Project Name: C J'S
SALES

Katolight File # 97232, S/O # 16538

Model:	D415FRJ4 Form: 415J/0303	kW:	415	KVA:	518.8
Phase:	THREE	Power Factor:	0.8	Leads:	12
Voltage:	277/480	RPM:	1800	Frequency:	60

Table of Contents

1) **Katolight Start-Up Validation and Inspection Form:**
(TO BE COMPLETED AT TIME OF START UP)
Katolight **TWO** Year Limited Warranty

2) **Operating Instructions, Weekly Check List and Start Up:**

3) **Basic Operation & Instruction Manual:**

4) **Specification Data and Engine Manuals: JD 6125**

5) **Unit Accessories:**
Katolight 50K Control Panel
Katolight 819-B-13514, AC Wiring Diagram
Katolight 819-C-6378, DC Ladder Wiring Diagram
Katolight 819-B-14001, Point to Point Wiring Diagram
Katolight Governor Control JDEC
Katolight Fuel System Data SB 400GL DW - # 78485 (108-700)
Katolight Dimensional and Base Drawings CQE-704, 100-2051-48 & 102-2633-A1
Katolight Mainline Circuit Breaker # 41171 TJK636600WL
Katolight Generator Model 433PSL6200
Katolight Voltage Regulator Model DVR 2000

6) **Parts List**

Date: 03/04

Cover Rev: Oct. 2003

KATOLIGHT CORPORATION
STANDBY LIMITED WARRANTY

"TWO YEAR 1500 HOURS"

Your Katolight Product has been manufactured and inspected with care by experienced craftspeople. If you are the original consumer, Katolight Corporation warrants, for the period indicated below, each product to be free from defects in materials and workmanship. Repair, replacement or appropriate adjustment at Katolight Corporation's option will be furnished if the product, upon Katolight Corporation's inspection, is properly installed, maintained and operated in accordance with Katolight Corporation instruction manuals. This warranty does not apply to malfunctions caused by damage, unreasonable use, misuse, repair or service by unauthorized persons, or normal wear and tear.

KATOLIGHT PRODUCT PERIOD OF WARRANTY: Engine Generator Set: Parts and Labor for two (2) years or 1500 hours from the date of invoice by factory. Accessories: Parts and labor for one (1) year from date of invoice from factory. Transfer switches: If purchased with a generator set: Parts and labor for two (2) years from date of invoice by factory. The warranty period can be adjusted to the date of start up if completed within twelve (12) months of invoice date. A valid warranty requires that: (1) the Katolight start-up validation form must be completed, returned with in 30 days of start-up date and on file at Katolight Corporation. (2) the engine registration form must be completed and returned to manufacturer as stated in the instructions with registration form. And (3) all supporting maintenance records must be kept on file with the end user and made available upon request from factory. The generator set must be routinely exercised in accordance with operating instructions. Engine generator sets that are stored longer than six (6) months (180 days) from date of shipment are subjected to special requirements. Contact Katolight's Factory Service Center for instructions

For a description of accessories and exclusions from this limited warranty, review the listings on the reverse side of this document.

TO OBTAIN WARRANTY SERVICE: Contact your nearest Katolight Service Representative. For assistance in locating your nearest authorized service representative, contact Katolight Corporation, Attention: Service Department. (See contact information below.)
Warranty service may only be performed by Katolight authorized service providers. Service performed by unauthorized persons will void all warranties.

Katolight shall not be liable for any claim greater in amount than the purchase price of the product, in respect of which such claim is made, and in no event shall Katolight be liable for any special, indirect or consequential damages.

THERE ARE NO EXPRESS WARRANTIES OTHER THAN THOSE DESCRIBED HEREIN. NO WARRANTIES SHALL BE IMPLIED OR OTHERWISE CREATED UNDER THE UNIFORM COMMERCIAL CODE, INCLUDING BUT NOT LIMITED TO A WARRANTY OF MERCHANTABILITY, AND A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

State laws regarding rights of consumers may vary from state to state.

KATOLIGHT CORPORATION
100 Power Drive / PO Box 3229
Mankato, MN 56002-3229
Phone: (507) 625-7973 / Fax: (507) 625-2247 www.Katolight.com

1. The following items are among those that are not considered nor will they be covered under the existing warranty program.
   a. Battery or Batteries of any type or kind. The Battery Manufacturer warranty applies to these only. Any warranty for such, should be handled with the manufacturer's local distributor according to their policies.
   b. Adjustments to fuel systems or governor system at time of start up or any time after. This is acceptable only when a defective part has been replaced, returned to the factory and approved as defective.
   c. Normal maintenance costs: adjustments, loose/leaking fittings or clamps, and tune-ups performed during start up or anytime thereafter.
   d. Due to shipping, manufacture is not responsible for loose connections. All connections must be checked at time of start-up.
   e. Non-Katolight replacement part(s) will void the entire limited warranty.
   f. Products that are modified in any form without the written consent of Katolight will void the entire limited warranty.
   g. Shipping damage of any type. All equipment is shipped F.O.B. factory and is consigned to the carrier once loaded for shipment. It is the responsibility of the receiver to sign and note any damage to the equipment and a freight damage claim filed by the receiver.
   h. Any installation errors or damage of the equipment when shipped as ordered.
   i. Any overtime travel or labor to make repairs under warranty.
   j. Any special access fees required to gain access to Katolight equipment not limited to but including any training or safety policy requirements to gain access.
   k. Additional costs associated with inaccessible installations, including removal and reinstallation of the generator set.
   l. Rental equipment used during warranty work such as Generators, rigging equipment such as a crane or boom truck, load banks and special testing above factory requirements, etc.
   m. Excess mileage charges. Any authorized service provider may perform warranty service anywhere, but will only be paid travel from the nearest service center and limited to 400 miles round trip.
   n. Any equipment not factory approved and engineered for use on Katolight products. This includes but is not limited to, after market items such as special fuel systems, enclosures, exhaust systems, or switch gear that had been sought out and quoted by a third party to be included in billing of the Katolight equipment.
   o. Misuse or abuse including installation and thereafter.
   p. Normal wear and tear, maintenance and consumable items that are not required as part of a warranty repair. Consumable items include but are not limited to belts, hoses, coolant, oil, filters, and fuses.
   q. Acts of nature such as lightning, wind, flood, or earthquake.
   r. Any damage due to situations beyond the control of the manufacturing of the product or workmanship of the product.
   s. Installation or operation outside the guidelines as stated in the Installation Guide and Owners Manual.
   t. Diesel engine "Wet Stacking" due to lightly loaded diesel engines.
   u. Misapplication of the equipment such as usage outside the original design parameters as stated on the nameplate of the equipment.
   v. Travel expense on portable equipment.
   w. Trailer lights, wiring and brakes.
   x. More than one trip to job-site because Service Vehicle was not stocked with normal service parts.
   y. Lodging expense of person(s) performing service unless approved in advance by factory.
   z. Engine fluids.
   aa. Units purchased at the Standby Power rating that are being used in a prime power application.
   bb. Any repair labor time that is determined to be excessive, e.g., two or more people performing a one-person job.
   cc. Any expenses associated with investigating performance complaints in which no defect is found.
   dd. Any associated costs for replacing components that are found not to be defective.
   ee. Any adjustments covered in the start-up and inspection forms that are to be completed during start-up.

2. The aforementioned is a representation of things not covered by the **"LIMITED WARRANTY"**. If there are questions as to warranty coverage it is advisable to contact the factory in advance of filing a claim.

3. The accessories that are limited to one (1) year parts and labor include but are not limited to:
   a. Battery Chargers
   b. Water Heaters
   c. Load Banks
   d. Tap changing switches
   e. Circuit breakers
   f. Day tank pumps and controls
   g. Hand priming pumps
   h. Oil leveler systems
   i. Strip heaters
   j. Gas solenoid valves
   k. Gas flex pipes
   l. Cords, receptacles and cord reels
   m. Housing lights, space heaters and associated equipment.

Operating Instructions

MANUAL START:

If the Engine-Generator Set is located in a closed space, start the ventilation fan or open the doors and windows to allow an ample supply of air to the unit.

A. Place the generator circuit breaker in the **OPEN** position.
B. Put the engine control in the **MANUAL / RUN** position.
   NOTE: If the engine does not start, check the Operator's Manual.

MANUAL:

C. Check the unit frequency. Speed should be 3 to 5 % of rated speed (60 Hz). If not, refer to Operator's Manual for governor adjustment.
D. Check the unit AC voltage. (If the AC voltage is not reading correct, refer to the Operator's Manual for the proper procedure to adjust the voltage regulator to the rated voltage.)
E. Check engine parameters, via gauges or by scrolling through the microprocessor control panel for proper readings.
F. Close the generator circuit breaker.

The Engine-Generator Set is now ready to supply power to the load and will continue to supply power until the operator shuts down the set or an engine failure occurs.

MANUAL SHUTDOWN:

A. Open the generator circuit breaker, move handle to the **DOWN** position.
B. Put the engine control in the **OFF** position.
   NOTE: Following daily service or other maintenance on generator set, place the engine control to desired operating mode. When desired operating mode is automatic, reset the generator circuit breaker by placing its handle in the **UP** position.

EMERGENCY STOP PUSH BUTTON: (OPTIONAL EQUIPMENT)

In case of emergency the operator may shutdown the generator set by pushing the red mushroom head button. If equipped, this is located in the lower right corner of the control panel. This will stop and lock out the generator set. The push button's red light will also turn on to indicate the generator was stopped, by initiating the emergency stop button. The red push button must be pulled out to reset the generator set and turn off the red indicating light. Place the engine control to the "OFF" position to reset the engine control before restarting the unit. Reset the main line circuit breaker before returning the generator set to "AUTOMATIC" operation.

AUTOMATIC OPERATIONS

For automatic operation the Engine-Generator Set will be controlled by the automatic transfer switch and the automatic engine control.

A. For detailed operations of the transfer switch, refer to the Operations Manual supplied with the transfer switch.

B. For detailed operations of the automatic engine control, refer to Operations Manual, supplied with the Genset.

I. Standby State

(a) Leave the engine control in the "AUTO" position.
(b) Leave the generator set circuit breaker in the "ON" position.

II. Power Fails

(a) The remote start contact in the transfer switch will close and complete a circuit to the automatic start control terminals marked "E" in the control panel.
(b) This will cause the engine to start and come up to speed and voltage, then transfer to the load to the Engine-Generator Set.

III. Power Returns

(a) The load transfers back to normal power after a time delay (if provided).
(b) The remote start contact in the transfer switch will open after a time delay (if provided), and the unit will shutdown and be ready for the next power failure.

WEEKLY CHECK LIST EXPLANATION

Date:	- fill in the date of the inspection.
Ambient Temp:	- record outside or room air temperature.
Oil Level:	- record the level from the oil dipstick and the amount of oil added to engine if it was needed.
Water Level:	- record the level of the water in radiator and the amount of water added to radiator if it was needed.
Heaters:	- feel the block heater inlet and outlet hoses to make sure they are warm.
Belts:	- check belts to make sure they are tight. You cannot hear loose belts over the unit noise. **Make sure the engine control is in the "OFF" position.**
Battery Charger:	- visual inspection of charger to verify operation. If equipped with a dial meter verify charge rate. If equipped with LEDs verify LEDs lit. **Red** LED only indicates battery discharged, charging at "Bulk" rate. **Red & Green** LED only indicates charger charging at "Absorption" rate. **Green** LED only indicates "Float" rate, battery is fully charged.
Battery Levels & Cables:	- make sure batteries are full of water, cables are tight and battery posts are clean.
Leaks: (Oil-Water-Fuel)	- check all hoses and connections for dripping, tighten hose clamps if needed.
Amps:	- when the unit is running with load, record the amp reading.
Volts:	- when the unit is running with load, record the volt reading.
Frequency:	- when the unit is running with load, record the hertz reading.
Oil Pressure:	- when the unit is running with load, record the oil pressure.
Water Temperature:	- when the unit is running with load, record the water temperature reading once stabilized.
BC Volts:	- battery charger DC voltage reading.
RTM:	- running time meter total should be recorded before each test - this will allow you to determine if the unit has run since the last exercise.
ATS:	- automatic transfer switch should be filled in as "OK" if the test performed a load transfer properly.
Mechanic:	- should be initialed by the person doing the test.

WEEKLY CHECK LIST

Date:	Ambient Temp:	Oil Level:	Water Level:	Heaters:	Belts:	Battery Charger:	Battery Levels & Cables:	Leaks Oil, Water or Fuel:	Amp:	Volts:	Freq:	Oil Pressure:	Water Temp:	BC Amp:	RTM:	ATS:	Mechanic:	Comments:

START-UP REQUEST FORM

To provide an authorized factory start-up at the lowest possible prices, we must request that the following checklist and tasks be completed prior to a Katolight representative's arrival at the installation site to perform the start-up.

(Please Print)
Unit Serial Number: _____ **Contact Name:** _____

Company Name: _____ **Title:** _____

Please attach a map or directions to the site. **Phone Number:** _____

- ☐ Unit set in place on vibration pads with floor anchor/studs to prevent movement.
- ☐ Radiator ducted to properly sized air discharge louvers.
- ☐ Unit full of oil and water/anti-freeze mix.
- ☐ Battery filled with acid and fully charged.
- ☐ Battery charger mounted with AC and DC wired, if not supplied mounted by the factory.
- ☐ All AC and DC electrical connections made.
- ☐ Engine heater wired to normal AC power supply.
- ☐ Fuel inlet and return lines run between the unit and fuel storage system, system filled and primed to the engine with proper fuel.
- ☐ Exhaust system in place and supported so that the exhaust manifold does not carry weight of exhaust system.
- ☐ Air inlet louver motor wired to an emergency generator source point to open upon the start of an engine generator set.
- ☐ Generator room cleaned of construction debris including excess nails, bolts, nuts, panel knockouts, etc. It is very important that the radiator fan area is checked for debris, as damage to the equipment and personal injury can occur if loose items come in contact with the fan when the unit is initially started.

Consult your Katolight Installation Guide on any questions.

If, upon arrival at the installation site, our representative cannot perform the start-up as a result of defective Katolight equipment, the problems will be resolved and we will reschedule another start-up date at the earliest possible date at no additional charge.

If the start-up cannot be performed due to an incomplete installation or for reasons beyond Katolight's control, you may incur an additional start-up charge at a later date.

Signature: _____ **Date:** _____



Basic Generator Set Operation and Instruction Manual

Rev. 072503

CALIFORNIA

Proposition 65 Warning Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries

SAFETY PRECAUTIONS

Before operating the generator set, read the operators manual! Become familiar with the equipment and safe operating procedures. Safe operation can be achieved only if the equipment is properly operated and maintained.

Dangers, Warnings and Cautions are used in this publication to alert the operator to special instructions concerning a particular procedure that may be hazardous if performed incorrectly. These "Safety Alerts" alone can not eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus "common sense" operation, are major accident prevention measures. Katolight Corporation can not anticipate every possible circumstance that might involve a hazard. The warnings in this Manual and on tags and decals affixed to equipment are, therefore, not all-inclusive.



This symbol signifies high voltage.

The following safety rules should be strictly complied with:

The standby electric system must be installed, tested, and inspected per the manufacturer's recommendations. All codes, standards, regulations, and laws pertaining to the installation must be strictly complied with.

DANGEROUS voltages are present at power terminals of this equipment. Contact with such terminals will result in extremely dangerous and possibly lethal electric shock. Never allow any unqualified person to install, operate or service the equipment.

! CAUTION !

The frame and external electrically conductive parts of this equipment must be properly connected to an approved earth ground, in accordance with applicable electrical codes. A grounding lug is provided on the generator and in other equipment for this purpose.

WARNING

Accidental contact with electrical equipment can cause severe injury and death if the equipment is not properly grounded. Ensure that all equipment is properly grounded.

Gaseous, Natural Gas and Liquid Propane Gas are extremely flammable and vapors are ***EXPLOSIVE.***

Diesel fuel is highly flammable. Comply with all laws regulating the storage and handling of these fuels. Check for leaks frequently and correct such leakage immediately.

Engine exhaust gases contain ***DEADLY*** carbon monoxide gas. If breathed in sufficient concentrations, this gas can cause unconsciousness or even death. Provide adequate ventilation to prevent buildup of exhaust gases. When the generator is installed inside a room or enclosure, exhaust gases must be piped outdoors. Install the exhaust system so exhaust gas does not leak at joints or piping connections. The exhaust manifold, turbocharger(s), and extended exhaust piping are ***HOT*** when the engine is running. These can remain hot for long periods of time after the engine shuts off. Avoid contact with these parts. Consider insulating the exhaust system if installation is such that unintentional contact with the exhaust system components is likely.

Coolants under pressure have a higher boiling point than water. ***DO NOT*** open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.

Wear protective safety eyeglasses and gloves when handling starting batteries and electrolyte. Battery acid can cause serious burns if it contacts eyes and skin.

Servicing of batteries is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

CAUTION-The replacement starting battery or batteries must be of equal size and cold cranking amps. Observe all precautions listed below.

CAUTION-The generator controls must be in the off position when replacing the batteries.

CAUTION-Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

CAUTION-Do not open or mutilate the battery or batteries. Released electrolyte has been known to be harmful to the skin and eyes and to be toxic.

CAUTION-A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

1. Remove watches, rings, or other metal objects.
2. Use tools with insulated handles.

Vented Batteries

The installation of the engine generator shall provide enough ventilation to ensure that gases generated by vented batteries during charging or caused by equipment malfunction are removed.

CAUTION-The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. It is electrically conductive and corrosive. The following procedures are to be observed:

1. Wear full eye protection and protective clothing.
2. Where electrolyte contacts the skin, wash it off immediately with water.
3. Where electrolyte contacts the eyes, flush thoroughly and immediately with water.
4. Spilled electrolyte is to be washed down with an acid-neutralizing agent. A common practice is to use a solution of one pound (500 grams) bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.

CAUTION-Lead acid batteries present a risk of fire because they generate hydrogen gas. The following procedures are to be followed:

1. DO NOT SMOKE when near batteries.
2. DO NOT cause flame or spark in battery area.
3. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

Moving parts can cause severe personal injury or death. Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on

electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.

Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage, which present a potential fire hazard.

When an open bottom is used, instructions shall state that the stationary engine generator assembly is to be installed over noncombustible materials and shall be located such that it prevents combustible materials from accumulating under the generator set.

OPERATION PROCEDURES

Installation Procedures: Refer to Katolight's "Installation Guide" Procedures

! CAUTION !

The high engine temperature shutdown system will not operate if the coolant level is too low. The high engine temperature sensor monitors coolant temperature. Loss of coolant will prevent sensor operation and allow the engine to overheat causing severe damage to the engine. Therefore, maintain adequate coolant level for proper operation of the high engine temperature shutdown system.

Low Coolant Level Shutdown – A submerged sensor in the top portion of the radiator shuts down the engine and lights the Hi Engine Temp fault lamp when the coolant level falls below the level of the sensor. Top off coolant frequently.

Prior to starting or testing the generator set refer to the engine manual for maintenance checkpoints. Items such as oil level, coolant level, belt tension, battery electrolyte level, wire connections, air filter are some of those that should be checked frequently.

! CAUTION !

Stop engine before filling fuel tank. Never fill tank when engine is hot.

STARTING PROCEDURE

The following sections cover the three systems used to start the generator set. See Pages 8 – 14 for panel description and illustrations.

Starting at Control Panel
Move the RUN/OFF/AUTO switch on the control panel to the RUN position. This will activate the engine control system and the starting system. The starter will begin cranking and after a few seconds the engine should start. The starter will disconnect when the engine reaches a speed of 500-750 RPM. If the engine does not start, the starter will disengage at the end of the cranking cycle. Katolight generator sets with the cycle cranking will crank for 10 seconds and then rest for 10 seconds until 5 cycles have been completed, then lock out on overcrank (fail to start). To clear an overcrank fault, place the RUN/OFF/AUTO switch in the OFF position. Wait two minutes for the starter motor to cool and then repeat the starting procedure. If the engine does not run after a second attempt at starting, refer to the Troubleshooting section.

Automatic Starting
Place the RUN/OFF/AUTO switch on the generator set control panel in the AUTO position if an automatic transfer switch is used. This allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns. **Be aware the genset could start at any time in the "AUTO" mode – keep clear of all moving parts and be sure to turn switch to "OFF" position before servicing and disconnect the negative battery cable after disconnecting the battery charger circuit.**

STOPPING

Before Stopping
Run the generator set at no load for three to five minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

To Stop
If the set was started at the set control panel or at a remote control panel, move the RUN/OFF/AUTO switch or remote starting switch to the OFF position. If an automatic transfer switch started the set, the set will automatically stop after the normal power source returns, and time delays have been satisfied.

BREAK-IN

Drain and replace the crankcase oil and oil filter(s) after the first 30 to 50 hours of operation on new generator sets. Refer to the MAINTENANCE section of the Engine manual for the recommended procedures. It is recommended to achieve the break in during the first 2 months after installation is completed. This will familiarize the operator with the system.

NO-LOAD OPERATION

Periods of no load operation should be held to minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of Load Banks.

EXERCISE PERIOD

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts. Regular exercising keeps engine parts lubricated, prevents oxidation of electrical contacts and in general helps provide reliable engine starting. Exercise the generator set at least once a week for a minimum of 30 minutes with load so the engine reaches normal operating temperatures. The Automatic Transfer switch has an optional exerciser that can be preset to provide regular exercise periods. Typically the exerciser can be set for time of start, length of run, and day of week.

LOW OPERATING TEMPERATURES

Use a coolant heater if a separate source of power is available. The optional heater will help provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating. The heater should be in use year round. A heater is required on all automatic systems to prevent engine damage due to short warm up cycles.

AUTOMATIC TRANSFER SWITCH

! DANGER !

HAZARDOUS VOLTAGE
Will cause severe injury or death.
Turn OFF all power before installation, adjustment or removal of transfer switch or any of its components.

EQUIPMENT INSPECTION

Immediately inspect the transfer switch when received to detect any damage, which may have occurred during transit. If damage is found or suspected, file claims as soon as possible with the carrier and notify the nearest Katolight representative. The switch cabinet should be opened at inspection to check for internal freight damage, even if the box and cabinet enclosure appear undamaged.

FINAL EQUIPMENT INSPECTION

Prior to energizing the transfer switch:

Remove any debris incurred due to shipment or installation. DO NOT use a blower since debris may become lodged in the electrical and mechanical components and cause damage. Use of a vacuum is recommended.

Verify that all cabled connections are correct. Verify phase rotation and position of the high leg at both sources on the delta system.

Check engine start connections and verify the correct connection of all control wires.

Check settings of all timers and adjust as necessary. Also adjust any optional accessories as required.

Check the integrity of power connections by verifying actual lug torque values as specified in the ATS manual.

Make sure that all covers and barriers are installed and properly fastened.

FUNCTIONAL TEST

Since there are various transfer switch designs available, please refer to the operator manual provided with the transfer switch for specific details.

The functional testing of the transfer switch consists of electrical tests described in this section. Before proceeding, refer to the information package supplied with the transfer switch. Read

and understand all instructions and review the operation of all accessories provided.

Before starting the operation test, check the equipment-rating nameplate on the transfer switch to **verify the correct system voltage.**

To begin the test, close the Normal source circuit breaker. The micro-controller will illuminate the Normal Available LED if proper voltage is sensed. Verify the phase-to-phase voltages at the Normal line terminals.

Next, close the Emergency source breaker and start the engine generator. The Emergency Available LED indicator will illuminate when preset voltage and frequency levels are achieved. Check the phase-to-phase voltages at the Emergency line terminals. Also, verify that the phase rotation of the Emergency source is the same as the phase rotation of the Normal source.

After the sources have been verified, shut down the engine generator, and put the starting control in the automatic position. Complete the visual inspection of the transfer switch, and close and lock the cabinet door.

Initiate the electrical transfer test by activating the test switch. **Hold the test switch until transfer to Emergency is accomplished.** After the engine start time delay, the micro-controller will send an engine start signal and sensing will determine when the auxiliary source reaches preset levels. The switch will transfer to the Emergency source after the time delay of the transfer to the Emergency timer.

Deactivating the test switch will start retransfer to the Normal source. The switch will retransfer to the Normal source after the time delay of the retransfer to Normal timer. The engine over-run timer allows the engine generator to run unloaded for a preset cool-down period.

For complete details of timer and voltage sensing operations, please refer to the Automatic Transfer Switch Operation Manual.

MAINTENANCE AND TESTING

A preventive maintenance program will insure high reliability and long life for the transfer switch. The preventive maintenance program for the transfer switch should include the following items.

INSPECTION AND CLEANING

! DANGER !

HAZARDOUS VOLTAGE
De-energize all sources of power before doing any work on the transfer switch. Note: If approved disconnects are not in place contact your Local Electric Utility or a qualified Electrician before proceeding.

The switch should be inspected for any accumulation of dust, dirt, or moisture, and should be cleaned by vacuuming or wiping with a dry cloth or soft brush. DO NOT use a blower since debris may become lodged in the electrical and mechanical components and cause damage.

Remove the transfer switch barriers and check the condition of the contacts. Any surface deposits must be removed with a clean cloth (DO NOT USE EMERY CLOTH OR A FILE). If the contacts are pitted or worn excessively, they should be replaced. A general inspection of mechanical integrity should be made to include loose, broken or badly worn parts.

SERVICING

All worn or inoperative parts must be replaced using recommended replacement parts. Please refer to the Replacement Parts manual for specific part information and ordering procedures. Please contact your nearest Distributor.

The operating mechanism of the transfer switch is lubricated. The lubricant applied at the factory provides adequate lubrication for the lifetime of the switch. Should debris contaminate the mechanism, clean and apply additional lubricant. (See Automatic Transfer Switch Manual for proper lubricant type).

TESTING

A manual operator handle is provided with the transfer switch for maintenance purposes only. Manual operation of the switch must be checked before it is operated electrically. Both power sources MUST be disconnected before manual operation of the switch. Insert the handle and operate the transfer switch between the Normal and Emergency positions. The transfer switch should operate smoothly without binding. Return the switch to the Normal position, remove the handle, and return it to the holder provided.

After completing the inspection, cleaning and servicing of the transfer switch, reinstall the switch cover, and close and lock the cabinet door. Reclose the circuit breakers feeding the utility and generator sources to the switch.

Initiate the electrical transfer test by activating the test switch. Engine start timer will time out and the micro-controller will send an engine start signal. When the transfer to Emergency time has elapsed, the switch will complete its transfer by closing into the Emergency source.

Deactivating the test switch will start retransfer to the Normal source. The switch will complete its retransfer to Normal after the time delay of the retransfer to Normal timer. The engine over-run timer allows the engine generator to run unloaded for a preset cool down period.

GOVERNORS

MECHANICAL GOVERNOR ADJUSTMENTS

All Katolight Gen-Sets are tested at full load prior to shipment and the speed settings are adjusted. The typical settings will vary from 60 – 63 Hz at no load and are set to operate at 60 Hz when loaded to the nameplate rating. If the system load does not reach the nameplate rating the speed can be adjusted down to 60 Hz. Care must be taken to insure that the Katolight Gen-Set operates at no less than 60 Hz when the entire load to be on the unit is applied. See Figures 2 – 1 and 3 – 1 to find the typical speed adjust locations.

ELECTRONIC GOVERNOR DIESEL ADJUSTMENTS

Governor Speed Setting (Diesel)

The governed speed set point is increased by clockwise rotation of the Speed adjustment control. Remote speed adjustment can be obtained with an optional Speed Trim Control. See Figure 1 –1.

Governor Performance (Diesel)

Once the engine is at operating speed and at no load, the following governor performance adjustments can be made: Rotate the Gain adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment 1/8 of a turn further counterclockwise to insure stable performance.

Rotate the Stability adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Move the adjustment 1/8 of a turn further counterclockwise to insure stable performance.

Gain and stability adjustment may require minor changes after engine load is applied. Normally, adjustments made at no load achieve satisfactory performance. A strip chart recorder can be used to optimize the adjustments further. If instability cannot be corrected or further performance improvements are required, contact the nearest distributor or Service Center.

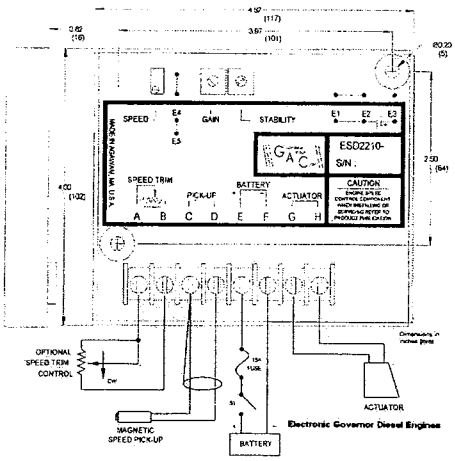


FIGURE 1-1
STANDARD GAC GOVERNOR CONTROL

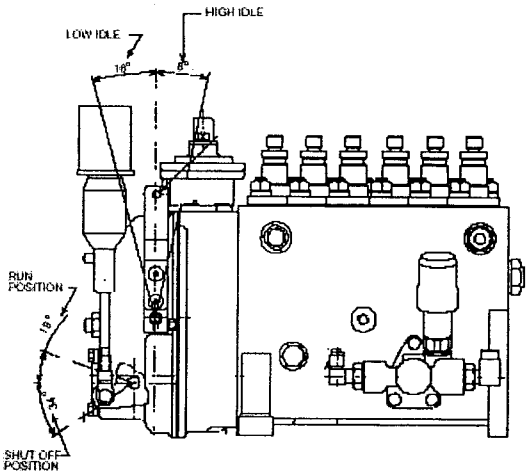


FIGURE 2-1
STANDARD MECHANICAL GOVERNOR FOR DIESEL ENGINES.

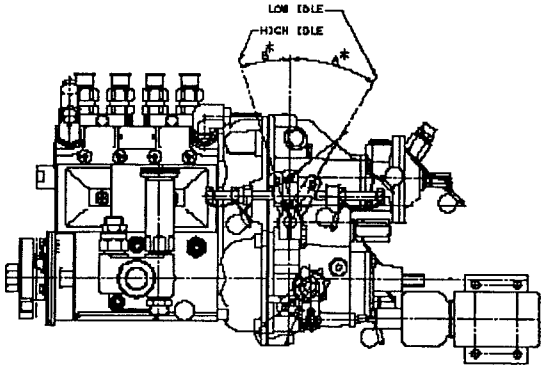


FIGURE 3-1
STANDARD MECHANICAL GOVERNOR FOR DIESEL ENGINES

40 Series Panel

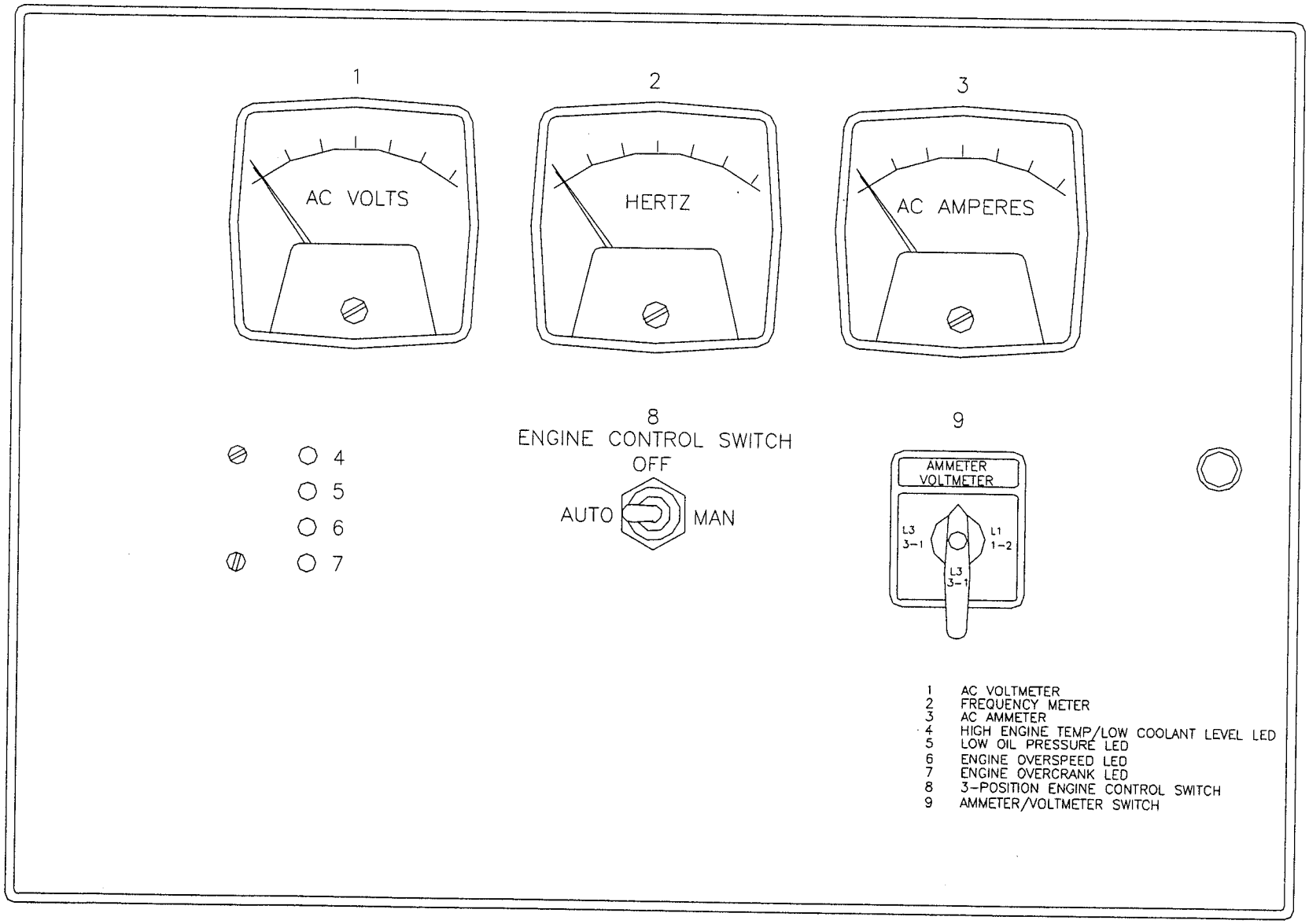
1. AC Voltmeter
This meter will monitor generator output voltage. There are 2 scales on the meter upper for 208/240-volt systems and lower for 480-volt systems.

2. Frequency Meter
This meter will monitor generator speed, which is measured in Hertz. Typical relationship with RPM is Hertz x 30 = RPM. Standard systems will operate at a minimum of 60.0 Hz – maximum of 63.0 Hz.

3. AC Ammeter
This meter will monitor the load applied to the generator. This load is measured in amperes. The reading on this meter will vary with the load, but should never exceed the nameplate rating.

4. Ammeter/Voltmeter Selector Switch
This switch allows the operator to change the output lines to be monitored by the AC ammeter and the AC voltmeter (amperage is monitored on each line and voltage is monitored line to line) Example: L1 - L2 = Volts position 1 and Amps on L1.

STANDARD 40 SERIES CONTROL PANEL FACE



1 AC VOLTMETER
2 FREQUENCY METER
3 AC AMMETER
4 HIGH ENGINE TEMP/LOW COOLANT LEVEL LED
5 LOW OIL PRESSURE LED
6 ENGINE OVERSPEED LED
7 ENGINE OVERCRANK LED
8 3-POSITION ENGINE CONTROL SWITCH
9 AMMETER/VOLTMETER SWITCH

STANDARD 40 SERIES CONTROL PANEL BACK PLATE

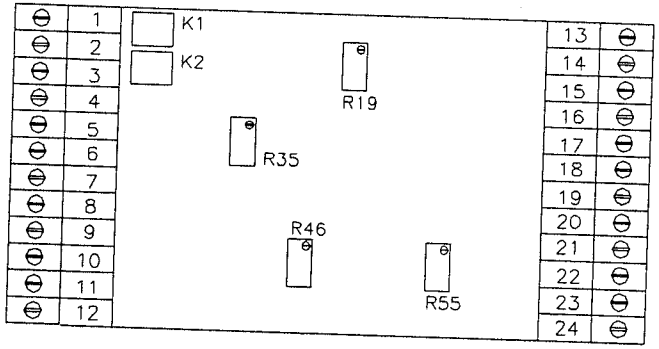
R46 Mag Pickup Crank Disconnect
Clockwise increases
disconnect frequency

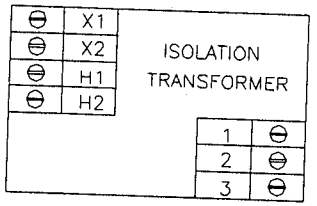
R35 Engine Alternator
Clockwise increases
disconnect frequency

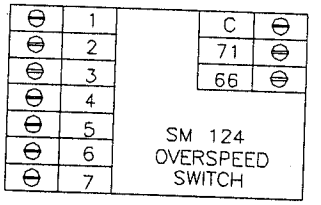
R55 Oil Failure Time Set
Counter clockwise increases

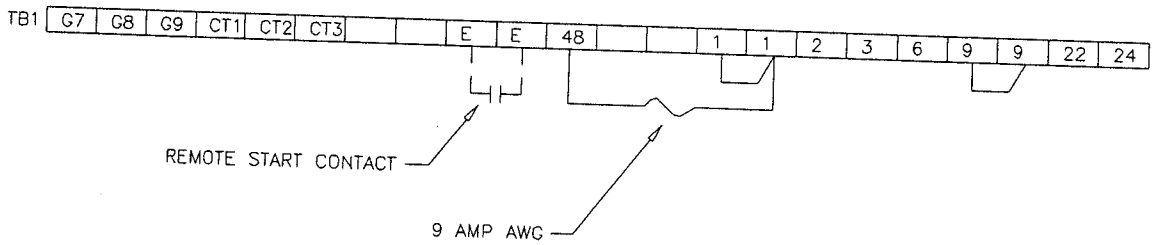
R19 Crank Time Set
Counter clockwise increases
length of crank time

JMP1 1TO 2 Yields one shot
3 to 2 Yields 5 cycle









45 Series Panel

1. AC Voltmeter
This meter will monitor generator output voltage. There are 2 scales on the meter upper for 208/240-volt systems and lower for 480-volt systems.

