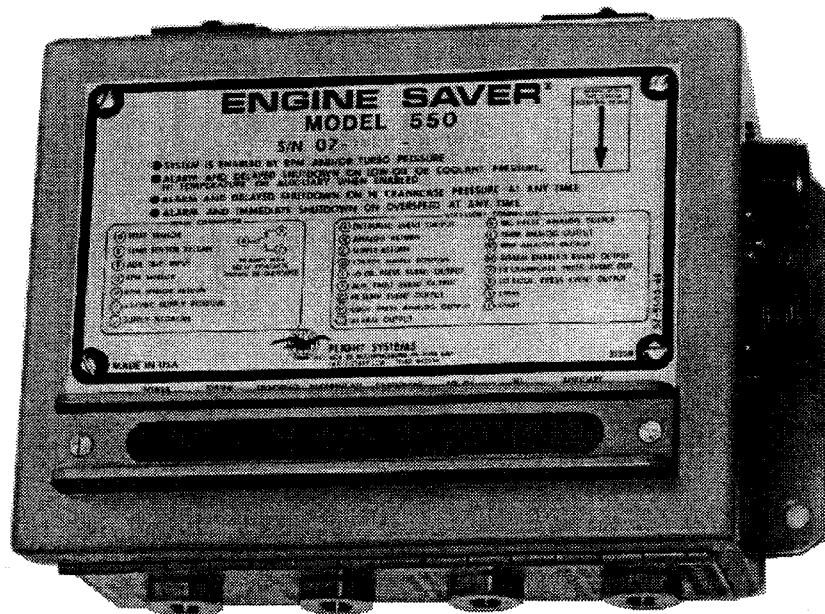


ENGINE SAVER®

LEVEL 7

MANUAL



FLIGHT SYSTEMS

505 Fishing Creek Road Lewisberry, PA 17339 USA
717-932-9900 Fax: 717-932-9925

CONTENTS

SELECTING A LOCATION	1
<i>(General... Protection... Access... Mounting... Location... Clearly Visible)</i>	
MOUNTING AND PRESSURE CONNECTIONS	1
<i>(Unit Mounting... Pressure Hose... Marine Application... Fittings... Swivel... Caution Reusing Fittings... Compound... Tightening Important... Metal Tubing... Tubing Bends... Support Bulkhead Fitting... Tube Diameter... Caution)</i>	
PLUMBING (PICK-OFF POINTS)	2
General	
Oil Pressure (Location... Tap)	
Coolant Pressure (Location... Pump)	
Coolant and Oil (Routing... Location)	
TURBO ENABLE	3
<i>(Settings... Enabling... Optional... Location)</i>	
CRANKCASE PRESSURE	3
<i>(Location)</i>	
ELECTRICAL	3
<i>(RPM Sensing... Source... RPM Type... Alternator Tachometer Output)</i>	
RELUCTANCE MAGNETIC SENSOR	3
<i>(General... Cam Gear Sensing... Mounting... Air Gap... Electrical... Shrink Tubing)</i>	
TACHOMETER GENERATORS	4
<i>(General... Mounting... Version... Take-Off Points... Feed-Thru)</i>	
ALTERNATOR TACHOMETER OUTPUT	5
<i>(General)</i>	
COOLANT TEMPERATURE	6
<i>(Location... Size... Contact... Electrical... Probe Wires... Twisted... Electrical Noise... Routing... Time Delay)</i>	
RELAY	7
<i>(General... Relay Armature... Normally Closed Contact... De-Activation... Remote Reset)</i>	
ALARM OUTPUT	7
<i>(General)</i>	
ANALOG OUTPUT	7
<i>(General... Output... Connector)</i>	
EVENT OUTPUTS	7
<i>(General)</i>	
AUXILIARY INPUT WIRING	7
<i>(General... Auxiliary Input... Non-Fault... Enable... No Used)</i>	
POWER WIRING	8
<i>(Supply... Reset)</i>	

ELECTRICAL CONNECTIONS	8
<i>(General... Main 10-Pin Connector... Acc--, 10-Pin Connector... Harness... Length... Routing)</i>	
MAIN HARNESS	8
<i>(Harness... Functions... Ms Plug)</i>	
WIRING COMPATIBILITY WITH PREVIOUS LEVELS	12
<i>(Compatibility... Level 2 & 6)</i>	
ACCESSORY CONNECTOR WIRING	12
<i>(General... Harness... Not Used... Event Outputs)</i>	
ACCESSORY CONNECTOR	12
<i>(Table 2, Accessory Connector Wiring)</i>	
Figure 15, Typical Wiring of Accessory Connector for Remote Indicator Panel	13
TESTING AND ADJUSTMENT	14
<i>Equipment Required (General... Model 9550 Test Set... Model 9666 Quick Tester)</i>	
RPM CALIBRATION	14
<i>(General... Procedure... Coarse and Fine Dials)</i>	
Table 3, RPM Source Selection and Calibration Chart	15
<i>(RPM [Monitored or Simulated]... RPM Test Point... Not Used)</i>	
Programming Switches, Figure 17, Table 4	16
Calibrated RPM Output Volts vs. Engine RPM, Graph 1	17
RPM ENABLE ADJUSTMENT	17
<i>(General... Dial Protection... Idle Pressure... RPM Above Enable)</i>	
OVERSPEED ADJUSTMENT	17
<i>(General... Dial Range... RPM Above Overspeed... Not Used)</i>	
TURBO ENABLE	18
<i>(General... Turbocharger Pressure as a Backup... Optional... Overriding RPM Enable... Exceeding 15 Inches Hg. ... Turbo Enabling... No RPM Sensing... Operation)</i>	
OIL PRESSURE ADJUSTMENT	18
<i>(General... Idle Trip... Run Trip... Choosing Trip Point... Operation... Not Used... Run Oil Pressure Reading)</i>	
Oil Pressure Trip Point VS. RPM, Graph 2	19
COOLANT PRESSURE ADJUSTMENT	19
<i>(General... Idle Trip... Run Trip... Not Used)</i>	
Coolant Pressure Trip Point VS. RPM, Graph 3	19
Coolant Pressure VS. RPM, Graph 4	19
BENCH TEST WITH 9550 TEST SET	20
CRANKCASE PRESSURE TEST (OPTIONAL)	20
TEMPERATURE CHANNEL TEST	20
Probe resistance VS. Temperature, Graph 5	20
ENABLE LOGIC AND EXCLUSIVITY TEST	21

ENABLE TIME DELAY TEST	21
SENSOR FAIL-SAFE TESTS	21
ACCESSORY INPUT/OUTPUT TESTS.....	21
(General)	
RECORDING INSTALLATION DATA	22
(General... Valuable to Future... Copy... Form)	
TAMPER RESISTANT FEATURES	22
(General... Prevent Removal... Lead Seal... Engine Saver Application Checklist)	
TROUBLESHOOTING INSIDE THE ENGINE SAVER	24
PRESSURE SENSORS	24
(General... Pressures... Crankcase... Coolant... Oil and Coolant... Turbo)	
Sensor Resistance Table 6.....	24
(Replacing Sensors... Intermittent Connection... Leds Flashing... Clogged Line... Jumper Crankcase Pressure Switch... Turbo Pressure Switch)	
TEMPERATURE SENSOR	25
(General... Open Sensor... Intermittent Connection... Shielding... If Sensor Not Used)	
RPM SENSOR	25
(General... Open or Intermittent... Reluctance Pickups... Resistance Check... Voltage Test Ohmmeter Test... Tachometer Generators)	
ELECTRONIC MODULE	26
(Replacing... Encapsulated... Mounting... Electrical Connections... Test Voltages)	
Electronic Module, Figure 20.....	27
RELAY	27
INDICATORS	27
ELECTRONIC MODULE TEST POINTS FIGURE 21	27
ELECTRONIC MODULE TEST POINTS VOLTAGES Table 7	28
WARRANTY INFORMATION.....	29
SPARE PARTS ORDERING INFORMATION	29
REPLACEMENT PARTS LOCATIONS.....	30
INDIVIDUAL PARTS - VISUAL IDENTIFICATION.....	30
OPTIONAL PARTS LIST	31
REPAIR SERVICE LOCATIONS.....	32

SELECTING A LOCATION

GENERAL: Several factors should be considered when selecting a location for the Model 550 Engine Saver to insure maximum usefulness and trouble-free operation. The chosen locations should provide all of the following:

1. **PROTECTION:** Reasonable protection from physical damage, high temperatures, or heavy soil buildup on the unit.
2. **ACCESS:** Easy access for service personnel.
3. **TAMPERING:** Resistance to operator tampering or willful damage.
4. **MOUNTING:** Substantially higher than the engine pick-off points for the Oil, Coolant, and Crankcase Pressure Lines.
5. **LOCATIONS:** Such as wheel well and tightly closed engine compartments should be avoided if possible. The chance of damage due to flying rocks, heavy soils (sometime highly corrosive) or excessively high temperatures are greatly increased in these areas.
6. **CLEARLY VISIBLE:** The location and mounting position should allow the indicators to be clearly visible and the cover to be fully opened.
7. **DRAIN:** Pressure lines must drain away (downward) from the unit. Low spots and loops in pressure hoses are to be avoided for reasons explained below.
8. **THE UNIT MUST BE MOUNTED WITH THE PRESSURE CONNECTIONS FACING TOWARD THE GROUND.**

NOTE 1: For the following reasons.

- A. *Avoiding solids entrapment in pressure lines and sensor inlet ports.*
- B. *Avoiding false relay actuation due to mechanical shocks in the vertical plane.*
- C. *Insure proper operation of case drain and vent system, to prevent moisture buildup inside the unit.*

NOTE 2: Although severe shock and vibration transmitted directly to the unit is detrimental over the long term, a small amount of vibration is beneficial as it tends to reduce the deadband or hysteresis in the pressure sensors and results in more accurate pressure sensing.

MOUNTING AND PRESSURE CONNECTIONS

1. **UNIT MOUNTING:** The unit is to be securely fastened by its mounting flanges (four 1/4 in bolts), with its Pressure Connection side DOWN. Use locking or vibration resistant hardware.
2. **PRESSURE HOSE:** Pressure connections may be made to the engine by means of armored flexible hose, AEROQUIP 1503-4 (SAE100R5 rated) or equal, except for *Coolant Pressure Hose*. *This should be a Teflon Metal Jacketed Hose such as Everflex P/NXXXX.*
3. **MARINE APPLICATION:** When installing Engine Saver on a Marine Engine, COAST GUARD APPROVED hose may be required for certification. In these installations, use AEROQUIP FC234-5 (SAExxxx rated) hose.
4. **FITTINGS:** Use suitable adapter fittings at each end of each line, terminating in a 1/8 inch male pipe thread (NPT) at the Engine Saver end.
5. **SWIVEL:** Swivel type fittings should be used on all flexible hose connections. In many instances, a 45 or 90 degree fitting improves the neatness and durability of the installation. Sometimes a reducing bushing is required.
6. **CAUTION REUSING FITTINGS:** Use caution when installing reusable type fittings on the flexible hose. Some times a small piece of rubber may be shaved from the inside of the hose by the tail of the fitting. These pieces can block the line or sensors and cause false tripping. This is critical on the crankcase pressure line due to its very low operation pressure.

7. **COMPOUND:** Use Teflon pipe compound on all connections.

8. **TIGHTENING: IMPORTANT!** When tightening, support the 7/8" hex on the unit with a wrench (spanner) in order to prevent the fitting in the unit from turning. Tighten snugly, but do not over tighten, as the threads may be damaged. Make certain all fittings and threads are clean before final assembly, and that no pipe compound lodges inside the lines, fitting or adapters.

9. **METAL TUBING:** If metal tubing is used, make certain that the proper flare or compression fittings are installed for the type of tubing being used.

10. **TUBING BENDS:** Make certain that all tubing bends are smooth and that no kinks or dents are present.

11. **SUPPORT:** Long runs of pipe, tubing or hose should be supported in several places to avoid excessive movement in high-vibration areas.

12. **BULKHEAD FITTING:** In places where hose passes through a bulkhead or near a sharp object, a rubber grommet or bulkhead fitting must be provided to prevent chafing.

13. **TUBE DIAMETER:** All tubes or hoses must have a minimum inside diameter of 3/16 inch.

CAUTION! Use extreme care in connecting and properly identifying the various lines, as a wrong connection will cause improper operation or permanent damage. Use metal identification tags for each hose connection to the box. Under no circumstances should the pressure on the crankcase sensor be allowed to exceed 5 psi.

PLUMBING (PICK-OFF POINTS)

GENERAL: Hose or Tubing connections are to be made to the Engine's Turbo, Oil, Coolant and Crankcase pick-off points.

• OIL PRESSURE

1. **LOCATION:** The pressure pick-off point is placed at the source of piston cooling oil since this is most critical. Protection is assured over the full operating range.
2. **TAP:** Locate tap on Pressure Piston Cooling Nozzle or its gallery farthest from the oil source. If not equipped with direct piston cooling (such as DETROIT), then use tap on Main Oil Gallery either side of engine.

• COOLANT PRESSURE

1. **LOCATION:** The pressure pick-off point is critical, and MUST be at the Pump Outlet, or in the block closest to this point.
2. **PUMP:** Locate tap as close as possible to Water Pump Output or Oil Cooler Water Inlet if fed directly by pump. DO NOT connect to Pump Inlet, By-Pass Loop, Cylinder Head or Thermostat Housing as these points will result in false information.

COOLANT AND OIL

3. **ROUTING:** If possible, route the Oil and Coolant Pressure Lines such that there is vertical or upwards slanting section of line as it leaves the connection point on the engine.
4. **LOCATION:** If possible, choose a location for the Engine Saver that is higher than any of its lines or their connection points on the engine. This will lessen the chance of solids entrapment.

• TURBO ENABLE

1. **SETTING:** The Engine Saver is equipped with a Turbo Pressure Sensor that is factory set at 15 inches Hg. (Non-Adjustable).
2. **ENABLING:** In most applications, Turbo Pressure has proven to be a good backup or auxiliary means of enabling the OIL & Coolant Pressure monitoring functions of the Engine Saver, when normal RPM sensing is lost.
3. **OPTIONAL:** The use of Turbo Pressure enable is entirely optional and this decision is deferred to the installer. If it is not used, the Pressure Port should be Plugged.

4. **LOCATION:** Locate tap on Blower Outlet of Turbo-Charger Outlet downstream of aftercooler (if equipped) air crossover pipe or any air box cover. NOTE: It is OK if some oil vapor enters the turbo pressure line. This will not cause a false trip.

• CRANKCASE PRESSURE

1. **LOCATION:** Locate tap on any Rocker (without a Breather) on a Valve Cover or on the Side of the Fill Pipe if well above the oil level. Oil must not enter this line. Line must drain back toward engine tap point with no low spots or loops.

ELECTRICAL

• RPM SENSING GENERAL

1. **RPM SENSING:** In order to sense engine RPM, an RPM pickup of some type must be fitted. Engine RPM is monitored by one of the following:

- A. Flywheel Pickup (Magnetic Pickup)
- B. Tachometer Generator
- C. Alternator Pickup ("R" Terminal)

2. **SOURCE:** The RPM signal can come from a variable reluctance pickup mounted on the Flywheel Bell Housing or Cam Gear, a Rotary Tachometer Generator or an Alternator with an Electronic Tachometer Output, or "R" Terminal.

3. **RPM TYPE:** The choice of RPM Sensing method to be used in a given installation depends on the availability or accessibility of a Flywheel or Cam Gear pickup mounting site or a take-off point for a Tachometer Generator. An existing Tachometer Generator can be "shared" by the Engine Saver if the installation meet the following criteria:

- A. Generator impedance is below 1000 Ohms.
- B. AC output only (NO DC component).
- C. Generator is "Floating" from Frame or Battery.
- D. Output is at least 8 Pulses/Revolution.

4. **ALTERNATOR TACHOMETER OUTPUT:** When available, provides a very simple means of obtaining an RPM signal without the need to install any additional devices on the engine.

• RELUCTANCE MAGNETIC SENSOR

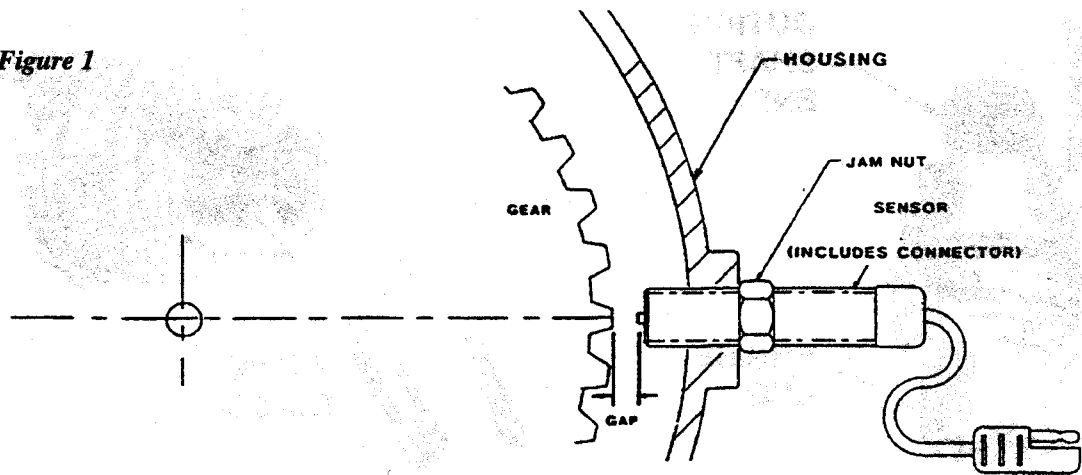
1. **GENERAL:** The speed of the engine can be sensed by a variable reluctance pickup mounted in close proximity to the Flywheel Ring Gear or Cam Gear.

