QUIETPACT® 75D

DIAGNOSTIC REPAIR MANUAL

RECREATIONAL VEHICLE GENERATOR

MODEL 4270

GUARDIAN® RV
by Generac Power Systems, Inc.

SAFETY

Throughout this publication, "DANGER!" and "CAUTION!" blocks are used to alert the mechanic for special instructions concerning a particular service or operation that might be hazardous if performed incorrectly or carelessly. PAY CLOSE ATTENTION TO THEM.

DANGER! UNDER THIS HEADING WILL BE FOUND SPECIAL INSTRUCTIONS WHICH, IF NOT COMPLIED WITH, COULD RESULT IN PERSONAL INJURY OR DEATH.

CAUTION! Under this heading will be found special instructions which, if not complied with, could result in damage to equipment and/or property.

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance with these special Instructions plus "common sense" are major accident prevention measures.

NOTICE TO USERS OF THIS MANUAL

This SERVICE MANUAL has been written and published by Generac to aid our dealers, mechanics, and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures for these products, or similar products manufactured and marketed by Generac; that they have been trained in the recommended servicing procedures for these products, including the use of common hand tools, special Generac tools, or tools from other suppliers.

Generac could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. Generac has not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or tool not recommended by Generac, must ensure that neither personal safety nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.

When working on these products, remember that the electrical system and engine ignition system are capable of violent and damaging short circuits or severe electrical shocks. If work must be done where electrical terminals could be grounded or touched, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings of the engine are exposed during service, they should be covered to prevent accidental entry of foreign material. Entry of such materials will result in extensive damage when the engine is started.

During any maintenance procedure, replacement fasteners must have the same measurements and strength as the fasteners that were removed. Metric bolts and nuts have numbers that indicate their strength. Customary bolts use radial lines to indicate strength, while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can cause damage, malfunction and possible injury.

REPLACEMENT PARTS

Components on Generac recreational vehicle generators are designed and manufactured to comply with Recreational Vehicle Industry Association (RVIA) Rules and Regulations to minimize the risk of fire or explosion. The use of replacement parts that are not in compliance with such Rules and Regulations could result in a fire or explosion hazard. When servicing this equipment, It is extremely important that all components be properly installed and tightened. If parts are improperly installed or tightened, sparks could ignite fuel vapors from fuel system leaks.

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MAGNETISM

Magnetism can be used to produce electricity and electricity can be used to produce magnetism.

Much about magnetism cannot be explained by our present knowledge. However, there are certain patterns of behavior that are known. Application of these behavior patterns has led to the development of generators, motors and numerous other devices that utilize magnetism to produce and use electrical energy.

See Figure 1-1. The space surrounding a magnet is permeated by magnetic lines of force called “flux”. These lines of force are concentrated at the magnet's north and south poles. They are directed away from the magnet at its north pole, travel in a loop and re-enter the magnet at its south pole. The lines of force form definite patterns which vary in intensity depending on the strength of the magnet. The lines of force never cross one another. The area surrounding a magnet in which its lines of force are effective is called a “magnetic field”.

Like poles of a magnet repel each other, while unlike poles attract each other.

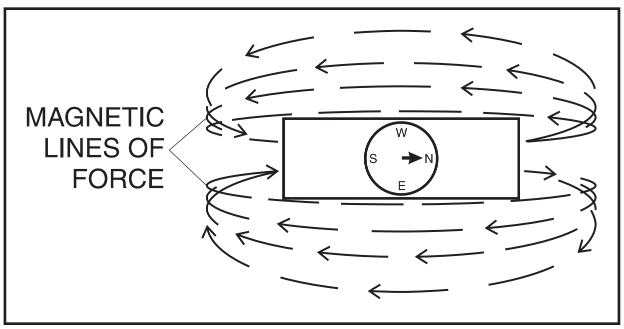


Figure 1-1. – Magnetic Lines of Force

ELECTROMAGNETIC FIELDS

All conductors through which an electric current is flowing have a magnetic field surrounding them. This field is always at right angles to the conductor. If a compass is placed near the conductor, the compass needle will move to a right angle with the conductor. The following rules apply:

- The greater the current flow through the conductor, the stronger the magnetic field around the conductor.
- The increase in the number of lines of force is directly proportional to the increase in current flow and the field is distributed along the full length of the conductor.
- The direction of the lines of force around a conductor can be determined by what is called the “right hand rule”. To apply this rule, place your right hand around the conductor with the thumb pointing in the direction of current flow. The fingers will then be pointing in the direction of the lines of force.

NOTE: The “right hand rule” is based on the “current flow” theory which assumes that current flows from positive to negative. This is opposite the “electron” theory, which states that current flows from negative to positive.

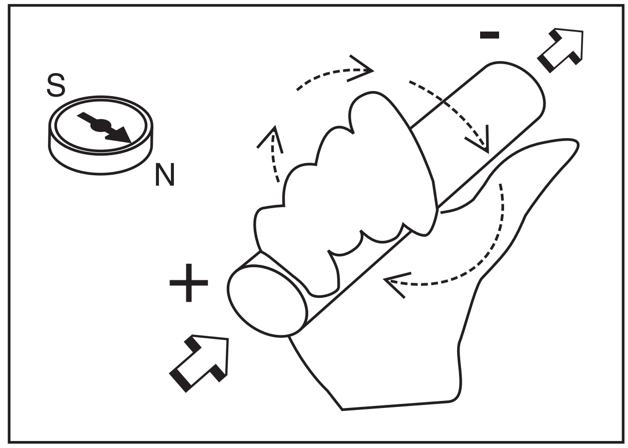


Figure 1-2. – The Right Hand Rule

ELECTROMAGNETIC INDUCTION

An electromotive force (EMF) or voltage can be produced in a conductor by moving the conductor so that it cuts across the lines of force of a magnetic field.

Similarly, if the magnetic lines of force are moved so that they cut across a conductor, an EMF (voltage) will be produced in the conductor. This is the basic principal of the revolving field generator.

Figure 1-3, below, illustrates a simple revolving field generator. The permanent magnet (Rotor) is rotated so that its lines of magnetic force cut across a coil of wires called a Stator. A voltage is then induced into the Stator windings. If the Stator circuit is completed by connecting a load (such as a light bulb), current will flow in the circuit and the bulb will illuminate.

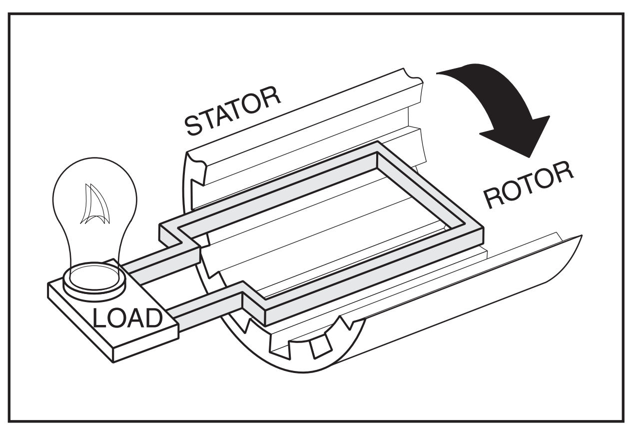


Figure 1-3. – A Simple Revolving Field Generator

A SIMPLE AC GENERATOR

Figure 1-4 shows a very simple AC Generator. The generator consists of a rotating magnetic field called a ROTOR and a stationary coil of wire called a STATOR. The ROTOR is a permanent magnet which consists of a SOUTH magnetic pole and a NORTH magnetic pole.

As the MOTOR turns, its magnetic field cuts across the stationary STATOR. A voltage is induced into the STATOR windings. When the magnet's NORTH pole passes the STATOR, current flows in one direction. Current flows in the opposite direction when the magnet's SOUTH pole passes the STATOR. This constant reversal of current flow results in an alternating current (AC) waveform that can be diagrammed as shown in Figure 1-5.

The ROTOR may be a 2-pole type having a single NORTH and a single SOUTH magnetic pole. Some ROTORS are 4-pole type with two SOUTH and two NORTH magnetic poles. The following apply:

1. The 2-pole ROTOR must be turned at 3600 rpm to produce an AC frequency of 60-Hertz, or at 3000 rpm to deliver an AC frequency of 50-Hertz.
2. The 4-pole ROTOR must operate at 1800 rpm to deliver a 60-Hertz AC frequency or at 1500 rpm to deliver a 50-Hertz AC frequency.

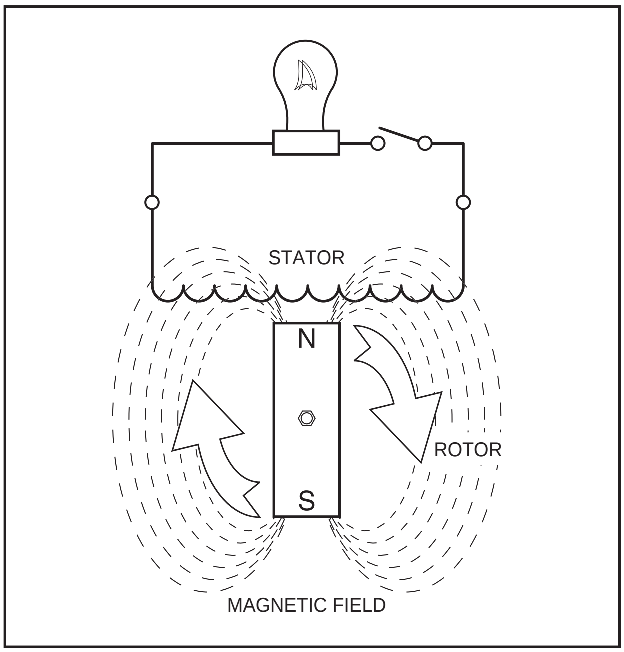


Figure 1-4. – A Simple AC Generator

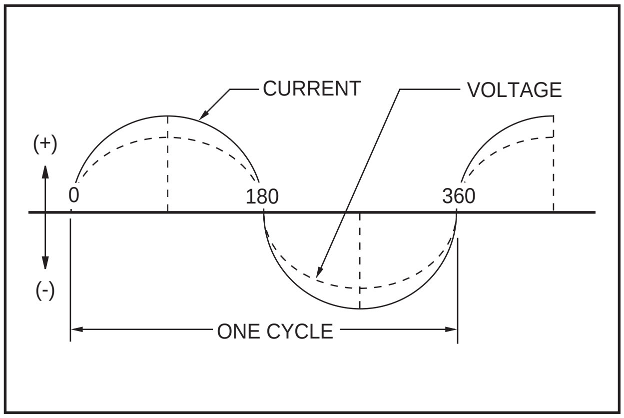


Figure 1-5. – Alternating Current Sine Wave

A MORE SOPHISTICATED AC GENERATOR

Figure 1-6 represents a more sophisticated generator. A regulated direct current is delivered into the ROTOR windings via carbon BRUSHES AND SLIP RINGS. This results in the creation of a regulated magnetic field around the ROTOR. As a result, a regulated voltage is induced into the STATOR. Regulated current delivered to the ROTOR is called “EXCITATION” current.

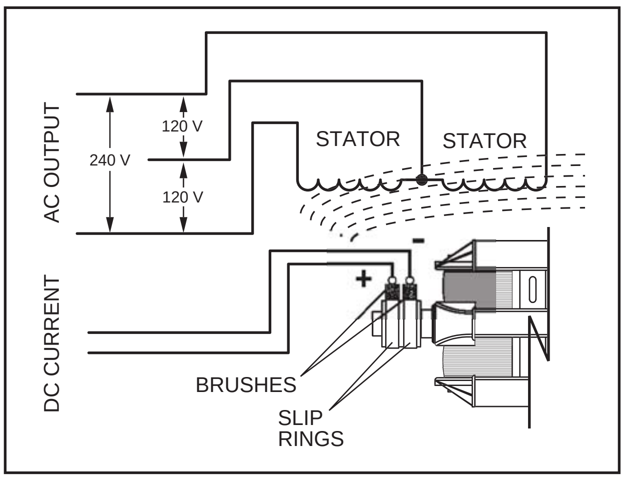


Figure 1-6. – A More Sophisticated Generator

See Figure 1-7 (next page). The revolving magnetic field (ROTOR) is driven by the engine at a constant speed. This constant speed is maintained by a mechanical engine governor. Units with a 2-pole rotor require an operating speed of 3600 rpm to deliver a 60-Hertz AC output. Engine governors are set to maintain approximately 3720 rpm when no electrical loads are connected to the generator.

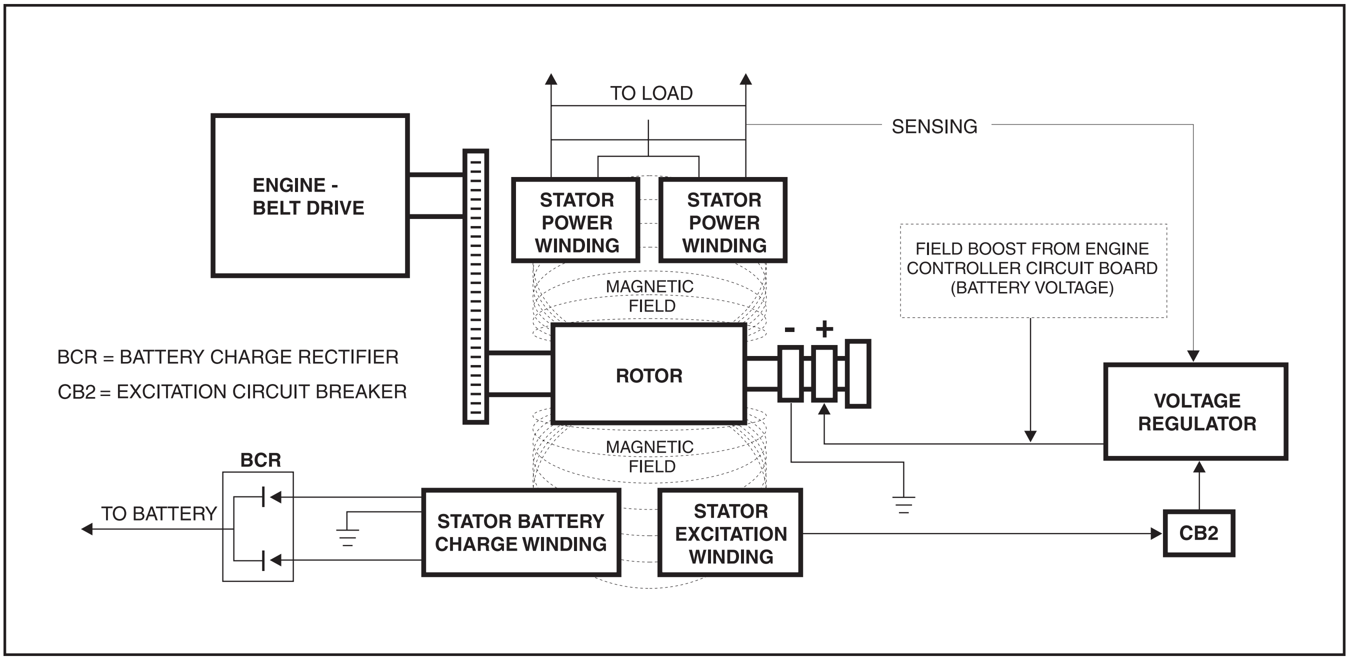


Figure 1-7. – Generator Operating Diagram

NOTE: AC output frequency at 3720 rpm will be about 62-Hertz. The "No-Load" is set slightly high to prevent excessive rpm, frequency and voltage droop under heavy electrical loading.

Generator operation may be described briefly as follows:

1. Some "residual" magnetism is normally present in the rotor and is sufficient to induce approximately 7 to 12 VAC Into the stator's AC power windings.
2. During startup, an engine controller circuit board delivers battery voltage to the rotor, via the brushes and slip rings.
   a. The battery voltage is called "Field Boost".
   b. Flow of direct current through the ROTOR increases the strength of the magnetic field above that of "residual" magnetism alone.
3. "Residual" plus "Field Boost" magnetism induces a voltage into the Stator excitation (DPE), battery charge and AC Power windings.
4. Excitation winding unregulated AC output is delivered to an electronic voltage regulator, via an excitation circuit breaker.
   a. A "Reference" voltage has been pre-set into the Voltage Regulator.
   b. An "Actual" ("sensing") voltage is delivered to the Voltage Regulator via sensing leads from the Stator AC power windings.
   c. The Regulator "compares" the actual (sensing) voltage to its pre-set reference voltage.
      (1) If the actual (sensing) voltage is greater than the pre-set reference voltage, the Regulator will decrease the regulated current flow to the Rotor.
      (2) If the actual (sensing) voltage is less than the pre-set reference voltage, the Regulator will increase the regulated current flow to the Rotor.
      (3) In the manner described, the Regulator maintains an actual (sensing) voltage that is equal to the pre-set reference voltage.

NOTE: The Voltage Regulator also changes the Stator excitation windings alternating current (AC) output to direct current (DC).

5. When an electrical load is connected across the Stator power windings, the circuit is completed and an electrical current will flow.
6. The Rotor's magnetic field also induces a voltage Into the Stator battery charge windings.
   a. Battery charge winding AC output is delivered to a battery charge rectifier (BCR) which changes the AC to direct current (DC).
   b. The rectified DC is then delivered to the unit battery, to maintain the battery in a charged state.
   c. A one ohm, 25 watt Resistor is installed in series with the grounded side of the battery charge circuit.

FIELD BOOST

When the engine is cranked during startup, the engine control circuit board Terminals 9, 10, and 11 (Wire 14) are energized with 12 VDC. Connected to a Wire 14 is a resistor (R2) and a diode (D2). Battery current flows through the 20 ohm 12-watt resistor and the field boost diode D2, the voltage is reduced to 3-5 VDC. After passing through R2 and D2 it becomes Wire 4 and current travels to the Rotor via brushes and slip rings. This is called “Field Boost” current.

The effect is to “flash the field” every time the engine is cranked. Field boost current helps ensure that sufficient “pickup” voltage is available on every startup to turn the Voltage Regulator on and build AC output voltage.

NOTE: Loss of the Field Boost function may or may not result in loss of AC power winding output. If Rotor residual magnetism alone is sufficient to turn the Regulator on, loss of Field Boost may go unnoticed. However, if residual magnetism alone is not enough to turn the Regulator on, loss of the Field Boost function will result in loss of AC power winding output to the load. The AC output voltage will then drop to a value commensurate with the Rotor's residual magnetism (about 7-12 VAC).

GENERATOR AC CONNECTION SYSTEM

The generator set is equipped with dual stator AC power windings. These two stator windings supply electrical power to customer electrical loads by means of a dual two-wire connection system.

Generators may be installed to provide the following outputs:

1. 120/240 VAC loads — one load with a maximum total wattage requirement equal to the generator’s rated power output, and 240 VAC across the generator output terminals; or two separate loads, each with a maximum total wattage requirement equal to half of the generator’s rated power output (in watts), and 120VAC across the generator output terminals. Figure 1.9 shows the generator lead wire connections for 120/240 VAC loads.

2. 120 VAC loads only — one load with a maximum total wattage requirement equal to the generator’s rated power output (in watts), and 120V across the generator output terminals. Figure 1.8 shows the generator lead wire connections for 120VAC ONLY.

The generator set can be used to supply electrical power for operating one of the following electrical loads:

- QUIETPACT 75D: 120 and/or 240 VAC, single phase, 60-Hertz electrical loads. These loads can require up to 7500 watts (7.5 kW) of total power, but cannot exceed 62.5 AC amperes of current at 120 VAC or exceed 31.2 AC amperes at 240 VAC.

CAUTION! Do not overload the generator. Some installations may require that electrical loads be alternated to avoid overloading. Applying excessively high electrical loads may damage the generator and may shorten its life. Add up the rated watts of all electrical lighting, appliance, tool and motor loads the generator will power at one time. This total should not be greater than the wattage capacity of the generator. If an electrical device nameplate gives only volts and amps, multiply volts times amps to obtain watts (volts x amps = watts). Some electric motors require more watts of power (or amps of current) for starting than for continuous operation.

LINE BREAKERS (120 VAC ONLY):

Protects generator’s AC output circuit against overload (i.e., prevents unit from exceeding wattage/amperage capacity). The circuit breaker ratings are as follows:

Model	Circuit Breaker 1	Circuit Breaker 2
QuietPact 75D	35A	35A

GENERATOR CONVERSION TO 120 VAC ONLY — DUAL CIRCUITS

NOTE: Conversion of a QUIETPACT™ generator from "120/240 VAC dual voltage" to "120 VAC only - dual circuits" (or vice-versa) requires rerouting wires within the unit enclosure. It is recommended that this conversion be performed by a Generac Authorized Service Dealer.

Figure 1-9 shows the stator power winding connections for 120 VAC only - dual circuits. Two stator power windings are used, with each winding capable of supplying half of the unit's rated wattage/amperage capacity. The circuit from each winding is protected against overload by a line breaker (CB1 and CB1A). Line breakers CB1 and CB1A have a trip rating of 35 amps.

To convert from "120/240 VAC dual voltage" to "120 VAC only - dual circuits", disconnect battery power from the generator and reverse stator lead Wires 33 and 44 as follows:

NOTE: It is necessary to feed stator lead Wires 33 and 44 through grommets on the electrical enclosure and engine control box in order to perform the rerouting outlined below. The front and top unit enclosure panels, as well as the user control panel, must be removed to perform this. After rerouting, wires should be properly tied down to prevent chafing or contact with moving internal components

1. Remove stator lead Wire 33, as shown in Figure 1-8, from the ground stud adjacent to the four-position terminal block.

Reroute stator lead 44 from the line side terminal of CB1 (renamed as CB1A in Figure 1-9) to the ground stud location previously occupied by stator lead Wire 33.

2. Move smaller gauge (#18 AWG) Wire labeled #44 (not shown), from the top of CB1A to the top of CB1. Renumber this Wire 11.
3. Reroute stator lead Wire 33, removed in step 1, to the line side terminal on CB1A.
4. Renumber ground Wire 33, located between the four-position terminal block and ground in Figure 1-8, as ground Wire 44, as shown in Figure 1-9.
5. Renumber Wire 44A from Figure 1-8 as Wire 33A in Figure 1-9.
6. Connect a 12 AWG jumper wire between line breakers CB1 and CB1A, as shown in Figure 1-9.
7. Remove the "tie bar" between the two-line breaker switch handles.

When connecting vehicle load leads, the following rules apply:

- Connect 120 VAC, single-phase, 60-Hertz, AC electrical loads, requiring up to the trip rating of circuit breaker CB1, across AC output leads T1 (red) and T2 (white).
- Connect 120 VAC, single-phase, 60-Hertz, AC electrical loads, requiring up to the trip rating of circuit breaker CB1A, across AC output leads T3 (black) and T2 (white).
- Try to keep the load balanced between the two circuit breakers and the stator windings.
- The neutral line (T2, white) on all units is a grounded neutral.

Do NOT connect electrical loads in excess of any circuit breaker rating, or problems will develop with circuit breaker tripping, which causes a loss of AC output. Also, do NOT exceed the generator's rated wattage capacity. Add the watts or amps of all lighting, appliance, tool, and motor loads the generator will operate at one time. This total should be less than the unit's rated wattage/amperage capacity.

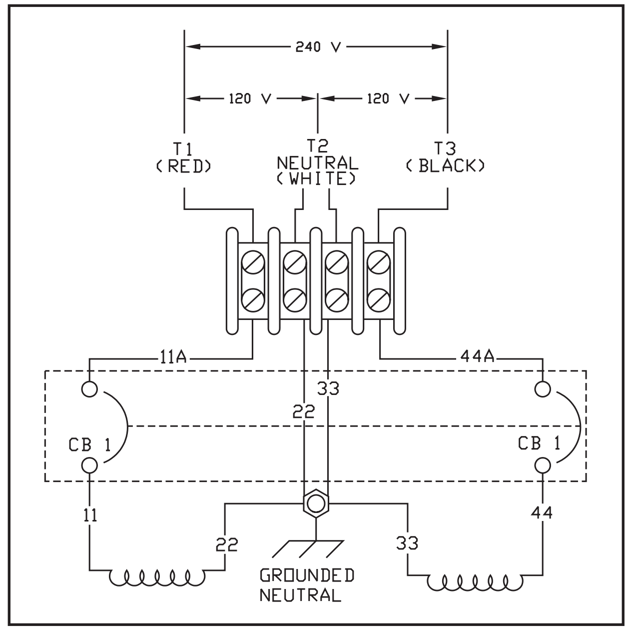


Figure 1-8. – Connection for 120/240 VAC Dual Voltage

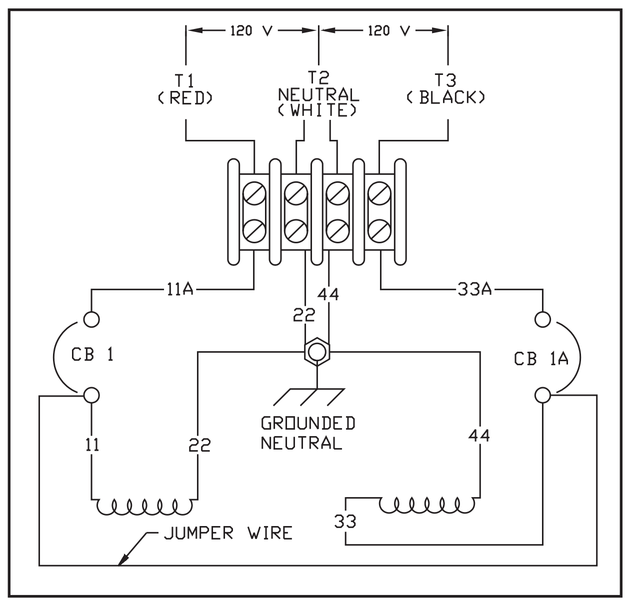


Figure 1-9 - Connection for 120 VAC Only — Dual Circuits

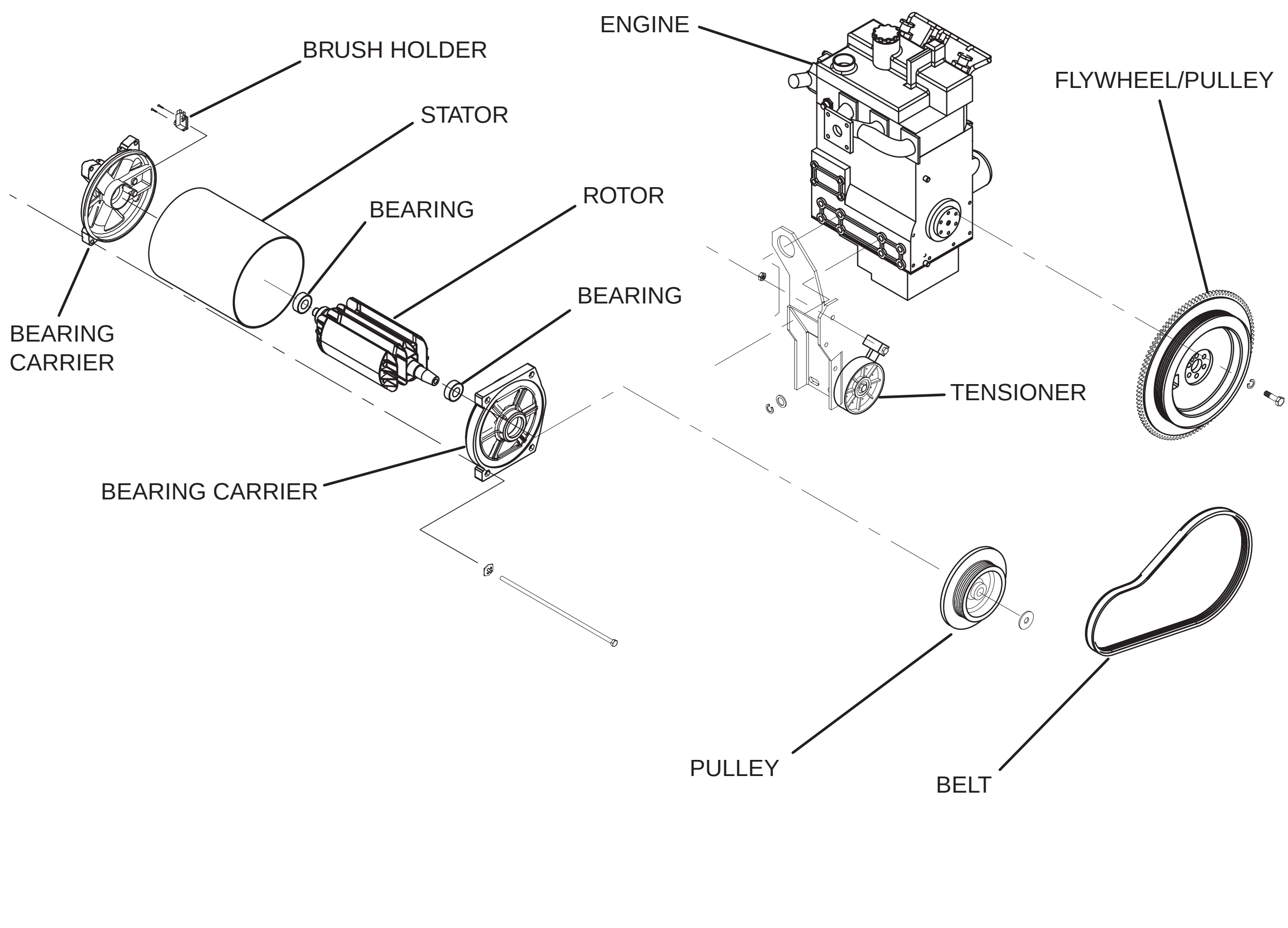


Figure 2-1. Exploded View of Generator

ROTOR ASSEMBLY

The Rotor is sometimes called the “revolving field”, since it provides the magnetic field that induces a voltage into the stationary Stator windings. Slip rings on the Rotor shaft allow excitation current from the voltage regulator to be delivered to the Rotor windings. The Rotor is driven by the engine at a constant speed through a pulley and belt arrangement.

The QUIETPACT 75D utilizes a 2-pole Rotor. This type of Rotor must be driven at 3600 rpm for a 60-Hertz AC output, or at 3000 rpm for a 50-Hertz output.

Slip rings should be cleaned. If dull or tarnished, clean them with fine sandpaper (a 400 grit wet sandpaper is recommended). DO NOT USE ANY METALLIC GRIT OR ABRASIVE TO CLEAN SLIP RINGS.

STATOR ASSEMBLY

The Stator is assembled between the front and rear bearing carriers and retained in that position by four Stator studs. Windings included in the Stator assembly are (a) dual AC power windings, (b) an excitation or DPE winding, and (c) a battery charge winding. A total of eleven (11) leads are brought out of the Stator as follows:

1. Four (4) Stator power winding output leads (Wires No. 11, 22, 33 and 44). These leads deliver power to connected electrical loads.
2. Stator Power winding “sensing” leads (11 and 22). These leads deliver an “actual voltage signal to the electronic Voltage Regulator.

3. Two excitation winding output leads (No. 2 and 6). These leads deliver unregulated excitation current to the voltage regulator.
4. Three (3) battery charge output leads (No. 55, 66 and 77).

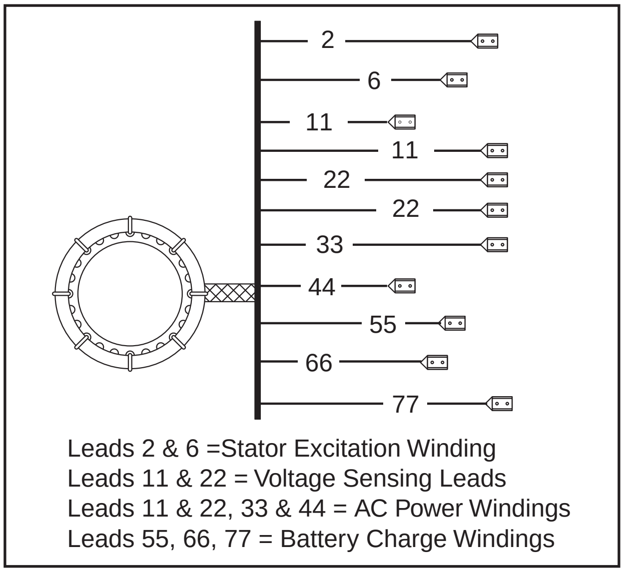


Figure 2-2. – Stator Output Leads

BRUSH HOLDER

The brush holder is retained in the rear bearing carrier by two M5 screws. It retains two brushes, which contact the Rotor slip rings and allow current flow from stationary parts to the revolving Rotor. The positive (+) brush is located nearest the Rotor bearing.

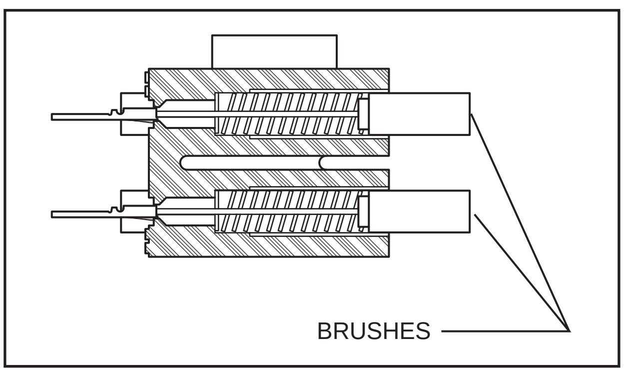


Figure 2-3. – Brush Holder

BATTERY CHARGE COMPONENTS

The Stator incorporates dual battery charge windings. A battery charge rectifier (BCR) changes the AC output of these windings to direct current (DC). Battery charge winding output is delivered to the unit battery via the rectifier, a 14 amp fuse and Wire No. 15. A one ohm, 25 watt resistor is connected in series with the grounded side of the circuit.

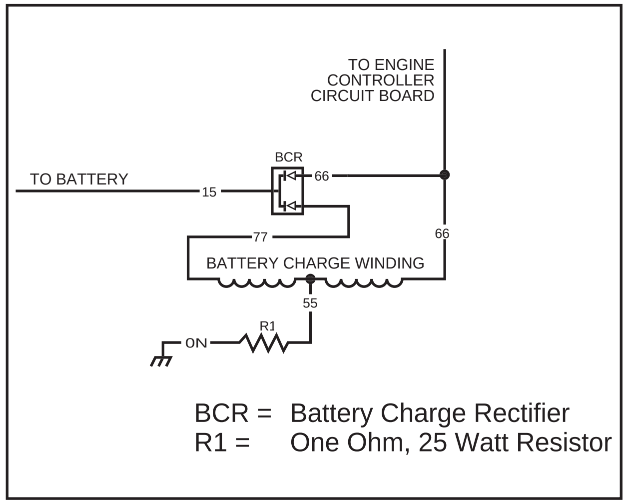


Figure 2-4. – Battery Charge Circuit

EXCITATION CIRCUIT COMPONENTS

GENERAL:

During operation, the Rotor's magnetic field induces a voltage and current flow into the Stator excitation winding. The resultant AC output is delivered to a voltage regulator via an excitation circuit breaker (CB2).

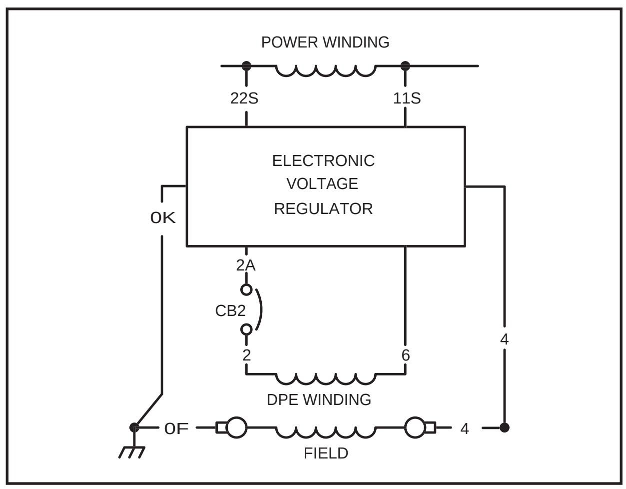


Figure 2-5. – Schematic: Excitation Circuit

EXCITATION CIRCUIT BREAKER:

The excitation circuit breaker (CB2) is self-resetting and cannot be reset manually. Should the breaker open for any reason, excitation current flow to the Rotor is lost. The unit’s AC output voltage will then drop to a value equal to the Rotor's residual magnetism (about 7-12 VAC).

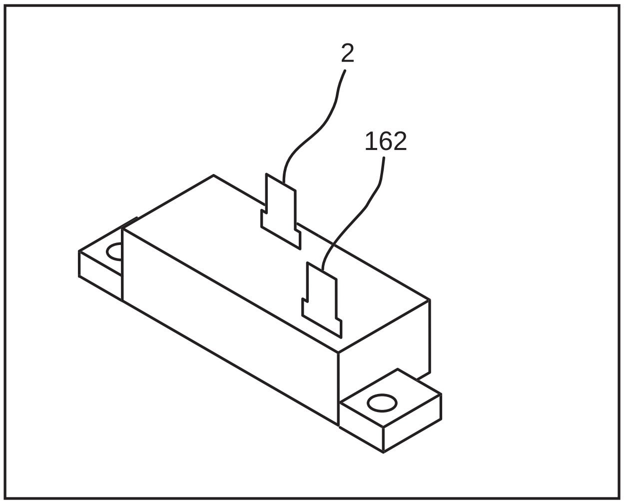


Figure 2-6. – Excitation Circuit Breaker

VOLTAGE REGULATOR:

Six (6) leads are connected to the voltage regulator as follows:

- Two (2) SENSING leads deliver ACTUAL AC output voltage signals to the regulator. These are Wires No. 11 and 22.
- Two (2) leads (4 and 1) deliver the regulated direct current to the Rotor, via brushes and slip rings.
- Two (2) leads (No. 6 and 162) deliver Stator excitation winding AC output to the regulator.

The regulator mounts a “VOLTAGE ADJUST” potentiometer, used for adjustment of the pre-set REFERENCE voltage. An LED will turn on to indicate that SENSING voltage is available to the regulator and the regulator is turned on.

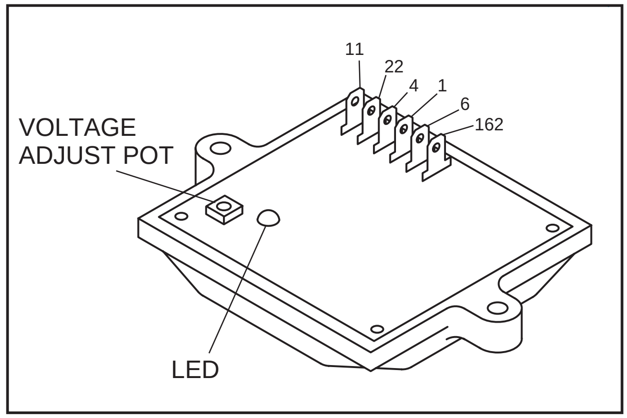


Figure 2-7. – Voltage Regulator

ADJUSTMENT PROCEDURE:

With the frequency set at 62.5-Hertz and no load on the generator, slowly turn the voltage adjust pot on the voltage regulator until 124 VAC is measured. If voltage is not adjustable, proceed to Section 6 - Troubleshooting.

NOTE: If, for any reason, sensing voltage to the regulator is lost, the regulator will shut down and excitation output to the Rotor will be lost. The AC output voltage will then drop to a value that is equal to Rotor residual magnetism (about 7-12 VAC). Without this automatic shutdown feature, loss of sensing (actual) voltage to the regulator would result in a “full field” or “full excitation” condition and an extremely high AC output voltage.

NOTE: Adjustment of the regulator's “VOLTAGE ADJUST” potentiometer must be done only when the unit is running at its correct governed no-load speed. Speed is correct when the unit's no-load AC output frequency is about 62.5-Hertz. At the stated frequency, AC output voltage should be about 125 volts.

CONTROL PANEL COMPONENT IDENTIFICATION

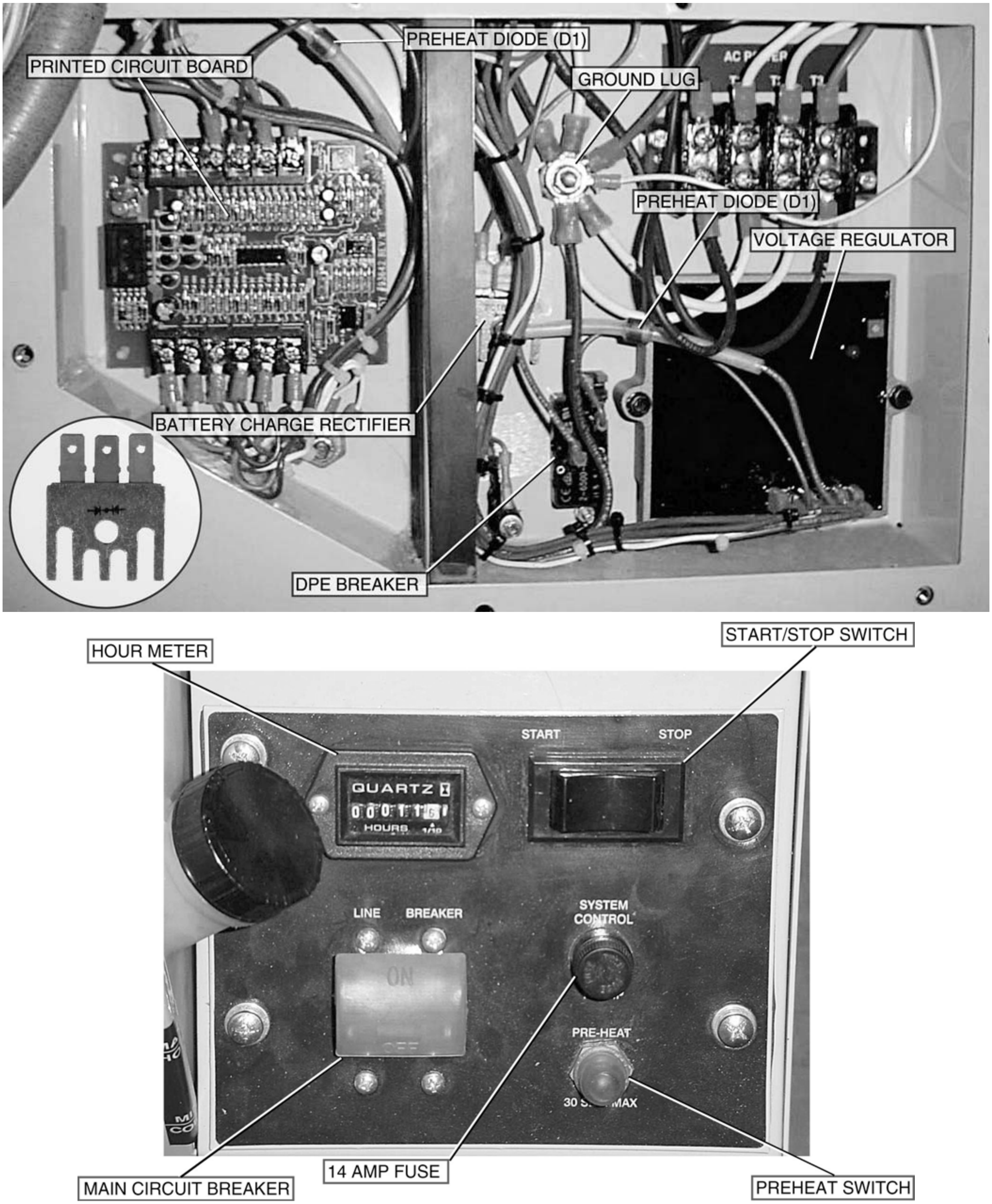


Figure 2-9. – Control Panel Components

EFFECTS OF DIRT AND MOISTURE

Moisture and dirt are harmful to the continued good operation of any generator set.

If moisture is allowed to remain in contact with the Stator and Rotor windings, some of the moisture will be retained in voids and cracks of the winding insulation. This will result in a reduced insulation resistance and, eventually, the unit's AC output will be affected.

Insulation used in the generator is moisture resistant. However, prolonged exposure to moisture will gradually reduce the resistance of the winding insulation.

Dirt can enhance the problem, since it tends to hold moisture into contact with the windings. Salt, as from sea air, contributes to the problem since salt can absorb moisture from the air. When salt and moisture combine, they make a good electrical conductor.

Due to the detrimental affects of dirt and moisture, the generator should be kept as clean and as dry as possible. Rotor and Stator windings should be tested periodically with an insulation resistance tester (such as a megohmmeter or hi-pot tester).

If the insulation resistance is excessively low, drying may be required to remove accumulated moisture. After drying, perform a second insulation resistance test. If resistance is still low after drying, replacement of the defective Rotor or Stator may be required.

INSULATION RESISTANCE TESTERS

Figure 3-1 shows one kind of hi-pot tester. The tester shown has a “Breakdown” lamp that will glow during the test procedure to indicate an insulation breakdown in the winding being tested.

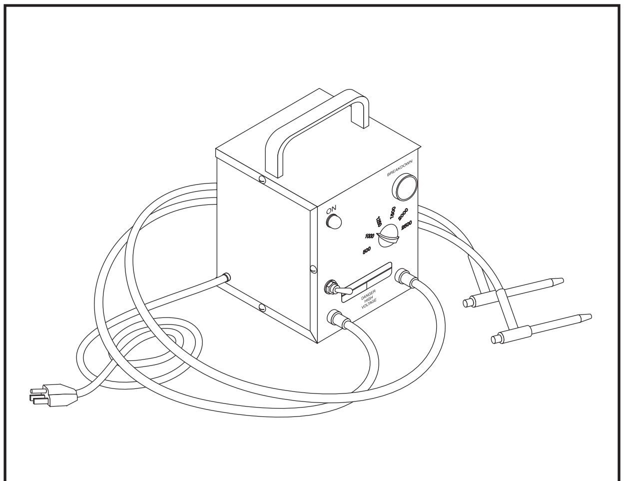


Figure 3-1. – One Type of Hi-Pot Tester

DANGER! INSULATION RESISTANCE TESTERS SUCH AS HI-POT TESTERS AND MEGOHMMETERS ARE A SOURCE OF HIGH AND DANGEROUS ELECTRICAL VOLTAGE.