2. Frequency Meter
This meter will monitor generator speed, which is measured in Hertz. Typical relationship with RPM is Hertz x 30 = RPM. Standard systems will operate at a minimum of 60.0 Hz – maximum of 63.0 Hz.

3. AC Ammeter
This meter will monitor the load applied to the generator. This load is measured in amperes. The reading on this meter will vary with the load, but should never exceed the nameplate rating.

4. High Engine Temp/Low Coolant Level LED
Indicates the unit has sensed coolant temperature in excess of 225°F and/or indicates the coolant level is low.

5. Low Oil pressure LED
Indicates the unit has sensed the oil pressure has fallen below 15 PSI.

6. Engine over speed LED
Indicates the unit has exceeded the speed limit of 71Hz for gas units or 66 Hz for diesel units.

7. Engine Overcrank LED
Indicates the unit has exceeded the 5 crank cycles.

8. Engine Control Switch
This switch allows the operator to choose from three control's modes – MANUAL for local start and run (to (the left) OFF for no run and reset (center) AUTO for remote start and run (to the right).

9. Ammeter/Voltmeter Selector Switch
This switch allows the operator to change the output lines to be monitored by the AC ammeter and the AC voltmeter (amperage is monitored on each line and voltage is monitored line to line) Example: L1 - L2 = Volts position 1 and Amps on L1.

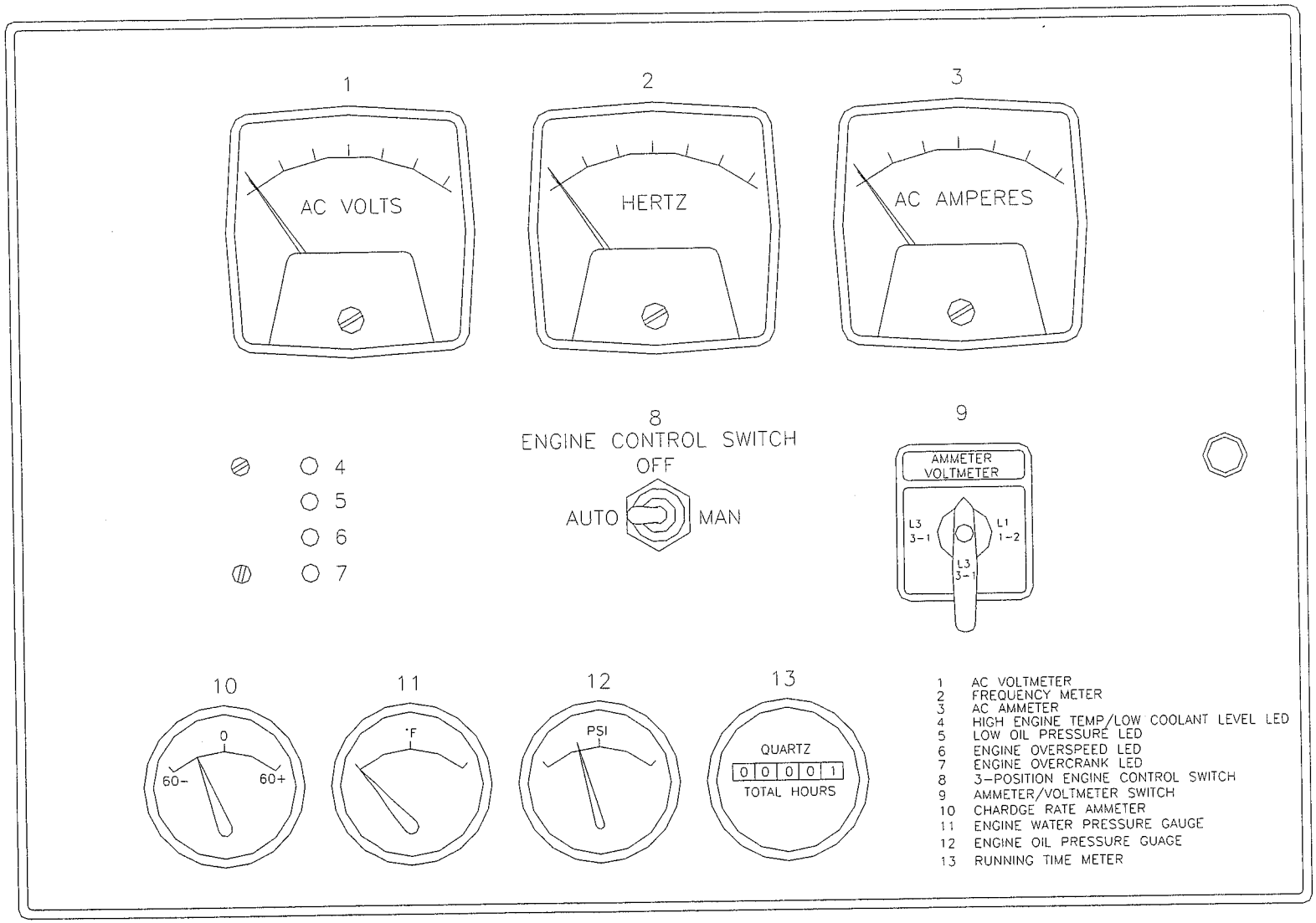
10. Charge Rate Ammeter
This gauge indicates the rate of charge from the engine-mounted alternator to the starting battery; reading is shown in DC amperes.

11. Engine Water Temperature Gauge
This gauge indicates operating temperature of the engine coolant. The reading is shown in degree Fahrenheit. **Note:** This gauge will not read zero when unit is not running.

12. Engine Oil Pressure Gauge
This gauge indicates operating pressure of the engine lubricating system. The reading is shown in pounds per square inch (PSI). **Note:** This gauge will not read zero when unit is not running.

13. Run Time Meter
This meter will indicate accumulative run time in hours of operating increments of 1/10.

STANDARD 45 SERIES CONTROL PANEL FACE



1 AC VOLTMETER
2 FREQUENCY METER
3 AC AMMETER
4 HIGH ENGINE TEMP/LOW COOLANT LEVEL LED
5 LOW OIL PRESSURE LED
6 ENGINE OVERSPEED LED
7 ENGINE OVERCRANK LED
8 3-POSITION ENGINE CONTROL SWITCH
9 AMMETER/VOLTMETER SWITCH
10 CHARDGE RATE AMMETER
11 ENGINE WATER PRESSURE GAUGE
12 ENGINE OIL PRESSURE GUAGE
13 RUNNING TIME METER

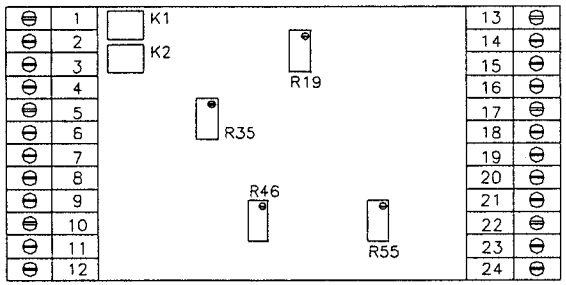
STANDARD 45 SERIES CONTROL PANEL BACK PLATE

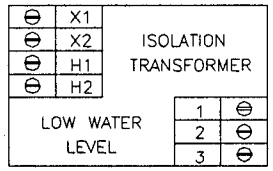
R46 Mag Pickup Crank Disconnect
Clockwise increases disconnect frequency

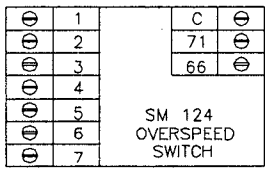
R35 Engine Alternator
Clockwise increases disconnect frequency

R55 Oil Failure Time Set
Counter clockwise increases Time before failure

R19 Crank Time Set
Counter clockwise





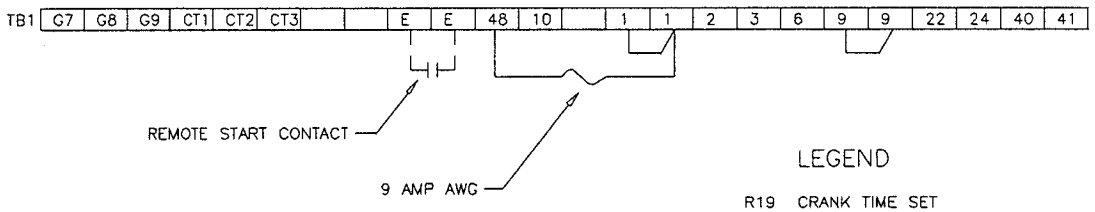


RELAYS

RELAYS INCLUDE: GOVENOR PILOT, AUXILARY, AIR DAMPER OR ALARM RELAYS, EITHER 2 POLE OR 3 POLE, IF THERE ARE 2 OR MORE RELAYS THEY WILL BE STACKED IN THIS CORNER OR WHERE THER IS ROOM.

ELECTRONIC GOVERNOR

(GOVERNOR WILL BE LOCATED HERE OR ON SIDE OF PANEL)



LEGEND

R19 CRANK TIME SET
R35 ENGINE ALTERNATOR FREQUENCY ADJUST
R46 MAG PICK-UP CRANK DISCONNECT
R55 OIL FAILURE TIME SET

50 Series Panel

1. Low Battery Voltage LED
Indicates that the starting battery voltage has dropped below 10 volts DC on 12-volt system or 22 on 24-volt system. Possible problem with the battery(s) or charging system.

2. Charger Malfunction LED
Indicates that the starting battery is at a high DC voltage above 15 volts for 12-volt systems or 30 on 24-volt system. Possible problem with the charging system.

3. High Engine Temp/Low Coolant Level LED
Indicates the unit has sensed coolant temperature in excess of 225° F and/or indicates the coolant level is low.

4. Low Oil pressure LED
Indicates the unit has sensed the oil pressure has fallen below 15 PSI.

5. Engine over-speed LED
Indicates the unit has exceeded the speed limit of 71Hz for gas units or 66 Hz for diesel units.

6. Engine Overcrank LED
Indicates the unit has exceeded the 5 crank cycles.

7. EPS Supplying Load LED
Indicates that the automatic transfer switch is in the emergency position and generator is supplying power to the load.

8. Low Water Temp LED
Indicates that the coolant temperature has reached 50°F. Possible problem with the jacket water heater.

9. High Engine Temp Pre -alarm LED
Indicates the jacket water temp has dropped below 215°F and may go into a high temp shut down.

10. Low Oil Pressure Pre-alarm LED
Indicates that the engine oil pressure has dropped below 20 PSI and may go into a low oil pressure shut down.

11. Low Fuel LED
Indicates that the fuel supply is critically low on fuel and requires refueling.

12. Unit Not In Auto LED
Indicates that the engine control switch is not in the AUTO position.

13. Press To Test Button
This is the red button on the panel face. By pressing it will activate all LED's and sound the alarm for testing purposes.

14. Panel Lights
These are located on the top of the panel face and will illuminate the control panel and gauges.

15. AC Voltmeter
This meter will monitor generator output voltage. There are 2 scales on the meter, upper for 208/240-volt systems and lower for 480-volt systems.

16. Frequency Meter
This meter will monitor generator speed, which is measured in Hertz. Typical relationship with RPM is Hertz x 30 = RPM. Standard systems will operate at a minimum of 60.0 Hz – maximum of 63.0 Hz.

17. AC Ammeter
This meter will monitor the load applied to the generator. This load is measured in amperes. The reading on this meter will vary with the load, but should never exceed the nameplate rating.

18. Buzzer
This is an audible alarm that will sound when any of the LED's are activated indicating engine failure or pre-alarm (Exception EPS Supplying Load LED).

19. Alarm Silence Button
This is the black button on the panel face. By pressing it will turn the audible alarm off.

20. Panel Light Switch
This switch will activate the panel lights for use in low light conditions.

21. Engine Control Switch
This switch allows the operator to choose from three control's modes – MANUAL for local start and run (to the left) OFF for no run and reset (center) AUTO for remote start and run (to the right).

22. Ammeter/Voltmeter Selector Switch
This switch allows the operator to change the output lines to be monitored by the AC ammeter and the AC voltmeter (amperage is monitored on each line and voltage is monitored line to line) Example: L1 - L2 = Volts position 1 and Amps on L1.

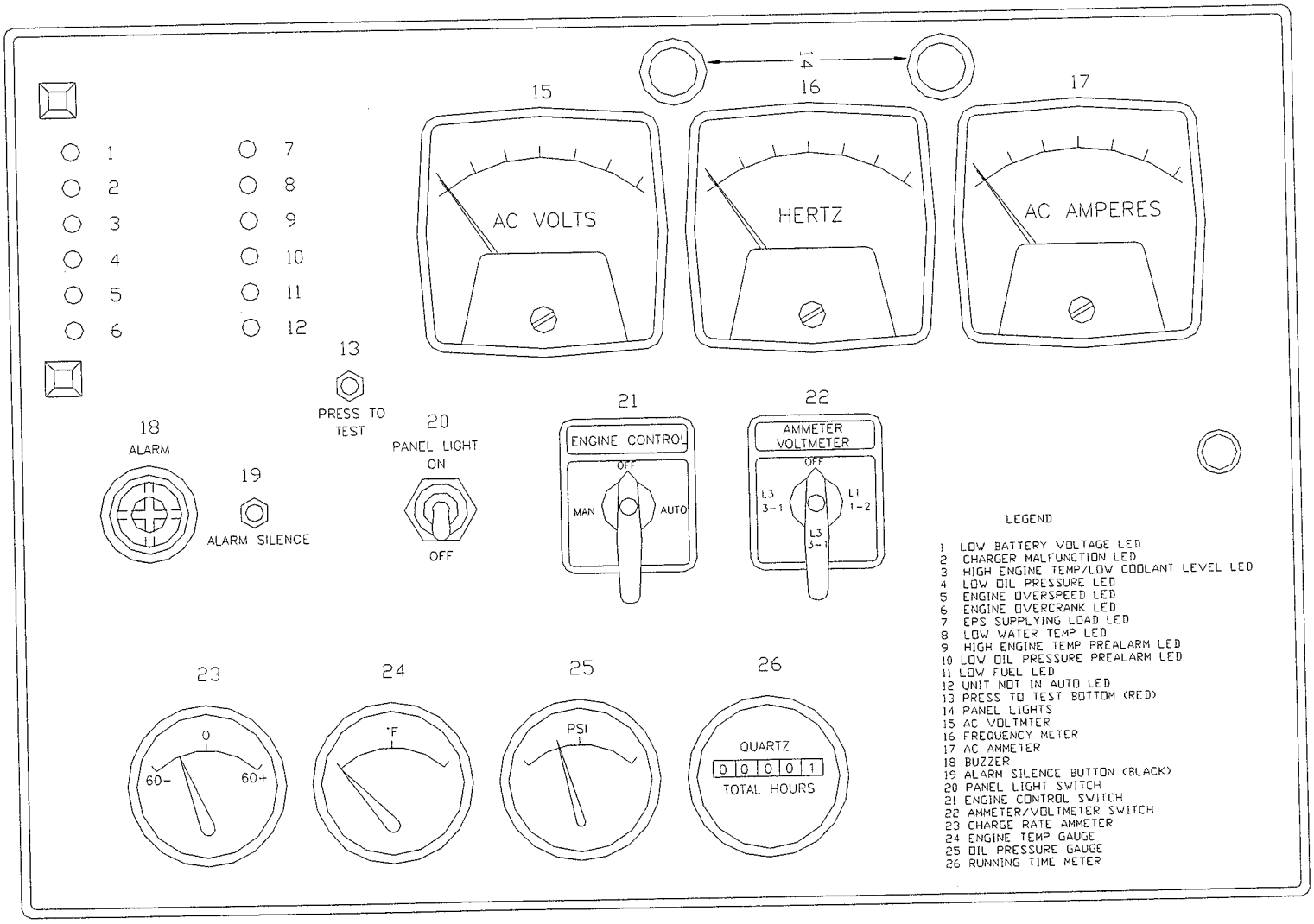
23. Charge Rate Ammeter
This gauge indicates the rate of charge from the engine-mounted alternator to the starting battery; reading is shown in DC amperes.

24. Engine Water Temperature Gauge
This gauge indicates operating temperature of the engine coolant. The reading is shown in degree Fahrenheit. **Note:** This gauge will not read 0 when unit is not running

25. Engine Oil Pressure Gauge
This gauge indicates operating pressure of the engine lubricating system. The reading is shown in pounds per square inch (PSI). **Note:** This gauge will not read zero when unit is not running.

26. Run Time Meter
This meter will indicate accumulative run time in hours of operating increments of 1/10.

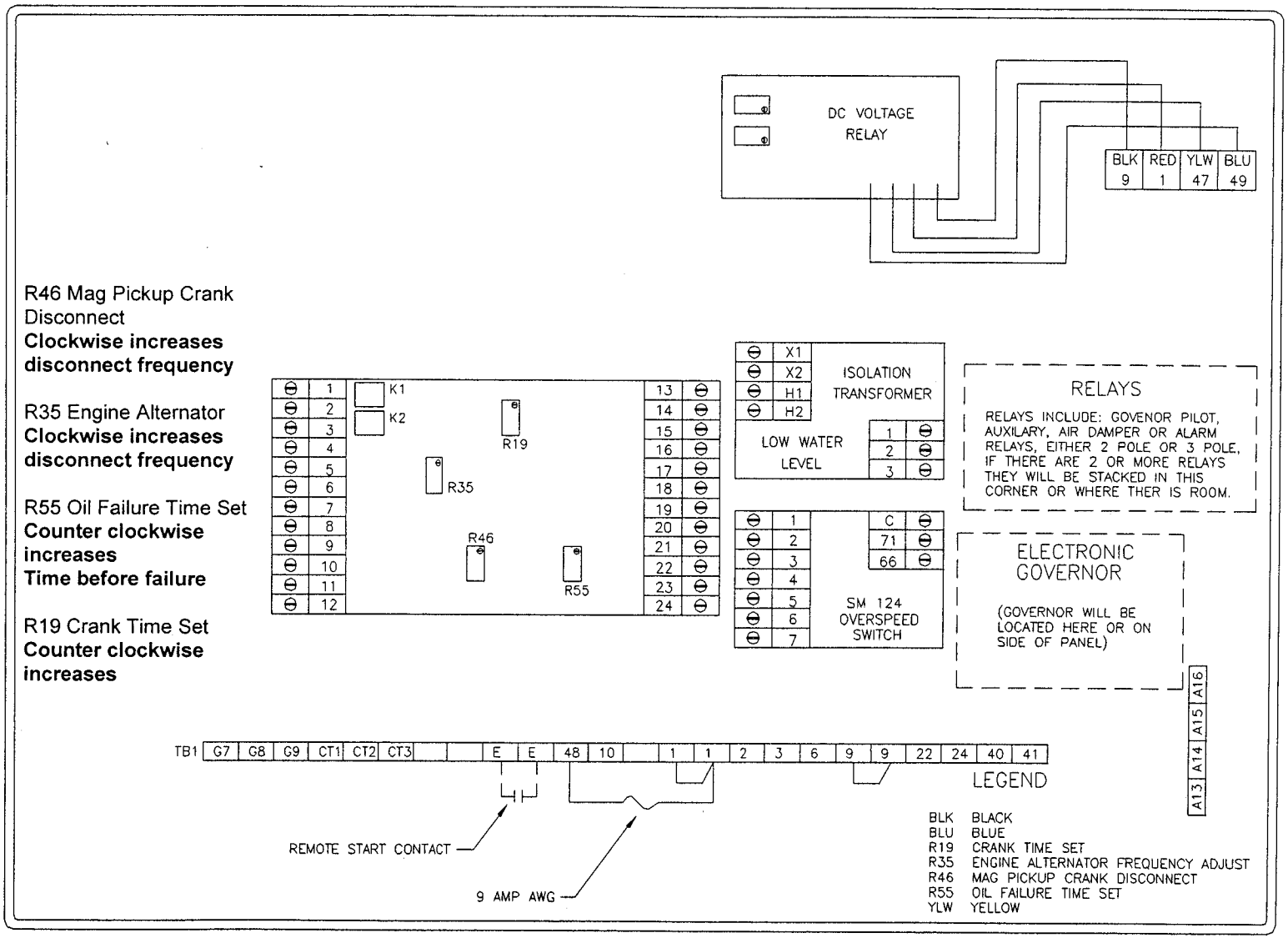
STANDARD 50 SERIES CONTROL PANEL FACE



LEGEND

1 LOW BATTERY VOLTAGE LED
2 CHARGER MALFUNCTION LED
3 HIGH ENGINE TEMP/LOW COOLANT LEVEL LED
4 LOW OIL PRESSURE LED
5 ENGINE OVERSPEED LED
6 ENGINE OVERCRANK LED
7 EPS SUPPLYING LOAD LED
8 LOW WATER TEMP LED
9 HIGH ENGINE TEMP PREALARM LED
10 LOW OIL PRESSURE PREALARM LED
11 LOW FUEL LED
12 UNIT NOT IN AUTO LED
13 PRESS TO TEST BUTTON (RED)
14 PANEL LIGHTS
15 AC VOLTMTER
16 FREQUENCY METER
17 AC AMMETER
18 BUZZER
19 ALARM SILENCE BUTTON (BLACK)
20 PANEL LIGHT SWITCH
21 ENGINE CONTROL SWITCH
22 AMMETER/VOLTMETER SWITCH
23 CHARGE RATE AMMETER
24 ENGINE TEMP GAUGE
25 OIL PRESSURE GAUGE
26 RUNNING TIME METER

STANDARD 50 SERIES CONTROL PANEL BACK PLATE



KGM-250 Controller

A. Low Oil Pressure
Pre-alarm and shut down set points.

B. High Engine Temperature
Pre-alarm and shut down set points.

C. Low Engine Temperature
Pre-alarm set points.

D. Overspeed
Programmable to tenths of a Hertz shutdown.

E. Cranking Cycles
Number and length of cranks as well as crank rest time period.

F. Universal DC Voltage
Detects 12 or 24 VDC systems and uses corresponding set points for high and low battery pre-alarms.

G. Automatic AC
Automatically detects single or three phase operation as well as AC voltage for each operation of the generator.

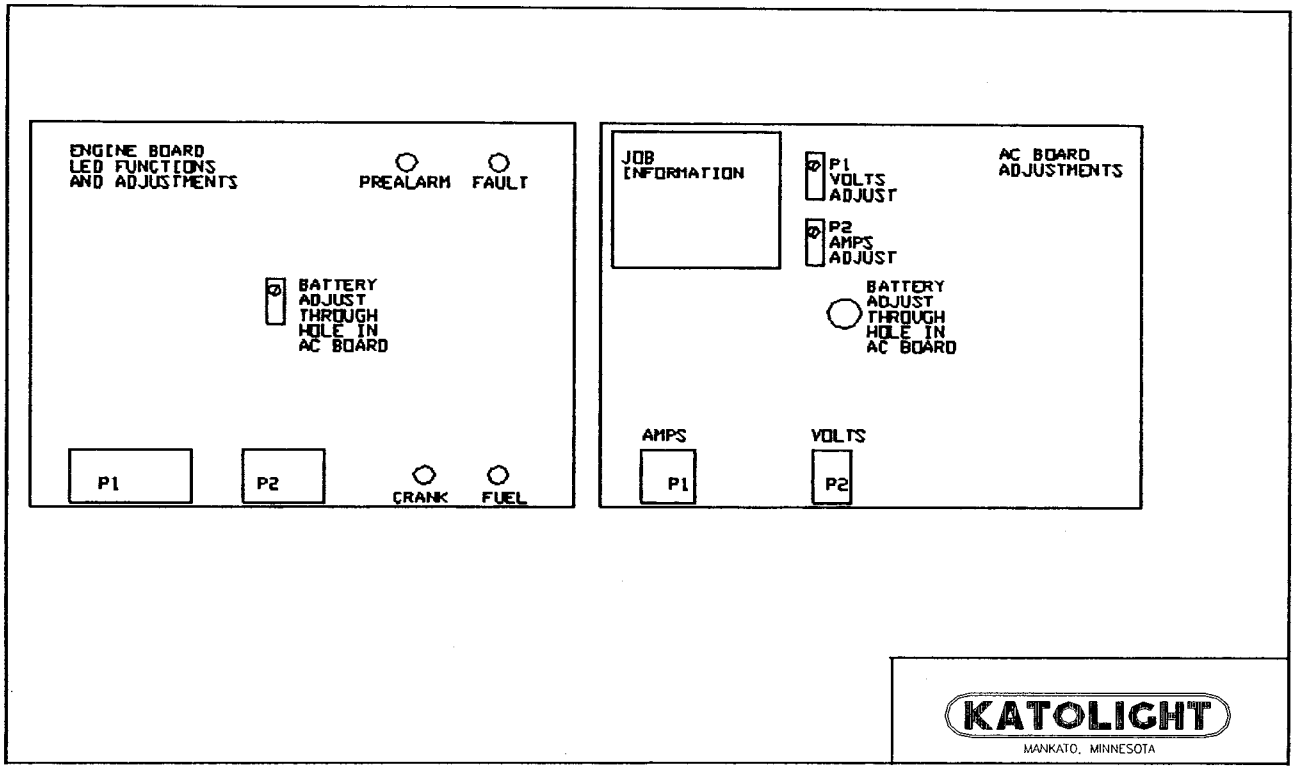
H. Speed Set
Using a push button through the faceplate, frequency is set to 60Hz and/or RPM to 1800.

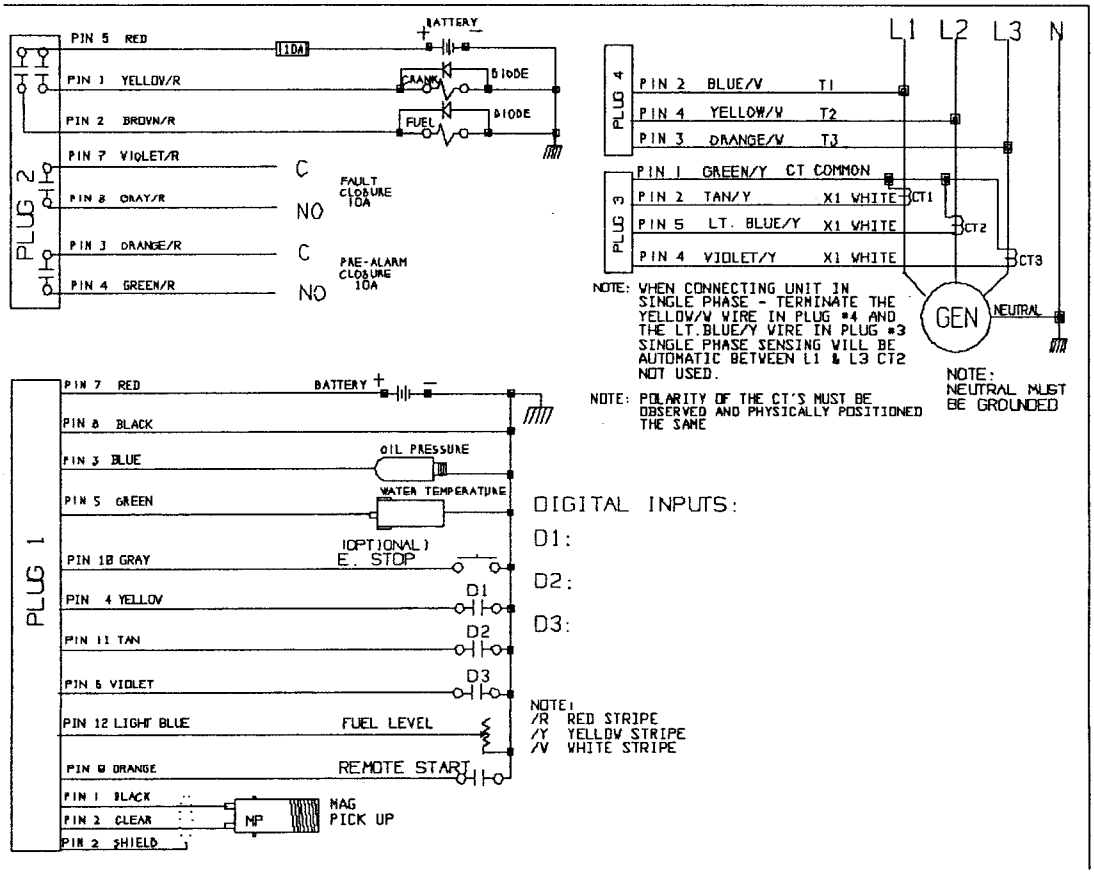
I. Speed Sender Failure
A condition when speed signal is lost. "Speed Sender Failure" is displayed on LCD as a pre-alarm.

J. Secondary Crank Termination
In the event of a speed sender failure, the controller will crank terminate using AC voltage.

K. Automatic Fuel Level
When a fuel sender is connected to the control, the LCD will display the % fuel level and corresponding pre-alarm and shut down set points will be active. Without a fuel sender attached, the fuel area of the LCD will be blank.

KGM-250 Controller





KDGC-2001 Digital Genset Controller With J1939 Interface

A. Liquid Crystal Display
The backlit, two line by 16 character LCD is the primary interface for metering, alarms, pre-alarms, and protective functions. The LCD has three display modes: Normal, Alternate, and Menu. In Normal mode, the displayed parameters correspond to one of the eight labels surrounding the LCD. In Alternate mode, the LCD displays parameters and the corresponding labels. In Menu mode, the LCD scrolls through the KDGC-500 setup parameters.

B. Not in Auto Indicator
This red LED lights when the KDGC-500 is not operating in Auto mode.

C. Phase Toggle Pushbutton
Pressing this control scrolls through the parameters available in Normal display mode.

D. Alarm Indicator
This red LED lights continuously during alarm conditions and flashes during pre-alarm conditions.

E. Alarm Silence Pushbutton
Pressing this control resets the KDGC-500 audible alarm.

F. Supplying Load Indicator
This green LED lights when the generator is supplying more than two percent of rated current.

G. Lamp Test Pushbutton
Pressing this control tests the KDGC-500 indicators by exercising all LCD segments and lighting all LEDS.

H. Auto Mode Indicator
This green LED lights when the KDGC-500 is operating in Auto mode.

I. Auto Pushbutton
Pressing this control places the KDGC-500 in Auto mode.

J. Off Mode Indicator
This red LED lights when the KDGC-500 is in Off mode.

K. Off Pushbutton
Pressing this control places the KDGC-500 in Off mode.

L. Run Mode Indicator
This green LED lights when the KDGC-500 is operating in Run mode.

M. Run Pushbutton
Pressing this control places the KDGC-500 in Run mode.

N. Display Toggle Pushbutton
Pressing this control scrolls through the display modes.

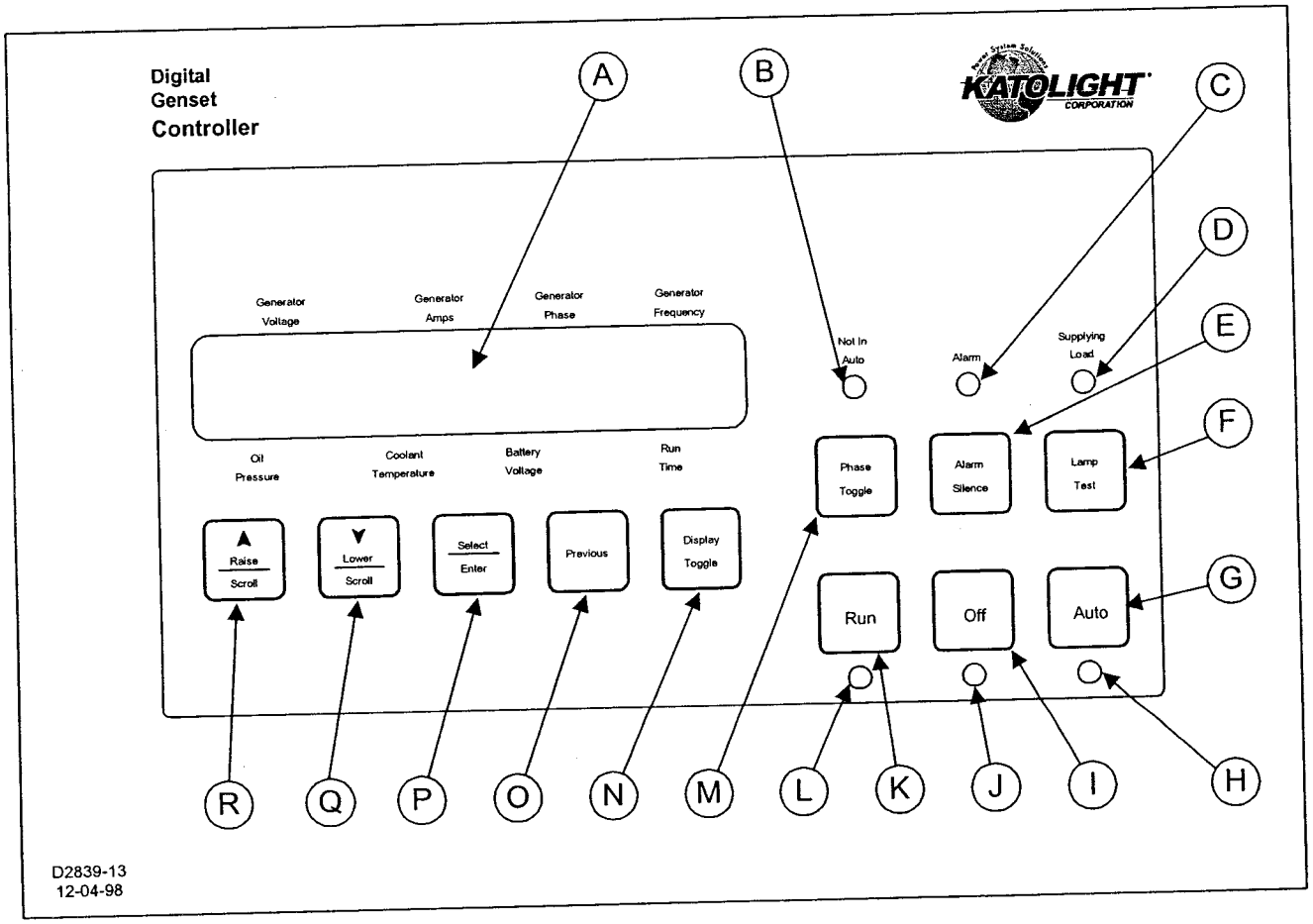
O. Previous Pushbutton
Pressing this control scrolls through the LCD display modes.

P. Enter Pushbutton Select
This control is pressed to enter menu sub-levels and select setpoints.

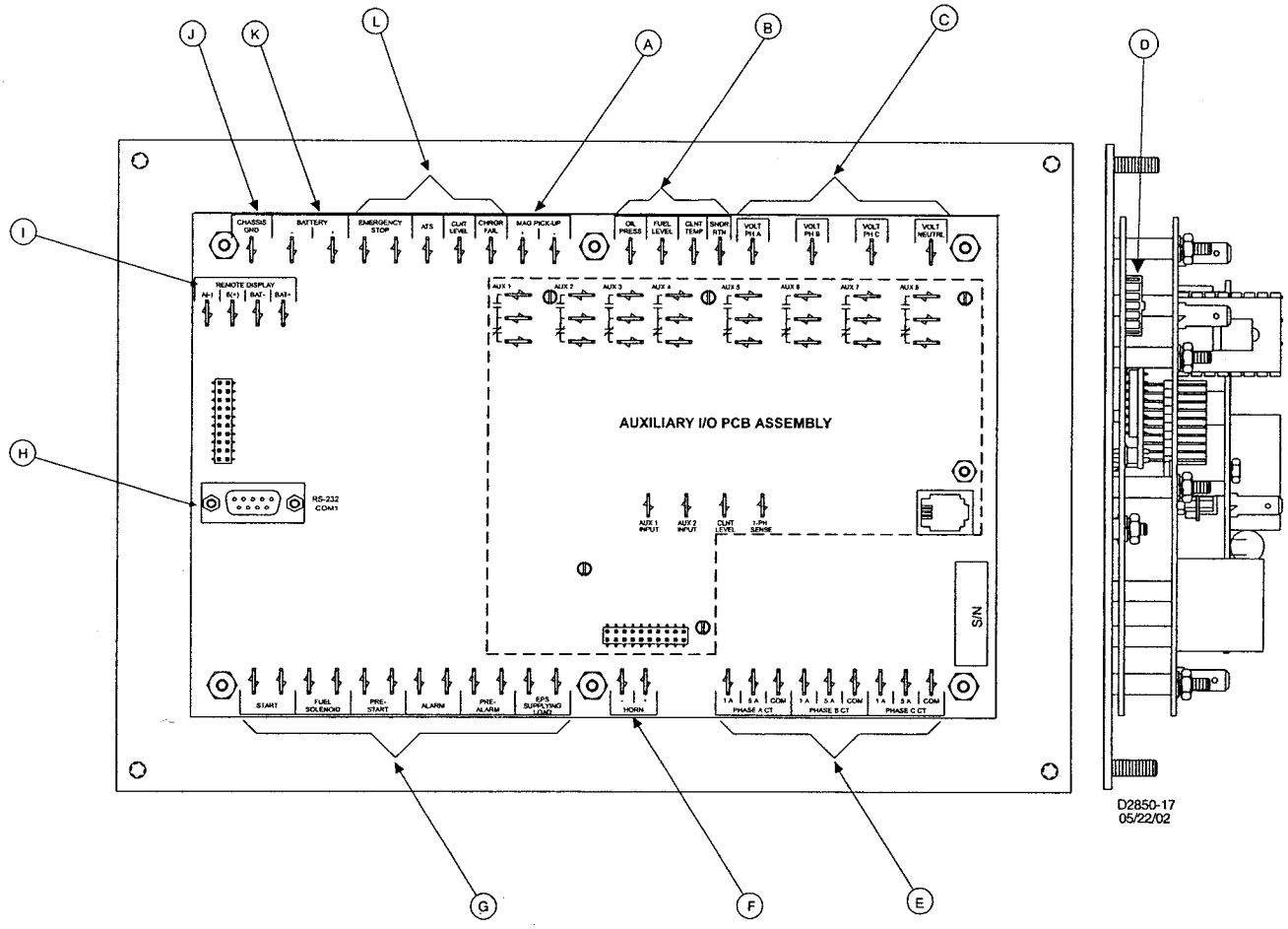
Q. Lower/Scroll Pushbutton
This control is pressed to scroll backward through menus or decrement setpoints.

