery enough to prevent starting. Systems that use both of the above components may remain idle for a month or more without excessive battery drain. Cold weather decreases battery efficiency and will reduce these time periods even more.

In most applications, the engine is started weekly or a battery charger is used to keep the battery at full charge, so few problems have been noted. For those applications where the engine is not used for extended periods (such as rental fleets), the suggestions that follow can be used to prevent battery discharge.

If the engine will not be operated for several weeks (without a battery charger), disconnect the battery cable from the negative (-) side of the battery. If it is expected that this condition will happen frequently, the 7N0718 Battery Disconnect Switch can be installed for convenience. This switch should be installed between the negative terminal of the battery and the negative terminal of the starter motor.

A suitable bracket should be fabricated to mount the switch close to either the battery or the starter motor (the switch can be mounted inside the power distribution box on generator set engines). In all applications, the 7N0718 Battery Disconnect Switch should be mounted within 30° of vertical.

Service Procedure L

Air Inlet Temperature Switch

Use the 8T0470 Thermistor Thermometer Group and the 8T0500 Continuity Testing Light for this test. Install a probe from the thermometer group into the inlet air manifold as close as possible to the temperature switch. Unplug the electrical connector from the temperature switch.

With the wires disconnected from the temperature switch, check the continuity of both the N.O. and the N.C. terminals to the common terminal with the engine stopped. Now use the N.O. terminal (had not continuity when the engine was stopped) for the test with the engine running. This will make sure that, when the switch breaks contact across the N.C. terminal, it moves all the way to close across the N.O. set of contacts at the other terminal.

Start the engine and with the engine under load, restrict the aftercooler, radiator or heat exchanger water flow to bring up the engine inlet air temperature. When engine inlet air temperature reaches the activation point of the temperature switch, the N.O. terminal should close. The switch is okay. If the N.O. terminal does not close, the switch is defective.

Immediately reduce the load and reduce the inlet air temperature. Allow the engine to run at idle until the temperature returns to normal before stopping the engine. Replace the switch if necessary and reconnect wiring before starting the engine.

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