2. **CAM GEAR SENSING:** In cases where it is inconvenient to use the Flywheel Ring Gear for the RPM pickup, a Cam Gear with fewer teeth (typically 68) may be used.

3. **MOUNTING:** The RPM Sensor mounting hole is already provided on many engines by removing a plug in the Flywheel or Cam Gear housing at the rear of the engine. The threaded hole may not already be 5/8-18 UNF (SAE), or maybe a larger diameter (such as 7/8 or 1 inch) in these cases a reducing bushing or a different Mag Pickup is required. If it is necessary to drill and tap a mounting hole, be certain that the hole is located on the gear centerline, at right angles to the shaft, and that there is adequate metal thickness at the chosen location. (Be sure to use caution to prevent Metal Shavings from falling into Bell housing, or Genset if exposed).

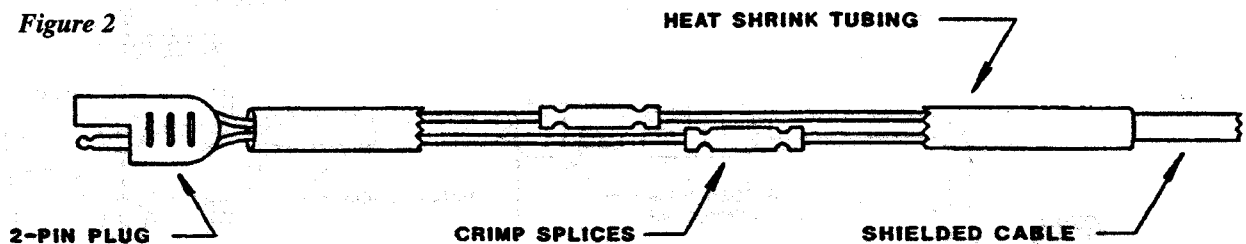
4. **AIR GAP:** For proper performance, the air gap between the sensor pole piece ("button" on end of sensor) and the gear teeth must be set at 0.20-.040 inches (0.5-1.0 MM). Since the sensor should never be allowed to touch the gear while it is turning, the gear run-out must be taken into account when setting this gap. It is suggested that the gear be rotated until the point closest to the sensor is found, then thread the sensor in (CW) until it touches the gear tooth, Then back the sensor out (CCW) one-half of a turn, and lock it in place.

Figure 1



5. ELECTRICAL: Electrical connection is made by means of a 2-pin weatherproof rubber connector (furnished with the sensor) that mates with the connector on the rear of the sensor. This connection is to be attached to the end of the shielded-pair cable that is a part of the installation harness furnished with the Engine Saver. After cutting to the proper length, Trim shield flush with end and pull the jacket over to insulate shield.

Figure 2



6. SHRINK TUBING: The 2-pin rubber connector has short leads already attached and molded in. This connector is jointed to the black and clear wires by means of crimp splices (soldering if desired). If solder is used, each finished connection must be insulated with heat shrinkable tubing. An overall jacket of heat shrink tubing is desirable with either method as an added protection.

• TACHOMETER GENERATORS

- 1. GENERAL:** A popular and convenient means of RPM sensing is the tachometer generator. It is a small, rugged, permanent-magnet AC generator that is driven from a take-off on the accessory drive cover, camshaft or injector pump shaft.
- 2. MOUNTING:** A variety of mounting adaptors and drive couplings (or drive tangs) are available to permit use on any engine. The most common take-off configuration is a 7/8-18 SAE male thread.
- 3. VERSIONS:** Other versions include General Motors flange mount (accessory drive and blower drive) as well as a metric M22X 1.5-6 thread. Various drive shafts (including E1/E2 Din 75 532 Metric) are also available.
- 4. TAKE-OFF POINTS** are usually provided, no modification of the engine is required. Some engine manufacturers use a take-off to drive a mechanical service hourmeter. A tachometer drive take-off maybe created by interimposing a T-drive adaptor between the engine and the hourmeter.
- 5. FEED-THRU:** On engine equipped with only a single take-off that is already used to drive an existing device such as a mechanical tachometer, a "feed-thru" style of tachometer generator is needed. This allows the existing tachometer drive cable to be re-connected to the opposite end of the tachometer generator.
(See illustrations on next page)

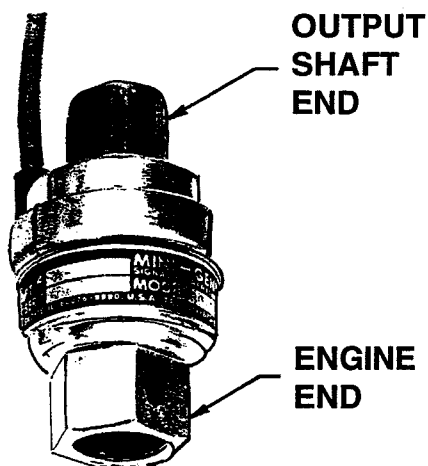


Figure 3



57-SGEN-FT
FEED THRU



DRIVE
TANGS

SEE ACCESSORY CATALOG FOR COMPLETE ORDERING INFORMATION FOR TACHOMETER GENERATORS, MOUNTING ADAPTERS, DRIVE TANG KITS AND CONNECTING CABLES.

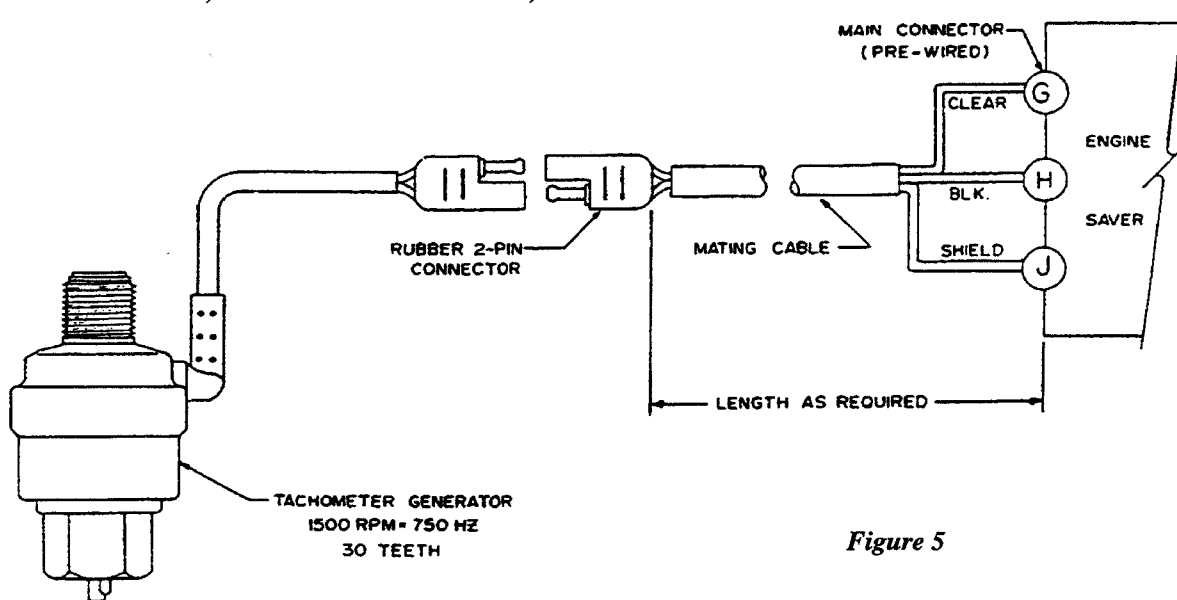


Figure 5

• ALTERNATOR TACHOMETER OUTPUT

1. GENERAL: Nearly all modern heavy equipment and diesel power plants utilize an alternator for Battery Charging. Most of these alternators have a special electrical output terminal ("R" terminal) for operating a tachometer. This eliminates the need for installing a magnetic pickup or tachometer generator, where these may not be convenient or possible. If this "R" Terminal is tried and does not work initially you have to use one of the other sources.

DC OUTPUT
TERMINAL

"R" TERMINAL
TACHOMETER
OUTPUT

WIRE W/ SPECIAL
CONNECTOR &
RUBBER BOOT
(DELCO P/N 1969007)

Figure 6

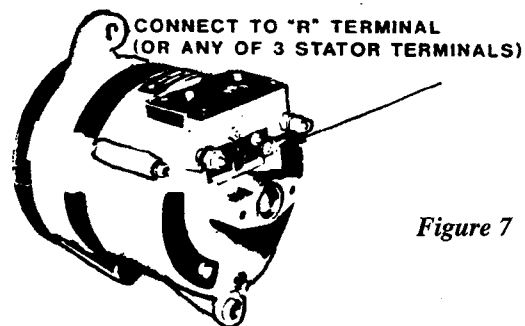
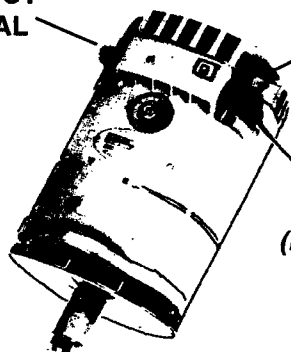


Figure 7

NEVILLE 2300 SERIES ALTERNATOR

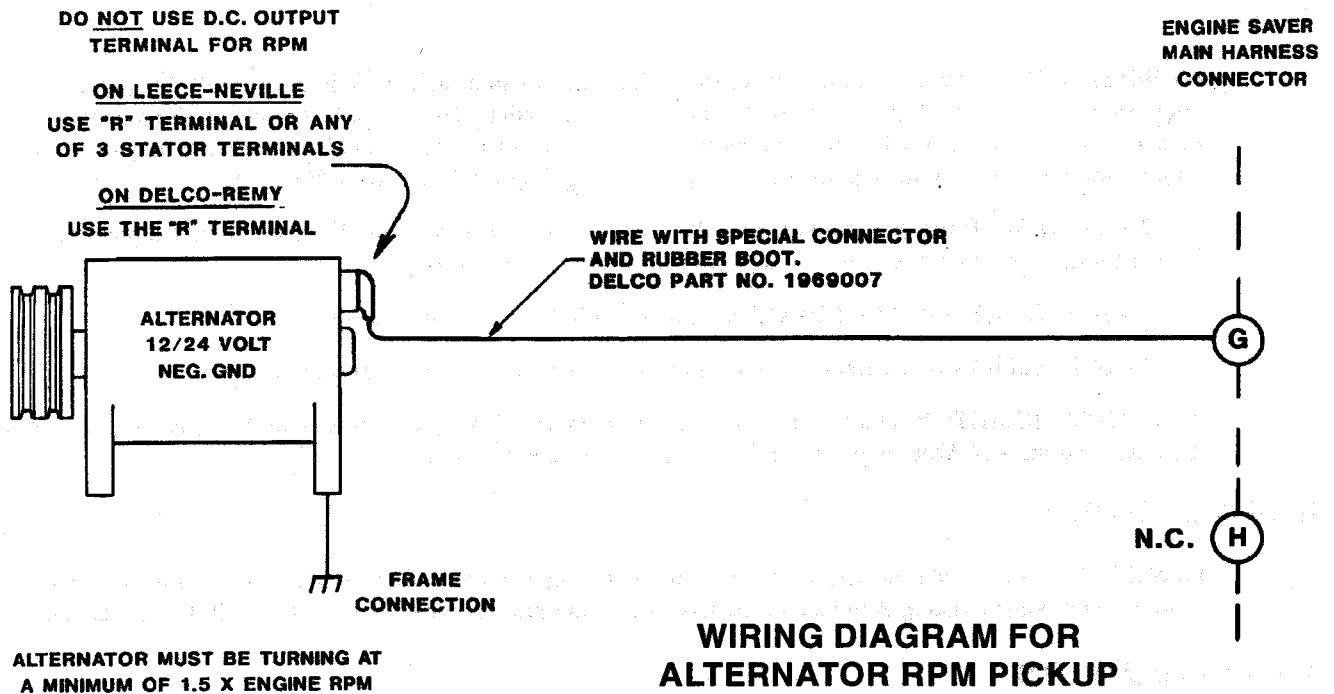


Figure 8

• COOLANT TEMPERATURE SENSOR

1. **LOCATION:** Install the sensor (P/N 57-5500-65 Supplied) at the appropriate location on the engine. We recommend installing the sensor before the Thermostat Manifold or in the head where engine coolant temperature is being monitored (Do NOT install in Water Jacket at Rear of Engine).
 2. **SIZE:** The brass body has a 1/2 inch NPT thread, with a one inch hex nut. If the sensor is to be installed in a smaller hole, an optional 3/8 inch NPT sensor is available.
 3. **CONTACT:** Make certain that the liquid will come in full contact with the sensor.
 4. **ELECTRICAL:** Electrical connection is made by means of 2 isolated tabs. These connections are not polarized.
 5. The temperature probe wires are connected to Pin D (Yellow) and E (Violet) of the MAIN connector.
 6. **TWISTED:** The temperature probe wires should be twisted, (*"Tip": Use an electric hand Drill connect the ends in the chuck.*)
 7. **ELECTRICAL NOISE:** If electrical noise is extreme, they should be run with a twisted shielded pair such as that used on the RPM sensor.
 8. **ROUTING:** Be careful that electrical wires are away from Stacks, Turbos, Exhaust Manifolds or any source of electrical interference such as Alternator/Starter Cables.
- IMPORTANT: IF TEMPERATURE SENSING IS NOT USED, THE TEMPERATURE INPUT CANNOT SIMPLY BE LEFT UNWIRED OR OPEN BECAUSE OF THE FAIL-SAFE FEATURE.**
9. **TIME DELAY:** If a 20 second enable delay is desired, short or jumper MAIN connector Pins D (Yellow) and E (Violet) together and turn the temperature dial fully clockwise.
 10. If a 10 second enable delay is desired, connect a 180 Ohm (1/4 or 1/2 Watt) Resistor between Main connection Pins D and E and turn the temperature dial fully clockwise.

• RELAY

GENERAL: The relay in the unit is equipped with 2 sets of single-pole, double throw (SPDT) contacts rated at 10 amperes, resistive load. They are internally connected in parallel. They must be de-rated to 8 amperes for 24 VDC, inductive loads. These contacts are floating from the supply power and internal circuitry and may be wired in any configuration suitable to the application. A typical wiring diagram is shown in Figure 11.

1. **RELAY ARM:** If the Armature of the Relay Contacts is connected to the Positive 24 Volt supply, as shown, the normally open contact maybe used to supply power to the Fuel Valve.
2. **NORMALLY CLOSED CONTACT** can supply 24 Volts to a Remote device.
3. **DE-ACTIVATION** of the Relay then turns on the Remote Device and turns off the Fuel.
4. **REMOTE RESET:** If remote reset is desired, a switch (preferably Key type) may be included in series at the Fuse, and the +24 Volt Supply to the Engine Saver as shown in Figure 12.

• ALARMS OUTPUT

GENERAL: Audible alarms, LED indicators and interconnect cables are available for custom panel installations or to accommodate existing Annunciator Panels. Refer to optional parts listing at the end of this manual.

• ANALOG OUTPUTS

IN NO CASE SHOULD VOLTAGE BE APPLIED DIRECTLY TO THESE ANALOG OUTPUTS OR DAMAGE WILL RESULT. See Outline Drawing Figure 12 for additional information.

GENERAL: Four Analog Outputs, RPM, OIL PRESSURE, COOLANT PRESSURE and TEMPERATURE allow continuous real-time monitoring and/or recording of engine parameters by another system connected to the Engine Saver. These outputs are pre-scaled to the industry standard 0-5 VDC for Analog Data, and are designed to feed a system with high impedance inputs. The output source impedance of each output is typically 5K Ohms.

1. **OUTPUTS:** The Analog Outputs may be connected to other on-board systems that record engine parameters over an extended period for the purpose of maintenance scheduling and/or trend analysis. The data may also be telemetered (by radio link) in "real time" to a central location for continuous storage and/or monitoring by a computer.
2. **CONNECTOR:** The Analog Outputs are available on the 17-Pin MS Connector marked "ACCESSORY".
 1. RPM Analog Signal 3000 RPM = 5.0 VDC (Pin "M")
 2. OIL PRESSURE Analog Signal 60 PSI = 5.0 VDC (Pin "R")
 3. COOLANT PRESSURE Analog Signal 30 PSI = 5.0 VDC (Pin "A")
 4. TEMPERATURE Analog Signal 180 Deg. C.= 5.0 VDC (Pin "L")

• EVENT OUTPUTS

GENERAL: Each EVENT output appears as an open circuit when it is not activated. When activated, the output is switched to common "Negative", and will handle up to 1/2 Amp, at 24 VDC. All event outputs will withstand up to 60 VDC when not activated, and are designed for resistive type loads such as LED's or incandescent lamps. The Alarm output has additional suppression incorporated that allows the use of an inductive type load.