R. Raise/Scroll Pushbutton
This control is pressed to scroll forward through menus or increment setpoints.

KDGC-2001 Digital Genset Controller with J1939 Interface



KDGC-2001 Digital Genset Controller with J1939 Interface Back Plate



KDGC-500 Digital Genset Controller

A. Liquid Crystal Display
The backlit, two line by 16 character LCD is the primary interface for metering, alarms, pre-alarms, and protective functions. The LCD has three display modes: Normal, Alternate, and Menu. In Normal mode, the displayed parameters correspond to one of the eight labels surrounding the LCD. In Alternate mode, the LCD displays parameters and the corresponding labels. In Menu mode, the LCD scrolls through the KDGC-500 setup parameters.B *Not in Auto Indicator.* This red LED lights when the KDGC-500 is not operating in Auto mode.

C. Phase Toggle Pushbutton
Pressing this control scrolls through the parameters available in Normal display mode.

D. Alarm Indicator
This red LED lights continuously during alarm conditions and flashes during pre-alarm conditions.

E. Alarm Silence Pushbutton
Pressing this control resets the KDGC-500 audible alarm.

F. Supplying Load Indicator
This green LED lights when the generator is supplying more than two percent of rated current.

G. Lamp Test Pushbutton
Pressing this control tests the KDGC-500 indicators by exercising all LCD segments and lighting all LEDS.

H. Auto Mode Indicator
This green LED lights when the KDGC-500 is operating in Auto mode.

I. Auto Pushbutton
Pressing this control places the KDGC-500 in Auto mode.

J. Off Mode Indicator
This red LED lights when the KDGC-500 is in Off mode.

K. Off Pushbutton
Pressing this control places the KDGC-500 in Off mode.

L. Run Mode Indicator
This green LED lights when the KDGC-500 is operating in Run mode.

M. Run Pushbutton
Pressing this control places the KDGC-500 in Run mode.

N. Display Toggle Pushbutton
Pressing this control scrolls through the display modes.

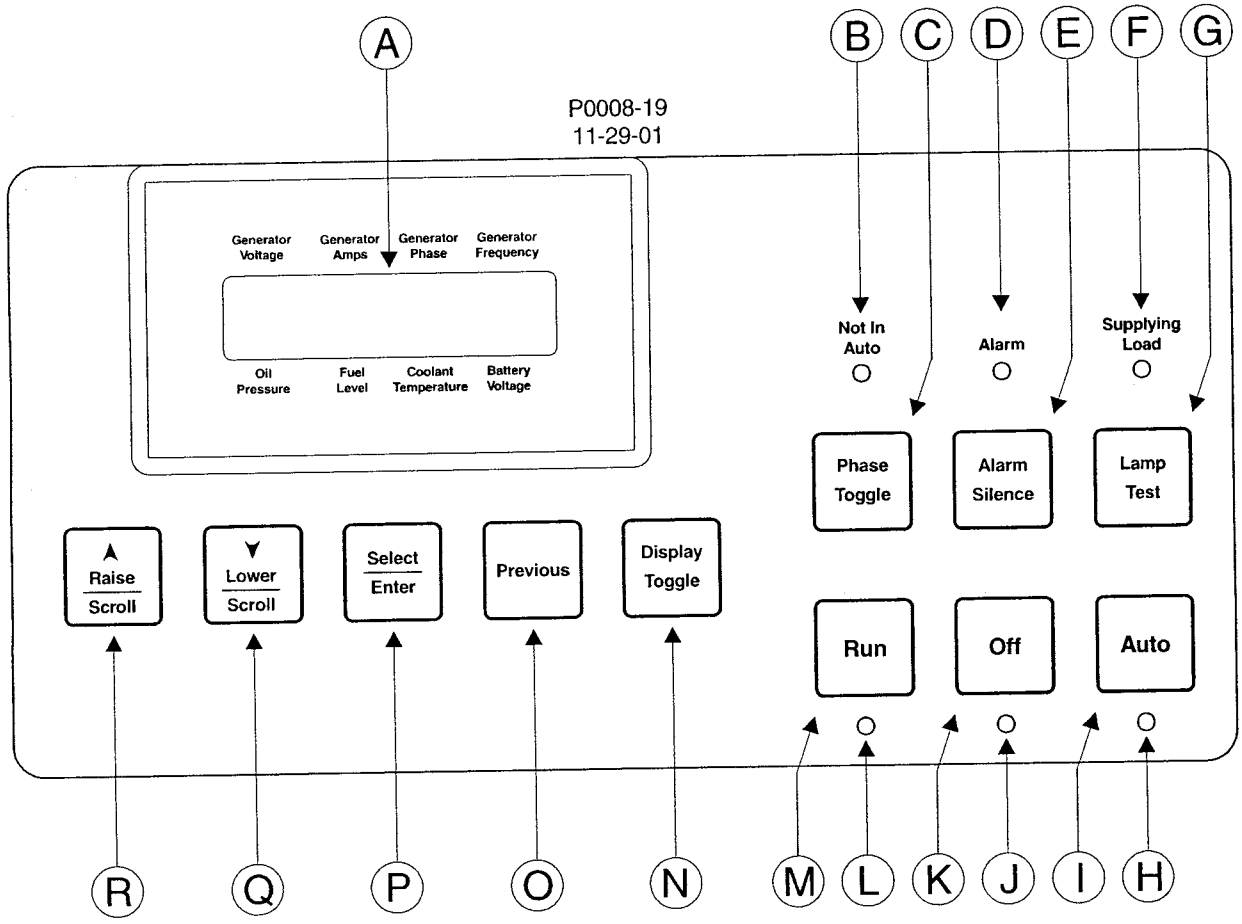
O. Previous Pushbutton
Pressing this control scrolls through the LCD display modes.

P. Select/Enter Pushbutto
This control is pressed to enter menu sub-levels and select setpoints.

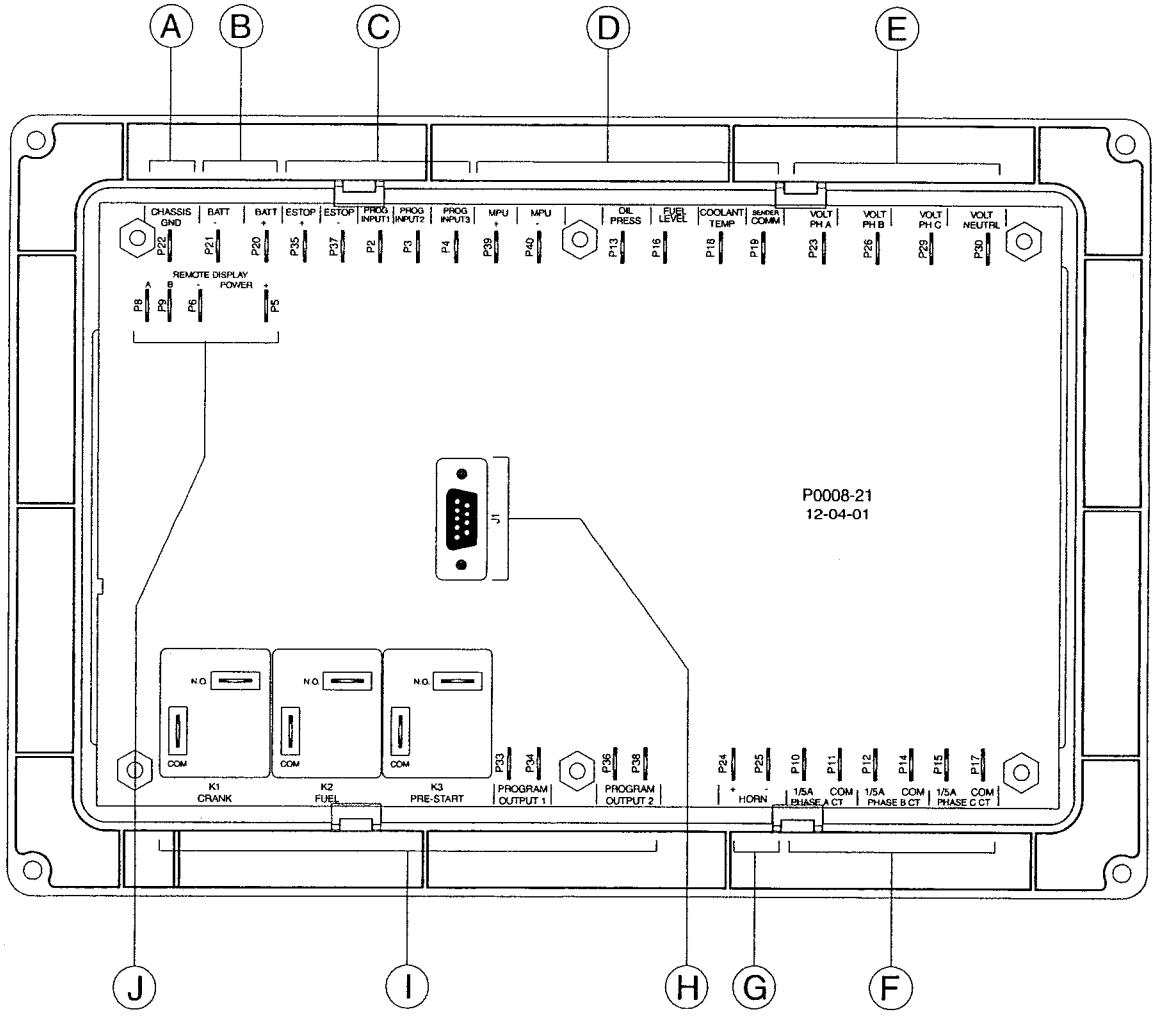
Q. Lower/Scroll Pushbutton
This control is pressed to scroll backward through menus or decrement setpoints.

R. Raise/Scroll Pushbutton
This control is pressed to scroll forward through menus or increment setpoints.

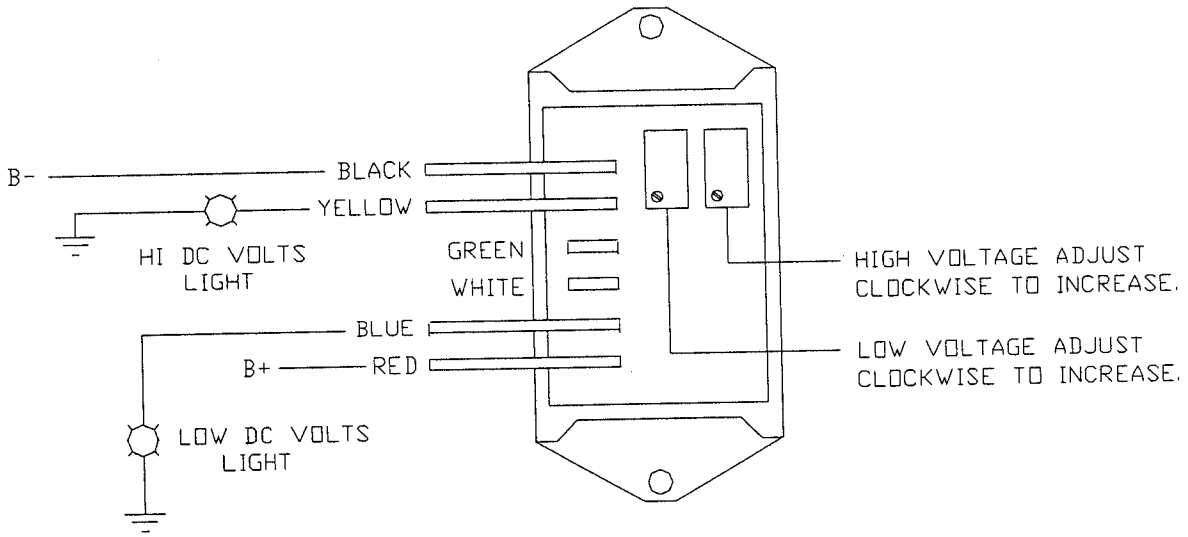
KDGC-500 Digital Genset Controller



KDGC-500 Digital Genset Controller Back Plate



DC VOLTAGE SENSING RELAY



NOTE:

1. HIGH VOLTAGE RELAY SHOULD CLOSE AT 15 VDC FOR 12VDC SYSTEMS AND 30 VDC FOR 24VDC SYSTEMS
2. LOW VOLTAGE RELAY SHOULD CLOSE AT 10.3 VDC FOR 12VDC SYSTEMS AND 22.3 VDC FOR 24VDC SYSTEMS
3. WHITE JUMPER IS CUT FOR 12VDC OPERATION.
4. GREEN JUMPER IS CUT FOR 24VDC OPERATION.

REVISION:
1. REDRAWN ON COMPUTER 6-1-98 LJS
2. UPDATED PRINT 11-16-99 SKB

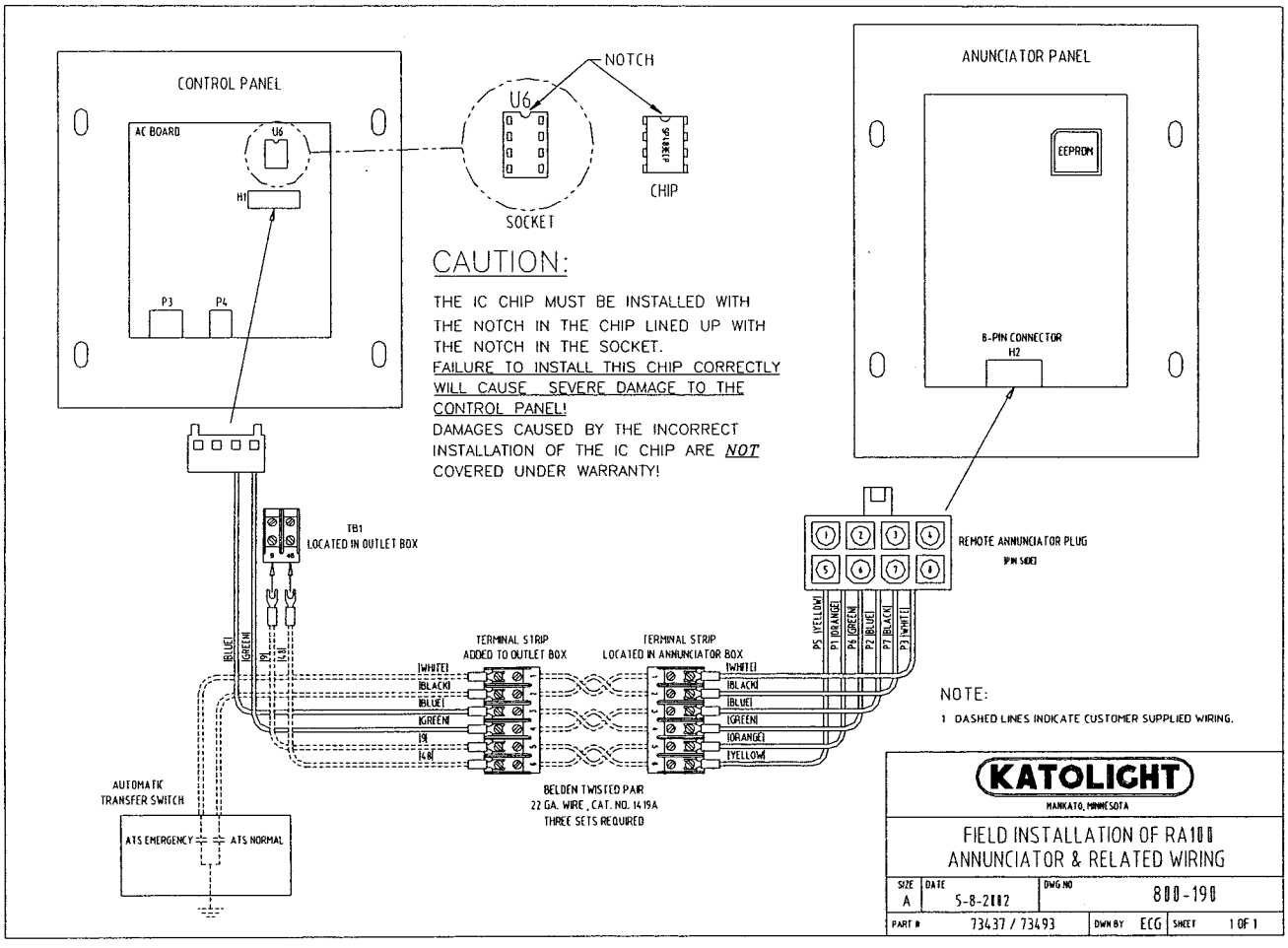
KATOLIGHT
MANKATO, MINNESOTA

DC VOLTAGE SENSING RELAY

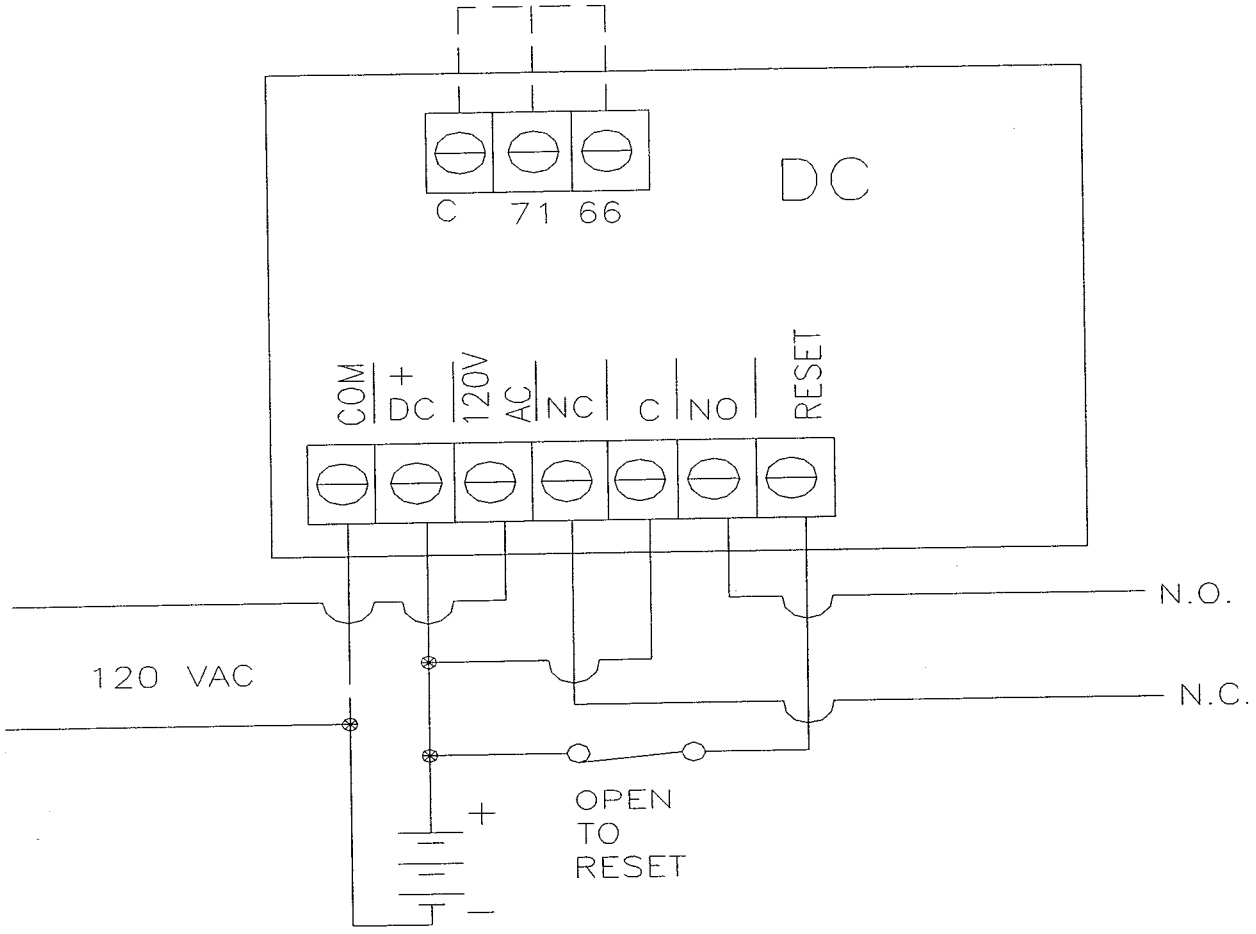
SIZE	DATE	DWG NO	
A	6-1-98	800-151	
SCALE NONE	PART NO 35064	DWN BY LJS	SHEET 1 OF 1

RA 100 Remote Annunciator

Mimic display of the KGM-250 LCD display transmitted through a RS485 port utilizing twisted pair wire. The remote display is powered from then engine batteries and can be located up to 4000' away from the control system. The display has green, amber and red LED's to indicate pre-alarms, faults and transfer switch position. The remote annunciator has to ring back circuit to silence the alarm horn. Should another pre-alarm or fault occur, after the alarm horn has been silenced, the alarm horn will resound until silenced. When a pre-alarm or fault is acknowledged and the amber or red LED will flash on and off to indicate alarm acknowledged. Multiple remote annunciators can be connected to one control system.



SM124 Speed Monitor



Kassec

Note: "battery voltage" or "supply voltage" will refer to the battery's positive voltage. "Ground" will refer to the negative side of the battery.

Terminal 1
Supplies battery voltage to the high current requirement sections of the circuit. Battery voltage is supplied by Kassec to the six Failure Lamps (Terminals 13, 14,15,16,17,20), the Common Alarm Terminal 23, the Start Terminal 3, and the Energized to Run terminal 2.

Terminal 2
Is the Energized to Run terminal. Up to 8 amps is available from this terminal to supply a starter solenoid on the engine.

Terminal 4
Supplies battery voltage to all the logic circuitry. Any time Terminal 4 is brought from the ground to battery voltage, Kassec will be reset. **Note:** Terminal 4 is the main reset terminal for Kassec.

Terminal 5
Is the Mag Pickup Crank Disconnect input. This is one of four crank disconnect on Kassec. When Kassec is in the cranking mode and the input frequency of the mag pickup equals a value set by the adjustable resistor on Kassec, Kassec will crank disconnect and go into the run mode. If the signal from the mag pickup is lost while Kassec is in the run mode and this is the only crank disconnect being used, Kassec will go into the overcrank failure mode and shut the engine down. **Note:** Whenever Terminal 5 is not in use, it must be tied to Terminal 9 Ground, to prevent accidental triggering of the crank disconnect circuitry.

Terminal 6
Is the Engine Alternator Crank Disconnect terminal. This is one of four crank disconnect on Kassec. When an AC signal from the stator terminal of the engine alternator is fed to this terminal and Kassec is in the cranking mode, Kassec will crank disconnect and go into the run mode. With Kassec in the run mode, the unit will not shut down or go into overcrank with loss of the Alternator Crank Disconnect.

Terminal 7
Is the Auxiliary Crank Disconnect Terminal. This is one of four crank disconnects on Kassec. When a positive voltage is placed on this terminal and Kassec is in the cranking mode, Kassec will go into a run mode. When Kassec is in a run mode and this is the only crank disconnect being used, loss of the positive voltage on Terminal 7 will place Kassec into an overcrank failure mode and shut the engine down.

Terminal 8
Is the Transfer Switch Terminal. This terminal is the main controlling terminal. Any time this terminal is at battery positive the unit will be in active modes of trying to start, run, failure. If Terminals 1 and 4 have battery voltage on them and Terminal 8 has no battery voltage present, Kassec is in a standby position. Whenever this terminal is brought to battery voltage, Kassec will be in an operate mode. The only exception to this is when a shutdown failure has occurred. Kassec can only be reset from a failure mode by bringing Terminal 4 from ground to battery voltage.

Terminal 9
Is the Ground Terminal for Kassec. All the grounded points should be common to this terminal.

Terminal 10
Is not connected.

Terminal **11**
Is not connected.

Note: Terminals 10 and 11 are left open for isolation between ground and the 120 volts AC. These terminals may be used as tie points if needed.

Terminal 12
Is the 120-volt AC Crank Disconnect. This is one of four crank disconnects on Kassec. When Kassec is in the cranking mode and a 120 volt AC 60Hz signal is fed to this terminal, Kassec will crank disconnect and go into a run mode. With Kassec in the run mode, the unit will not shut down or go into overcrank mode with loss of the 120 volt Crank Disconnect.

Terminal 13
Is the Overcrank Failure Indicator Terminal. When an overcrank failure occurs, the unit has cranked for a preset number of times and failed to start of the loss of the overcrank signal (mag pickup or auxiliary crank disconnect) has occurred. The maximum on state load current that Terminal 13 can supply is 2 amps resistive.

Terminal **14**
Is the Oil Failure Indicator Terminal. If Terminal 24 is brought to ground after the oil timer on Kassec times out, Terminal 14 will supply battery voltage indicating an oil failure. The maximum on state load current that Terminal 14 can supply is 2 amps resistive.

Terminal 15
Is a Failure Indicator Output terminal. If Terminal 22 is brought to ground, Terminal 15 will supply battery voltage for a failure lamp. The maximum on state load current that Terminal 15 can supply is 2 amps resistive.

Terminal 16
Is a Failure Indicator output terminal. If Terminal 18 is brought to ground, Terminal 16 will supply battery voltage for a failure lamp. The maximum on state load current that Terminal 16 can supply is 2 amps resistive.

Terminal 17
Is a Failure Indicator Output terminal. If Terminal 21 is brought to ground, Terminal 17 will supply battery voltage for a failure lamp. The maximum on state load current that Terminal 17 can supply is 2 amps resistive.

Terminal 18
Is a Failure Sender Input terminal. If this terminal is brought to ground, Terminal 16 will indicate a failure, and the engine will shut down.

Terminal 19
Is a Failure Sender Input terminal. If this terminal is brought to ground, Terminal 20 will indicate a failure, and the engine will shut down.

Terminal 20
Is a Failure Indicator Output terminal. If Terminal 19 is brought to ground, Terminal 20 will supply battery voltage for a failure lamp. The maximum on state load current that Terminal 20 can supply is 2 amps resistive.

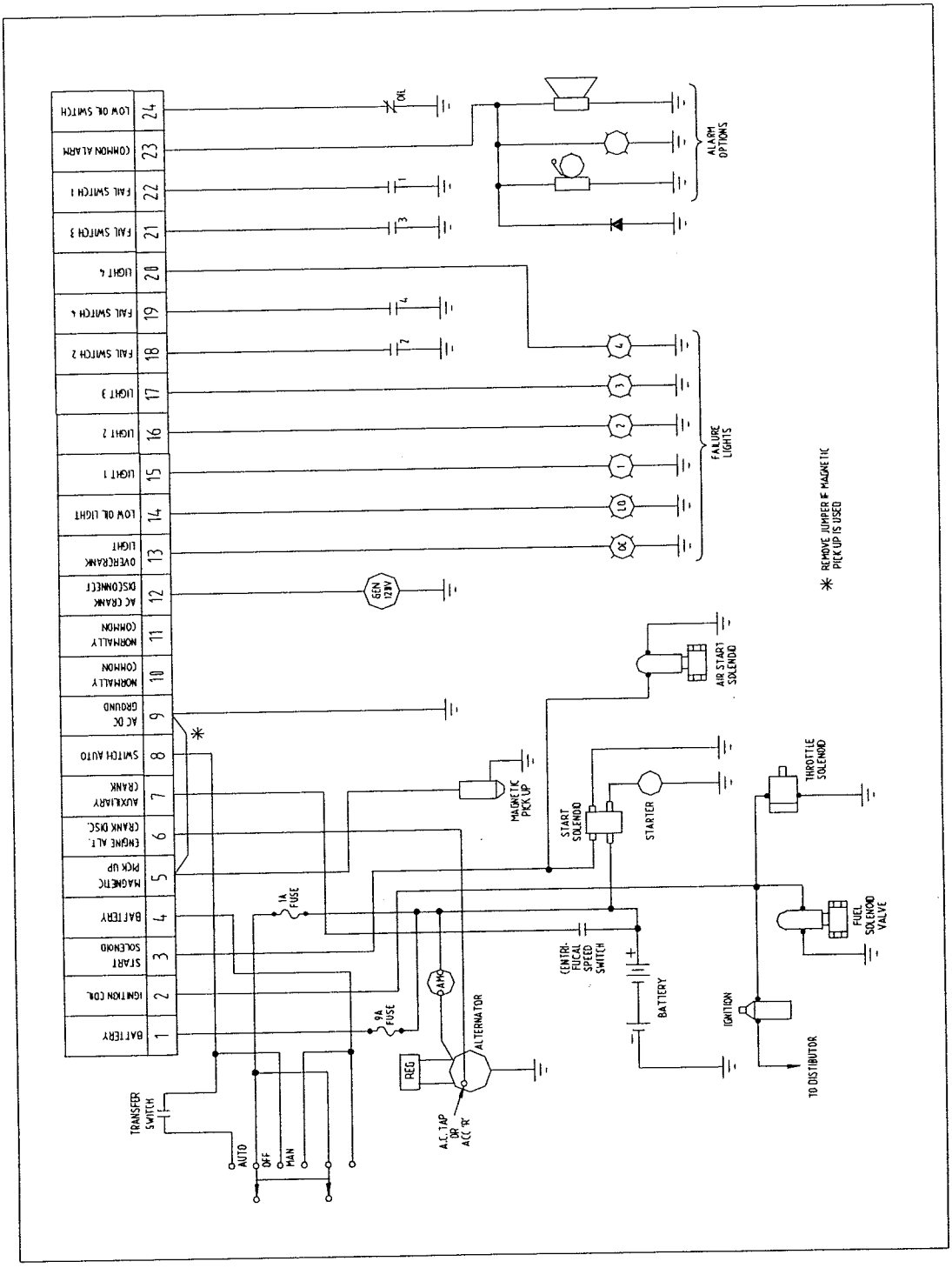
Terminal 21
Is a Failure Sender Input terminal. If this terminal is brought to ground, Terminal 17 will indicate a failure, and the engine will shut down.

Terminal 22
Is a Failure Sender Input terminal. If this terminal is brought to ground, Terminal 15 will indicate a failure, and the engine will shut down.

Terminal 23
Is the Common Alarm Terminal. When any of the failures (Terminal 13, 14, 15, 16, 17, or 20) are supplying battery voltage, Terminal 23 will be supplying battery voltage. This terminal will also supply battery voltage if the number of recranks has been satisfied of is a crank disconnect (mag pickup or auxiliary crank disconnect) has been lost. The maximum on state load current that Terminal 23 can supply is 2 amps resistive. Note: When an inductive load is connected on Terminal 23, a clamping diode must be connected across the inductive load.

Terminal 24
Is the Oil Failure Sender terminal. If this terminal is brought to ground after a preset time delay, set by an adjustable resistor, Terminal 14 will supply battery voltage for a failure lamp, and the engine will shut down.

Kassec


LOW OIL SWITCH 24
COMMON ALARM 23
FAIL SWITCH 1 22
FAIL SWITCH 3 21
LIGHT 4 20
FAIL SWITCH 4 19
FAIL SWITCH 2 18
LIGHT 3 17
LIGHT 2 16
LIGHT 1 15
LOW OIL LIGHT 14
OVERRANK LIGHT 13
AC CRANK DISCONNECT 12
NORMALLY COMMON 11
NORMALLY COMMON 10
AC DC GROUND 9
SWITCH AUTO 8
AUXILIARY CRANK 7
ENGINE ALT. CRANK DISC. 6
MAGNETIC PICK UP 5
BATTERY 4
START SOLENOID 3
IGNITION COIL 2
BATTERY 1
OIL
ALARM OPTIONS
FAILURE LIGHTS
GEN TERM
REMOVE JUMPER IF MAGNETIC PICK UP IS USED
AIR START SOLENOID
MAGNETIC PICK UP
START SOLENOID
STARTER
THROTTLE SOLENOID
FUEL SOLENOID VALVE
1A FUSE
9A FUSE
CENTRIFUGAL SPEED SWITCH
BATTERY
IGNITION
TO DISTIBUTOR
ALTERNATOR
REG
A.C. TAP OR ACC 'R'
TRANSFER SWITCH
AUTO
OFF
MAIN

Gas Engine Governor System

The gaseous engines utilize an electronic governor as standard. The governors are microprocessor controlled and have no operator accessible adjustments. The speed is factory set to operate at 60.1 hertz.

TROUBLESHOOTING

The generator set has a number of sensor units that continuously monitor the engine for abnormal conditions such as low oil pressure or high coolant temperature. If an abnormal condition does occur, the engine monitor will activate a fault lamp and may also stop the engine depending on the condition. If the generator set does shut down, the operator may be able to restart the set after making certain adjustments or corrections. This section describes the operation of the fault condition system and suggested troubleshooting procedures for the operator.

Safety Considerations

High voltages are present within the control panel and generator outlet box when the generator is running.

! WARNING !

Contacting high voltage components can cause serious personal injury or death. Keep control and outlet box covers in place during troubleshooting.

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down make certain the generator set cannot be accidentally restarted. Place the RUN/OFF/AUTO switch in the OFF position and remove the negative battery cable from the starting battery. Also, be sure to turn battery charger disconnect off before servicing battery circuits.

! WARNING !

Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set before troubleshooting.

When a fault comes on during operation the type of fault will be displayed on the LCD panel. The control panel will also illuminate an indicator light to correspond with the display. The red LED light will indicate fault (shutdown alarm) or the yellow LED pre-alarm (approaching shut down point).

Display Mode Switch

This switch allows the operator to lock the display by moving the switch upward when in the scroll lock mode, the display will not update. By moving the toggle downward the display will show total run time. When the mode switch is in the mid position (normal mode), the display will scroll through all parameters. Follow the trouble shooting procedures to locate and correct the problem. For any symptom not listed, contact your Distributor for service. Voltage and amperage may display 3 phases, when operated single phase. The unused positions will display "0".

Resetting the Control

Placing the RUN/OFF/AUTO switch in the OFF position and pressing the alarm silence switch can deactivate the external alarm and fault lamp. Locate the problem and make the necessary corrections before restarting the generator set.

Main Line Circuit Breaker

The generator output mainline circuit breaker is mounted inside the generator outlet box. If the load exceeds the breaker current rating, the breaker will open to prevent the generator from being overloaded. If the circuit breaker trips, locate the source of the overload and correct as required. Manually reset the breaker to reconnect the load to the generator, by pushing the handle down to the open OFF position, then up to the closed ON position.

TROUBLESHOOTING

! WARNING

Many troubleshooting procedures present hazards, which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.

SYMPTOM As Indicated on Display Screen	CORRECTIVE ACTION
1. PRE HI ENGINE TEMP. Engine continues to operate.	**1.** Indicates engine has begun to overheat and engine temperature has risen to approximately 215°F (102°C). If generator is powering non-critical and critical loads and cannot be shut down. Use the following: a. Reduce load if possible by turning off non-critical loads. b. Check air inlets and outlets and remove any obstructions to airflow. c. Open doors or windows in generator area to increase ventilation. If engine can be stopped, follow procedure in Step 2.
2. HI ENGINE TEMP LED. Engine shuts down.	**2.** Indicates engine has overheated (engine temperature has risen above 225°F/107°C) or coolant level is low (sets with coolant level sensor). Allow engine to cool down completely before proceeding with the following checks: a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary. b. Check for obstructions to cooling airflow and correct as necessary. c. Check for a slipping fan belt and tighten if loose. d. Reset control and restart after locating and correcting problem. Contact your Dealer or Distributor if none of the above.

3. PRE LOW OIL PRESSURE. Engine continues to operate.	**3.** Indicates engine oil pressure has dropped to 20 psi (138kPa). If generator is powering critical loads and cannot be shut down, wait until next shutdown period and then follow Step 4 procedure. If engine can be stopped, follow procedures in Step 4.
4. LOW OIL PRESSURE. Engine shuts down. **NOTE:** See also Step 5	**4.** Indicates engine oil pressure has dropped to 15 psi (103kPa). Check oil level, lines and filters. If oil system is okay, but oil level is low, replenish. Reset control and restart. Contact your Dealer or Distributor if oil pressure is not in the range of 35 to 55 psi (241 to 379 kPa).
5. OVERCRANK. Engine stops cranking. Or Engine runs, shuts down, and LOW OIL PRESSURE.	**5.** Indicates possible fuel system problem. a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. b. Check for dirty fuel filter and replace if necessary (See Maintenance section of Engine Manual). c. Check for dirty or plugged air filter and replace if necessary (See Maintenance section of Engine Manual). d. Refer to Step 4. e. Reset the control and restart after correcting the problem. Contact your Dealer or Distributor for service if none of the above.
6. OVERSPEED, Engine runs and then shuts down.	**6** Indicates engine has exceeded normal perating speed. Refer to governor adjust procedure. Contact your Dealer or Distributor for service.
***7.** UNIT NOT IN AUTO.	**7.** Indicates AUTO/OFF/RUN switch is in the OFF position which will prevent automatic starting if an automatic transfer switch is used. Move the AUTO/OFF/RUN switch to the AUTO position for automatic starting.
8. LOW FUEL. Engine continues to run.	**8.** Indicates diesel fuel supply is running low. Check fuel supply and replenish as required.
9. LOW FUEL and LOW OIL.	**9.** Indicates engine has run out of fuel. Check fuel level and replenish as required. See Engine Manual for fuel system priming procedure.