FOLLOW THE TESTER MANUFACTURER'S INSTRUCTIONS CAREFULLY. USE COMMON SENSE TO AVOID DANGEROUS ELECTRICAL SHOCK

DRYING THE GENERATOR

GENERAL:

If tests indicate the insulation resistance of a winding is below a safe value, the winding should be dried before operating the generator. Some recommended drying procedures include (a) heating units and (b) forced air.

HEATING UNITS:

If drying is needed, the generator can be enclosed in a covering. Heating units can then be installed to raise the temperature about 15°-18° F. (8°-10° C.) above ambient temperature.

FORCED AIR:

Portable forced air heaters can be used to dry the generator. Direct the heated air into the generator’s air intake openings. Remove the voltage regulator and run the unit at no-load. Air temperature at the point of entry into the generator should not exceed 150° F. (66° C.).

CLEANING THE GENERATOR

GENERAL:

The generator can be cleaned properly only while it is disassembled. The cleaning method used should be determined by the type of dirt to be removed. Be sure to dry the unit after it has been cleaned.

NOTE: A shop that repairs electric motors may be able to assist you with the proper cleaning of generator windings. Such shops are often experienced in special problems such as a sea coast environment, marine or wetland applications, mining, etc.

USING SOLVENTS FOR CLEANING:

If dirt contains oil or grease a solvent is generally required. Only petroleum distillates should be used to clean electrical components. Recommended are safety type petroleum solvents having a flash point greater than 100° F. (38° C.).

CAUTION!: Some generators may use epoxy or polyester base winding varnishes. Use solvents that will not attack such materials.

Use a soft brush or cloth to apply the solvent. Be careful to avoid damage to wire or winding insulation. After cleaning, dry all components thoroughly using moisture-free, low-pressure compressed air.

DANGER!: DO NOT ATTEMPT TO WORK WITH SOLVENTS IN ANY ENCLOSED AREA. PROVIDE ADEQUATE VENTILATION WHEN WORKING WITH SOLVENTS. WITHOUT ADEQUATE VENTILATION, FIRE, EXPLOSION OR HEALTH HAZARDS MAY EXIST . WEAR EYE PROTECTION. WEAR RUBBER GLOVES TO PROTECT THE HANDS.

CLOTH OR COMPRESSED AIR:

For small parts or when dry dirt is to be removed, a dry cloth may be satisfactory. Wipe the parts clean, then use low pressure air at 30 psi (206 Kpa) to blow dust away.

BRUSHING AND VACUUM CLEANING:

Brushing with a soft bristle brush followed by vacuum cleaning is a good method of removing dust and dirt. Use the soft brush to loosen the dirt, then remove it with the vacuum.

STATOR INSULATION RESISTANCE

GENERAL:

Insulation resistance is a measure of the integrity of the insulating materials that separate electrical windings from the generator's steel core. This resistance can degrade over time due to the presence of contaminants, dust, dirt, grease and especially moisture.

The normal insulation resistance for generator windings is on the order of “millions of ohms” or “megohms”.

When checking the insulation resistance, follow the tester manufacturer's instructions carefully. Do NOT exceed the applied voltages recommended in this manual. Do NOT apply the voltage longer than one (1) second.

CAUTION!: DO NOT connect the Hi-Pot Tester or Megohmmeter test leads to any leads that are routed into the generator control panel. Connect the tester leads to the Stator or Rotor leads only.

STATOR SHORT-TO-GROUND TESTS:

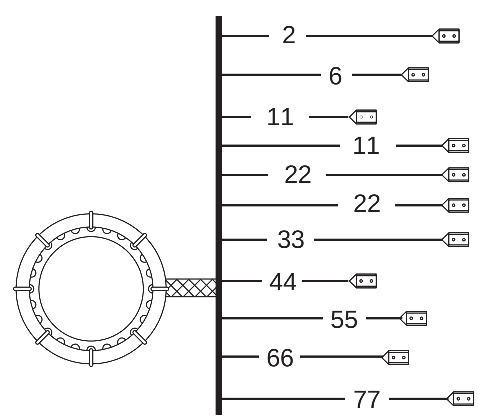
See Figure 3-2. To test the Stator for a short-to-ground condition, proceed as follows:

1. Disconnect and isolate all Stator leads as follows:
   a. Disconnect sensing leads 11 and 22 from the voltage regulator.
   b. Disconnect excitation winding lead No. 6 from the voltage regulator.
   c. Disconnect excitation lead No. 2 from the excitation circuit breaker (CB2).
   d. Disconnect battery charge winding leads No. 66 and 77 from the battery charge rectifier (BCR).
   e. Disconnect battery charge winding lead No. 55 from the battery charge resistor (R1).
   f. At the main circuit breakers, disconnect stator power leads No. 11P and 33.
   g. At the ground stud (GND5), disconnect Stator power leads No. 22 and 33.
2. When all leads have been disconnected as outlined in Step 1 above, test for a short-to-ground condition as follows:
   a. Connect the terminal ends of all Stator leads together (11, 22, 33, 44, 2,6, 55, 66, 77).
   b. Follow the tester manufacturer's instructions carefully. Connect the tester leads across all Stator leads and to frame ground on the Stator can. Apply a voltage of 1500 volts. Do NOT apply voltage longer than one (1) second.

If the test indicates a breakdown in insulation, the Stator should be cleaned, dried and re-tested. If the winding fails the second test (after cleaning and drying), replace the Stator assembly.

TEST BETWEEN ISOLATED WINDINGS:

1. Follow the tester manufacturer's instructions carefully. Connect the tester test leads across Stator leads No. 11 (POWER) and No. 2. Apply a voltage of 1500 volts- DO NOT EXCEED ONE SECOND.



Leads 2 & 6 =Stator Excitation Winding
Leads 11 & 22 = Voltage Sensing Leads
Leads 11 & 22, 33 & 44 = AC Power Windings
Leads 55, 66, 77 = Battery Charge Windings

Figure 3-2. – Stator Leads

2. Repeat Step 1 with the tester leads connected across the following Stator leads:

a. Across Wires No. 33 and 2.
b. Across Wires No. 11 (POWER) and 66.
c. Across Wires No. 33 and 66.
d. Across Wires No. 2 and 66.

If a breakdown in the insulation between isolated windings is indicated, clean and dry the Stator. Then, repeat the test. If the Stator fails the second test, replace the Stator assembly.

TEST BETWEEN PARALLEL WINDINGS:

Connect the tester leads across Stator leads No. 11 (POWER) and 33. Apply a voltage of 1500 volts. If an insulation breakdown is indicated, clean and dry the Stator. Then, repeat the test between parallel windings. If the Stator fails the second test, replace it.

TESTING ROTOR INSULATION

To test the Rotor for insulation breakdown, proceed as follows:

1. Remove the brush holders with brushes.
2. Connect the tester positive (+) test lead to the positive (+) slip ring (nearest the Rotor bearing). Connect the tester negative (-) test lead to a clean frame ground (like the Rotor shaft).

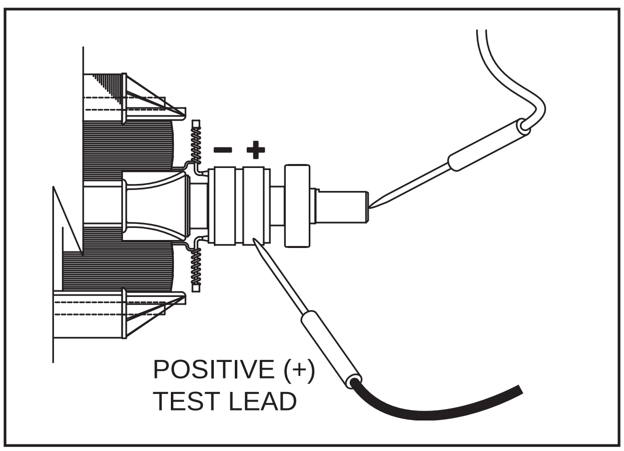


Figure 3-3. – Rotor Test Points

3. Apply 1000 volts. DO NOT APPLY VOLTAGE LONGER THAN 1 SECOND.

If an insulation breakdown is indicated, clean and dry the Rotor then repeat the test. Replace the Rotor if it fails the second test (after cleaning and drying).

THE MEGOHMMETER

GENERAL:

A megohmmeter, often called a “megger”, consists of a meter calibrated in megohms and a power supply. Use a power supply of 1500 volts when testing Stators; or 1000 volts when testing the Rotor. DO NOT APPLY VOLTAGE LONGER THAN ONE (1) SECOND.

TESTING STATOR INSULATION:

All parts that might be damaged by the high megger voltages must be disconnected before testing. Isolate all Stator leads (Figure 3-2) and connect all of the Stator leads together. FOLLOW THE MEGGER MANUFACTURER'S INSTRUCTIONS CAREFULLY.

Use a megger power setting of 1500 volts. Connect one megger test lead to the junction of all Stator leads, the other test lead to frame ground on the Stator can. Read the number of megohms on the meter.

$$\text{MINIMUM INSULATION RESISTANCE (in “Megohms”)} = \frac{\text{GENERATOR RATED VOLTS}}{1000} + 1$$

The MINIMUM acceptable megger reading for Stators may be calculated using the following formula:

EXAMPLE: Generator is rated at 120 VAC. Divide “120” by “1000” to obtain “0.12”. Then add “1” to obtain “1.12” megohms. Minimum insulation resistance for a 120 VAC Stator is 1.12 megohms.

If the Stator insulation resistance is less than the calculated minimum resistance, clean and dry the Stator. Then, repeat the test. If resistance is still low, replace the Stator.

Use the Megger to test for shorts between isolated windings as outlined “Stator Insulation Resistance”.

Also test between parallel windings. See “Test Between Parallel Windings”on this page.

TESTING ROTOR INSULATION:

Apply a voltage of 1000 volts across the Rotor positive (+) slip ring (nearest the rotor bearing), and a clean frame ground (i.e. the Rotor Shaft). DO NOT EXCEED 1000 VOLTS AND DO NOT APPLY VOLTAGE LONGER THAN ONE SECOND. FOLLOW THE MEGGER MANUFACTURER'S INSTRUCTIONS CAREFULLY.

ROTOR MINIMUM INSULATION RESISTANCE:

1.5 megohms

METERS

Devices used to measure electrical properties are called meters. Meters are available that allow one to measure (a) AC voltage, (b) DC voltage, (c) AC frequency, and (d) resistance in ohms. The following apply:

- To measure AC voltage, use an AC voltmeter.
- To measure DC voltage, use a DC voltmeter.
- Use a frequency meter to measure AC frequency in "Hertz" or "cycles per second"..
- Use an ohmmeter to read circuit resistance, in "ohms".

THE VOM

A meter that allows both voltage and resistance to be read is the "volt-ohm-milliammeter" or "VOM".

Some VOM's are of the "analog" type (not shown). These meters display the value being measured by physically deflecting a needle across a graduated scale. The scale used must be interpreted by the user.

"Digital" VOM's (Figure 4-1) are also available and are generally very accurate. Digital meters display the measured values directly by converting the values to numbers.

NOTE: Standard AC voltmeters react to the AVERAGE value of alternating current. When working with AC, the effective value is used. For that reason a different scale is used on an AC voltmeter. The scale is marked with the effective or "rms" value even though the meter actually reacts to the average value. This is why the AC voltmeter will give an incorrect reading if used to measure direct current (DC).

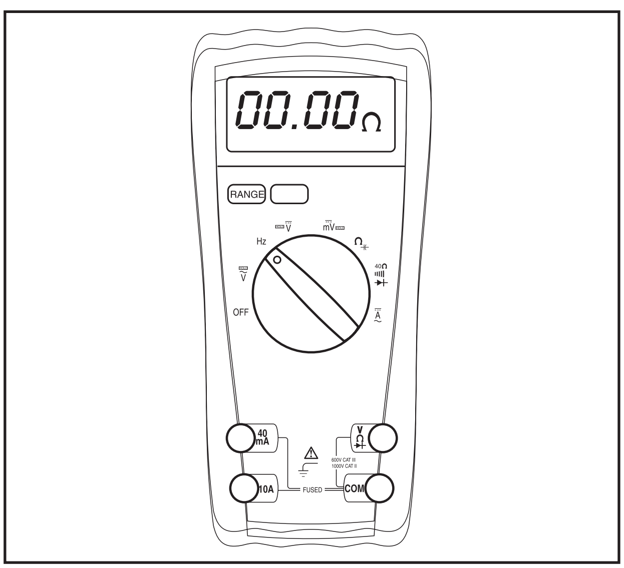


Figure 4-1. – Digital VOM

MEASURING AC VOLTAGE

An accurate AC voltmeter or a VOM can be used to read the generator's AC output voltage. The following apply:

1. Always read the generator's AC output voltage only at the unit's rated operating speed and AC frequency.
2. The generator's voltage regulator can be adjusted for correct output voltage only while the unit is operating at its correct rated speed and frequency.
3. Only an AC voltmeter may be used to measure AC voltage. DO NOT USE A DC VOLTMETER FOR THIS PURPOSE.

DANGER!: RV GENERATORS PRODUCE HIGH AND DANGEROUS VOLTAGES. CONTACT WITH HIGH VOLTAGE TERMINALS WILL RESULT IN DANGEROUS AND POSSIBLY LETHAL ELECTRICAL SHOCK.

MEASURING DC VOLTAGE

A DC voltmeter or a VOM can be used to measure DC voltages. Always observe the following rules:

1. Always observe correct DC polarity.
   a. Some VOM's may be equipped with a polarity switch.
   b. On meters that do not have a polarity switch, DC polarity must be reversed by reversing the test leads.
2. Before reading a DC voltage, always set the meter to a higher voltage scale than the anticipated reading. If in doubt, start at the highest scale and adjust the scale downward until correct readings are obtained.
3. The design of some meters is based on the "current flow" theory while others are based on the "electron flow" theory.
   a. The "current flow" theory assumes that direct current flows from the positive (+) to the negative (-).
   b. The "electron flow" theory assumes that current flows from negative (-) to positive (+).

NOTE: When testing generators, the "current flow" theory is applied. That is, current is assumed to flow from positive (+) to negative (-).

MEASURING AC FREQUENCY

The generator's AC output frequency is proportional to Rotor speed. Generators equipped with a 2-pole Rotor must operate at 3600 rpm to supply a frequency of 60-Hertz.

Correct engine and Rotor speed is maintained by an engine speed governor. For models rated 60-Hertz, the governor is generally set to maintain a no-load frequency of about 62-Hertz with a corresponding output voltage of about 125 VAC line-to-neutral. Engine speed and frequency at no-load are set slightly high to prevent excessive rpm and frequency droop under heavy electrical loading.

MEASURING CURRENT

To read the current flow, in AMPERES, a clamp-on ammeter can be used. This type of meter indicates current flow through a conductor by measuring the strength of the magnetic field around that conductor. The meter consists essentially of a current transformer with a split core and a rectifier type instrument connected to the secondary. The primary of the current transformer is the conductor through which the current to be measured flows. The split core allows the instrument to be clamped around the conductor without disconnecting it.

Current flowing through a conductor may be measured safely and easily. A line-splitter can be used to measure current in a cord without separating the conductors.

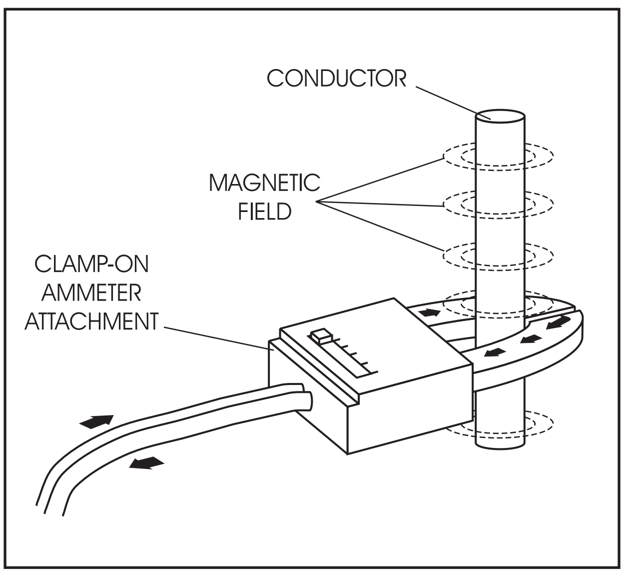


Figure 4-2. – Clamp-On Ammeter

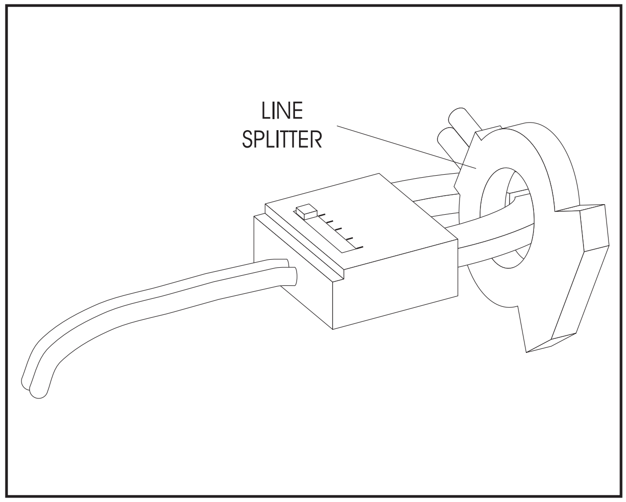


Figure 4-3. – A Line-Splitter

NOTE: If the physical size of the conductor or ammeter capacity does not allow all lines to be measured simultaneously, measure current flow in each individual line. Then, add the individual readings.

MEASURING RESISTANCE

The volt-ohm-milliammeter may be used to measure the resistance in a circuit. Resistance values can be very valuable when testing coils or windings, such as the Stator and Rotor windings.

When testing Stator windings, keep in mind that the resistance of these windings is very low. Some meters are not capable of reading such a low resistance and will simply read “continuity”.

If proper procedures are used, the following conditions can be detected using a VOM:

- A “short-to-ground” condition in any Stator or Rotor winding.
- Shorting together of any two parallel Stator windings.
- Shorting together of any two isolated Stator windings.
- An open condition in any Stator or Rotor winding.

Component testing may require a specific resistance value or a test for “infinity” or “continuity.” Infinity is an OPEN condition between two electrical points, which would read as no resistance on a VOM. Continuity is a closed condition between two electrical points, which would be indicated as very low resistance or “ZERO” on a VOM.

ELECTRICAL UNITS

AMPERE:

The rate of electron flow in a circuit is represented by the AMPERE. The ampere is the number of electrons flowing past a given point at a given time. One AMPERE is equal to just slightly more than six thousand million billion electrons per second.

With alternating current (AC), the electrons flow first in one direction, then reverse and move in the opposite direction. They will repeat this cycle at regular intervals. A wave diagram, called a “sine wave” shows that current goes from zero to maximum positive value, then reverses and goes from zero to maximum negative value. Two reversals of current flow is called a cycle. The number of cycles per second is called frequency and is usually stated in “Hertz”.

VOLT:

The VOLT is the unit used to measure electrical PRESSURE, or the difference in electrical potential that causes electrons to flow. Very few electrons will flow when voltage is weak. More electrons will flow as voltage becomes stronger. VOLTAGE is considered to be a state of unbalance and current flow as an attempt to regain balance. One volt is the amount of EMF that will cause a current of one ampere to flow through one ohm of resistance.

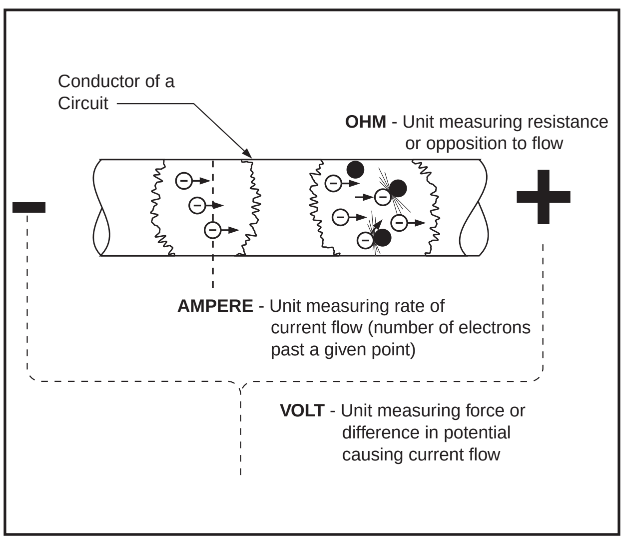


Figure 4-4. – Electrical Units

OHM:

The OHM is the unit of RESISTANCE. In every circuit there is a natural resistance or opposition to the flow of electrons. When an EMF is applied to a complete circuit, the electrons are forced to flow in a single direction rather than their free or orbiting pattern. The resistance of a conductor depends on (a) its physical makeup, (b) its cross-sectional area, (c) its length, and (d) its temperature. As the conductor's temperature increases, its resistance increases in direct proportion. One (1) ohm of resistance allows one (1) ampere of current to flow when one (1) volt of electromotive force (EMF) is applied.

OHM'S LAW

A definite and exact relationship exists between VOLTS, OHMS and AMPERES. The value of one can be calculated when the value of the other two are known. Ohm's Law states that in any circuit the current will increase when voltage increases but resistance remains the same, and current will decrease when resistance increases and voltage remains the same.

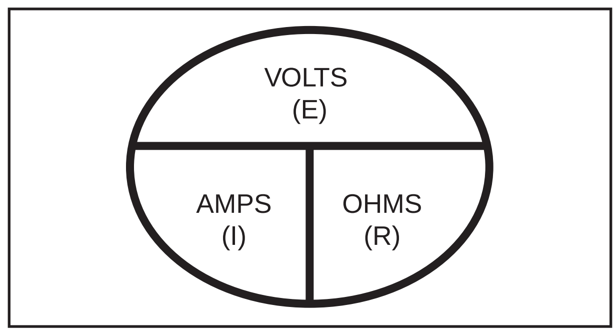


Figure 4-5.

If AMPERES is unknown while VOLTS and OHMS are known, use the following formula:

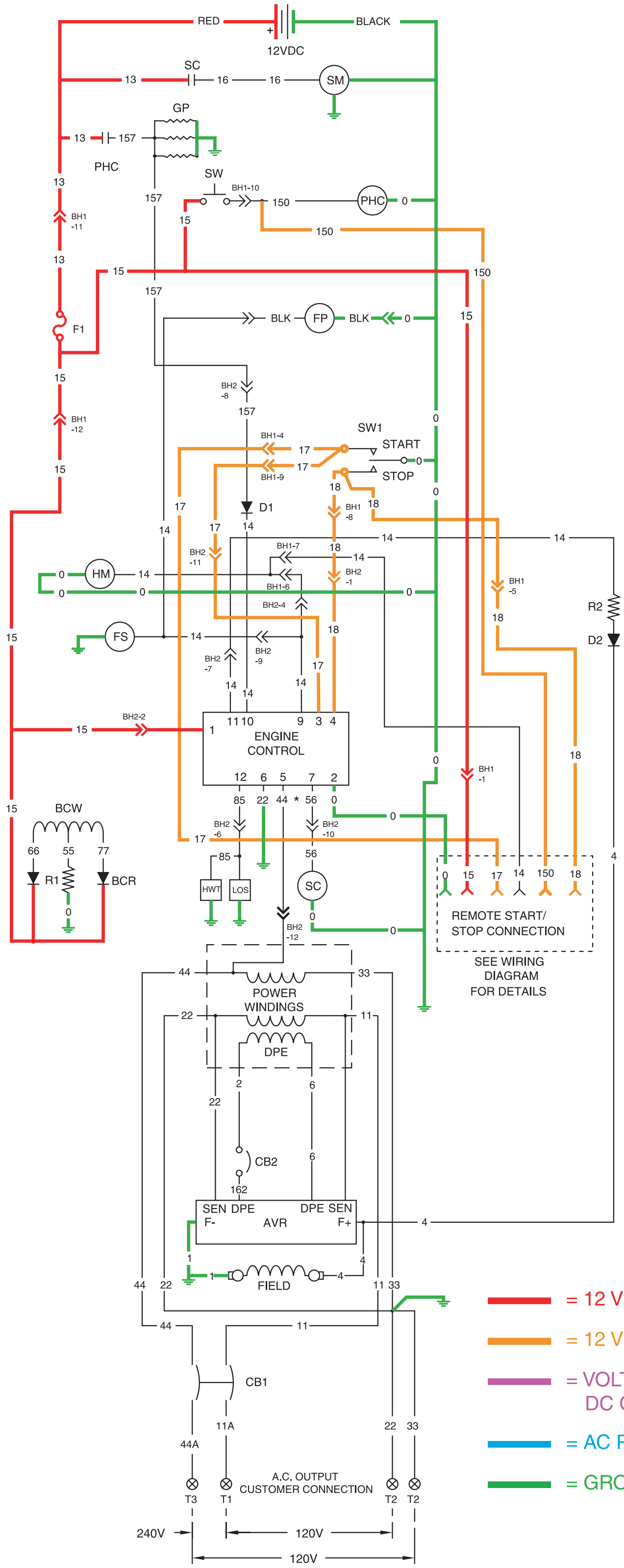
$$\textbf{AMPERES} = \frac{\textbf{VOLTS}}{\textbf{OHMS}}$$

If VOLTS is unknown while AMPERES and OHMS are known, use the following formula:

VOLTS = AMPERES x OHMS

If OHMS is unknown but VOLTS and AMPERES are known, use the following:

$$\textbf{OHMS} = \frac{\textbf{VOLTS}}{\textbf{AMPERES}}$$



= 12 VDC SUPPLY

= 12 VDC CONTROL

= VOLTAGE REGULATOR DC OUTPUT

= AC POWER

= GROUND

INTRODUCTION

The engine DC control system includes all components necessary for the operation of the engine. Operation includes off, preheat, cranking/starting, running, shutdown, and fault shutdown. The system is shown schematically.

OPERATIONAL ANALYSIS

CIRCUIT CONDITION- OFF:

Battery voltage is available to the engine controller circuit board from the unit BATTERY and via (a) the RED battery cable, Wire 13, a 14 amp FUSE (F1), Wire 15 and engine controller Terminal 1. However, circuit board action is holding the circuit open and no action can occur.

Battery voltage is available to the contacts of a STARTER CONTACTOR (SC), but the contacts are open.

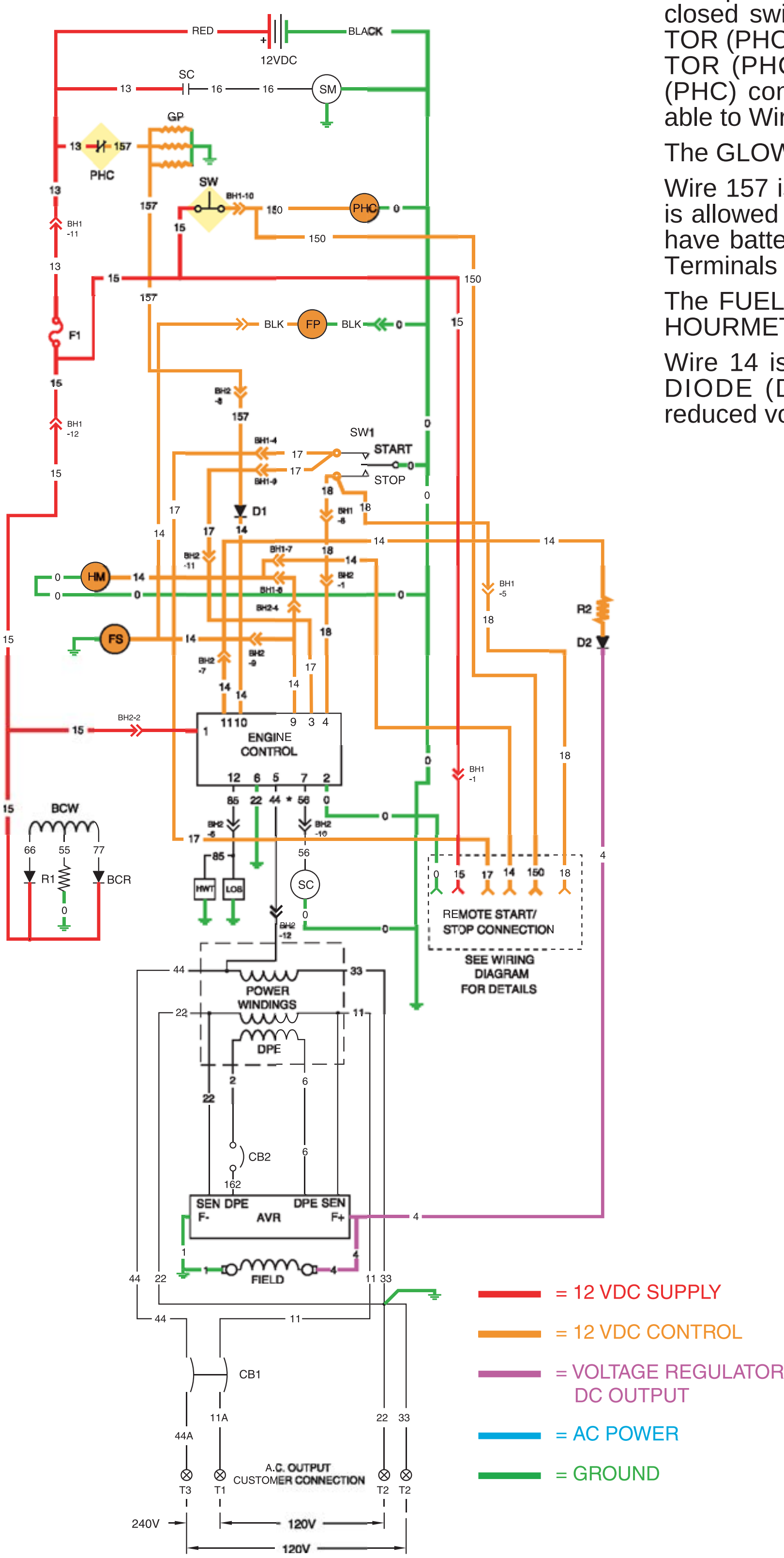
Battery voltage is available to the contacts of a PREHEAT CONTACTOR (PHC), but the contacts are open.

Battery voltage is available to the PREHEAT SWITCH (SW).

The switch is open and the circuit is incomplete. Battery voltage is also available to the remote connection for a remote preheat switch.

Battery voltage is available to the BATTERY CHARGE RECTIFIER (BCR). This is used as a return path for Battery Charge Winding current.

LEGEND
AVR -AUTOMATIC VOLTAGE REGULATOR
BCR -BATTERY CHARGE RECTIFIER
BCW -BATTERY CHARGER
CB1 -CIRCUIT BREAKER 35A
CB2 -CIRCUIT BREAKER (4A)
D1 -DIODE 600V, 6AMP
D2 -DIODE 600V, 6AMP
DPE -EXCITATION WINDING
F1 -FUSE 14AMP SFE
FS -FUEL SOLENOID
FP -FUEL PUMP
GP -GLOW PLUGS
HM -HOURMETER
HWT -HIGH WATER TEMP SWITCH
LOS -LOW OIL PRESSURE SWITCH
PHC -PREHEAT CONTACTOR
R1 -RESISTOR, 1 OHM, 25W
R2 -RESISTOR, 20 OHM, 12W
S -STARTER
SC -START CONTACTOR
SW -PREHEAT SWITCH
SW1 -SWITCH, START/STOP



CIRCUIT CONDITION- PRE-HEAT:

When the PRE-HEAT SWITCH (SW) or the REMOTE PANEL PRE-HEAT SWITCH is closed by the operator, battery voltage is delivered across the closed switch contacts to the PRE-HEAT CONTACTOR (PHC) via Wire 150. The PRE-HEAT CONTACTOR (PHC) is now energized. The normally open (PHC) contacts close, battery voltage is now available to Wire 157.

The GLOW PLUGS (GP) are energized via Wire 157.

Wire 157 is also connected to a DIODE (D1), current is allowed to pass through (D1) and Wire 14 will now have battery voltage applied to it " Engine Controller Terminals 9, 10 , and 11 are connected".

The FUEL PUMP (FP), FUEL SOLENOID (FS), and HOURMETER (HM) will be energized via Wire 14.

Wire 14 is also connected to RESISTOR (R2) and DIODE (D2). After passing through R2 and D2 reduced voltage is applied to Wire 4.

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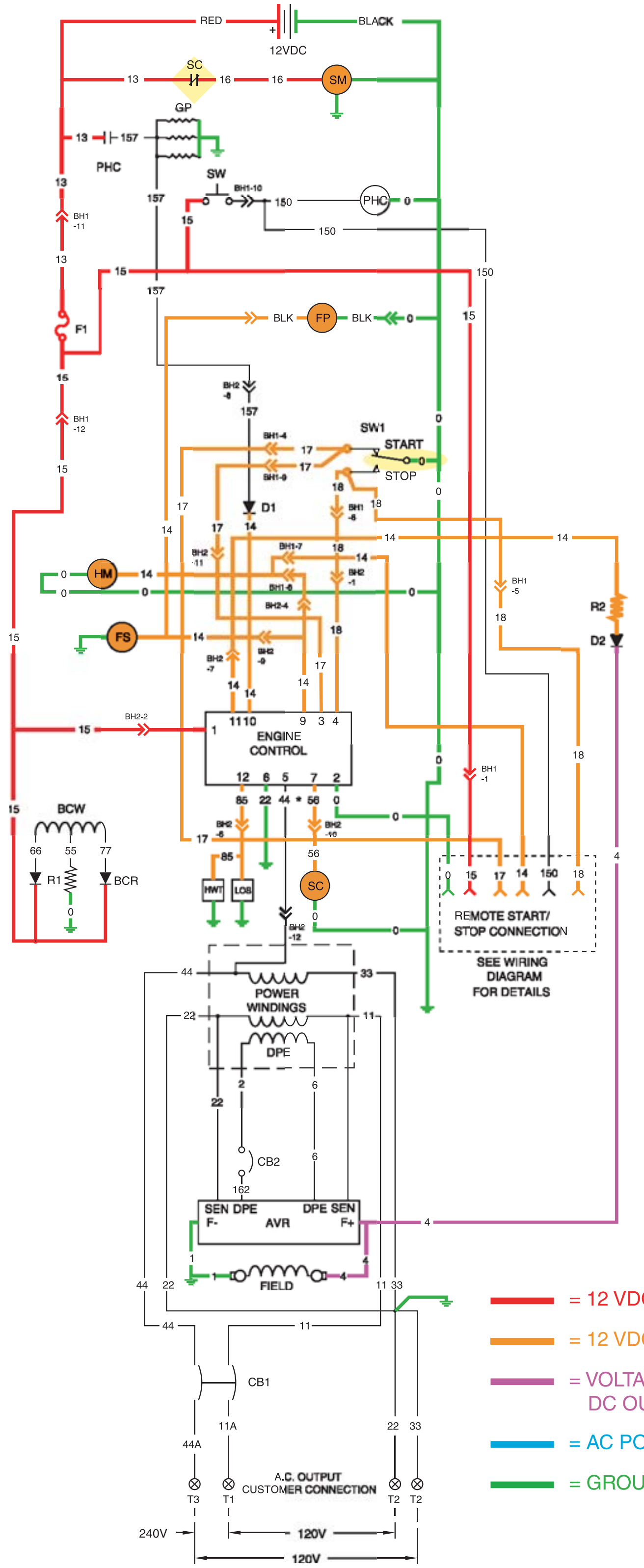

CIRCUIT CONDITION- CRANKING:

When the START-STOP-SWITCH (SW1) or REMOTE PANEL START-STOP-SWITCH is held at "START" position, Wire 17 from the Engine Control circuit board is connected to Ground. Engine control circuit board action will then deliver battery voltage to a STARTER CONTACTOR (SC) via Terminal 7 Wire 56.

The STARTER CONTACTOR (SC) energizes and its contacts close, battery output is delivered to the STARTER MOTOR (SM) via Wire 16.The STARTER MOTOR energizes and the engine cranks.

Also, while cranking, engine control circuit board action energizes Terminals 9, 10, and 11 which delivers battery voltage to the Wire 14 circuit. This energizes the FUEL PUMP (FP), FUEL SOLENOID (FS), HOURMETER (HM), and optional light or hourmeter in remote panel.

Wire 14 is also connected to RESISTOR (R2) and DIODE (D2). After passing through R2 and D2 reduced voltage is applied to Wire 4. The reduced voltage, approximately 3-5VDC, is sent to the ROTOR via The BRUSHES and SLIP RINGS. This voltage is used for Field Boost.

Also while cranking, engine control circuit board action energizes Terminal 12 which delivers battery voltage to Wire 85. "Refer to Circuit Condition-Fault Shutdown for operation".

= 12 VDC SUPPLY
= 12 VDC CONTROL
= VOLTAGE REGULATOR DC OUTPUT
= AC POWER
= GROUND

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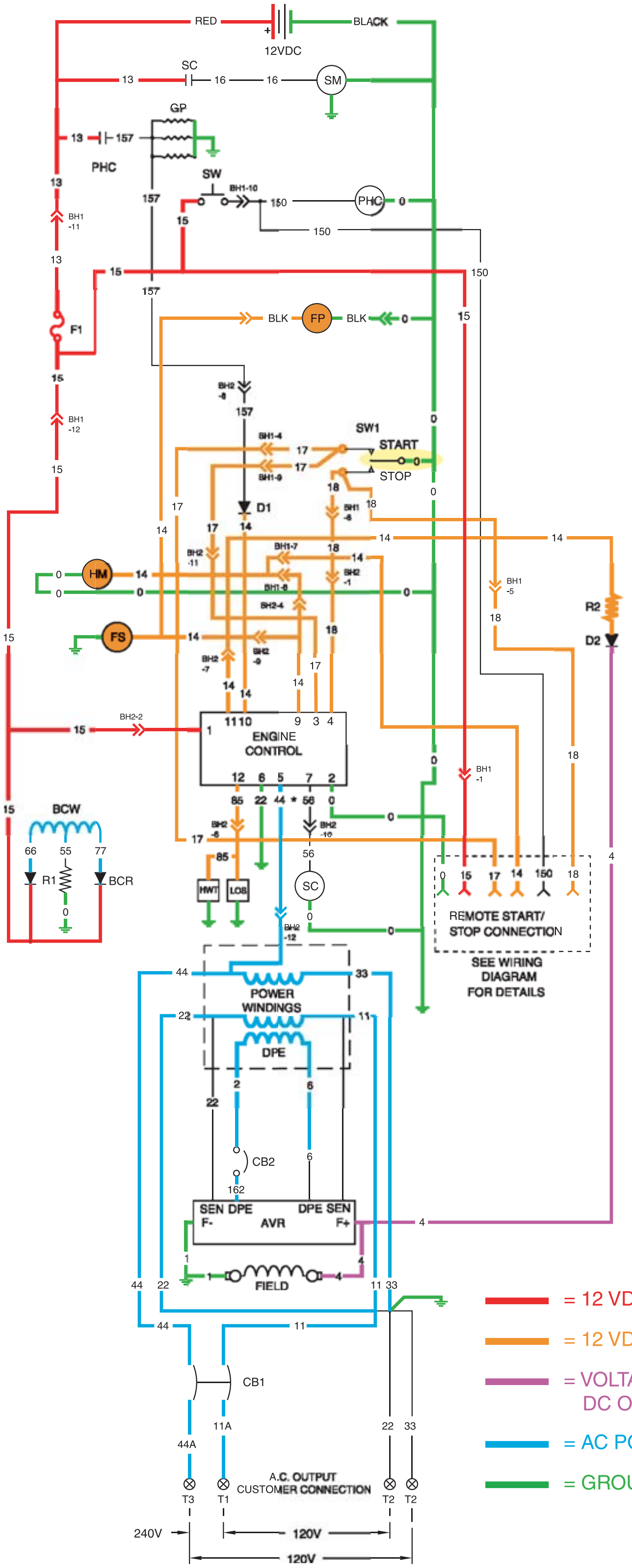

CIRCUIT CONDITION-RUNNING:

With the FUEL PUMP (FP) and FUEL SOLENOID (FS) operating the engine should start. The START-STOP SWITCH (SW1) is then released. Engine control circuit board action terminates DC output to the STARTER CONTACTOR (SC), which then de-energizes the (SC) to end cranking.

While running, engine control circuit board action keeps Terminals 9, 10, and 11 energized which delivers battery voltage to the Wire 14 circuit. This energizes the FUEL PUMP (FP), FUEL SOLENOID (FS), HOURMETER (HM), and optional light or hourmeter in remote panel. This will maintain engine operation.

While running, engine control circuit board action keeps Terminal 12 (Wire 85) energized with battery voltage. Connected in parallel to Wire 85 are the LOW OIL PRESSURE SWITCH (LOS) and HIGH WATER TEMP SWITCH (HWT). The (LOS) has normally closed contacts. After start-up, engine oil pressure will open the contacts. The HWT has normally open contacts. High coolant temperature will close the contacts. "Refer to Circuit Condition-Fault Shutdown for operation".

A voltage is induced into the Stator's POWER WINDING. This voltage is delivered to the Engine control circuit board Terminals 5 & 6 (via Wires 22 & 44). The engine control circuit board uses this frequency signal to determine engine speed for overspeed sensing and starter disengage.

= 12 VDC SUPPLY

= 12 VDC CONTROL

= VOLTAGE REGULATOR DC OUTPUT

= AC POWER

= GROUND

LEGEND

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PHC -PREHEAT CONTACTOR
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SW -PREHEAT SWITCH
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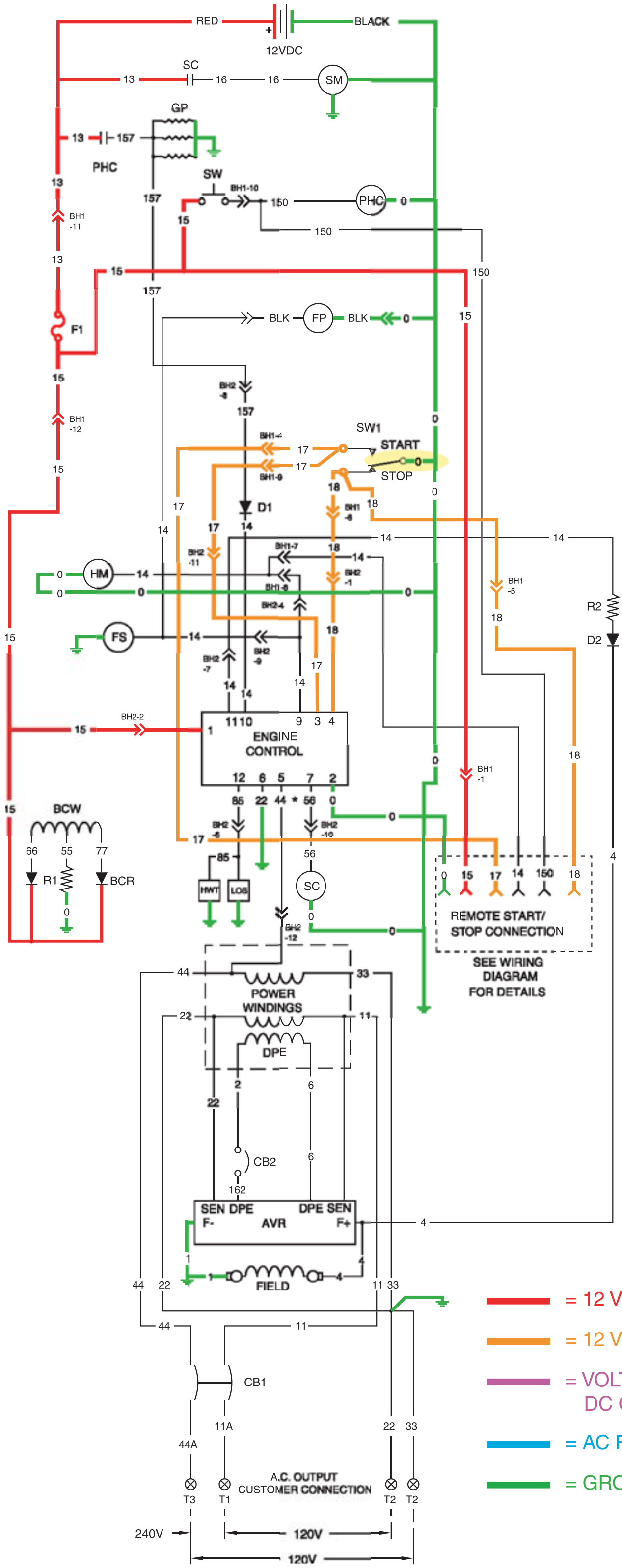

CIRCUIT CONDITION- SHUTDOWN:

Setting the START-STOP SWITCH (SW1) or the REMOTE PANEL START-STOP SWITCH to its "STOP" position, connects the Wire 18 circuit to ground. ENGINE CONTROL circuit board action de-energizes DC output to Terminal 9,10, & 11 (Wire 14). The FUEL PUMP (FP), FUEL SOLENOID (FS) and HOURMETER (HM) are de-energized by the loss of DC to Wire 14. Fuel flow terminates and the engine shuts down.