IN NO CASE SHOULD VOLTAGE BE APPLIED DIRECTLY TO ANY EVENT OUTPUT OR DAMAGE WILL RESULT. See diagram for "Typical Wiring of the Accessory Connector", Figure 15, and Table 2.

• AUXILIARY INPUT WIRING

GENERAL: MAIN Connector Pin F (Gray)

AUXILIARY INPUT is provided on the Main Connector Pin "F" (Gray) to allow monitoring of an additional parameter which may or may not be directly related to engine operation.

1. **AUXILIARY FAULT** is activated by applying 24 Volts at pin F, typically from a switch closure.

2. **NON-FAULT** condition may be zero volts or simply an open circuit.

3. **ENABLE:** Can be Enabled ALL the time or only when Engine Saver is enabled by way of a dip switch. See Figure 17, and Table 4.

4. **NOT USED:** The input may be unwired if not used.

• POWER WIRING

1. **SUPPLY:** The Power to the unit should be supplied directly from the Battery Connector via a 1 to 5 Amp. Control Fuse.

NOTE 1: The control of power to this circuit should NOT be accessible to the operator. If it is, the unit can be Re-set and the "TELL-TALE" indications will be lost.

2. **RESET:** A Reset Switch accessible only to maintenance personnel is provided inside the unit.

• ELECTRICAL CONNECTIONS

GENERAL: The electrical connection of the Engine Saver to the vehicle or equipment is straightforward and is done by means of two Military type (MS) connector.

CAUTION: AVOID THE USE OF AN ELECTRIC ARC WELDER IN CLOSE PROXIMITY TO THE ENGINE SAVER OR A WELDING OPERATION ON A PART OF THE VEHICLE FRAME TO WHICH IT IS MOUNTED. THE VOLTAGES PRESENT MAY CAUSE DAMAGE TO THE ELECTRONICS OF THE ENGINE SAVER. IF WELDING IS NECESSARY, DISCONNECT THE ELECTRICAL CONNECTOR(S) AT THE ENGINE SAVER BEFORE PROCEEDING. PROTECT ALL ELECTRICAL WIRING FROM SPARK DAMAGE DURING WELDING.

1. **MAIN 10-PIN CONNECTOR:** The Main 10-Pin connector carries the circuits for 24 Volts Power, RPM Sensing, Temperature Sensing, Auxiliary Trip and the Output Relay Contacts. (Alarm Device, Shutdown devices, etc.)

2. **ACCESSORY 17-PIN CONNECTOR:** The 17-pin Accessory connector carries the circuits for the 6 engine "Events", 1 Auxiliary "Event", 4 Analog Outputs, and an Alarm Output.

3. **HARNESS:** The electrical connection of the Engine Saver to the machine or vehicle is simplified through the use of the 12-foot pre-wired harness assembly supplied (Order Separately).

4. **LENGTH:** The wires or cables may be cut as required to fit each installation, with the various wires brought out at points along the harness.

5. **ROUTING:** Care should be taken to route the cable in a protected area away from hot objects such as exhaust manifolds, turbochargers, stacks, etc., or where it might be accidentally stepped on or used as a hand grip by operating or maintenance personnel. We suggest using Conduit or similar for Wiring.

MAIN HARNESS

6. **HARNESS:** The harness consists of a mating 10-pin MS plug, eight No. 18 AWG stranded color-coded wires and a shielded, twisted-pair cable (Provided with ENGINE SAVER).

7. **FUNCTIONS:** The circuits to be connected are for

- A. Supply Power to the unit (24 VDC).
- B. Relay Contacts as necessary for operation of Alarms, Fuel Restricting Devices, etc.
- C. RPM Sensor.
- D. Temperature Sensor.
- E. Auxiliary Trip input (Optional).

IMPORTANT: IF TEMPERATURE SENSING IS NOT USED, PINS D AND E ON MAIN CONNECTOR MUST BE JOINED TOGETHER.

9. **MS PLUG:** The connector pins are identified by letters, with the function of each indicated on the unit's front cover.

MAIN CONNECTOR WIRING

<u>MS PIN</u>	<u>WIRE COLOR</u>	<u>FUNCTION</u>
A	Brown	Relay K1 A Common
B	Green	Relay K1 A N.C.
C	Blue	Relay K1 A N.O. *
D*	Yellow	Temperature Sensor *
E*	Violet	Temp. Sensor Return *
F*	Gray	Aux. Trip Input
G	Shielded cable Clear	RPM Sensor
H	Black	RPM Sensor Return
I	Red	Supply Power Positive
J	Cable Shield and Black	Common Negative

* Different from Level 6 Connections

Table 1

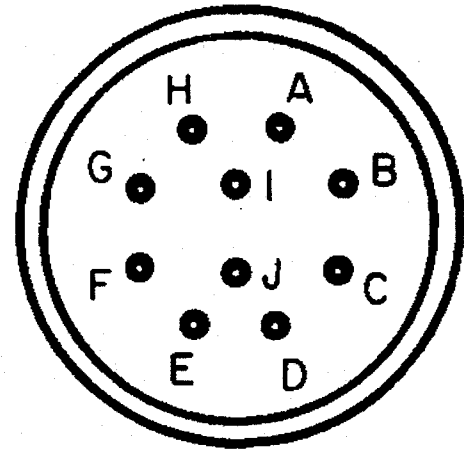


Figure 9
(Back View)

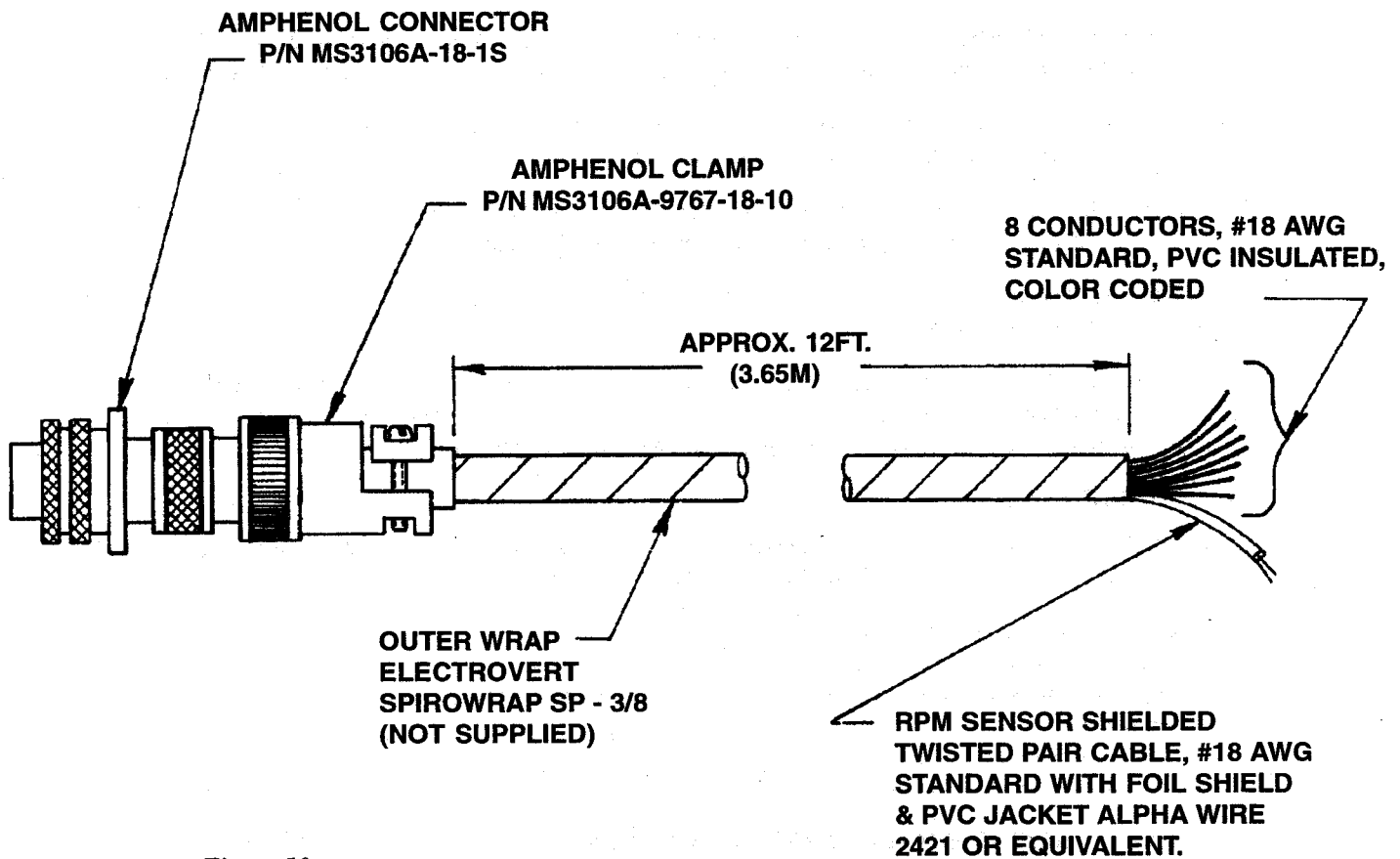
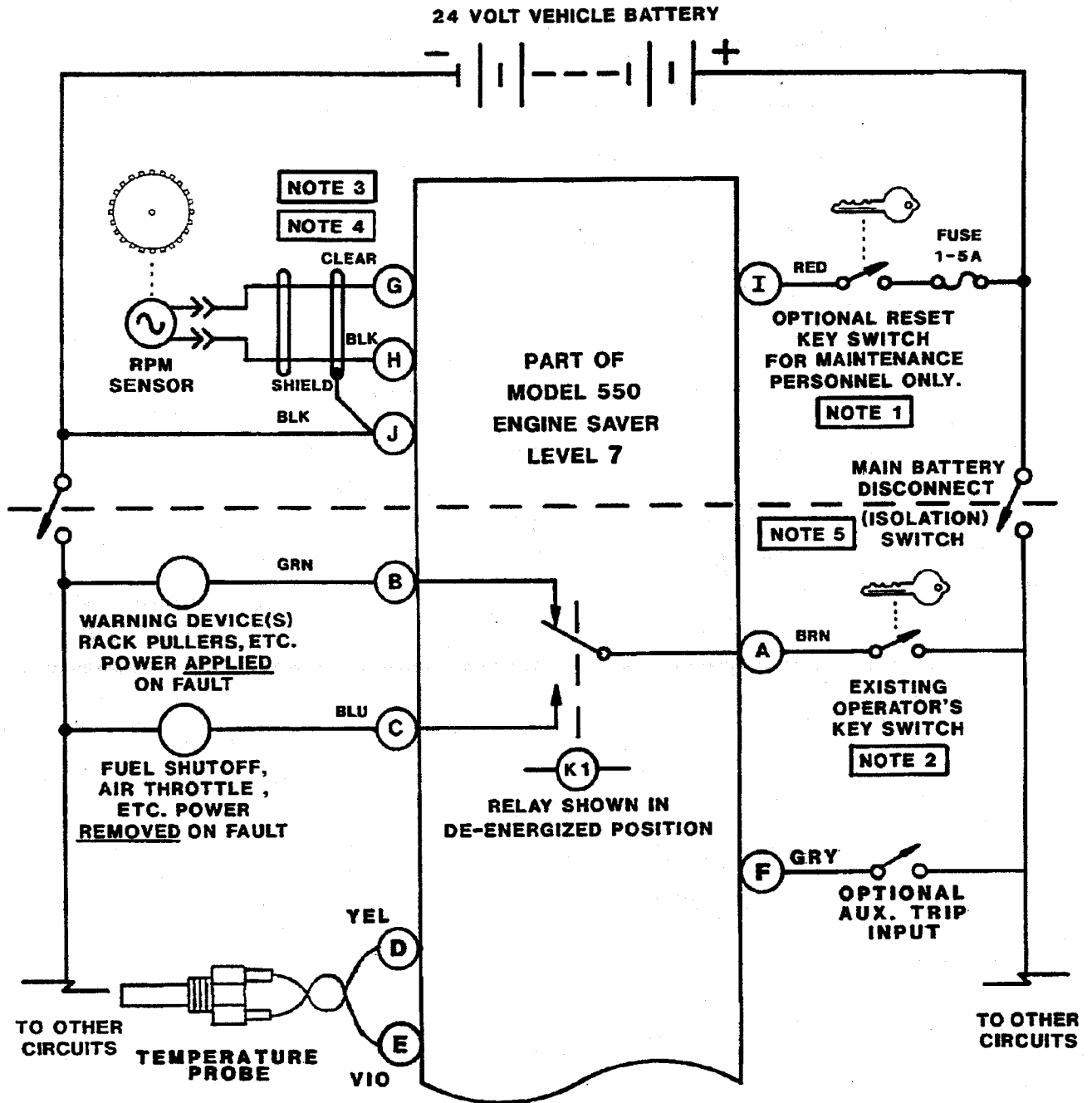