10. LOW ENGINE TEMPERATURE. Set is in standby mode but not operating.	**10.** Indicates engine coolant heater is not operating or is not circulating coolant. Check for the following conditions: a. Coolant heater not connected to power supply. Check for blown fuse, open circuit breaker or disconnected heater cord and correct as required. b. Check for low coolant level and replenish if required. Look for possible coolant leakage points and repair as required. c. Contact your Dealer or Distributor if none of the above.
11. Engine starts from generator control panel, but will not start automatically or from a remote panel. (Note: The AUTO/OFF/RUN switch must be in the AUTO position.) Automatic or remote starting	**11.** Indicates possible fault with remote start circuit. Check the following: a. Check wire to ATS. b. See ATS section for further troubleshooting. c. Contact your Dealer or Distributor for assistance.
12. Engine will not crank.	**12.** Indicates possible fault with control or starting system. Check for the following conditions: a. Fault lamp on. Correct fault and reset control. b. Poor battery cable connections. Clean the battery cable terminals and tighten all connections. c. Discharged or defective battery. Recharge or replace the battery. d. Contact your Dealer or Distributor for assistance if none of the above.
13. No AC output voltage.	**13.** Indicates possible fault with voltage regulator. a. Verify output with another meter if ok check meter, if ok check meter fuses. b. Regulator fuse is blown. Replace fuse. Contact your Dealer or Distributor if voltage build-up causes fuse to blow. c. Check rotating rectifier for damaged diodes. Replace all diodes if any are failed.

14. No Engine Start	**14.** Indicates Engine Start wires not terminated properly or Generator in OFF position. a. Check Engine Start connections. b. Investigate why Engine Control Switch was put in off. c. Contact your Dealer or Distributor for assistance.
15. No Engine Stop	**15.** Indicates Timing Cycle not complete, Engine Start wires not terminated correctly or Generator in RUN. a. Check Engine Start Timer setting. b. Check Engine Start Connections. c. Investigate why the Engine Control Switch was put in Manual. d. Contact your Dealer or Distributor for assistance.
16. ATS will not transfer to Emergency	**16.** Indicates Emergency voltage or frequency not within acceptable parameters, Power supply harness unplugged, Limit Switch harness unplugged or Timing Cycle not complete. a. Check Engine Start connections, Generator output, and Engine Control Switch. b. Plug in Power Supply harness. c. Plug in Limit Switch harness. d. Check transfer to Emergency Timer setting. e. Contact your Dealer or Distributor for assistance.
17. ATS will not transfer to Normal	**17.** Indicates Normal voltage or frequency not within acceptable parameters, Power Supply harness unplugged, Limit Switch harness unplugged or retransfer to Normal timing cycle not complete. a. Check Utility and Utility breakers. b. Plug in Power Supply harness. c. Plug in Limit Switch harness. d. Check retransfer to Normal Timer setting. e. Contact your Dealer or Distributor for assistance.

Contact Katolight At

1-800-325-5450

To Locate Your Local Distributor

Or Service Agent

100 Power Drive
Mankato, MN 56001
507-625-7973 fax
www.katolight.com

DIESEL

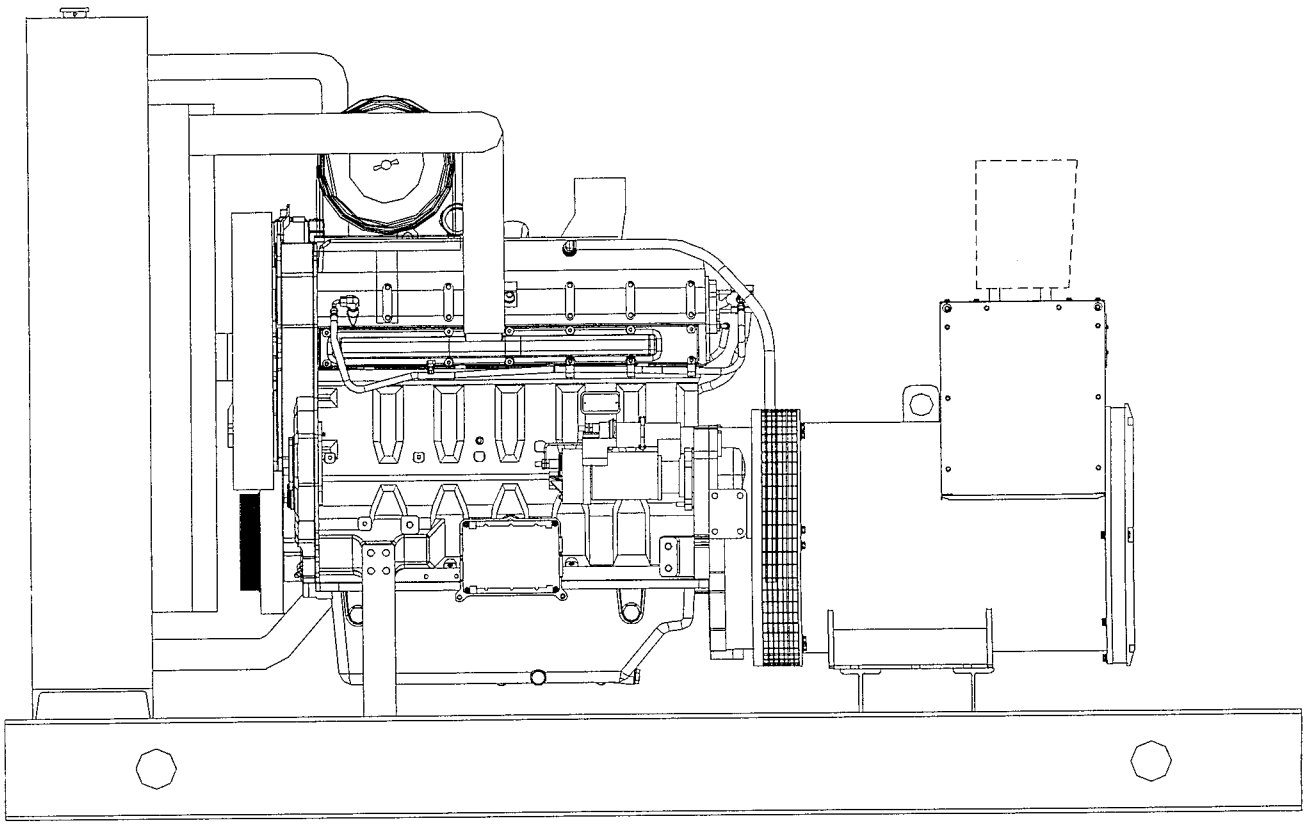
D415F*J4

Power System Solutions

KATOLIGHT® CORPORATION

415 KW @ 60 Hz.
Stand-By Power

345 KW @ 60 Hz.
Prime Power



- Katolight's commitment to quality has been an industry standard since 1952.
- Katolight specializes in custom designing any application to meet the customers' most difficult specifications.
- Each and every unit is factory tested. This can eliminate costly startup and installation delays.
- Katolight supplies a broad range of accessories, fully integrated to our generator sets, to match any requirement worldwide.
- Katolight generator sets come standard with a 2 year, 1500 hour limited warranty. Optional warranty periods are also available, contact factory for details.
- This model accepts 100% of nameplate rating, per NFPA 110.

Model	Volts	Hz	Phase	Power Factor	Standby Ratings		Prime Ratings		Connection
					Amps	kW/kVA	Amps	kW/kVA	
D415FRJ4	277/480	60	3	0.8	624	415/518.75	519	345/431.25	12 LEAD HI WYE
D415FPJ4	120/208	60	3	0.8	1440	415/518.75	1197	345/431.25	12 LEAD LOW WYE
D415FJJ4	120/240	60	3	0.8	1248	415/518.75	1037	345/431.25	12 LEAD HI DELTA
D415FNJ4	347/600	60	3	0.8	499	415/518.75	415	345/431.25	4 LEAD WYE
D415FGJ4	120/240	60	1	1.0	1729	415/415	1438	345/345	12 LEAD ZIG-ZAG

KATOLIGHT

D415F*J4

Diesel Gen-Set

STANDARD EQUIPMENT

CONTROL PANEL

- Model #45 control panel
- AC voltmeter, $3^1/_2$", 2% accuracy
- AC ammeter, $3^1/_2$", 2% accuracy
- Combination VM/AM selector switch, 4 position
- Frequency meter, $3^1/_2$", 55-65 Hz.
- Vibration shock mounts (4)
- Engine control - KASSEC-24 VDC, with cyclic cranking timer
- 4 engine shutdowns with separate failure lights
  - * High water temperature / Low water level
  - * Low oil pressure
  - * Engine overspeed
  - * Engine overcrank
- Engine gauges - 2"
  - * Battery voltmeter
  - * Water temperature
  - * Oil pressure
  - * Running time meter - 5 digits
- 3 position mode switch (auto-off-manual)

ENGINE

- Air cleaner
- Fuel pump
- Fuel filter
- Oil pump
- Full flow oil filter
- Jacket water pump
- Thermostat
- Exhaust manifold – dry
- Oil cooler
- Blower fan & fan drive
- Radiator - unit mounted
- Vibration isolators - pad type
- Electric starting motor - 24v

ENGINE (cont.)

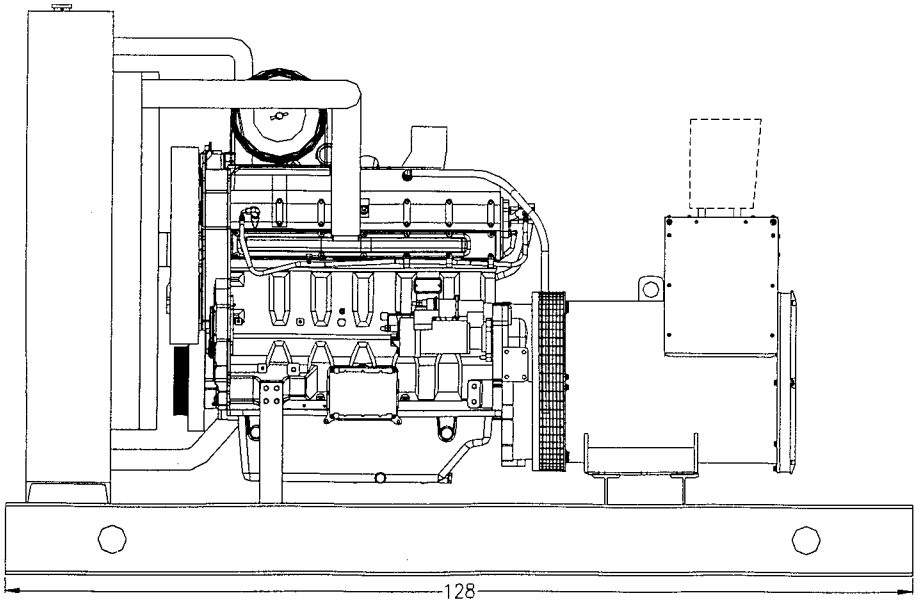
- Turbocharged – Air to Air
- Governor - JDEC
- Base - formed steel
- Housing & flywheel
- Charging alternator - 24v
- Battery box & cables
- Flexible fuel & exhaust connectors

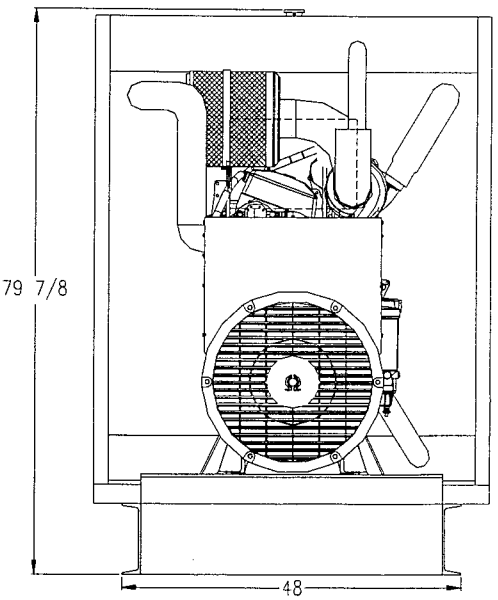
GENERATOR

- A.C. Generator
- Brushless design
- Single bearing
- Direct connection with flex plate
- Class H insulation
- All models manufactured to meet NEMA MG1-22.4 and CSA standards
- Telephone influence factor is well within NEMA standards
- Wave form deviation factor is no more than 5%, well within NEMA standards
- Harmonic content is 3.0% maximum
- Permanently lubricated ball type bearings
- Generator is self-ventilated
- Drip-proof construction

VOLTAGE REGULATOR

- Voltage adjust rheostat
- EMI filter (Internal Electromagnetic Interference)
- Underspeed protection
- Overexcitation protection
- Fully encapsulated
- Regulation – ± .25%





Drawing above for Illustration purposes only, based on standard open power 480 volt generator. Lengths may vary with other voltages.

KATOLIGHT

D415F*J4
Diesel Gen-Set

ENGINE TECHNICAL DATA

	60 Hz	
Model:	6125HF070	
Type:	4 - Cycle	
Aspiration:	Turbocharged – Air to Air Intercooled	
Cylinder Arrangement: (Number,inline,V,etc.):	6 - Inline	
Displacement - Cu. In. (lit)	766 (12.5)	
Bore - in. (cm) x stroke - in. (cm)	5.0 (12.7) x 6.5 (16.5)	
Compression Ratio:	16:1	
Rated RPM	1800	
Rating	**Standby**	**Prime**
BMEP: psi (kPa)	353 (2,436)	294 (2,027)
Maximum Power at Rated RPM - hp(kW)	617 (460)	512 (382)

INSTALLATION DATA *

Dimensions & Weight		
Length: in. (cm)	128 (325)	
Width: in. (cm)	48 (122)	
Height: in. (cm)	79.9 (203)	
Weight (dry) : lb. (Kg)	5,745 (2,606)	
Liquid Capacity		
Total Oil System: gal/(lit)	11 (42)	
Engine Jacket Water Capacity: gal/(lit)	4.3 (16.2)	
System Coolant Capacity: gal/(lit)	27.6 (104.5)	
Electrical System		
Electric Volts DC	24	
Cold Cranking Amps under 0°F (-17.8°C)	900	
Exhaust System		
Gas Temp. (Stack): °F (°C)	936 (502)	752 (400)
Gas Volume at Stack Temp.: CFM (m^3/min)	3,069 (87)	2,365 (67)
Maximum Allowable Back Pressure: in. H20 (kPa)	30 (7.5)	30 (7.5)
Emissions - HC: g/hp-hr	0.20	C/F
Emissions - CO: g/hp-hr	0.68	C/F
Emissions - NO_X: g/hp-hr	4.32	C/F
Cooling System		
Ambient Capacity of Radiator: °F (°C)	118 (48)	118 (48)
Maximum Allowable Static Pressure on Rad. Exhaust: in. H2O (kPa)	0.5 (.12)	0.5 (.12)
Water Pump Capacity: gpm (lit/min)	73 (276)	73 (276)
Heat Rejection to Coolant: BTUM (kW)	9,502 (167)	8,338 (147)
Heat Rejection to Air/Air Exchanger: BTUM (kW)	7,554 (133)	4,173 (73)
Heat Radiated to Ambient: BTUM (kW)	5,239 (92)	3,772 (66)
Air Requirements		
Aspirating: CFM (m^3/min)	1,280 (36.2)	1,059 (30)
Air Flow Required for Rad. Cooled Unit: CFM (m^3/min)	18,100 (513)	17,200 (487)
Air Flow Required for Heat Exchanger/Remote Rad. based on 20°F Rise: CFM (m^3/min)	N/A	N/A
Fuel Consumption: gal/hr (lit/hr)		
At 100% of Power Rating:	30.9 (117.4)	20.3 (77.2)
At 75% of Power Rating:	20.5 (78)	15.6 (59.2)
At 50% of Power Rating:	14.4 (54.5)	11.2 (42.5)
Sound Level Data ♦		
Sound level at full load		
23 ft (7m) opu w/ critical grade muffler (dBA)	91.5	91.1
23 ft (7m) Sound Attenuated Housing (dBA)	85.1	84.6
Sound level at no load		
23 ft (7m) opu w/ critical grade muffler (dBA)	89.6	89.0
23 ft (7m) Sound Attenuated Housing (dBA)	84.1	84.3
Deration		
Altitude		
5% per 1,000 ft above	9,000 ft	
5% per 305 m above	2,745 m	
Temperature		
.5% per 10°F above	77°F	
.5% per 5.5°C above	25°C	

* Installation data based on 480 volt, 60 Hz. application and open power unit.

♦ For sound level readings with other Katolight housings, please contact factory.
Sound level data acquired per Test Method SAE J1074. Installation factors and site conditions can affect sound levels.

OPTIONS

Diesel Gen-Set

Control Panel

** NOTE: #45 series control panel is standard on all units, see page 2 of spec sheet for standard features.

- O Model #45 Series Control Panel Options
  - O Emergency stop button
  - O Alarm buzzer with silencing switch
  - O Auxiliary relay for dry contacts (2 max.)
  - O A separate low water level light is optional
  - O Hooded panel lights (2) and on/off switch
  - O NEMA 12 Panel Face
  - O Additional LED lights (4 max.) One or two of the following conditions may be indicated:
    - □ unit not in auto
    - □ low fuel level
    - □ low water level
    - □ low water temp.
    - □ EPS supplying load
    - □ pre-alarm oil
    - □ pre-alarm temp.
    - □ charger malfunction
- O Model #50 Series Control Panel
  STANDARD FEATURES: same as #45 series control panel except for these added features:
  - O Hooded panel lights (2) and on/off switch
  - O 4 Engine shutdowns
  - O 12 light engine control package meeting NFPA-110 requirement
  - O Repetitive alarm buzzer and silencing switch
  - O Light and alarm press to test

  #50 SERIES OPTIONS
  - O Emergency stop button
  - O Additional space for one $3^1/_2$ meter
  - O Auxiliary relay for dry contacts (2 max.)
  - O A separate low water level light is optional
  - O Additional LED lights (4 max.) One to four additional conditions may be indicated: customer to specify
  - O NEMA 12 Panel Face
- O Model #60 and #80 Series Custom Control Panels
  It may be necessary to use a 60 or 80 series control panel on certain units where numerous options are required.
- O Microprocessor Control Panel – KDGC

GEN-SET OPTIONS

Cooling System

- O Radiator Duct Flange

Fuel System

- O Fuel/Water Separator
- O Day Tank
- O Above Ground Fuel Tank
- O Auxiliary Fuel Pump
- O Sub-Base Mounted Fuel Tank
  - □ Single Wall
  - □ Double Wall
  - □ UL Listed

Exhaust System

- O Residential Grade Muffler
- O Critical Grade Muffler
- O Hospital Grade Muffler
- O Rain Cap

Engine Electrical System

- O Battery
  - □ Lead-Acid
  - □ Nicad
- O Battery Warmer Plate
- O Battery Rack
- O Battery Charger
  - □ Automatic
  - □ Trickle
  - □ Mounted & Wired

Generator

- O Main Line Circuit Breaker (2-pole or 3-pole)
  - □ Shunt trip
  - □ Auxiliary switch
- O PMG Excitation & DVR 2000 Regulator
- O Medium Voltage Available up to 4160 volt
- O Space Heaters 120/240 volt
- O Special Testing
- O Additional Temperature Rise Generators Available (80°C, 105°C, & 130°C)

Additional Optional Equipment

- O Spring vibration isolators
- O Oil Drain Extension
- O Housings
  - □ Sound Attenuated
  - □ Weather Proof
  - □ Aluminum
  - □ Interior lights AC or DC
  - □ Floor Plate
- O Jacket Water Heater
- O Crankcase Oil Heater
- O Trailer Mounting
- O Remote Annunciator
- O 12 Light Annunciator
  - □ Flush Mounted
  - □ Surface Mounted
  - □ 4 additional lights, if needed
- O Export Boxing
- O Warranties
  - □ 2 Year
  - □ 5 Year
- O Operating instructions under plexi-glass
- O Service indicator light

KATOLIGHT® CORPORATION

100 Power Drive • Mankato, MN 56001

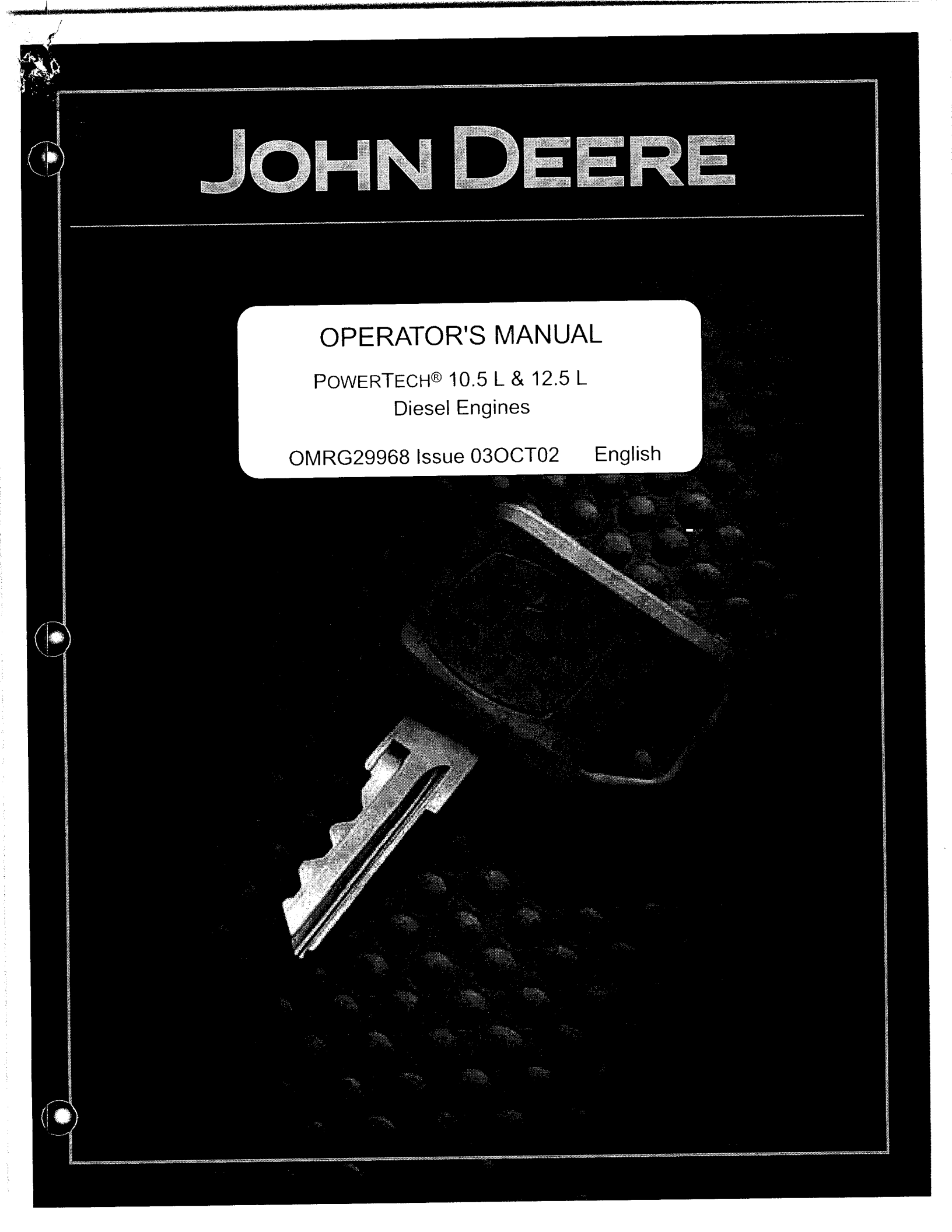
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JOHN DEERE

OPERATOR'S MANUAL

POWERTECH® 10.5 L & 12.5 L
Diesel Engines

OMRG29968 Issue 03OCT02 English



POWERTECH®
10.5 L & 12.5 L
6105 (003764—)
and 6125 (010967—)
OEM Diesel Engines

OPERATOR'S MANUAL
POWERTECH 10.5/12.5 L Diesel Engines

OMRG29968 Issue 03OCT02 (ENGLISH)

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

If this product contains a gasoline engine:

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

The State of California requires the above two warnings.

John Deere Power Systems
LITHO IN U.S.A.

Introduction

Foreword

READ THIS MANUAL carefully to learn how to operate and service your engine correctly. Failure to do so could result in personal injury or equipment damage.

THIS MANUAL SHOULD BE CONSIDERED a permanent part of your engine and should remain with the engine when you sell it.

MEASUREMENTS IN THIS MANUAL are given in both metric and customary U.S. unit equivalents. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

RIGHT-HAND AND LEFT-HAND sides are determined by standing at the drive or flywheel end (rear) of the engine and facing toward the front of the engine.

WRITE ENGINE SERIAL NUMBERS and option codes in the spaces indicated in the Record Keeping section. Accurately record all the numbers. Your dealer also needs these numbers when you order parts. File the identification numbers in a secure place off the engine.

SETTING FUEL DELIVERY beyond published factory specifications or otherwise overpowering will result in loss of warranty protection for this engine.

CERTAIN ENGINE ACCESSORIES such as radiator, air cleaner, and instruments are optional equipment on John Deere OEM Engines. These accessories may be provided by the equipment manufacturer instead of John Deere. This operator's manual applies only to the engine and those options available through the John Deere distribution network.

NOTE: This operator's manual covers only engines provided to OEM (Outside Equipment Manufacturers). For engines in Deere machines, refer to the machine operator's manual.

In this manual, reference to earlier engines applies to engine serial numbers (—29999). Later 12.5 L engines with "070" suffix in model number begin with serial number (30000—). These later engines went into production in January, 2001 and meet all Tier II emission standards beginning in the year 2001.

Earlier engines are covered in a separate manual, OMRG25752. These engines are 10.5 L (—003763) and 12.5 L (—010966).

CALIFORNIA PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

OMRG25752,IFC -19-03SEP02-1/1

Engine Owner

John Deere Engine Owner:

Don't wait until you need warranty or other service to meet your local John Deere Engine Distributor or Service Dealer.

Learn who he is and where he is. At your first convenience, go meet him. He'll want to get to know you and to learn what your needs might be.

Utilisateurs De Moteurs John Deere:

N'attendez pas d'être obligé d'avoir recours a votre Concessionnaire ou Point de Service le plus proche pour vous adresser a lui.

Renseignez-vous des que possible pour l'identifier et le localiser. A la premiere occasion, prenez contact avec lui et faites-vous connaître. Il sera lui aussi heureux de faire votre connaissance et de savoir que vous pourrez compter sur lui le moment venu.

An Den Besitzer Des John Deere Motors:

Warten Sie nicht auf einen evt. Reparaturfall um den nächstgelegenen John Deere Händler kennen zu lernen.

Machen Sie sich bei ihm bekannt und nutzen Sie sein "Service Angebot".

Proprietario Del Motore John Deere:

Non aspetti fino a quando ha bisogno della garanzia o di un altro tipo di assistenza per incontrarsi con il Suo Concessionario che fornisce l'assistenza tecnica.

Impari a conoscere chi è e dove si trova. Alla Sua prima occasione cerchi d'incontrarlo. Egli desidera farsi conoscere e conoscere le Sue necessità.

Propietario De Equipo John Deere:

No espere hasta necesitar servicio de garantía o de otro tipo para conocer a su Distribuidor de Motores John Deere o al Concesionario de Servicio.

Entérese de quién es, y dónde está situado. Cuando tenga un momento, vaya a visitarlo. A él le gustará conocerlo, y saber cuáles podrían ser sus necesidades.

John Deere MotorÄgare:

Vänta inte med att besöka Din John Deere återförsäljare till dess att Du behöver service eller garanti reparation.

Bekanta Dig med var han är och vem han är. Tag första tillfälle att besöka honom. Han vill också träffa Dig för att få veta vad Du behöver och hur han kan hjälpa Dig.

DPSG,OUOE003,2736 –19–11JAN99–1/1

Identification of Deere Engine Control Unit (ECU)

This operation and maintenance manual is for use with engines that have the **Deere** Engine Control Unit (ECU). The ECU is a self-contained "black box" unit containing computer software and electronic circuitry needed to operate the electronic control system.

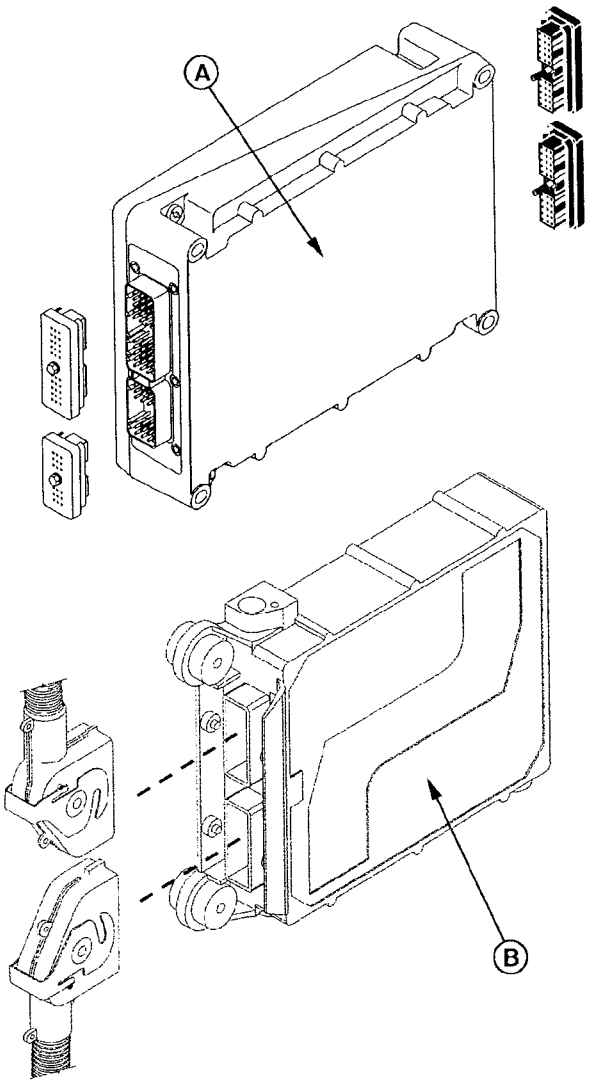
The Deere ECU (A) can be identified by an attached label. On one end are two black 30-pin connectors. On the other end there are two white connectors, one 30-pin and one 18-pin.

The ECU has the ability to detect internal engine problems and problems in the engine electronic control system. This includes determining if any sensor input voltages are too high or too low. If the ECU detects a problem with the electronic control system, a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU's memory.

See the Troubleshooting section of this manual and your John Deere engine distributor or servicing dealer for more information.

NOTE: Earlier engines with the Lucas Engine Control Unit (ECU) (B) are covered in a separate Operation and Maintenance manual, OMRG25752.

A—Deere ECU
B—Lucas ECU

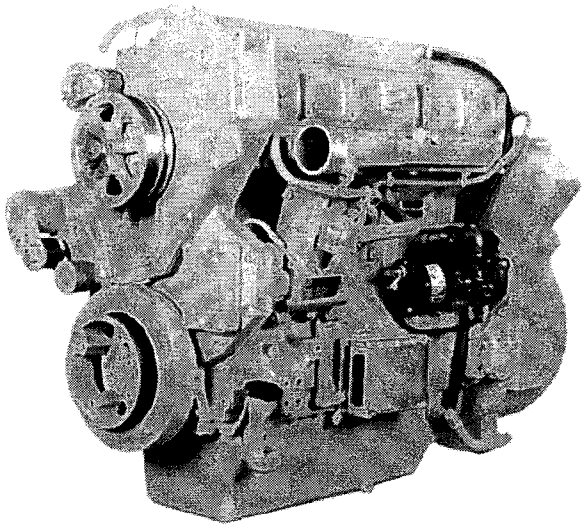


RG10674 –UN–21DEC99

Identification of ECU

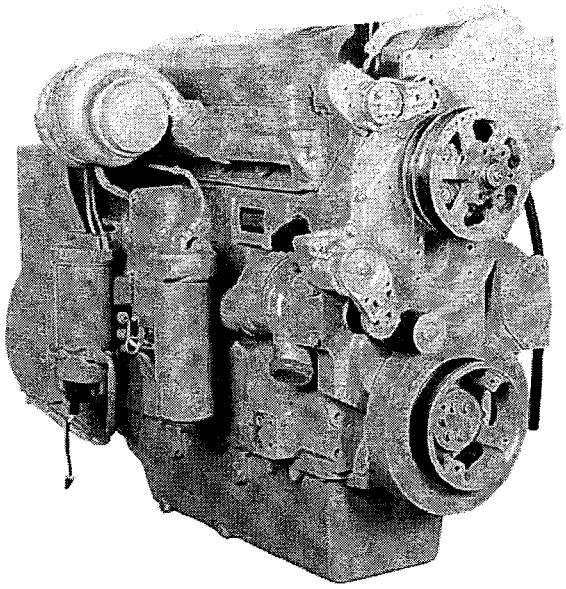
AG,OUOD007,2893 –19–03NOV99–1/1

Engine Identification Views S.N. (—29999)



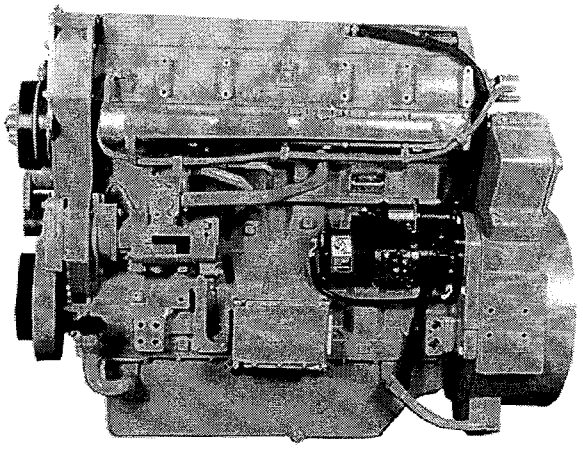
RG9934 –UN–17NOV99

Left Front View (—29999)



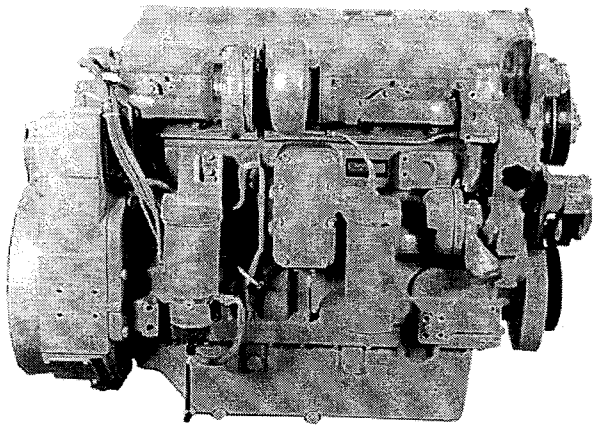
RG9936 –UN–17NOV99

Right Front View (—29999)



RG9935 –UN–17NOV99

Left Side View (—29999)

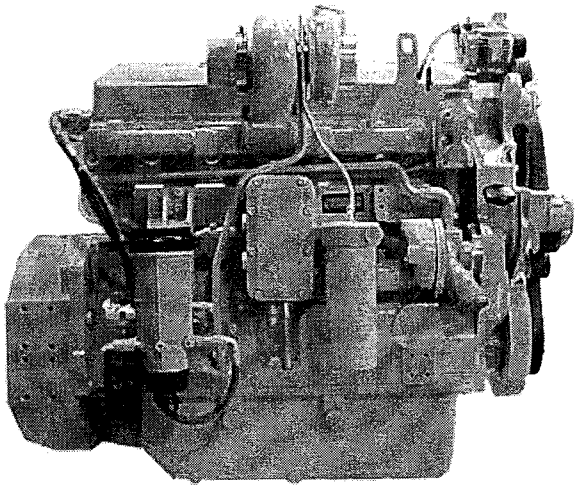


RG9937 –UN–17NOV99

Right Side View (—29999)

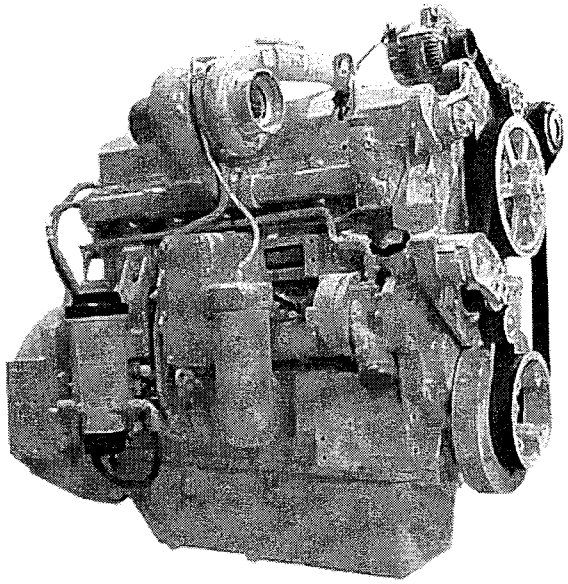
DPSG,OUOD007,2914 –19–04DEC00–1/1

Engine Identification Views S.N. (30000—)(Tier II Emission Certified)



RG11171A –UN–03NOV00

Right Side View (30000—)



RG11172A –UN–04DEC00

Right Front View (30000—)

OUO1004,0000C26 –19–03OCT02–1/1

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A John Deere ILLUSTRUCTION® Manual
Previous Editions
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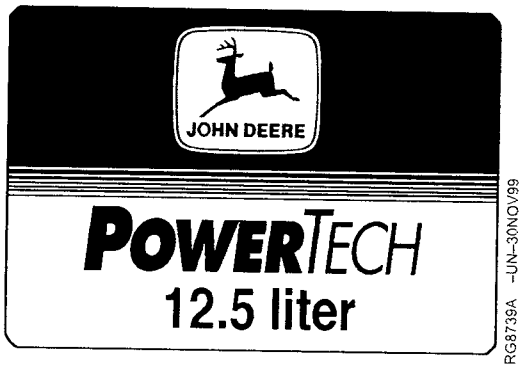
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The Right Tools IBC-1
Well-Trained Technicians IBC-1
Prompt Service IBC-1

Record Keeping

POWERTECH® Medallion

A medallion is located on the rocker arm cover which identifies each engine as a John Deere POWERTECH® engine.