= 12 VDC SUPPLY

= 12 VDC CONTROL

= VOLTAGE REGULATOR DC OUTPUT

= AC POWER

= GROUND

LEGEND

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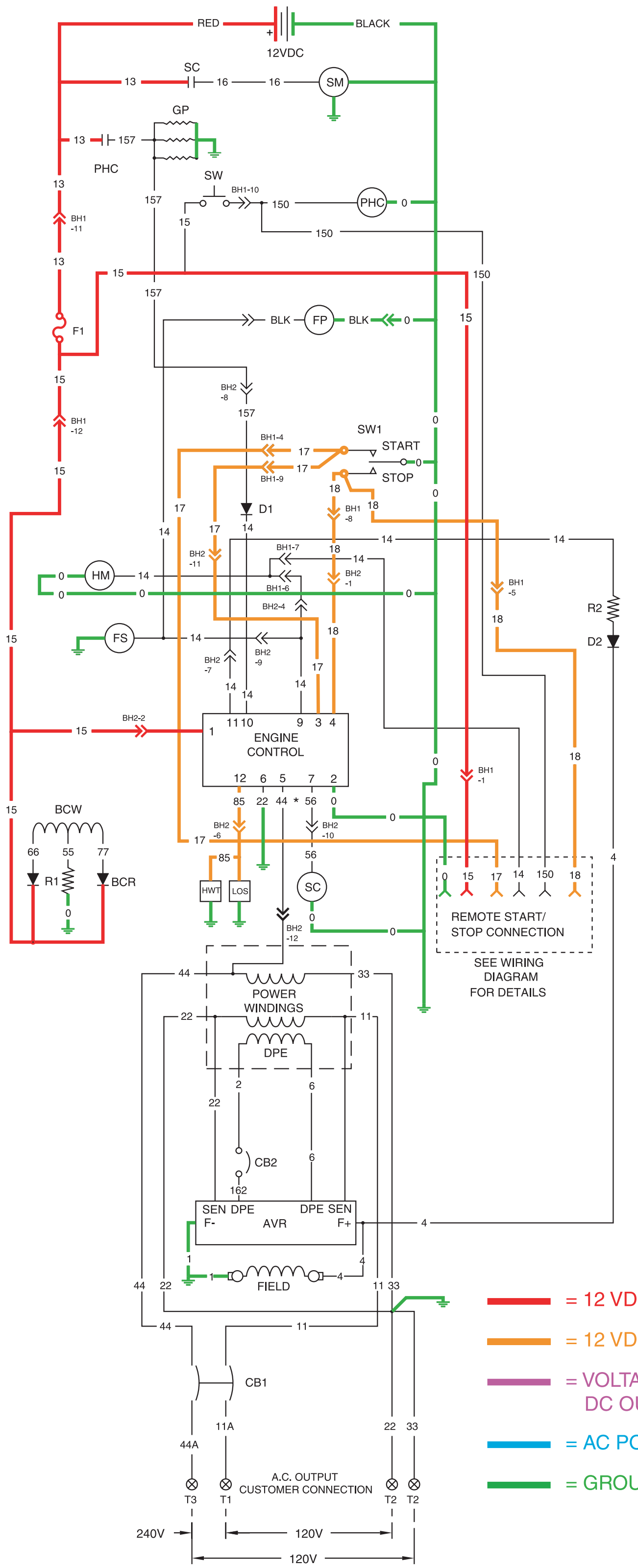


CIRCUIT CONDITION- FAULT SHUTDOWNS:

The engine has mounted to it a HIGH WATER TEMPERATURE SWITCH (HWT) and a LOW OIL PRESSURE SWITCH (LOS). While running, ENGINE CONTROL circuit board action keeps Terminal 12 Wire 85 energized with battery voltage. Connected in parallel to (Wire 85) are the LOW OIL PRESSURE SWITCH (LOS) and HIGH WATER TEMP SWITCH (HWT). The (LOS) has normally closed contacts. After start-up, engine oil pressure will open the contacts. The HWT has normally open contacts. High coolant temperature will close the contacts.

Should engine water temperature exceed a preset value, the switch contacts will close. Wire 85 from the circuit board will connect to ground. Circuit board action will then initiate a shutdown.

Should engine oil pressure drop below a safe pre-set value, the switch contacts will close.

On contact closure, Wire 85 will be connected to ground and circuit board action will initiate an engine shutdown.

The circuit board has a time delay built into it for the Wire 85 fault shutdowns. At STARTUP ONLY the circuit board will wait approximately six (6) seconds before looking at the Wire 85 fault shutdowns. Once running after the six (6) second time delay, grounding Wire 85 through either switch will cause an immediate shutdown.

The ENGINE CONTROL circuit board also has overspeed protection. The circuit board senses the AC output from the stators POWER winding at Terminals 5 & 6 via Wires 22 & 44. This AC voltage and frequency signal is used indirectly to monitor engine RPM. If the frequency should increase above a preset "adjustable" limit, the ENGINE CONTROL circuit board will cause an immediate shutdown.

= 12 VDC SUPPLY
= 12 VDC CONTROL
= VOLTAGE REGULATOR DC OUTPUT
= AC POWER
= GROUND

LEGEND
AVR -AUTOMATIC VOLTAGE REGULATOR
BCR -BATTERY CHARGE RECTIFIER
BCW -BATTERY CHARGER
CB1 -CIRCUIT BREAKER 35A
CB2 -CIRCUIT BREAKER (4A)
D1 -DIODE 600V, 6AMP
D2 -DIODE 600V, 6AMP
DPE -EXCITATION WINDING
F1 -FUSE 14AMP SFE
FS -FUEL SOLENOID
FP -FUEL PUMP
GP -GLOW PLUGS
HM -HOURMETER
HWT -HIGH WATER TEMP SWITCH
LOS -LOW OIL PRESSURE SWITCH
PHC -PREHEAT CONTACTOR
R1 -RESISTOR, 1 OHM, 25W
R2 -RESISTOR, 20 OHM, 12W
S -STARTER
SC -START CONTACTOR
SW -PREHEAT SWITCH
SW1 -SWITCH, START/STOP

ENGINE CONTROL CIRCUIT BOARD

GENERAL:

The ENGINE CONTROL circuit board is responsible for cranking, startup, running, and shutdown operations. The board interconnects with other components of the DC control system to turn them on and off at the proper times. It is powered by fused 12 VDC power from the unit battery.

CIRCUIT BOARD CONNECTIONS:

The circuit board mounts two, six-wire terminal strips.

They are labeled 1-6 and 7-12.

The following chart shows the associated wires and the function(s) of each terminal and wire.

TERMINAL	WIRE	FUNCTION
1	15	Power supply (12VDC) for the circuit board and DC control system.
2	0	Common Ground
3	17	To Start Stop Switch and remote connector. When grounded by setting Start-Stop Switch to "START", engine will crank.
4	18	To Start-Stop Switch and remote connector. When grounded by setting Start-Stop-Switch to "STOP", engine shuts down.
5	44	Frequency signal for overspeed shutdown/starter disengage.
6	22	Frequency signal for overspeed shutdown/starter disengage.
7	56	Delivers 12 VDC to Starter Contactor (SC) while cranking only.
8	__	Not Used
9	14	Engine run circuit. Delivers 12 VDC during cranking and running. Connected to Fuel Pump, Fuel Solenoid, Hourmeter, and field boost circuit.
10	14	Engine run circuit. Delivers 12 VDC during cranking and running. Connected to Fuel Pump, Fuel Solenoid, Hourmeter, and field boost circuit.
11	14	Engine run circuit. Delivers 12 VDC during cranking and running. Connected to Fuel Pump, Fuel Solenoid, Hourmeter, and field boost circuit.
12	85	Fault shutdown circuit. When grounded by High Water Temperature or Low Oil Pressure switch, engine will shut down.

LED FUNCTIONS:

Green LED will be illuminated when Wire 14 is energized during cranking and running.

Red LED will be illuminated when Wire 56 is energized during cranking only.

OVERSPEED SHUTDOWN POTENTIOMETER:

The overspeed shutdown potentiometer is used to set the frequency at which the board will initiate a engine shutdown. Proper setting of the potentiometer is critical to the correct operation of the generator.

ADJUSTMENT PROCEDURE:

The overspeed shutdown potentiometer MUST be adjusted on replacement circuit boards.

If not replacing a board, start at STEP 6.

1. Remove 14 amp fuse (F1) from control panel.
2. Disconnect all wires from circuit board terminals.
3. Remove old circuit board and install new circuit board.
4. Connect all wires to proper circuit board terminals. Follow electrical schematic if needed.
5. Reinstall 14 amp (F1) fuse into control panel.
6. Turn the overspeed shutdown potentiometer slowly counterclockwise until it stops. DO NOT FORCE.

Note: If immediate shutdown occurs when the engine starts and the START/STOP switch is released, reverse overspeed shutdown pot setting, turn pot clockwise and proceed. In Step 10 and Step 11, turn the overspeed shutdown pot counterclockwise.

7. Connect an accurate AC frequency meter across the generator's AC output leads.
8. Start the generator, let it stabilize and warm up.
9. Use the injection throttle lever to SLOWLY increase engine speed until the frequency meter reads 64 hertz.
10. Hold the throttle at 64 hertz and SLOWLY turn the overspeed shutdown potentiometer clockwise until engine shutdown occurs.
11. Turn the overspeed shutdown potentiometer clockwise an additional 1/8 turn. The overspeed setting is now correct.

BATTERY

RECOMMENDED BATTERY:

When anticipated ambient temperatures will be consistently above 32° F. (0° C.), use a 12 VDC automotive type storage battery rated 70 amp-hours and capable of delivering at least 360 cold cranking amperes.

The QUIETPACT 75D generator is rated at about 160 DC Amps of cranking current to operate the starter and glow plugs.

BATTERY CABLES:

Use of battery cables that are too long or too small in diameter will result in excessive voltage drop. For best cold weather starting, voltage drop between the

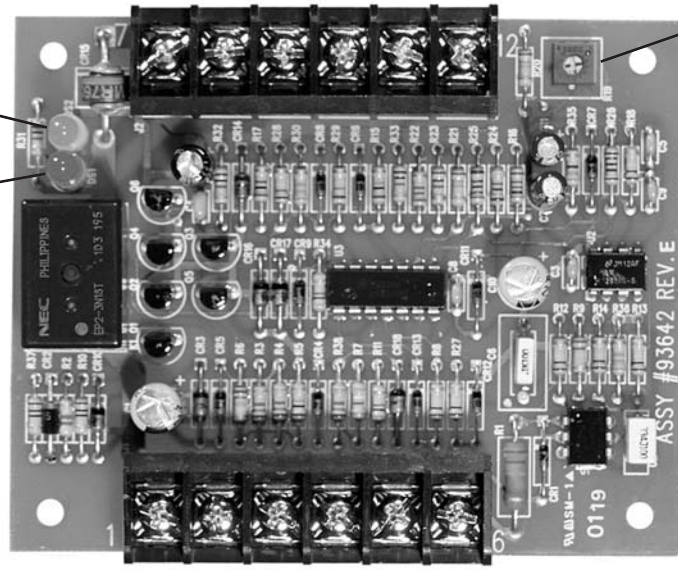


Figure 5-4 – Engine Control Circuit Board

battery and starter should not exceed 0.12 VDC per 100 amperes of cranking current.

Select the battery cables based on total cable length and prevailing ambient temperature. Generally, the longer the cable and the colder the weather, the larger the required cable diameter.

The following chart applies:

CABLE LENGTH (IN FEET)	RECOMMENDED CABLE SIZE
0-10	No. 2
11-15	No. 0
16-20	No. 000

EFFECTS OF TEMPERATURE:

Battery efficiency is greatly reduced by a decreased electrolyte temperature. Such low temperatures have a decided numbing effect on the electrochemical action. Under high discharge rates (such as cranking), battery voltage will drop to much lower values in cold temperatures than in warmer temperatures. The freezing point of battery electrolyte fluid is affected by the state of charge of the electrolyte as indicated below:

SPECIFIC GRAVITY	FREEZING POINT
1.220	-35° F. (-37° C.)
1.200	--20° F. (-29° C.)
1.160	0° F. (-18° C.)

ADDING WATER:

Water is lost from a battery as a result of charging and discharging and must be replaced. If the water is not replaced and the plates become exposed, they may become permanently sulfated. In addition, the plates cannot take full part in the battery action unless they are completely immersed in electrolyte. Add only DISTILLED WATER to the battery. DO NOT USE TAP WATER.

NOTE: Water cannot be added to some "maintenance-free" batteries.

CHECKING BATTERY STATE OF CHARGE:

Use an automotive type battery hydrometer to test the battery state of charge. Follow the hydrometer manufacturer's instructions carefully. Generally, a battery may be considered fully charged when the specific gravity of its electrolyte is 1.260. If the hydrometer used does not have a "Percentage of Charge" scale, compare the readings obtained with the following:

SPECIFIC GRAVITY	PERCENTAGE OF CHARGE
1.260	100%
1.230	75%
1.200	50%
1.170	25%

CHARGING A BATTERY:

Use an automotive type battery charger to recharge a battery. Battery fluid is an extremely corrosive, sulfuric acid solution that can cause severe burns. For that reason, the following precautions must be observed:

- The area in which the battery is being charged must be well ventilated. When charging a battery, an explosive gas mixture forms in each cell.
- Do not smoke or break a live circuit near the top of the battery. Sparking could cause an explosion.
- Avoid spillage of battery fluid. If spillage occurs, flush the affected area with clear water immediately.
- Wear eye protection when handling a battery.

14 AMP FUSE

This panel-mounted Fuse protects the DC control circuit against overload and possible damage. If the Fuse has melted open due to an overload, neither the priming function nor the cranking function will be available.

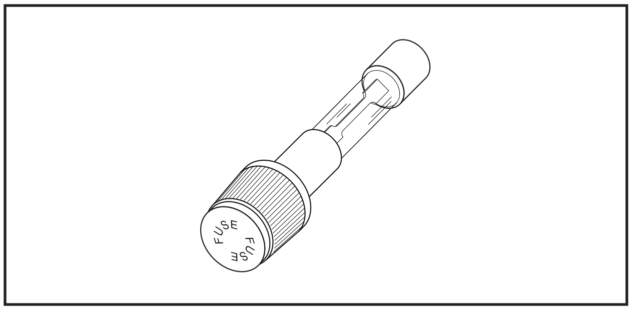


Figure5-4

PREHEAT SWITCH

The diesel engine is equipped with glow plugs, one for each cylinder. When the preheat switch is pressed, voltage will go through the switch to the preheat contactor. The preheat contactor (normally open) now closes, allowing battery voltage to go to the glow plugs via Wire 157. Power from Wire 157 goes through a diode and changes to Wire 14. This Wire 14 goes to the circuit board powering the fuel pump, fuel solenoid, hourmeter, and field boost through another diode and resistor. The glow plugs now heat the engine combustion chamber, and the injector pump is primed with fuel for starting.

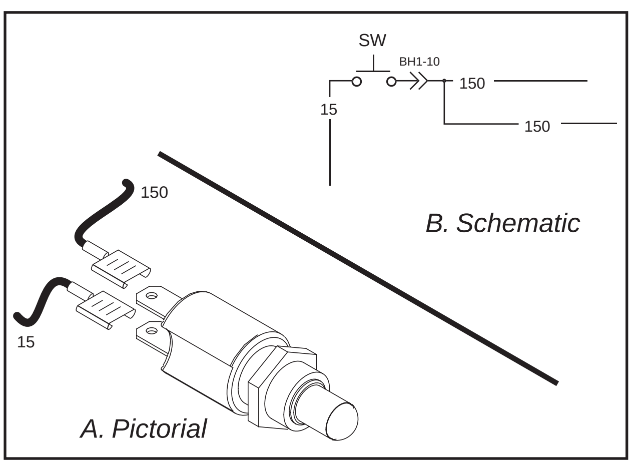


Figure 5-5. – Pre-heat Switch

START/STOP SWITCH

The start/stop switch allows the operator to control cranking, startup, and shutdown. The following wires connect to the start/stop switch:

WIRE 17 (FROM THE ENGINE CONTROL BOARD):

This is the crank and start circuit. When the switch is set to start, Wire 17 is connected to ground via Wire 0. With Wire 17 grounded, a crank relay on the circuit board energizes and battery voltage is delivered to the starter contactor via Wire 56. The starter contactor energizes and its normally open contacts close allowing battery voltage through Wire 16 to the starter motor and the engine will now crank. With Wire 17 grounded, a run relay on the circuit board energizes and battery voltage is delivered to the Wire 14 circuit. Now the fuel pump, fuel solenoid, hourmeter, and field boost has battery voltage for operation.

WIRE 18 (FROM THE ENGINE CONTROL BOARD):

This is the engine stop circuit. When the start/stop switch is set to stop, Wire 18 is connected to ground via Wire 0. Circuit board action then opens the circuit to Wire 14, stopping fuel flow, causing the unit to stop.

WIRE 0:
Connects the switch to ground.

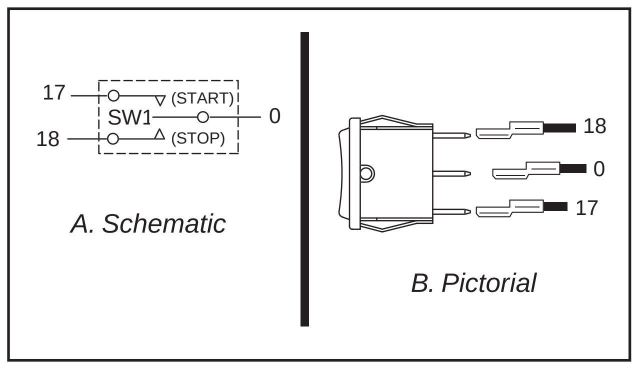


Figure 5-6. – Start/Stop Switch

STARTER CONTACTOR & MOTOR

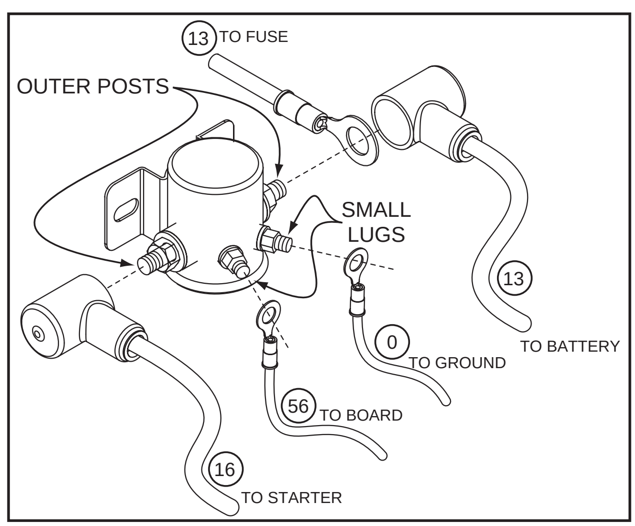


Figure 5-7. – Starter Contactor and Connections

The positive (+) battery cable (13) attaches to one of the outer posts of the contactor along with Wire 13 for the DC supply to the fuse (F1). The starter cable (16) attaches to the remaining outer post. Attached to the small 2 lugs are Wires 56 and 0. When the start/stop switch is set to start, the circuit board delivers battery voltage to the contactor coil via Wire 56. The contactor energizes and its contacts close. Battery voltage is then delivered from the positive battery cable, across contacts and to the starter motor via Wire 16.

ENGINE GOVERNOR

A mechanical, all-speed governor is used on the diesel engine. It is housed in the gear case. A flyweight movement is transmitted to the injection pump control rack by way of the slider, control lever and link. A spring is attached to the arm and the tension lever. The spring regulates flyweight movement. By changing the set angle of the governor lever, tension on the tension lever spring is changed. In this manner, engine speed can be regulated by the governor lever.

The generators A/C output frequency is directly proportional to engine speed. Low governor speed will result in a reduced A/C frequency and voltage, and high governor speed will produce an increased frequency and voltage.

FUEL INJECTION PUMP

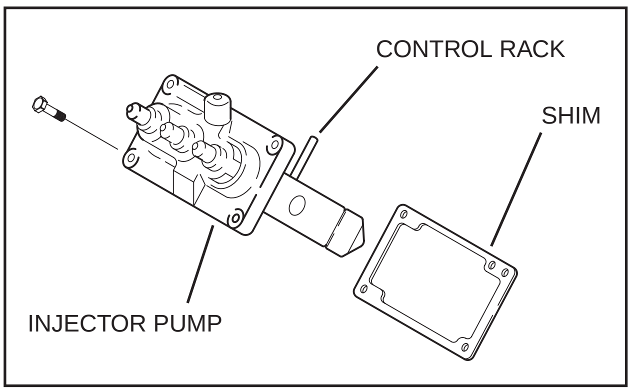


Figure 5-8. – Fuel Injection Pump

The fuel injection pump is mounted on the side of the engine and rides on a three-lobe camshaft. The lobes on the camshaft press the bottom of the pump, which mechanically opens the fuel path to deliver fuel to the fuel injectors. Timing for the fuel injector pump is determined by the distance between the camshaft lobes and the pump. This distance is regulated by metal shims. If the shim space is incorrect, the fuel pressure will be incorrect and combustion will not occur. When the fuel injector pump is removed for maintenance, be sure to reassemble with the same number of shims. The engine governor controls the fuel injector pump by linkage connecting the two.

FUEL NOZZLES/INJECTORS

Fuel supplied by the injector pump is delivered to the nozzle holder and to the nozzle body. When fuel pressure is sufficient to compress the spring, fuel is supplied from the nozzle and into the combustion chamber. Due to the high pressure of fuel being ejected from the nozzle, there is no safe test. If faulty fuel is suspected and a clogged injector pump was diagnosed, the replacement of the injector nozzles would be needed.

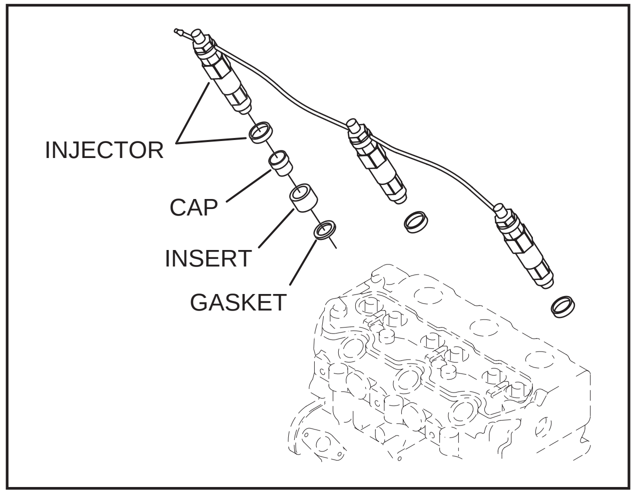


Figure 5-9. – Fuel Injectors

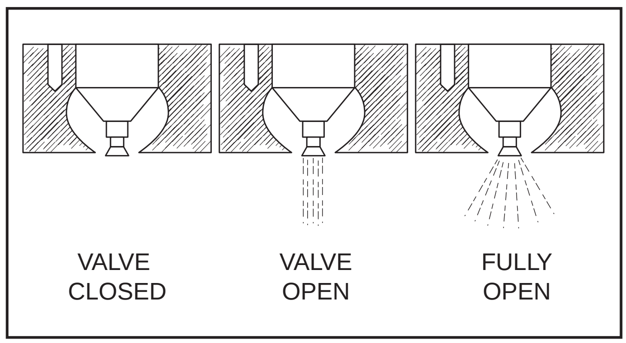


Figure 5-10. – Fuel Injector Nozzles

GLOW PLUGS

The glow plug consists of a thin coiled heat-wire that is encased in sintered magnesium oxide powder and enclosed by a stainless steel sheath. One end of the wire is welded to the sheath and the other end is welded to the center electrode. When voltage is applied to the center electrode, it heats the heat-wire, which in turn, heats the combustion chamber.

Glow plugs are connected in parallel. For that reason, if one plug fails open, the other plugs will continue to operate. However, loss of one plug will increase the possibility of the heat-wire melting open in the remaining plugs.

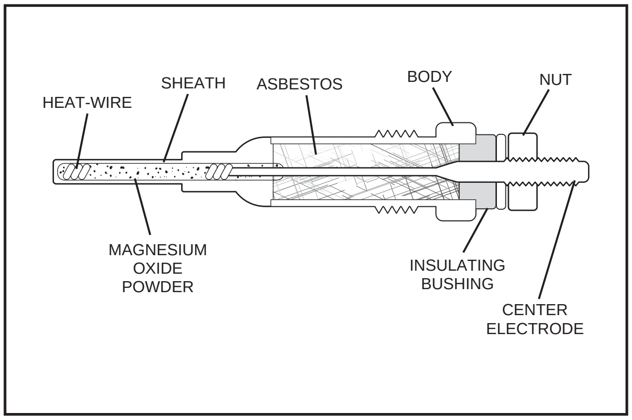


Figure 5-11. – Glow Plug

ENGINE PROTECTIVE DEVICES

The engine will shut down automatically in the event of anyone or more of the following occurrences:

- Low oil
- High engine coolant temperature
- Engine overspeed

LOW OIL PRESSURE SWITCH

The oil pressure switch has normally-closed contacts. When the engine is cranking or running, oil will pass through the switch, which opens the contacts. If oil pressure should drop below 10 PSI, the contacts will close to ground sending a signal to the printed circuit board to shut unit down on wire 85.

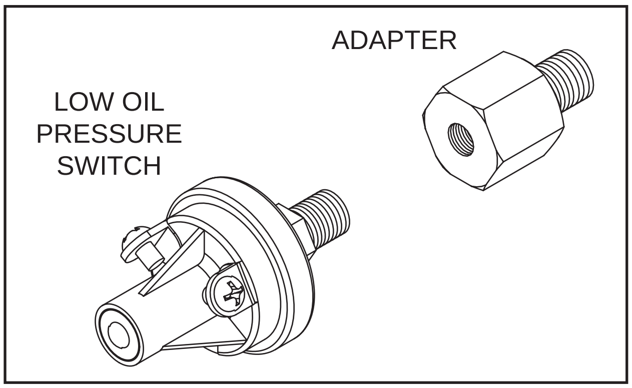


Figure 5-12. – Low Oil Pressure Switch

HIGH COOLANT TEMPERATURE SWITCH

The high coolant temperature switch has normally open contacts. This switch is immersed in engine coolant. If the coolant temperature should exceed 245-266 degrees F, the switches contacts will close to ground, sending a signal to the printed circuit board to shut down the unit via wire 85.

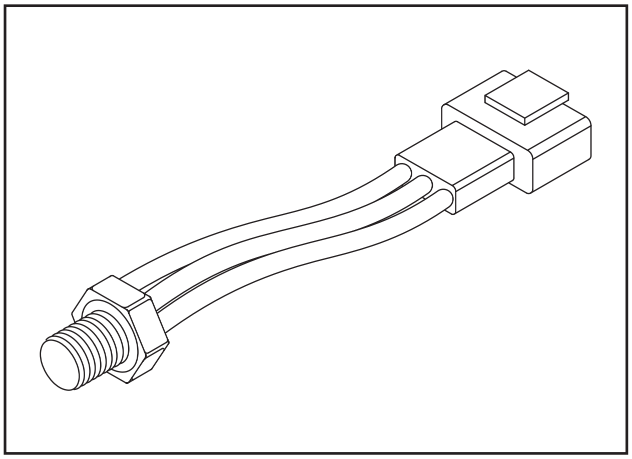


Figure 5-13. – High Coolant Temperature Switch

OVERSPEED PROTECTION

Generator A/C frequency signals are delivered to Terminals 5 and 6 of the engine control circuit board via wires 22 and 44. Should engine/generator speed exceed 69 to 71 Hertz for longer than 4 seconds, the circuit board will cause an engine shutdown.

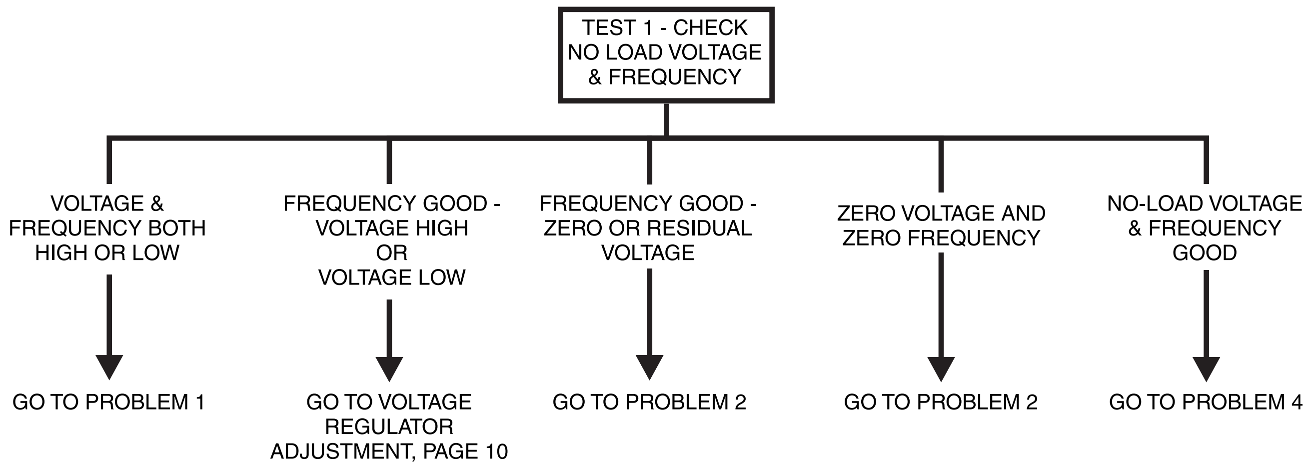
INTRODUCTION

The “Flow Charts” in this section can be used in conjunction with the “Diagnostic Tests” of Section 7. Numbered tests in the Flow Charts correspond to identically numbered tests of Section 7.

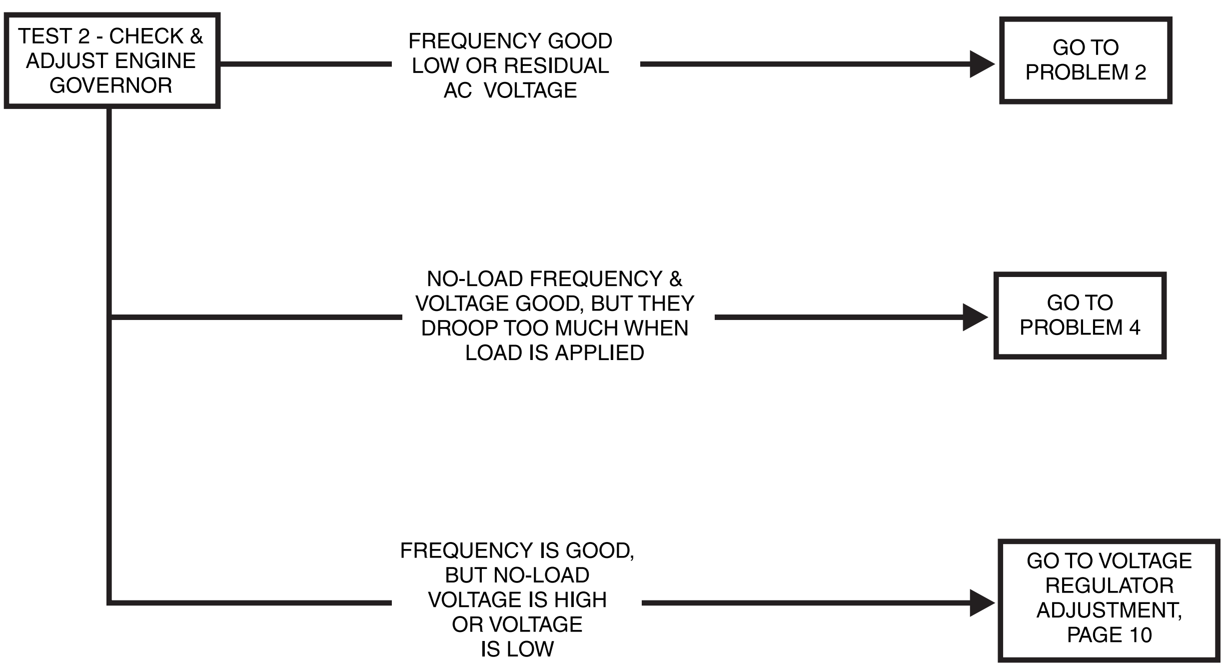
Problems 1 through 4 apply to the AC generator only.

Beginning with Problem 5, the engine DC control system is dealt with.

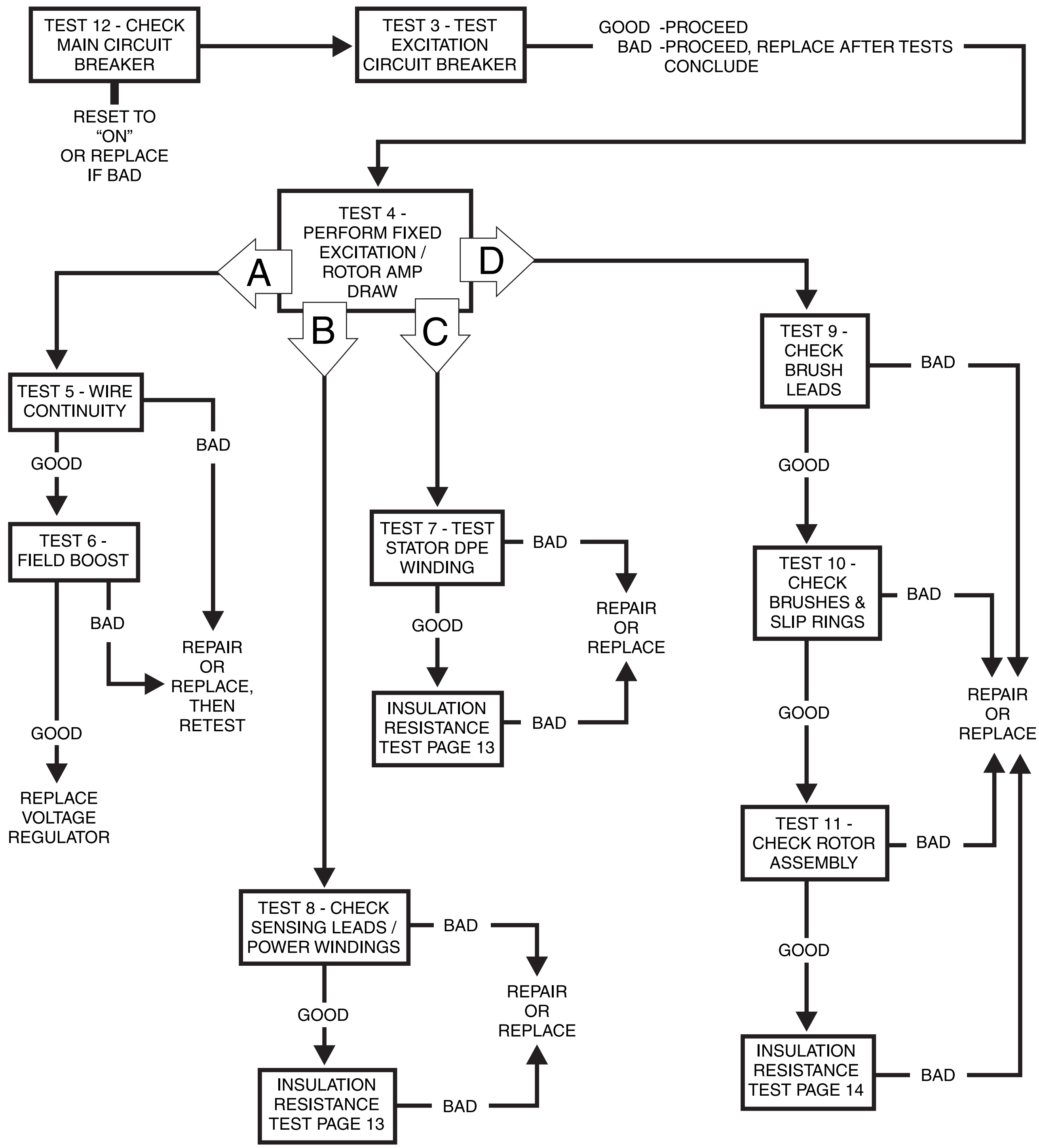
If Problem Involves AC Output



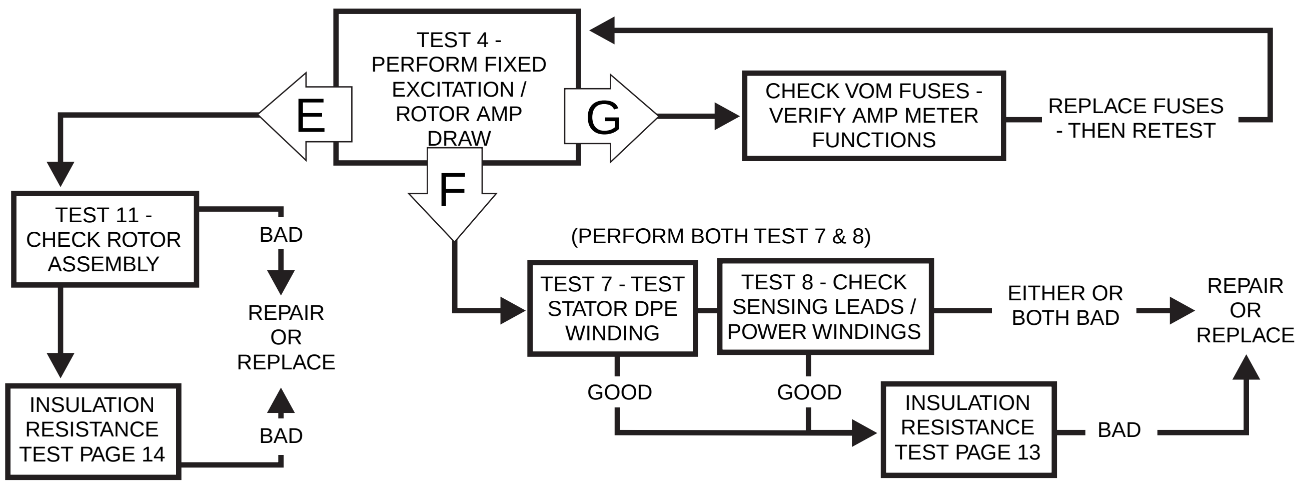
Problem 1 - Voltage & Frequency Are Both High or Low



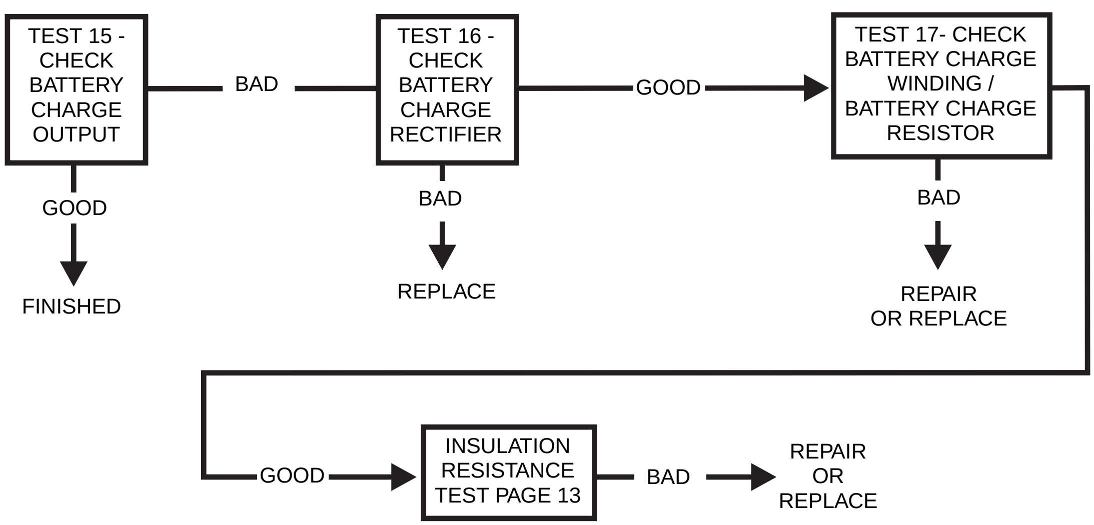
Problem 2 - Generator Produces Zero Voltage or Residual Voltage (5-12 VAC)



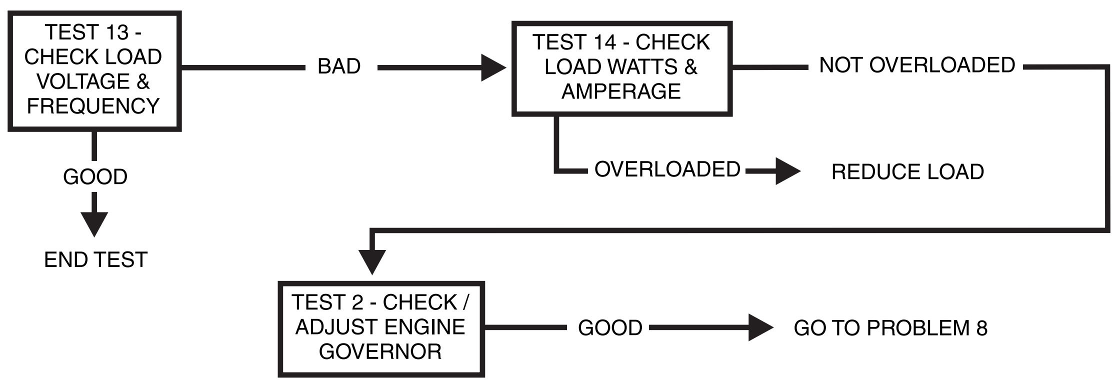
Problem 2 - Generator Produces Zero Voltage or Residual Voltage (5-12 VAC) (continued)



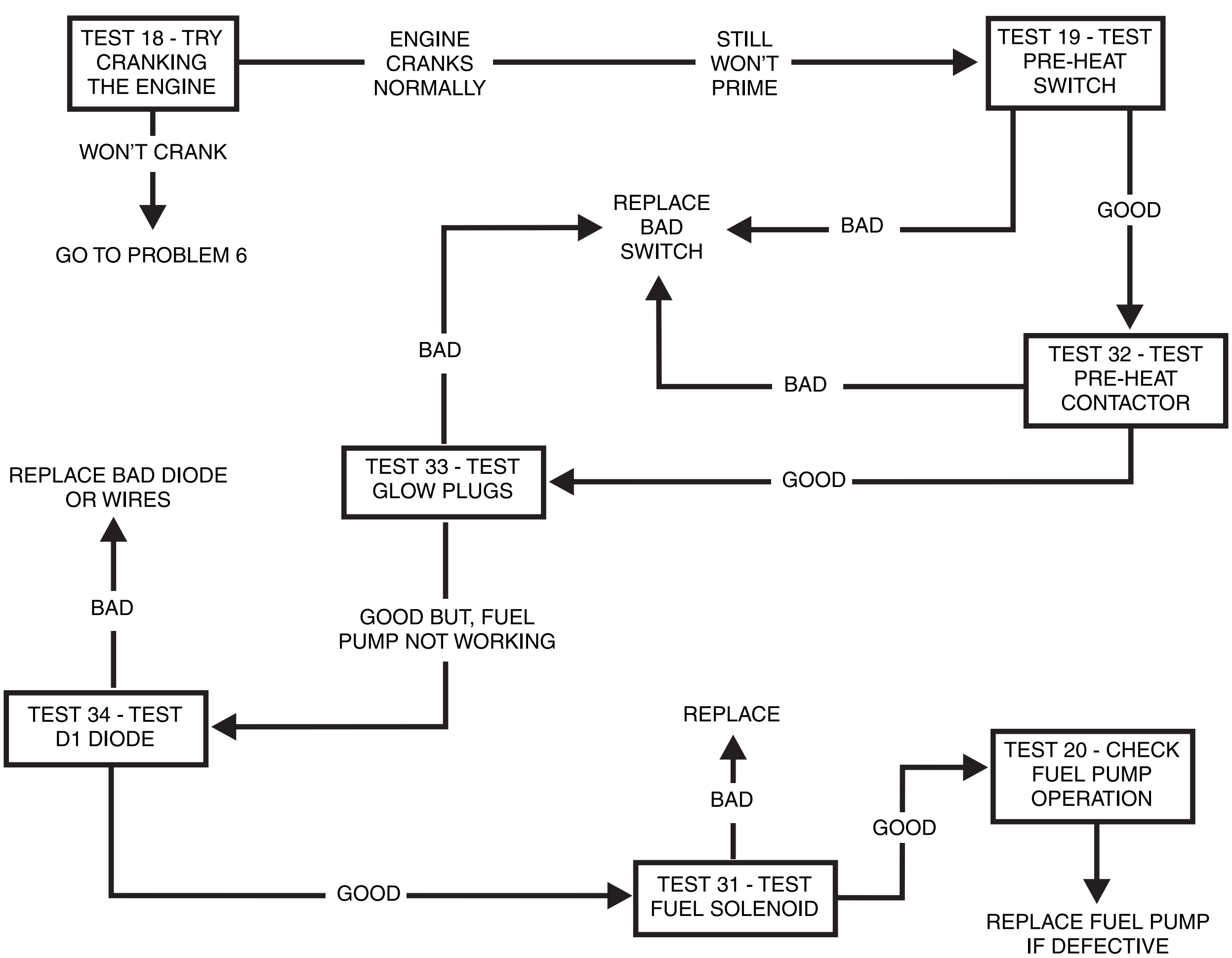
Problem 3 - No Battery Charge Output



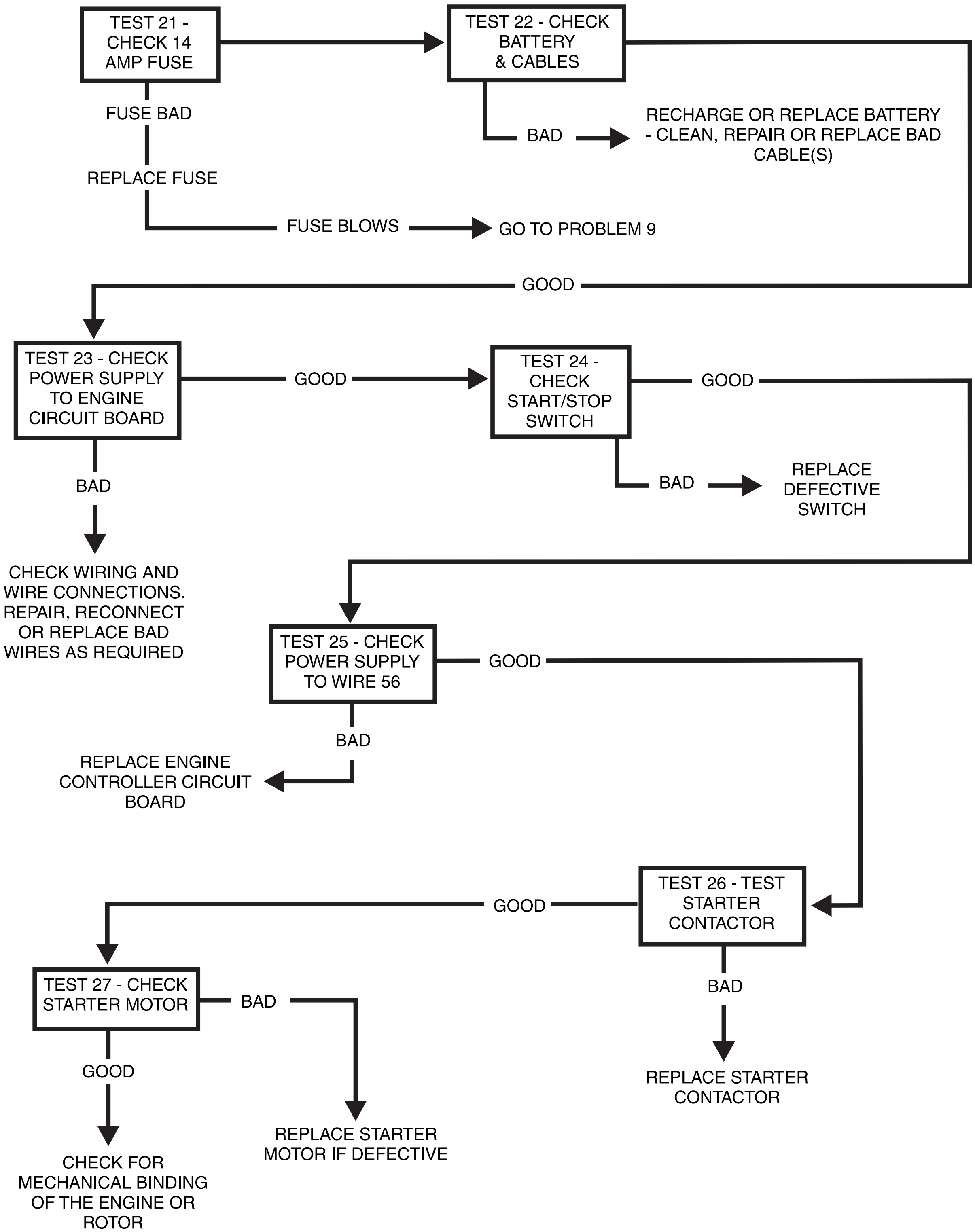
Problem 4 - Excessive Voltage/Frequency Droop When Load is Applied