Figure 10

TYPICAL WIRING DIAGRAM - MAIN CONNECTOR

Figure 11



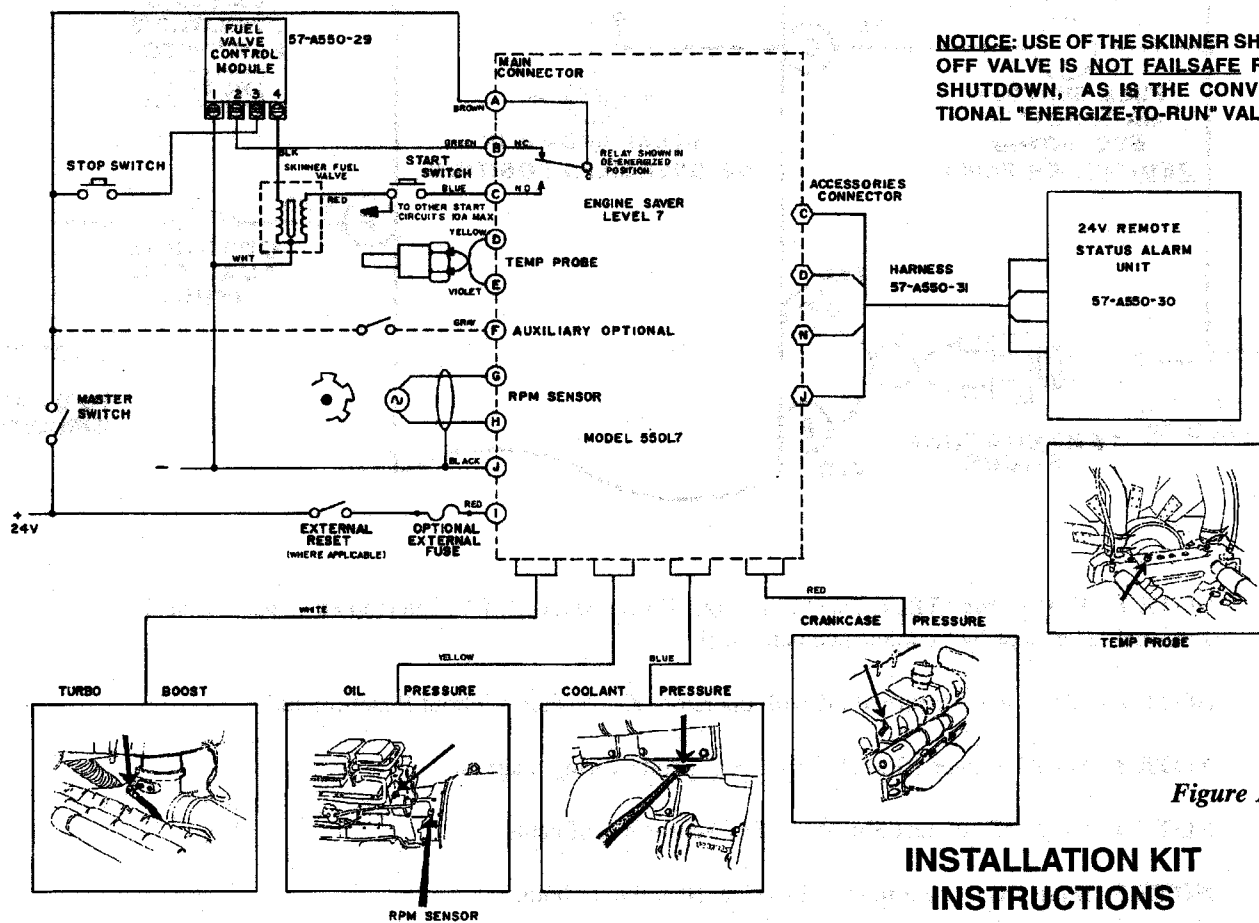
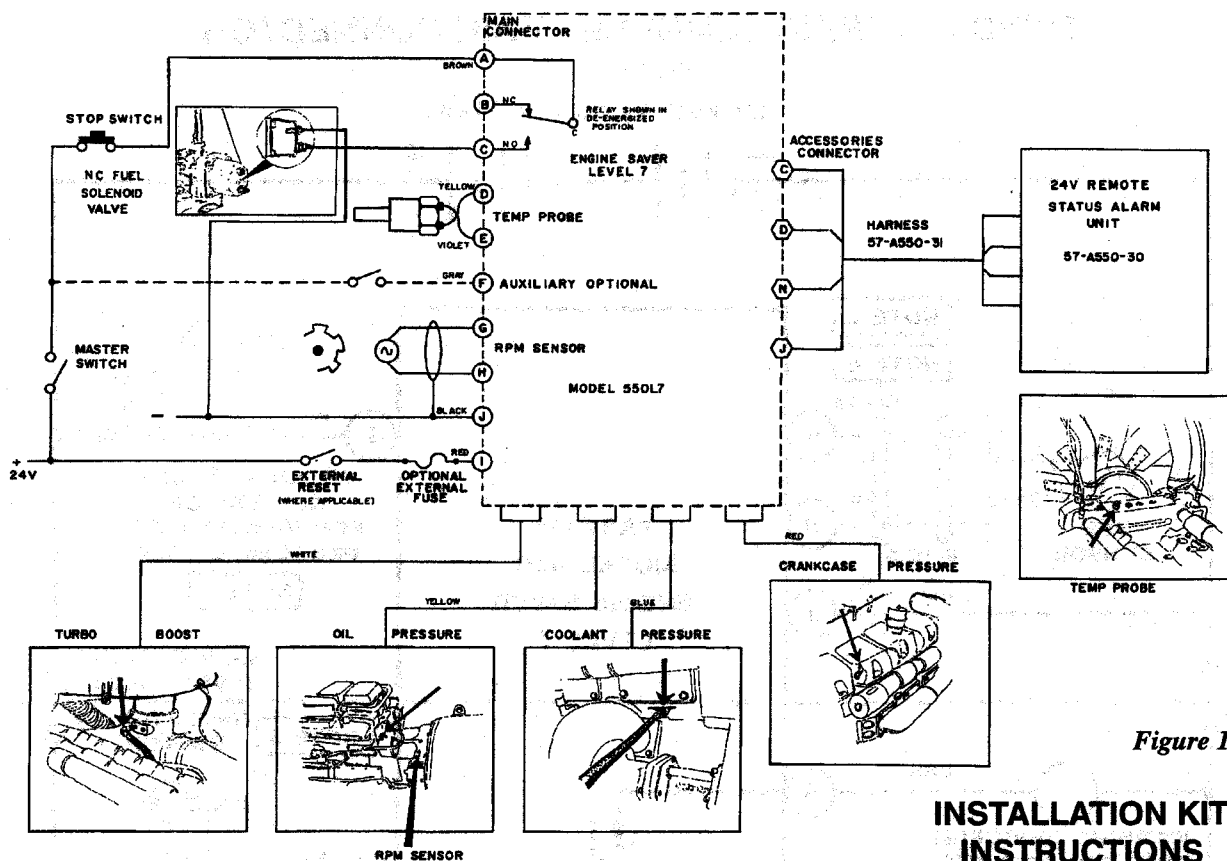
NOTE 1 - To Preserve "TELL-Tale" Indicators, Power Must NOT be Interrupted to the Engine Saver Terminal "I" except by maintenance personnel.

NOTE 2 - Alarm may be turned off with operators Key Switch Without Resetting unit.

NOTE 3 - For Alternator RPM Pickup; See separate wiring diagram.

NOTE 4 - DO NOT connect Shield at RPM Sensor end of cable.

NOTE 5 - Main Disconnect may be Positive, Negative or both.



• WIRING COMPATIBILITY WITH PREVIOUS LEVELS

1. **COMPATIBILITY:** The Level 7 Engine Saver has been designed to have a maximum amount of compatibility with previous levels (2 thru 6) with regard to the MAIN connector wiring.
2. **LEVEL 2 & 6:** If Level 7 Engine Saver is replacing an existing unit (Level 2 thru 6) already installed in a vehicle, it is NOT necessary to completely re-wire the MAIN Harness. Only Pins D, E and F have been re-assigned; these were used for the second set of output relay contacts.
3. **PREVIOUS LEVELS:** On many installations, these contacts were not required and were left unwired.
 - A. If Pins D, E and F were not used previously, connect them as applicable for your installation.
 - B. If these pins are now being used, the external devices connected to them must be re-connected to the output relay circuit on pins A, B and C of the MAIN connector.

• ACCESSORY CONNECTOR WIRING

GENERAL: Please refer to the Table 2 showing pin assignment, wire color and function.

1. **HARNESS:** A pre-wired Accessory Harness is available as an option under P/N 57-5500-52 and in a length of 15 feet. (Custom Harnesses available upon request).
2. **NOT USED:** If this connector is not used, it should remain tightly Capped.
3. **EVENT OUTPUTS:** A total of eight EVENT outputs are available for operating remote indicators and/or a remote alarm device. These include:
 1. **SYSTEM ENABLE**
 2. **OVERSPEED**
 3. **HI CRANKCASE PRESSURE**
 4. **LO COOLANT PRESSURE**
 5. **LO OIL PRESSURE**
 6. **HI TEMPERATURE**
 7. **AUXILIARY FAULT**
 8. **ALARM**

ACCESSORY CONNECTOR

MS PIN	WIRE COLOR	FUNCTION
A	Wht/ Brn	Overspeed Event Output
B	Wht/Blk	Analog Return
C	Blk	Supply Return
D	Red	24 VDC Supply Positive (to Accessory)
E	Wht/Red	Low Oil Pressure Event Output
F	Wht/Org	Auxiliary Fault Event Output
G	Wht/Yel	Hi Temperature Event Output
H	Wht/Grn	Coolant Pressure Event Output
J	Wht/Blue	Alarm Output
K	Wht/Vio	Oil Pressure Analog Output
L	Wht/Gray	Temperature Analog Output
M	Wht/Blk/Brn	RPM Analog Output
N	Wht/Blk/Red	System Enable Event Output
P	Wht/Blk/Org	Hi Crankcase Pressure Event Output
R	Wht/Blk/Yel	Lo Coolant Pressure Event Output
S	NC	Spare
T	NC	Spare

Table 2

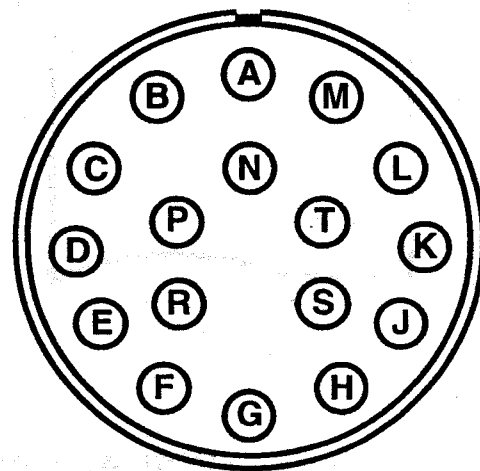
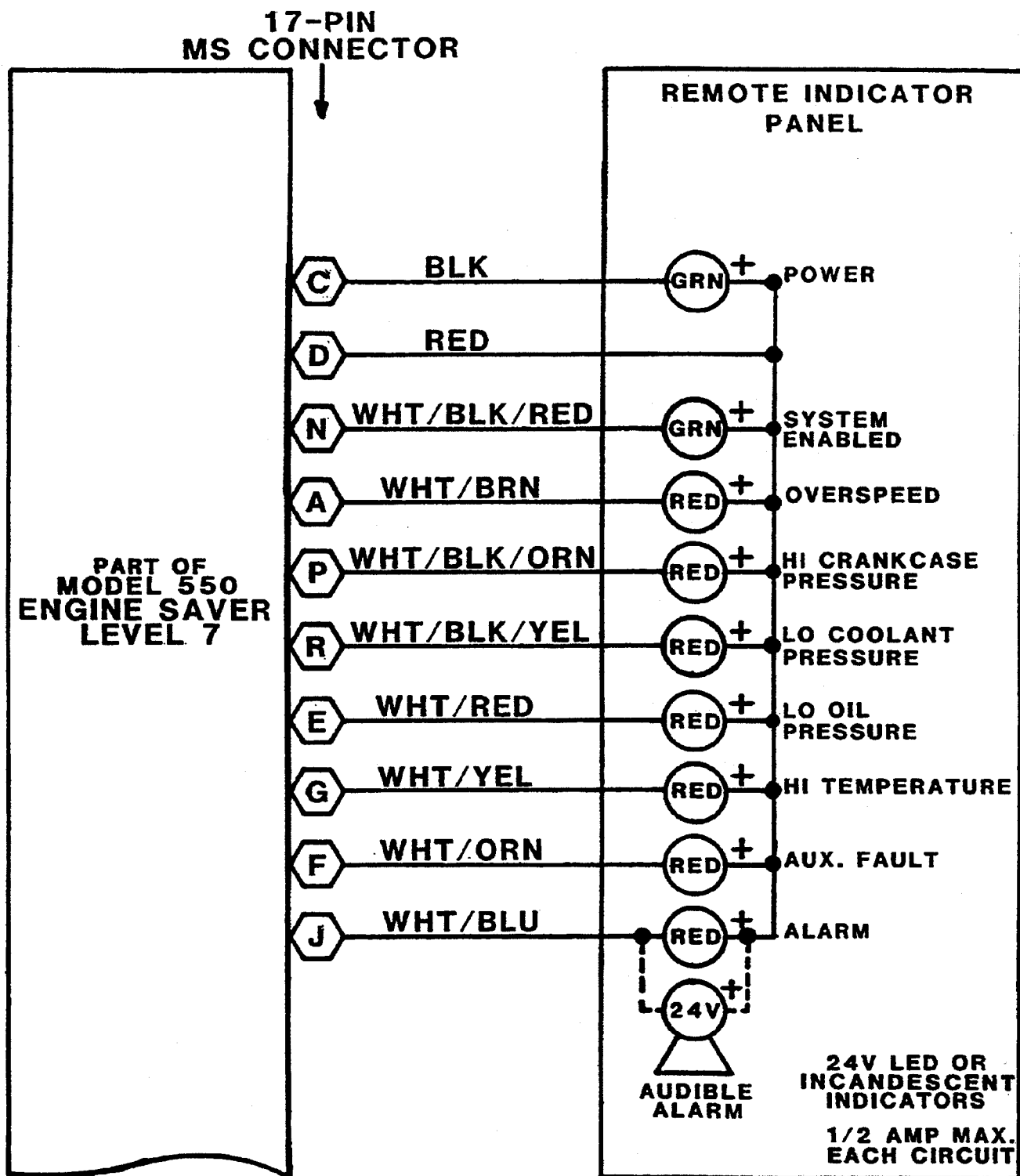


Figure 14



**TYPICAL WIRING OF ACCESSORY CONNECTOR
FOR REMOTE INDICATOR PANEL**

Figure 15

TESTING AND ADJUSTMENT

• EQUIPMENT REQUIRED

1. **General:** The Engine Saver can be conveniently tested with either the Model 9550 Engine Saver Test Set or the Model 9666 Quick Tester.

2. **MODEL 9550:** The Model 9550 provides a more complete test, with simultaneous simulation of six engine parameters, digital RPM readout and indicators for all functions. The Model 9550 is intended primarily for off-vehicle testing and pre-installation adjustment.

3. **MODEL 9666 QUICK TESTER:** The Model 9666 Quick Tester has been designed specifically for on-vehicle testing, adjustment and troubleshooting. It is more portable, lighted, and has the provision for measuring pressures from the engine. It does not test the temperature, auxiliary trip or accessory functions on the Engine Saver. The Model 9570 adapter is used with older 9550 Test Sets and 9666 Quick Tester to provide these functions.

NOTE: Model 9570 adapter is used with older 9550 Test Sets, and Model 9666 Quick Tester to provide these functions.

Both pieces of test equipment are supplied with a short-form instruction card.

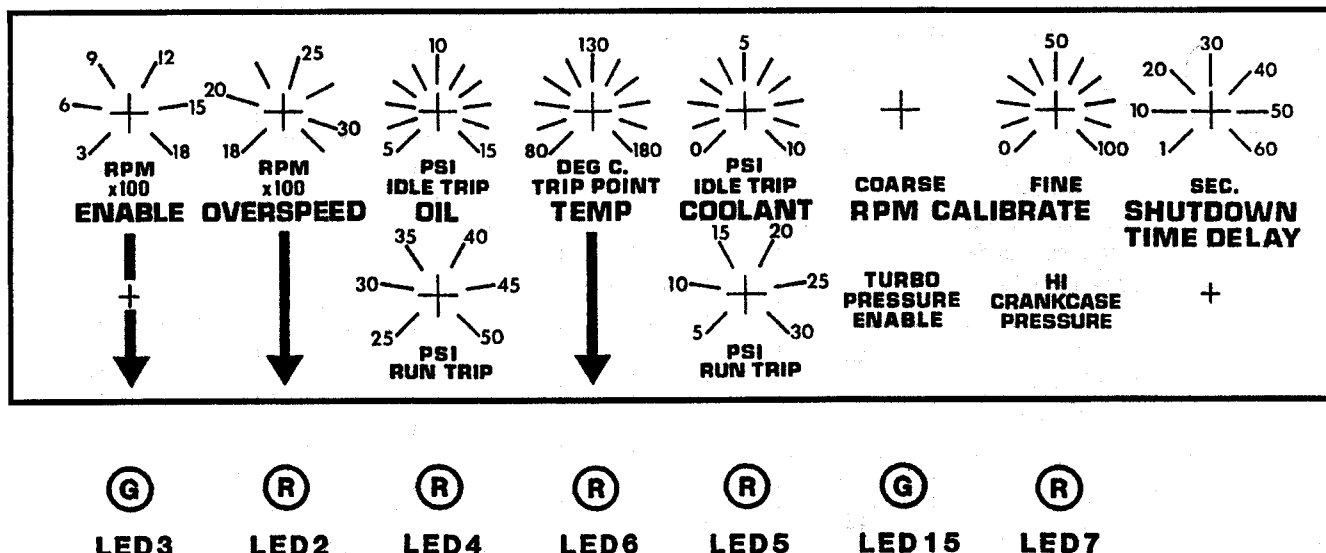


Figure 16

• RPM CALIBRATION

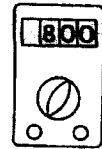
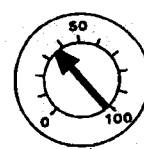
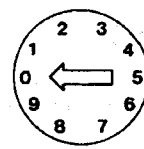
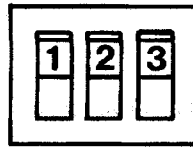
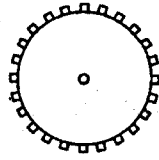
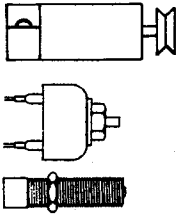
GENERAL: In order to sense engine RPM, an RPM pickup of some type must be fitted see RPM Selection and Calibration, Table 3.

1. **PROCEDURE:** The RPM calibration procedure on the vehicle or engine is as follows:

- Determine the source of RPM signal.
- Set S1, S2, and S3 Dipswitches according to Table 4 (Electronic Module).
- Hold engine at 1250 RPM (or other from curve)
- Adjust COARSE and FINE RPM dials for 4.00 VDC at 2500 RPM at the RPM TEST POINT (TP1, Electronic Module).

2. **COARSE AND FINE DIALS:** The chart gives approximate "ball park" number values for the settings of the COARSE and FINE dials, however for an accurate setting, the voltage at the RPM TEST POINT must be set to 8.00 VDC at 2500 RPM or 4.00 VDC at 1250 RPM. If it is more convenient, other points on the calibration curve may be used. Refer to Graph 1 entitled "CALIBRATED RPM OUTPUT VOLTS vs. ENGINE RPM".