Medallion

POWERTECH is a registered trademark of Deere & Company.

RG,RG34710,7501 –19–30JUN97–1/1

Record Engine Serial Number

The engine serial number plate (C) is located on the left-hand side of engine block between intake manifold and starter motor.

Record all of the numbers and letters found on your engine serial number plate in the spaces provided below.

This information is very important for repair parts or warranty information.

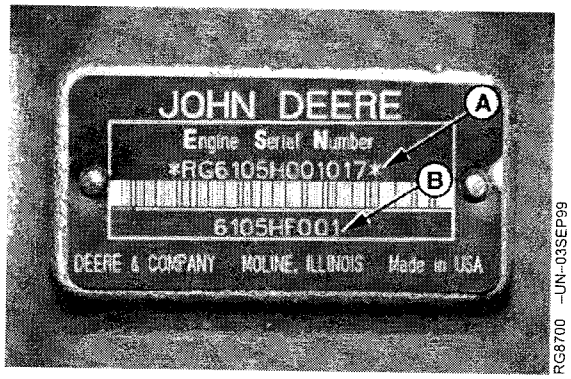
Engine Serial Number (A)

_____

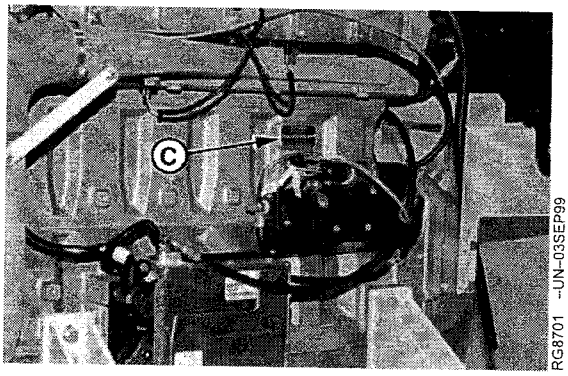
Application Data or Type (B)

_____

A—Engine Serial Number
B—Application Data or Type
C—Engine Serial Number Plate



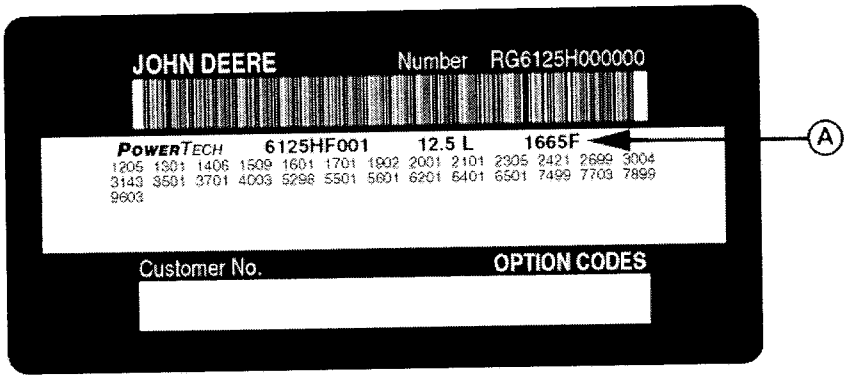
Engine Serial Number/Application Data



Engine Serial Number Plate

RG,RG34710,7502 –19–03SEP02–1/1

Engine Option Codes



Option Code Label

A—Base Engine Code

NOTE: Your engine option code label may not contain all option codes if an option has been added after the engine left the producing factory.

If option label is lost or destroyed, consult your servicing dealer or engine distributor selling the engine for a replacement.

In addition to the serial number plate, OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

The engine option code label includes an base engine code (A) (1665F, bold print in label above). Record this code along with option codes on following page.

The first two digits of each code identify a specific group, such as alternators. The last two digits of each code identify one specific option provided on your engine, such as a 24-volt, 60-amp alternator.

If an engine is ordered without a particular component, the last two digits of that functional group option code will be 99, 00, or XX. The list on the next page shows only the first two digits of the code numbers. For future reference, such as ordering repair parts, it is important to have these code numbers available. To ensure this availability, enter the third and fourth digits shown on your engine option code label in the spaces provided on the following page.

Continued on next page

Base Engine Code_____

Option Codes	Description	Option Codes	Description
11_____	Rocker Arm Cover	47_____	Crankshaft
12_____	Oil Fill	48_____	Connecting Rods and Pistons
13_____	Crankshaft Pulley/Damper	49_____	Valve Actuating Assembly
14_____	Flywheel Housing	50_____	Oil Pump
15_____	Flywheel	51_____	Cylinder Head
16_____	Fuel System	52_____	Gear-Driven Auxiliary Drive
17_____	Air Intake Manifold	55_____	Transport Skid/Engine Mounts
19_____	Oil Pan	56_____	Paint Option
20_____	Coolant Pump	57_____	Coolant Pump Inlet
21_____	Thermostat Cover	59_____	Oil Cooler/Oil Filter
22_____	Thermostat	62_____	Alternator Mounting
23_____	Fan Drive with Belt Tensioner	64_____	Exhaust System
24_____	Fan Belt	65_____	Turbocharger
26_____	Engine Coolant Heater	69_____	Engine Serial Number Plate
27_____	Heat Exchanger	72_____	Electronic Control Software Option
28_____	Exhaust Manifold	74_____	Air Conditioner (Freon) Compressor
29_____	Crankcase Vent System	76_____	Pressure Switches and Sensors
30_____	Starter Motor	77_____	Timing Gear Cover
31_____	Alternator	78_____	Air Compressor Mounting
32_____	Instrument Panel	83_____	Electronic Software (Vehicle Option)
35_____	Fuel Filter	84_____	Electrical Wiring Harness
37_____	Fuel Transfer Pump	92_____	Rear PTO Option
39_____	Thermostat Housing	96_____	Special Equipment (Factory Installed)
40_____	Oil Dipstick and Tube	97_____	Special Equipment (Field Installed)
44_____	Electronic Sensors	98_____	Shipping
46_____	Cylinder Block	99_____	Service Only Items

NOTE: These option codes are based on the latest information available at the time of publication.

The right is reserved to make changes at any time without notice.

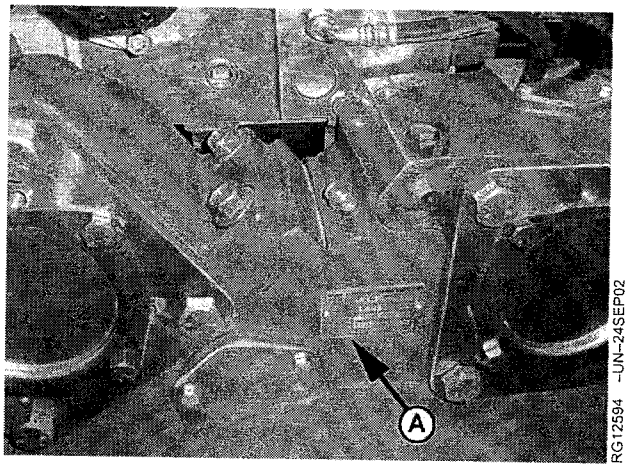
RG,RG34710,7503 –19–11SEP02–2/2

Record Rear Power Take-Off (PTO) Serial Number (If Equipped)

Record the rear power take-off (PTO) serial number found on rear PTO serial number plate (A) (if equipped).

Rear PTO Serial Number

_____



Rear PTO Serial Number Plate

OUOD006,0000066 –19–04SEP02–1/1

Safety

Recognize Safety Information

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.



Safety-alert symbol

T81389 –UN–07DEC88

DX,ALERT –19–29SEP98–1/1

Understand Signal Words

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.



Signal Words

TS187 –19–30SEP88

DX,SIGNAL –19–03MAR93–1/1

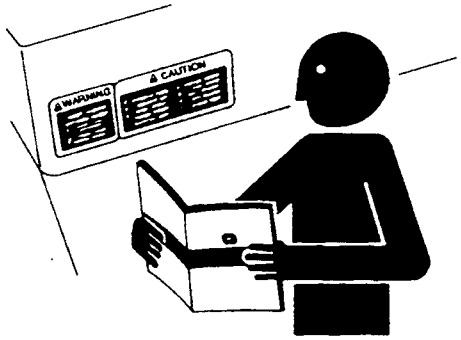
Follow Safety Instructions

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

Learn how to operate the engine and how to use controls properly. Do not let anyone operate without instruction.

Keep your engine in proper working condition. Unauthorized modifications to the engine may impair the function and/or safety and affect engine life.

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.



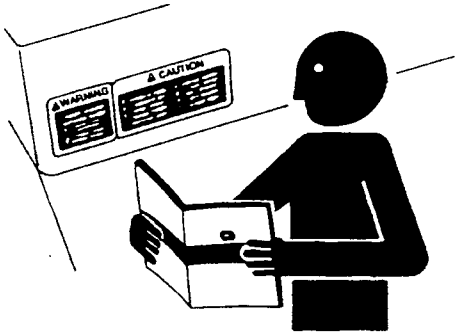
TS201 –UN–23AUG88

Safety Messages

DX,READ –19–03MAR93–1/1

Replace Safety Signs

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



TS201 –UN–23AUG88

Safety Signs

DX,SIGNS1 –19–04JUN90–1/1

Prevent Bypass Starting

Avoid possible injury or death from engine runaway.

Do not start engine by shorting across starter terminal. Engine will start with PTO engaged if normal circuitry is bypassed.

Start engine only from operator's station with PTO disengaged or in neutral.



RG5419 –UN–28FEB89

Prevent Bypass Starting

RG,RG34710,7508 –19–30JUN97–1/1

Handle Fuel Safely—Avoid Fires

Handle fuel with care: it is highly flammable. Do not refuel the engine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping engine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.



TS202 –UN–23AUG88

Avoid Fires

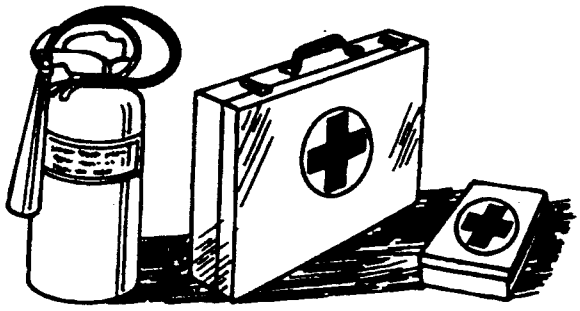
DX,FIRE1 –19–03MAR93–1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 –UN–23AUG88

First Aid Kit

DX,FIRE2 –19–03MAR93–1/1

Handle Starting Fluid Safely

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.



TS1356 –UN–18MAR92

Store Safely

DX,FIRE3 –19–16APR92–1/1

Handle Fluids Safely—Avoid Fires

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure engine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.



TS227 –UN–23AUG88

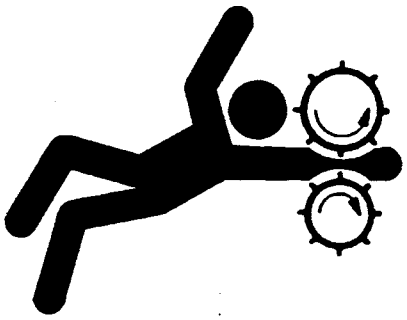
Avoid Fires

DX,FLAME –19–29SEP98–1/1

Service Engines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near engine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 –UN–23AUG88

Moving Parts

DX,LOOSE –19–04JUN90–1/1

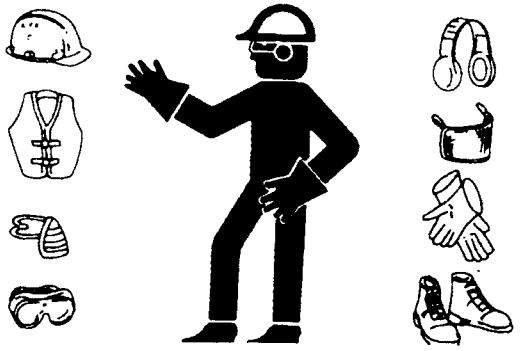
Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



TS206 –UN–23AUG88

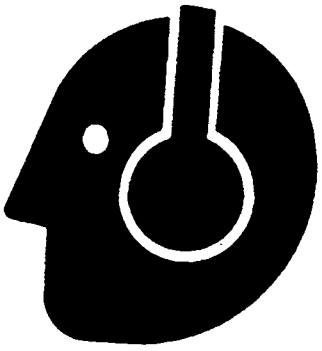
Protective Clothing

DX,WEAR –19–10SEP90–1/1

Protect Against Noise

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



TS207 –UN–23AUG88

Noise Exposure

DX,NOISE –19–03MAR93–1/1

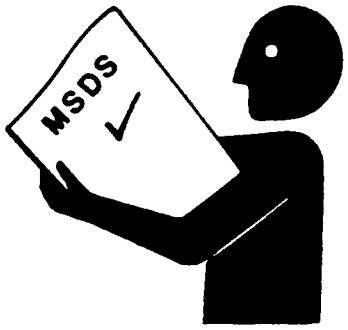
Handle Chemical Products Safely

Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques.

Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

(See your John Deere dealer for MSDS's on chemical products used with John Deere equipment.)



TS1132 –UN–26NOV90

Material Safety Data Sheet

DX,MSDS,NA –19–03MAR93–1/1

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep master shield and driveline shields in place at all times. Make sure rotating shields turn freely.

Wear close-fitting clothing. Stop the engine and be sure PTO driveline is stopped before making adjustments, connections, or performing any type of service on the engine or PTO-driven equipment.



TS1644 –UN–22AUG95

Rotating Drivelines

OUO1004,0000BD8 –19–03NOV00–1/1

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust engine while it is moving. Keep hands, feet, and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow engine to cool.

Securely support any engine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

Disconnect battery ground cable (-) before making adjustments on electrical systems or welding on engine.



TS218 –UN–23AUG88

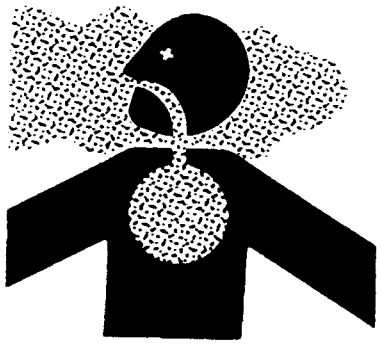
Keep Area Clean

DX,SERV –19–17FEB99–1/1

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area



TS220 –UN–23AUG88

Engine exhaust fumes

DX,AIR –19–17FEB99–1/1

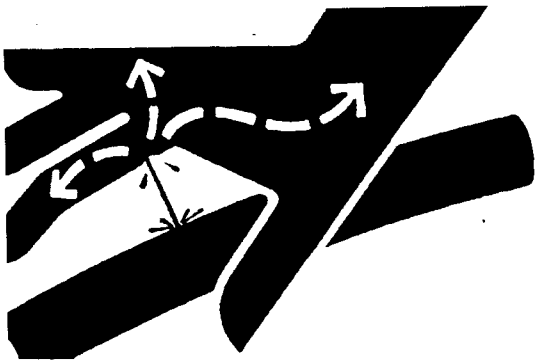
Avoid High-Pressure Fluids

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



X9811 –UN–23AUG88

High-Pressure Fluids

DX,FLUID –19–03MAR93–1/1

Avoid Heating Near Pressurized Fluid Lines

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

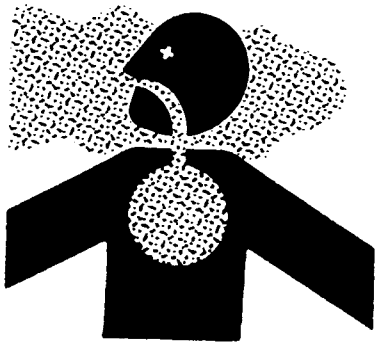


TS953 –UN–15MAY90

Flammable Spray

DX,TORCH –19–03MAR93–1/1

Remove Paint Before Welding or Heating



TS220 –UN–23AUG88

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 101 mm (4 in.) from area to be affected by heating. If paint cannot be removed, wear an approved respirator before heating or welding.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT –19–24JUL02–1/1

Service Cooling System Safely



TS281 –UN–23AUG88

Cooling System

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

DX,RCAP –19–04JUN90–1/1

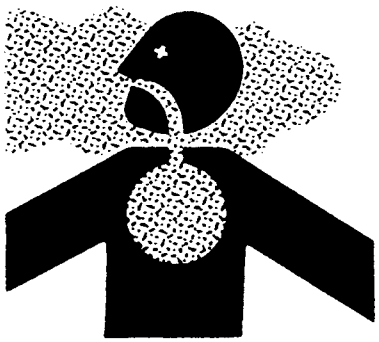
Avoid Harmful Asbestos Dust

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos.

Keep bystanders away from the area.



TS220 –UN–23AUG88

Asbestos Dust

DX,DUST –19–15MAR91–1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).



TS204 –UN–23AUG88

Battery Explosions

DX,SPARKS –19–03MAR93–1/1

Handling Batteries Safely

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (—) battery clamp first and replace it last.



TS204 –UN–23AUG88

Explosion

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

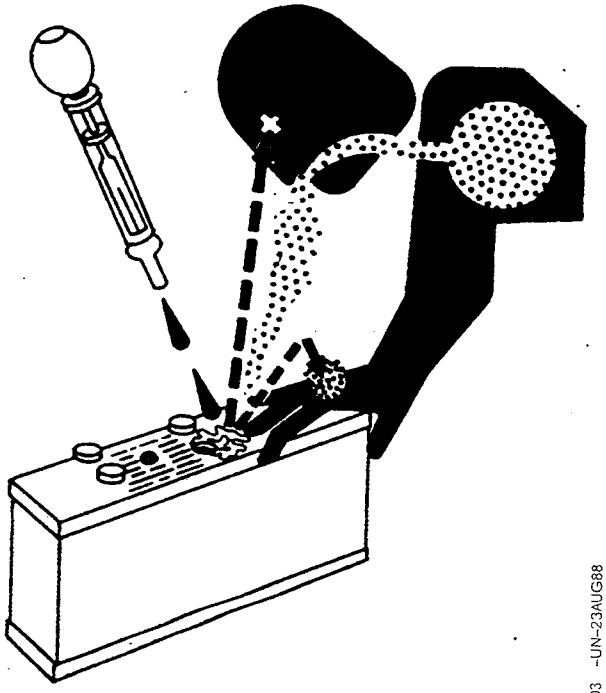
1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Using proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 15—30 minutes. Get medical attention immediately.**

If acid is swallowed:

1. **Do not induce vomiting.**
2. **Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).**
3. **Get medical attention immediately.**



TS203 –UN–23AUG88

Acid

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

DPSG,OUO1004,2758 –19–11MAY00–1/1

Protect Against High Pressure Spray

Spray from high pressure nozzles can penetrate the skin and cause serious injury. Keep spray from contacting hands or body.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.



TS1343 –UN–18MAR92

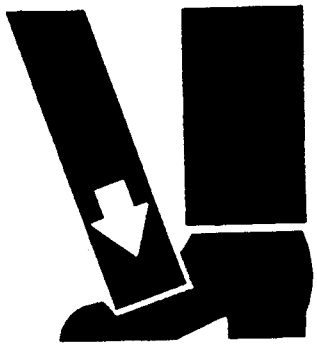
High Pressure Spray

DX,SPRAY –19–16APR92–1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.



TS226 –UN–23AUG88

Proper Lifting Equipment

DX,LIFT –19–04JUN90–1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.



TS779 –UN–08NOV89

Proper Tools

DX,REPAIR –19–17FEB99–1/1

Dispose of Waste Properly

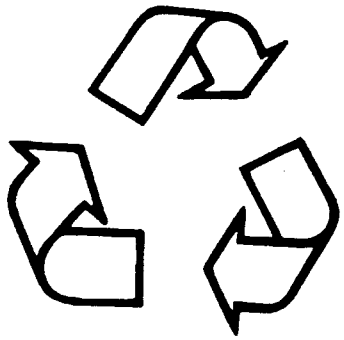
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133 –UN–26NOV90

Recycle Waste

DX,DRAIN –19–03MAR93–1/1

Fuels, Lubricants, and Coolant

Diesel Fuel

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended.

Required fuel properties

In all cases, the fuel must meet the following properties:

Cetane number of 45 minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1500 m (5000 ft).

Cold Filter Plugging Point (CFPP) below the expected low temperature OR **Cloud Point** at least 5°C (9°F) below the expected low temperature.

Fuel lubricity should pass a minimum load level of 3100 grams as measured by ASTM D6078 or, maximum scar diameter of 0.45 mm as measured by ASTM D6079.

Sulfur content:

- Diesel fuel quality and fuel sulfur content must comply with all existing regulations for the area in which the engine operates.
- Sulfur content less than 0.05% (500 ppm) is preferred.
- If diesel fuel with sulfur content greater than 0.05% (500 ppm) is used, crankcase oil service intervals may be affected. (See recommendation for Diesel Engine Oil.)
- DO NOT use diesel fuel with sulfur content greater than 1.0%.

IMPORTANT: DO NOT mix used engine oil or any other type of lubricating oil with diesel fuel.

OUOD002,0000171 –19–18SEP02–1/1

Lubricity of Diesel Fuel

Diesel fuel must have adequate lubricity to ensure proper operation and durability of fuel injection system components.

Diesel fuels for highway use in the United States and Canada require sulfur content less than 0.05% (500 ppm).

Diesel fuel in the European Union requires sulfur content less than 0.05% (500 ppm).

Experience shows that some low sulfur diesel fuels may have inadequate lubricity and their use may reduce performance in fuel injection systems due to inadequate lubrication of injection pump components. The lower concentration of aromatic compounds in these fuels also adversely affects injection pump seals and may result in leaks.

Use of low lubricity diesel fuels may also cause accelerated wear, injection nozzle erosion or corrosion, engine speed instability, hard starting, low power, and engine smoke.

Fuel lubricity should pass a minimum load level of 3100 gram as measured by the ASTM D6078 or maximum scar diameter of 0.45 mm as measured by ASTM D6079.

ASTM D975 and EN 590 specifications do not require fuels to pass a fuel lubricity test.

If fuel of low or unknown lubricity is used, add John Deere PREMIUM DIESEL FUEL CONDITIONER (or equivalent) at the specified concentration.

OUOD002,0000179 –19–18DEC01–1/1

Filling Fuel Tank

CAUTION: Handle fuel carefully. Do not fill the fuel tank when engine is running.

DO NOT smoke while filling fuel tank or servicing fuel system.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

Fill fuel tank at the end of each day's operation to prevent condensation in tank. As moist air cools, condensation may form and freeze during cold weather.



TS202 –UN–23AUG88

RG,RG34710,7527 –19–30JUN97–1/1

Diesel Fuel Storage

CAUTION: Handle fuel carefully. Do not fill the fuel tank when engine is running.

DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

IMPORTANT: DO NOT store diesel fuel in galvanized containers. Diesel fuel stored in galvanized containers reacts with zinc coating on container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and flakes will quickly plug fuel filters, damage injection nozzles and injection pump.

DO NOT use brass-coated containers for fuel storage. Brass is an alloy of copper and zinc.

Store diesel fuel in plastic, aluminum, and steel containers specially coated for diesel fuel storage.

Avoid storing fuel over long periods of time. If fuel is stored for more than a month prior to use, or there is a slow turnover in fuel tank or supply tank, add a fuel conditioner such as John Deere PREMIUM DIESEL FUEL CONDITIONER or equivalent to stabilize the fuel and prevent water condensation. John Deere PREMIUM DIESEL FUEL CONDITIONER is available in winter and summer formulas. Fuel conditioner also reduces fuel gelling and controls wax separation during cold weather.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace with an original vented cap.

RG,RG34710,7526 –19–18DEC01–1/1

DIESELSCAN™ Fuel Analysis

DIESELSCAN™ is a John Deere fuel sampling program to help you monitor the quality of your fuel source. It verifies fuel type, cleanliness, water content, suitability for cold weather operation, and if fuel is within ASTM specifications. Check with your John Deere dealer for availability of DIESELSCAN kits.

DIESELSCAN is a trademark of Deere & Company

OUOD006,0000068 –19–24SEP02–1/1

Minimizing the Effect of Cold Weather on Diesel Engines

John Deere diesel engines are designed to operate effectively in cold weather.

However, for effective starting and cold weather operation, a little extra care is necessary. The information below outlines steps that can minimize the effect that cold weather may have on starting and operation of your engine. See your authorized engine distributor or servicing dealer for additional information and local availability of cold weather aids.

Use Grade No. 1-D Fuel

When temperatures fall below 5°C (40°F), Grade No. 1-D fuel is best suited for cold weather operation. Grade No. 1-D fuel has a lower cloud point and a lower pour point.

Cloud point is the temperature at which wax will begin to form in the fuel and this wax causes fuel filters to plug. **Pour point** is the temperature at which fuel begins to thicken and becomes more resistant to flow through fuel pumps and lines.

NOTE: On an average, Grade No. 1-D fuel has a lower BTU (heat content) rating than Grade No. 2-D fuel. When using Grade No. 1-D fuel you may notice a drop in power and fuel efficiency, but should not experience any other engine performance effects. Check the grade of fuel being used before troubleshooting for low power complaints in cold weather operation.

Coolant Heaters

Engine block heaters (coolant) are an available option to aid cold weather starting.

Seasonal Viscosity Oil and Proper Coolant Concentration

Use seasonal grade viscosity engine oil based on expected air temperature range between oil changes and a proper concentration of low silicate antifreeze as recommended. (See DIESEL ENGINE OIL and ENGINE COOLANT REQUIREMENTS later in this section).

Diesel Fuel Flow Additive

IMPORTANT: Treat fuel when outside temperature drops below 0°C (32°F). For best results, use with untreated fuel. Follow all recommended instructions on label.

Use John Deere Premium Diesel Fuel Conditioner (Winter) or equivalent to treat fuel during the cold weather season. This winter formulation is a combination diesel fuel conditioner and anti-gel additive.

Winterfronts

Use of fabric, cardboard, or solid winterfronts is not recommended with any John Deere engine. Their use can result in excessive engine coolant, oil, and charge air temperatures. This can lead to reduced engine life, loss of power and poor fuel economy. Winterfronts may also put abnormal stress on fan and fan drive components potentially causing premature failures.

If winterfronts are used, they should never totally close off the grill frontal area. Approximately 25% area in the center of the grill should remain open at all times. At no time should the air blockage device be applied directly to the radiator core.

Radiator Shutters

If equipped with a thermostatically controlled radiator shutter system, this system should be regulated in such a way that the shutters are completely open by the time the coolant reaches 93°C (200°F) to prevent excessive intake manifold temperatures. Manually controlled systems are not recommended.

Continued on next page

If air-to-air aftercooling is used, the shutters must be completely open by the time the intake manifold air temperature reaches the maximum allowable temperature out of the charge air cooler.

For more information, see your John Deere engine distributor or servicing dealer.

RG,RG34710,7529 -19-11SEP02-2/2

Bio-Diesel Fuel

Consult your local fuel distributor for properties of the bio-diesel fuel available in your area.

Bio-diesel fuels may be used ONLY if the bio-diesel fuel properties meet the latest edition of ASTM PS121, DIN 51606 or equivalent specification.

It has been found that bio-diesel fuels may improve lubricity in concentrations up to a 5% blend in petroleum diesel fuel.

When using a blend of bio-diesel fuel, the engine oil level must be checked daily when the air temperature is -10°C (14°F) or lower. If the oil becomes diluted with fuel, shorten oil change intervals accordingly.

IMPORTANT: Raw pressed vegetable oils are NOT acceptable for use for fuel in any concentration in John Deere engines.

These oils do not burn completely, and will cause engine failure by leaving deposits on injectors and in the combustion chamber.

A major environmental benefit of bio-diesel fuel is its ability to biodegrade. This makes proper storage and handling of bio-diesel fuel especially important. Areas of concern include:

- Quality of new fuel
- Water content of the fuel
- Problems due to aging of the fuel

Potential problems resulting from deficiencies in the above areas when using bio-diesel fuel in concentrations above 5% may lead to the following symptoms:

- Power loss and deterioration of performance
- Fuel leakage
- Corrosion of fuel injection equipment
- Coked and/or blocked injector nozzles, resulting in engine misfire
- Filter plugging
- Lacquering and/or seizure of internal components
- Sludge and sediments
- Reduced service life of engine components

RG41183,0000046 -19-18DEC01-1/1

Handling And Storing Bio-Diesel Fuel

CAUTION: Handle fuel carefully. Do not fill the fuel tank when engine is running.

DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

Keep all storage tanks as full as practicable to minimize condensation.

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering.

Monitor water content of the fuel regularly.

Fuel filter may require more frequent replacement due to premature plugging.

Check engine oil level daily prior to starting engine. A rising oil level may indicate fuel dilution of the engine oil.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier for recommendations.

OUOD002,0000176 –19–18DEC01–1/1

Diesel Engine Break-In Oil

New engines are filled at the factory with John Deere ENGINE BREAK-IN OIL. During the break-in period, add John Deere ENGINE BREAK-IN OIL as needed to maintain the specified oil level (order TY22041).

Change the oil and filter after the first 100 hours of operation of a new or rebuilt engine.

After engine overhaul, fill the engine with John Deere ENGINE BREAK-IN OIL.

If John Deere ENGINE BREAK-IN OIL is not available, use a diesel engine oil meeting one of the following during the first 100 hours of operation:

- API Service Classification CD
- API Service Classification CC
- ACEA Specification E1

After the break-in period, use John Deere PLUS-50® or other diesel engine oil as recommended in this manual.

IMPORTANT: Do not use PLUS-50 oil or engine oils meeting any of the following during the first 100 hours of operation of a new or rebuilt engine:

- **API CI-4**
- **ACEA E5**
- **API CH-4**
- **ACEA E4**
- **API CG-4**
- **ACEA E3**
- **API CF-4**
- **ACEA E2**

These oils will not allow the engine to break-in properly.

PLUS-50 is a registered trademark of Deere & Company.

OUOD002,0000178 –19–26APR02–1/1

Diesel Engine Oil

Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following oil is preferred:

- John Deere PLUS-50®

The following oils are also recommended:

- John Deere TORQ-GARD SUPREME®
- Oils meeting ACEA Specification E4/E5

Other oils may be used if they meet one or more of the following:

- API Service Classification CI-4
- API Service Classification CH-4
- ACEA Specification E3

Multi-viscosity diesel engine oils are preferred.

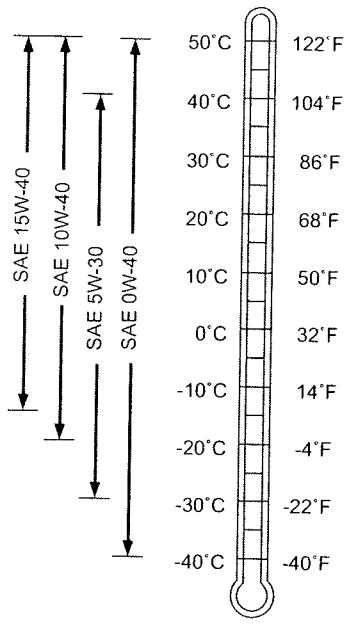
Diesel fuel quality and sulfur content must comply with all existing emissions regulations for the area in which the engine operates.

If diesel fuel with sulfur content greater than 0.05% (500 ppm) is used, reduce the oil and filter change interval by 100 hours.

If diesel fuel with sulfur content greater than 0.5% (5000 ppm) is used, reduce the service interval by 50%.

Diesel fuel with sulfur content greater than 1.0% (10,000 ppm) is not recommended.

Extended service intervals may apply when John Deere preferred engine oils are used. Consult your John Deere dealer for more information.



Diesel Engine Oil

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TORQ-GARD SUPREME is a trademark of Deere & Company

OUOD002,0000172 –19–27SEP02–1/1

Extended Diesel Engine Oil Service Intervals

When John Deere PLUS-50® or ACEA-E4/E5 oil and the specified John Deere filter are used, the service interval for engine oil and filter changes may be increased by 50%.

If other than PLUS-50® or ACEA-E4/E5 oil and the specified John Deere filter are used, change the engine oil and filter at the normal service interval.

PLUS-50 is a trademark of Deere & Company

OUOD006,0000069 –19–24SEP02–1/1

Mixing of Lubricants

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere engine distributor or servicing dealer to obtain specific information and recommendations.

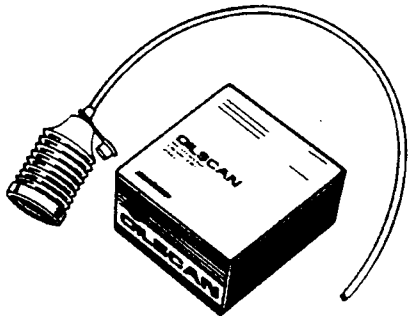
DX,LUBMIX –19–18MAR96–1/1

OILSCAN®and COOLSCAN™

OILSCAN,® OILSCAN PLUS,® COOLSCAN™ and, COOLSCAN PLUS™ are John Deere sampling programs to help you monitor machine performance and identify potential problems before they cause serious damage.

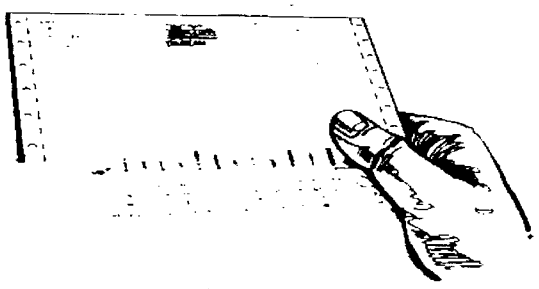
Oil and coolant samples should be taken from each system prior to its recommended change interval.

Check with your John Deere engine distributor or servicing dealer for the availability of OILSCAN,® OILSCAN PLUS,® COOLSCAN™ and, COOLSCAN PLUS™ kits.



T6828AB –UN–15JUN89

Sampling Programs



T6829AB –UN–18OCT88

Recommended Change Interval

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OUOD002,0000173 –19–23NOV01–1/1

Alternative and Synthetic Lubricants

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual.

Some John Deere brand coolants and lubricants may not be available in your location.

Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic oils.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

DX,ALTER –19–15JUN00–1/1

Lubricant Storage

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Whenever possible, store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST –19–18MAR96–1/1

Grease

Use grease based on NLGI consistency numbers and the expected air temperature range during the service interval.

The following greases are preferred:

- John Deere SD POLYUREA GREASE

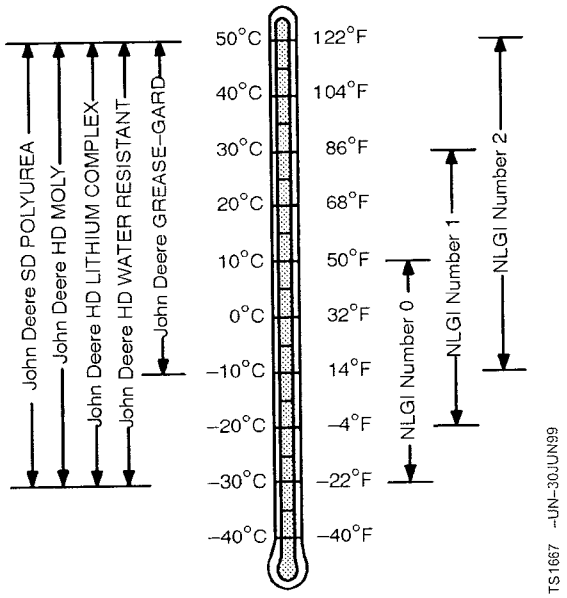
The following greases are also recommended:

- John Deere HD MOLY GREASE
- John Deere HD LITHIUM COMPLEX GREASE
- John Deere HD WATER RESISTANT GREASE
- John Deere GREASE-GARD

Other greases may be used if they meet the following:

- NLGI Performance Classification GC-LB

IMPORTANT: Some types of grease thickener are not compatible with others. Consult your grease supplier before mixing different types of grease.



DX,GREA1 –19–24JAN00–1/1

Diesel Engine Coolant

The engine cooling system is filled to provide year-round protection against corrosion and cylinder liner pitting, and winter freeze protection to -37°C (-34°F).

John Deere COOL-GARD

The following engine coolant is preferred for service:

- John Deere COOL-GARD Prediluted Coolant

The following engine coolant is also recommended:

- John Deere COOL-GARD Coolant Concentrate in a 40 to 60% mixture of concentrate with quality water.