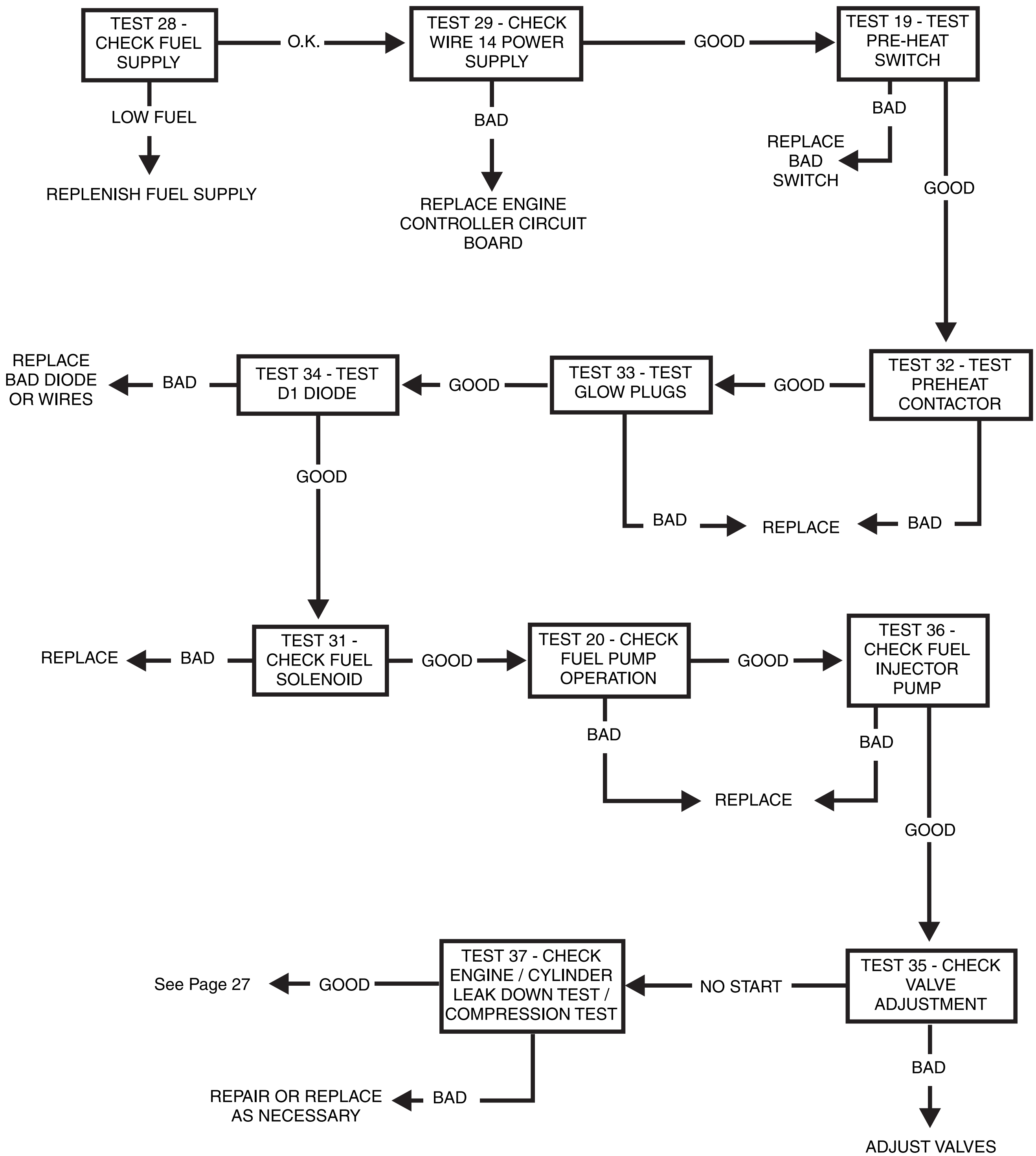
Problem 5 - Pre-Heat Function Does Not Work



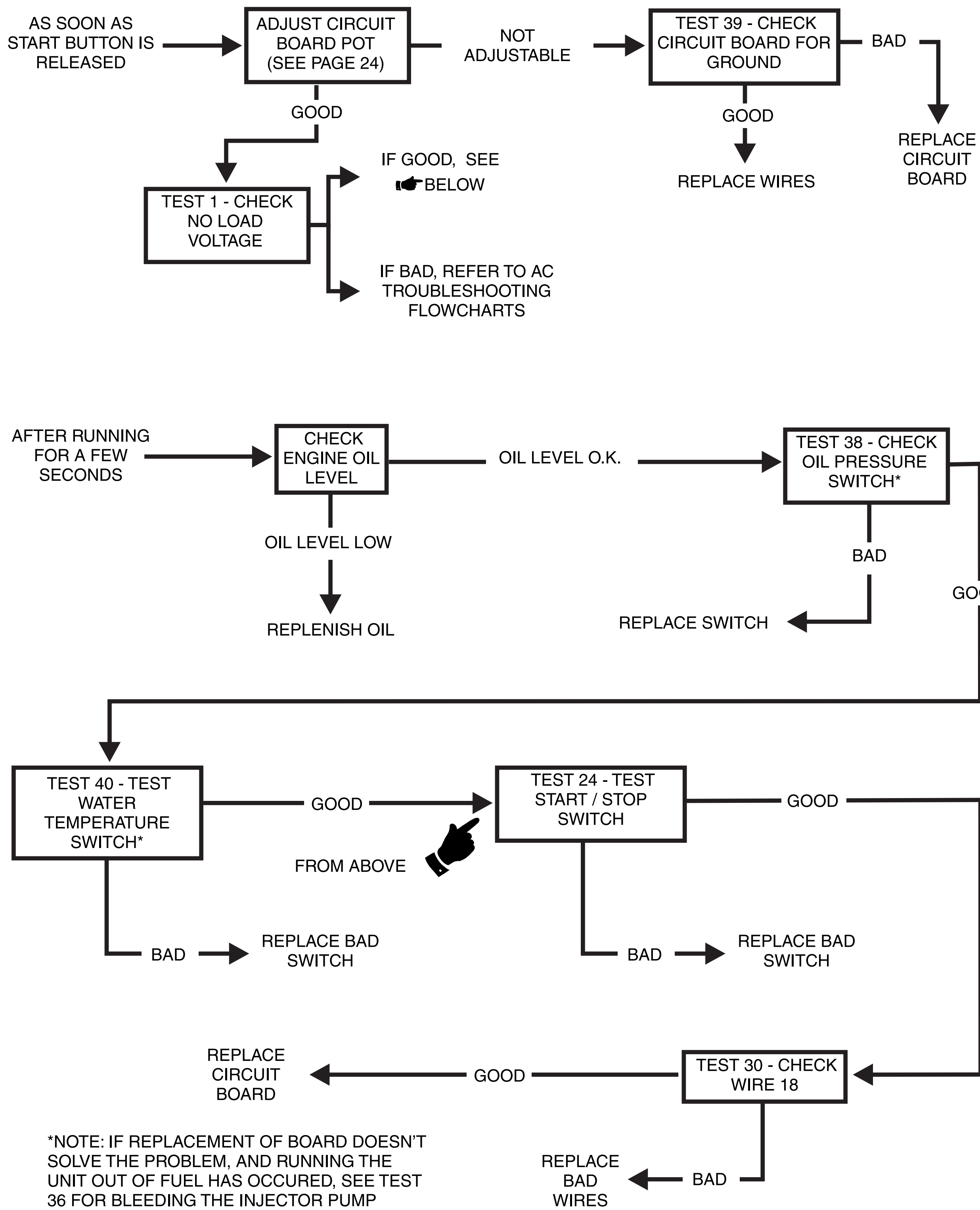
Problem 6 - Engine Will Not Crank



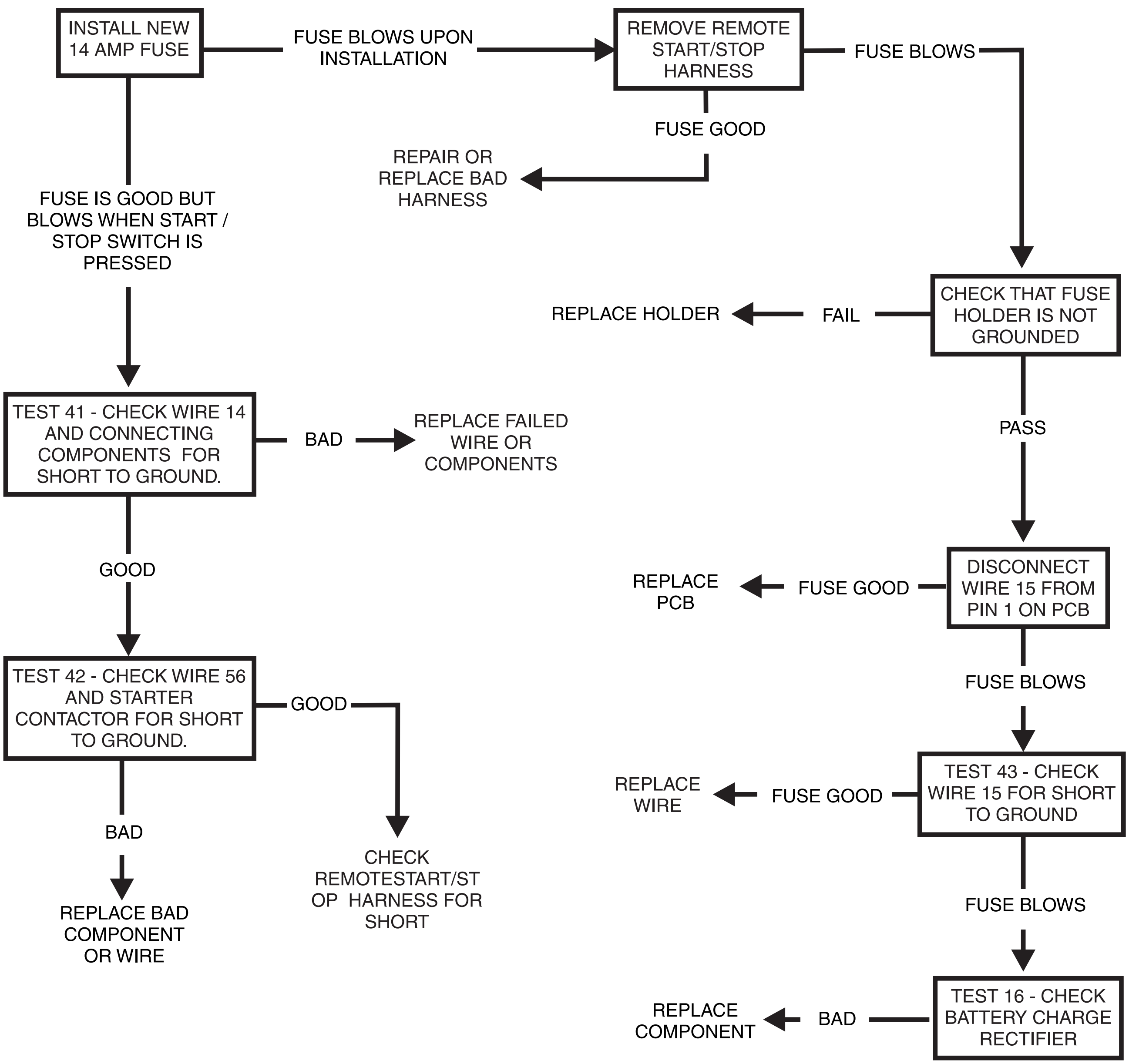
Problem 7 - Engine Cranks But Will Not Start / Runs Rough



Problem 8 - Engine Starts Then Shuts Down



Problem 9 - 14 Amp (F1) Fuse Blowing



INTRODUCTION

The "Diagnostic Tests" in this chapter may be performed in conjunction with the "Flow Charts" of Section 6. Test numbers in this chapter correspond to the numbered tests in the "Flow Charts".

Tests 1 through 17 are procedures involving problems with the generator's AC output voltage and frequency (Problems 1 through 4 in the "Flow Charts").

Tests 18 through 42 are procedures involving problems with engine operation (Problems 5 through 9 in the "Troubleshooting Flow Charts").

Review and become familiar with Section 4, "Measuring Electricity".

NOTE: Test procedures in this Manual are not necessarily the only acceptable methods for diagnosing the condition of components and circuits. All possible methods that might be used for system diagnosis have not been evaluated. If any diagnostic method other than the method presented in this Manual is utilized, ensure that neither personnel safety nor the product's safety will be endangered by the procedure or method utilized.

TEST 1- CHECK NO-LOAD VOLTAGE AND FREQUENCY

DISCUSSION:

The first step in analyzing any problem with the AC generator is to determine the unit's AC output voltage and frequency.

PROCEDURE:

1. Set a volt-ohm-milliammeter (VOM) to read AC voltage. Connect the meter test leads across customer connection leads T1 (Red) and T2 (White).
2. Disconnect or turn OFF all electrical loads. Initial checks and adjustments are accomplished at no-load.
3. Start the engine, let it stabilize and warm up.
4. Read the AC voltage.
5. Connect an AC frequency meter across AC output leads T1 (Red) and T2 (White) on the customer connection. Repeat the above procedure.

RESULTS:

For units rated 60-Hertz, no-load voltage and frequency should be approximately 122-126 VAC and 61-63 Hertz respectively.

1. If AC voltage and frequency are BOTH correspondingly high or low, go to Test 2.
2. If AC frequency is good but low or residual voltage is indicated, go to Test 3.
3. If AC output voltage and frequency are both "zero", go to Test 12.
4. If the no-load voltage and frequency are within the stated limits, go to Test 13.

NOTE: The term "low voltage" refers to any voltage reading that is lower than the unit's rated voltage. The term "residual voltage" refers to the output voltage supplied as a result of Rotor residual magnetism (approximately 5-12 VAC).

TEST 2 - CHECK & ADJUST ENGINE GOVERNOR

DISCUSSION:

Rotor operating speed and A/C output frequency is proportional. The generator will deliver a frequency of 60 HERTZ at 1950 RPM or 62 HERTZ at 2015 RPM. The voltage regulator should be adjusted to deliver 120 VAC (line-to-neutral) at a frequency of 60 HERTZ or 124 VAC (line-to-neutral) at 62 HERTZ. It is apparent that if governor speed is high or low, A/C frequency and voltage will be correspondingly high or low. Governor speed at no-load is usually set slightly above the rated speed of 60HERTZ (to 62.8 HERTZ) to prevent excessive RPM, frequency, and voltage droop under heavy electrical loading.

ENGINE GOVERNOR ADJUSTMENT:

Initial adjustment of governed speed should be accomplished at no-load condition. Prior to engine startup, turn off all electrical loads by whatever means available (such as generator main circuit breaker).

Figure 7-1. – Governor Adjustment Points

PROCEDURE:

1. Connect an accurate A/C frequency meter and voltmeter to the proper generator leads.
2. Start the engine, let it stabilize and warm up at no-load.
3. Frequency meter should read between 62-63 HERTZ. Line-to-

line voltage should read between 242-252 VAC. If voltage and frequency are good, no adjustment is needed. If voltage and frequency are low or high, proceed to next step.

4. Turn the governor adjusting screws to obtain a no-load frequency as close as possible to 62-63 HERTZ. With no-load frequency set, apply an electrical load as close as possible to the unit's rated load. Frequency with load applied should not fall below 58 HERTZ. If units frequency continues to drop below 58 HERTZ while under load, check for an overload condition.

TEST 3- TEST EXCITATION CIRCUIT BREAKER

DISCUSSION:

This circuit breaker (CB2) is normally closed and self-resetting. It will open in the event of excessive current from the Stator excitation (DPE) winding. The circuit breaker should re-close or reset automatically after it cools down (takes approximately two minutes).

When the breaker (CB2) is open, excitation current to the Regulator (and to the Rotor) will be lost. The unit's AC output voltage will then drop to a value that is equal to the Rotor's residual magnetism (about 5-12 volts AC). This test will determine if the breaker has failed in its open position.

PROCEDURE:

Note: After running the unit, allow two minutes for the breaker to reset.

1. Set a volt-ohm-milliammeter (VOM) to its “Rx1” scale and zero the meter.

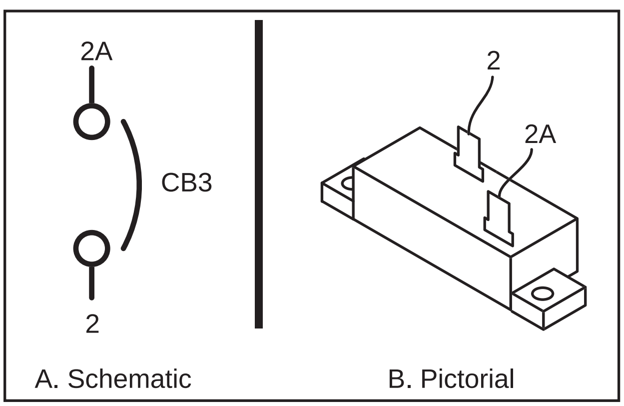


Figure 7-2. – Excitation “DPE” Circuit Breaker

2. In the generator panel, locate the excitation circuit breaker. Disconnect Wire 2 and Wire 162 from the breaker terminals.

3. Connect the meter test leads across the two circuit breaker (CB3) terminals. The meter should indicate “continuity”.

RESULTS:

1. If the meter did NOT read “continuity”, replace the excitation (DPE) circuit breaker (CB2), and go to Test 4.

2. If “continuity” was indicated, go to Test 4.

TEST 4- FIXED EXCITATION TEST/ROTOR AMP DRAW

DISCUSSION:

The fixed excitation test consists of applying battery voltage (12 VDC) to the Rotor windings. This allows that portion of the excitation circuit between the Voltage Regulator and the Rotor (including the Rotor itself) to be checked as a possible cause of the problem. When battery voltage is applied to the Rotor, the resulting magnetic field around the Rotor should induce a Stator power winding voltage equal to about one-half the unit's rated output voltage.

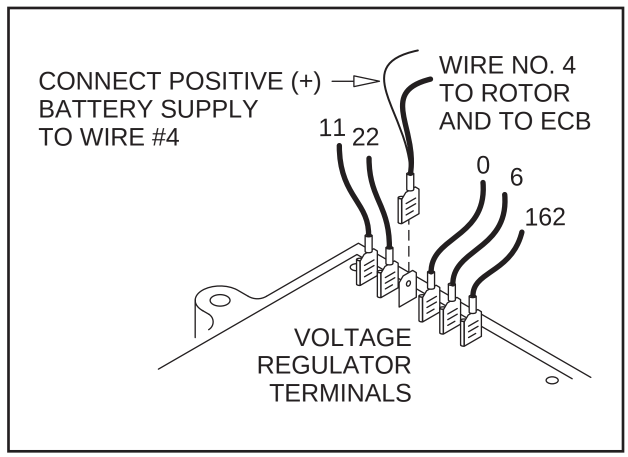


Figure 7-3. – Fixed Excitation Test

PROCEDURE:

1. Disconnect Wire 4 from the Voltage Regulator (VR). (Third terminal from the top of VR).

2. Connect a jumper wire to Wire 4 and to the 12 volt fused battery positive supply Wire 15 (Wire 15 located at fuse (F1) holder).

3. Set the VOM to measure AC voltage.

4. Disconnect Wire 2 from the DPE breaker (CB2) and connect one test lead to that wire. Disconnect Wire 6 from the Voltage Regulator and connect the other test lead to that wire. Start the generator and measure the AC voltage. It should be above 60 VAC. Record the results and stop the generator.

5. Re-connect Wire 2 to the DPE Circuit Breaker (CB2) and re-connect Wire 6 to the Voltage Regulator.

TEST 4 RESULTS	A	B	C	D	E	F	G
VOLTAGE RESULTS WIRE 2 & 6 EXCITATION WINDING	ABOVE 60 VAC	ABOVE 60 VAC	BELOW 60 VAC	ZERO OR RESIDUAL VOLTAGE (5-12 VAC)	BELOW 60 VAC	BELOW 60 VAC	ABOVE 60 VAC
VOLTAGE RESULTS WIRE 11 & 22 POWER WINDING SENSE LEADS	ABOVE 60 VAC	BELOW 60 VAC	ABOVE 60 VAC	ZERO OR RESIDUAL VOLTAGE (5-12 VAC)	BELOW 60 VAC	BELOW 60 VAC	ABOVE 60 VAC
ROTOR AMP DRAW QP75D (MODEL 4270)	.87-.79 A ± 20%	.87-.79 A ± 20%	.87-.79 A ± 20%	ZERO CURRENT DRAW	≥1.2 A	.87-.79 A ± 20%	ZERO CURRENT DRAW

(MATCH RESULTS WITH LETTER AND REFER TO FLOW CHART – Problem 2 on Pages 30 & 31)

6. Disconnect Wire 11 from the Voltage Regulator (VR) and connect one test lead to that wire. Disconnect Wire 22 from the Voltage Regulator and connect the other test lead to that wire. Start the generator and measure the AC voltage. It should be above 60 VAC. Record the results and stop the generator.
7. Re-connect Wire 11 and Wire 22 to the Voltage Regulator.
8. Remove the jumper wire between Wire 4 and 12 volt supply.
9. Set the VOM to measure DC amps.
10. Connect one test lead to the 12 volt fused battery supply Wire 15, and connect the other test lead to Wire 4 (should still be disconnected from the VR).
11. Start the generator. Measure the DC current. Record the rotor amp draw.
12. Stop the generator. Re-connect Wire 4 to the Voltage Regulator.

RESULTS:

Proceed to “TEST 4 RESULTS” (top of page 40). Match all results to corresponding column in the chart. The column letter refers to the Problem 4 flow charts on pages 28 and 29.

TEST 5- WIRE CONTINUITY

DISCUSSION:

The Voltage Regulator receives unregulated alternating current from the Stator Excitation Winding via Wires 2 (162 and CB2), and 6. It also receives voltage sensing from the Stator AC Power Windings via Wires 11 and 22. The regulator rectifies the AC from the Excitation Winding and, based on the sensing signals, regulates that DC current flow to the Rotor. The rectified and regulated current flow is delivered to the Rotor Brushes via Wires 4 (+) and 0 (-). This test will verify the integrity of Wires 0 and 162.

PROCEDURE:

1. Set a VOM to its “Rx1” scale.
2. Remove Wire 0 from the Voltage Regulator, fourth terminal from the top (identified by a negative (-) sign next to terminal).
3. Connect one test lead to Wire 0 and the other test lead to a clean ground. The meter should read continuity.
4. Disconnect Wire 162 from the Voltage Regulator, sixth terminal from the top. Disconnect the other end of this wire from the Excitation Circuit Breaker (CB2). Connect one test lead to one end of Wire 162 and the other test lead to the other end of the same wire. The meter should read continuity.

RESULTS:

If continuity was NOT measured across each wire, repair or replace the wires as needed.

If continuity WAS measured, proceed to Test 6.

TEST 6- CHECK FIELD BOOST

DISCUSSION:

Field boost current is delivered to the Rotor only while the engine is being cranked. This current helps ensure that adequate “pickup” voltage is available to turn the Voltage Regulator on and build AC output voltage.

Loss of the field boost function may or may not result in a problem with AC output voltage. If the Rotor's residual magnetism is sufficient to turn the Regulator on, loss of the function may go unnoticed. However, if the Rotor's residual magnetism is not enough to turn the Regulator on, loss of field boost can result in failure of the unit to generate an output voltage.

PROCEDURE:

1. Set VOM to measure DC voltage.
2. Disconnect Wire 4 from the Voltage Regulator and connect the positive (+) test lead to it. Connect the negative (-) test lead to a clean frame ground.

3. Set the Start-Stop Switch to “START.” During cranking only, measure DC voltage. It should read 3-5 VDC. Reconnect Wire 4 to the Voltage Regulator. If voltage is measured, it can be assumed that the Field Boost is working. Stop testing. If voltage is not measured, proceed to Step 4.
4. Test D2 diode: Place a VOM to measure continuity. Place one test lead on one end of the diode and the other test lead on the other end. Check for continuity, then reverse the leads and retest. Continuity should only be measured in one direction, and when it is measured, it should have a single beep and not a constant tone. If continuity is measured in both directions then the diode will need to be replaced. If diode tests good, proceed to Step 5.
5. Test R2 resistor: Place a VOM to measure resistance. Disconnect wires going to the terminals of the resistor. Place the test leads on each terminal of the resistor. Resistance should be 20 Ohms. If resistance is bad, replace the resistor. If resistor is good, proceed to Step 6.
6. Test Wire 14: Place a VOM to measure continuity. Disconnect Wire 14 from the R2 resistor. Unplug the BH2 connector. Place one test lead on the Wire 14 end that was previously on the resistor. Place the other test lead on Pin 7 of the BH2 connector. Continuity should be measured. If wire is open, replace it. If wire is good, disconnect Wire 14 from the circuit board located on Terminal 11. Place one test lead on this end and the other test lead on the other BH2 connector Pin 7. Continuity should be measured. If continuity is not measured, replace the wire. If continuity is measured, make sure that the connection on BH2 is good. If the connection appears to be good, then replace the circuit board.

RESULTS:

1. If field boost voltage checks good in step 3, than replace the voltage regulator.
2. If field boost is not measured, replace failed parts in Steps 4-6.

TEST 7 - TEST STATOR DPE WINDING

DISCUSSION:

An open circuit in the Stator excitation windings will result in a loss of unregulated excitation current to the Voltage Regulator. The flow of regulated excitation current to the Rotor will then terminate and the unit's AC output voltage will drop to a value that is equal to the rotor’s residual magnetism (about 5 - 12 VAC).

PROCEDURE:

1. Disconnect Wire 2 from the Excitation Circuit Breaker.
2. Disconnect Wire 6 from the Voltage Regulator.
3. Set a VOM to its “Rx1” scale and zero the meter.

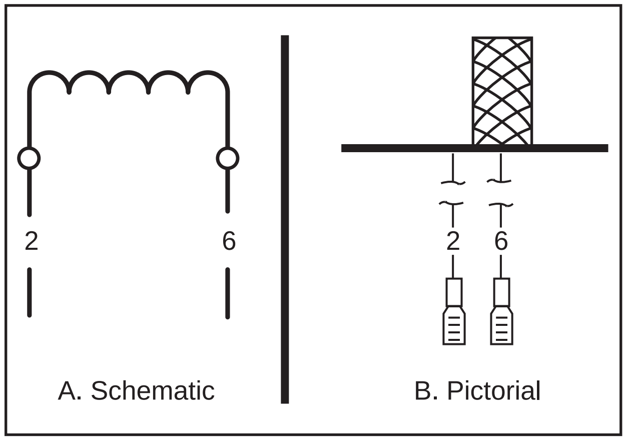


Figure 7-4. – Stator Excitation Winding

4. Connect the VOM test leads across the terminal ends of Wires 2 and 6. The VOM should indicate the resistance of the Stator Excitation (DPE) Windings.

EXCITATION “DPE” WINDING RESISTANCE * (Measured Across Wires 2 & 6)	
MODEL QP75D	1.24 OHMS

* Resistance values in ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

5. Now, set the meter to its “Rx1 K” or “Rx10,000” scale and zero the meter. Test for a “short-to-ground” condition as follows:
   a. Connect one meter test lead to Stator lead No. 2, the other test lead to a clean frame ground.
   b. The meter should read “Infinity”. Any other reading indicates a “short-to-ground” condition and the Stator should be replaced.
6. Test for a short between windings as follows:
   a. Meter should be set to its “Rx1 K” or “Rx10,000” scale.
   b. Connect one meter test lead to Stator Wire 2, the other test lead to Stator lead No. 11. The meter should read “Infinity”.
   c. Connect one VOM test lead to Stator lead No. 2 the other test lead to Stator lead No. 33. “Infinity” should be indicated.
   d. Connect one VOM test lead to Stator lead No. 2 and connect the other test lead to Stator lead No. 66. “Infinity” should be indicated.

RESULTS:

1. If the Stator excitation (DPE) windings are open or shorted, replace the Stator assembly.
2. If the excitation windings are good, perform “Insulation Resistance Test”, page 13.

TEST 8- CHECK SENSING LEADS / POWER WINDINGS

DISCUSSION:

The Voltage Regulator "regulates" excitation current flow to the Rotor by electronically comparing sensing voltage to a pre-set reference voltage. The sensing voltage is delivered to the Voltage Regulator via Wires 11 and 22.

If an open circuit exists in sensing leads 11S or 22S, the normal reaction of an unprotected Regulator would be to increase the excitation current to the Rotor in an effort to increase the actual AC output voltage. This would result in a "full field" condition and an extremely high AC output voltage.

To protect the system against such a high AC output voltage, the Voltage Regulator will shut down if sensing voltage signals are lost.

If the regulator shuts down, the generator's AC output voltage will decrease to a value that is equal to the Rotor's residual magnetism (about 5-12 VAC).

PROCEDURE:

Gain access to the generator control panel interior. Test the Stator power windings, as follows:

1. From main breaker, disconnect Wires 11 and 44.
2. Also disconnect Wires 22 and 33 from the ground terminal.
3. Disconnect Wires 11 and 22 (sensing leads) from the Voltage Regulator.
4. Set a VOM to its "Rx1" scale and zero the meter.
5. Connect the meter test leads across Stator leads 11 and 22. Normal power winding resistance should be read.
6. Connect the meter test leads across Stator leads 33 and 44. Normal power winding resistance should be read.
7. Connect the meter test leads across Stator sensing leads 11 and 22. Normal Power Winding resistance should be read.

AC POWER WINDING RESISTANCE * QP75D	
ACROSS WIRES:	OHMS
11 & 22	0.159W
33 & 44	0.184W

* Resistance values in ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

8. Now, set the VOM to its "Rx1 K" or "Rx10,000" scale and zero the meter.
9. Connect the meter test leads across Stator lead 11 and ground. "Infinity" should be read.
10. Connect the meter test leads across Stator lead 33 and ground. The reading should be "Infinity".
11. Connect the meter test leads across Stator leads Wire 11 and Wire 33. The reading should be "Infinity".
12. Connect the meter test leads across Stator leads Wire 11 and Wire 66. The reading should be "Infinity".
13. Connect the meter test leads across Stator leads Wire 33 and Wire 66. The reading should be "Infinity".
14. Connect the meter test leads across Stator leads Wire 11 and Wire 2. The reading should be "Infinity".
15. Connect the meter test leads across Stator leads Wire 33 and Wire 2. The reading should be "Infinity".

RESULTS:

1. If the Stator passes all steps except Step 7, repair, re-connect or replace Sensing leads 11 and 22.
2. Replace the Stator if it's power windings fail the test. (Note Result No. 1).
3. If the Power Windings test good, perform the "Insulation Resistance Test" on Page 13.

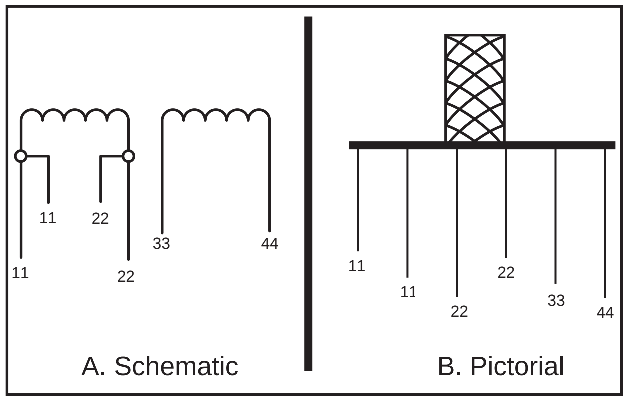


Figure 7-5. – Stator Power Winding Leads

TEST 9- CHECK BRUSH LEADS

DISCUSSION:

In Test 4, if application of battery voltage to the Rotor did NOT result in an output of about one-half rated voltage, the brush leads could be one possible cause of the problem. This test will check Wires 4 and 1 for an open circuit condition.

PROCEDURE:

1. Set a VOM to its "Rx1" scale and zero the meter.
2. Disconnect Wire 4 from the Voltage Regulator and from the Rotor brush terminal.
3. Connect the VOM test leads across each end of the wire. The meter should read "Continuity".
4. Disconnect Wire 1 from the Rotor Brush Terminal. Connect

one meter test lead to Wire 1. Connect the other test lead to a clean ground. The meter should read "Continuity".

RESULTS:

1. Repair, reconnect or replace any defective wire(s).
2. If wires check good, go to Test 10.

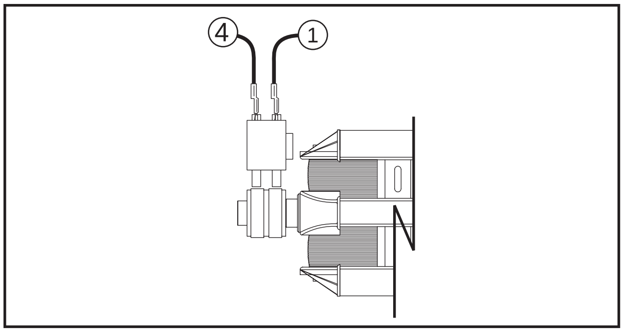


Figure 7-6. – Brush Leads

TEST 10 - CHECK BRUSHES & SLIP RINGS

DISCUSSION:

Brushes and slip rings are made of special materials that will provide hundreds of hours of service with little wear. However, when the generator has been idle for some time, an oxide film can develop on the slip rings. This film acts as an insulator and impedes the flow of excitation current to the Rotor.

If Test 4 resulted in less than one-half rated output voltage, it is possible that the brushes and slip rings are at fault.

PROCEDURE:

1. Gain access to the brushes and slip rings.
2. Remove Wire 4 from the positive (+) brush terminal.
3. Remove the ground wire (1) from the negative (-) brush.
4. Remove the brush holder, with brushes.
5. Inspect the brushes for excessive wear, damage, cracks, chipping, etc.
6. Inspect the brush holder, replace if damaged.
7. Inspect the slip rings.
   a. If slip rings appear dull or tarnished they may be cleaned and polished with fine sandpaper. DO NOT USE ANY METALLIC GRIT TO CLEAN SLIP RINGS. (A 400 grit wet sandpaper is recommended).
   b. After cleaning slip rings, blow away any sandpaper residue.

RESULTS:

1. Replace bad brushes. Clean slip rings, if necessary.
2. If brushes and rings are good, go to Test 11.

TEST 11- CHECK ROTOR ASSEMBLY

DISCUSSION:

During the "Fixed Excitation Test" (Test 4), if AC output voltage did not come up to about one-half rated volts, one possible cause might be a defective Rotor. The Rotor can be tested for an open or shorted condition using a volt-ohm-milliammeter (VOM).

Also see Chapter Three, "INSULATION RESISTANCE TESTS".

PROCEDURE:

Gain access to the brushes and slip rings. Disconnect Wire 4 and Wire 1 from their respective brushes and remove the brush holder. Then, test the Rotor as follows:

1. Set a VOM to its "Rx1" scale and zero the meter.
2. Connect the positive (+) meter test lead to the positive (+) slip ring (nearest the Rotor bearing). Connect the common (-) test lead to the negative (-) slip ring. Read the resistance of the Rotor windings, in OHMS.

ROTOR RESISTANCE *

MODEL QP75D:	**15.25 OHMS**

* Resistance values in ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

3. Set the VOM to its "Rx1 K" or "Rx10,000" scale and zero the meter.
4. Connect the positive (+) meter test lead to the positive (+) slip ring, the common (-) test lead to a clean ground (such as the Rotor shaft). The meter should read "Infinity".

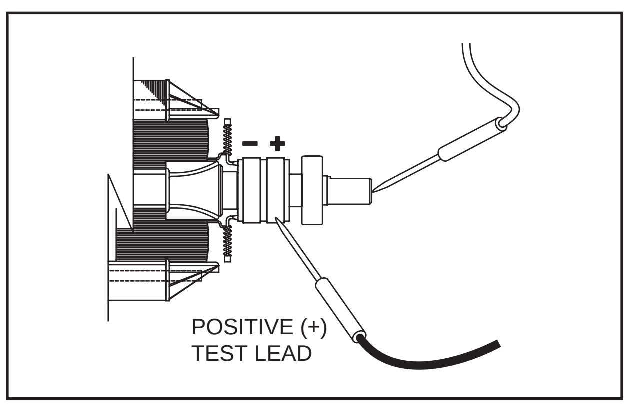


Figure 7-7. – Rotor Assembly

RESULTS:

1. Replace the Rotor if it fails the test.
2. If Rotor checks good, perform "Insulation Resistance Test," on Page 14.

TEST 12 - CHECK MAIN CIRCUIT BREAKER

DISCUSSION:

The main circuit breaker on the generator panel must be closed or no output to the load will be available. A defective breaker may not be able to pass current even though it is in the "ON" position.

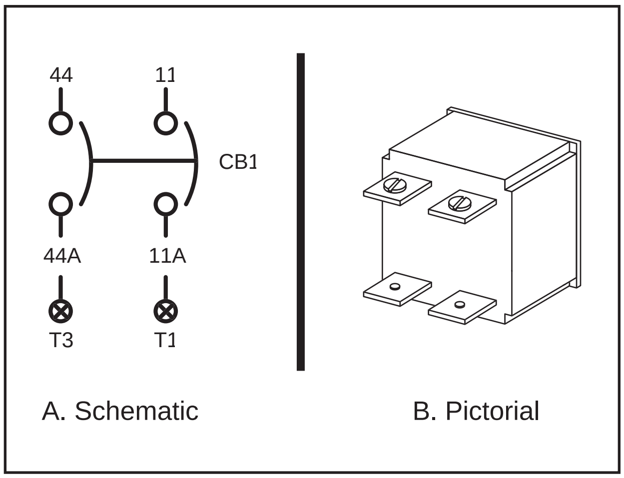


Figure 7-8. – Main Breaker (Typical)

PROCEDURE:

Set the coach main breaker to it's "OFF" position. Check that the appropriate main breaker on the generator panel is set to its "ON" (closed) position. Set a VOM to measure resistance and use it to check for continuity across the breaker terminals.

RESULTS:

1. If breaker is "ON" and "Continuity" is measured, go to Test 3.
2. If breaker is "OFF", reset to the "ON" position and check for AC output.
3. If breaker is "ON" and "Continuity" is not measured, replace the defective circuit breaker.

TEST 13- CHECK LOAD VOLTAGE & FREQUENCY

DISCUSSION:

If engine speed appears to drop off excessively when electrical loads are applied to the generator, the load voltage and frequency should be checked.

PROCEDURE:

Perform this test in the same manner as Test 1, but apply a load to the generator equal to its rated capacity. With load applied check voltage and frequency.

Frequency should not drop below about 58 Hertz with the load applied.

Voltage should not drop below about 115 VAC with load applied.

RESULTS:

1. If voltage and/or frequency drop excessively when the load is applied, go to Test 14.
2. If load voltage and frequency are within limits, end tests.

TEST 14- CHECK LOAD WATTS & AMPERAGE

DISCUSSION:

This test will determine if the generator's rated wattage/amperage capacity has been exceeded.

Continuous electrical loading should not be greater than the unit's rated capacity.

PROCEDURE:

Add up the wattages or amperages of all loads powered by the generator at one time. If desired, a clamp-on ammeter may be used to measure current flow. See "Measuring Current" on Page 16.

RESULTS:

1. If the unit is overloaded, reduce the load.
2. If load is within limits, but frequency and voltage still drop excessively, complete Test 2, "Check/Adjust Engine Governor". If governor adjustment does not correct the problem, go to Problem 8 (Flow Chart, Page 35).

TEST 15 - CHECK BATTERY CHARGE OUTPUT

DISCUSSION:

The Battery Charge system consists of a center tap Battery Charge Winding, a Battery Charge Rectifier, and a Battery Charge Resistor. During normal operation the battery charge output will vary between 1 to 2 amps, depending on the load applied to the generator.

PROCEDURE:

1. Disconnect Wire 15 from the Battery Charge Rectifier (center terminal). Wire 15 is the fused battery supply.
2. Set a VOM to measure DC Amps. Connect the positive (+) test lead to the center terminal of the Battery Charge Rectifier. Connect the negative (-) test lead to Wire 15 previously disconnected.
3. Start the generator. The amp reading on the VOM should be

approximately 0.8 Amps. Apply full load to the generator. The amp reading should increase to approximately 2 Amps.

RESULTS:

1. If amperage was measured between 0.8 to 2 Amps in Step 2 and Step 3, the charging system is working.
2. If no amperage was measured, check the VOM fuses and verify the functioning of the Amp Meter. If DC Amp Meter is good and no current is measured, go to Test 16

TEST 16 - CHECK BATTERY CHARGE RECTIFIER

DISCUSSION:

The Battery Charge Rectifier (BCR) is a full wave rectifier.

PROCEDURE:

1. Disconnect Wire 66, Wire 15 and Wire 77 from the Battery Charge Rectifier.
2. Set the VOM to the Diode Test range. Connect the negative (-) test lead to the center terminal of the BCR. Connect the positive (+) test lead to an outer terminal. The meter should measure approximately 0.47 to 0.5 volts.
3. Connect the positive (+) test lead to the center terminal of the BCR. Connect the negative (-) test lead to to an outer terminal. The meter should measure "Infinity." Connect the negative test lead to the other outer terminal. "Infinity" should once again be measured.

Short to Ground:

4. Set the VOM to measure resistance. Connect the positive (+) test lead to the case housing of the BCR. Connect the negative (-) test lead to an outer terminal. "Infinity" should be measured. Now connect the negative test lead to the BCR center terminal. "Infinity" should be measured. Next, connect the negative test lead to the remaining outer BCR terminal. Once again "Infinity" should be measured.

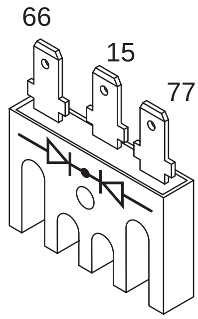


Figure 7-9. – Battery Charge Rectifier

RESULTS:

1. If any of the previous steps has failed, replace the Battery Charge Rectifier.

TEST 17 - CHECK BATTERY CHARGE WINDINGS / BATTERY CHARGE RESISTOR

DISCUSSION:

The Battery Charge Winding (BCW) produces AC voltage that is delivered to the Battery Charge Rectifier. The Battery Charge Winding is a center tapped winding consisting of the following Stator Leads: Wire 66, Wire 77 and Wire 55. The Battery Charge Resistor is used as a current limiting resistor.