RPM SOURCE SELECTION AND CALIBRATION CHART



Type of Pickup	Rpm Source (Take-Off Point Of Engine)	Equivalent No. of Teeth	Programming Switch			RPM Calibration (Approx. Setting)		RPM Test Point Voltage	
			S1	S2	S3	Coarse	Fine		
Variable Reluctance Magnetic	Flywheel Ring Gear	168	DN	UP	UP	0	0	RPM TP 8.0 Volts At 2500 RPM	
		142					10		
		118					20		
		103					25		
		68					50		
	Cam Gear (2 Cycle)	68					50		
GE Tach Gen	Crankshaft on GE Electric Drive Equipped Vehicles (Feeds LD Cont CD	50				1	30		
Mini-Gen	Crankshaft on 2 or 4 Cycle: Cam on 2-Cycle	30				2	22		
							25-45		
Other Tach Generators	On Crankshaft E.T. = Pulses /Rev. on Camshaft on 4- Cycle E.T.= <u>Pulses/Rev</u> 2	20-28				3	40		
		18					40-50		
		12-15					4		55
		10							60
		8					5		60
		6					7		60
		4					3-9		60
		4					3-9		60
Alternators	E.T.= Poles X Pulley Ratio to Crankshaft	20-28	UP	DN	DN	2	25-45		
		18				3	40		
		12-15				4	40-50		

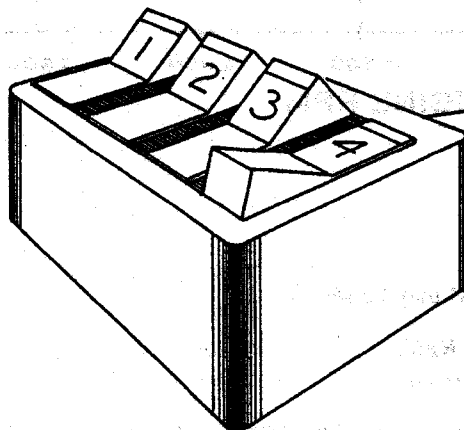
Table 3

3. RPM (MONITORED OR SIMULATED): The actual engine RPM must be monitored (or simulated with the Model 9550) during the calibration procedure. This can be done on the vehicle by means of the tachometer in the cab, or by an electronic strobe tachometer.

4. RPM TEST POINT: If the voltage at the RPM TEST POINT TP-1 is too LOW and cannot be brought into range with the RPM FINE dial, then select a HIGHER number on the RPM COARSE dial. Conversely, if the voltage at the RPM TEST POINT is too high, select a LOWER number on the RPM COARSE dial. If still having difficulty, re-check the settings of S1, S2 and S3 to be sure they are correct for the type of pickup being used. Finally, re-check the source of the RPM signal.

5. NOT USED: IF RPM SENSING IS NOT USED, SET PROGRAMMING SWITCH S3 TO THE "DOWN" (ON) POSITION. Notice when RPM Sensing is not used, the engine is only protected when the Turbo Boost is above 15" Hg.

PROGRAMMING SWITCHES



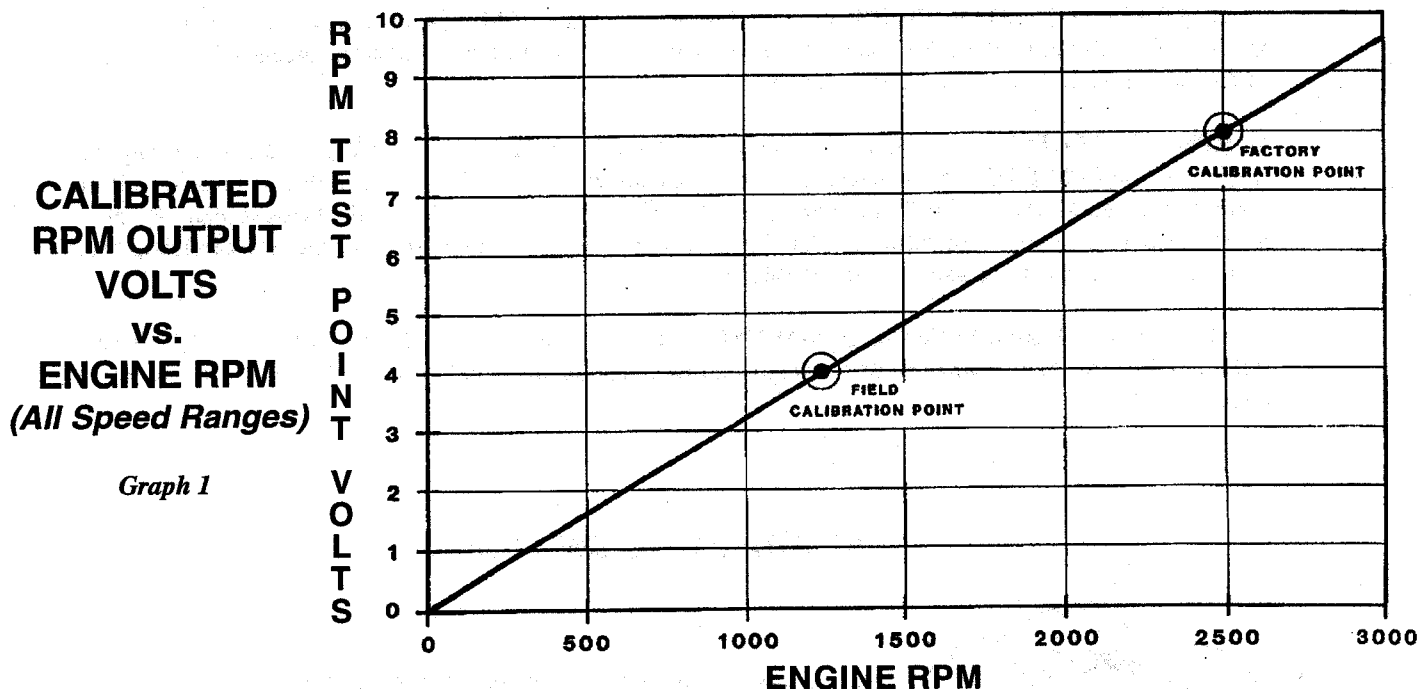
Switch 4 shown in "Down" Position.

(Use a Blunt object to set switches in order to avoid Damage to the Switch.)

Figure 17

Table 4

Source of RPM Information	Switch 1 Position	Switch 2 Position	Switch 3 Position	Switch 2 Position
Flywheel Magnetic Pickup	DOWN	UP	UP	Below
All Tachometer Generator	DOWN	UP	UP	Below
Alternator	UP	DOWN	DOWN	Below
Auxiliary Fault Input Response	-----	-----	-----	-----
Depends on "System Enable" Signal	Above	Above	Above	UP
Always Enable	Above	Above	Above	DOWN



• RPM ENABLE ADJUSTMENT

GENERAL: After the RPM is calibrated, the ENABLE RPM may be set.

1. DIAL RANGE: The dial covers the range of 300 to 1800 RPM.

A. A typical setting might be 1200 -1300 RPM or higher.

2. IDLE PROTECTION: If idle protection is desired, and the normal idle RPM is 600-650, an enable RPM of 500-550 should be used.

3. IDLE PRESSURE: Also, due to the very low pressures encountered on idle (particularly coolant pressure on some engines) it will be necessary to use the lowest setting on coolant and possibly on oil as well.

Note: All Coolant and Oil Pressure monitoring ceases below the enable RPM, regardless of the pressure setting. The dial markings are a good guide, but for exact RPM settings, test equipment should be used.

4. RPM ABOVE ENABLE: When engine RPM is above the enable RPM;

A. The green indicator light (LED 3) on the electronic module will light after a 10 second delay.

B. Oil and Coolant Pressure monitoring begins after "SYSTEM ENABLED" indicator on the front panel (LED9) of the unit is turned on (and Remote indicator, if used). Refer to this for information on RPM ENABLE DELAY by temperature

• OVERSPEED ADJUSTMENT

1. GENERAL: Use the dial markings as a guide. Use test equipment for exact settings.

2. DIAL RANGE: The OVERSPEED dial covers the range of 1800 to 3000 RPM.

A. Typical setting might be 2500 RPM or higher.

3. RPM ABOVE OVERSPEED: When Engine RPM is ABOVE the OVERSPEED RPM, the Red indicator (LED 2) on the component side of the electronic module will light immediately.

A. After a 0.5 (One-Half) second delay, the red OVERSPEED indicator on the front panel (LED 8) of the unit turns on (and Remote indicator, if used).

B. The Relay is de-energized when LED 8 comes on.

C. The front panel indicator (and Remote) remains on and the Relay remains de-energized until the unit is reset.

4. NOT USED: If OVERSPEED protection is not desired, turn the Overspeed dial fully clockwise.

• TURBO ENABLE

GENERAL: The Engine Saver is equipped with a Turbo Pressure Sensor that is factory set at 15 inches Hg. (Non-Adjustable).

1. **TURBOCHARGER PRESSURE AS A BACKUP:** In most applications, Turbocharger Pressure is a dependable backup or auxiliary means of enabling the OIL and Coolant Pressure functions of the Engine Saver.
2. **OPTIONAL:** The decision to use Turbo Pressure enable is entirely optional and should be deferred to the installer. If it is not used, the Pressure Port should be Plugged.
3. **OVERRIDING RPM ENABLE:** Although the Turbo Pressure can override the RPM enable at any time, it is rather unlikely, unless the RPM input had failed to produce a sufficient signal (An open in the RPM circuit will produce an Alarm).
4. **EXCEEDED 15 INCHES HG:** The only other conditions under which the Turbo Pressure would take precedence over RPM is if the Turbo Pressure exceeded 15 inches Hg. any RPM below the enable RPM setting. If 1800 RPM, the enable RPM would have to be set near the top of its range for this to be possible. Using such a high setting for the enable point would sacrifice Idle protection.
5. **NO RPM SENSING:** When no RPM sensing is used, it is necessary to
 - A. *Set the programming Switch S3 to the "DOWN" (ON) position to defeat the RPM fail-safe feature. See Figure 17, and Table 4.*
 - B. *The Oil and Coolant Pressure Idle dials should be set to full clockwise. There will be no Idle protection. The Run Pressure dial settings will not apply.*
6. **OPERATION:** When Turbo Pressure is ABOVE 15" Hg.:
 - A. *Green indicator light (LED 15) on the component side of electronic module lights immediately.*
 - B. *After a 10 second delay, Turbo Pressure functions the same as for RPM enable.*
 - C. *Whichever signal (RPM or Turbo) arrives first enables the system.*
 - D. *If the Turbo Pressure drops slightly below the enable pressure, (15" Hg.) the system will be disabled with no delay, unless still enabled by RPM.*

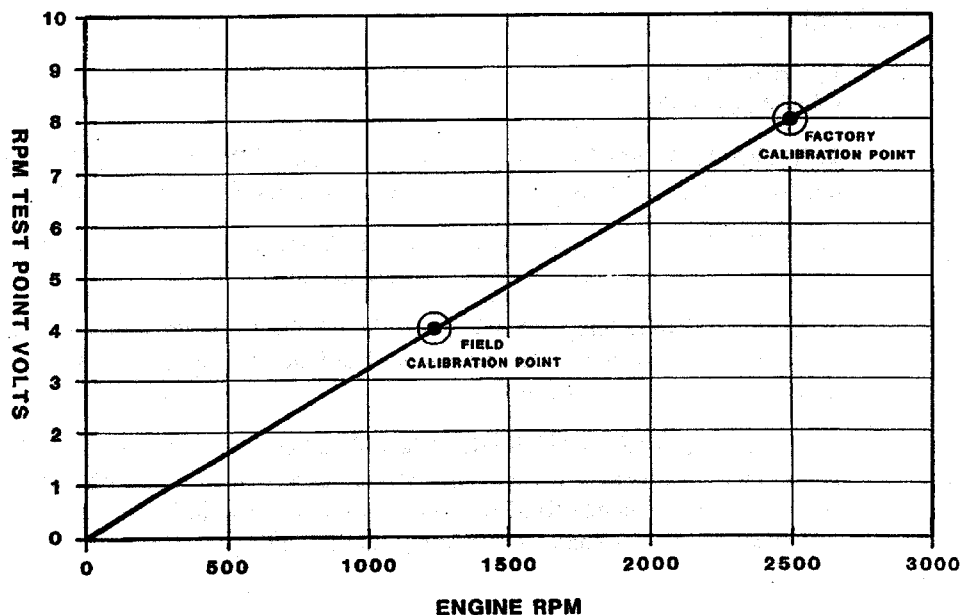
• OIL PRESSURE ADJUSTMENT

GENERAL: There are TWO dials for Oil Pressure marked "IDLE TRIP" and "RUN TRIP".

1. **IDLE TRIP:** Dial determines the trip point below 1800 RPM, and at Idle speed, typically below 900 RPM. This point is at the intersection of the sloped and flat parts of the curve. See graph 2. The Trip point is automatically modulated by RPM between the flat parts of the curve.
2. **RUN TRIP:** Dial determines the trip point above 1800 RPM
3. **CHOOSING TRIP POINT:** The trip point should be chosen so that under normal operating conditions, the pressure from the engine at any RPM will exceed this value by a safe margin.
4. **OPERATION:** While enabled, Oil Pressure drops below the trip point the following occurs.
 - A. *The red indicator (LED 4) on the component side of the electronic module lights immediately;*
 - B. *After an 8-10 second delay.*
 - C. *Alarm is activated and the Red LOW OIL PRESSURE indicator on the front panel (and remote indicator) is turned on.*
 - D. *After the SHUTDOWN DELAY, the Relay is de-energized until the unit is reset.*
5. **NOT USED:** If RPM sensing is NOT used, set the IDLE OIL dial Fully Clockwise (15 PSI). The RUN OIL dial will have NO effort.
6. **RUN OIL PRESSURE READING FOR DIAL:** An approximate Oil Pressure reading from the engine may be read directly from the "RUN" OIL Pressure dial when the engine is at 1800 RPM or above. This is accomplished by turning the dial CLOCKWISE until LED 4 lights, then read the pressure from the dial.

OIL PRESSURE TRIP POINT VS. ENGINE RPM

Graph 2



• COOLANT PRESSURE ADJUSTMENT

GENERAL: There are TWO dials for Coolant Pressure marked "IDLE TRIP" and "RUN TRIP":

1. IDLE TRIP: Dial determines the trip point above 1800 RPM, and at Idle speed, typically below 900 RPM. This point is at the intersection of the sloped and flat parts of the curve. See graph 3 and 4. The Trip point is automatically modulated by RPM between the flat parts of the curve.

2. RUN TRIP: This trip point should be chosen so that under normal operating conditions, the pressure from the engine at any RPM will exceed this value by a safe margin.

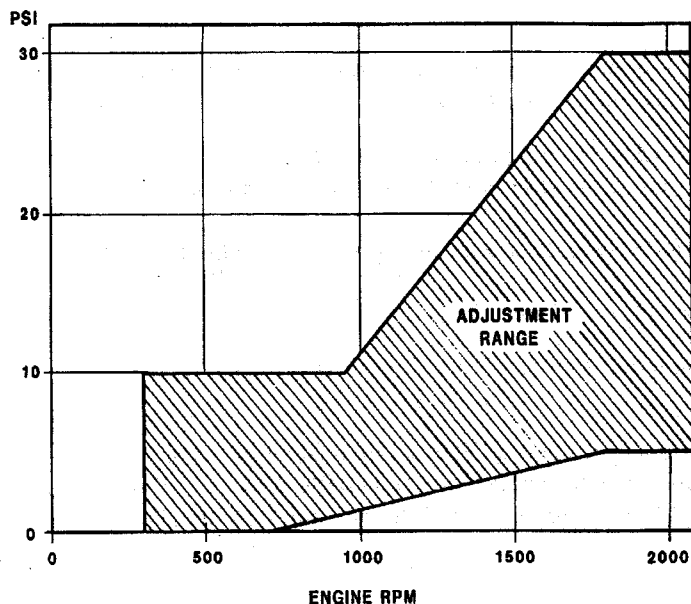
NOTE: We recommend choosing the *RUN COOLANT PRESSURE TRIP* point always above the Radiator Cap Pressure to assure an optimum coolant engine protection level.

NOTE: In NO CASE should the pressure setting of the *RUN COOLANT* dial be Below the setting of the *IDLE COOLANT* dial, as this results in undesirable interaction between the dials.

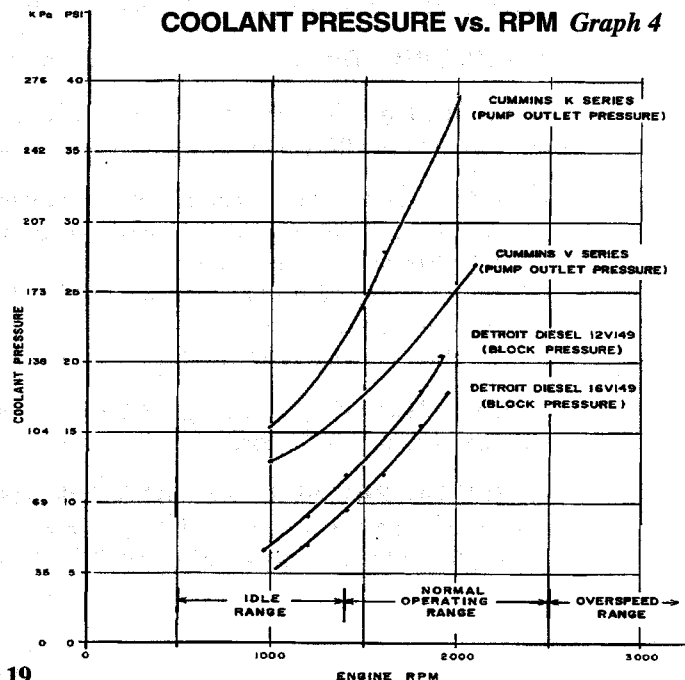
3. NOT USED: If RPM sensing is NOT used, set IDLE COOLANT dial and RUN COOLANT dial fully clockwise.