John Deere COOL-GARD coolants do not require use of supplemental coolant additives, except for periodic replenishment of additives during the drain interval.

Ethylene glycol base coolants

Other fully formulated low silicate ethylene or propylene glycol base coolants for heavy-duty engines may be used if they meet one of the following specifications:

- ASTM D6210 prediluted coolant
- ASTM D6210 coolant concentrate in a 40 to 60% mixture of concentrate with quality water

Coolants meeting ASTM D6210 do not require use of supplemental coolant additives, except for periodic replenishment of additives during the drain interval.

Other low silicate ethylene glycol base coolants for heavy-duty engines may also be used if they meet one of the following specifications:

- ASTM D5345 prediluted coolant
- ASTM D4985 coolant concentrate in a 40 to 60% mixture of concentrate with quality water

Coolants meeting ASTM D5345 or ASTM D4985 require an initial charge of supplemental coolant additives, formulated for protection of heavy duty diesel engines against corrosion and cylinder liner erosion and pitting. They also require periodic replenishment of additives during the drain interval.

Propylene glycol base coolants

Fully formulated low silicate propylene glycol base coolants for heavy-duty engines may be used if they meet one of the following specifications:

- ASTM D6211 prediluted coolant
- ASTM D6211 coolant concentrate in a 40 to 60% mixture of concentrate with quality water

Coolants meeting ASTM D6211 do not require use of supplemental coolant additives, except for periodic replenishment during the drain interval.

Freeze protection

A 50% mixture of ethylene glycol engine coolant in water provides freeze protection to -37°C (-34°F).

A 50% mixture of propylene glycol engine coolant in water provides freeze protection to -33°C (-27°F).

If protection at lower temperatures is required, consult your John Deere dealer for recommendations.

Water quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

IMPORTANT: Do not use cooling system sealing additives or antifreeze that contains sealing additives.

IMPORTANT: Do not mix ethylene glycol and propylene glycol base coolants.

Additional Information About Diesel Engine Coolants and Supplemental Coolant Additives

Engine coolants are a combination of three chemical components: ethylene glycol or propylene glycol antifreeze, inhibiting coolant additives, and quality water.

Coolant specifications

Some products, including John Deere COOL-GARD Prediluted Coolant, are fully formulated coolants that contain all three components in their correct concentrations. Do not add an initial charge of supplemental coolant additives to these fully formulated products.

Coolants meeting ASTM D6210 or ASTM D6211 do not require an initial charge of supplemental coolant additives.

Some coolant concentrates, including John Deere COOL-GARD Coolant Concentrate, contain both glycol antifreeze and inhibiting coolant additives. Mix these products and quality water, but do not add an initial charge of supplemental coolant additives.

Coolants meeting ASTM D5345 or ASTM D4985 require an initial charge of supplemental coolant additives.

Replenish coolant additives

The concentration of coolant additives is gradually depleted during engine operation. Periodic replenishment of inhibitors is required, even when John Deere COOL-GARD or another fully formulated coolant is used. Follow the recommendations in this manual for the use of supplemental coolant additives.

Why use supplemental coolant additives?

Operating without proper coolant additives will result in increased corrosion, cylinder liner erosion and pitting, and other damage to the engine and cooling system. A simple mixture of ethylene glycol or propylene glycol and water will not give adequate protection.

Use of supplemental coolant additives reduces corrosion, erosion, and pitting. These chemicals reduce the number of vapor bubbles in the coolant and help form a protective film on cylinder liner surfaces. This film acts as a barrier against the harmful effects of collapsing vapor bubbles.

Avoid automotive-type coolants

Never use automotive-type coolants (such as those meeting ASTM D3306 or ASTM D4656). These coolants do not contain the correct additives to protect heavy-duty diesel engines. They often contain a high concentration of silicates and may damage the engine or cooling system.

Water quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol base engine coolant concentrate. All water used in the cooling system should meet the following minimum specifications for quality:

Chlorides	<40 mg/L
Sulfates	<100 mg/L
Total Dissolved Solids	<340 mg/L
Total Hardness	<170 mg/L
pH	5.5 to 9.0

Freeze protection

The relative concentrations of ethylene glycol and water in the engine coolant determine its freeze protection limit.

Ethylene Glycol	Freeze Protection Limit
40%	-24°C (-12°F)
50%	-37°C (-34°F)
60%	-52°C (-62°F)

Continued on next page

Propylene Glycol	Freeze Protection Limit
40%	-21°C (-6°F)
50%	-33°C (-27°F)
60%	-49°C (-56°F)

DO NOT use a coolant-water mixture greater than 60% ethylene glycol or propylene glycol.

DX,COOL7 -19-16NOV01-2/2

Testing Diesel Engine Coolant

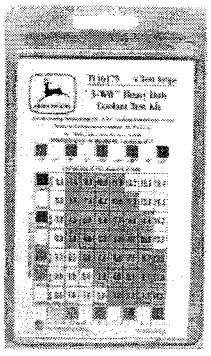
Maintaining adequate concentrations of glycol and inhibiting additives in the coolant is critical to protect the engine and cooling system against freezing, corrosion, and cylinder liner erosion and pitting.

Test the coolant solution at intervals of 12 month or less and whenever excessive coolant is lost through leaks or overheating.

Coolant Test Strips

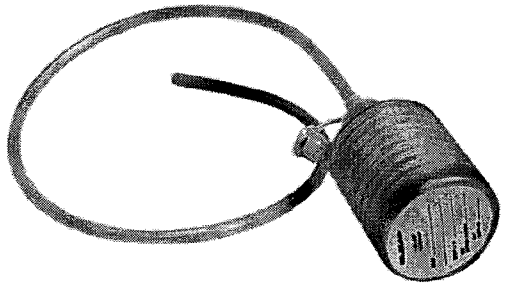
Coolant test strips are available from your John Deere dealer. These test strips provide a simple, effective method to check the freeze point and additive levels of your engine coolant.

Compare the results to the supplemental coolant additive (SCA) chart to determine the amount of inhibiting additives in your coolant and whether more John Deere COOLANT CONDITIONER should be added.



RG7297 -UN-22SEP99

Coolant Test Strips



RG7397 -UN-05DEC97

CoolScan Bellows

COOLSCAN™ and COOLSCAN PLUS™

For a more thorough evaluation of your coolant, perform a COOLSCAN or COOLSCAN PLUS™ analysis. See your John Deere dealer for information.

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COOLSCAN PLUS is a trademark of Deere & Company.

OUOD002,0000174 -19-18DEC01-1/1

Supplemental Coolant Additives

The concentration of coolant additives is gradually depleted during engine operation. For all recommended coolants, replenish additives between drain intervals by adding a supplemental coolant additive every 12 months or as determined necessary by coolant testing.

John Deere COOLANT CONDITIONER is recommended as a supplemental coolant additive in John Deere engines.

IMPORTANT: Only use coolant additive to replenish the coolant. Do not use additive when the entire system is drained and refilled with John Deere COOL GARD.

If other coolants are used, consult the coolant supplier and follow the manufacturer's recommendation for use of supplemental coolant additives.

The use of non-recommended supplemental coolant additives may result in additive drop-out and gelation of the coolant.

Add the manufacturer's recommended concentration of supplemental coolant additive. DO NOT add more than the recommended amount.

OUOD006,0000019 –19–11JUN02–1/1

Operating in Warm Temperature Climates

John Deere engines are designed to operate using glycol base engine coolants.

Always use a recommended glycol base engine coolant, even when operating in geographical areas where freeze protection is not required.

IMPORTANT: Water may be used as coolant *in emergency situations only.*

Foaming, hot surface aluminum and iron corrosion, scaling, and cavitation will occur when water is used as the coolant, even when coolant conditioners are added.

Drain cooling system and refill with recommended glycol base engine coolant as soon as possible.

DX,COOL6 -19-18MAR96-1/1

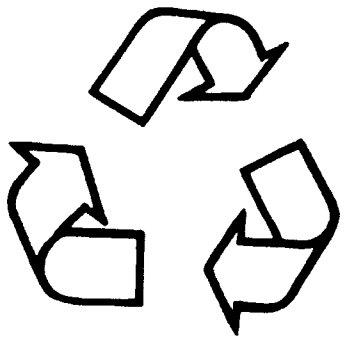
Disposing of Coolant

Improperly disposing of engine coolant can threaten the environment and ecology.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere engine distributor or servicing dealer.



TS1133 -UN-26NOV90

RG,RG34710,7543 -19-30JUN97-1/1

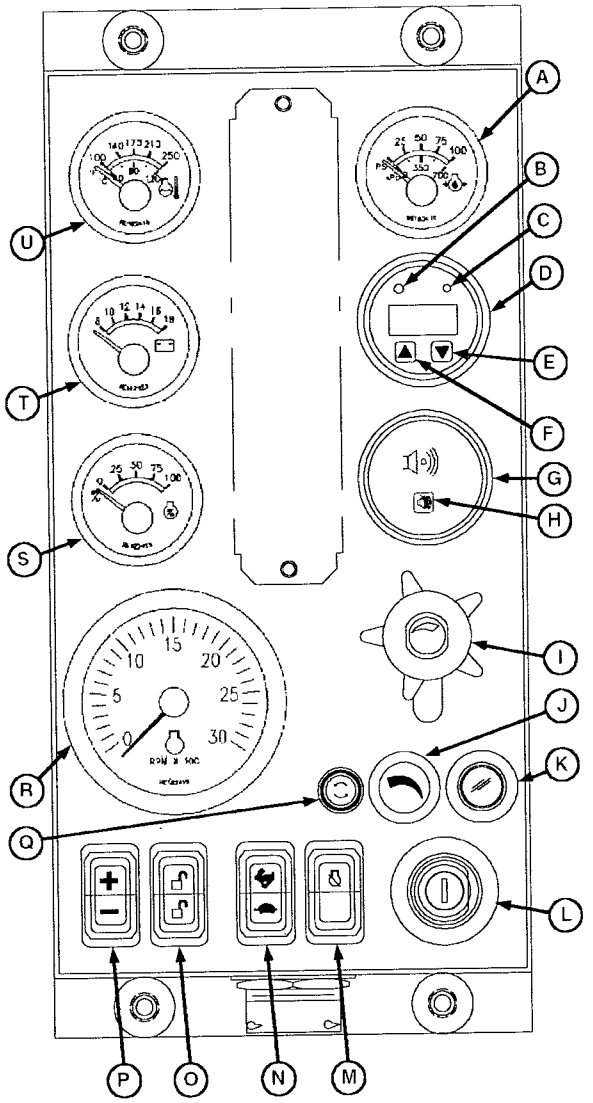
Engine Operating Guidelines

Instrument Panel —Function

This instrument panel for ***POWER**TECH*® 10.5 L and 12.5 L engines is electronically linked to the John Deere engine control unit (ECU). This allows the operator to monitor engine performance as well as to diagnose any troubles during engine operation.

All electronic engine controls are optional equipment for John Deere ***POWER**TECH*® OEM Engines. These electronic controls may be provided by the equipment manufacturer instead of purchased from John Deere. Refer to your engine application manual for specific guidelines if John Deere sourced controls and instrumentation are not used.

A—Engine Oil Pressure Gauge
B—Amber "WARNING" Indicator
C—Red "STOP ENGINE" Indicator
D—Diagnostic Gauge/Hour Meter
E—Touch Switch
F—Touch Switch
G—Audible Alarm (Optional)
H—Audible Alarm Override Switch (Optional)
I—Analog Throttle Control (Optional)
J—Dimmer Control (Optional)
K—Engine Preheater Indicator (Optional)
L—Key Start Switch
M—Override Shutdown Rocker Switch
N—High-Low Speed Select Rocker Switch
O—Bump Speed Enable Rocker Switch
P—Speed Select Rocker Switch
Q—Fuse Holder (5-Amp Fuse)
R—Tachometer
S—Power Meter (Percent Load) (Optional)
T—Voltmeter (Optional)
U—Engine Coolant Temperature Gauge



Instrument Panel

POWERTECH is a registered trademark of Deere & Company.

Continued on next page

IMPORTANT: Any time an electric gauge or meter does not register correctly, replace with a new one. Do not attempt to repair it. All gauges are plug-in type.

Following is a brief description of the electronic controls found on John Deere-provided instrument panels. Refer to manufacturer's literature for information on controls not provided by Deere.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge (A) indicates engine oil pressure in pounds per square inch (psi) or kPa. An optional audible alarm (G) warns the operator if engine oil pressure falls below a safe operating pressure.

AMBER "WARNING" INDICATOR

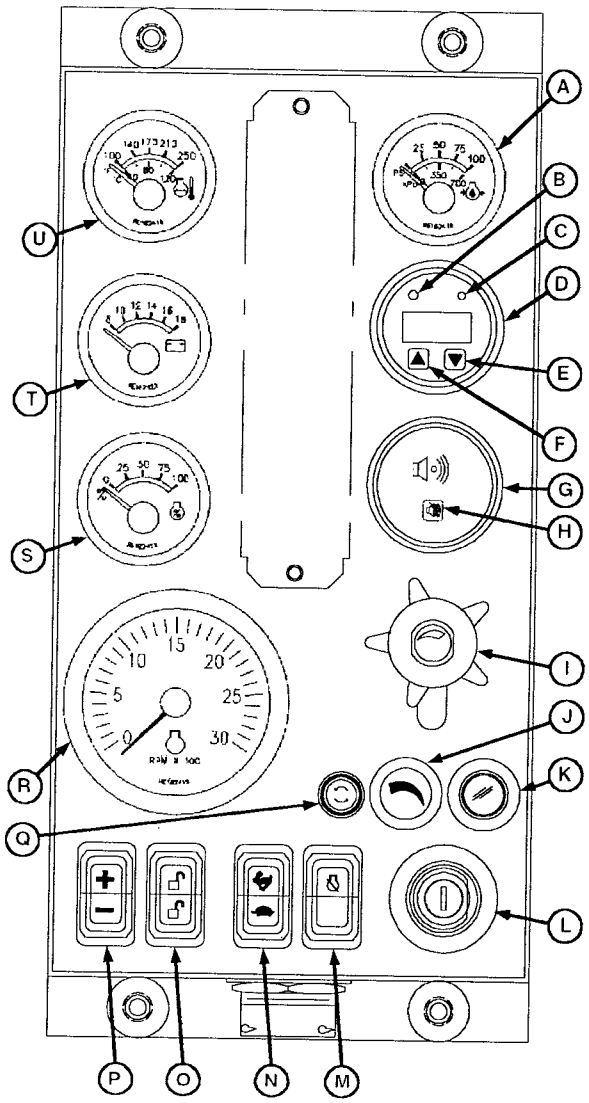
The amber "WARNING" indicator (B) signals an abnormal condition such as low oil pressure, high coolant temperature, water in fuel, low battery voltage, etc. Observe displayed code in window of diagnostic gauge/hour meter (D) for diagnostic trouble code (DTC). (Use the service code menu. See USING DIAGNOSTIC GAUGE TO ACCESS ENGINE INFORMATION later in this section.)

RED "STOP ENGINE" INDICATOR

The Red "STOP ENGINE" indicator (C) signals operator to stop engine immediately or as soon as safely possible. A condition exists that could cause damage to engine.

DIAGNOSTIC GAUGE/HOUR METER

The diagnostic gauge/hour meter (D) displays diagnostic trouble codes (DTCs) as they are accessed. Other information on the engine can be accessed using the touch switches (E and F). The hour meter shows the operating hours of the engine. If engine trouble occurs, the gauge will alternately flash from displayed parameter to the message "SvrcCode". Then the touch switches (E and F) can be used to access the trouble code (see following).



Instrument Panel

Continued on next page

TOUCH SWITCHES

The touch switches are used to change the display on the window of the diagnostic gauge to access engine performance data. Pressing the DOWN switch (E) or UP switch (F) scrolls through various engine parameters and diagnostic trouble codes. (See Using Diagnostic Gauge To Access Engine Information on the following pages for instructions.)

AUDIBLE ALARM (OPTIONAL)

The audible alarm (G) sounds whenever a low oil pressure, high coolant temperature or water-in-fuel/plugged fuel filter condition exists. This includes all signals that light up the amber "WARNING" indicator (B) or the red "STOP ENGINE" indicator (C).

AUDIBLE ALARM OVERRIDE SWITCH (OPTIONAL)

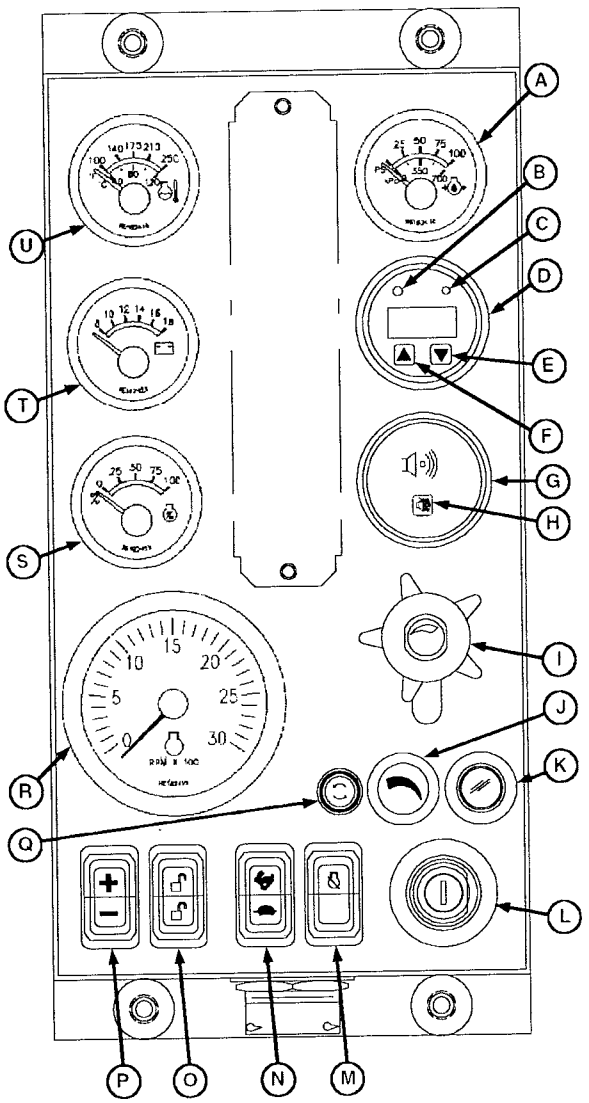
The audible alarm override switch (H) can be pressed to silence the alarm for approximately 2-1/2 minutes.

ANALOG THROTTLE CONTROL (OPTIONAL)

The throttle control (I) is used to control engine speed. This control is available only on engines with analog throttle.

DIMMER CONTROL (OPTIONAL)

The dimmer control (J) is used to control illumination of the instrument panel gauges.



Instrument Panel

Continued on next page

DPSG,OUOD007,2776 -19-04SEP02-3/7

ENGINE PREHEATER INDICATOR (OPTIONAL)

The engine preheater indicator (K) lights up while the engine is being preheated for cold weather starting. When the engine is warmed up, the light goes off, indicating the engine can now be started.

KEY START SWITCH

The three-position key start switch (L) controls the engine electrical system. When the key switch is turned clockwise to "START", the engine will crank. When the engine starts, the key is released and returns to the "ON" (RUN) position.

OVERRIDE SHUTDOWN ROCKER SWITCH

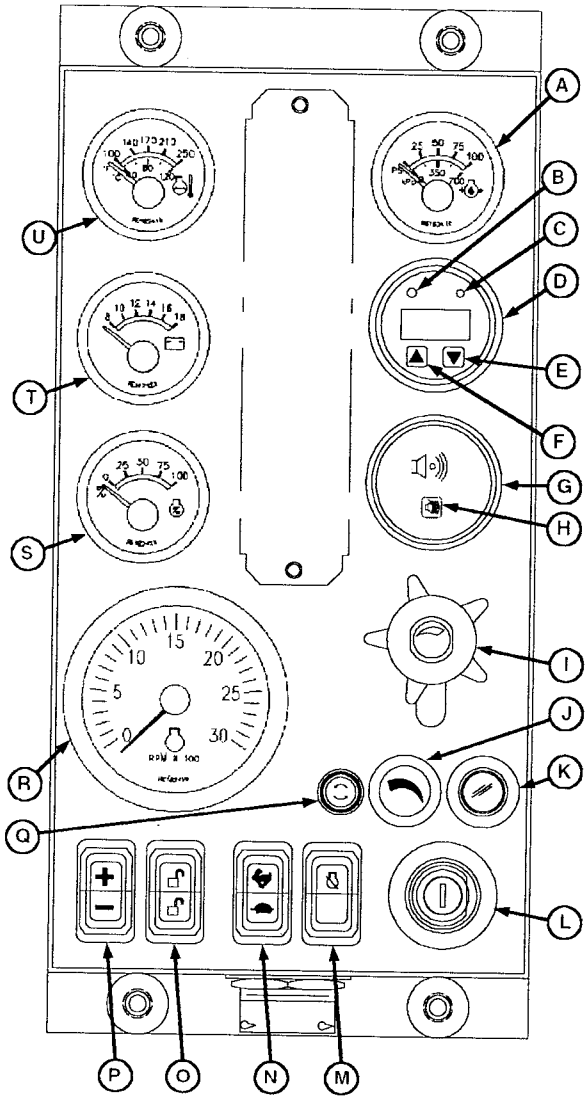
Switch will be present, but may not be active, depending on engine controller (ECU) options originally selected. If switch is active, pressing the upper half of the override shutdown switch (M) will override an engine shutdown signal. The switch must be pressed within 30 seconds to prevent undesired shutdown of engine.

HIGH-LOW SPEED SELECT ROCKER SWITCH

The high/low speed select switch (N) is used to set the engine operating speeds at slow (turtle) or fast (rabbit). Factory preset idle speeds can also be adjusted using bump speed enable switch (O) with speed select switch (P).

BUMP SPEED ENABLE ROCKER SWITCH

This is a three-position switch (O) with the center position as "OFF" (locked). With this switch in the "OFF" position, the speed select switch (P) is also locked, to prevent accidental changes in operating speed. Pressing upper or lower half of switch (O) will unlock or enable the bump speed switch to take effect using speed select switch (P).



Instrument Panel

Continued on next page

SPEED SELECT ROCKER SWITCH

The speed select switch (P) is used to bump engine speed up (+) or down (—) in small increments during operation. This switch must be used with the bump speed enable switch (O) in the unlocked position (top or bottom half of button depressed).

HOW TO SELECT PRESET OPERATING SPEEDS (BUMP SPEEDS)

First select slow or fast speed option by pressing high-low speed select switch (N) to "turtle" (slow) or "rabbit" (fast). Then you can press either the upper or lower portion of the bump speed enable switch (O) to unlock the high or low setting. The bump speed enable must be held down as the speed select switch (P) is used to change the high or low setting by pressing (+) to increase speed or (—) to decrease speed.

Once the slow idle speed has been set, the bump speed enable **switch must be pressed and released three times within two seconds to commit the new operating speed to memory.** If not done, the engine's new speed will only be effective until the key switch is shut off. Then the speed will revert back to the previous setting.

The fast idle speed cannot be locked into memory. It will always go back to the factory preset fast idle speed.

FUSE HOLDER

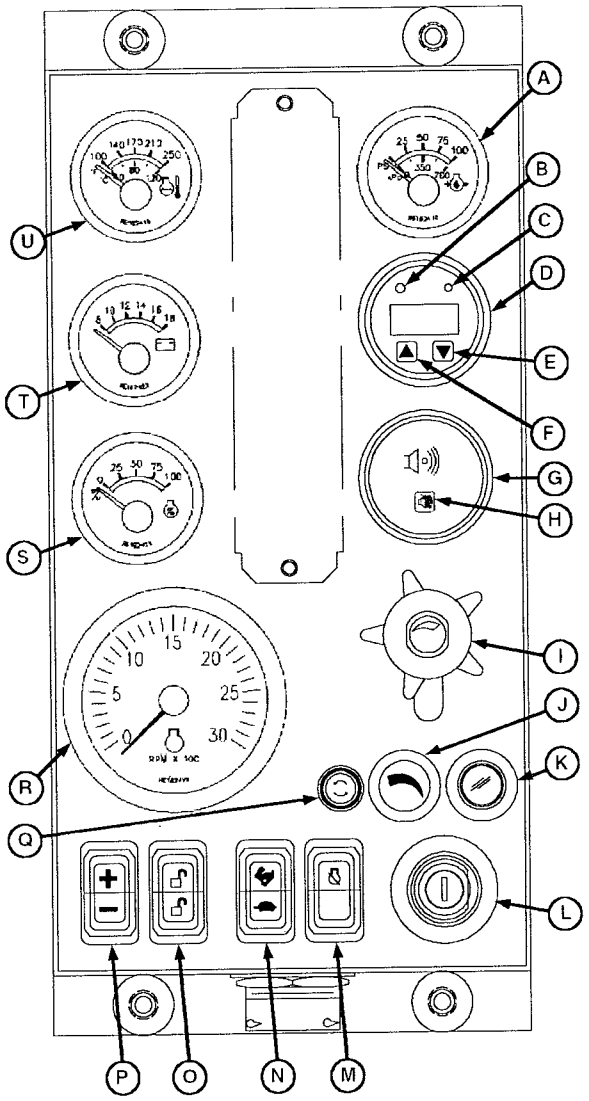
The fuse holder (Q) contains a 5-amp fuse for power to the instrument panel.

TACHOMETER

The tachometer (R) indicates engine speed in hundreds of revolutions per minute (rpm).

POWER METER (PERCENT LOAD) (OPTIONAL)

The power meter (S) shows percent of available power being used by the engine.



Instrument Panel

Continued on next page

VOLTMETER

The voltmeter (T) indicates system battery voltage. The amber "WARNING" light (B) will illuminate when battery voltage is too low for proper operation of the fuel injection system.

ENGINE COOLANT TEMPERATURE GAUGE

The coolant temperature gauge (U) indicates engine coolant temperature in degrees Celsius or Fahrenheit. An optional audible alarm (G) warns the operator if coolant temperature rises above the preset safe operating temperature.

CRUISE CONTROL

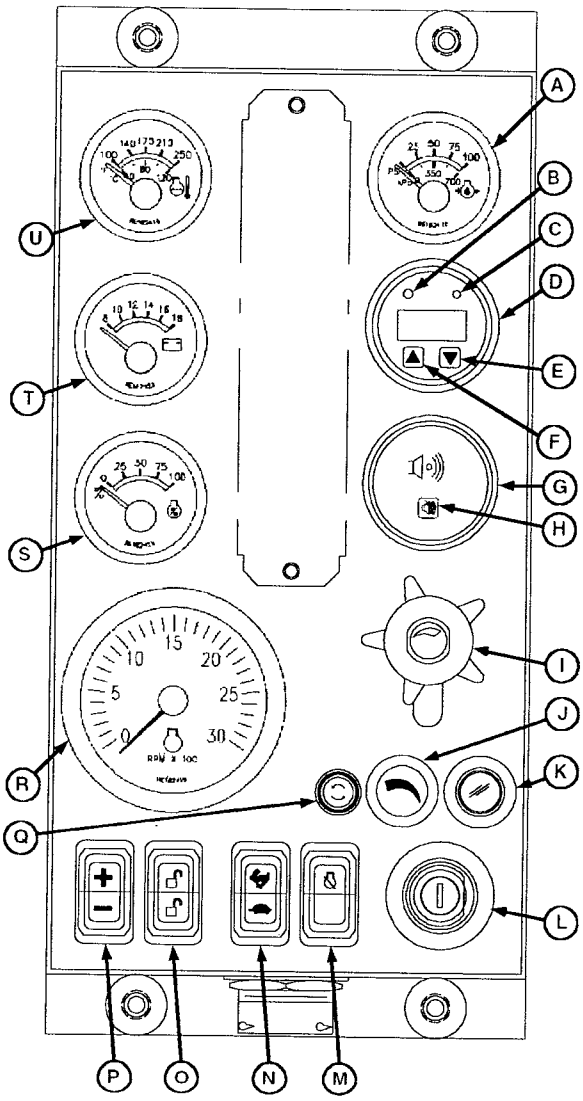
Engine ECUs are available with the cruise control function. The cruise control is an off-road type that maintains a constant engine rpm under varying load conditions.

The cruise cancel/resume function is a one-button cancel, then resume, function. The first time contact is made with the cruise control active, the cruise control will disengage and the engine speed will drop to idle. If the contact is made again within one minute and with the engine speed above 1300 rpm, the cruise control will "resume". This feature allows the placement of the cancel/resume button in a convenient location in the vehicle cab and does not require the use of the normal cruise controls for momentary interruptions in cruise operation.

The cancel/resume function is intended for applications like agricultural tractors and sprayers that turn around at the end of each row in a field. This allows the operator to use the throttle and/or brake to turn the vehicle around. When ready to resume field operations, the operator brings the engine speed above 1300 rpm and activates the cancel/resume function again to resume cruise speed. An internal timer gives the operator one minute to complete the turnaround maneuver.

The cruise control has the normal functions of:

- Cruise control power "ON" or "OFF".
- "Set" or "bump up" engine speed.



Instrument Panel

Continued on next page

DPSG,OUOD007,2776 -19-04SEP02-6/7

- "Resume" or "bump down" engine speed.
- Use vehicle brake or clutch pedal to disengage cruise control.

The "bump up" and "bump down" speed controls allow the operator to change the set speed. Small engine speed changes can be made by "bumping" the control switch. Holding the "bump up" or "bump down" switch will result in greater engine rpm changes until the engine reaches either full speed or idle. The cruise control cannot operate beyond the normal min/max engine speeds.

DPSG,OUOD007,2776 -19-04SEP02-7/7

Using Diagnostic Gauge to Access Engine Information

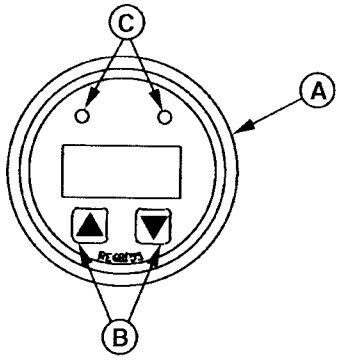
The diagnostic gauge (A) allows the operator to view many readouts of engine functions and diagnostic trouble codes (DTCs). The gauge is linked to the electronic control system and its sensors. This allows the operator to monitor engine functions and to troubleshoot the engine systems when needed.

Press the two touch switches (B) to view the various engine functions in sequence. The displays can be selected as either customary English or metric units.

NOTE: Engine parameters which can be accessed will vary with the engine application.

The following menu of engine parameters can be displayed on the diagnostic gauge window:

- Accelerator pedal position
- Percentage load @ current speed
- Actual engine percent torque
- Engine speed
- Trip distance
- Total vehicle distance
- Engine hours
- Trip fuel
- Total fuel used
- Coolant temperature
- Fuel temperature
- Engine oil temperature
- Engine intercooler temperature
- Fuel delivery pressure
- Engine oil level
- Engine oil pressure
- Coolant pressure
- Coolant level
- Wheel base vehicle speed
- Fuel rate
- Instantaneous fuel economy
- Average fuel economy
- Barometric pressure
- Air inlet temperature
- Boost pressure
- Intake manifold temperature



RG10031 –UN–28OCT99

Diagnostic Gauge

A—Diagnostic Gauge
B—Touch Switches
C—Lights

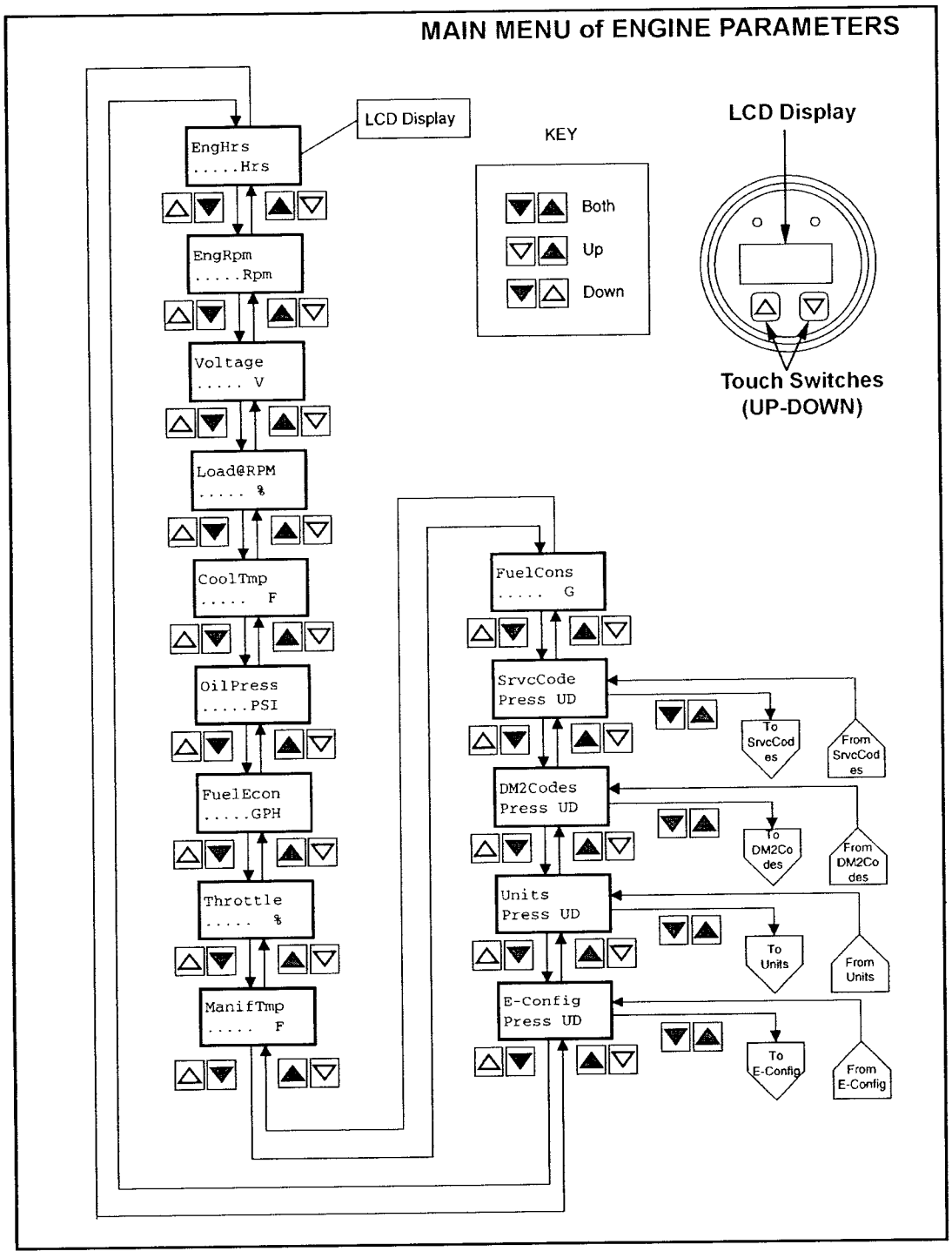
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- Air filter differential pressure
- Exhaust gas temperature
- Electrical potential (voltage)
- Battery potential (voltage), switched
- Transmission oil pressure
- Transmission oil temperature
- Injector metering rail #1 pressure
- Injector metering rail #2 pressure
- Estimated percent fan speed
- Active service (diagnostic) codes
- Stored service (diagnostic) codes

The diagnostic gauge includes a two-line by eight-character backlit Liquid Crystal Display (LCD). The top line displays the data label, i.e. "EngHrs" and the bottom line displays the matching unit information, i.e. "1246 hrs.". The diagnostic gauge uses two touch switches (UP and DOWN) for scrolling through the engine parameter list and viewing the menu list. Two lights (C) (amber and red) are used to signal active trouble messages received by the diagnostic gauge.

DPSG,OUOD007,2840 –19–04SEP02–2/2

Using Touch Switches to Display Information



Using Touch Switches

Continued on next page

The touch switches on the diagnostic gauge allow quick and easy navigation through the menu to find the information needed.

The diagram on the preceding page is a typical Main Menu of Engine Parameters. The Main Menu has 14 entries; the first 10 are engine data parameters, and the last four are sub-menu entry points.

Accessing the Menus

The following two rules are used for accessing the various items on the menus:

1. To scroll through the parameter list, press ***either*** the UP or DOWN touch switch.
2. To select or exit a sub-menu, ***simultaneously*** press the UP and DOWN switches.