PROCEDURE:

1. Disconnect the Stator Leads (Wire 66 and Wire 77) from the Battery Charge Rectifier. (Be sure to disconnect Stator Lead Wire 66 "Black" from Wire 66 "Blue" connector for this test). Disconnect the Stator Lead Wire 55 from the Battery Charge Resistor.
2. Set the VOM to measure resistance at the "R x 1" scale. Connect one test lead to Stator Lead Wire 66. Connect the other test lead to Stator Lead Wire 55. Normal Battery Charge Winding resistance should be measured.
3. Connect one test lead to Stator Lead Wire 77. Connect the other test lead to Stator Lead Wire 55. Normal Battery Charge Winding resistance should be measured.
4. Connect one test lead to Stator Lead Wire 55. Connect the other test lead to Stator Leads Wire 11 & 33 at the back of CB1. "Infinity" should be measured.
5. Connect one test lead to Stator Lead Wire 55. Disconnect Stator Lead Wire 2 from the DPE circuit breaker (CB2) and connect the other test lead to Wire 2. "Infinity" should be measured.

6 Connect one test lead to Stator Lead Wire 55. Connect the other test lead to frame ground. "Infinity" should be measured.

7. Connect one test lead to the Battery Charge Resistor terminal that Wire 55 was removed from. Connect the other test lead to frame ground. One (1) ohm should be measured. If 1 ohm was not measured, remove Wire 0 from the Battery Charge Resistor. Connect one test lead to Wire 0 and the other test lead to frame ground. "Continuity" should be measured. Repair or replace Wire 0 if defective and retest the Battery Charge Resistor.

BATTERY CHARGE WINDING RESISTANCE *
QP75D (Model 4270)

ACROSS WIRES:	OHMS
55 & 66	0.7Ω
55 & 77	0.5Ω

* Resistance values in ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

RESULTS:

1. For Steps 2 & 3, keep in mind that the resistance values are very low. Depending upon the quality of the VOM, it may read “Continuity” across these windings. Exercise good judgement with these values.
2. If Steps 2, 3, 4, 5 & 6 fail any test, replace the Stator.
3. In Step 7, if Wire 0 reads “Continuity”, but resistor does not measure 1 ohm, replace the Battery Charge Resistor.
4. If all of the Steps in this test pass, perform “Insulation Resistance Test” on page 13.

TEST 18 - TRY CRANKING THE ENGINE

DISCUSSION:

If the Pre-Heat Switch on the generator panel is actuated, but the Fuel Pump does not run (priming function doesn't work), perhaps battery voltage is not available.

PROCEDURE:

Hold the Start-Stop Switch at “START”. The engine should crank and start.

RESULTS:

1. If the engine cranks normally, but the pre-heat function still doesn't work, go to Test 19.
2. If engine will not crank, go to Test 21. Refer to Problem 6 of Section 6.
3. If engine cranks but won't start, go to Problem 7 of Section 6.
4. If engine starts hard and runs rough, go to Problem 8 of Section 6.

TEST 19- TEST PRE-HEAT SWITCH

DISCUSSION:

A defective pre-heat switch can prevent the pre-heat function from occurring.

(Also see “Pre-Heat Switch,” page 26).

NOTE: The glow plugs can be damaged by excessive use of the preheat switch. Press the preheat switch for 30 seconds or less to prevent such damage.

PROCEDURE:

1. Set a VOM to read battery voltage (12 VDC).
2. Connect the positive (+) meter test lead to the Wire 15 terminal of the Pre-Heat Switch (leave Wire 15 connected to the switch). Connect the negative (-) meter test lead to ground. The meter should indicate battery voltage.
3. Connect the positive (+) meter test lead to the Wire 150 terminal of the Pre-Heat Switch, the negative (-) meter test lead to frame ground.
   a. With the Pre-Heat Switch NOT actuated, no voltage should be indicated.
   b. Actuate the switch to its “PRE-HEAT” position and the meter should read battery voltage.
4. Set VOM to measure ohms.
5. Connect the positive (+) meter test lead to the Wire 150 terminal of the Pre-Heat Switch (leave Wire 150 connected to the switch). Connect the negative (-) meter test lead to a clean frame ground. Continuity should be measured.

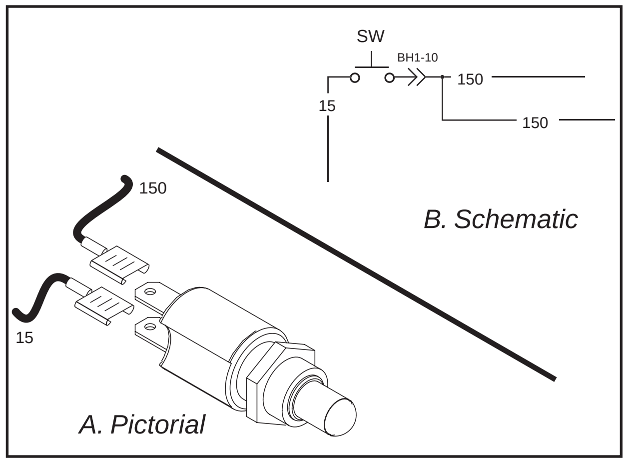


Figure 7-10. – Pre-Heat Switch

RESULTS:

1. If battery voltage is not indicated in Step 2, and the battery and fuse are both good, Wire 15 will need to be checked for an open condition.
2. If “Infinity” is measured in Step 5, Wire 150 will need to be replaced.
3. If battery voltage is not present in Step 3, replace the switch.
4. If battery voltage is present in Step 3, proceed to the next test in the Flow Chart.

TEST 20- CHECK FUEL PUMP

DISCUSSION:

The fuel pump delivers fuel to the fuel injector pump. It is powered by Wire 14 when the pre-heat switch is pressed or when the unit is running. Without fuel to the engine, combustion will not occur.

PROCEDURE:

1. Set a VOM to measure DC voltage.
2. Disconnect the connector from the wires of the fuel pump.
3. Place the positive (+) test lead on Wire 14 and the negative (-) test lead to clean ground. Press the pre-heat switch, battery voltage should be measured, if not, disconnect the other end of Wire 14. Place test leads on each end of Wire 14. Set a VOM to measure continuity. Continuity should be measured.
4. Disconnect Wire 0 from the black wire of the fuel pump. Place one test lead on Wire 0 and the other test lead to ground. Continuity should be measured. If continuity is not measured, replace Wire 0.
5. Jump 12 VDC to white wire of fuel pump, and jump black wire to clean frame ground. Fuel pump should pump.

RESULTS:

1. If battery voltage and continuity are not measured in step 3, then replace bad wire.
2. If pump does not pump in step 5, replace the pump

TEST 21- CHECK 14 AMP FUSE

DISCUSSION:

If the panel-mounted 14 amp fuse (F1) has blown, engine cranking will not be possible.

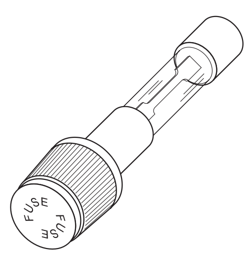


Figure 7-11. – 14 Amp Fuse

PROCEDURE:

Push in on fuse holder cap and turn counterclockwise. Then, remove the cap with fuse. Inspect the Fuse.

RESULTS:

If the Fuse element has melted open, replace the Fuse with an identical size fuse. If Fuse is good, go to Test 22.

TEST 22- CHECK BATTERY & CABLES

DISCUSSION:

If the engine won't crank or cranks too slowly, the battery may be weak or discharged. See "Battery" on Page 24.

PROCEDURE:

1. Inspect the battery cables and battery posts or terminals for corrosion or tightness. Measure the voltage at the terminal of the starter contactor and verify 11-12 VDC is available to the generator during cranking. If voltage is below 11 VDC, measure at the battery terminals during cranking. If battery voltage is below 11 VDC, recharge/replace battery. If battery voltage is above 11 VDC, check for proper battery cable sizing (see "BATTERY CABLES" on Page 24). If battery or cables are still suspected, connect an alternate battery and cables to the generator and retest.
2. Use a battery hydrometer to test the battery for (a) state of charge and (b) condition. Follow the hydrometer manufacturer's instructions carefully.

RESULTS:

1. Clean battery posts and cables as necessary. Make sure battery cables are tight.
2. Recharge the battery, if necessary.
3. Replace the battery, if necessary.
4. If battery is good, but engine will not crank, go to Test 23.

TEST 23- CHECK POWER SUPPLY TO CIRCUIT BOARD

DISCUSSION:

If battery voltage is not available to the circuit board, engine cranking and running will not be possible.

If battery voltage is available to the board, but no DC output is delivered to the board's Wire 56 terminal while attempting to crank, either the circuit board is defective or the Start-Stop Switch has failed.

This test will determine if battery voltage is available to the Engine Controller circuit board. Test 24 will check the Start-Stop Switch. Test 25 will check the DC power supply to the circuit board's Wire 56 terminal (Receptacle J1, Pin 1).

PROCEDURE:

1. On the Engine Controller Circuit Board, locate Terminal 1 to which Wire 15 connects (see chart on Page 24).
2. Set a VOM to read battery voltage. Connect the meter test leads across circuit board Terminal 1 and ground. The meter should read battery voltage.

3. Set the VOM to measure resistance ("Rx1" scale). Connect one meter test lead to Wire 0, Terminal 2 on the Engine Controller Circuit Board. Connect the other test lead to a clean frame ground. "Continuity" should be measured.

RESULTS:

1. If battery voltage is NOT indicated in Step 1, check continuity of:
   a. Wire 13 between Starter Contactor and Preheat Contactor.
   b. Wire 13 between Preheat Contactor and 14 Amp Fuse (F1).
   c. Wire 15 between the 14 Amp fuse (F1) and the Battery Charge Rectifier.
   d. Wire 15 between the Battery Charge Rectifier and the Engine Controller Board.

   Repair, reconnect or Replace bad wiring as necessary.
2. If battery voltage is indicated but engine will not crank, go to Test 24.
3. If "Continuity" was not measured in Step 3, repair or replace Wire 0 between the Engine Controller Circuit Board and the Ground Terminal.

TEST 24 - CHECK START-STOP SWITCH

DISCUSSION:

Engine cranking and startup is initiated when Wire 17 from the Engine Controller board is connected to frame ground by setting the Start-Stop Switch to "START".

Engine shutdown occurs when circuit board Wire 18 is connected to ground by the Start-Stop Switch.

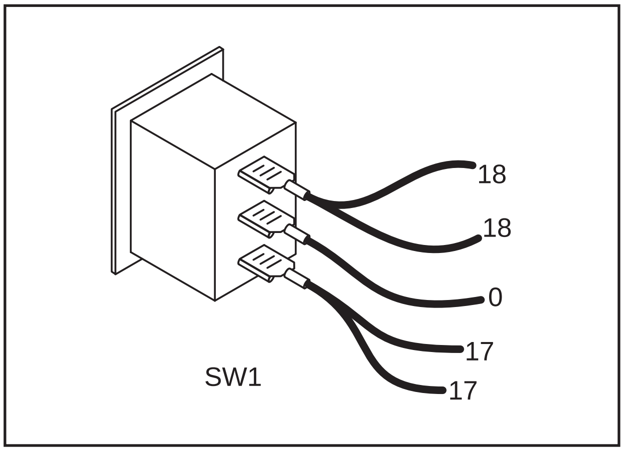


Figure 7-12. – Start-Stop Switch

A defective Start-Stop Switch can result in (a) failure to crank when the switch is set to "START", and/or (b) failure to shut down when the switch is set to "STOP".

PROCEDURE:

For Problem 6 (Section 6), perform all steps. For Problem 9, perform Step 1 and Step 5 ONLY.

1. Set a VOM to its "Rx1" scale and zero the meter.
2. Inspect the ground Wire 0, between the Start-Stop Switch and the grounding terminal. Connect one meter test lead to Wire 0 on SW1. Connect the other test lead to a clean frame ground. "Continuity" should be measured.
3. Disconnect Wire 17 from its Switch terminal and connect it to ground. The engine should crank.
4. Remove the 14 amp fuse. Disconnect Wire 18, Wire 0 and Wire 17 from the Start-Stop Switch (SW1).
5. Connect one test lead to the center terminal of SW1. Connect the other test lead to an outer terminal of SW1. "Infinity" should be measured. Remove the test lead from the outer terminal of SW1 and connect it to the opposite outer terminal. "Infinity" should be measured.
6. Leave the test lead connected to the center terminal of SW1 from Step 5. Connect the other test lead to an outer terminal. Depress the switch away from the terminal being tested (see Figure 7-13). "Continuity" should be measured. Repeat the procedure with the test lead connected to the other outer terminal. "Continuity" should be measured.

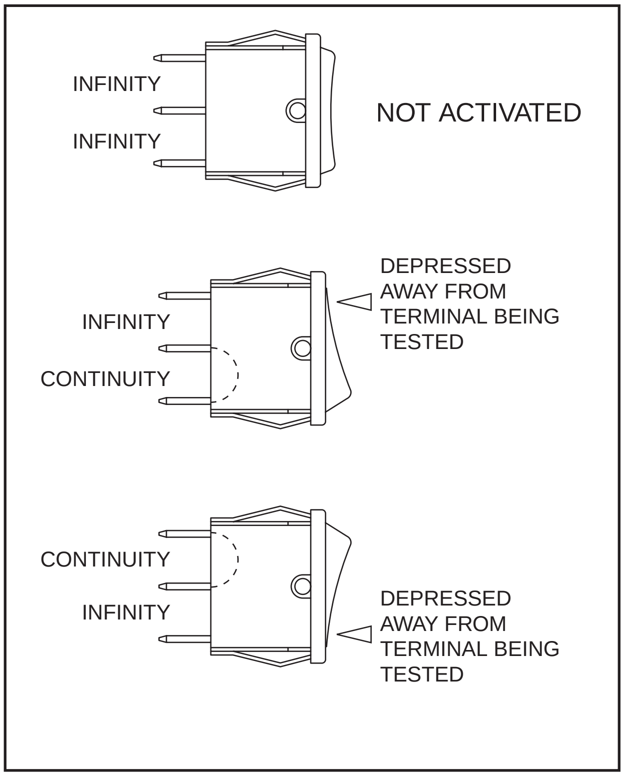


Figure 7-13. – Test 24, Step 6

RESULTS:

1. If "Continuity" is not measured in Step 2, repair, reconnect or replace Wire 0 (between Start-Stop Switch and ground terminal) as necessary.
2. If engine cranks in Step 3 when Wire 17 is grounded, but will not crank when the Switch is set to "START", replace the Start-Stop Switch.
3. If the Start-Stop Switch (SW1) failed any part of Steps 5 or 6, replace the switch.
4. If engine will not crank when Wire 17 is grounded, proceed as follows:
   a. Use a jumper wire to connect the circuit board's Wire 17 (Pin Location 3) to ground. If engine does NOT crank, proceed to Test 25.
   b. If engine cranks now, but would not crank in Step 3 of the procedure, check Wire 17 for continuity between the circuit board and Start-Stop Switch. If "Continuity" is not measured, repair or replace Wire 17 between the engine control board and the Start-Stop Switch.
5. For Problem 9 (Section 6), if switch tests GOOD, go to Test 30.

TEST 25 - CHECK POWER SUPPLY TO WIRE 56

DISCUSSION:

If battery voltage is available to the Engine Controller board in Test 23, then DC voltage should be delivered to Wire 56 when the Start-Stop Switch is set to "START" (Test 24). This test will check to see if the circuit board is delivering battery voltage to the Wire 56 terminal.

PROCEDURE:

1. Set a VOM to measure DC voltage (12 VDC).
2. Disconnect Wire 56 from its Starter Contactor terminal.
3. Connect the meter positive (+) test lead to Wire 56, just disconnected. Connect the other test lead to ground. No voltage should be indicated.
4. Actuate the Start-Stop Switch to its "START" position. The meter should indicate battery voltage. If battery voltage is present, stop the procedure.
5. Connect the VOM positive (+) test lead to Wire 56 (Pin Location 7) at the Engine Controller Circuit Board. Connect the other test lead to frame ground.
6. Actuate the Start-Stop Switch to the "START" position. The meter should indicate battery voltage.

RESULTS:

1. If battery voltage was measured in Step 6, but not in Step 4, repair or replace Wire 56 between the Engine Controller Circuit Board and Starter Contactor Relay.
2. If battery voltage was not available in Step 6, replace the Engine Controller Circuit Board.
3. If battery voltage is available in Step 4 but engine does not crank, go to Test 26.

TEST 26- TEST STARTER CONTACTOR

DISCUSSION:

If battery voltage is available to the Wire 56 circuit, but engine will not crank, one possibility of the problem is a failed starter contactor.

PROCEDURE:

1. Set a VOM to measure resistance.
2. Connect one test lead to Wire 0 on the starter contactor terminal. Connect the other test lead to frame ground. Continuity should be measured.
3. Momentarily connect a suitable jumper cable across the two large terminal studs of the starter contactor. The engine should crank.
4. Set the VOM to measure resistance.
5. Disconnect Wire 56 and 0 from the starter contactor from terminals.
6. Connect one test lead to the starter contactor terminal from which Wire 56 was removed. Connect the other test lead to where Wire 0 was removed. A starter contactor coil resistance of 4.6 ohms should be measured.

RESULTS:

1. If continuity is not measured in step 1, repair or replace Wire 0 between the starter contactor and the ground terminal.
2. If engine cranks during step 3, but would not crank in test 25, remove and replace starter contactor.
3. If resistance is incorrect in step 6, replace starter contactor.
4. If starter contactor checks good, proceed to next step in flowchart.

TEST 27 - CHECK STARTER MOTOR

CONDITIONS AFFECTING STARTER MOTOR PERFORMANCE:

1. A binding or seizing condition in the Starter Motor bearings.
2. A shorted, open or grounded armature.
   a. Shorted, armature (wire insulation worn and wires touching one another). Will be indicated by low or no RPM.

b. Open armature (wire broken) will be indicated by low or no RPM and excessive current draw.

c. Grounded armature (wire insulation worn and wire touching armature lamination or shaft). Will be indicated by excessive current draw or no RPM.

3. A defective Starter Motor switch.

4. Broken, damaged or weak magnets.

5. Starter drive dirty or binding.

DISCUSSION:

Test 25 verified that circuit board action is delivering DC voltage to the Starter Contactor Relay (SCR). Test 26 verified the operation of the Starter Contactor (SC). Another possible cause of an "engine won't crank" problem is a failure of the Starter Motor.

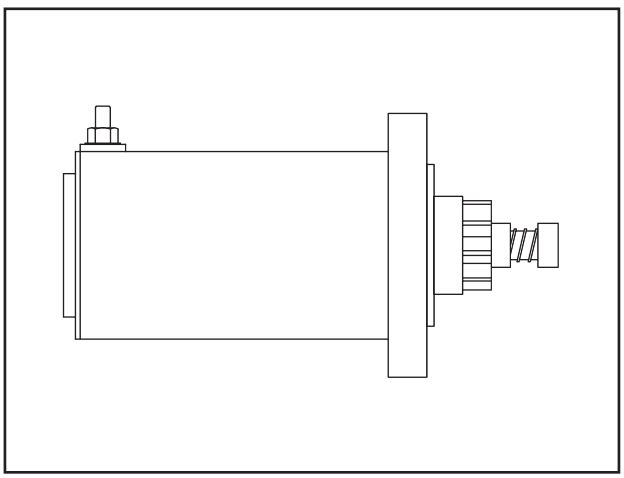


Figure 7-14. – Starter Motor (SM)

PROCEDURE:

The battery should have been checked prior to this test and should be fully charged.

Set a VOM to measure DC voltage (12 VDC). Connect the meter positive (+) test lead to the Starter Contactor stud which has the small jumper wire connected to the Starter. Connect the common (-) test lead to the Starter Motor frame.

Set the Start-Stop Switch to its "START" position and observe the meter. Meter should indicate battery voltage, Starter Motor should operate and engine should crank.

RESULTS:

1. If battery voltage is indicated on the meter but Starter Motor did not operate, remove and bench test the Starter Motor (see following test).

2. If battery voltage was indicated and the Starter Motor tried to engage (pinion engaged), but engine did not crank, check for mechanical binding of the engine or rotor.

If engine turns over slightly, go to Test 35 “Check and Adjust Valves.”

NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plugs and turning the crankshaft over slowly by hand, to be sure it rotates freely.

WARNING!: DO NOT ROTATE ENGINE WITH ELECTRIC STARTER WITH SPARK PLUGS REMOVED. ARCING AT THE SPARK PLUG ENDS MAY IGNITE THE GASOLINE VAPOR EXITING THE SPARK PLUG HOLE.

CHECKING THE PINION:

When the Starter Motor is activated, the pinion gear should move and engage the flywheel ring gear. If the pinion does not move normally, inspect the pinion for binding or sticking.

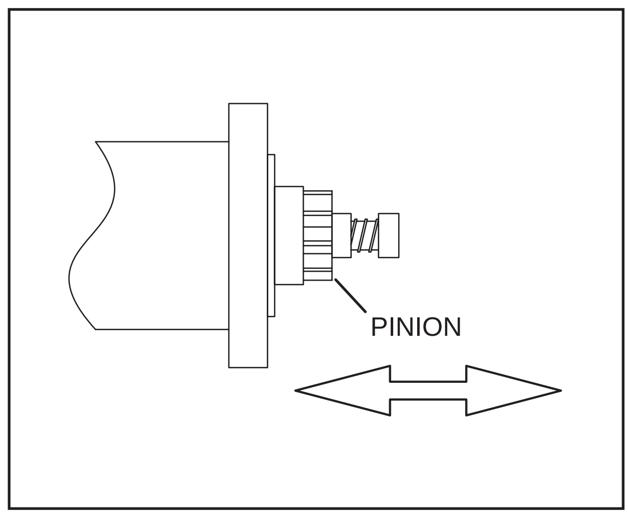


Figure 7-15. – Check Starter Pinion

TOOLS FOR STARTER PERFORMANCE TEST:

The following equipment may be used to complete a performance test of the Starter Motor:

- A clamp-on ammeter.
- A tachometer capable of reading up to 10,000 rpm.
- A fully charged 12 VDC battery.

MEASURING CURRENT:

To read the current flow, in AMPERES, a clamp-on ammeter may be used. This type of meter indicates current flow through a conductor by measuring the strength of the magnetic field around that conductor.

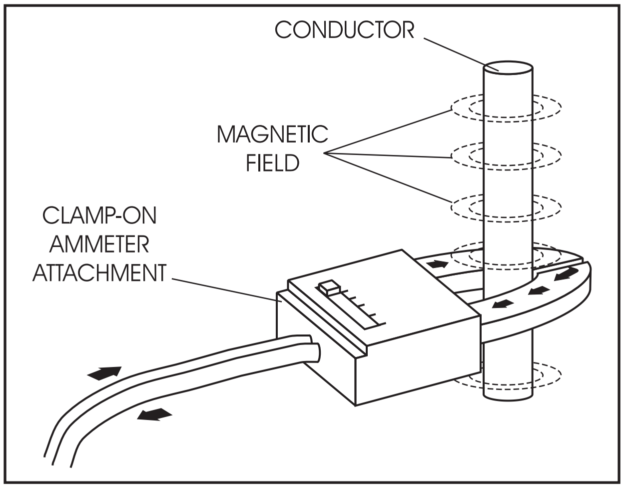


Figure 7-16. – Clamp-On Ammeter

TACHOMETER:

A tachometer is available from your Generac Power Systems source of supply. Order as P/N 042223. The tachometer measures from 800 to 50,000 RPM (see Figure 7-17).

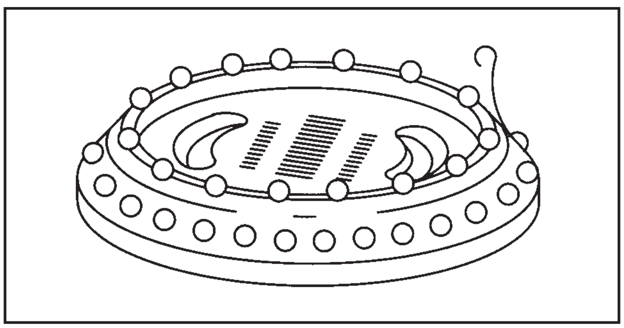


Figure 7-17. – Tachometer

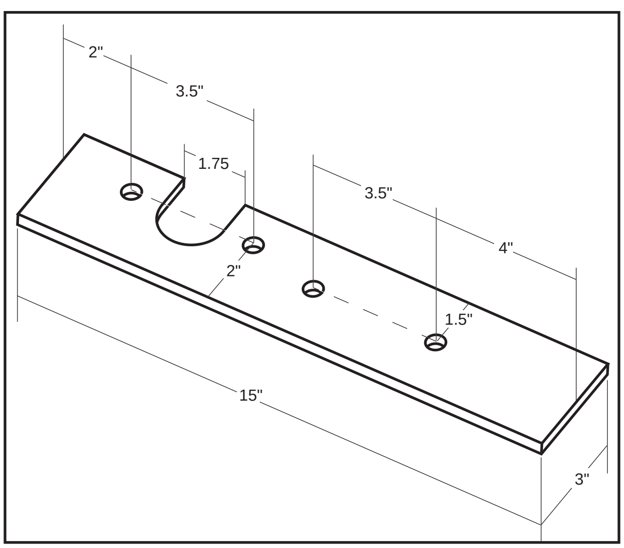


Figure 7-18. – Test Bracket

TEST BRACKET:

A starter motor test bracket may be made as shown in Figure 7-18.

REMOVE STARTER MOTOR:

It is recommended that the Starter Motor be removed from the engine when testing Starter Motor performance. Assemble starter to test bracket and clamp test bracket in vise (Figure 7-19).

TESTING STARTER MOTOR:

1. A fully charged 12 VDC battery is required.
2. Connect jumper cables and clamp-on ammeter as shown in Figure 7-19.
3. With the Starter Motor activated (jump the terminal on the Starter Contactor to battery voltage), note the reading on the clamp-on ammeter and on the tachometer (rpm).

Note: Take the reading after the ammeter and tachometer are stabilized, approximately 2-4 seconds.

4. A starter motor in good condition will be within the following specifications:

Minimum rpm	**4500**
Maximum Amps	**50**

Note: Nominal amp draw of starter in generator is 60 amps.

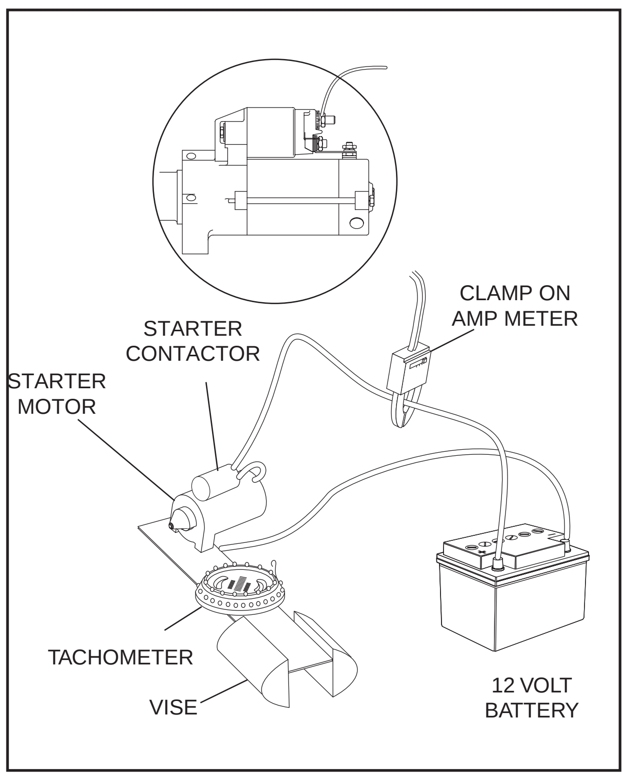


Figure 7-19. – Testing Starter Motor Performance

TEST 28- CHECK FUEL SUPPLY

DISCUSSION:

If the engine cranks but won't start, don't overlook the obvious. The fuel supply may be low. Many RV generator installations "share" the fuel tank with the vehicles engine. When such is the case, the installer may have used a generator fuel pickup tube that is shorter than the vehicle engines pickup tube. Therefore, the generator will run out of fuel before the vehicle engine does.

PROCEDURE:

1. Check the fuel level in the supply tank.
2. Attach a fresh fuel supply if necessary and restart. Fuel may be stale, causing a hard start.

RESULTS:

1. If necessary, replenish fuel supply.
2. If fuel is good, proceed to test 29.

TEST 29 - CHECK WIRE 14 POWER SUPPLY

DISCUSSION:

When the engine is cranked, Engine Controller Circuit Board action must deliver battery voltage to the Wire 14 circuit, or the engine will not start. This is because the Wire 14 circuit will operate the Fuel Pump and Fuel Solenoid.

PROCEDURE:

1. Set a VOM to read battery voltage (12 VDC).
2. Connect the meter positive (+) test lead to Pin 9 on the PCB, the common (-) test lead to ground.
3. Crank the engine and the meter should read battery voltage.

RESULTS:

1. If the meter indicated battery voltage, go to Test 19.
2. If battery voltage was NOT indicated in Step 3, replace the Engine Controller Circuit Board.

TEST 30 - CHECK WIRE 18

DISCUSSION:

Wire 18 controls sending the STOP signal to the Engine Controller Circuit Board. If Wire 18 contacts ground it will initiate a shutdown. Coach manufacturers sometimes install a 15 to 30 foot remote harness. A ground on Wire 18 in a remote harness can also cause a shutdown.

PROCEDURE:

1. Remove the remote harness connector from the generator and re-test. If generator continues to run, a short is present in the remote harness. Repair or replace the remote harness.
2. Remove the J1 connector from the Engine Controller Circuit Board. Set the VOM to measure resistance. Connect one test lead to Pin Location 4. Connect the other test lead to a clean frame ground. “Infinity” should be measured.

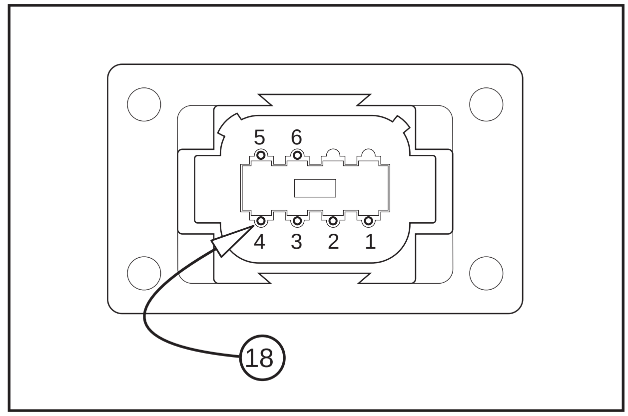


Figure 7-20. – Remote Harness Connector

3. Connect one test lead to Pin Location J1-15. Connect the other test lead to a clean frame ground. “Infinity” should be measured.

RESULTS:

1. If “Continuity” is measured in Step 2, repair or replace shorted Wire 18 between J1 Connector and Start-Stop Switch.
2. If “Continuity” was measured in Step 3, repair or replace shorted Wire 18 between J1 Connector and remote panel connector.
3. If Wire 18 checks GOOD, proceed to Problem 8 (Section 6).

TEST 31 - CHECK FUEL SOLENOID

DISCUSSION:

The fuel solenoid is mounted to the side of the injector pump. Once energized, it pulls a plunger in from the fuel injector pump and fuel will be allowed to flow to the injectors. If the fuel solenoid is faulty, fuel will never flow to the injector pump and the engine won't run.

PROCEDURE:

1. Set a VOM to measure D/C voltage.
2. Disconnect Wire 14 to the fuel solenoid.
3. Place the positive (+) test lead on Wire 14 and the negative (-) test lead on clean ground.
4. Press the prime switch, battery voltage should be measured. If measured, skip to Step 8. If not, proceed to next Step.
5. If battery voltage is not measured, disconnect other end of Wire 14 going to the printed circuit board on Pin 9.

6. Place test leads on each end of wire, continuity should be measured.
7. If continuity is measured, test battery voltage on Wire 14 going to circuit board on Pin 10, with prime switch pressed. Meter should read battery voltage.
8. Set a VOM to measure resistance.
9. Place a test lead on the terminal of the fuel solenoid where Wire 14 was previously located. Place the other test lead to clean ground, meter should read 12.4 ohms.

RESULTS:

1. If battery voltage is not measured in step 4, and continuity is measured in step 6 and battery voltage is measured in step 7, than replace the circuit board.
2. If infinity is measured in step 6, replace wire.
3. If battery voltage is not measured in step 7, work back to previous test on flow chart.
4. If continuity is measured in step 9, replace solenoid.
5. If 12.4 ohms was measured in step 9, proceed to next test on flow chart.

TEST 32- TEST PREHEAT CONTACTOR

DISCUSSION:

If battery voltage is available to the preheat contactor via Wire 150 and the glow plugs and fuel pump do not work, a possibility could be a failed contactor.

PROCEDURE:

1. Set a VOM to measure continuity.
2. Disconnect Wire 0 from the preheat contactor.
3. Place one test lead on the previously disconnected Wire 0 and the other to clean ground. Continuity should be measured.
4. Set a VOM to measure resistance.
5. Disconnect Wire 150 and 0 from the preheat contactor (front terminals).
6. Place one test lead to the terminal where Wire 150 was previously disconnected, and the other test lead where Wire 0 was previously disconnected.
7. Place a jumper lead from Wire 15 (battery positive) to the terminal where Wire 150 was previously. Prime function should occur.

RESULTS:

1. If infinity is measured in step 3, repair or replace Wire 0 and retest.
2. If resistance is incorrect in step 6, then replace preheat contactor.
3. If prime function did not occur in step 7, and resistance was incorrect in step 6, proceed to next test on flow chart.

TEST 33- TEST GLOW PLUGS

DISCUSSION:

Once the preheat contactors contacts close, positive battery voltage from Wire 13 to Wire 157 will power the glow plugs.

PROCEDURE:

1. Set a VOM to measure resistance.
2. Disconnect Wire 157 from glow plugs.
3. Place positive (+) test lead to center electrode, and the negative (-) test lead to ground. Resistance should be 1.0 ohm.
4. If resistance is good, remove glow plug from engine. Inspect the sheath for damage.

RESULTS:

1. If sheath is chipped or broken, replace glow plug.
2. If resistance and sheath are good, proceed to next step on flowchart.

TEST 34- TEST D1 DIODE

DISCUSSION:

The D1 diode is a protective device that prohibits the return flow of DC current to the glow plugs while the unit is running. If this diode is bad or shorted to ground, power will not be available to Wire 14 off the other end of the diode. If Wire 14 does not receive voltage, the fuel solenoid, fuel pump, and hourmeter will not operate.

PROCEDURE:

1. Set a VOM to measure continuity.
2. Place the test leads on each end of the diode, then reverse the leads to the opposite ends. Continuity should be measured only in one direction.

RESULTS:

1. If continuity is measured in both directions, replace the diode.
2. If diode checks good, then battery voltage should be measured on Wire 14 to the board on Pin 10. If it is not measured, then Wire 14 needs to be replace.

TEST 35- CHECK VALVE ADJUSTMENT

DISCUSSION:

If the engine is having a hard start, no start, or rough running condition, then the valves will need to be checked for proper clearance. If a unit has a lot of hours on it, the valves will need to be readjusted.

PROCEDURE:

1. Remove the valve cover from engine.
2. Disconnect the battery.
3. Manually turn flywheel until cylinder #1 (furthest from flywheel) is at top dead center (TDC) and adjust the clearances of the intake and exhaust valves of the No. 1 cylinder and the exhaust valve of the No. 2 cylinder.

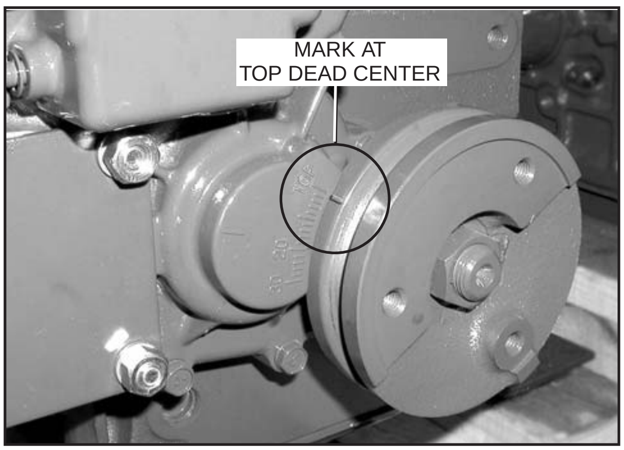


Figure 7-21. – Flywheel Position for Top Dead Center

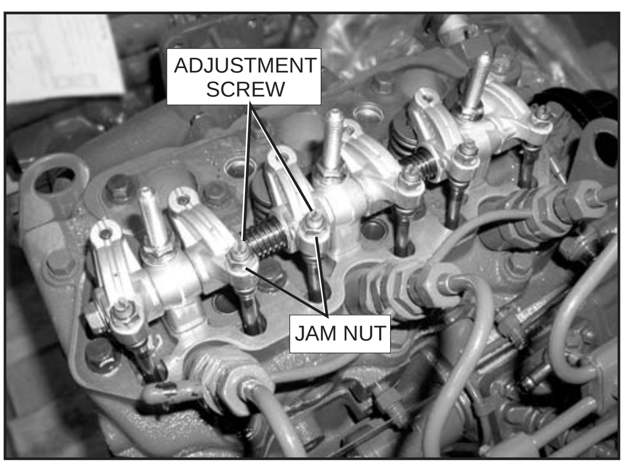


Figure 7-22. – Valve Adjustment Points

4. Check valve clearance using a feeler gauge. Both should have a clearance of 0.008” - 0.012”.
5. Adjust by loosening the nut and turning the adjustment screw.
6. Turn the crankshaft counterclockwise by 204° (view from front) to adjust the clearance of the intake valve of No. 2 cylinder and the intake and exhaust valves of the No. 3 cylinder.

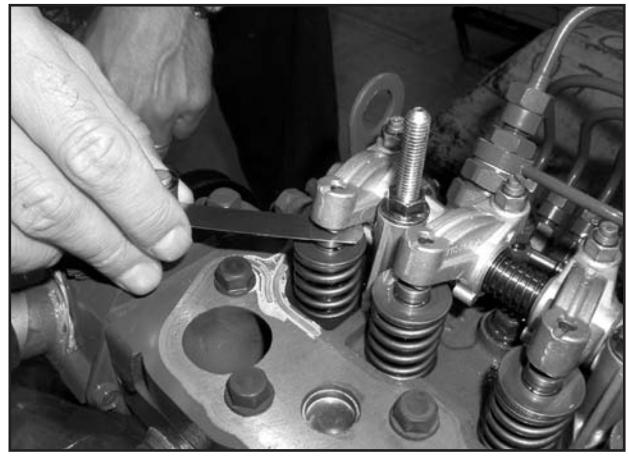


Figure 7-23. – Checking Valve Adjustment

RESULTS:

1. If clearance is incorrect, readjust
2. If clearance is correct, proceed to next test on flow chart.

TEST 36- FUEL INJECTOR PUMP

DISCUSSION:

The fuel injector pump takes the fuel that is provided by the electric fuel pump, and delivers it to the fuel injector nozzles. Given that the fuel solenoid is operating correctly and the linkage from the governor is not binding, the fuel injector pump will need little to no maintenance.

PROCEDURE:

1. If fuel injector pump is assumed to being faulty, remove the fuel lines going to the nozzle injectors.
2. Prime the engine for 15-20 seconds.
3. Crank the engine and watch to see if fuel is coming out of the fuel lines.

CAUTION: Fuel is hazardous.

NOTE: Bleeding the fuel injector pump takes time. Crank the engine for 15 second intervals for as long as 5 minutes.

4. If no fuel is coming out, remove the four (4) screws mounting the injector pump to the engine.
5. Unscrew the fuel solenoid from the side of the injector pump.
6. Lift fuel injector pump out and remove one shim.
7. Reinstall fuel injector pump and retaining screws.

8. Crank engine again and see if fuel is coming out of the fuel lines.

RESULTS:

1. If no fuel is noted in Steps 3 or 8, replace fuel injector pump. (Reinstallation of all original shims will be required.)
2. If fuel is noted, proceed to next step in flowchart.

TEST 37 - CHECK ENGINE / CYLINDER LEAK DOWN TEST / COMPRESSION TEST

GENERAL:

Most engine problems may be classified as one or a combination of the following:

- Will not start.
- Starts hard.
- Lack of power.
- Runs rough.
- Vibration.
- Overheating.
- High oil consumption.

DISCUSSION:

The Cylinder Leak Down Tester checks the sealing (compression) ability of the engine by measuring air leakage from the combustion chamber. Compression loss can present many different symptoms. This test is designed to detect the section of the engine where the fault lies before disassembling the engine.

PROCEDURE:

1. Remove a fuel injector.
2. Gain access to the flywheel. Remove the valve cover.
3. Rotate the engine crankshaft until the piston reaches top dead center (TDC). Both valves should be closed.
4. Lock the flywheel at top dead center.
5. Attach cylinder leak down tester adapter to spark plug hole.
6. Connect an air source of at least 90 psi to the leak down tester.
7. Adjust the regulated pressure on the gauge to 80 psi.
8. Read the right hand gauge on the tester for cylinder pressure. 20 percent leakage is normally acceptable. Use good judgement, and listen for air escaping at the carburetor, the exhaust, and the crankcase breather. This will determine where the fault lies.
9. Repeat Steps 1 through 8 on remaining cylinder.

RESULTS:

- Air escapes at the air intake chamber – check intake valve.
- Air escapes through the exhaust – check exhaust valve.
- Air escapes to the crankcase – check piston rings.
- Air escapes from the cylinder head – the head gasket should be replaced.

CHECK COMPRESSION:

Lost or reduced engine compression can result in (a) failure of the engine to start, or (b) rough operation. One or more of the following will usually cause loss of compression:

- Blown or leaking cylinder head gasket.
- Improperly seated or sticking-valves.
- Worn Piston rings or cylinder. (This will also result in high oil consumption).

NOTE: It is extremely difficult to obtain an accurate compression reading without special equipment. For that reason, compression values are not published. Testing has proven that an accurate compression indication can be obtained using the following method.

PROCEDURE:

1. Remove fuel injectors.
2. Insert a compression gauge into one of the cylinders.
3. Crank the engine until there is no further increase in pressure.
4. Record the highest reading obtained.
5. Repeat the procedure for the remaining cylinder and record the highest reading.

RESULTS:

The difference in pressure between the three cylinders should not exceed 25 percent. If the difference is greater than 25 percent, loss of compression in the lowest reading cylinder is indicated.

Example 1: *If the pressure reading of cylinder #1 is 165 psi and of cylinder #2, 160 psi, the difference is 5 psi. Divide "5" by the highest reading (165) to obtain the percentage of 3.0 percent.*

Example 2: *No. 1 cylinder reads 160 psi; No. 2 cylinder reads 100 psi. The difference is 60 psi. Divide "60" by "160" to obtain "37.5" percent. Loss of compression in No. 2 cylinder is indicated.*

If compression is poor, look for one or more of the following causes:

- Loose cylinder head bolts.
- Failed cylinder head gasket.
- Burned valves or valve seats.
- Insufficient valve clearance.
- Warped cylinder head.
- Warped valve stem.
- Worn or broken piston ring(s).
- Worn or damaged cylinder bore.
- Broken connecting rod.
- Worn valve seats or valves.
- Worn valve guides.

NOTE: For units out of warranty, refer to Quicksilver Diagnostic & Service Manual - Diesel, P/N 082034 for further engine service information. This manual can be found at www.guardiangenerators.com, under "Brochures,Manual & Specs - Recreational Vehicle - Manuals".

TEST 38 - CHECK OIL PRESSURE SWITCH

DISCUSSION:

Also see "Operational Analysis" on Pages 18-23. The Low Oil Pressure Switch is normally-closed, but is held open by engine oil pressure during cranking and startup. Should oil pressure drop below a safe level, the switch contacts will close to ground the Wire 85 circuit. Engine controller board action will then initiate an automatic shutdown.

If the switch fails CLOSED, the engine will crank and start, but will then shut down after a few seconds.

If the switch fails OPEN, low oil pressure will not result in automatic shutdown.

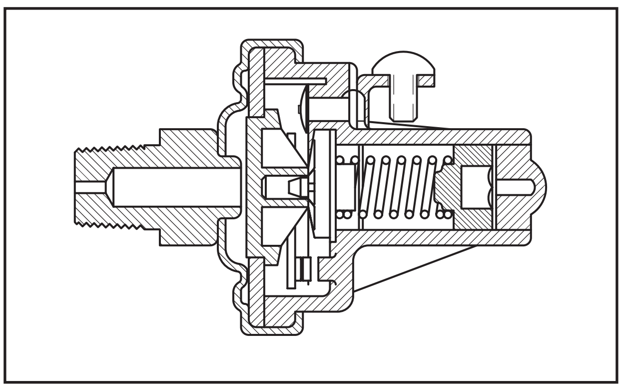


Figure 7-23. – Oil Pressure Switch

PROCEDURE:

1. Check engine oil level. If necessary, replenish oil level to the dipstick "FULL" mark.
2. Set a VOM to its "Rx1" scale and zero the meter.
3. Connect the meter test leads across the switch terminals, with engine shut down. The meter should read "Continuity". A small amount of resistance is acceptable.
4. Crank the engine. Oil pressure should open the switch contacts at some point while cranking and starting. Meter should then indicate "Infinity".
5. If the contacts did not open in Step 5, remove the low oil pressure switch and connect an oil pressure gauge in it's place. Start the engine and measure oil pressure. Pressure should be above 10 psi.