4. RUN COOLANT PRESSURE READING FROM DIAL: An approximate Coolant Pressure reading from the engine may be read directly from the "RUN" Coolant Pressure dial when the engine is at 1800 RPM or above. This is accomplished by turning the dial **CLOCKWISE** until LED 5 lights, then read pressure from the dial.

COOLANT PRESSURE TRIP POINT vs. RPM Graph 3



COOLANT PRESSURE vs. RPM Graph 4



BENCH TEST WITH 9550 TEST SET

• CRANKCASE PRESSURE TEST (OPTIONAL)

GENERAL: The Green "SYSTEM ENABLE" light should be off for this test. Decrease RPM or Turbo-Boost Pressure using the 9550 Test Set with unit disconnected from the engine.

1. SLOWLY increase the Crankcase Pressure from its initial value.
 - A. At a Crankcase Pressure of 10 inches W. C. Normal, +/- 1.5 inches.
 - B. The Red indicator on the electronic module (LED 7) should turn-on.

NOTE: If this tolerance cannot be met, the pressure switch must be replaced, as it is non-adjustable.

2. Repeat several times, reducing the pressure to zero each time.
 - A. The red "HIGH CRANKCASE PRESSURE" light on the front of the unit (and remote light) should turn on approximately 10 seconds after diagnostic LED 7 turns on.
 - B. Relay will de-energize after the shutdown time delay.
3. Return the Crankcase Pressure to zero and verify that only diagnostic LED 7 turns-off.
4. Momentarily press the reset button.
 - A. The relay should energize as the button is released. No other lights should be on.

• TEMPERATURE CHANNEL TEST

GENERAL: The Green "SYSTEM ENABLED" light should be OFF for this test.

1. Rotate the Simulated Temperature dial on the 9550 Test Set slowly clockwise until the Red indicator on the electronic module (LED 6) just turns-on.

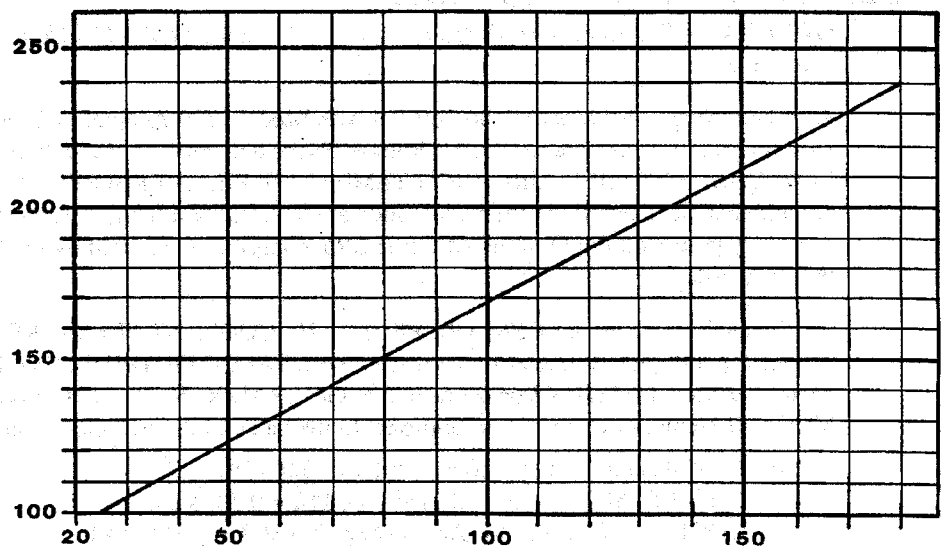
NOTE: At this point, the setting of the temperature dial on the electronic module should agree closely with the setting of the simulated temperature and the dial on the 9550 Test Set.

2. Set the Engine Saver dial to the desired temperature and verify.
 - A. The Red "HIGH TEMPERATURE" light on the front of the unit (and Remote Light) should Turn-On approximately 20 seconds after diagnostic LED 6 turns on..
 - B. The Alarm should activate and the Relay should de-energize after the Shutdown Time Delay.
3. Decrease the simulated temperature to where the diagnostic LED 6 turns off.
 - A. Momentarily depress the Reset Button. and Release.
 - B. No other lights will be on.

NOTE: Specific Temperatures may be simulated by connecting a resistor of appropriate value in place of the Temperature Probe (P/N 57-5500-65). Refer to the Graph below "PROBE RESISTANCE vs. TEMPERATURE".

**PROBE
RESISTANCE
vs.
TEMPERATURE**

Graph 5



• ENABLE LOGIC AND EXCLUSIVITY TEST

GENERAL: The Green "SYSTEM ENABLE" light should be ON for this test. Make sure the unit is Reset.

1. Decrease the Oil Pressure First and the Coolant Pressure Second to 0 PSI, and wait at least 30 seconds.
 - A. *Diagnostic LED's 4 and 5 should be ON, the component side of the electronic module.*
 - B. *The Alarm should not be activated.*
 - C. *NO lights on the front of the unit should turn on.*
 - D. *Approximately 8 seconds later.*
 - E. *LOW OIL PRESSURE light on the front of the unit will Turn-On.*
2. Wait an additional 30 seconds.
 - A. *No other lights on the front of the unit should Turn-On.*
 - B. *This shows that of these two channels the first fault to occur is the fault that latches.*

NOTE: The TEMPERATURE channel bypasses the exclusivity logic and CAN register a trip even if another parameter such as Oil Pressure has already tripped. However, if TEMPERATURE trips first, it will lock out ALL other faults.

• ENABLE TIME DELAY TEST

GENERAL: The ENABLE time delay is the time that elapses before the SYSTEM ENABLE light on the front of the unit is turned on by sufficient RPM or TURBO PRESSURE. To allow for the slower pressure response of a cold engine, the Enable Delay is modulated by temperature.

1. This function is tested by noting the Enable Delay with the simulated temperature.
 - A. *Set first at 60 Deg. C. - The Enable Delay should be 20 seconds*
 - B. *Then at 100 Deg. C. - The Enable Delay should be 10 seconds.*

NOTE: The change over point occurring at below 80 Deg. C. increase enable up to 75 seconds.

• SENSOR FAIL-SAFE TESTS

1. The Engine Saver is equipped with automatic Sensor Monitoring for RPM, Temperature, (External), Oil and Coolant Pressure Sensors (Internal). An Open in any of these circuits, WILL cause an Alarm and a Delayed Shutdown, thereby preventing a loss of protection due to a Failed Sensor or a Broken Wire.

- A. *And Open Circuit condition is indicated on the front Panel of the Unit by Flashing the OVERSPEED, Oil, Temp, Coolant, and Crankcase.*
 - B. *The Fail-Safe Detector is self resetting when the circuit is restored for all circuits in (A).*

• ACCESSORY INPUT/OUTPUT TESTS

GENERAL: The Accessory Outputs are available on the 17-Pin MS Connector marked "ACCESSORY". See Table 2.

1. When using older Model 9550 Test Set with Model 9570 Adapter and the above procedures for testing and adjusting the various parameters, the Remote Event outputs for SYSTEM ENABLE, LOW OIL PRESSURE, LOW COOLANT PRESSURE, HIGH TEMPERATURE, OVERSPEED, AUXILIARY FAULT and ALARM are automatically tested via the remote indicators on the Test Set and Adapter. Additionally, the presence of accessory power on Pin D of the ACCESSORY connector is verified by the Green Acc. POWER indicator on the 9570 Adapter.
2. The analog outputs for RPM, OIL PRESSURE, COOLANT PRESSURE and TEMPERATURE are tested by connecting a digital voltmeter to the respective ANALOG OUTPUT TEST POINTS on the 9570 Adapter. The Meter Negative lead should be connected to the ANALOG RETURN test point. An analog voltage from 0 to 5 VDC will be measured that is proportional to the value of the parameter that it represents, as follows:
 - A. *RPM Analog Signal 0-3000 RPM = 0- 5.0 VDC*
 - B. *OIL PRESSURE Analog Signal 0-60 PSI = 0-5.0 VDC*
 - C. *COOLANT PRESSURE Analog Signal 0-30 PSI = 0-5.0 VDC*
 - D. *TEMPERATURE Analog Signal 0-180 Deg. C.= 0-5.0 VDC*

• RECORDING INSTALLATION DATA

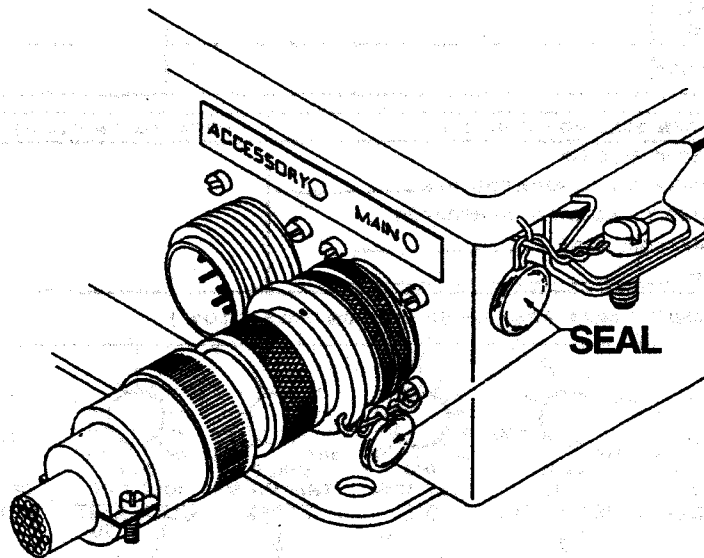
1. **GENERAL:** After the installation is complete and all adjustments have been made satisfactorily, the installing agent or user is encouraged to record all installation particulars and settings.
2. **VALUABLE TO FUTURE:** A permanent record of this information will prove valuable to the user in the future for reference when doing additional installations, or for simple verifying settings.
3. **COPY:** A duplicate copy of the complete form should be forwarded to Flight Systems or its agent for Warranty support and inclusion in the master installation data file. Please take this extra step, as it will benefit YOU as well as others.
4. **FORM:** A convenient form will be found on the following page for this purpose.

• TAMPER RESISTANT FEATURES

1. **GENERAL:** After the Engine Saver has been installed and properly adjusted, it maybe desirable in some installation to, discourage or prevent entry into the unit by unauthorized personnel.
2. **PREVENT REMOVAL:** Since the unit can be Reset by momentarily disconnecting it from the vehicle, it may also be desirable to prevent removal of the harness (loom) connector.
3. **LEAD SEAL:** A means has been provided to attach a lead seal or similar device to both the cover and/or electrical connector. See Figure 18 below.

LEAD SEAL LOCATION

Figure 18



ENGINE SAVER APPLICATION CHECKLIST / WARRANTY REGISTRATION

Fill Out and Return a Copy of this Page to FLIGHT SYSTEMS to Activate Warranty

CUSTOMER INFORMATION

COMPANY _____ DIVISION _____
LOCATION _____
SUPERINTENDENT/CONTACT _____ TITLE _____
TELEPHONE NO. _____ TELEX/TWX NO. _____

APPLICATION INFORMATION

EQUIPMENT MAKE _____ MODEL _____ TYPE _____
ENGINE MAKE _____ MODEL _____ NO. CYLS _____
ENGINE CONDITION _____ ENGINE HRS. _____
OPERATION IS: ☐ FULLY ATTENDED ☐ PARTIALLY ATTENDED ☐ UNATTENDED

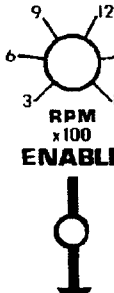
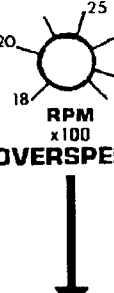
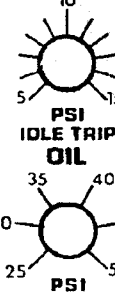
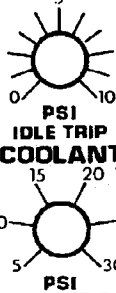
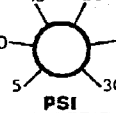
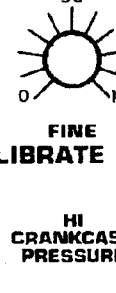
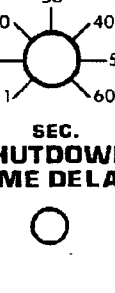
INSTALLATION DATA

ENGINE SAVER S/N _____ DATE OF INSTALLATION _____
BY: ☐ EQUIPMENT OEM ☐ EQUIPMENT DEALER ☐ FS AGENT/DIST ☐ OWNER/USER
LOCATION OF ENGINE SAVER ON VEHICLE OR EQUIPMENT _____

PARAMETER	PICK-OFF LOCATION	PICK-OFF FITTINGS	HOSE LENGTH
TURBO PRESSURE			
OIL PRESSURE			
COOLANT PRESSURE			
CRANKCASE PRESSURE			
TEMPERATURE			N/A

TYPE OF RPM SENSING (IF USED)	LOCATION ON ENGINE	SPEED RANGE	EQUIV. TEETH
☐ MAGNETIC PICK-UP ☐ TACHOMETER GENERATOR P/N _____ ☐ EXISTING TACHOMETER GENERATOR ☐ ALTERNATOR: MAKE _____ ☐ OTHER _____			

ADJUSTMENTS (MARK POSITION OF EACH ON DIALS BELOW)

 RPM x100 ENABLE	 RPM x100 OVERSPEED	 PSI IDLE TRIP OIL	 DEG C. TRIP POINT TEMP	 PSI IDLE TRIP COOLANT	 PSI RUN TRIP	 COARSE RPM CALIBRATE	 FINE CRANKCASE PRESSURE	 SEC. SHUTDOWN TIME DELAY
--	---	--	---	--	---	--	--	---

OUTPUT (CHECK AS MANY AS APPLY)

☐ ALARM ☐ SHUT-DOWN ☐ DELAYED SHUT-DOWN ☐ INTERLOCKED/CONDITIONAL SHUT-DOWN
☐ FUEL SOLENOID ☐ RACK-PULLER ☐ INTAKE AIR SHUT-OFF ☐ OTHER _____

ACCESSORY DEVICES USED _____

COMMENTS _____

• FILL OUT, MAKE COPY AND MAIL OR FAX TO FLIGHT SYSTEMS AT:
505 Fishing Creek Road, Lewisberry, PA 17339 USA Fax: 717-932-9925

TROUBLESHOOTING INSIDE THE ENGINE SAVER

• PRESSURE SENSORS

1. **GENERAL:** Pressure Sensors used in the Engine Saver are Diaphragm type. The movement of the diaphragm causes a resistance to change or a switch to close.
2. **PRESSURES:** These sensors will withstand much higher pressures, however, without damage. See Specifications in Table 6 below.
3. **CRANKCASE:** The Crankcase Pressure Sensor (switch) is very delicate and may be damaged by Pressures exceeding 5 PSI. Its normal trip point is 10 inches of water $\pm$ 20%.
4. **COOLANT:** The Coolant Pressure Sensor has a range of 0 to 30 PSI.
5. **OIL:** The Oil Pressure Sensor is very similar but has a range of 0 to 75 PSI.
6. **OIL AND COOLANT** Sensors may be easily checked in or out of the unit by applying a source of regulated air pressure and measuring the resistance with a volt-ohmmeter (VOM) such as a Simpson 260.
 - A. *The resistance should change smoothly with changing pressure. The sensor should be "tapped" to minimize frictional effects during measurement.*
 - B. *If the resistance change "sticks" or is erratic in any way, the Sensor should be replaced. A leaking or tightly clogged sensor may not give repeatable results. Use the table 5 below as a guide.*
5. **TURBO:** The Turbo Pressure Sensor (Switch) is normally open and closes at about 15 inches Hg. (approximately 7 PSI).

SENSOR RESISTANCE *Table 6*

<u>SENSOR</u>	<u>PRESSURE</u>	<u>RESISTANCE (Ohms)</u>	<u>HOW TO MEASURE</u>
TURBO	Below 6 PSI	Infinity	Between Terminals R X 1 Range
	Above 8 PSI	- 0 -	
COOLANT	0 PSI	6 - 12	Between Terminals R X 1 Range
	15 PSI	80 - 100	
	30 PSI	190 - 210	
OIL	0 PSI	6 - 12	Between Terminals R X 1 Range
	25 PSI	70 - 80	
	50 PSI	130 - 140	
CRANKCASE*	0 to 10 in. Water	Infinity - 0 -	Between Terminals R X 100 Range

***DO NOT exceed 5 PSI. DO NOT use R X 1 for this test.**

8. **REPLACING SENSORS:** When replacing sensors, make sure the new unit is installed in the correct position (Turbo, Oil or Coolant) in the enclosure.
 - A. *Tighten snugly, but do not over-tighten.*
 - B. *Teflon pipe compound should be used on the threads.*
 - C. *Make certain that the tubing on the crankcase pressure switch is not kinked or clogged, and that it is connected to the inlet marked "high" on the switch.*
 - D. *The push-on electrical connections are not polarized and it is immaterial if they are reversed.*
9. **INTERMITTENT CONNECTION:** If erratic operation is encountered and the suspect sensor checks okay, the problem could be a broken or intermittent connection within the unit's Internal an External wiring harness or a pressure line problem.
10. **LEDs FLASHING:** An open circuit in All but Auxiliary, Crankcase and Turbo channels will cause this.
11. **CLOGGED LINE:** A piece of rubber or other solid material may Clog a line acting like a check valve. Pressure will enter and charge the line but will not fall as the actual engine pressure does. This can result in excessively long delays in tripping or failure to trip. Make sure lines are clear. There is virtually no way to guard against this potential loss of protection other than periodic checks of the system.