Selecting Engine Data Parameters

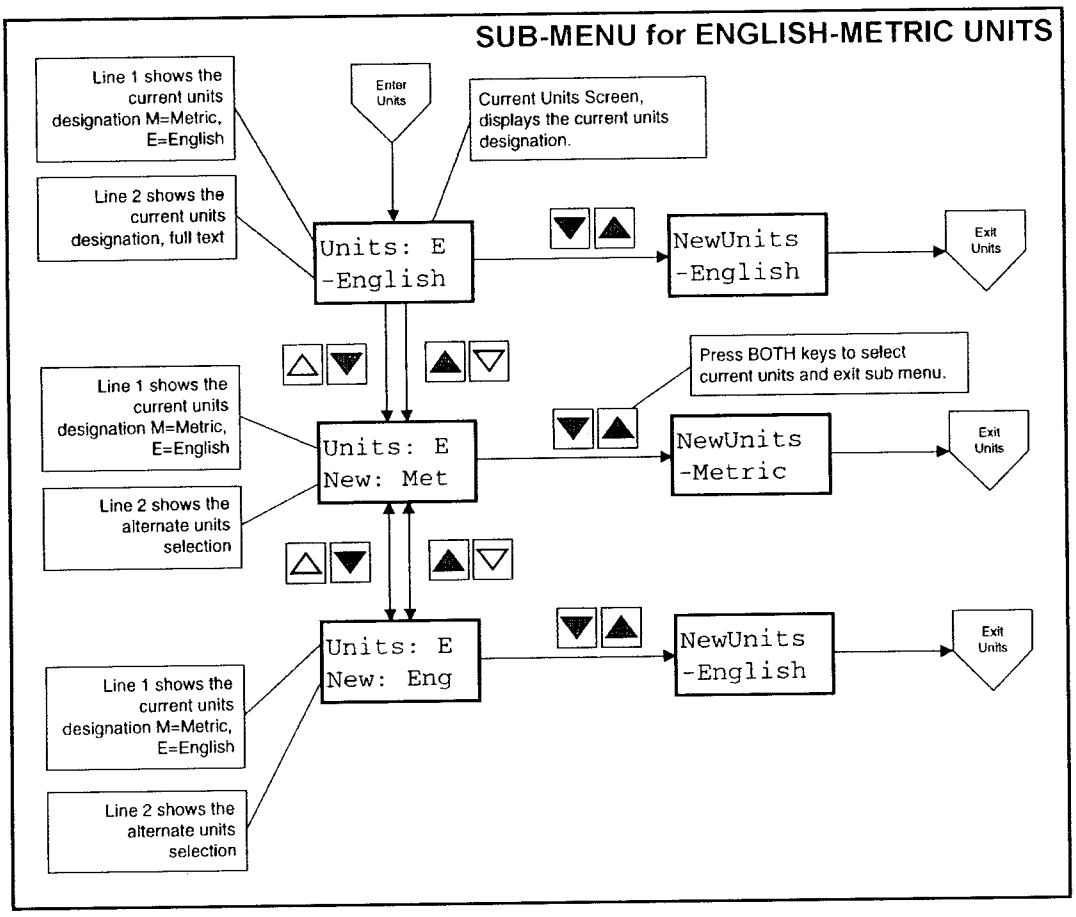
To read any of the engine parameters, press either UP or DOWN switch (as shown on diagram) until the top line of the display shows the desired information.

Selecting Sub-Menus

Press either the UP or DOWN switch until the top line of the display shows the label of the desired sub-menu. Then press **BOTH** the UP and DOWN switches at the same time. This action will select the sub-menu and the next screen on the display will list the sub-menu items. This is also the way to access diagnostic trouble codes (DTCs).

DPSG,OUOD007,2841 –19–01DEC00–2/2

Changing Units of Measure (English or Metric)



Changing Units Of Measure

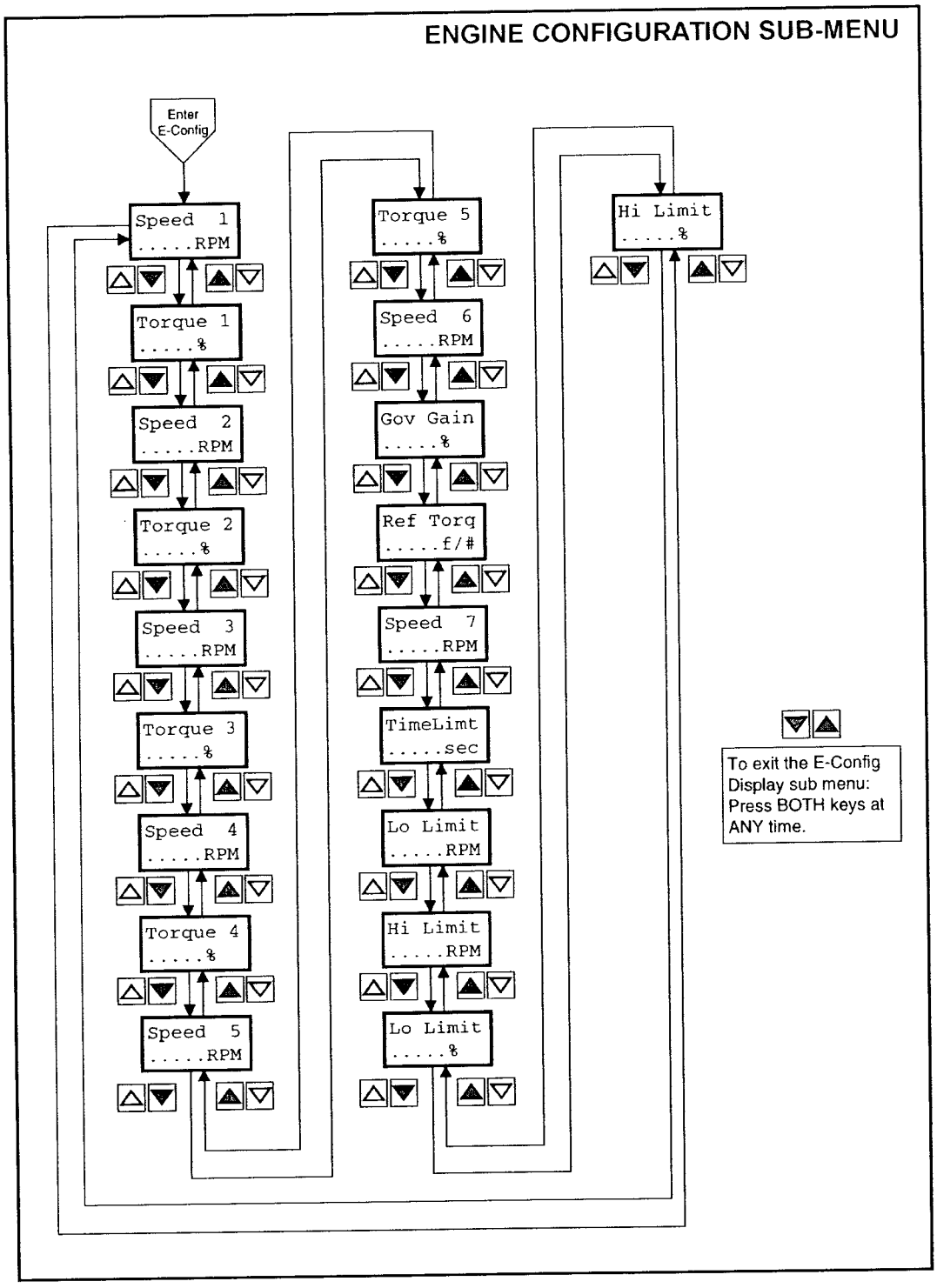
The diagnostic gauge can display engine data in either English or Metric units. To toggle between these, the *Units Sub-Menu*, must be selected.

To select the *Units Sub-Menu*, press the UP or DOWN switch until the top line of the display reads "Units". Then press BOTH the UP and DOWN switches at the same time to select the *Units Sub-Menu*. The above diagram shows the steps for selecting the desired units of measure. Two options are available:

1. Press both the switches to retain the current units designation.
2. Press either UP or DOWN switch to toggle the units selection, then press both switches to select the desired unit of measure.

DPSG,OUOD007,2842 –19–21OCT99–1/1

Viewing Engine Configuration Data



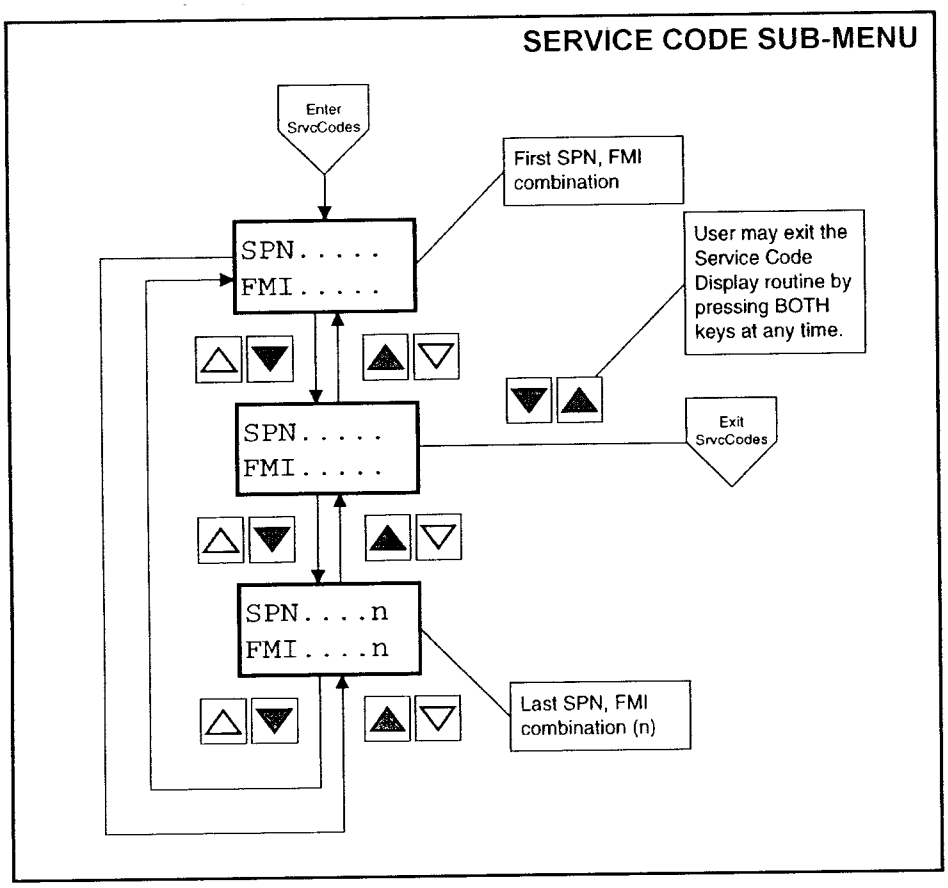
Viewing Engine Configuration Data

Continued on next page

The diagnostic gauge can display the engine configuration data stored in the engine control unit (ECU). To select the *Engine Configuration Sub-Menu* (see diagram on previous page), press the UP or DOWN switch until the top line of the display reads "E-Config". Then press BOTH the UP and DOWN switches at the same time to select the *Engine Configuration Sub-Menu*. The diagnostic gauge will display the engine configuration data as shown in the diagram.

DPSG,OUOD007,2842 –19–21OCT99–2/2

Viewing Active Engine Service Codes/Diagnostic Trouble Codes (DTCs)



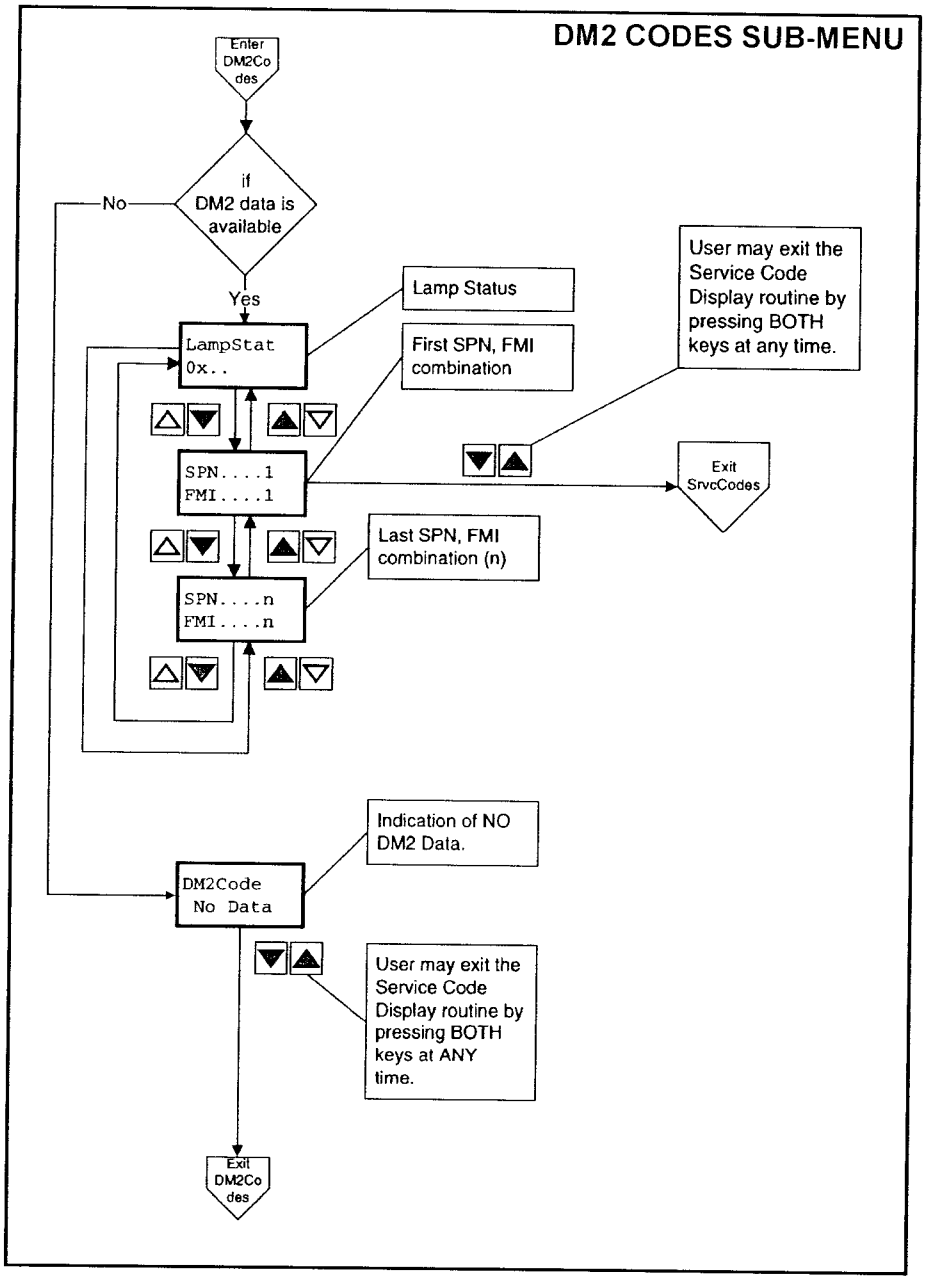
Viewing Active Service Codes/Diagnostic Trouble Codes (DTCs)

The diagnostic gauge continuously monitors all messages broadcast over the Control Area Network (CAN) and displays all active service codes /diagnostic trouble codes (DTCs) at the time the message is broadcast. The word "SrvcCode" is displayed on the second line. The display will cycle every 5 seconds between the currently displayed parameter and the "SrvcCode" message until the active service code (DTC) clears. To view the active codes, select the *Service Code Sub-Menu* by pressing the UP or DOWN switch until the top line of the display reads "SrvcCode". Then press BOTH the UP and DOWN switches at the same time to select the Service Code (DTC) Sub-Menu. The diagnostic gauge has the ability to display all active service codes (DTCs) received. The diagram above titled *Service Code (DTC) Sub-Menu* shows the process for selecting active service codes (DTCs) and their values.

NOTE: For a list of service codes/diagnostic trouble codes (DTCs), refer to the Troubleshooting section later in this manual.

OUOD006,000006A –19–24SEP02–1/1

Viewing Stored Service Codes/Diagnostic Trouble Codes (DTCs) in the Engine ECU



Viewing Stored Service Codes/Diagnostic Trouble Codes (DTCs)

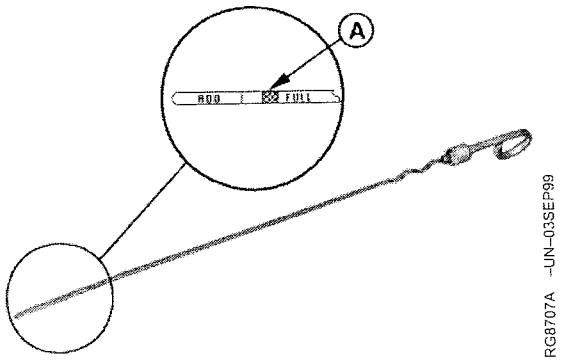
The diagnostic gauge can request stored service codes (DTCs) from the engine. The stored service codes may be used for diagnostic and service needs. To view the stored service codes, it is necessary to select the *DM2 Codes Sub-Menu* by pressing the UP or DOWN switch until the top line of the display reads "DM2 Codes". Then press BOTH the UP and DOWN switches at the same time to select the *DM2 Codes Sub-Menu*. The gauge will display the stored service codes according to the menus shown in the diagram.

OUOD006,000006B –19–24SEP02–1/1

Break-In Service



Check Engine Oil



Crosshatch Pattern on Dipstick

A—Crosshatch Pattern

The engine is ready for normal operation. However, extra care during the first 100 hours of operation will result in more satisfactory long-term engine performance and life. DO NOT exceed 100 hours of operation with break-in oil.

1. This engine is factory-filled with John Deere Engine Break-In Oil. Operate the engine at heavy loads with minimal idling during the break-in period.

2. If the engine has significant operating time at idle, constant speeds, and/or light load usage, or makeup oil is required in the first 100 hour period, a longer break-in period may be required. In these situations, an additional 100 hour break-in period is recommended, using a new change of John Deere Engine Break-In Oil and a new John Deere oil filter.

IMPORTANT: DO NOT add makeup oil until the oil level is BELOW the ADD mark on dipstick. John Deere Engine Break-In Oil (TY22041) should be used to make up any oil consumed during the break-in period.

3. Check engine oil level more frequently during engine break-in period. If oil must be added during this period, John Deere Engine Break-In Oil is preferred. See DIESEL ENGINE BREAK-IN OIL, in Fuels, Lubricants, and Coolant section.

IMPORTANT: DO NOT use PLUS-50® Engine Oil during the break-in period of a new engine or engine that has had a major overhaul. PLUS-50® oil will not allow a new or overhauled engine to properly wear during this break-in period.

IMPORTANT: DO NOT fill above the crosshatch pattern (A). Oil levels anywhere within the crosshatch are considered in the acceptable operating range.

Specification	
Engine Oil Pressure[1]—Full Load Rated Speed	310±103 kPa (3.10±1.03 bar) (45±15 psi)
Engine Oil Pressure—Low Idle	138 kPa (1.38 bar) (20 psi) (minimum)
Engine Coolant Temperature Range—Temperature	82°—94°C (180°—202°F)

PLUS-50 is a registered trademark of Deere & Company.

[1] At normal operating sump temperature of 115°C (240°F) and at speeds of 1500—2100 rpm).

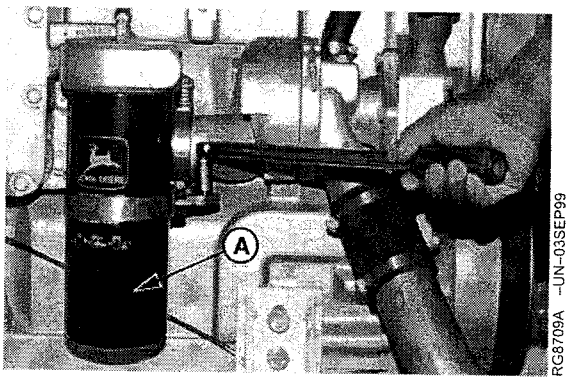
Continued on next page

4. During the first 20 hours, avoid prolonged periods of engine idling or sustained maximum load operation. If engine will idle longer than 5 minutes, stop engine. At low idle, engine should have an oil pressure of at least 138 kPa (1.38 bar)(20 psi).

5. Before the first 100 hours (maximum), change engine oil and replace engine oil filter (A). (See CHANGING ENGINE OIL AND REPLACING OIL FILTER in Lubrication and Maintenance/250 Hour/6 Month section.) Fill crankcase with seasonal viscosity grade oil. (See DIESEL ENGINE OIL, in Fuels, Lubricants, and Coolant section.)

NOTE: Some increase in oil consumption may be expected when low viscosity oils are used. Check oil levels more frequently.

If air temperature is below -10°C (14°F), use an engine block heater.



Replace Engine Oil Filter

A—Oil Filter

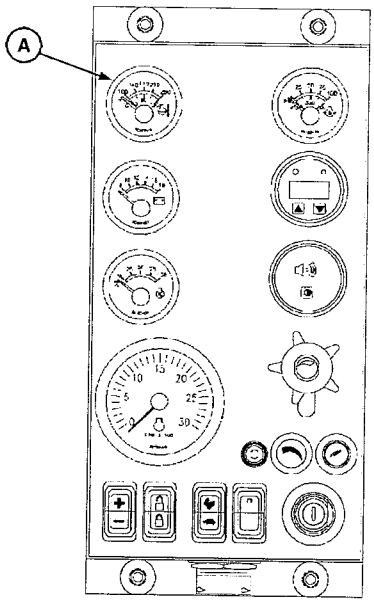
RG,RG34710,7546 –19–04SEP02–2/3

6. Watch engine coolant temperature gauge (A) closely. If coolant temperature rises above 100°C (212°F), reduce load on engine. Unless temperature drops quickly, stop the engine and determine the cause before resuming operation. Normal temperature range at full load rated speed is 82°—94°C (180°—202°F).

NOTE: When the coolant temperature gauge reads approximately 100°C (212°F), the engine will derate automatically, if equipped with safety controls.

7. Check V-belts for proper alignment and seating in pulley grooves.

A—Engine Coolant Temperature Gauge



Watch Coolant Temperatures

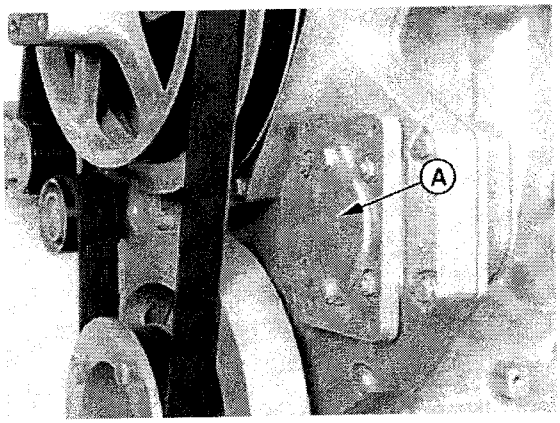
RG,RG34710,7546 –19–04SEP02–3/3

Auxiliary Gear Drive Limitations

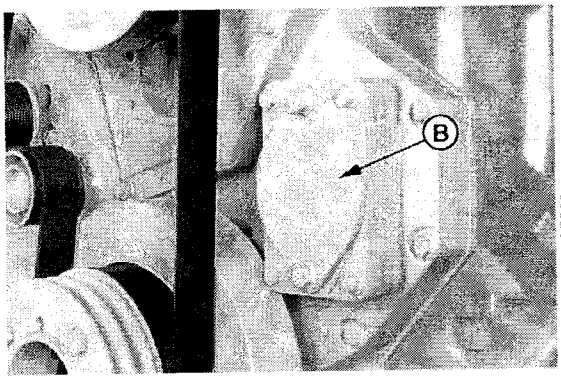
IMPORTANT: When attaching an air compressor, hydraulic pump, or other accessory to be driven by the auxiliary gear drive (engine timing gear train at front of engine), power requirements of the accessory must be limited to values listed below:

SAE Drive	Continuous Power (Maximum)	Intermittent Power (Maximum)
A	26 kW (35 hp)	30 kW (40 hp)
B or (A + B) or (B + B)	52 kW (70 hp)	60 kW (80 hp)
C	52 kW (70 hp)	60 kW (80 hp)

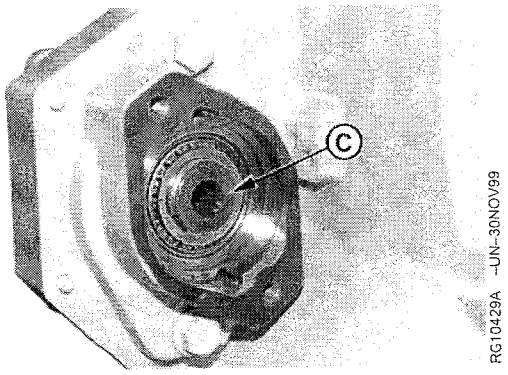
A—SAE "A"
B—SAE "B" Front
C—SAE "B" Rear
D—SAE "C"



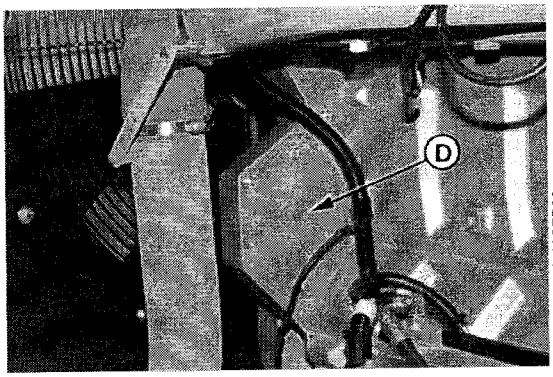
SAE Drive "A"



SAE Drive "B" Front



SAE Drive "B" Rear



SAE Drive "C"

RG,RG34710,7548 –19–27SEP02–1/1

Generator Set (Standby) Applications

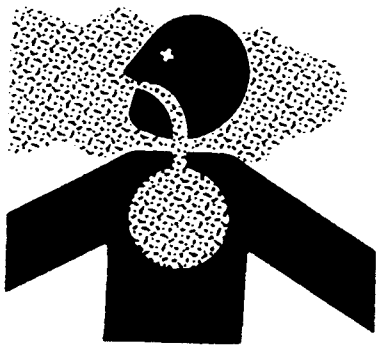
To ensure that your engine will deliver efficient standby operation when needed, start engine and run at rated speed (with 50%—70% load) for 30 minutes every 2 weeks. DO NOT allow engine to run for an extended period of time with no load.

RG,RG34710,7549 –19–30JUN97–1/1

Starting the Engine

The following instructions apply to the optional controls and instruments available through the John Deere Parts Distribution Network. The controls and instruments for your engine may be different from those shown here; always follow manufacturer's instructions.

CAUTION: Before starting engine in a confined building, install proper outlet exhaust ventilation equipment. Always use safety approved fuel storage and piping.



Use Proper Ventilation

TS220 –UN–23AUG88

NOTE: If temperature is below 0°C (32°F), it may be necessary to use cold weather starting aids. (See COLD WEATHER OPERATION in this group.)

1. Perform all prestarting checks outlined in Lubrication and Maintenance/Daily section later in this manual.
2. Open the fuel supply shut-off valve, if equipped.
3. Disengage power to any engine drivelines.

Continued on next page

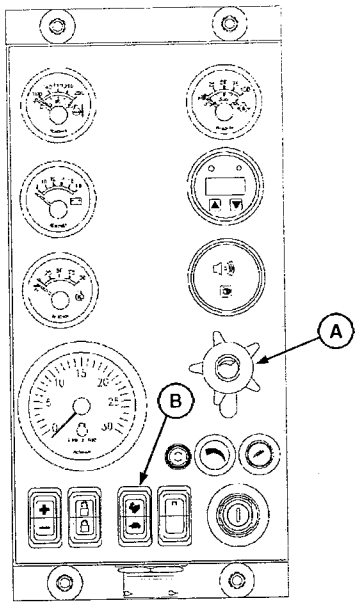
RG,RG34710,7550 –19–24SEP02–1/3

4. Set slow idle as follows:

   Panels with high-low speed select rocker switch (B) only: Set slow speed by pressing lower half of switch.

   Panels with optional analog throttle(s) (A) : Set high-low speed select rocker switch to slow (turtle), then push in on analog throttle handle or turn full counterclockwise to set analog throttle(s) to slow speed.

IMPORTANT: Do not operate the starter for more than 30 seconds at a time. To do so may overheat the starter. If the engine does not start the first time, wait at least 2 minutes before trying again. If engine does not start after four attempts, see Troubleshooting section.



RG9915 –UN–16NOV99

Analog Throttle Control and Speed Select Switch

A—Analog Throttle Control (Optional)
B—Speed Select Rocker Switch

Continued on next page

RG,RG34710,7550 –19–24SEP02–2/3

5. Turn the key start switch (A) clockwise to crank the engine. When the engine starts, release the key switch so that it returns to the "ON" position.

IMPORTANT: If the key switch is released before the engine starts, wait until the starter and the engine stop turning before trying again. This will prevent possible damage to the starter and/or flywheel.

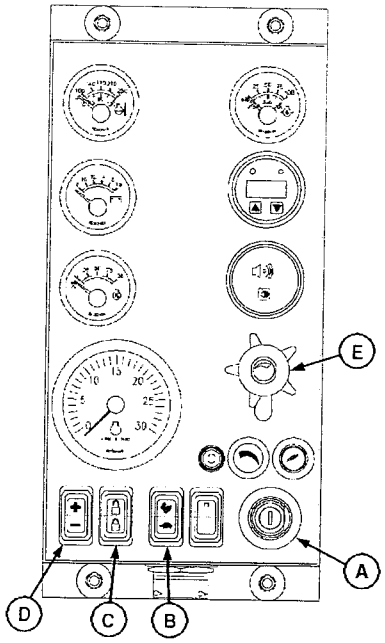
6. After engine starts, idle engine at not more than 1200 rpm until warm. (See WARMING ENGINE later in this section).

   Panels with high-low speed select rocker switch (B) only: Set rpm using bump speed enable switch (C) with speed select rocker switch (D).

   Panels with optional analog throttle (E): Set either high-low speed select switch (B) or analog throttle (E) to slow speed, and set desired speed with remaining control.

NOTE: Engine control unit (ECU) reads the higher of the high-low speed select rocker switch or the analog throttle speed settings.

7. Check all gauges for normal engine operation. If operation is not normal, stop the engine and determine the cause. (For normal gauge pressures and temperatures, see BREAK-IN SERVICE earlier in this section.)



RG9916 –UN–16NOV99

Start And Idle Engine

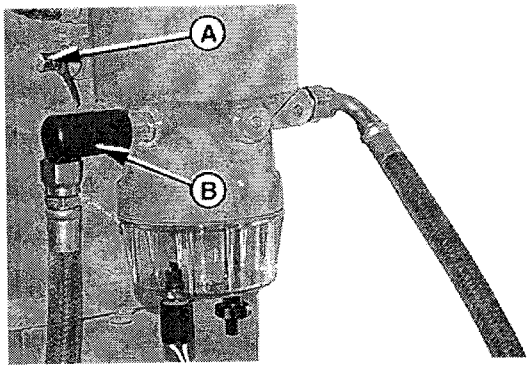
A—Key Start Switch
B—High-Low Speed Select Rocker Switch
C—Bump Speed Enable Rocker Switch
D—Speed Select Rocker Switch
E—Analog Throttle Control (Optional)

RG,RG34710,7550 –19–24SEP02–3/3

Restarting Engine Which Has Run Out of Fuel

NOTE: The procedures provided here pertain to normal initial start-up, not to the "hard starting" problem that may be associated with initial starting of engines.

1. Fill tank with fuel.
2. Loosen the fuel system quick connect port (A) or connect a fitting to it and run a hose to a container.
3. Pump the hand primer (B) roughly 150—200 times until there is fuel coming out consistently.
4. Tighten the quick connect port or disconnect the fitting to this port.
5. Pump the hand primer 200 times. (Priming should become more difficult as 200 is approached.)
6. Crank engine for no more than 20 seconds.
7. If engine does not start, pump hand primer an additional 100 times and crank the engine again for no more than 20 seconds.



RG9949A –UN–21JAN00

Fuel Filter Hand Primer

A—Quick Connect Port
B—Hand Primer

DPSG,OUOD007,3461 –19–21DEC99–1/1

Cold Weather Operation

CAUTION: Ether injector starting fluid is highly flammable. DO NOT use starting fluid on engines equipped with air intake heaters.

DO NOT use starting fluid near fire, sparks, or flames. DO NOT incinerate or puncture a starting fluid container.

IMPORTANT: Engines with Rear PTO- Turn off or unload all pumps, auxiliary drives, and compressors before cold weather starting to reduce drag on engine.

Engines may be equipped with coolant heaters or ether injectors as a cold weather starting aid.

Starting aids are required below 14°F (-10°C). They will enhance starting performance above these temperatures and may be needed to start applications that have high parasitic loads during cranking and/or start acceleration to idle.

Using correct grade oil (per engine and machine operator's manual) is critical to achieving adequate cold weather cranking speed.

Other cold weather starting aids are required at temperatures below -22°F (-30°C) or at altitudes above 1500 m (5000 ft).

1. Follow steps 1—4 as listed under STARTING THE ENGINE, earlier in this section, then proceed as follows according to the instrument (control) panel on your engine.

2. Use cold weather starting aids as needed. Follow supplier instructions for starting aid provided on your engine.

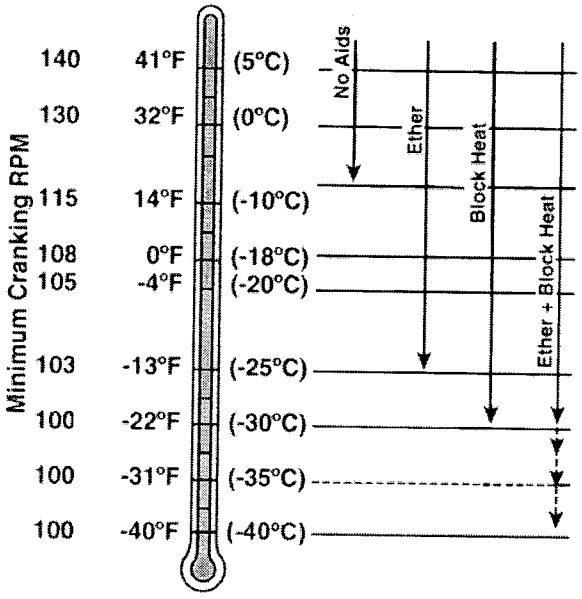
3. Follow remaining steps 5—7 as listed under STARTING THE ENGINE earlier in this section.

Additional information on cold weather operation is available from your engine distributor or authorized servicing dealer.



TS1356 –UN–18MAR92

Starting Fluid is Flammable



RG12592 –19–06SEP02

Cold Weather Starting Guidelines

RG,RG34710,7551 –19–04SEP02–1/1

Warming Engine

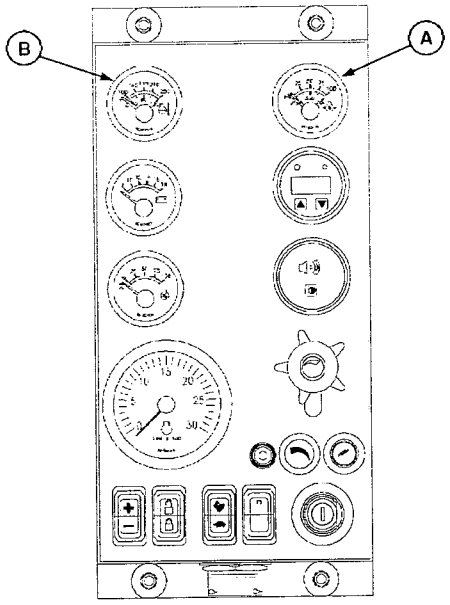
IMPORTANT: To ensure proper lubrication, operate engine at or below 1200 rpm with no load for 1—2 minutes. Extend this period 2—4 minutes when operating at temperatures below freezing.

Engines used in generator set applications where the ECU is programmed to lock engine at a specified speed, may not have a slow idle function. Operate these engines at high idle for 1 to 2 minutes before applying the load. This procedure does not apply to standby generator sets where the engine is loaded immediately upon reaching rated speed.

1. Check oil pressure gauge (A) as soon as engine starts. If gauge needle does not rise to minimum oil pressure of 138 kPa (1.38 bar) (20 psi) within 5 seconds, stop the engine and determine the cause. Normal engine oil pressure is 310 ± 103 kPa (3.10 ± 1.03 bar) (45 ± 15 psi) at rated full-load speed (1500—2100 rpm) with oil at normal operating temperature of 115°C (240°F).

2. Watch coolant temperature gauge (B). Do not place engine under full load until it is properly warmed up. The normal engine coolant temperature range is 82°—94°C (180°—202°F).

NOTE: It is a good practice to operate the engine under a lighter load and at lower speeds than normal for the first few minutes after start-up.



RG9917 –UN–16NOV99

Oil Pressure and Coolant Temperature Gauges

A—Engine Oil Pressure Gauge
B—Engine Coolant Temperature Gauge

RG,RG34710,7552 –19–24SEP02–1/1

Normal Engine Operation

Observe engine coolant temperature and engine oil pressure. Temperatures and pressures will vary between engines and with changing operating conditions, temperatures, and loads.

Normal engine coolant operating temperature range is 82°—94°C (180°—202°F). If coolant temperature rises above 100°C (212°F), reduce load on engine. Unless temperature drops quickly, stop engine and determine cause before resuming operation.

Operate the engine under a lighter load and at slower than normal speed for first 15 minutes after start-up. DO NOT run engine at slow idle.

IMPORTANT: Should the engine die when operating under load, immediately disengage PTO clutch and restart the engine. Overheating of turbocharger parts may occur when oil flow is stopped.

Stop engine immediately if there are any signs of part failure. Symptoms that may be early signs of engine problems are:

- Sudden drop in oil pressure
- Abnormal coolant temperatures
- Unusual noise or vibration
- Sudden loss of power
- Excessive black exhaust
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

RG,RG34710,7545 –19–30JUN97–1/1

Changing Engine Speed

Changing from slow idle to fast idle using high-low speed select rocker switch (A):

- For slow idle, press lower half of switch (indicated by turtle symbol).
- For fast idle, press upper half of switch (indicated by rabbit symbol).