RESULTS:

1. In Step 3, if "Continuity" is not indicated, replace the switch.
2. If oil pressure checked good in Step 5, but Step 4 measured "Infinity," replace the low oil pressure switch.
3. If oil pressure is below 10 psi, determine cause of low oil pressure. Refer to Engine Service manual No. 0E2081 for further engine service information. Verify that the oil is the proper viscosity for the climate and season.
4. If all steps check GOOD, go to Test 40.

TEST 39- CHECK CIRCUIT BOARD FOR GROUND

DISCUSSION:

If the engine shuts down immediately after start switch is released, a possible cause would be the ground wire is faulty, forcing the unit to ground the circuit board through the start/stop switch. Once the switch is released, the ground is removed from the board, causing the unit to shut down.

PROCEDURE:

1. Remove Wire 0 from the circuit board on Terminal 2.
2. Set a VOM to measure continuity.
3. Place one test lead on Wire 0, previously removed and the other test lead on clean ground. Continuity should be measured.
4. Reconnect wire, making sure it has good contact on Pin 2 of the circuit board.

RESULTS:

1. If continuity was not measured in step 3, replace wire.
2. If continuity was measured in step 3, replace the circuit board.

TEST 40- TEST WATER TEMPERATURE SWITCH

DISCUSSION:

This normally-open thermostatic switch has a sensing tip, which is immersed in engine coolant. Should coolant temperature exceed approximately 245-266 F, the switch contacts will close to ground Terminal 12 on the circuit board. Circuit board action will then shutdown the engine.

PROCEDURE:

1. Disconnect Wire 85 from the switch terminal.
2. Set a VOM to measure continuity.
3. Place one test lead on switch and the other on clean ground. Infinity should be measured.

RESULTS:

1. If continuity is measure, replace the switch.
2. If infinity is measured, proceed to next test on the flow chart.

TEST 41- CHECK WIRE 14 AND CONNECTING COMPONENTS FOR SHORT TO GROUND

DISCUSSION:

Once the start/stop switch is pressed, the circuit board will take battery voltage from Wire 15 on Pin 1 and provide it to Wires 14 on Pins 9,10,11. If Wire 14 or any components attached to 14 are shorted to ground, the 14-amp fuse will blow. This test will check the wires and components in this cranking circuit.

PROCEDURE:

1. Set a VOM to measure continuity.
2. (Pin 9, Wire 14) Remove Wire 14 from Terminal 9, fuel solenoid, hourmeter, and fuel pump.
3. (Testing Wire 14 to ground) Place one test lead on Wire 14 (disconnected from the circuit board) and the other test lead on clean ground. Meter should read infinity.
4. (Testing fuel solenoid to ground) If wire checks good but fuse still blows when Wire 14 is connected, place one test lead on the fuel solenoid where Wire 14 was connected. Place the other test lead on clean ground. Fuel solenoid resistance should be 12.4 ohms.
5. (Testing hourmeter to ground) Place on test lead on the hourmeter where Wire 14 was previously connected. Place the other test lead on clean ground. Infinity should be measured. Hourmeter resistance should be 3.21 ohms.
6. (Testing fuel pump to ground) Place one test lead on the fuel pumps white wire. Place the other test lead on clean ground. Infinity should be measured.
7. (Pin 10, Wire 14) Remove Wire 14 from Pin 10 on the circuit board. Place one test lead on Wire 14, previously on Pin 10 and the other test lead on clean ground. Infinity should be measured.
8. (Pin 11, Wire 14) See test 6 for testing field boost.

RESULTS:

1. If continuity was measured in Steps 3-6, replace faulty wires are components.
2. If continuity was measured in Step 7, see test 34- testing D1 diode.
3. If Wire 14 and components check to be good, proceed to next test on the flow chart.

TEST 42 - CHECK WIRE 56 AND STARTER CONTACTOR FOR SHORT TO GROUND.

DISCUSSION:

Once the start/stop switch is pressed, the circuit board will send battery voltage to Wire 56 to energize the starter contactor in order for the starter motor to crank the engine. If Wire 56 or the starter contactor is shorted to ground, the 14-amp fuse will blow.

PROCEDURE:

1. Set a VOM to measure continuity.
2. (testing Wire 56 to ground) Disconnect Wire 56 from the circuit board on Terminal 7 and from the starter contactor.
3. Place one test lead on one end of Wire 56 and the other test lead to clean ground. Infinity should be measured.
4. (testing starter contactor to ground) Place one test lead on terminal where Wire 56 was previously connected and the other test lead to clean ground. Infinity should be measured. Starter contactor resistance should be 4.6 ohms (across the 2 small terminals).

RESULTS:

1. If continuity was measured in steps 3 or 4, replace faulty wire or starter contactor.
2. If no fault was indicated, proceed to next test on flow chart.

TEST 43 - CHECK WIRE 15 FOR SHORT TO GROUND

DISCUSSION:

If Wire 15 is shorted to ground, the fuse will blow immediately when replaced. This test will determine if Wire 15 is bad.

PROCEDURE:

1. Set a VOM to measure continuity.
2. Disconnect Wire 15 from the fuse holder and from the battery charge rectifier.
3. Place one test lead on Wire 15 (previously disconnected from fuse) and place the other test lead to clean ground. Meter should read infinity.

RESULTS:

1. If continuity was measured, replace bad wire.
2. If infinity was measured, proceed to next test on the flow chart.

MAJOR DISASSEMBLY

ENCLOSURE/ PANEL REMOVAL:

Using a 10-mm socket, remove all screws on all panels except the lower screws on the radiator side panel. Remove the top panel first, then the side and rear. When removing the front panel, the main control panel is mounted onto the front sheet metal. There are five nuts holding them together that will need to be removed in order to separate. The wiring harness connections will need to be disconnected to completely separate the two pieces.

STATOR/ROTOR/ENGINE REMOVAL:

After the panel assemblies are removed, the tech will have full access to the components of the unit for easier removal.

STATOR:

1. Remove the front belt tensioner by using a ¾" socket and wrench.
2. Loosen bolt and nut and remove.
3. Use a 16-mm socket for the rear tensioner.
4. Remove the rear and front belts.
5. Remove the two screws mounting the electric fuel pump to the bottom frame by using a 10-mm socket.
6. Disconnect the wiring harness from the fuel pump.
7. Remove air filter and rubber hose from the metal cross member frame by using a flat tip screwdriver.
8. Place a block of wood under the rear of the engine for support.

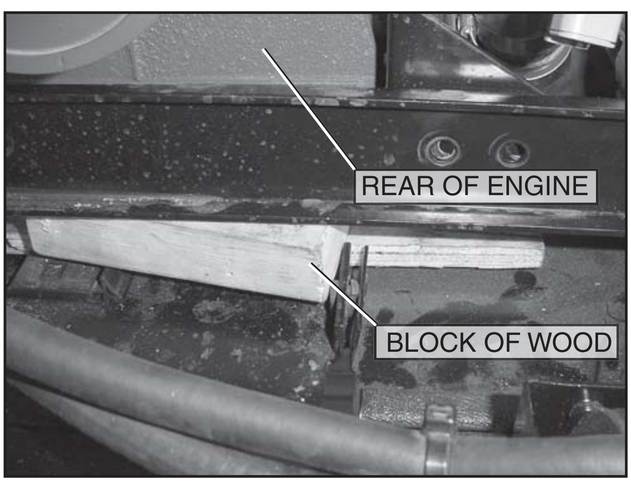


Figure 8-1. – Block of Wood Under Rear of Engine

9. Remove the two bolts that mount the rear cross member frame to the bottom frame through the rubber mount.
10. Remove the four bolts that mount the engine to the cross member.
11. Remove the two hold down bolts mounting the brush assembly to the rear-bearing carrier.
12. Remove Wire 55 going to the battery charge resistor right below the stator.
13. Using a 13-mm, remove the four stator hold down bolts. The bottom two run through the rear cross member frame. With the bottom two removed, the rear cross member will be able to be removed.
14. Using a rubber mallet, tap off the rear-bearing carrier.
15. Remove the stator (be careful, not to hit the battery charge resistor).

ROTOR:

1. Use a prybar to stabilize the rotor pulley and loosen from rotor bolt.
2. Using a rubber mallet, tap off the rotor pulley.
3. Remove the rotor.

The front bearing carrier is now available for removal as well.

ENGINE:

In order for the engine to be removed, the flywheel will need to be removed first.

1. Using a prybar, stabilize the flywheel and remove the 6 bolts mounting the flywheel to the engine.
2. Remove flywheel.
3. Remove rubber fuel lines mounting to the top of the fuel injector pump.

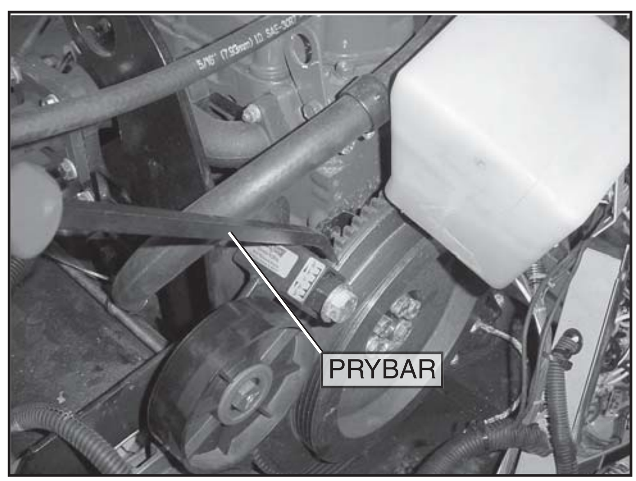


Figure 8-2. – Using Prybar to Stabilize Flywheel

CAUTION! Fuel is hazardous.

4. Attach a hoist hook to the top lifting bracket attached to the engine.
5. Slightly lift the engine to take pressure off of the block of wood.
6. Remove the bolts holding front cross member frame to the engine.

STARTER REMOVAL:

To get access to the starter for either testing or removal, the unit will need to be lifted in order to remove the bottom center panel. The battery will need to be disconnected prior to removing the starter if found to be faulty. The panel is held on by 2 latches. Lift latches and remove lower panel. Remove positive battery cable from the starter. Remove the 2 allen bolts mounting the starter to front cross member frame. Remove starter.

FUEL INJECTOR PUMP REMOVAL:

Prior to removing the injector pump, the top and side panels will need to be removed. Remove rubber fuel lines going to the brass fittings located at the top of the fuel injector pump. CAUTION: Fuel is hazardous. Disconnect Wire 14 going to the fuel solenoid that is mounted to the left of the fuel injector pump. Remove the fuel solenoid by using a small channel lock wrench and turn the solenoid counter clockwise. Remove the metal fuel lines located at the top of the fuel injector pump. Remove the other end of the metal lines going to the nozzle injectors. Remove the two retaining screws and two nuts holding injector pump to the governor assembly. Lift and remove fuel injector pump and spacer shims.

RADIATOR REMOVAL:

Prior to removing the radiator, the top panel will need to be removed.

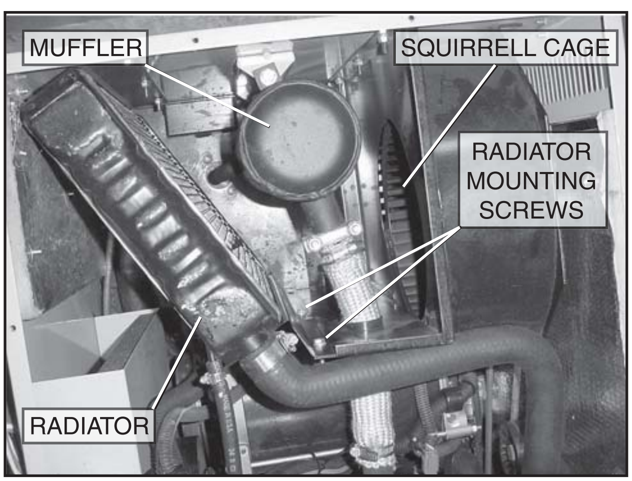


Figure 8-3. – Radiator Removal Points

1. Lift unit by engine lifting bracket to gain access to the bottom hole under radiator.
2. Loosen drain plug and drain coolant into appropriate container able to hold 1.4 gallons.
3. With the coolant drained, lower the unit and remove the lower and 2 upper coolant hoses.
4. Remove the 4 screws and 2 nuts mounting the radiator to the side panel and squirrel cage shroud.
5. Lift radiator out of unit.

When replacing the radiator, use a RTV sealant when attaching the radiator hoses. When refilling the radiator, use a 50/50 mixture of coolant and water.

RE-ASSEMBLY

To re-assemble the generator, reverse the previous procedures.

BELT TENSIONING

DRIVE BELT:

1. Install drive belt tensioner as shown in Figure 8-4. Snug mounting bolt but do not tighten.
2. Using a 3/4” wrench, apply tension to the belt as shown in Figure 8-5.

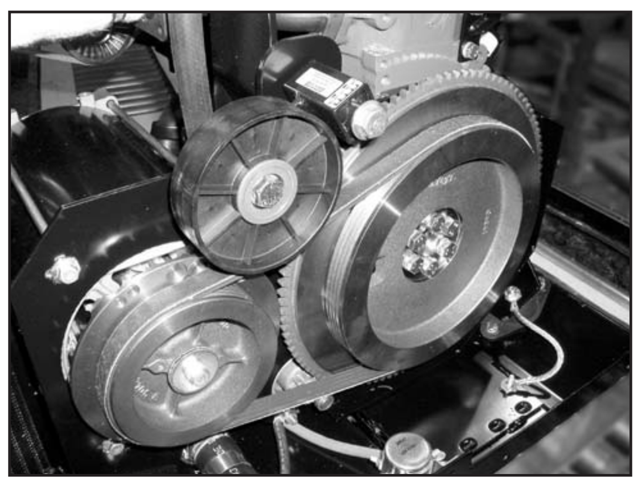


Figure 8-4. – Drive Belt Tensioner

3. Belt tension should be between 5-10° (see Figure 8-6). When the proper tension is achieved, tighten the mounting bolt to 49 ft-lbs.

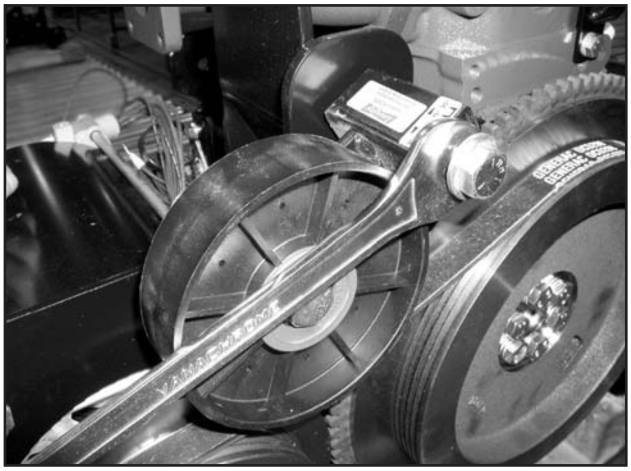


Figure 8-5. – Applying Tension to Drive Belt Tensioner

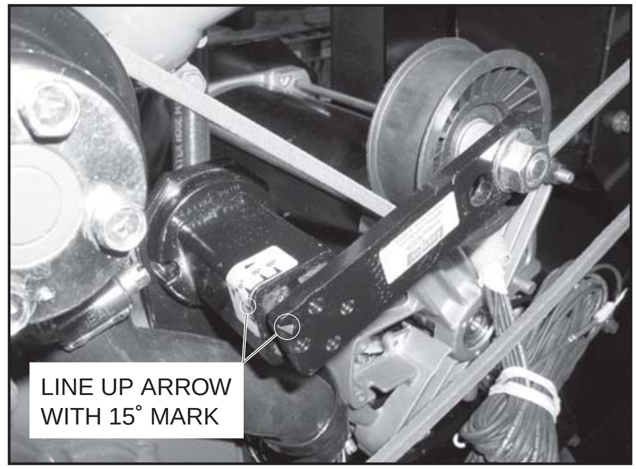


Figure 8-7. – Position of Fan Belt Tensioner

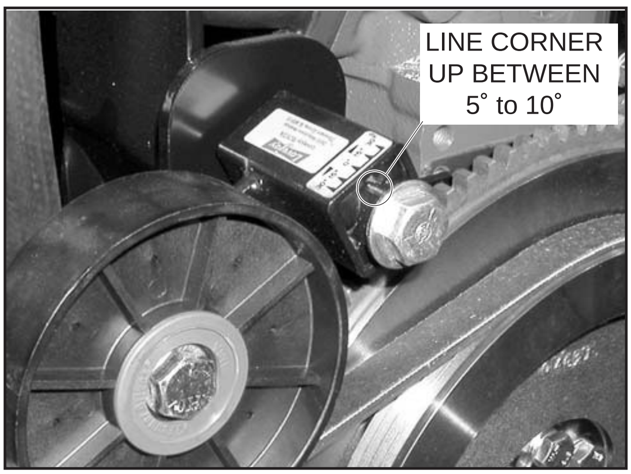


Figure 8-6. – Position of Drive Belt Tensioner

FAN BELT:

1. Install fan belt tensioner as shown in Figure 8-7. Snug mounting bolt but do not tighten.
2. Using a small bubble level, verify that tensioner is level horizontally. If needed, tap the mounting bracket to level it (see Figure 8-8).
3. Using a 36mm wrench or equivalent, apply tension to the belt (see Figure 8-9).Belt tension should be 15° (Figure 8-7). Once proper tension is achieved tighten hold down bolt to 49 ft-lbs using a 16mm socket.

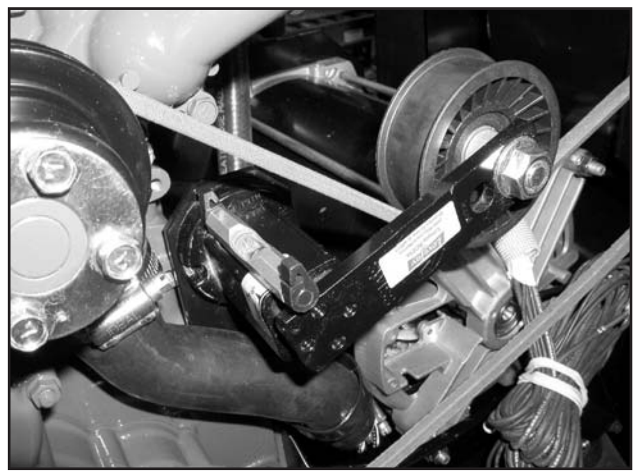


Figure 8-8. – Leveling Fan Belt Tensioner

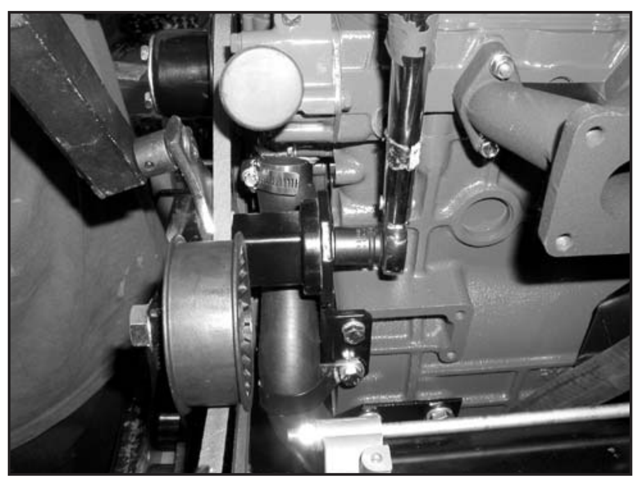
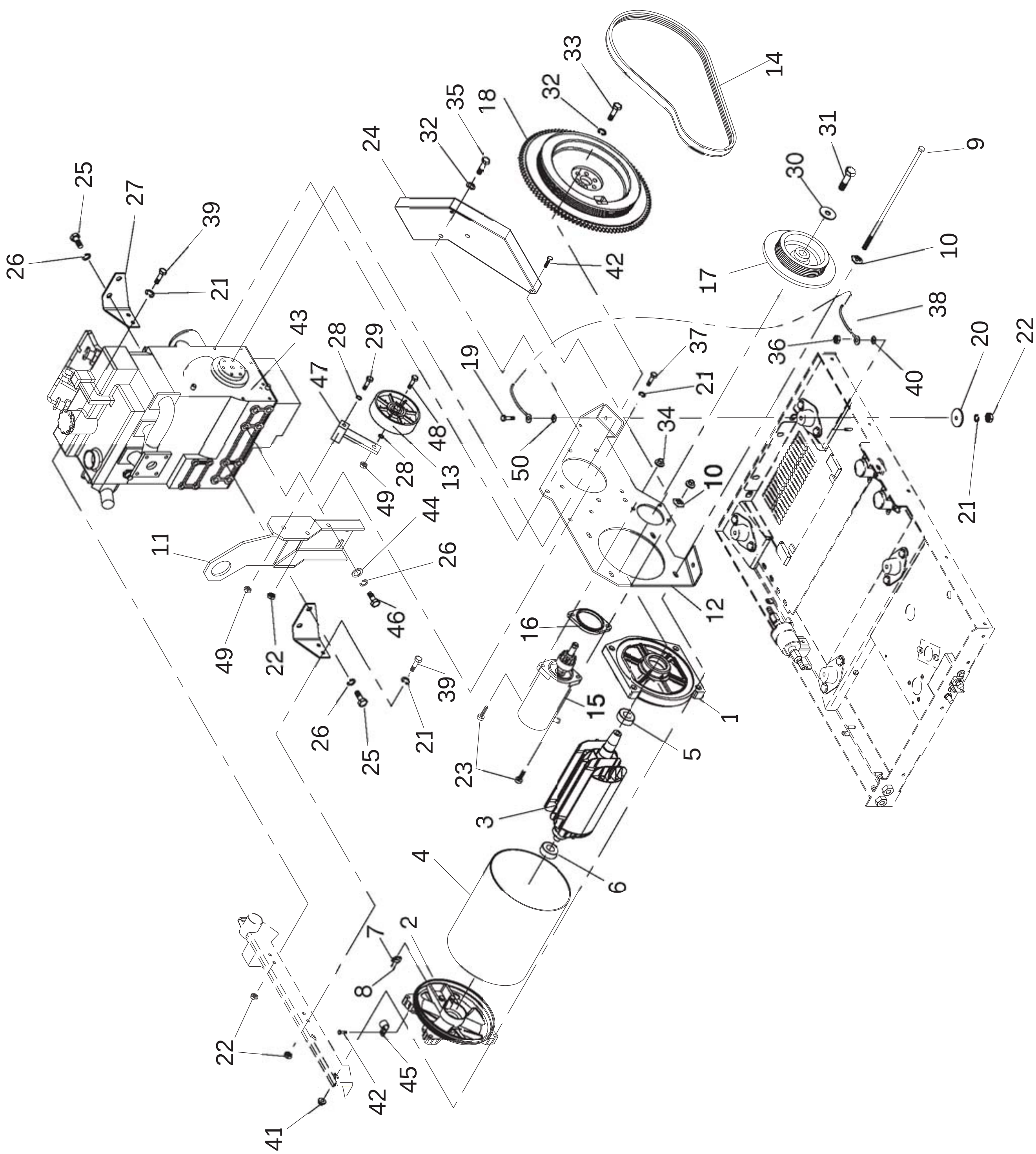


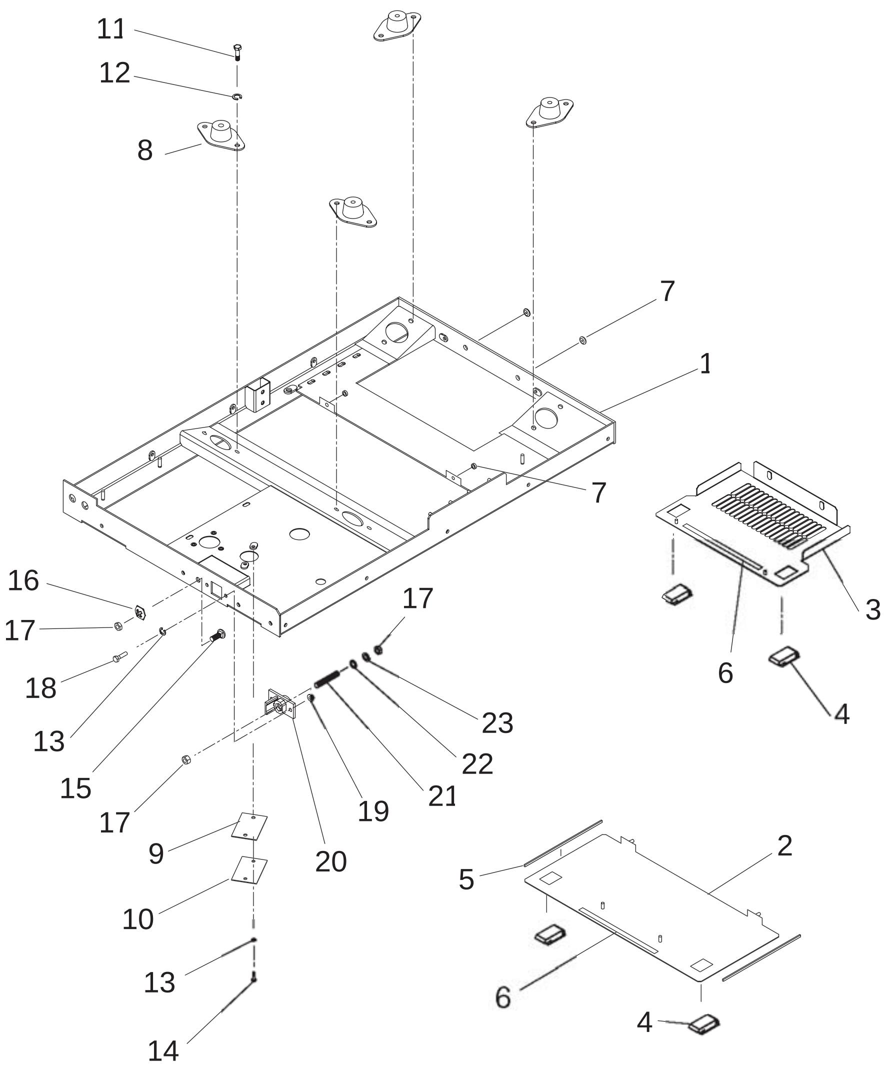
Figure 8-9. – Tensioning Fan Belt Tensioner

Engine, Alternator Drive & Starter – Drawing No. 0D2355-B



ITEM	QTY.	DESCRIPTION
1	1	Bearing Carrier, Front
2	1	Bearing Carrier, Upper
3	1	Rotor Assembly
4	1	Stator Assembly
5	1	Ball Bearing
6	1	Ball Bearing
7	1	Brush Holder
8	2	Taptite M5-0.8 x 16mm
9	4	Bolt , Stator
10	6	5/16 Special Lock Washer
11	1	Lug, Lift
12	1	Rail, Engine RH
13	1	Pulley, 4.5" Flat
14	1	Belt, V-Rib
15	1	Starter Motor
16	1	Spacer, Starter
17	1	Pulley, Alternator
18	1	Flywheel Assembly
19	2	HHCS M8-1.25 x 55mm
20	2	Washer, Vibration Isolator
21	8	Washer, Split Lk -M8
22	8	Nut, Hex M8-1.25
23	2	SHCS 5/16"-18 x 1-1/2"
24	1	Guard, Flywheel
25	4	HHCS M12-1.25 x 20mm
26	6	Washer, Split Lk -M12
27	2	Engine Bracket
28	2	½" Flat washer
29	1	½"-13 x 4" HHCS
30	1	Fender Washer 7GA
31	1	HHCS 3/8-24 x 1"
32	11	Lockwasher M10
33	6	HHCS M10-1.25 x 25mm
34	2	5/16 Flange Nut
35	5	HHCS M10-1.25 x 20mm
36	1	M6 Hex Nut
37	2	HHCS M8-1.25 x 25mm
38	1	Earth Strap
39	4	HHCS M8-1.25 x 20mm
40	1	¼" Special Lock Washer
41	4	M8 Flange Nut
42	3	Taptite, M6-1.0 x 8mm
43	1	Engine, 1.0L Diesel
44	2	Washer, Flat M12
45	1	Clamp, Vinyl Coated, 1-1/16"
46	2	HHCS M12-1.25 x 25mm
47	1	Tensioner, SE-F18-4.5"
48	1	½"-13 x1-3/4" HHCS
49	2	½"-13 Flange Nut
50	2	Flat Washer, 5/16"

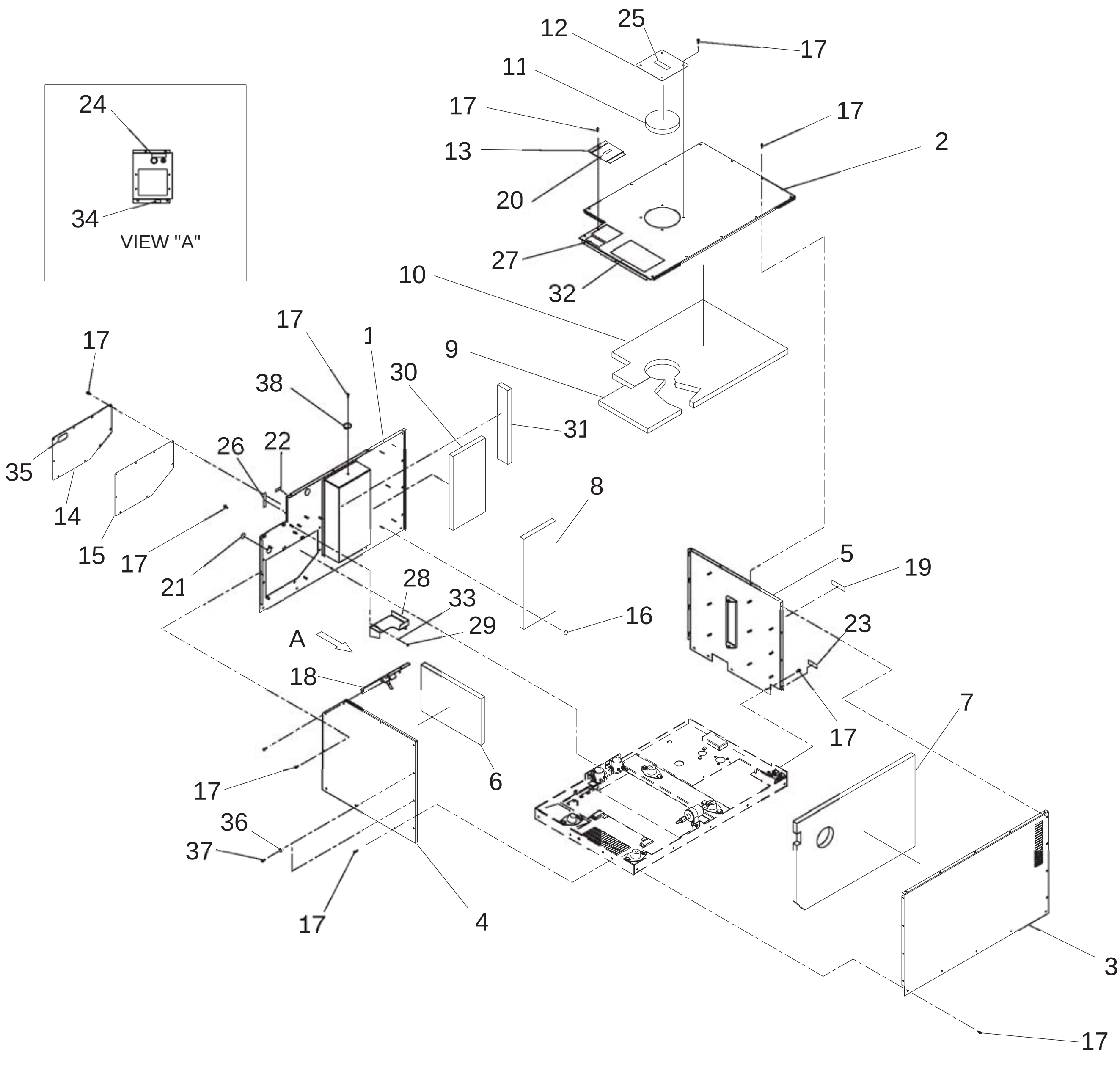
Base Frame – Drawing No. 0D2357-A



ITEM	QTY.	DESCRIPTION
1	1	Base Frame Weldment
2	1	Door, Service Rear
3	1	Door, Service Front
4	4	Slide Latch Flush
5	2	Vinyl Trim -Black 180mm
6	677mm	Rubber Tape 1/8 x ½"
7	4	Grommet 1/8 x 13/32
8	4	Vibration Mount
9	1	Gasket, Cleanout
10	1	Plate, Cleanout
11	8	HHCS M8-1.25 x 16
12	8	Washer, Split Lk- M8
13	3	Washer, Split Lk -1/4-M6
14	2	HHCS M6-1.00 x 10
15	1	Carriage Bolt 3/8 -16 x 55mm
16	1	3/8 Special Lock Washer
17	3	Hex Nut 3/8-16 Brass
18	2	HHCS M6-1.00 x 16
19	2	Nut, Hex M6.0 -1.0
20	1	Block, Terminal Battery Post
21	1	Stud 3/8-16 x 55mm
22	1	Washer 3/8 Flat
23	1	Washer Split Lk -3/8

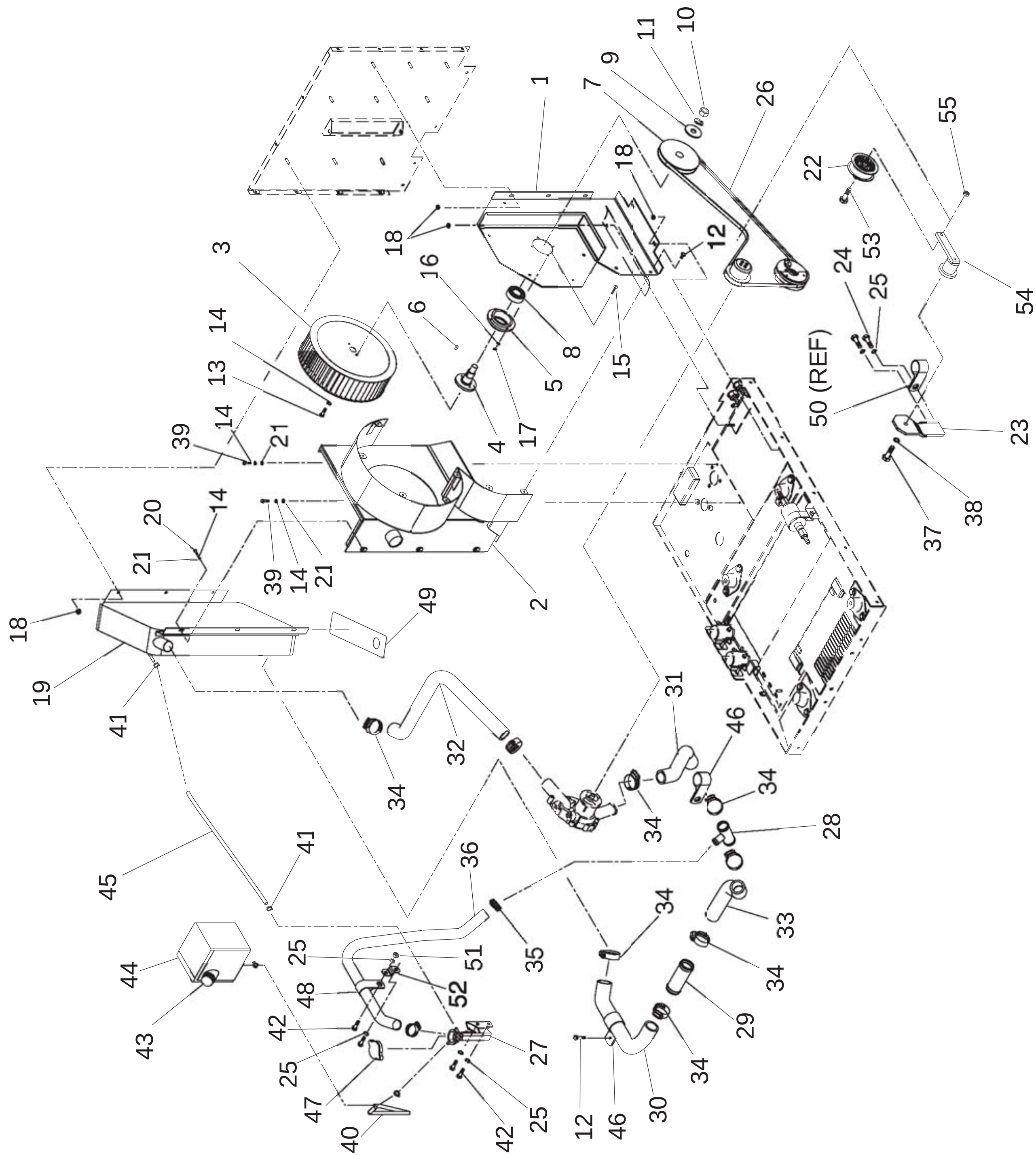
mm = Millimetres

Enclosure – Drawing No. 0D2358-D



ITEM	QTY.	DESCRIPTION
1	1	Enclosure Panel RH
2	1	Enclosure Panel Top
3	1	Enclosure Panel LH
4	1	Enclosure Panel Front
5	1	Enclosure Rear Panel
6	1	Insulation, Front Panel
7	1	Insulation, LH Side Panel
8	1	Insulation, RH Side Panel
9	1	Insulation, Top Front Panel
10	1	Insulation, Top Rear Panel
11	1	Insulation, Lifting Lug Cover
12	1	Cover, Access Lift
13	1	Cover, Radiator Fill
14	1	Cover, Access Electrical
15	1	Gasket, Electrical Access
16	33	Washer, Self Locking
17	57	¼ -20 x 5/8 W/Washer
18	1	Frame Control Panel - Refer to Drawing C8005
19	1	Decal, Battery +/-
20	1	Decal, Radiator Cap
21	1	Decal, Remote
22	1	Decal, Coolant
23	1	Decal, Fuel Return/Supply
24	1	Decal, Oil Fill / Level
25	1	Decal, Lifting Lug
26	1	Decal, Max Hot / Min Coolant
27	1	Decal, Warning Rv
28	1	Support, Coolant Tank
29	3	Nut, Hex M6-1.0
30	1	Foam, Air Duct Face
31	1	Foam, Air Duct Side
32	1	Decal, Unit
33	3	Washer, Split Lock ¼" - M6
34	1	Decal, Engine Data
35	1	Decal, CSA Approval
36	2	Washer Nylon 0.250"
37	2	Screw SW ¼"-20 X 3/8" Long
38	1	Clamp Vinyl 1.5" X 0.281"

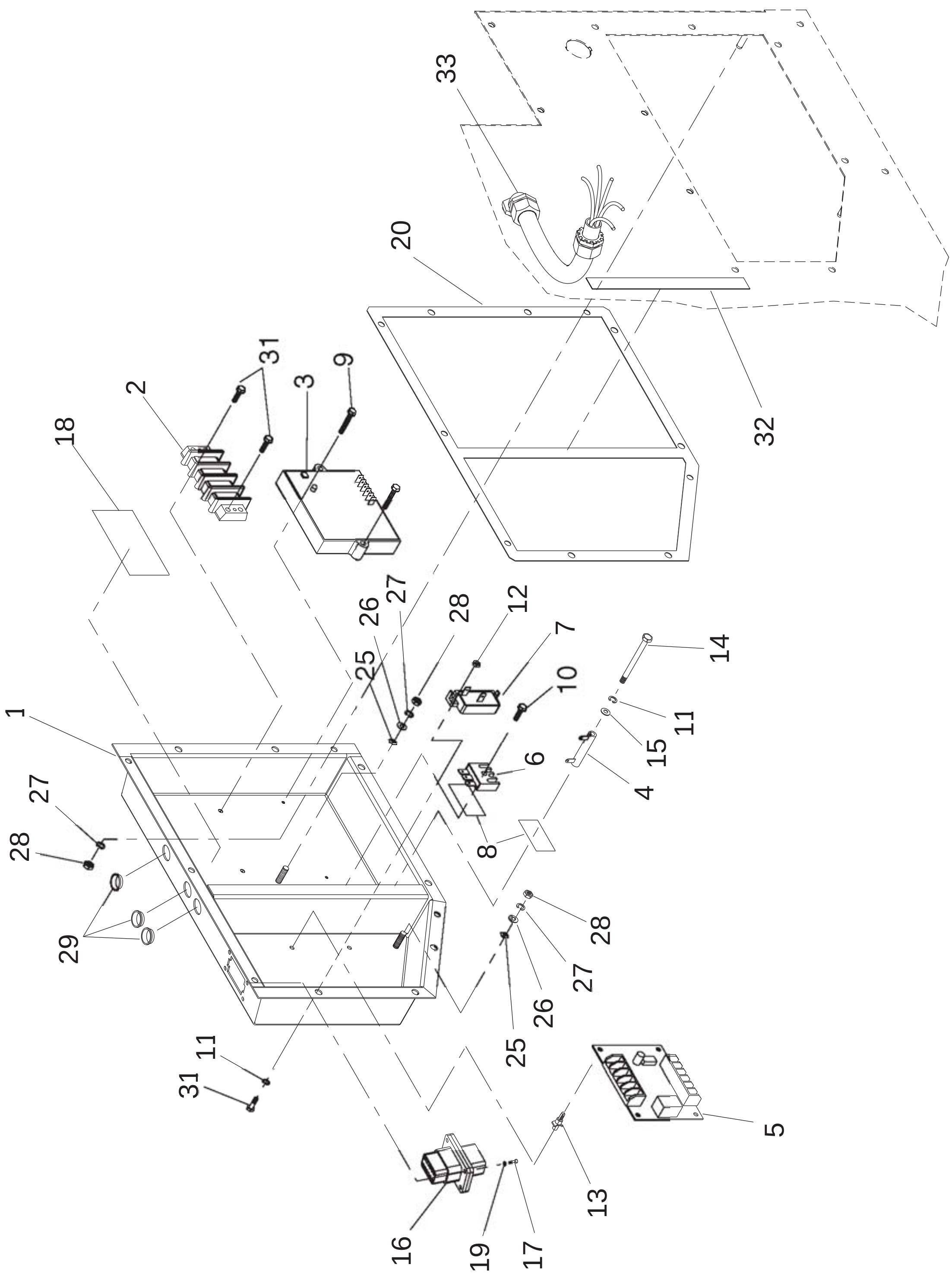
Cooling System – Drawing No. 0D2360-B



ITEM	QTY.	DESCRIPTION
1	1	Cover Plate, Scroll Weldment
2	1	Housing, Fan Scroll Weldment
3	1	Fan, Squirrel Cage
4	1	Shaft, Fan
5	1	Carrier, Bearing
6	1	Key, Square 3/16" x 3/16" x ½"
7	1	Pulley, Fan 4-7/8"
8	1	Bearing 2 Row Ball
9	1	Fender Washer M16
10	1	Nut, Hex M16.0 -1.5mm
11	1	LockWasher M16.0
12	7	Crimptite, ¼"-20 x 5/8"
13	2	HHCS M6-1.00 x 10mm
14	7	Washer, Split Lk ¼"- M6
15	4	HHCS M5-0.8 x 16mm
16	4	Washer, Split Lk #10
17	4	Hex Nut M5
18	12	Nut Top Lock Flange M6-1.0
19	1	Radiator 1.0L RV
20	3	HHCS M6-1.00 x 12mm
21	5	Washer ¼"-M6
22	1	Pulley, 3" Flat Flanged
23	1	Bracket, Rotary Tensioner
24	2	HHCS M8-1.25 x 20mm
25	6	Washer, Split Lk -M8
26	1	61" Green Belt
27	1	Filler Neck Assembly, Radiator Remote
28	1	Hose Tee
29	1	Coupling, Hose
30	1	Hose, Radiator Lower
31	1	Hose, Water Pump Lower
32	1	Hose, Top
33	1	Hose, Lower Intermediate
34	8	Hose Clamp Hi Trq 1-3/4" Max
35	2	Hose Clamp #12
36	720mm	Hose, ¾" SAE-20R3
37	1	M10-1.5 x 30mm HHCS
38	1	M10 Lockwasher
39	2	HHCS M6-1.00 x 16mm
40	270mm	Hose, 5/16" SAE-20R4
41	4	Hose Clamp 7/8" 3/8"
42	4	HHCS M8-1.25 x 16mm
43	1	Cap, Coolant Fill
44	1	Tank, Coolant Overflow
45	510mm	Hose 5/16" SAE-20R4
46	2	Clamp, Vinyl Coated 1-5/8"
47	1	Cap, Radiator Pressure
49	1	Gasket, Radiator Base
51	1	Nut, Hex M8-1.25
52	1	Bracket, Support
53	1	½"-13 x 1-¾" HHCS
54	1	Tensioner, SE-18-3"
55	1	½"-13 Flange Nut

mm = Millimeters

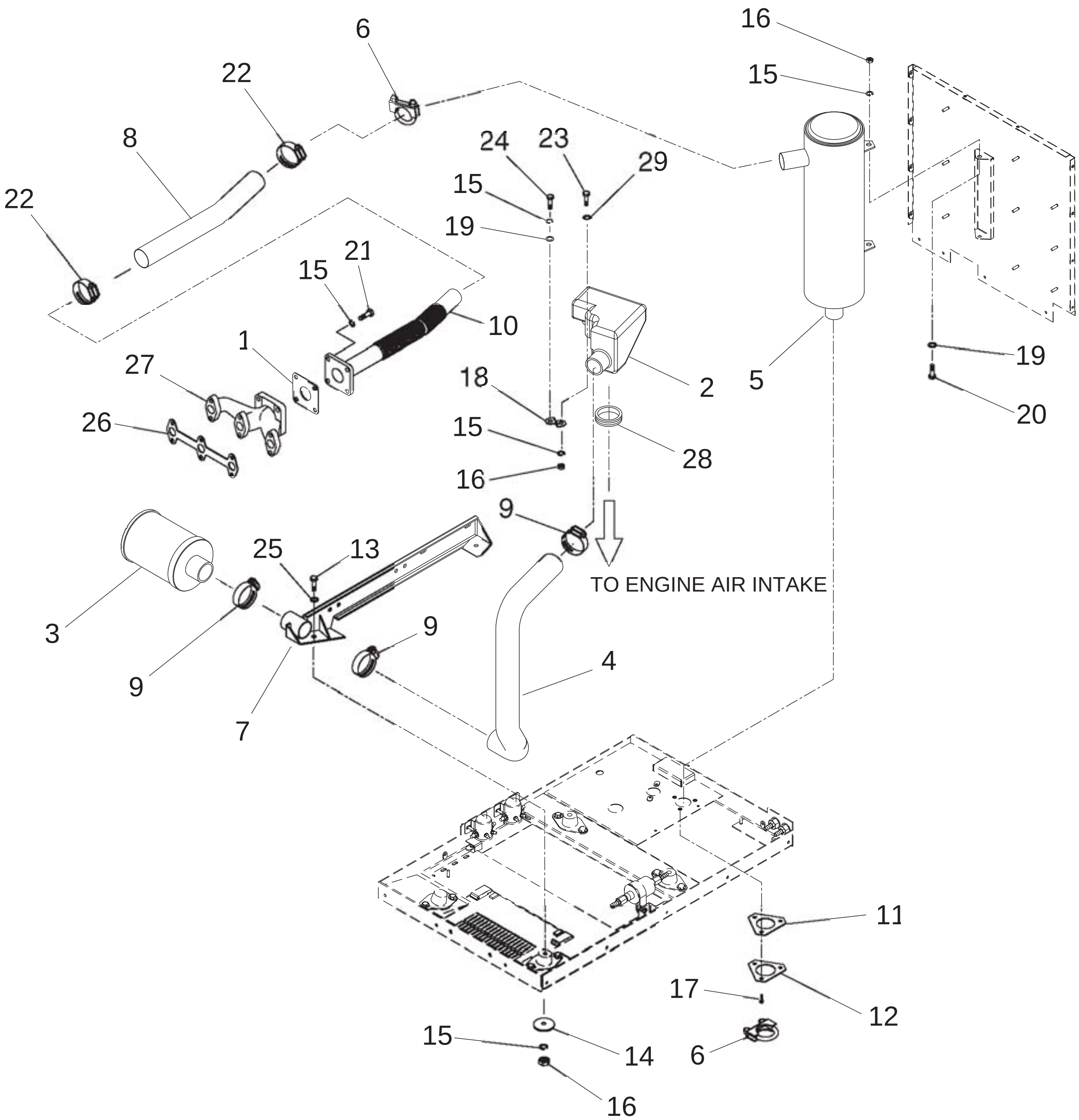
Electrical Enclosure Assembly – Drawing No. 0D2361-E