12. JUMPER: Any of the four sensors may be temporarily JUMPED out (shorted) for troubleshooting purposes. A short on the oil or coolant sensors corresponds to zero pressure and will cause a fault.

14. CRANKCASE PRESSURE SWITCH: A jumper (short) corresponds to pressure above 10 inches of water and will cause a fault.

15. TURBO PRESSURE SWITCH: A short on the turbo pressure switch corresponds to pressure above 15 in. Hg. and will cause a fault.

CAUTION: WHEN REMOVING OR REPLACING WIRES ON THE PRESSURE SENSORS, DO NOT UNDER ANY CIRCUMSTANCES PRY OFF THE TERMINALS OR ALLOW TOOLS OR OTHER METAL OBJECTS TO FORM A CIRCUIT BETWEEN EITHER SENSOR TERMINAL AND THE SENSOR CASE. PERMANENT SENSOR DAMAGE MAY RESULT.

• TEMPERATURE SENSOR

GENERAL: The Temperature Sensor used with the Engine Saver is a Silicon Semiconductor device that has a Positive Temperature Coefficient. Its resistance is nominally 100 ohms at 25 degrees C, and increases with rising temperature. See graph 5.

1. OPEN SENSOR: This property makes the temperature sensing feature of the Engine Saver inherently fail-safe, since an Open Probe or Broken Wire will be interpreted as an over temperature condition, and will cause an alarm.

2. INTERMITTENT CONNECTION: If false tripping occurs, check probe resistance against the Graph 6 and check probe wiring for continuity.

3. SHIELDING: Extreme electrical noise or long wire runs may also cause false tripping. Under these conditions probe wires should be twisted or shielded. The shield should be connected to MAIN connector Pin J (Gnd.).

4. IF SENSOR NOT USED: In an installation where temperature sensing is not used, the temperature input must be satisfied with a jumper. This will increase the time delay for Enable, Coolant, and Oil from 75 to 90 seconds connected between Pins D and E of the MAIN (10-pin) connector.

• RPM SENSOR

GENERAL: Failure of the Reluctance Pickup, Tachometer Generator, Alternator "R" terminal output or the interconnecting cable will result in a loss of the RPM ENABLE and OVERSPEED function of the Engine Saver, except when the engine is in Turbo Boost range above 15 Hg.

When RPM is the only means of Enabling the Engine Saver, a failure of the RPM signal would result in a loss of engine protection.

1. OPEN OR INTERMITTENT: To guard against this possibility, the Fail-Safe circuit detects the open circuit, activates the Alarm immediately and de-energizes the Output Relay after the Shutdown Time Delay elapses. The OVERSPEED indicator remains flashing to show that an open circuit exists in the RPM sensor or wiring. **NOTE: THERE IS NO RPM FAIL-SAFE WHEN "R TERMINAL" IS USED.**

2. RELUCTANCE PICKUPS: Part numbers listed below may be checked with the following procedure:

57-A995-01 RPM SENSOR ASSY 5/8" - 18 / 2" Length/WPC*

57-A995-03 RPM SENSOR ASSY 5/8" - 18 / 3" Length/WPC

57-A995-04 RPM SENSOR ASSY 3/4" - 16 / 3" 1/2 Length/WPC

57-A995-05 RPM SENSOR ASSY 5/8" - 18 / 1" Length/MC**

57-A995-06 RPM SENSOR ASSY 5/8" - 18 / 4" Length/WPC

57-A995-07 RPM SENSOR ASSY 3/4" - 16 / 4" Length/WPC

57-CU66-22 RPM SENSOR ASSY 3/4" - 16 / 4" Length/MC

57-CU66-75 RPM SENSOR ASSY 5/8" - 18 / 4" Length/MC

* WPC = Weather Proof Connector

** MC = Military Connector

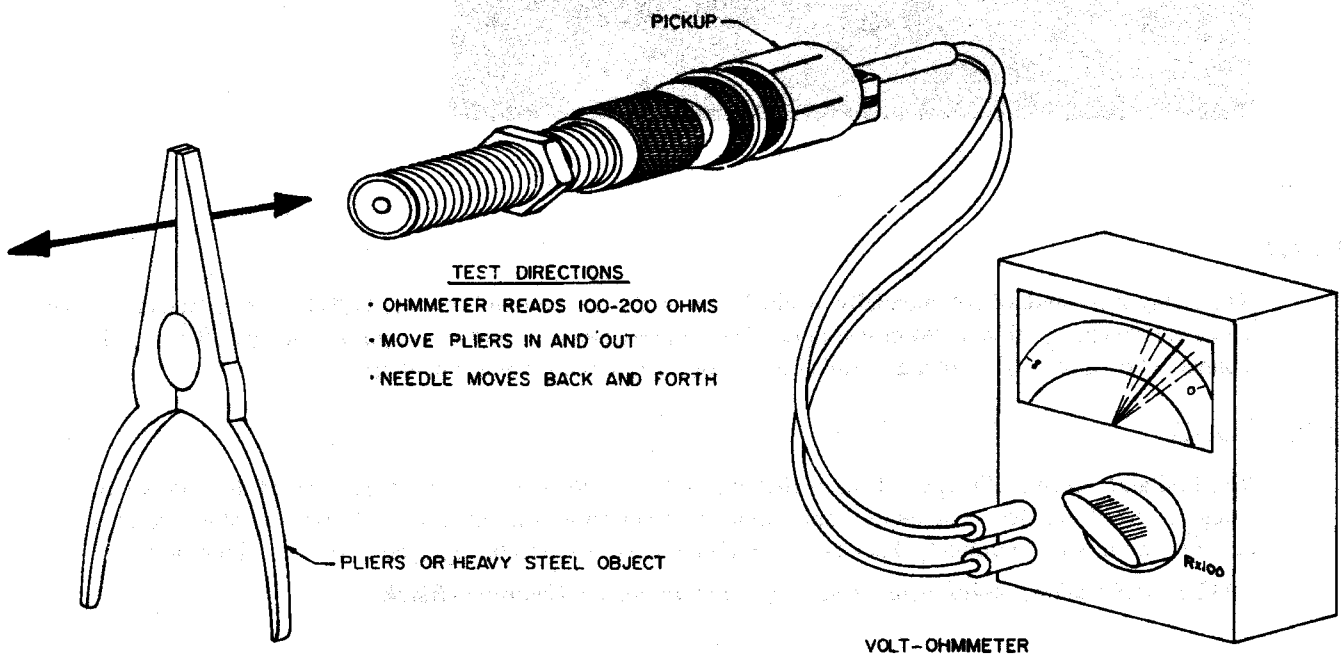
4. RESISTANCE CHECK: Disconnect the cable from the pickup and measure its resistance with a VOM (such as a Simpson 260) set to "R x 1". The above Pickups should measure from 100 to 200 ohms. This reading can vary from 100 ohms to several thousand ohms, for other Pickups. It would be helpful to compare this reading with an identical known good Pickup, if possible. If the reading is near Zero or Infinity, the Pickup is likely defective.

5. VOLTAGE TEST: The output may be checked with a VOM at cranking speeds. If the Pickup is okay, the Gap is set properly it will produce approximately 0.5 volts AC (RMS) as measured on the lowest AC volts range of a VOM (such as a Simpson 260). If the needle barely moves when the engine is turned over, the Gap may be too wide.

6. OHMMETER TEST: If still in doubt, remove the pickup from the engine and place a steel object (at least .125 in. or 3-4 mm. in thickness) across the face of the pickup. Move the steel piece in and out and note that the VOM needle moves either side of its resistance reading. (A pair of diagonal cutters or side-cutting pliers works well for this test.) If this response cannot be obtained, the pickup is likely defective.

RELUCTANCE PICKUP TEST

Figure 19



7. TACHOMETER GENERATORS: The Tachometer generators 57-SGEN-FT and 57-SGEN-NF may be tested with a VOM. A resistance reading of 250-300 ohms should be obtained on the RX100 scale. Turning the shaft slowly should cause the needle to flutter. When the engine is running, an AC voltage of 1-30 volts is generated, depending on RPM.

• ELECTRONIC MODULE

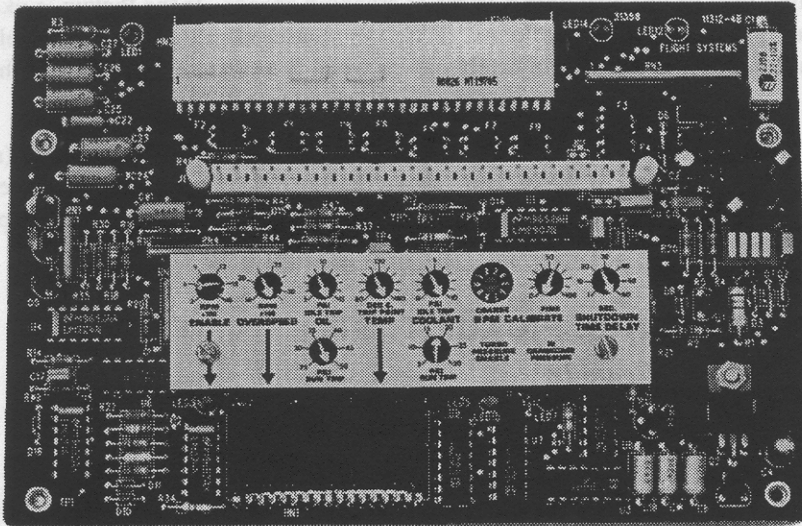
1. REPLACING: The electronic module is replaced as a unit since the necessary equipment and parts make field repair impractical.

2. ENCAPSULATED: Also, the module is encapsulated in a clear jelly-like silicone compound for environmental protection, which may be difficult to replace.

3. MOUNTING: The module is held in place by means of four screws in the corners of the nameplate.

4. ELECTRICAL CONNECTIONS are made by means of a single 24-pin connector. This connector has a protective cover that slides off to expose the numbered test points.

5. TEST VOLTAGES: Table 6 (on Page 28) gives the voltages appearing at each test point (Figure 21) under the conditions specified. These readings are useful in isolating a faulty electronic module or a fault elsewhere in the system. A module that does not give the correct voltages, or fails to respond to correct input signals may be presumed to be defective. A defective module is repairable and should not be discarded.



**ELECTRONIC MODULE
P/N 57-5500-49B**

Figure 20

• RELAY

The Relay is a standard commercially available unit with a 24 volt DC coil and DPDT silver contacts. It may be easily checked with a VOM or test light. The coil resistance (A and B) is approximately 500 ohms. It is connected by means of a polarized eight conductor plug, making replacement easy.

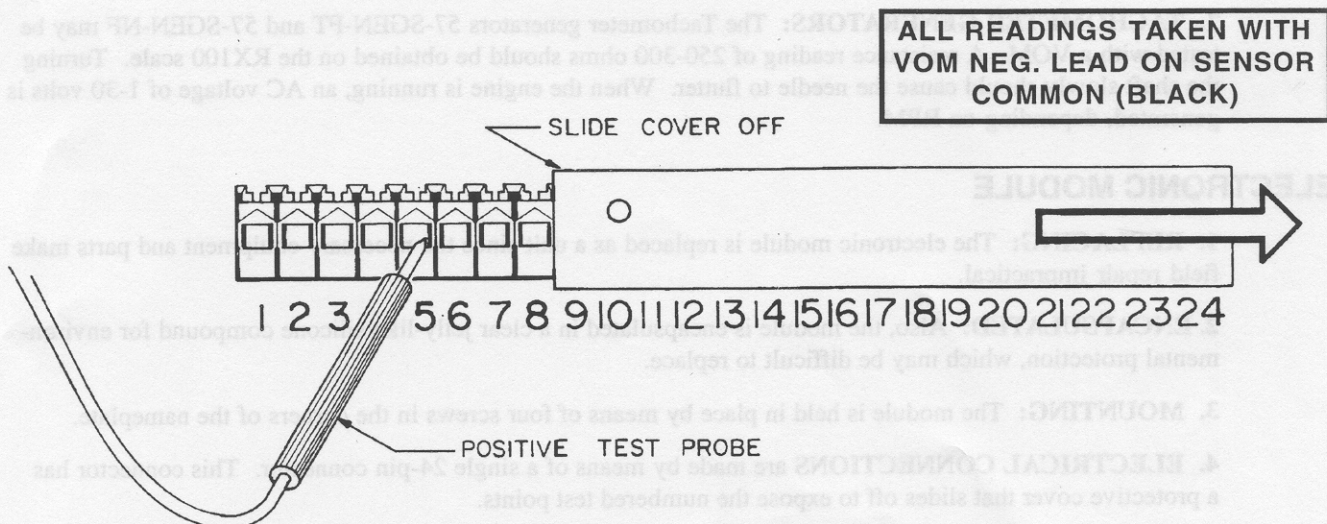
• INDICATORS

The Red and Green LED type indicators that appear behind the plastic lens on the front of the unit are an integral part of the electronic module and cannot be replaced as separate items. These indicators are very reliable and it is quite unlikely that any of them would ever have to be replaced in the life of the unit.

NOTE: All readings taken with VOM Neg. Lead on Sensor Common (Black)

ELECTRONIC MODULE TEST POINTS

Figure 21



ELECTRONIC MODULE TEST POINT VOLTAGES

Table 7

24 Pin Connector	Wire Color	Main Connector	Accessory Connector	Function	Voltages/Condition
1	Brown	--	--	Turbo Pressure Sensor	1. 0V at 5.5 PSI or below
2	Red	--	--	Oil Pressure Sensor	1. .04V at 0 PSI 2. .54V at 50 PSI 3. 6.0V with Sensor Wire Off
3	Orange	--	--	Coolant Pressure Sensor	1. .04V at 0 PSI 2. .76V at 30 PSI 3. 6.0V with Sensor Wire Off
4	Yellow	--	H	Coolant Pressure Analog Output	1. .1 at 0 PSI 2. 5.0V at 30 PSI
5	Green	--	J	Alarm Output	1. Always 0V with No Connection 2. 24V 9570 Connected - No Alarm 3. On 9570 Connected - Steady Alarm
6	Blue	--	K	Oil Pressure Analog Output	1. .25V at 0 PSI 2. 5.0V at 60 PSI
7	Violet	--	L	Temperature Output	1. 0V at 50 C Simulated 2. 2.8V at 120 C Simulated 3. 5.0V at 180 C Simulated
8	Gray	--	M	RPM Analog Output	1. 0V at 0 RPM 2. 5.0V at 3000 RPM (RPM Cal.)
9	White	--	N	System Enable Event Output	1. 15 V - Not Tripped 2. 0V - Tripped
10	Black	--	A	Overspeed Event Output	1. 15 V - Not Tripped 2. 0V - Tripped
11	Brown	--	P	Hi Crankcase Pressure Event Output	1. 15V - Not Tripped 2. 0V - Tripped
12	Red	--	R	Lo Coolant Pressure event Output	1. 15V - Not Tripped 2. 0V - Tripped
13	Orange	--	E	Lo Oil Pressure Output	1. 15V - Not Tripped 2. 0V - Tripped
14	Yellow	--	F	Auxiliary Fault Event Output	1. 15V - Not Tripped 2. 0V - Tripped
15	Green	--	G	High Temperature Event Output	1. 15V - Not Tripped 2. 0V - Tripped
16	Blue	D	--	Temperature Sensor	1. 0.5V - 50 C Simulated 2. 1.0V - 180 C Simulated
17	Violet	E	--	Temp. Sensor Return	1. 0V at ALL TIMES
18	Gray	F	--	Auxiliary Trip Input	1. 0V - No Aux. Fault 2. 24V - Aux. Fault Simulated
19	White	G	--	RPM Sensor	1. *.03VAC-Simulated MAG. Pickup, 2. Higher with Actual Mag. Pickup 3. *.7VDC-Simulated Alt. Pickup, Higher with Actual Alternator.
20	Black	H	--	RPM Sensor Return	1. 0V at ALL TIMES
21	Brown	I	D	Positive 24V Supply	1. 24V at ALL TIMES
22	Red	J	C	Common Negative	1. 0V at ALL TIMES (Negative Ref.)
23	Orange	--	--	Crankcase Pressure Switch	1. 15V - C.C. Pressure Below 8 in. W.C. 2. 0V - C.C. Pressure Below 12 in. W.C.
24	Yellow	--	--	Relay Return	1. 0V - Relay Energized 2. 24V - Relay De-Energized

- Measured with SIMPSON 260 VOM, or equal. DMM's MAY NOT give same readings.

WARRANTY INFORMATION

The MODEL 550 ENGINE SAVER® is warranted to be free from defects in materials and workmanship for a period of two years from the date of shipment, or the date it is first put into service, if the latter is documented by completing and returning a copy of the APPLICATION CHECKLIST (on Page 23) within 10 days of installation.

FLIGHT SYSTEMS' liability is limited to the repair or replacement of defective product within the warranty period, and does not cover installation or removal costs incurred or possible damage to other equipment (including engines or parts thereof) as a result of a malfunction of the ENGINE SAVER.

If, in the opinion of FLIGHT SYSTEMS (or its authorized agent) the malfunction of the ENGINE SAVER was caused by abuse, misuse or improper installation, the warranty claim will be disallowed and established repair rates shall apply.

Units should be shipped, freight charges prepaid, directly to FLIGHT SYSTEMS, 505 Fishing Creek Rd, Lewisberry, PA 17339, USA, or any of the authorized agents listed in this publication.

SPARE PARTS ORDERING INFORMATION

RENEWAL PARTS LIST

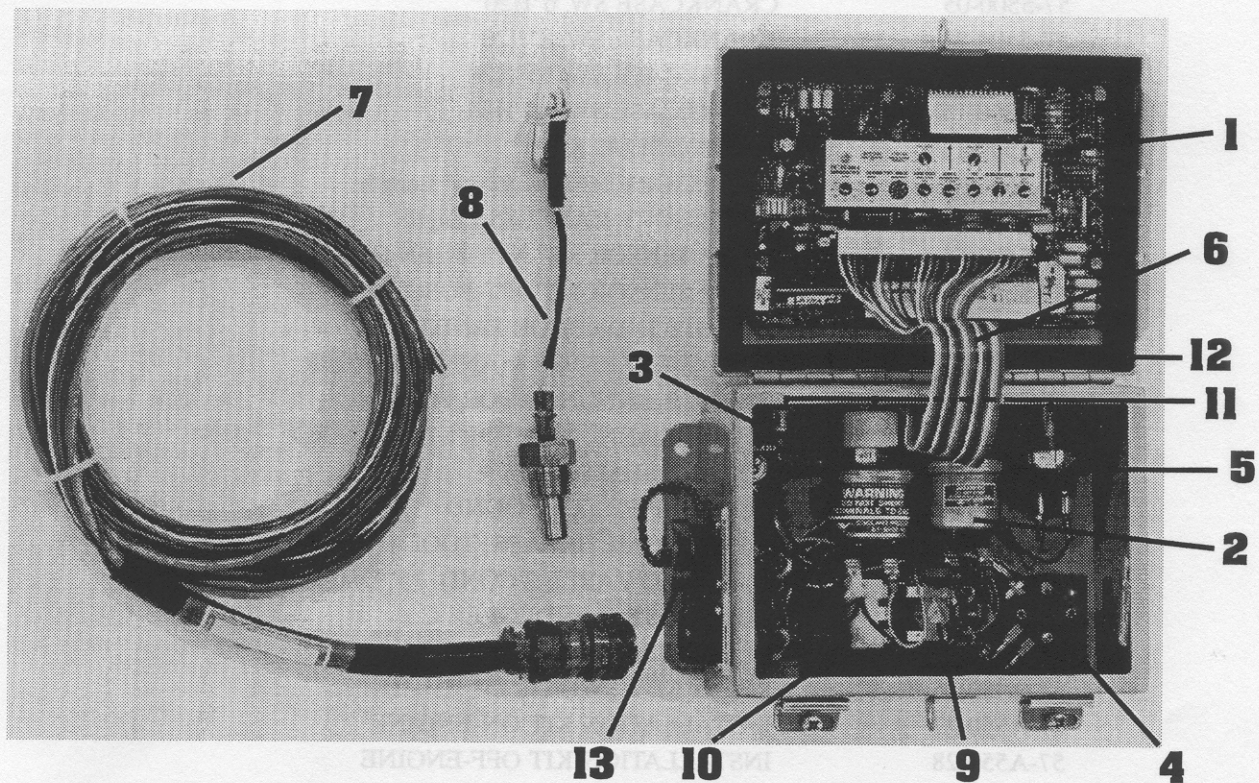
ITEM NO.	DESCRIPTION	RENEWAL PART NO.
*1	ELECTRONIC MODULE	57-5500-49B
*2	TRANSDUCER, OIL PRESSURE	57-5500-12
*3	TRANSDUCER, COOLANT PRESSURE	57-5500-45
*4	SWITCH, CRANKCASE PRESSURE W/TUBING	57-5500-38
*5	SWITCH, TURBO BOOST ENABLE	57-5500-53
6	INTERNAL WIRING HARNESS W/SWITCH	57-5500-67
7	EXTERNAL MAIN WIRING HARNESS - 12'	57-5500-24
8	TEMPERATURE SENSOR	57-5500-65
*9	RELAY (24v)	57-5500-02
10	RELAY MOUNTING BRACKET	57-5500-56
11	BULKHEAD ADAPTERS (4 per unit)	57-5500-10
12	GASKET (INSIDE COVER)	57-5500-25
13	ACCESSORY CONNECTOR CAP W/CHAIN	57-5500-54
14^	FACEPLATE	57-5500-48
15^	PRESSURE INLET LABEL	57-5500-50
16^	INSTALLATION/OPERATIONS MANUAL	57-A550-26

* THESE ITEMS ARE RECOMMENDED AS INVENTORY SPARES.

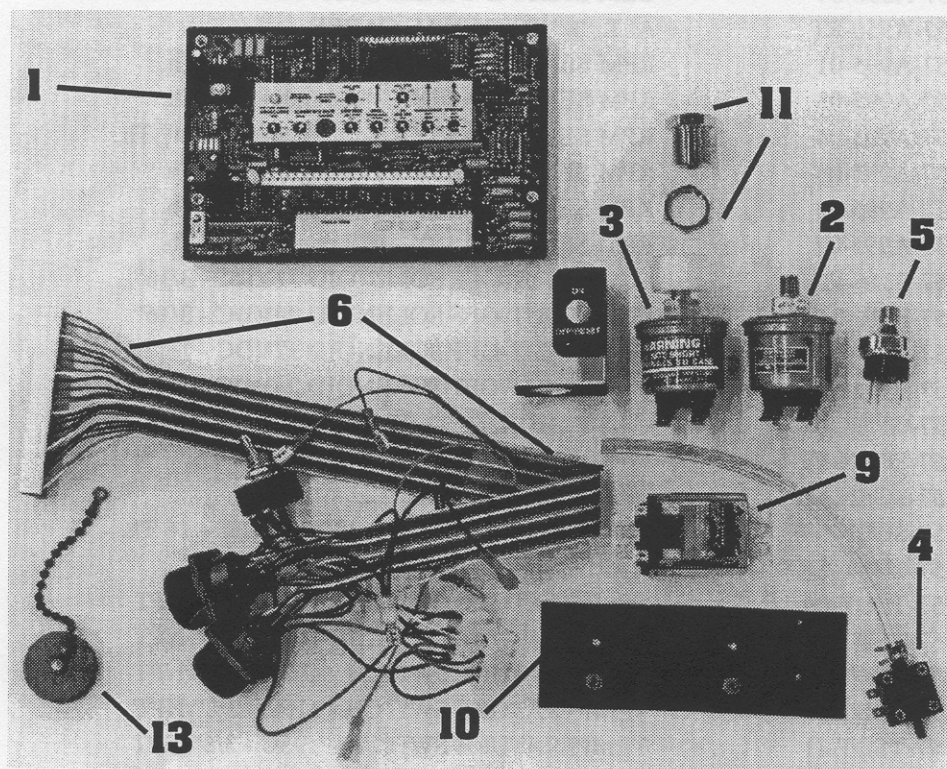
^ THESE ITEMS NOT SHOWN IN ILLUSTRATIONS ON NEXT PAGE.

• SEE NEXT PAGE FOR ILLUSTRATION OF PARTS & PART LOCATIONS

ENGINE SAVER® MODEL 550 LEVEL 7 REPLACEMENT PARTS LOCATIONS



ENGINE SAVER® MODEL 550 LEVEL 7 INDIVIDUAL PARTS - VISUAL IDENTIFICATION



OPTIONAL PARTS LIST

<u>PART NO.</u>	<u>DESCRIPTION</u>
57-5500-05	CRANKCASE SW. 6"H2O
57-5500-23	CRANKCASE SW. 8"H2O
57-5500-33	CRANKCASE SW. 15"H2O
57-5500-15	CRANKCASE SW. 40"H2O
57-5500-14	MATING PLUG KIT
57-5500-52	ACCESSORY HARNESS 15' Length
57-5500-66	ACCESSORY HARNESS Length
57-5500-55	TEMP. SENSOR 3/8" NPT-PUSH ON TAB
57-5500-59	TEMP. SENSOR 1/2"NPT-PUSH ON TAB
57-5500-57	REMOTE INDICATOR PANEL KIT
57-5500-60	CUSTOM HARNESS & ANNUNCIATOR
57-5500-61	REMOTE ANNUNCIATOR PORT
57-5500-62	REMOTE ANNUNCIATOR STARBOARD
57-A550-02	TORQUE SEAL
57-A550-03	TEFLON PIPE COMPOUND
57-A550-04	POTENTIOMETER ADJ. TOOL
57-A550-10	SHIELDED CABLE 2 COND. 15' Length
57-A550-11	THERMOSTAT 95 DEGREE C
57-A550-12	RPM SENSOR ASSY - 4" Length
57-A550-15	RESET KEY SWITCH
57-A550-27	INSTALLATION KIT ON-ENGINE
57-A550-28	INSTALLATION KIT OFF-ENGINE
57-A550-29	FUEL VALVE CONTROL MODULE
57-A550-30	REMOTE STATUS ALARM UNIT
57-A550-31	20' Light REMOTE UNIT HARNESS
57-A550-34	OEM BASIC INSTALLATION KIT
57-A550-RT	ALT. "R" TERMINAL CABLE
57-A995-01	RPM SENSOR ASSY - 2" Length - 5/8" Th.
57-A995-03	RPM SENSOR ASSY - 3" Length - 5/8" Th.
57-A995-04	RPM SENSOR ASSY - 3-1/2" Length - 3/4" Th.
57-A995-05	RPM SENSOR ASSY - 1" Length - 5/8" Th.
57-A995-06	RPM SENSOR ASSY - 4" Length - 5/8" Th.
57-A995-07	RPM SENSOR ASSY - 4" Length - 3/4" Th.
57-F316-12	FUEL SHUT-OFF SOLENOID 12VDC - 3/16"
57-F316-24	FUEL SHUT-OFF SOLENOID 24VDC - 3/16"
57-FS14-12	FUEL SHUT-OFF SOLENOID 12VDC - 1/4"
57-FS14-24	FUEL SHUT-OFF SOLENOID 24VDC - 1/4"
57-GPTK-01	GAS PRESSURE TEST KIT - 0 TO 35" H2O
57-SGEN-FT	MINI-GEN - FEED THRU - 7/8" - 18 Th.
57-SGEN-MF	MINI-GEN - METRIC - 22 - 1.5 mm
57-SGEN-NF	MINI-GEN - NON FEED THRU - 7/8" - 16 Th.
57-TEST-EX	HARNESS EXTENDER
57-TSDT-06	TEMPERATURE SWITCH - 115C - 1/2" NPT
57-TSDT-08	TEMPERATURE SWITCH - 100C - 3/8" NPT
57-TSDT-09	TEMPERATURE SWITCH - 105C - 3/8" NPT
57-TSDT-10	TEMPERATURE SWITCH - 110C - 3/8" NPT
57-TSDT-11	TEMPERATURE SWITCH - 95C - 3/8" NPT
57-TSDT-16	TEMPERATURE SWITCH - 150C - 1/2" NPT
57-VC12-24	VOLTAGE CONVERTER 12-24 VOLT

REPAIR SERVICE

The Engine Saver is fully rebuildable through any Flight Systems Manufacturing and Service Facility listed below. We also offer free applications assistance through Manufacturing and Service Facilities, as well as Agents and Distributors.

SALES AND SERVICE LOCATIONS

NORTH AMERICA

FLIGHT SYSTEMS, INC. *MANUFACTURING, ENGINEERING, TECH SUPPORT AND SPARES*
505 FISHING CREEK ROAD
LEWISBERRY, PA 17339

PHONE: 800-403-3728 / 717-932-9900
FAX: 800-333-9912 / 717-932-9925
www.flightsystems.com

SALES - BARRY ICKES
ENGINEERING - DOUGLAS MICKEY
TECH SUPPORT - ROSS HEUSTESS

ON-SITE INSTALLATION SERVICE

NORTHEASTERN USA

CAMPBELL MARINE SYSTEMS
1018 DOCKSER DRIVE
CROWNSVILLE, MD 21032

PHONE/FAX: (410) 987-8064

KEY CONTACT: DOUG CAMPBELL

SOUTHEASTERN USA

MARINE PROPULSION, INC.
P.O. BOX 1232
JOHN'S ISLAND, SC 29457

PHONE: (803) 559-1025
FAX: (803) 559-0095

KEY CONTACT: ANTHONY BLACK

SOUTHWESTERN USA

CUMMINS SOUTHWEST
2239 N. BLACK CANYON HWY
P.O. BOX 6688
PHOENIX, AZ 85009

PHONE: (602) 252-8021
FAX: (602) 253-6725

KEY CONTACT: STEVE RYBERG

CUMMINS INTERMOUNTAIN
5370 EAST IDAHO STREET
ELKO, NV 89801

PHONE: (702) 738-6405

KEY CONTACT: TOM BLAND

NORTHWESTERN USA

CUMMINS NORTHWEST INC.
926 N.W. MARYLAND STREET
CHEHALIS, WA 98532

PHONE: (360) 748-8841
FAX: (360) 748 7015

KEY CONTACT: MIKE DEATON

• SEE FOLLOWING PAGE FOR CANADA & INTERNATIONAL LOCATIONS

WESTERN CANADA

CUMMINS BRITISH COLUMBIA
18452 96TH AVENUE
SURREY, BRITISH COLUMBIA
V3T 4W2, CANADA

PHONE: (604) 882-5000
FAX: (604) 882-5080

KEY CONTACT: BILL LAPP

EASTERN CANADA

CUMMINS EASTERN CANADA
7200 TRANS CANADA HWY
PT. CLAIRE, QUEBEC
H9R 1C2 CANADA

PHONE: (514) 695-8410
FAX: (514) 695-9012

KEY CONTACT: LUCIEN FREDETTE

CENTRAL CANADA

CUMMINS ALBERTA
14755 - 121A AVENUE
EDMONTON, ALTA T5L 2T2
CANADA T5L 2T2

PHONE: (403) 455-2151
FAX: (403) 454-9512

KEY CONTACT: ERIC TEMPLETON

INTERNATIONAL

SOUTH AMERICA

SERVICIOS FORESTALES Y AUTOMOTRICES (SERVIFAR) - SALES, INSTALLATION, SPARES
CASILLA (P O BOX) 1059
CORREO 22
SANTIAGO,
CHILE

PHONE: (01156) 221 66221
FAX: (01156) 252 83243
KEY CONTACT: MARCELO MOUKARZEL

EUROPE, INDIA AND ASIA

FLIGHT SYSTEMS/EUROPE - SALES, INSTALLATION, REPAIR SERVICE, SPARES, TECH SUPPORT
UNIT 8 WOODLANDS YARD
HIGH STREET MARKET
LAVINGTON, WILTSHIRE SN10 4AF
ENGLAND

PHONE: (01144) 138 081 2952
FAX: (01144) 138 081 3090
KEY CONTACT: ANTHONY WELLER

CENTRAL AFRICA

BUREAU TECHNIQUE BIA S.A. - SALES, ON-SITE INSTALLATION, SPARES
RAMEISTRAAT 123
B-1900 OVERLIJSE
BELGIUM

PHONE: (01132) 2 6892811
FAX: (01132) 2 6892829
KEY CONTACT: ANDRE DUMOULIN

SOUTHERN AFRICA

FLIGHT SYSTEMS MINTECH - MFG., INSTALLATION, REPAIR SERVICE, SPARES, TECH SUPPORT
P.O. BOX 52708
SAXONWOLD 2132,
TRANVAAL
REPUBLIC OF SOUTH AFRICA

PHONE: (01127) 11 452 1452
FAX: (01127) 11 452 1466
KEY CONTACT: BRIAN STOWELL

AUSTRALIA

NORMAN G. CLARK (A/ASIA) PTY. LTD - SALES, ON-SITE INSTALLATION, SPARES
P.O. BOX 281
WEST HEIDELBERG,
VICTORIA 3081 AUSTRALIA

PHONE: (01161) 3 9457 5833
FAX: (01161) 3 9457 5781
KEY CONTACT: ROB CLARK,