ITEM	QTY.	DESCRIPTION
1	1	Weldment, Electrical Enclosure
2	1	Terminal Block 4 Position
3	1	Assembly, Potted Regulator
4	1	Resistor 20R 5% 12W
5	1	Assembly Marine Control Board
6	1	Rectifier, Battery Charging
7	1	Circuit Breaker 5 Amp
8	A/R	Tape, Glass Insulated
9	2	Taptite, M5-0.8 x 30
10	1	Taptite, M5-0.8 x 16
11	3	Lockwasher M5
12	2	Nut, Hex M4-0.7
13	4	Pcb Support Snap -In
14	1	HHMS, #8-32 x 2.25"
15	1	Washer, Flat M5
16	1	Harness
17	4	M4-0.7 x 16 HHCS Taptite
18	1	Decal, Customer Connection
19	4	Washer, Flat #8
20	1	Gasket, Electrical Enclosure
21	*1	Wire Assembly # 32
22	*1	Wire Assembly # 22
23	*1	Diode Assembly
24	*1	Wire Assembly # 162
25	2	¼ Special Lockwasher
26	2	Washer, Flat ¼-M6
27	7	Washer, Split Lk ¼-M6
28	7	Nut, Hex M6-1
29	3	Bushing, Snap
31	4	HHCS, M4-0.7 x 16mm
32	1	Gasket, Electrical Enclosure Divider
33	1	Harness, Ac Output

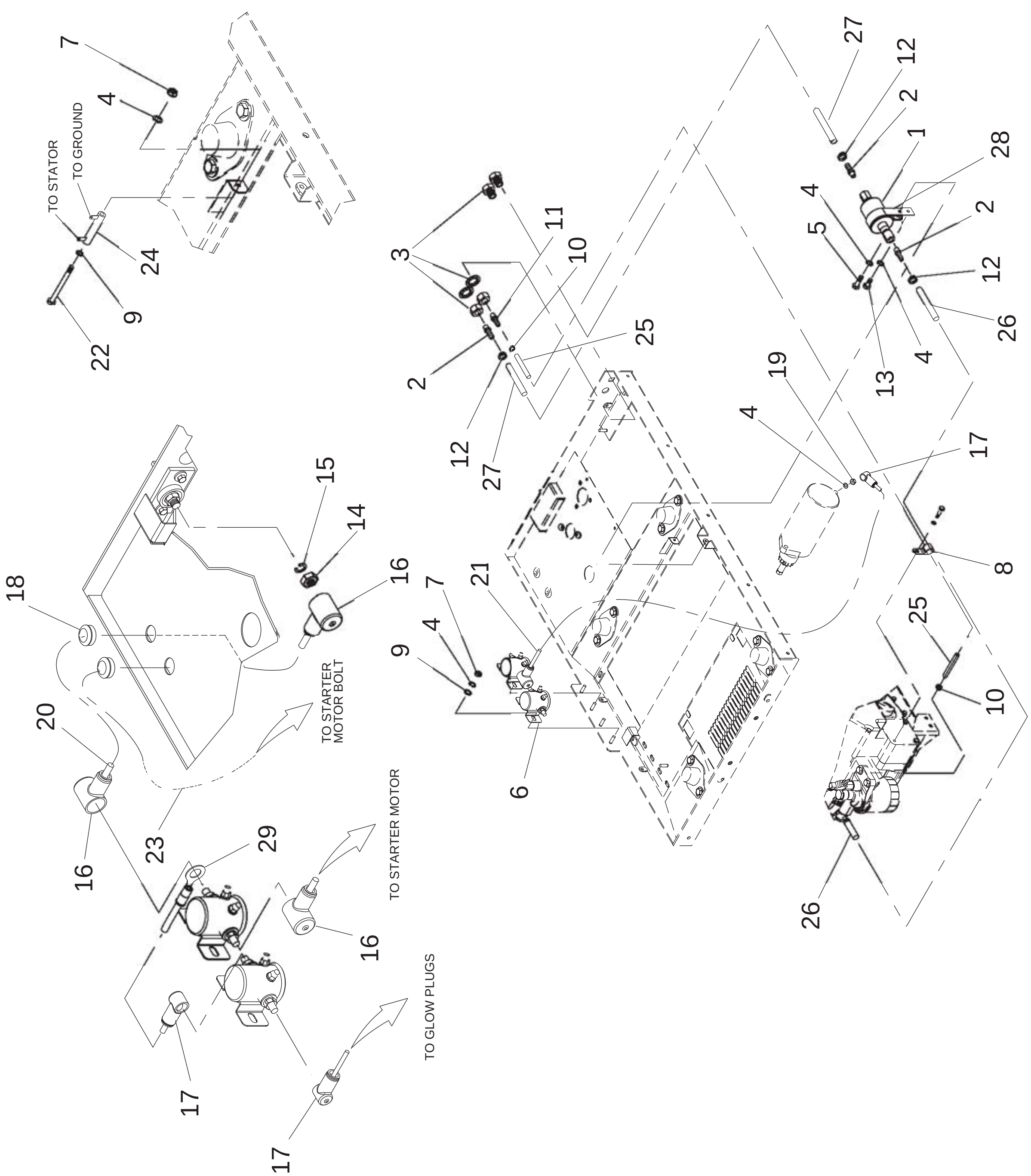
A/R = As Required
* Not shown refer to Wiring Diagram C4946

Intake and Exhaust System – Drawing No. 0D2362-B



ITEM	QTY.	DESCRIPTION
1	1	Exhaust Gasket
2	1	Chamber Air Intake
3	1	Air Filter
4	1	Hose, Air Inlet
5	1	Muffler Weldment
6	2	U Bolt & Saddle 1.25
7	1	Rail, Engine LH, Weldment
8	1	Insulation, Exhaust
9	3	Hose Clamp #28
10	1	Outlet, Exhaust Flex
11	1	Gasket, Exhaust Outlet
12	1	Plate, Exhaust Outlet
13	2	HHCS M8-1.25 x 55
14	2	Washer, Vibration Isolator
15	10	Washer, Split Lk -M8
16	5	Nut, Hex M8-1.25
17	3	Crimptite, ¼"-20 x 5/8"
18	1	Bracket, Support
19	4	Washer, Flat - M8
20	2	HHCS M8-1.25 x 20
21	4	HHCS M8-1.25 x 25
22	2	Hose Clamp #20
23	1	HHCS M8-1.25 x 30
24	1	HHCS M8-1.25 x 16
25	2	Flatwasher, 5/16"
26	1	Manifold Gasket
27	1	Horizontal Exhaust Manifold
28	1	Grommet 1-3/4" x 1/8" x 2"
29	1	WASHER FLAT 0.336"ID X 0.876"OD

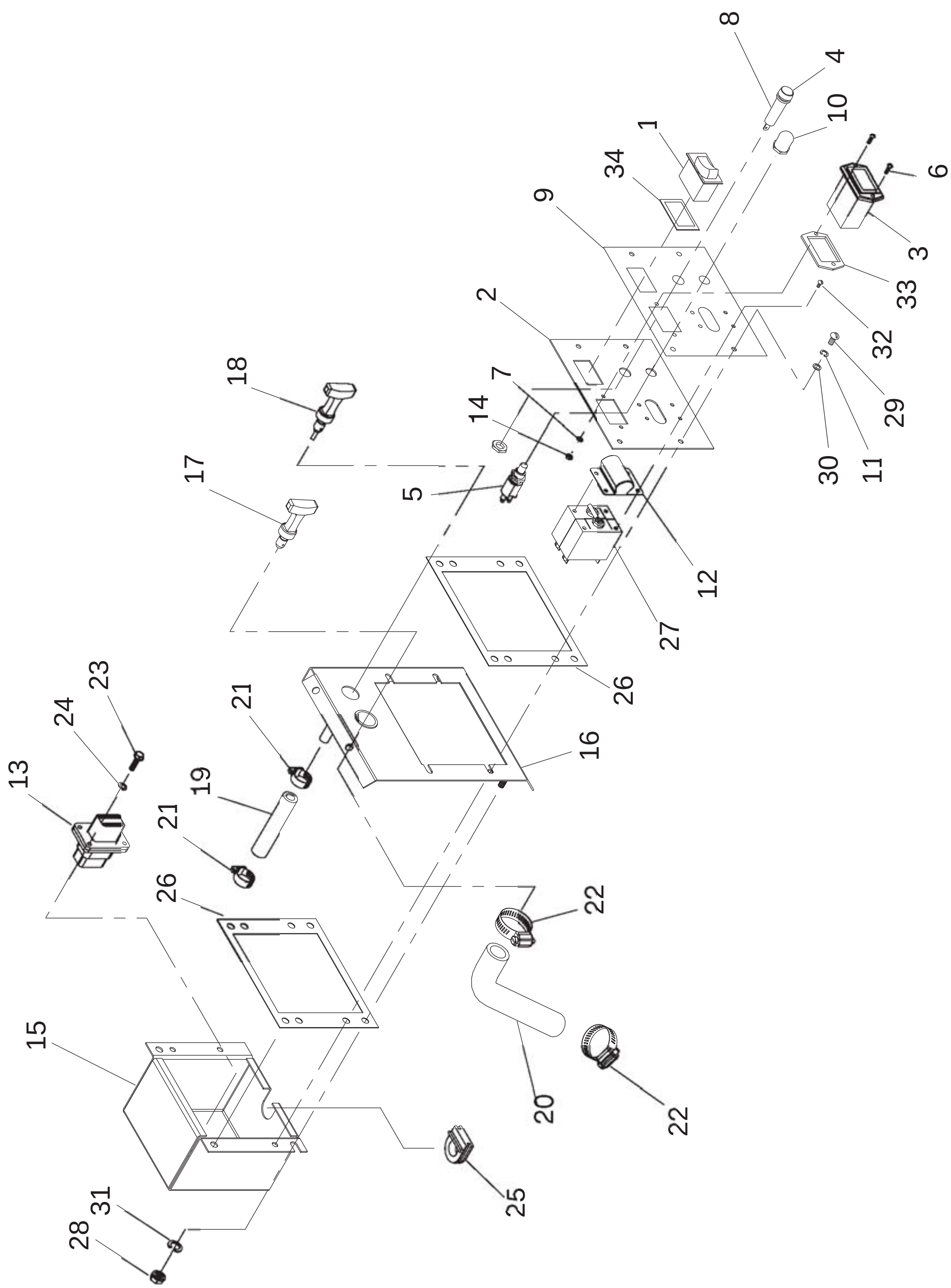
Fuel and Electrical Systems – Drawing No. 0D2363-C



ITEM	QTY.	DESCRIPTION
1	1	Fuel Pump Assembly
2	3	1/8 NPT x 5/16 Barbed Straight Fitting
3	2	Bulkhead Adaptor Fitting
4	7	Washer, Split Lk- ¼ -M6
5	1	HHCS M6-1.00 x 30
6	2	Relay Solenoid
7	5	Nut, Hex M6-1
8	1	Clamp, Vinyl Coat 1-1/16"
9	5	Washer, Flat -M6
10	2	Hose Clamp
11	1	1/8 NPT x 1/4 Barbed Straight Fitting
12	3	Hose Clamp 7/8 / 3/8
13	1	HHCS M6-1.00 x 16
14	1	Hex Nut 3/8-16 Brass
15	1	Washer Split Lk 3/8
16	3	Boot, Battery Cable
17	3	Boot, Battery Cable
18	2	Snap Bushing 1"
19	1	Hex Nut ¼ - 20
20	1	Cable, Battery
21	1	Cable, Starter
22	1	HHCS M6-1 x 65
23	1	Wire Assembly, Black #4 Ground
24	1	Resistor
25	1.04M	Hose, 1/4 ID SAE-30R7
26	635mm	Hose, 5/16 ID SAE-30R7
27	375mm	Hose, 5/16 ID SAE-30R7
28	1	Clamp, Fuel Pump
29	1	Wire Assy, #0 (PHC-SC)

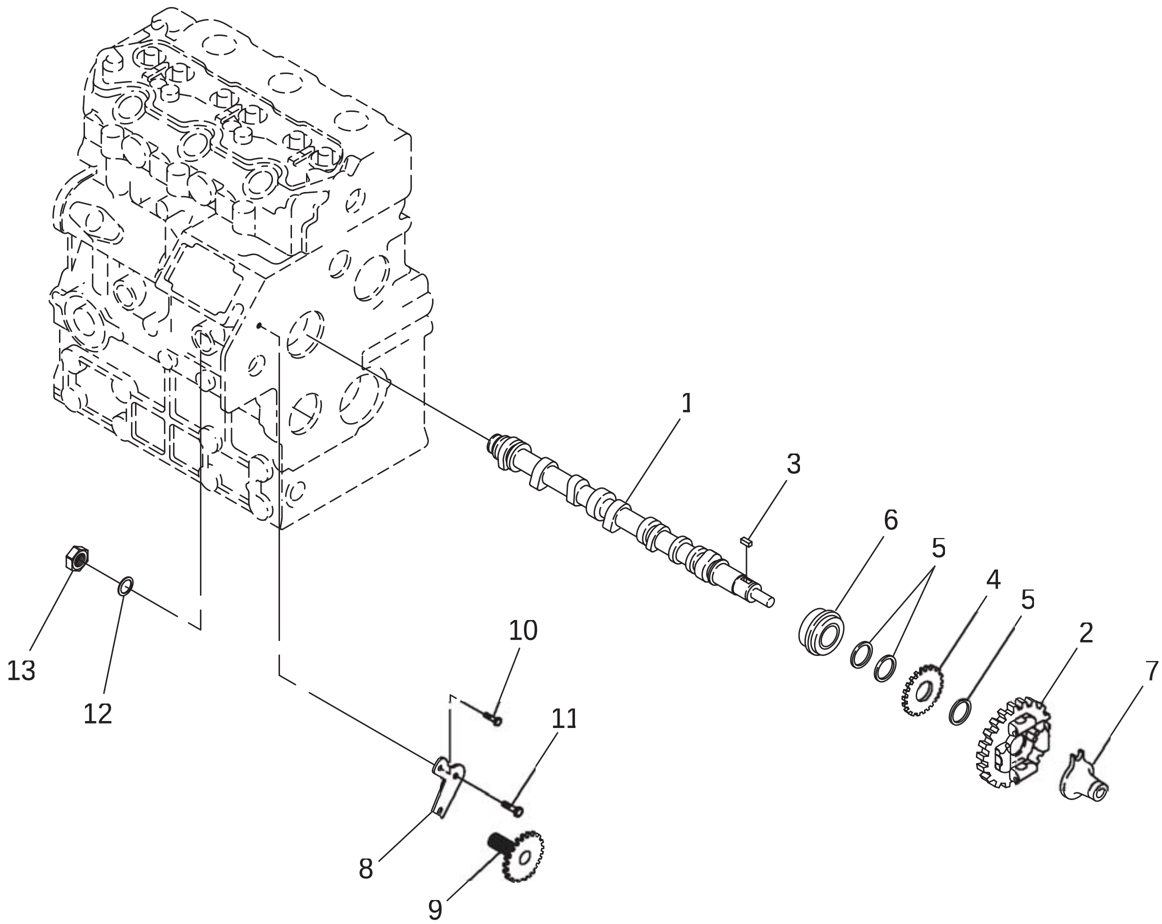
M = Meters
mm = Millimetres

Customer Controls Assembly – Drawing No. 0D2364-D



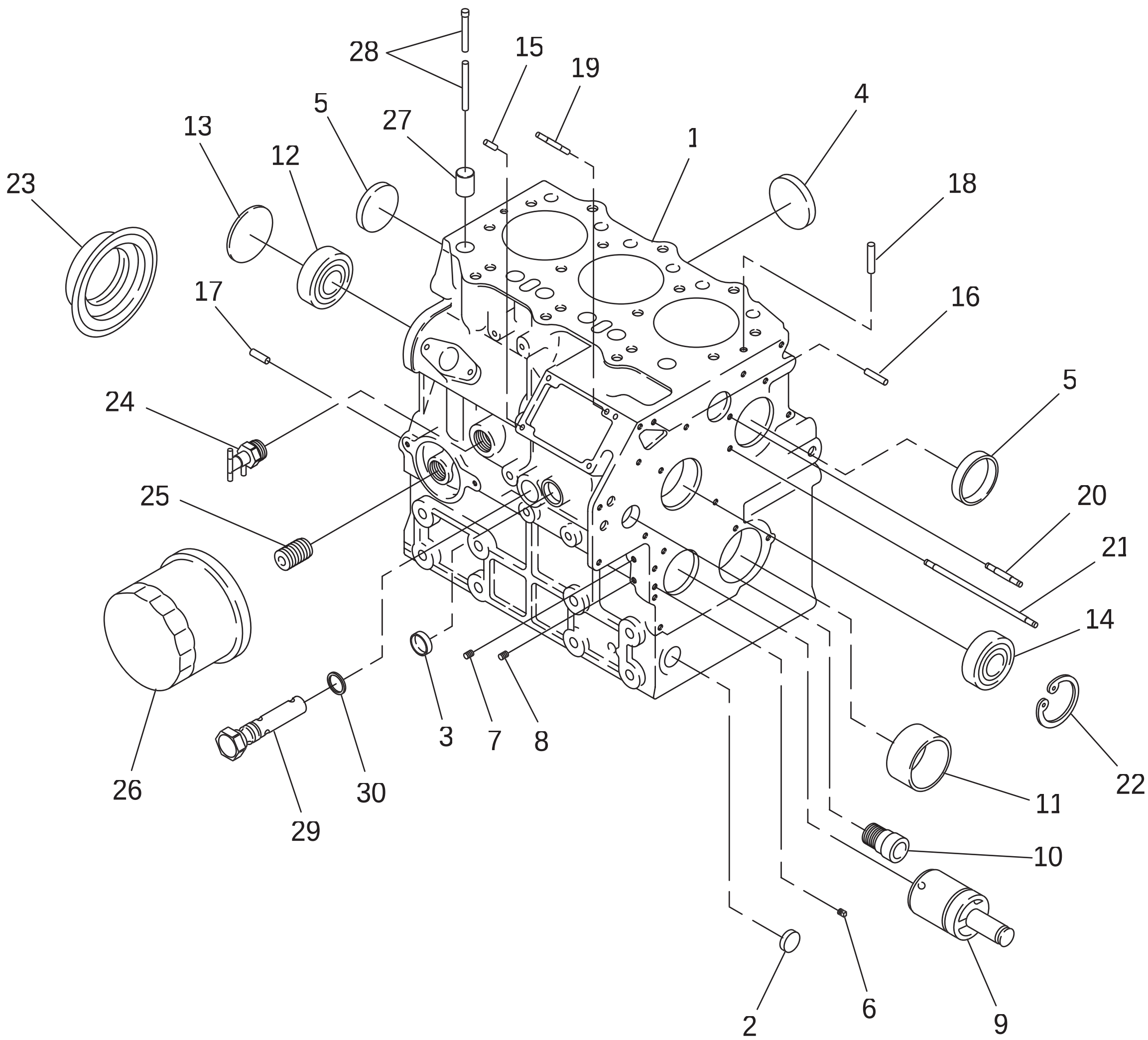
ITEM	QTY.	DESCRIPTION
1	1	Start / Stop Switch
2	1	Cover, Engine Control Box
3	1	Hour Meter
4	1	Fuse Holder, SFE-14
5	1	Switch, Pushbutton SPST
6	2	PPHMS M3-0.5 x 10
7	2	Lockwasher M3
8	1	Fuse, SFE-14
9	1	Decal
10	1	Boot / Nut / Preheat Switch
11	4	Lockwasher, M5
12	1	Boot, Circuit Breaker
13	1	Harness
14	2	Hex Nut, M3
15	1	Box, Engine Control
16	1	Frame, Control Panel
17	1	Plug, Oil Fill
18	1	Dipstick Assembly
19	1	Hose, Dipstick Tube
20	1	Hose, Filler Tube
21	2	Hose Clamp 7/8-3/8
22	2	Hose Clamp Size #16
23	4	M4-0.7 x 16 HHCS Taptite
24	4	Washer, Flat #6
25	1	Grommet
26	2	Gasket, Engine Control Box
27	1	Circuit Breaker, 35A, 2 Pole
28	2	Nut, Hex M6-1.0
29	4	PHMS M5-0.8 x 12
30	4	Flatwasher, #8
31	2	Washer, Split Lock ¼" - M6
32	4	Screw, PPHM #6-32 x 1/4"
33	1	Gasket, Hourmeter
34	1	Gasket, Switch

1.0 Liter Diesel Camshaft – Drawing No. 075677



ITEM	QTY.	DESCRIPTION
1	1	CAMSHAFT ASSEMBLY
2	1	CAMSHAFT GEAR
3	1	KEY
4	1	GEAR
5	3	SPACER
6	1	BALL BEARING
7	1	SLIDER
8	1	PLATE
9	1	TACHOMETER SHAFT
10	1	BOLT
11	1	BOLT
12	1	GASKET
13	1	NUT

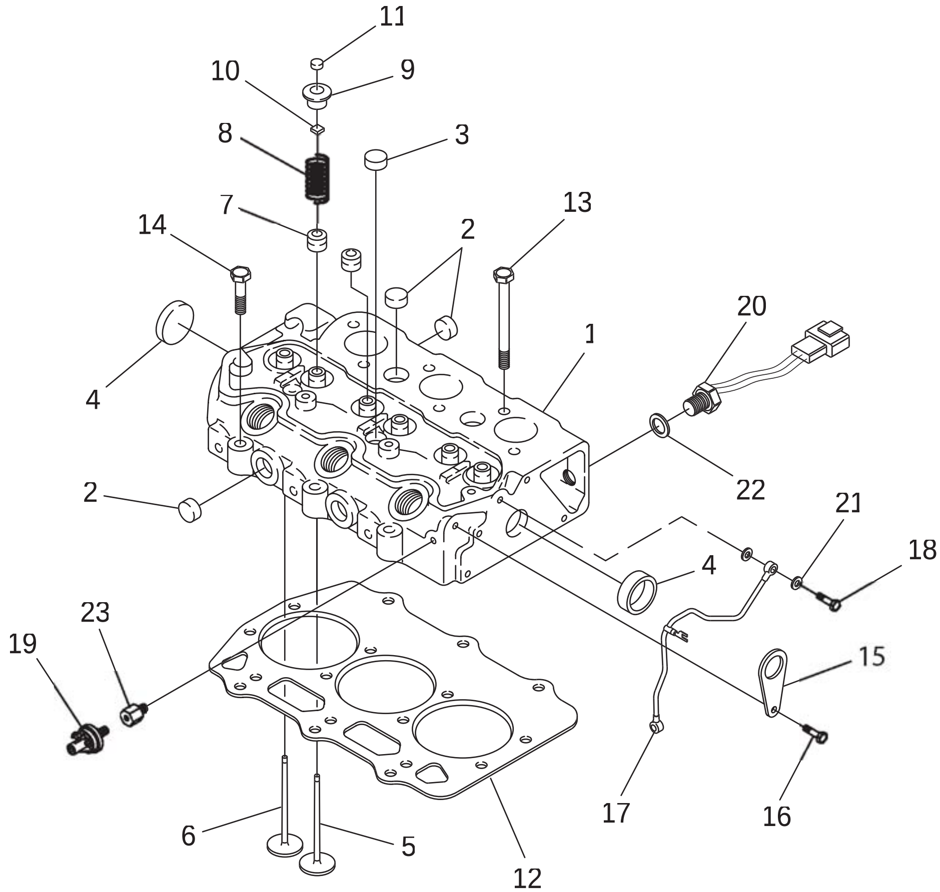
1.0 Liter Diesel Cylinder Block – Drawing No. 075676



ITEM	QTY.	DESCRIPTION
1	1	COMPLETE CYLINDER BLOCK
2	1	EXPANSION PLUG
3	1	EXPANSION PLUG
4	2	EXPANSION PLUG
5	2	EXPANSION PLUG
6	1	EXPANSION PLUG
7	4	PLUG
8	4	PLUG
9	1	IDLE GEAR SHAFT
10	1	BUSHING
11	1	BUSHING-STANDARD
	1	0.25MM U.S. BUSHING
	1	0.50MM U.S. BUSHING
12	1	BALL BEARING
13	1	EXPANSION PLUG
14	1	BALL BEARING
15	1	DOWEL PIN
16	1	DOWEL PIN
17	2	DOWEL PIN
18	2	SPRING PIN
19	2	STUD
20	1	STUD
21	1	STUD
22	1	SNAP RING
23	1	OIL SEAL
24	1	DRAIN COCK
25	1	CONNECTOR
26	1	OIL FILTER
27	6	TAPPET
28	6	PUSH ROD
29	1	RELIEF VALVE
30	1	O-RING

MM = MILLIMETER
U.S. = UNDERSIZE

1.0 Liter Diesel Cylinder Head – Drawing No. 0D2794

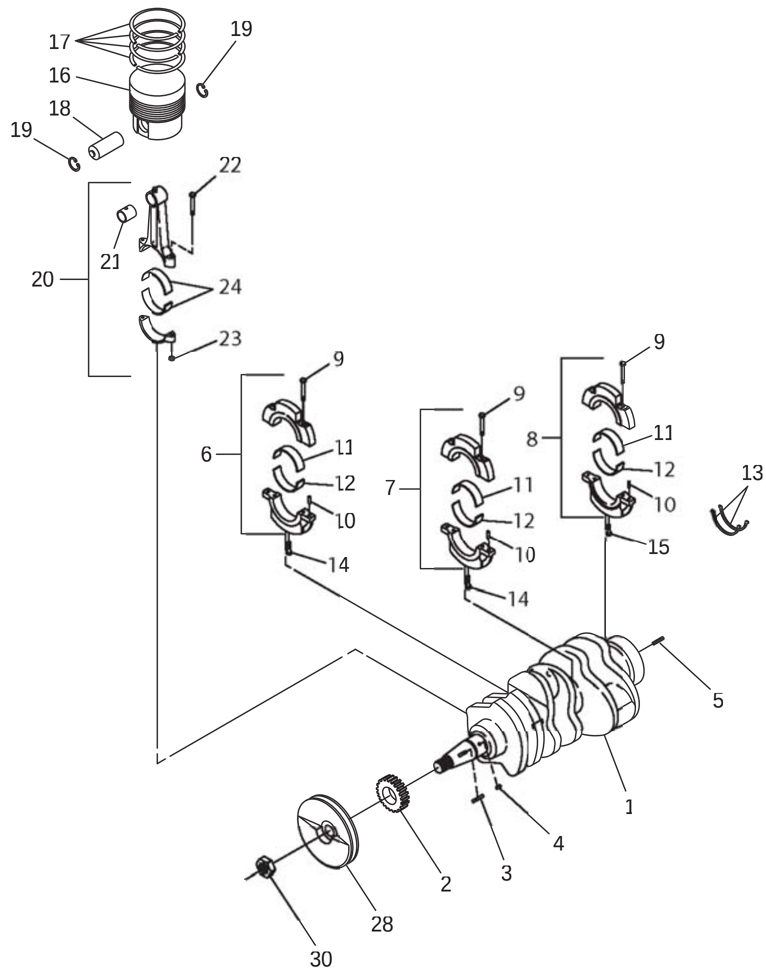


ITEM	QTY.	DESCRIPTION
1	1	CYLINDER HEAD ASSEMBLY
2	6	EXPANSION PLUG
3	3	EXPANSION PLUG
4	2	XPANSION PLUG
5	3	INTAKE VALVE
6	3	EXHAUST VALVE
7	3	VALVE GUIDE SEAL (EXHAUST)
	3	VALVE GUIDE SEAL (INTAKE)
8	6	SPRING
9	6	RETAINER
10	12	KEY
11	6	CAP
12	1	CYLINDER HEAD GASKET, 1.2MM THICK
	1	CYLINDER HEAD GASKET, 1.3MM THICK

ITEM	QTY.	DESCRIPTION
13	11	BOLT
14	3	BOLT
15	2	LIFTING EYE
16	2	BOLT
17	1	TUBING
18	2	BOLT
19	1	OIL SWITCH
20	1	THERMO-SWITCH
21	4	GASKET
22	1	WASHER
23	1	ADAPTOR

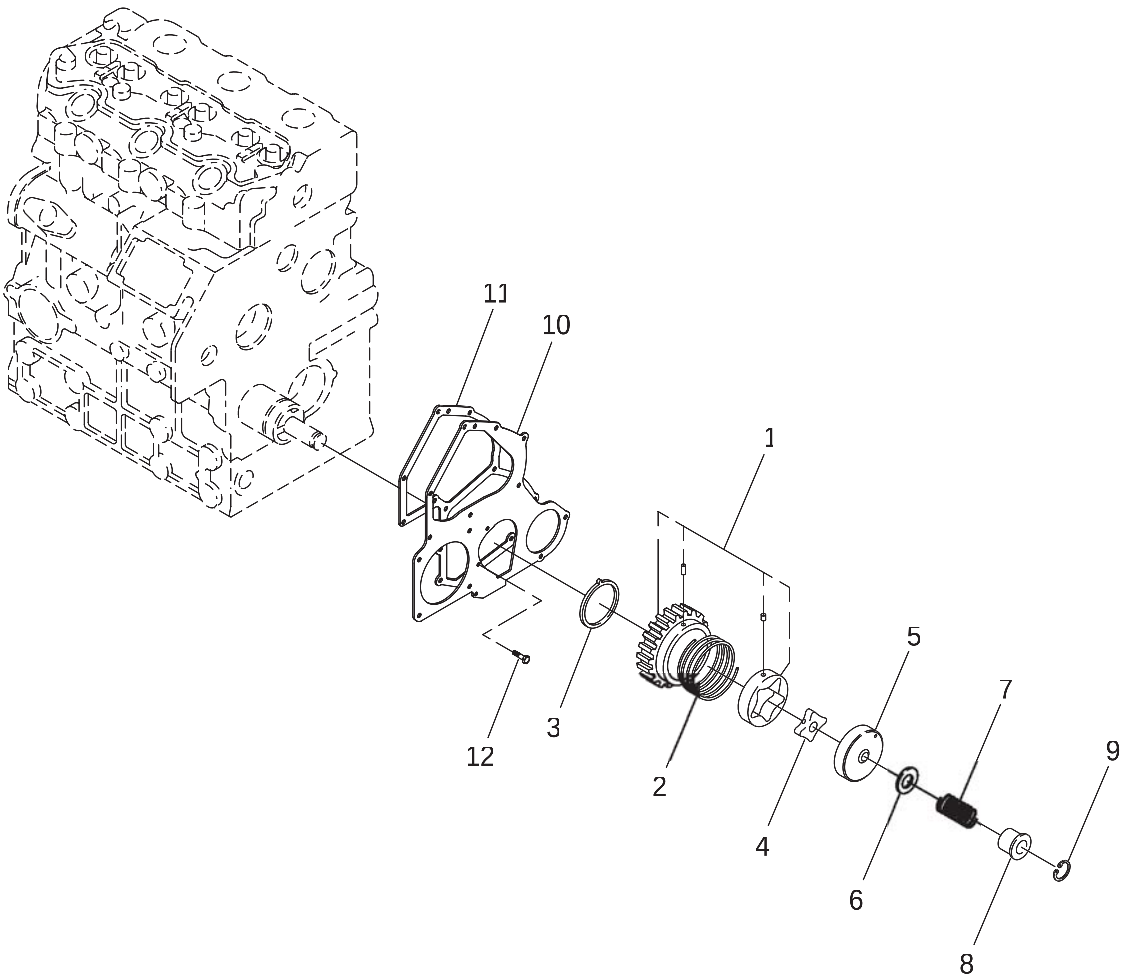
MM=MILLIMETER

1.0 Liter Diesel Crankshaft, Piston and Flywheel – Drawing No. 075679-B



ITEM	QTY.	DESCRIPTION	ITEM	QTY.	DESCRIPTION
1	1	CRANKSHAFT ASSEMBLY	17	3	STANDARD PISTON RING SET
2	1	CRANKSHAFT GEAR		AR	PISTON RING SET-0.5MM O.S.
3	1	KEY		AR	PISTON RING SET-1.0MM O.S.
4	1	DOWEL PIN	18	3	PISTON PIN
5	1	SPRING PIN	19	6	SNAP RING
6	1	BEARING HOLDER ASSEMBLY	20	3	CONNECTING ROD ASSEMBLY
7	1	BEARING HOLDER ASSEMBLY	21	3	BUSHING
8	1	BEARING HOLDER ASSEMBLY	22	6	CONNECTING ROD BOLT
9	6	BOLT	23	6	NUT, CONNECTING ROD BOLT
10	6	DOWEL PIN	24	6	STANDARD BEARING
11	3	STANDARD BEARING		AR	BEARING-0.25MM U.S.
	AR	0.25MM U.S. BEARING		AR	BEARING-0.50MM U.S.
	AR	0.50MM U.S. BEARING	28	1	PULLEY
12	3	STANDARD BEARING	30	1	NUT
	AR	0.25MM U.S. BEARING			
	AR	0.50MM U.S. BEARING			
13	2	THRUST WASHER			U.S. - UNDERSIZE
14	2	BOLT			O.S. - OVERSIZE
15	1	BOLT			AR - AS REQUIRED
16	3	STANDARD PISTON ASSEMBLY			MM - MILLIMETER
	AR	PISTON ASSEMBLY-0.5MM O.S.			
	AR	PISTON ASSEMBLY-1.0MM O.S.			

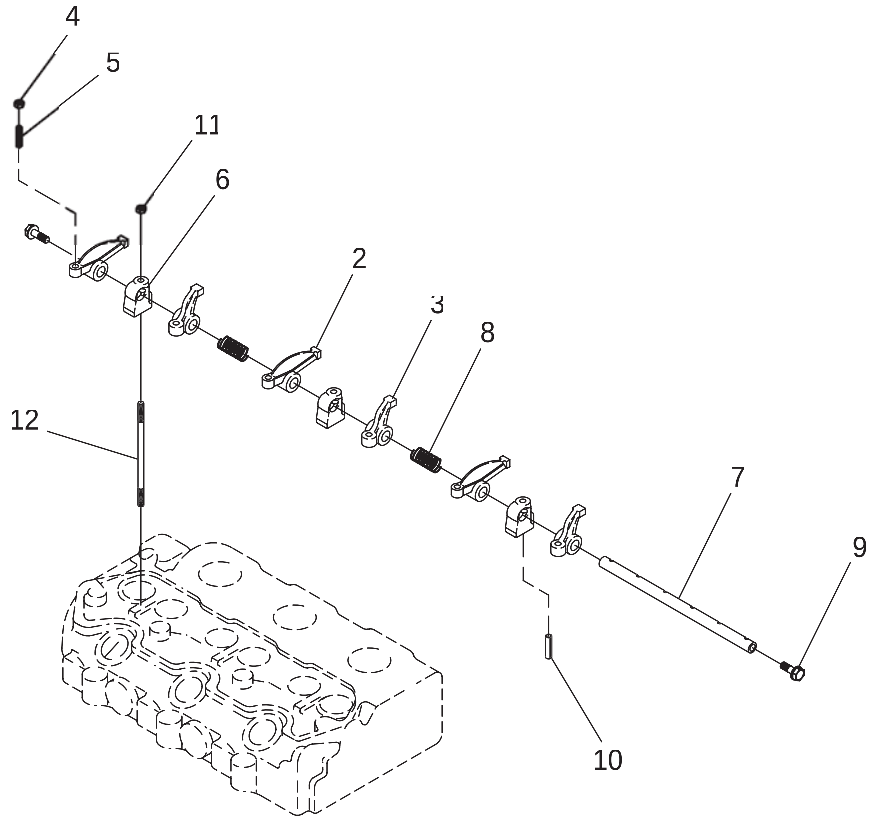
1.0 Liter Diesel Oil Pump – Drawing No. 75682



ITEM	QTY.	DESCRIPTION
1	1	IDLER GEAR ASSEMBLY
2	1	SPRING
3	1	THRUST WASHER
4	1	ROTOR
5	1	OIL PUMP COVER
6	AR	0.10MM SHIM
	AR	0.15MM SHIM
	AR	0.20MM SHIM
	AR	0.50MM SHIM
7	1	SPRING
8	1	COLLAR
9	1	SNAP RING
10	1	FRONT PLATE
11	1	GASKET
12	3	BOLT

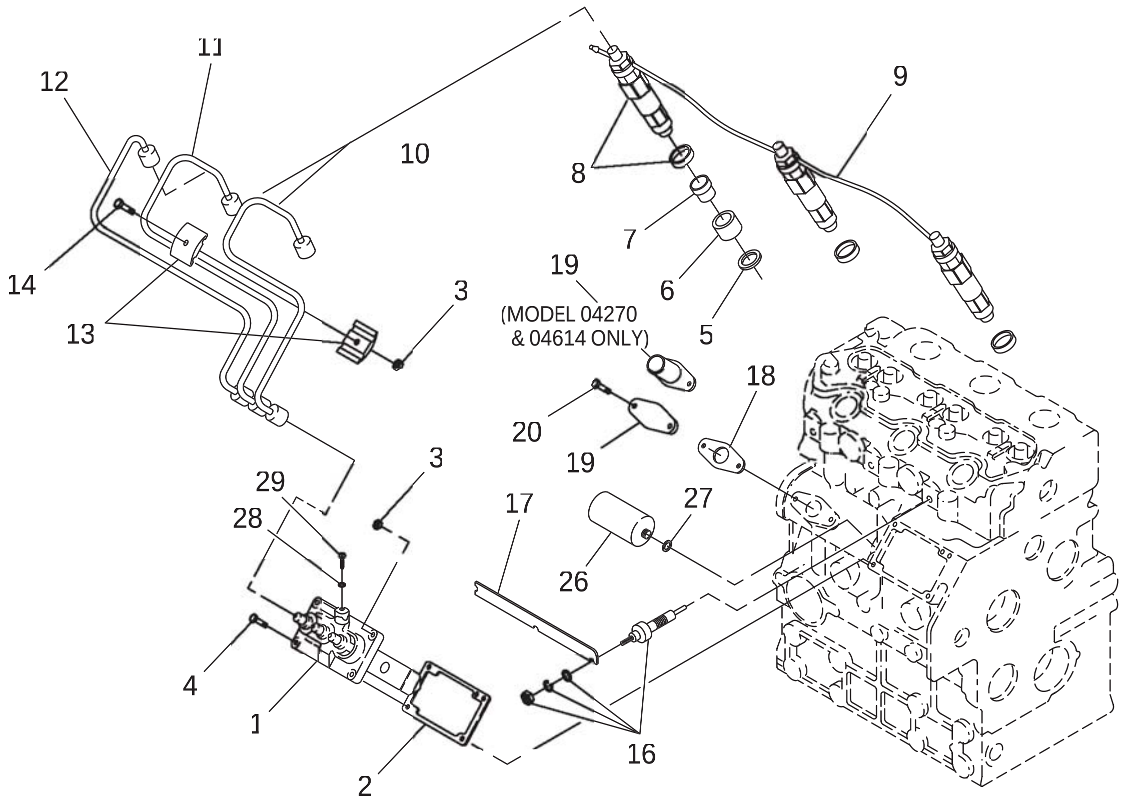
AR - AS REQUIRED

1.0 Liter Diesel Rocker Arm Assembly – Drawing No. 075683



ITEM	QTY.	DESCRIPTION
1	1	ROCKER ARM ASSEMBLY (INCLUDES ALL COMPONENTS SHOWN BELOW)
2	3	INTAKE ROCKER ARM
3	3	EXHAUST ROCKER ARM
4	6	NUT
5	6	STUD
6	3	ROCKER ARM BRACKET
7	1	ROCKER ARM SHAFT
8	2	SPRING
9	2	SCREW
10	3	SPRING,PIN
11	3	NUT
12	3	STUD

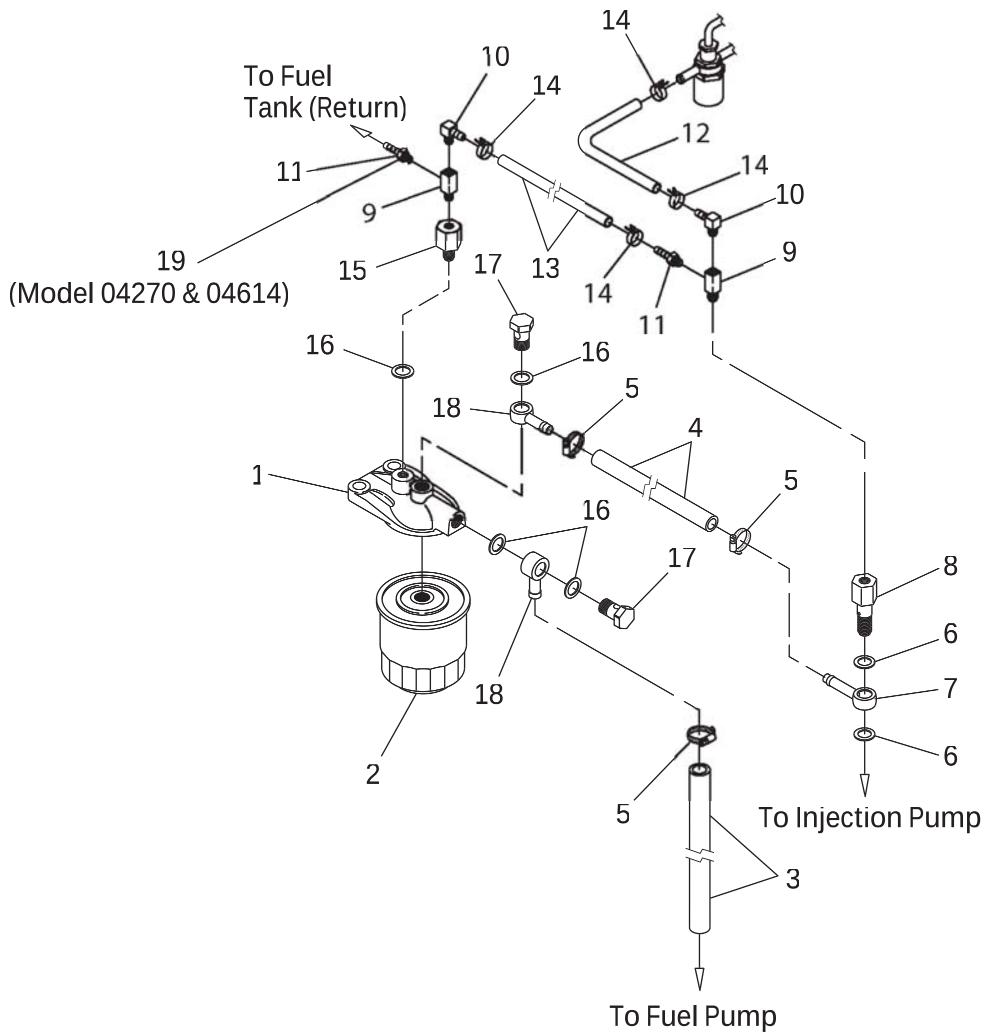
1.0 Liter Diesel Injector Pump – Drawing No. 075686-C



ITEM	QTY.	DESCRIPTION
1	1	INJECTOR PUMP ASSEMBLY
2	AR	SHIM-0.2MM
	AR	SHIM-0.3MM
	AR	SHIM-0.5MM
	AR	SHIM-1.0MM
3	3	NUT
4	2	BOLT
5	3	GASKET
6	3	INSERT
7	3	CAP
8	3	INJECTOR
9	1	TUBING
10	1	TUBING
11	1	TUBING
12	1	TUBING
13	1	CLAMP
14	1	BOLT
16	3	GLOW PLUG
17	1	CONNECTOR
18	1	GASKET
19	1	COVER (ALL MODELS EXCEPT 04270 & 04614)
	1	TUBE, ENGINE OIL FILL (MODEL 04270 & 04614)
20	2	BOLT
26	1	SOLENOID
27	1	WASHER
28	1	WASHER
29	1	SCREW

AR - AS REQUIRED

1.0 Liter Diesel Fuel Supply – Drawing No. 075693-C

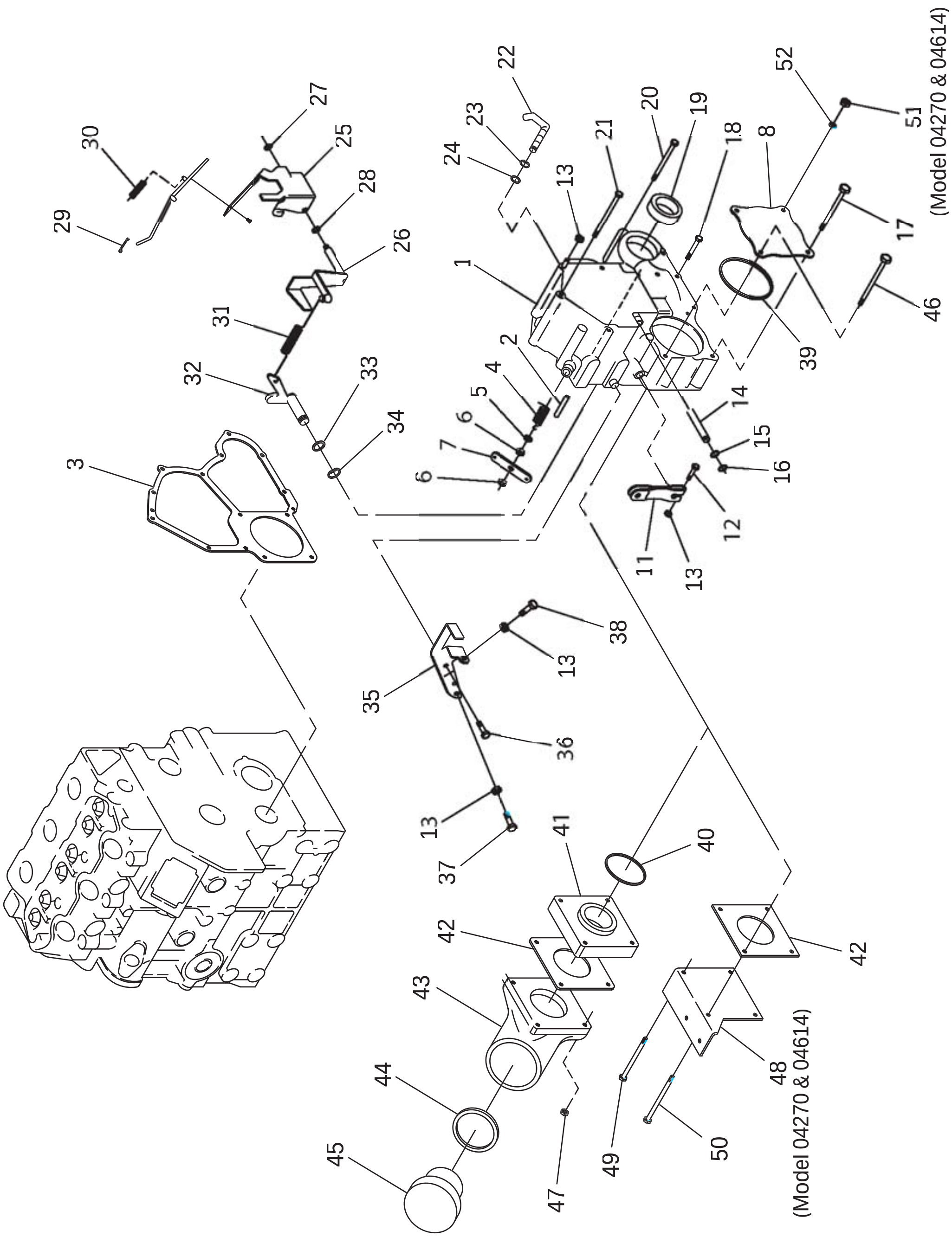


ITEM	QTY.	DESCRIPTION
1	1	FUEL FILTER SUPPORT
2	1	FUEL FILTER
3	AR	HOSE, 5/16" SAE 30R7
4	250MM	HOSE, 5/16" SAE 30R7
5	3	HOSE CLAMP
6	2	GASKET
7	1	BANJO FITTING
8	1	FUEL BLEED FITTING
9	2	1/8" NPT TEE (BRASS)
10	2	1/8" NPT x 3/16" 90 DEG. BARBED FITTING

ITEM	QTY.	DESCRIPTION
11	2 *	1/8" NPT x 3/16" BARBED STRAIGHT FITTING
12	275MM	HOSE, 3/16" SAE 30R2
13	240MM	HOSE, 3/16" SAE 30R2
14	4	HOSE CLAMP
15	1	FUEL BLEED FITTING
16	5	FUEL BLEED GASKET
17	2	HOLLOW BOLT
18	2	BANJO FITTING
19	1	1/8" NPT x 1/4" BARBED STRAIGHT FITTING (MODEL 04270 & 04614)

* -QTY 1 (MODEL 04270 & 04614)
AR - AS REQUIRED

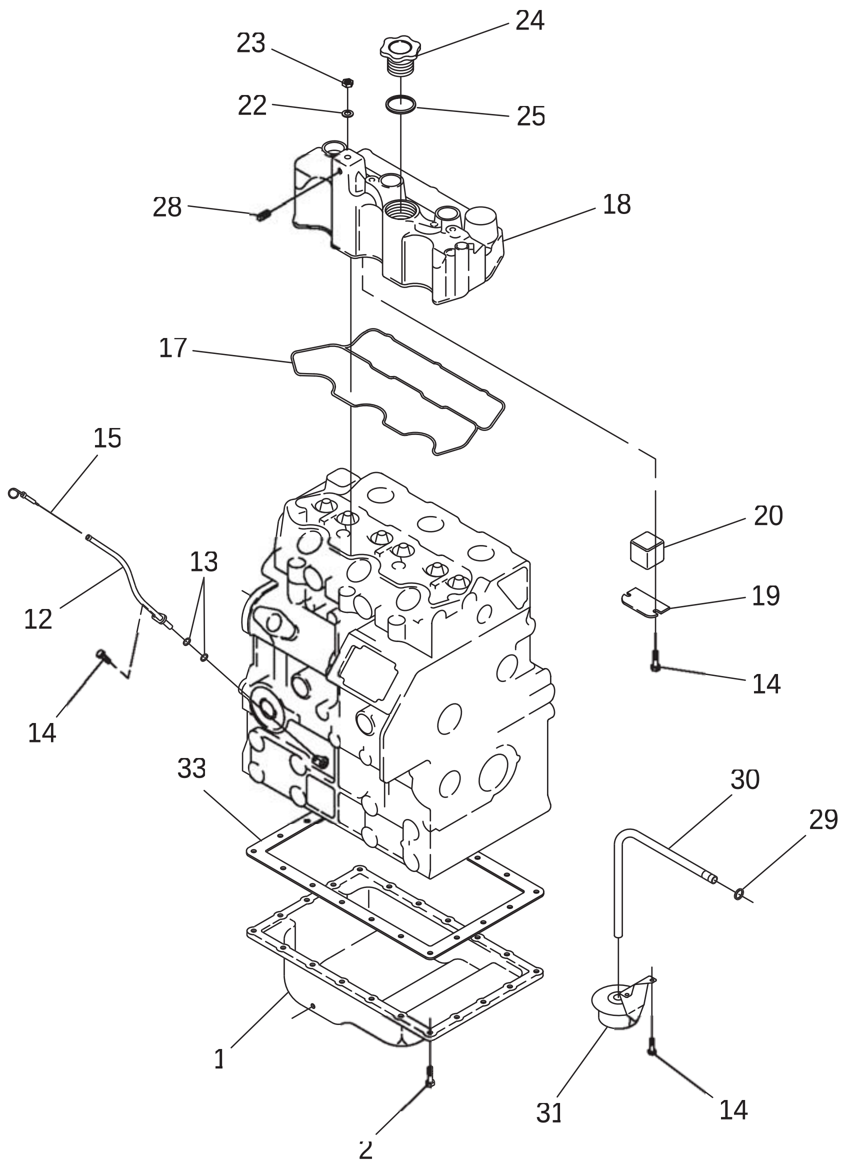
1.0 Liter Diesel Timing and Governor – Drawing No. 082067-B



ITEM	QTY.	DESCRIPTION
1	1	HOUSING, TIMING GEAR
2	1	SPRING PIN
3	1	GASKET
4	1	SPRING
5	1	WASHER
6	2	NUT
7	1	STOP LEVER
8	2	COVER
11	1	GOVERNOR LEVER
12	1	BOLT
13	1	NUT
14	1	SHAFT
15	1	O-RING
16	1	SNAP RING
17	3 *	BOLT
18	5	BOLT
19	1	OIL SEAL
20	4	BOLT
21	5	BOLT
22	1	ARM
23	1	SNAP RING
24	1	O-RING
25	1	GOVERNOR LEVER ASSEMBLY
26	1	TENSION LEVER
27	1	SNAP RING
28	1	WASHER
29	1	COTTER PIN
30	1	SPRING
31	1	SPRING
32	1	ARM
33	1	O-RING
34	1	SNAP RING
35	1	BRACKET
36	3	BOLT
37	2	BOLT
38	1	SCREW HHC M6-1.0 X 25
39	1	O-RING
40	1 *	O-RING
41	1 *	SPACER
42	1	GASKET
43	1 *	HOLDER (OIL FILL)
44	1 *	O-RING
45	1 *	CAP
46	1 *	BOLT
47	3 *	NUT
48	1	BRACKET, FUEL FILTER (MODEL 04270 & 04614)
49	3	SCREW HHC M8-1.25 X 60 G8.8 (MODEL 04270 & 04614)
50	1	SCREW HHC M8-1.25 X 65 G8.8 (MODEL 04270 & 04614)
51	4	NUT HEX M8-1.25 G8 (MODEL 04270 & 04614)
52	4	WASHER LOCK M8-5/16 (MODEL 04270 & 04614)

* NOT USED ON MODEL 04270 & 04614

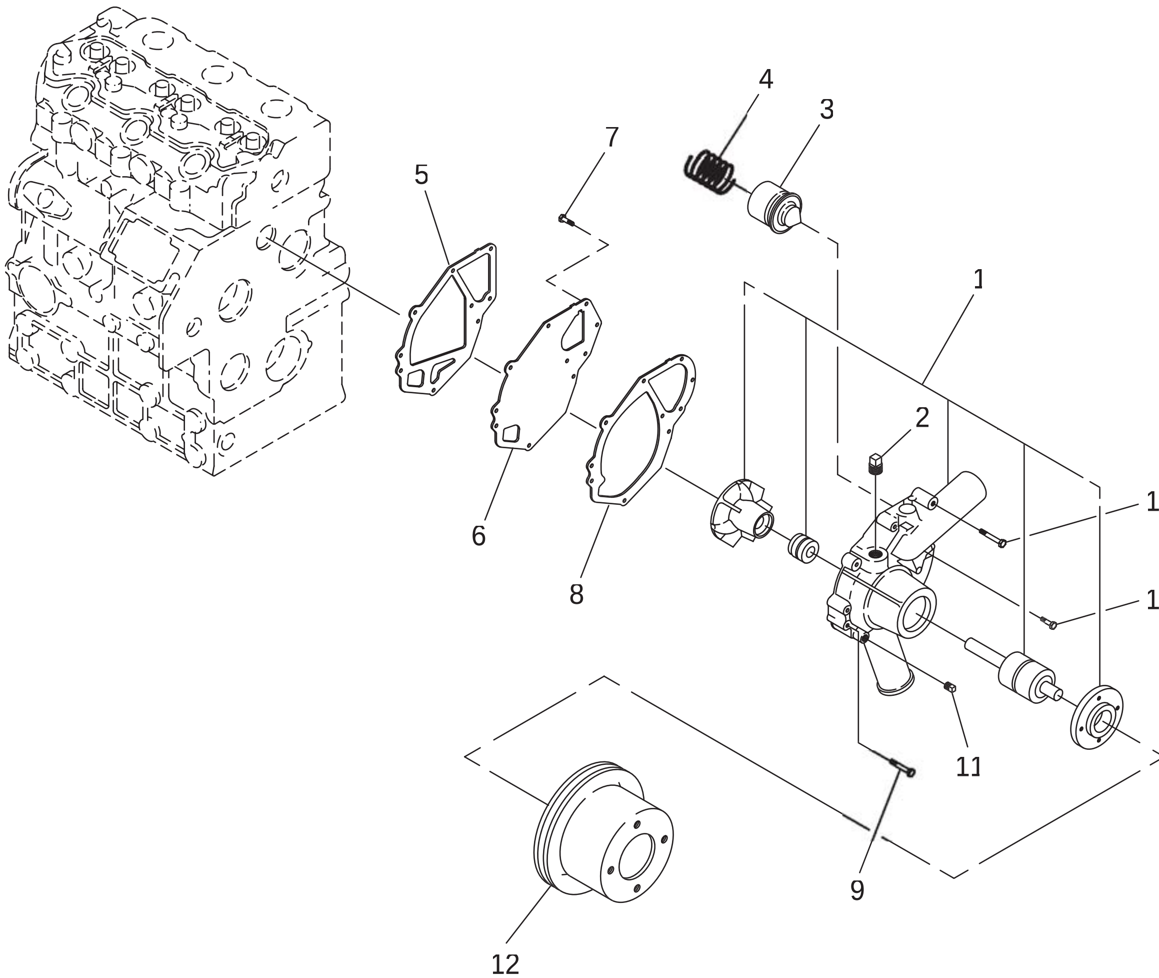
1.0 Liter Diesel Engine Block – Drawing No. 082961-C



ITEM	QTY.	DESCRIPTION
1	1	OIL PAN
2	20	BOLT
3	1	O-RING (MODELS 04270 & 04614 ONLY)
12	1	DIPSTICK TUBE (ALL MODELS EXCEPT 04270 & 04614)
	1	DIPSTICK TUBE (MODELS 04270 & 04614 ONLY)
13	2	O-RING (ALL MODELS EXCEPT 04270 & 04614)
14	5	BOLT
15	1	DIPSTICK (ALL MODELS EXCEPT 04270 & 04614)

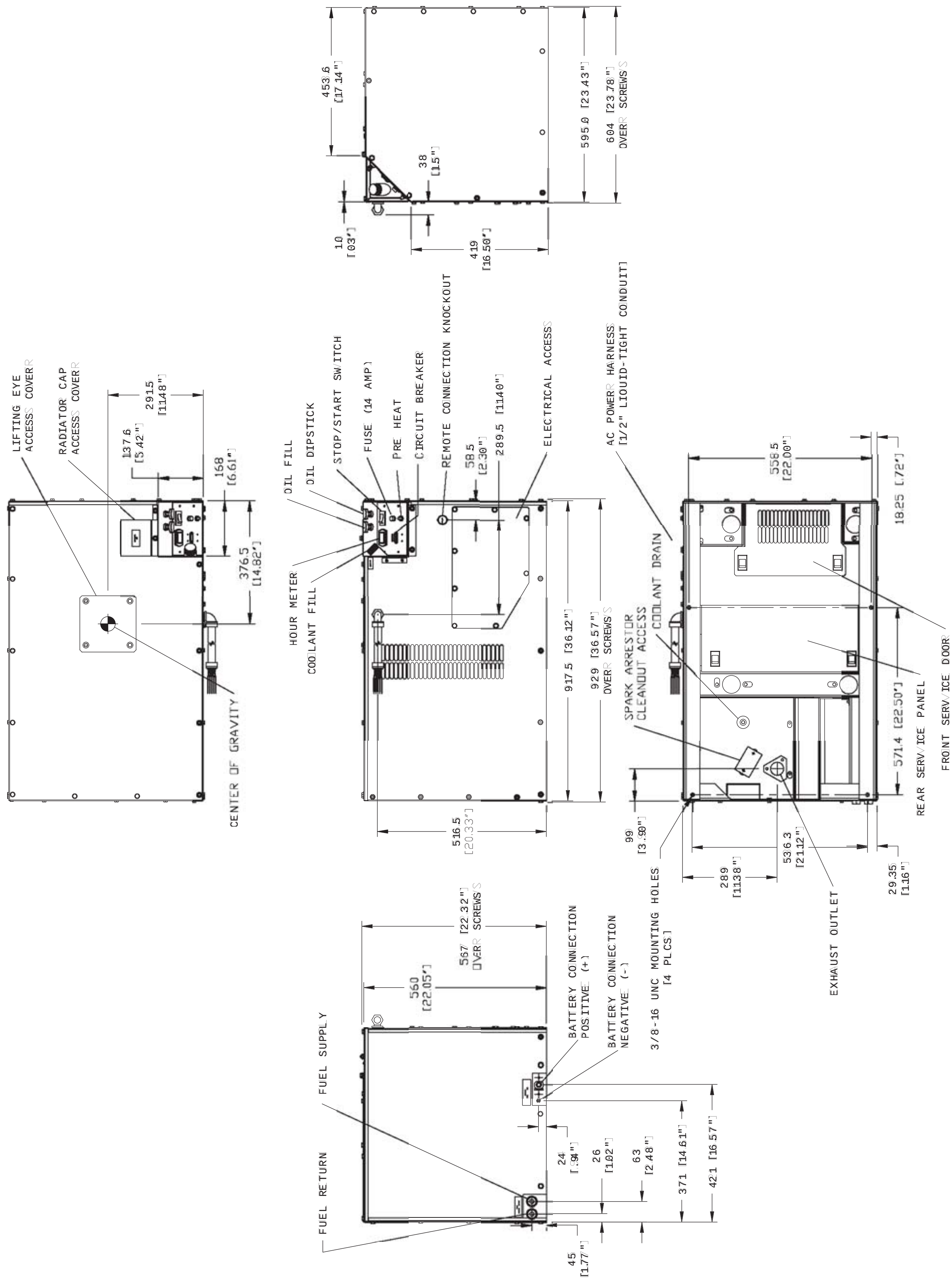
ITEM	QTY.	DESCRIPTION
17	1	ROCKER COVER GASKET
18	1	ROCKER COVER
19	1	OIL STOPPER
20	1	SCREEN
22	1	GASKET
23	3	NUT
24	1	CAP
25	1	O-RING
28	1	1/4" PIPE PLUG SQ. HD.
29	1	O-RING
30	1	TUBING
31	1	SUCTION FILTER
33	1	GASKET

1.0 Liter Diesel Water Pump – Drawing No. 082962



ITEM	QTY.	DESCRIPTION
1	1	WATER PUMP ASSEMBLY
2	1	PLUG
3	1	THERMOSTAT
4	1	SPRING
5	3	GASKET
6	1	SET PLATE
7	1	BOLT
8	1	GASKET
9	1	BOLT
10	1	BOLT
11	1	NUT
12	1	PULLEY
15	1	BOLT

Major Features and Dimensions – Drawing No. 0D2650-A



ENGINE SPECIFICATIONS

Type of Engine	ISM Diesel
Cylinder Arrangement	3, in-line
Displacement	58.2 in^3. (954 cc)
Bore	2.95 in. (75 mm)
Stroke	2.83 in. (72 mm)
Compression Ratio	23-to-1
Combustion Chamber Type	Pre-Combustion
Rated Horsepower	13 @ 1,950 rpm
Cylinder Block	Cast Iron
Number of Main Bearings	4
Number of Teeth on Flywheel	104
Type of Governor	Mechanical, Fixed Speed
Fuel Filter	Full Flow Spin-On
Oil Filter	Full Flow with Bypass Valve
Oil Pressure	29-71 psi
Type of Cooling System	Pressurized, Closed Recovery
Cooling Method	Liquid-cooled
Type of Cooling Fan	Centrifugal Puller
Cooling System Capacity	1.4 U.S. gals (5.3 L)
Air Cleaner	Disposable Filter (Part # C4880)
Starter	12-volt DC Electric
Recommended Battery	70 Ah, 360 Cold-cranking Amps (Minimum ratings)
Maximum Cranking Current	220 Amps
Ground Polarity	Negative

GENERATOR SPECIFICATIONS

Rated Maximum Continuous AC Output at ...	
85º F (29º C) Ambient	7,500 Watts (7.5 kW)
100º F (38º C) Ambient	7,000 Watts (7.0 kW)
120º F (49º C) Ambient	6,000 Watts (6.0 kW)
Rated Voltage	120/240 Volts AC*
Rated Maximum Continuous AC Current at ...	
7,500 Watts	
120 Volts	62.5 Amps
240 Volts	31.2 Amps
7,000 Watts	
120 Volts	58.3 Amps
240 Volts	29.2 Amps
6,000 Watts	
120 Volts	50.0 Amps
240 Volts	25.0 Amps
Phase	Single
Rotor Speed at No Load	3,780 rpm
Number of Rotor Poles	2
Engine RPM	1,950
Rated AC Frequency	60 Hz
Battery Charge Voltage	14 Volts DC
Battery Charge Current	2 Amps (max)
Weight	486 Pounds (Dry)
Length	36.6 inches (929 mm)
Width	23.8 inches (604 mm)
Height	22.3 inches (567 mm)

*All units are reconnectable to 120-volt-only AC output.

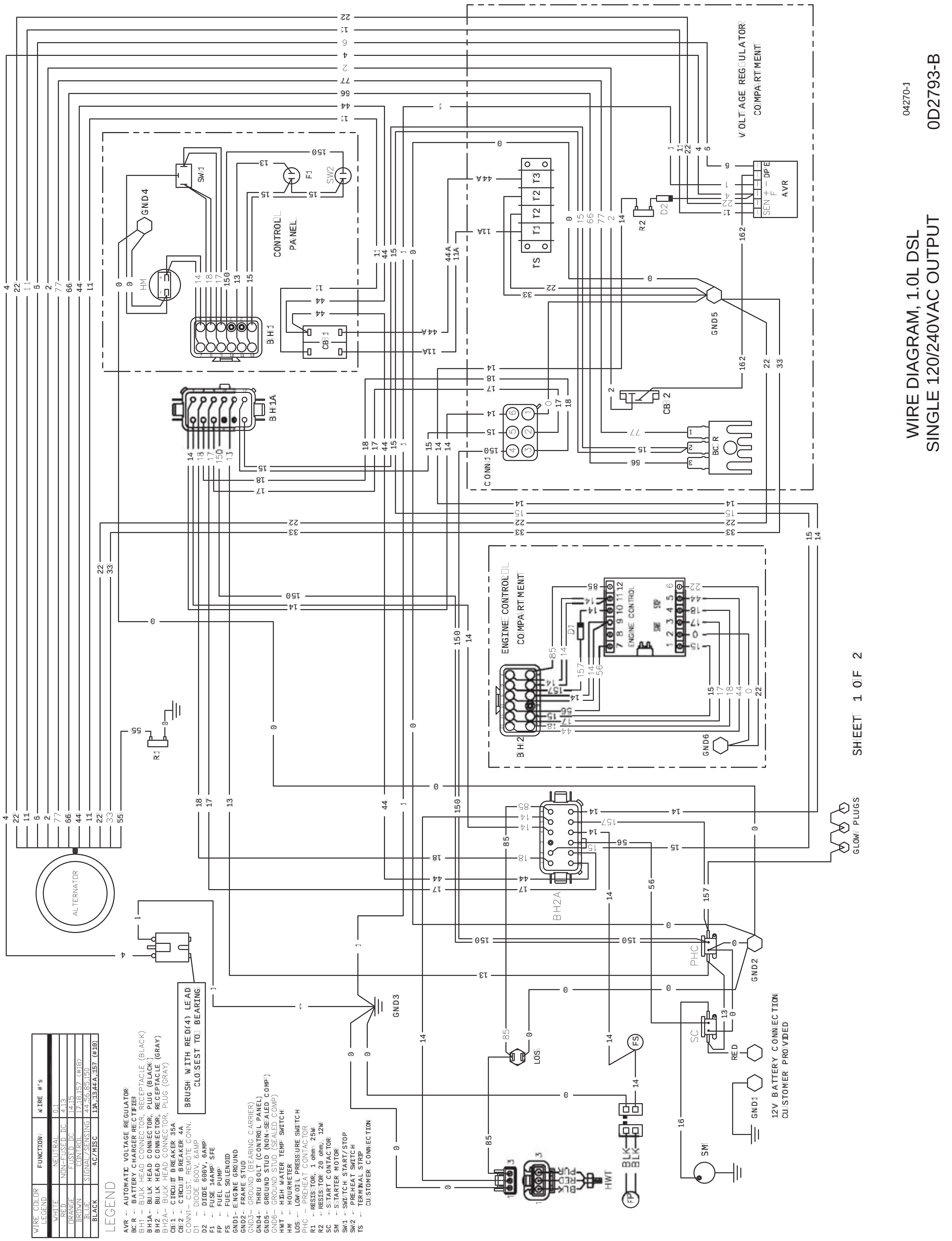
ROTOR/STATOR RESISTANCE VALUES

TYPE	QUIETPACT 75
MODEL	4270
Rotor resistance	15.25 ohms
Stator Winding 11/22	159 ohms
Stator Winding 33/44	184 ohms
DPE Winding 2/6	1.24 ohms
Battery charge Winding 55/66	.132 ohms
Battery charge Winding 55/77	.153 ohms

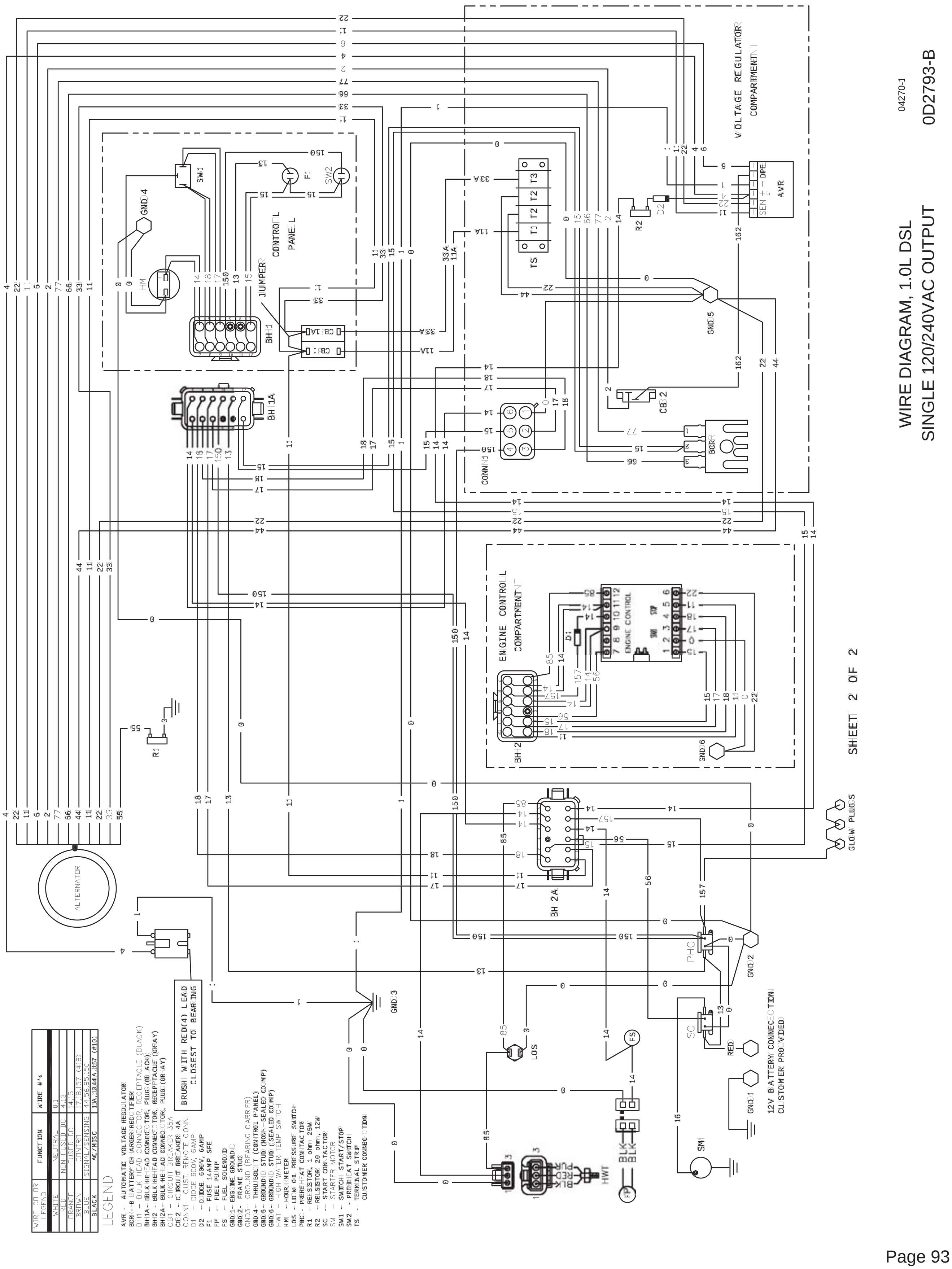
TORQUE SPECIFICATIONS

Starter	75 in-lbs.
Flywheel	16.2-19 ft-lbs.
Rotor Pulley	34.2-41.8 ft-lbs.
Stator Bolts	16.2-19.8 ft-lbs.
Tension Bolt	44.1-53.9 ft-lbs.
Pulley Tension	44.1-53.9 ft-lbs.
Weld Stud Nut	32.4-39.6 ft-lbs.
Injector Nozzles	58-61 ft-lbs.

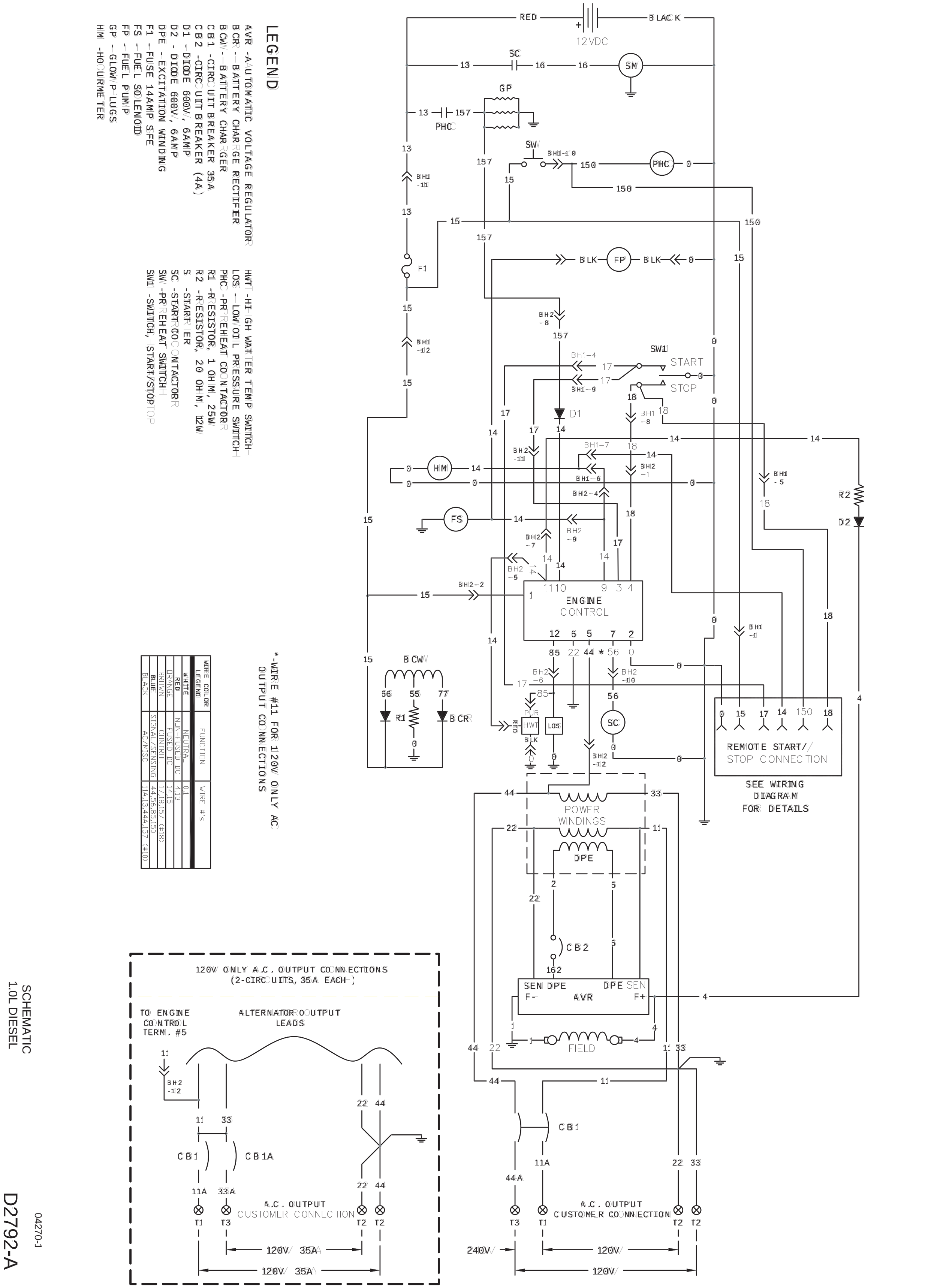
Wiring Diagram – Drawing No. 0D2793-B (1 of 2) Models 04270-1 & 04270-2 Single 120/240VAC Output



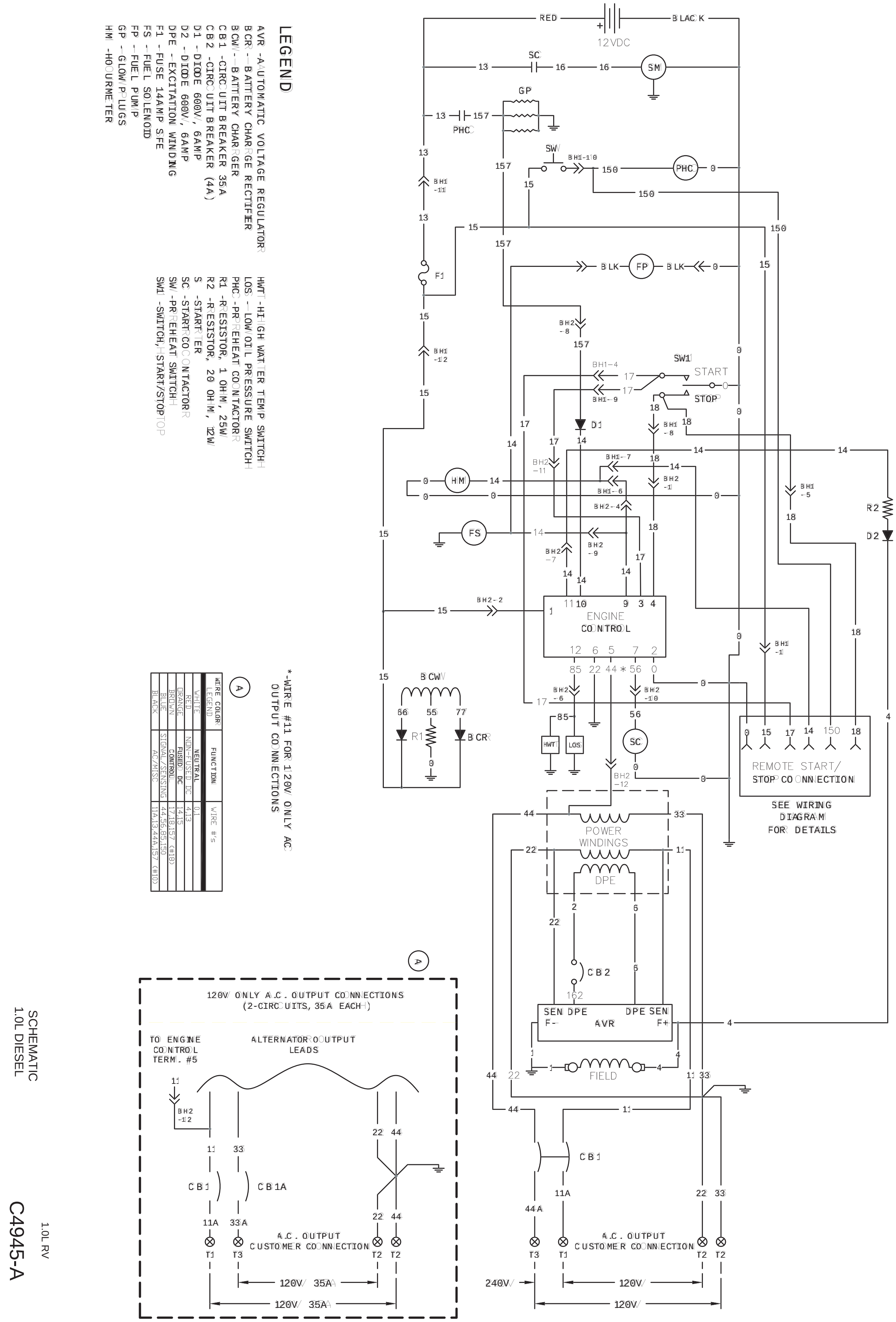
Wiring Diagram – Drawing No. 0D2793-B (2 of 2) Models 04270-1 & 04270-2 Dual 120VAC 35A Output



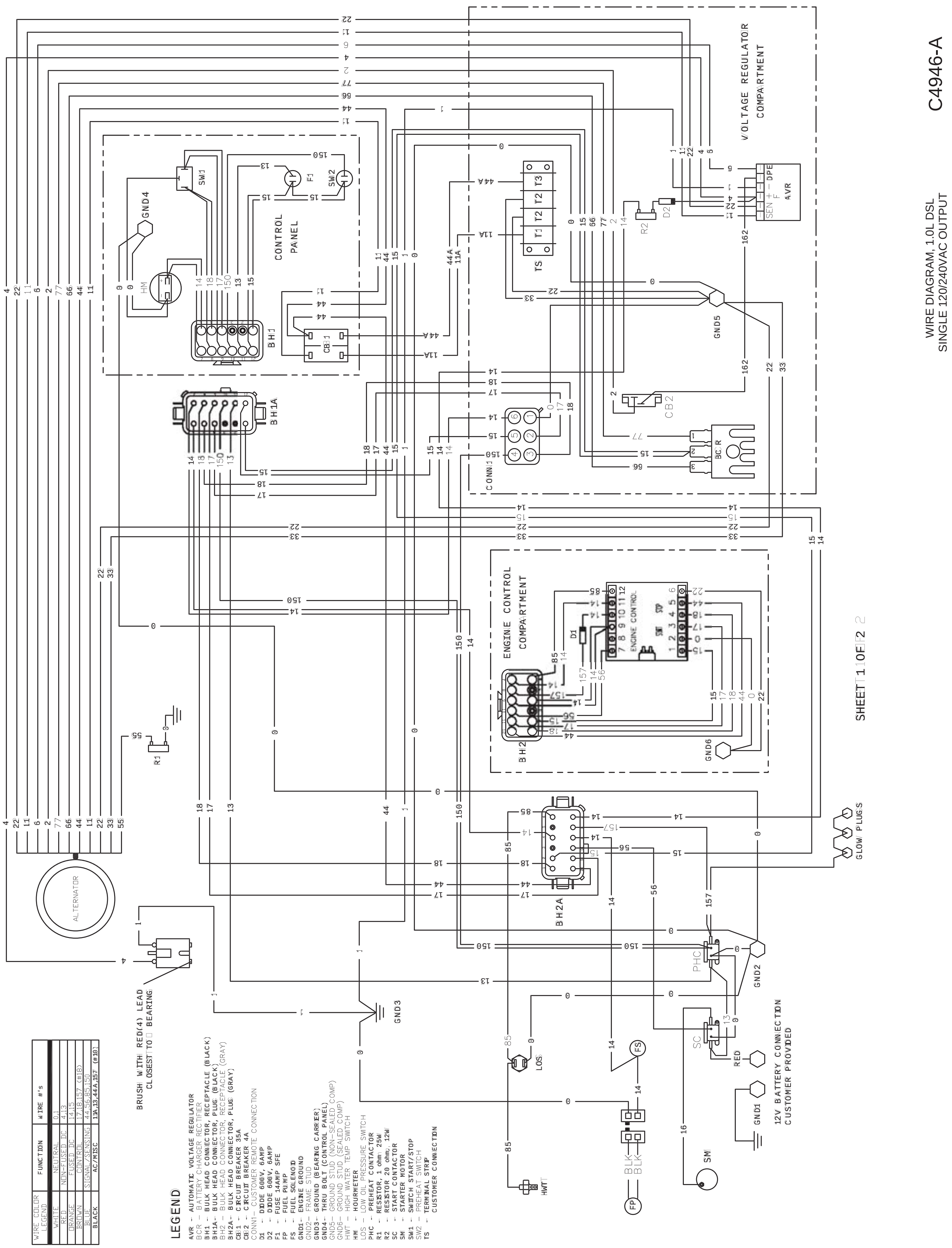
Schematic – Drawing No. 0D2792-A Models 04270-1 & 04270-2



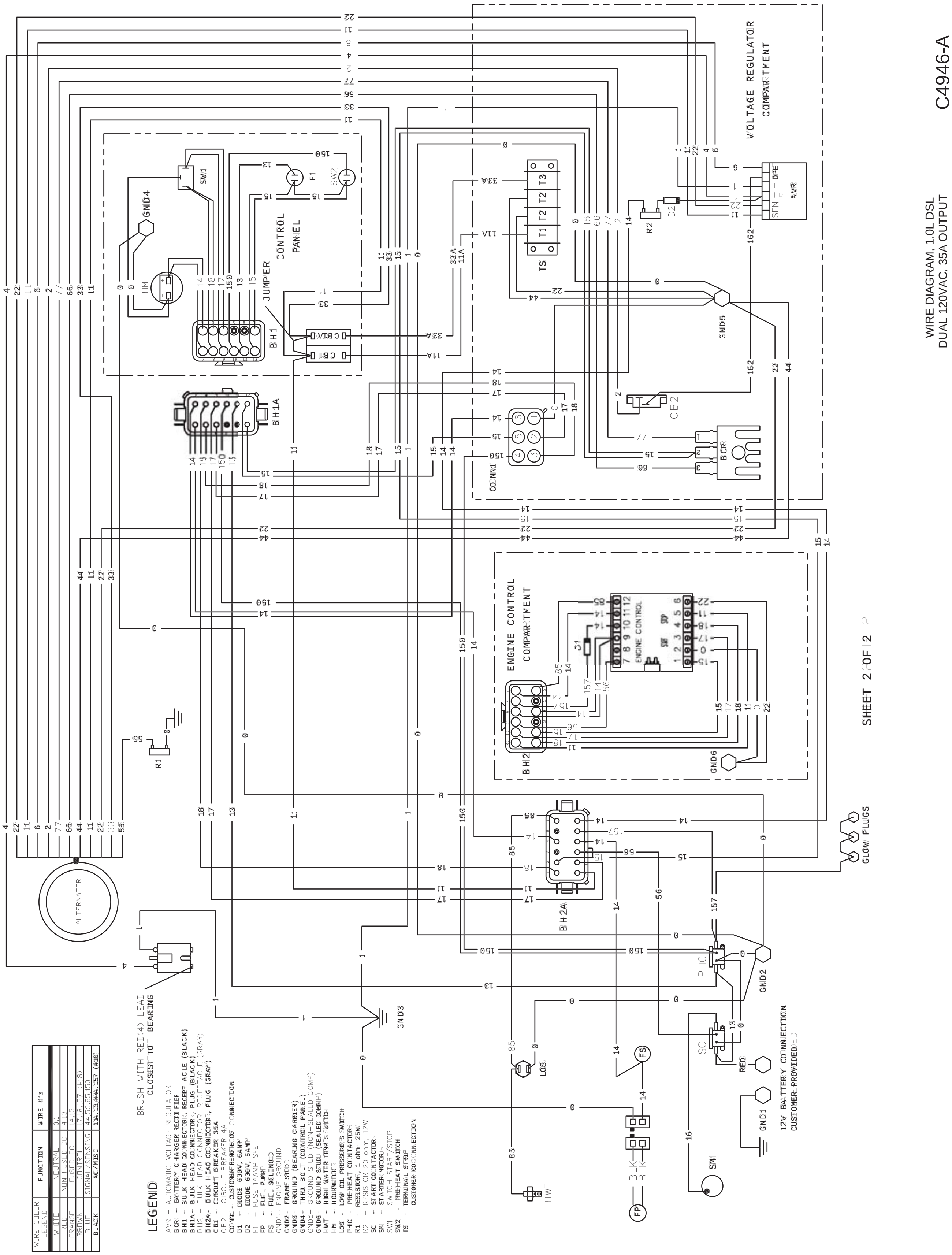
Schematic – Drawing No. 0C4945-A Model 04270-0



Wiring Diagram – Drawing No. 0C4946-A (1 of 2) Model 04270-0 Single 120/240VAC Output



Wiring Diagram – Drawing No. 0C4946-A (2 of 2) Models 04270-0 Dual 120VAC 35A Output



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