NOTE: To adjust preset fast or slow speeds for high-low speed select rocker switch:

1. *Select fast (rabbit) or slow (turtle) position on high-low speed select rocker switch (A).*
2. *Press and hold top or bottom half of bump speed enable rocker switch (B) while using speed select rocker switch (C).*
3. *Use speed select rocker switch (C) to bump engine speed up (+) or down (—).*

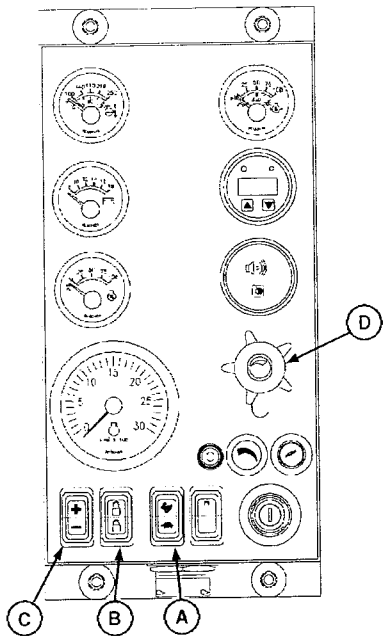
NOTE: Once the engine speed has been set, the bump speed enable switch (B) must be pressed and released three times within two seconds to commit the new slow or fast speed to memory. If not done, the engine's new slow or fast speed will only be effective until the key switch is shut off. Then the speed will revert to its previous setting.

Changing engine speed using optional analog throttle control (D):

NOTE: Pushing in on analog throttle control will immediately take engine to slow idle speed.

1. Set high-low speed select rocker switch (A) to slow speed position.
2. Turn throttle control clockwise to increase speed or counterclockwise to decrease speed.

NOTE: Engine control unit (ECU) reads the higher of the high-low speed select rocker switch or the analog throttle speed settings. With high-low switch at slow speed, analog throttle will control speed higher than slow idle setting.



RG9918 –UN–16NOV99

Changing Engine Speed

A—High-Low Speed Select Rocker Switch
B—Bump Speed Enable Rocker Switch
C—Speed Select Rocker Switch
D—Analog Throttle Control (Optional)

RG,RG34710,7553 –19–02OCT00–1/1

Avoid Excessive Engine Idling

Prolonged idling may cause the engine coolant temperature to fall below its normal range. This, in turn, causes crankcase oil dilution, due to incomplete fuel combustion, and permits formation of gummy deposits on valves, pistons, and piston rings. It also promotes rapid accumulation of engine sludge and unburned fuel in the exhaust system.

Once an engine is warmed to normal operating temperatures, engine should be idled at slow idle speed. Slow idle speed for this engine is 850 rpm at factory. If an engine will be idling for more than 5 minutes, stop and restart later.

NOTE: Generator set applications where the ECU is locked at a specified speed may not have a slow idle function. These engines will idle at no-load governed speed (high idle).

RG,RG34710,7554 –19–30JUN97–1/1

Stopping the Engine

1. Pull PTO clutch lever rearward (away from engine) to disengage clutch, if equipped.

IMPORTANT: Before stopping an engine that has been operating at working load, idle engine at least 2 minutes at 1000—1200 rpm to cool hot engine parts.

Engines in generator set applications where the ECU is locked at a specified speed and no slow idle function is available, run engine for at least 2 minutes at fast idle and no load.

2. Run engine at 1000—1200 rpm for at least 2 minutes to cool.

Panels with high-low speed select rocker switch (B) only: Set rpm using bump speed enable switch (C) with speed select rocker switch (D).

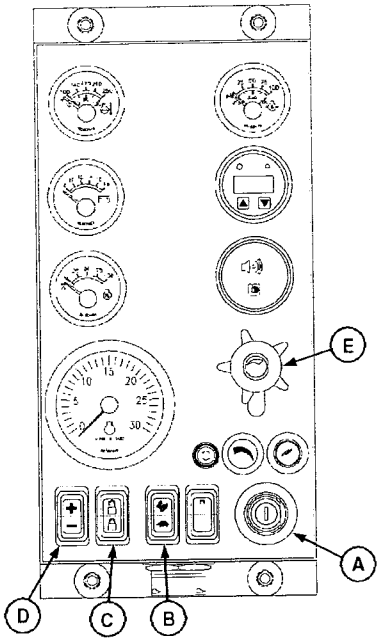
Panels with optional analog throttle (E): Set either high-low speed select switch (B) or analog throttle control (E) to slow idle, and set desired speed with remaining control.

NOTE: Engine control unit (ECU) reads the higher of the high-low speed select rocker switch or the analog throttle speed settings.

3. Push in on analog throttle control handle (if equipped) so that engine goes to slow idle, or set slow speed with high-low speed select rocker switch.

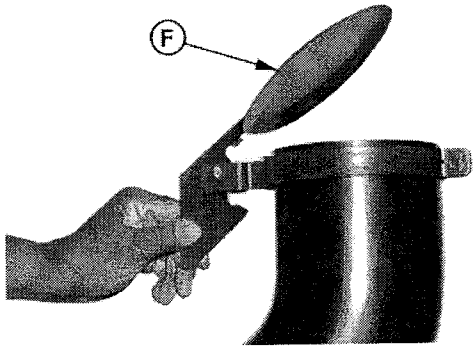
4. Turn key start switch (A) to "OFF" position to stop the engine. Remove ignition key.

IMPORTANT: Make sure that exhaust stack rain cap (F) is installed when engine is not running. This will prevent water and dirt from entering engine.



Stopping the Engine

RG9916 –UN–16NOV99



Exhaust Stack Rain Cap

RG9933 –UN–18NOV99

A—Key Start Switch
B—High-Low Speed Select Rocker Switch
C—Bump Speed Enable Rocker Switch
D—Speed Select Rocker Switch
E—Analog Throttle Control (Optional)
F—Exhaust Stack Rain Cap

RG,RG34710,7555 –19–30JUN97–1/1

Using a Booster Battery or Charger

A 12-volt booster battery can be connected in parallel with battery(ies) on the unit to aid in cold weather starting. ALWAYS use heavy-duty jumper cables.

CAUTION: Gas given off by battery is explosive. Keep sparks and flames away from battery. Before connecting or disconnecting a battery charger, turn charger off. Make last connection and first disconnection at a point away from battery. Always connect NEGATIVE (—) cable last and disconnect this cable first.

IMPORTANT: Be sure polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive to positive and negative to ground. Always use 12-volt booster battery for 12-volt electrical systems and 24-volt booster battery(ies) for 24-volt electrical systems.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

1. Connect booster battery or batteries to produce the required system voltage for your engine application.

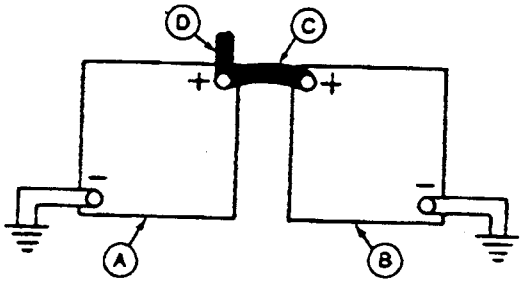
NOTE: To avoid sparks, DO NOT allow the free ends of jumper cables to touch the engine.

2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.
3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.
4. Connect one end of the other jumper cable to the NEGATIVE (—) post of the booster battery.
5. ALWAYS complete the hookup by making the last connection of the NEGATIVE (—) cable to a good ground on the engine frame and away from the battery(ies).



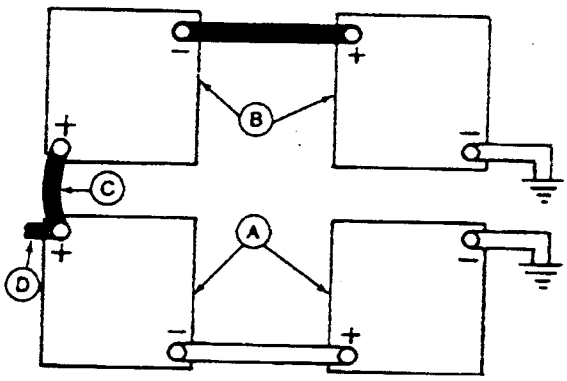
Exploding Battery

TS204 –UN–23AUG88



12-Volt System

RG4678 –UN–14DEC88



24-Volt System

RG4698 –UN–14DEC88

A—12-Volt Machine Battery(ies)
B—12-Volt Booster Battery(ies)
C—Booster Cable
D—Cable to Starter Motor

Continued on next page

6. Start the engine. Disconnect jumper cables immediately after engine starts. Disconnect NEGATIVE (—) cable first.

RG,RG34710,7556 –19–02OCT00–2/2

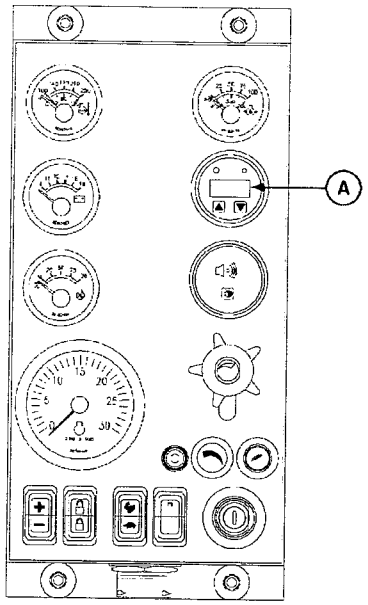
Lubrication and Maintenance

Observe Service Intervals

Using hour meter (A) as a guide, perform all services at the hourly intervals indicated on following pages. At each scheduled maintenance interval, perform all previous maintenance operations in addition to the ones specified. Keep a record of hourly intervals and services performed, using charts provided in Lubrication and Maintenance Records section.

IMPORTANT: Recommended service intervals are for normal operating conditions. Service MORE OFTEN if engine is operated under adverse conditions. Neglecting maintenance can result in failures or permanent damage to the engine.

A—Hour Meter



RG9920 –UN–16NOV99

Hour Meter

RG,RG34710,7557 –19–30JUN97–1/1

Use Correct Fuels, Lubricants, and Coolant

IMPORTANT: Use only fuels, lubricants, and coolants meeting specifications outlined in Fuels, Lubricants, and Coolant section when servicing your John Deere Engine.

Consult your John Deere engine distributor, servicing dealer or your nearest John Deere Parts Network for recommended fuels, lubricants, and coolant. Also available are necessary additives for use when operating engines in tropical, arctic, or any other adverse conditions.



TS100 –UN–23AUG88

John Deere Parts Network

RG,RG34710,7558 –19–30JUN97–1/1

Lubrication and Maintenance Service Interval Chart—Industrial and Generator (Prime Power)

Item	Lubrication and Maintenance Service Intervals					
	Daily	250 Hour/ 6 Month	500 Hour/ 12 Month	2000 Hour/ 24 Month	2500 Hour	As Required
Check Engine Oil and Coolant Level	•					
Check Fuel Filter/Water Separator Bowl	•					
Check Air Cleaner Dust Unloader Valve & Restriction Indicator Gauge[a]	•					
Visual Walkaround Inspection	•					
Service Fire Extinguisher		•				
Service Battery		•				
Change Engine Oil and Replace Oil Filter[b]		•				
Check Coolant Pump Weep Hole Foam Filter		•				
Clean Crankcase Ventilation Assembly			•			
Check Air Intake Hoses, Connections, & System			•			
Check Engine Ground Connection			•			
Check Automatic Belt Tensioners and Belt Wear			•			
Check Cooling System			•			
Coolant Solution Analysis; Add SCAs as Required			•			
Pressure Test Cooling System			•			
Check Crankshaft Vibration Damper[c]				•		
Flush and Refill Cooling System[d]				•		
Test Thermostats				•		
Adjust Engine Valve Clearance & EUI Preload[e]					•	
Replace Air Cleaner Elements						•
Replace Fuel Filter Element/Clean Water Separator[f]						•
Replace V-Belts						•
Check Fuses						•

[a]Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (25 in.) H2O.

[b]Change the oil for the first time before 100 hours maximum of (break-in) operation, then every 250 hours thereafter. If PLUS-50 or ACEA-E4/E5 oil is used along with a John Deere oil filter, the oil change interval may be extended by 50 percent to 375 hours.

[c]Replace crankshaft damper at 4500 hours or 60 months, whichever occurs first.

[d]If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished as needed by adding a supplemental coolant additive, the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

[e]This one-time adjustment is required after first 2500 hours for all new and overhauled engines.

[f]Replace fuel filter element when audible alarm sounds and trouble codes indicate plugged fuel filter (low fuel pressure). If no alarm sounds during a 12 month interval, replace element at that time, or after every 500 hours of operation.

Continued on next page

Item	Lubrication and Maintenance Service Intervals					
	Daily	250 Hour/ 6 Month	500 Hour/ 12 Month	2000 Hour/ 24 Month	2500 Hour	As Required
Check Air Compressors (If Equipped)						•
Check Rear Power Take-Off (PTO) (If Equipped)						•

RG,RG34710,7559 –19–04SEP02–2/2

Lubrication and Maintenance Service Interval Chart—Generator (Standby) Applications

NOTE: The service intervals in the Lubrication and Maintenance sections that follow reflect standard engines. Use service intervals listed below for generator (standby) applications. Match service items below to titles in Lubrication and Maintenance sections for procedures.

	Lubrication and Maintenance Service Intervals					
Item	Every 2 Weeks	250 Hours or 6 Months	500 Hours or 12 Months	2000 Hours or 24 Months	2500 Hours	As Required
Operate Engine at Rated Speed and 50%—70% Load a Minimum of 30 Minutes	•					
Check Engine Oil and Coolant Level	•					
Check Fuel Filter/Water Separator Bowl	•					
Check Air Cleaner Dust Unloader Valve & Restriction Indicator Gauge[a]	•					
Visual Walkaround Inspection	•					
Service Battery		•				
Change Engine Oil and Replace Oil Filter[b]		•				
Check Coolant Pump Weep Hole Foam Filter		•				
Check Engine Mounts		•				
Clean Crankcase Ventilation Assembly			•			
Check Air Intake Hoses, Connections, & System			•			
Check Engine Ground Connection			•			
Check Automatic Belt Tensioners and Belt Wear			•			
Check Cooling System			•			
Coolant Solution Analysis; Add SCAs as Required			•			
Pressure Test Cooling System			•			
Check Crankshaft Vibration Damper[c]				•		
Flush and Refill Cooling System[d]				•		
Test Thermostats				•		
Adjust Engine Valve Clearance and EUI Preload[e]					•	

[a]Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (25 in.) H2O.

[b]Change the oil for the first time before 100 hours maximum of (break-in) operation, then every 250 hours thereafter. If PLUS-50 or ACEA-E4/E5 oil is used along with a John Deere oil filter, the oil change interval may be extended by 50 percent to 375 hours.

[c]Replace crankshaft damper at 4500 hours or 60 months, whichever occurs first.

[d]If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished as needed by adding a supplemental coolant additive, the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

[e]This one-time adjustment is required after first 2500 hours for all new and overhauled engines.

Continued on next page

Item	Lubrication and Maintenance Service Intervals					
	Every 2 Weeks	250 Hours or 6 Months	500 Hours or 12 Months	2000 Hours or 24 Months	2500 Hours	As Required
Replace Air Cleaner Elements						•
Replace Fuel Filter Element/Clean Water Separator[1]						•
Replace V-Belts						•
Check Fuses						•
Check Air Compressors (If Equipped)						•
Check Rear Power Take-Off (PTO) (If Equipped)						•

[1]Replace fuel filter element when audible alarm sounds and trouble codes indicate plugged fuel filter (low fuel pressure). If no alarm sounds during a 12 month interval, replace element at that time, or after every 500 hours of operation.

RG,RG34710,7560 –19–04SEP02–2/2

Daily Prestarting Checks

Do the following BEFORE STARTING THE ENGINE for the first time each day:

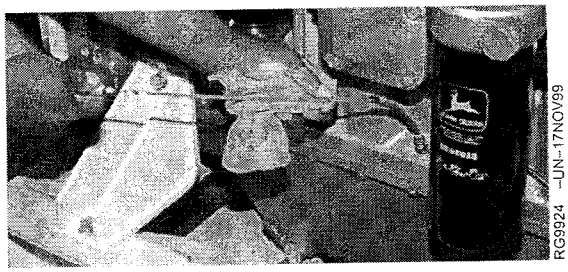
IMPORTANT: DO NOT add makeup oil until the oil level is BELOW the ADD mark.

1. Check engine oil level on dipstick. Add as required, using seasonal viscosity grade oil. (See DIESEL ENGINE OIL in Fuels, Lubricants, and Coolant section for oil specifications.)

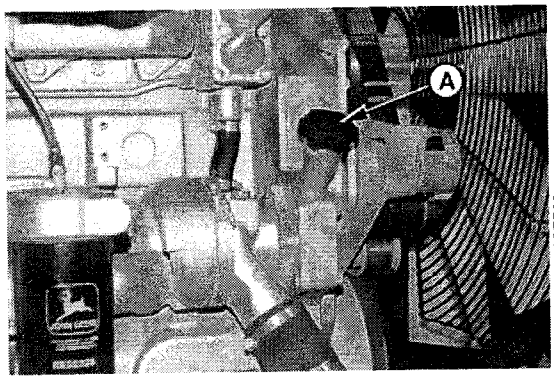
   Oil may be added at timing gear cover filler cap (A) or oil pan filler adapter ports (B), if equipped.

IMPORTANT: DO NOT fill above the top of crosshatch area (C) on the dipstick. Oil levels anywhere within crosshatch are considered in the acceptable operating range.

A—Timing Cover Filler Cap
B—Oil Pan Filler Adapter Port
C—Crosshatch Area of Dipstick

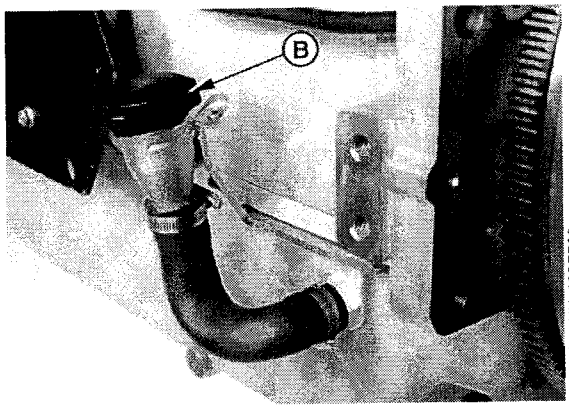

RG9924 –UN–17NOV99

Check Engine Oil



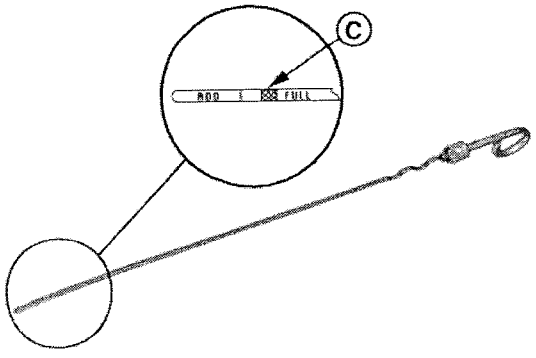
RG8724 –UN–03SEP99

Timing Gear Cover Filler Cap



RG8751 –UN–03SEP99

Oil Pan Filler Adapter Ports



RG8707B –UN–03SEP99

Do Not Fill Above Top Mark

Continued on next page

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Only remove filler cap when engine is cold or when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



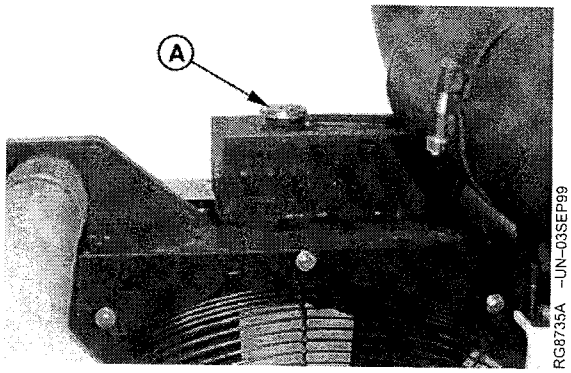
TS281 –UN–23AUG88

High-Pressure Fluids

2. Check the coolant level when engine is cold. Coolant level should be at bottom of filler neck. Fill radiator (A) with proper coolant solution if level is low. (See ADDING COOLANT in Service as Required section.) Check overall cooling system for leaks.

   Refer to your vehicle's operator's manual for recommendations for non-John Deere supplied accessories.

A—Radiator



RG8735A –UN–03SEP99

Fill Radiator

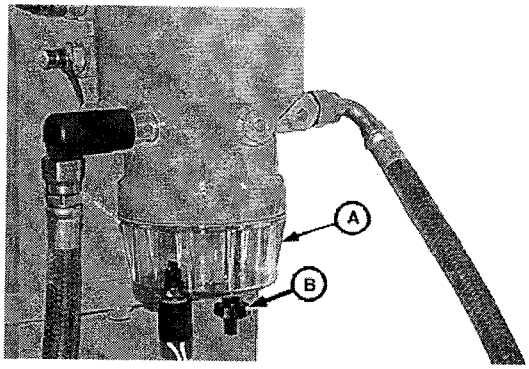
RG,RG34710,7561 –19–30JUN97–2/4

NOTE: Amber warning indicator on instrument panel diagnostic gauge will flash if amount of water in fuel filter sediment bowl is excessive.

3. Check the glass sediment bowl (A) of the fuel filter/water separator for water or debris.

   Loosen thumb screw (B) and drain water and debris from bowl into a suitable container, as needed.

   Dispose of water and debris in an environmentally safe manner.



RG9931 –UN–10DEC99

Glass Sediment Bowl and Thumb Screw

A—Sediment Bowl
B—Thumb Screw

Continued on next page

RG,RG34710,7561 –19–30JUN97–3/4

4. If the air cleaner has an automatic dust unloader valve (A), squeeze the unloader valve on air cleaner assembly to clear away any dust buildup.

IMPORTANT: Do not exceed maximum air intake restriction. A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine.

If equipped with air intake restriction indicator gauge (B), check gauge and service air cleaner if air intake restriction exceeds specifications.

Specification

Maximum Air Intake Restriction—
Vacuum..... 25 in. (625 mm) H_2O (6.25 kPa) (0.06 bar) (1.0 psi)

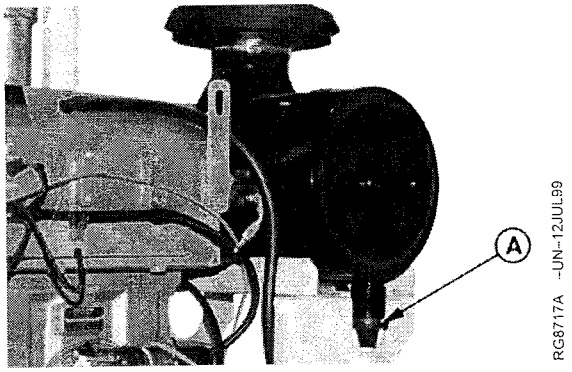
5. Make a thorough inspection of the engine compartment. Look for oil or coolant leaks, worn fan and accessory drive belts, loose connections and trash build-up. Remove trash build-up and have repairs made as needed if leaks are found.

NOTE: Wipe all fittings, caps, and plugs before performing any maintenance to reduce the chance of system contamination.

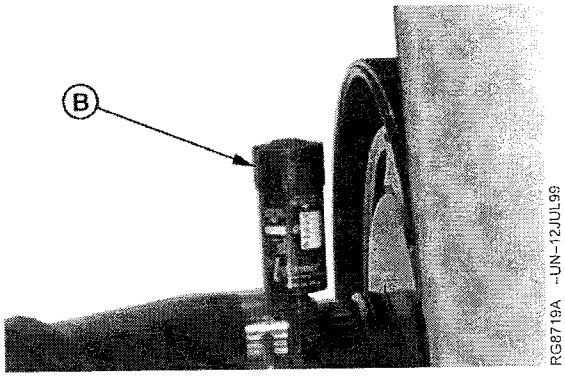
Inspect:

- Radiator for leaks and trash build-up.
- Engine shields and guards for trash build-up.
- Air intake system hoses and connections for cracks and loose clamps.
- Fan, alternator, and accessory drive belts for cracks, breaks or other damage.
- Coolant pump for coolant leaks.

NOTE: It is normal for a small amount of leakage to occur as the engine cools down and parts contract. Excessive coolant leakage may indicate the need to replace the coolant pump seal. Contact your engine distributor or servicing dealer for repairs.



Automatic Dust Unloader Valve



Air Intake Restriction Indicator Gauge

A—Dust Unloader Valve
B—Restriction Indicator Gauge

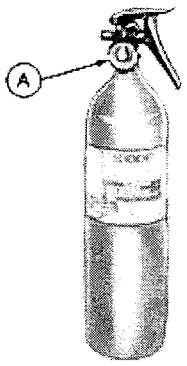
RG,RG34710,7561 –19–30JUN97–4/4

Servicing Fire Extinguisher

A fire extinguisher (A) is available from your authorized servicing dealer or engine distributor.

Read and follow the instructions which are packaged with it. The extinguisher should be inspected at least every 100 hours of engine operation or once a month. Once extinguisher is operated, no matter how long, it must be recharged. Keep record of inspections on the tag which comes with the extinguisher instruction booklet.

A—Fire Extinguisher



Fire Extinguisher

RW4918 –UN–15DEC88

RG,RG34710,7562 –19–30JUN97–1/1

Servicing Battery

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded NEGATIVE (—) battery clamp first and replace it last.



TS204 –UN–23AUG88

Exploding Battery

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

1. On regular batteries, check electrolyte level. Fill each cell to bottom of filler neck with distilled water.

NOTE: Low-maintenance or maintenance-free batteries should require little additional service. However, electrolyte level can be checked by cutting the center section of decal on dash-line, and removing cell plugs. If necessary, add clean, soft water to bring level to bottom of filler neck.

2. Keep batteries clean by wiping them with a damp cloth. Keep all connections clean and tight. Remove any corrosion, and wash terminals with a solution of 1 part baking soda and 4 parts water. Tighten all connections securely.

NOTE: Coat battery terminals and connectors with a mixture of petroleum jelly and baking soda to retard corrosion.

3. Keep battery fully charged, especially during cold weather. If a battery charger is used, turn charger off before connecting charger to battery(ies). Attach POSITIVE (+) battery charger lead to POSITIVE (+) battery post. Then attach NEGATIVE (—) battery charger lead to a good ground.

Continued on next page

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Using proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 10—15 minutes. Get medical attention immediately.**

If acid is swallowed:

1. **Drink large amounts of water or milk.**
2. **Then drink milk of magnesia, beaten eggs, or vegetable oil.**
3. **Get medical attention immediately.**



TS203 –UN–23AUG88

Sulfuric Acid

In freezing weather, run engine at least 30 minutes to ensure thorough mixing after adding water to battery.

Replacement battery(ies) must meet or exceed the following recommended capacities[1] at —18°C (0°F):

	Specification
12-Volt System—Minimum Battery Capacity—Cold Cranking Amps	800 Minimum
Reserve Capacity (Minutes)	350 Minimum
24-Volt System—Minimum Battery Capacity—Cold Cranking Amps	570 Minimum
Reserve Capacity (Minutes)	275 Minimum

[1] *Total recommended capacity based on batteries connected in series or parallel.*

RG,RG34710,7563 –19–05SEP02–2/2

Changing Engine Oil and Replacing Oil Filter

NOTE: Change engine oil and filter for the first time before 100 hours maximum of operation, then every 250 hours thereafter.

If John Deere PLUS-50® or ACEA-E4/E5 engine oil and the specified John Deere oil filter are used, the oil and filter change interval may be extended by 50 percent or to 375 hours.

OILSCAN® and OILSCAN PLUS® are John Deere sampling programs to help you monitor machine performance and identify potential problems before they cause serious damage. OILSCAN® and OILSCAN PLUS® kits are available from your John Deere dealer. Oil samples should be taken prior to the oil change. Refer to instructions provided with kit.

CAUTION: Metal surfaces of engine may be hot to the touch after shutdown.

Change engine oil as follows:

1. Run engine approximately 5 minutes to warm up oil. Shut off engine.
2. Remove oil pan drain plug.
3. Drain crankcase oil from engine while warm.

NOTE: Drain plug location may vary, depending on the application.

PLUS-50 is a registered trademark of Deere & Company.
OILSCAN is a registered trademark of Deere & Company
OILSCAN PLUS is a registered trademark of Deere & Company

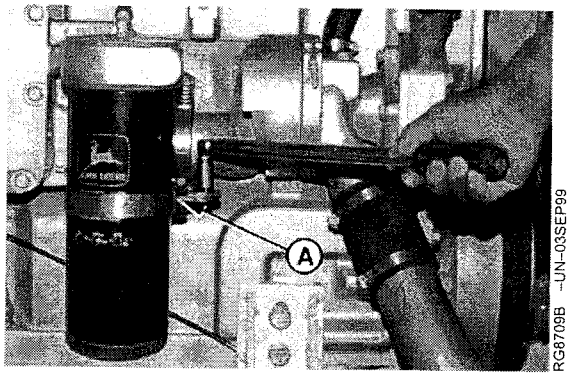
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4. Remove and discard oil filter element using a suitable filter wrench (A).

5. Remove oil filter packing and clean filter mounting pad.

IMPORTANT: Filtration of oils is critical to proper lubrication. Always change filter regularly. Use filter meeting John Deere performance specifications.

6. Oil new packing and install new filter element onto filter housing. Hand tighten element according to values printed on filter element. If values are not provided, tighten element approximately 1/2—3/4 turn after packing contacts filter housing. DO NOT overtighten filter element.



Remove Filter Element Using Wrench

A—Filter Wrench

Continued on next page

RG,RG34710,7565 –19–04SEP02–2/3

7. Install oil pan drain plug with a new O-ring. Torque plug to specifications.

Specification	
Oil drain plug (1-1/4 in.)—Torque	46 N•m (34 lb-ft)
Oil drain plug (1-1/2 in.)—Torque	64 N•m (47 lb-ft)

8. Fill engine crankcase with correct John Deere engine oil through timing gear cover fill port (A) or oil pan fill port (B) depending on engine application. (See DIESEL ENGINE OIL in Fuels, Lubricants, and Coolant section for determining correct engine oil.)

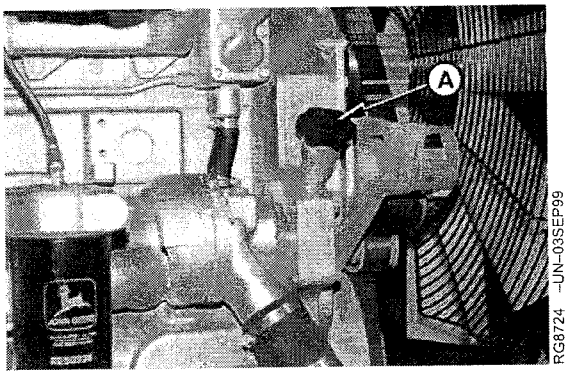
   To determine the correct oil fill quantity for your engine, see ENGINE CRANKCASE OIL FILL QUANTITIES in the Specifications section.

NOTE: Crankcase oil capacity may vary slightly. ALWAYS fill crankcase to full mark or within crosshatch on dipstick, whichever is present. DO NOT overfill.

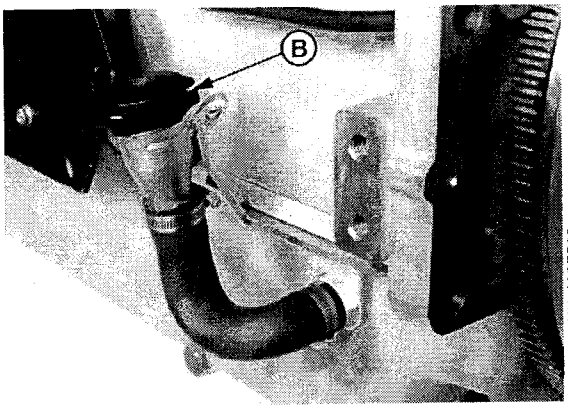
IMPORTANT: Immediately after completing any oil change, crank engine for 30 seconds without permitting engine to start. This will help ensure adequate lubrication to engine components before engine starts.

9. Start engine and run to check for possible leaks.

10. Stop engine and check oil level after 10 minutes. Oil level reading should be within crosshatch of dipstick.



Timing Gear Cover Fill Port



Oil Pan Adapter Fill Port

A—Timing Cover Fill Port
B—Oil Pan Adapter Fill Port

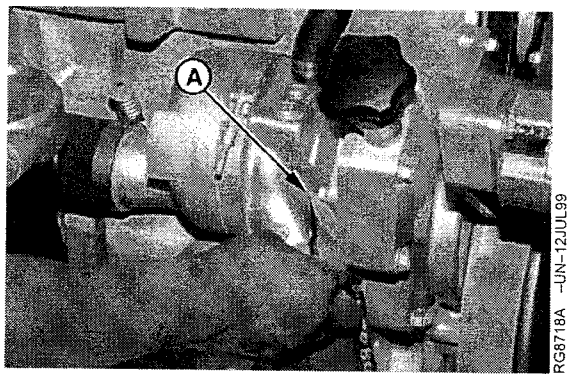
RG,RG34710,7565 –19–04SEP02–3/3

Visually Inspecting Coolant Pump

Inspect Weep Hole

1. Remove foam filter from coolant pump weep hole (A) as shown.
2. Inspect weep hole for oil or coolant leakage.
   - Oil leakage indicates a damaged rear seal.
   - Coolant leakage indicates a damaged front seal.

   Repair or replace complete coolant pump assembly if leakage is detected.



Coolant Pump Weep Hole

A—Weep Hole

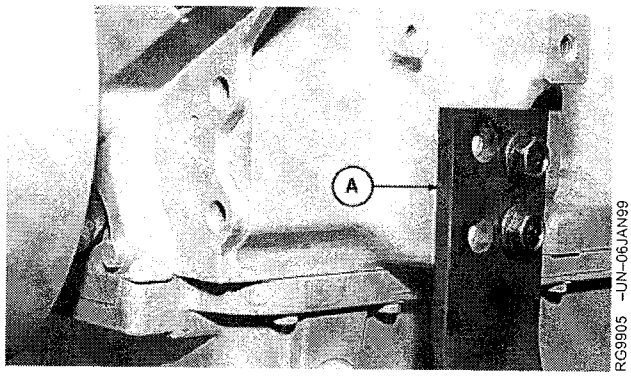
RG,RG34710,7567 –19–30JUN97–1/1

Checking Engine Mounts (Generator Sets)

Engine mounting is the responsibility of the generator manufacturer. Follow manufacturer's guidelines for mounting specifications.

IMPORTANT: Use only Grade SAE 8 or higher grade of hardware for engine mounting.

1. Check the engine mounting brackets (A), vibration isolators, and mounting bolts on support frame and engine block for tightness. Tighten as necessary.
2. Inspect overall condition of vibration isolators, if equipped. Replace isolators, as necessary, if rubber has deteriorated or mounts have collapsed.



Engine Mounting

A—Mounting Bracket

DPSG,RG34710,103 –19–04OCT99–1/1

Clean and Inspect Crankcase Ventilation Assembly

1. Remove ventilator outlet tube from rocker arm cover (shown removed).

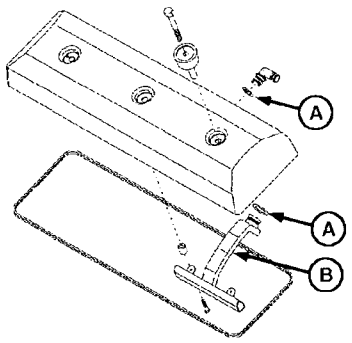
NOTE: Ventilator assembly-to-rocker cover self-tapping cap screws have been replaced by flange head cap screws with pre-applied sealant. Discard old self-tapping cap screws and replace with new cap screws.

2. Remove two cap screws securing ventilator assembly (B) to cover and remove.
3. Clean ventilator assembly in solvent and dry with compressed air.
4. Install ventilator assembly in reverse order of removal, replace O-rings (A) as necessary.
5. Tighten ventilator assembly-to-rocker arm cover cap screws to specifications.

Specification

Crankcase Vent Baffle-to-Rocker Arm Cover Cap Screws—Torque ..... 15 N•m (11 lb-ft) (133 lb-in.)

6. Install ventilator outlet tube onto elbow attached to rocker arm cover.



RG10242 –UN–20JUL99

Crankcase Ventilation Assembly

A—O-Rings
B—Ventilator Assembly

RG,RG34710,61 –19–16OCT00–1/1

Checking Air Intake System

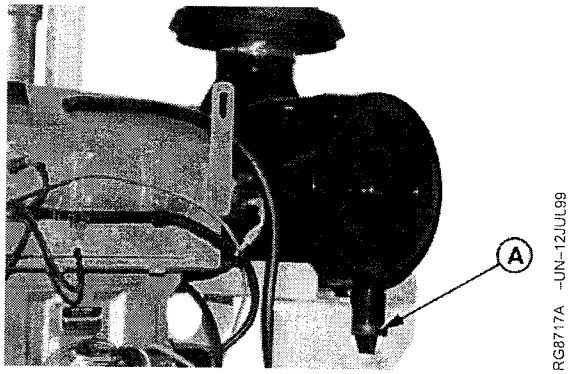
IMPORTANT: The air intake system must not leak. Any leak, no matter how small, may result in internal engine damage due to abrasive dirt and dust entering the intake system.

1. Inspect all intake hoses (piping) for cracks. Replace as necessary.
2. Check clamps on piping which connect the air cleaner to the engine. Tighten clamps as necessary. This will help prevent dirt from entering the air intake system through loose connections, causing internal engine damage.

RG,RG34710,7569 -19-04SEP02-1/3

3. If engine has a rubber dust unloader valve (A), inspect the valve on bottom of air cleaner for cracks or plugging. Replace as necessary.

A—Dust Unloader Valve



Rubber Dust Unloader Valve

Continued on next page

RG,RG34710,7569 -19-04SEP02-2/3

4. Test air restriction indicator (B) for proper operation. Replace indicator as necessary.

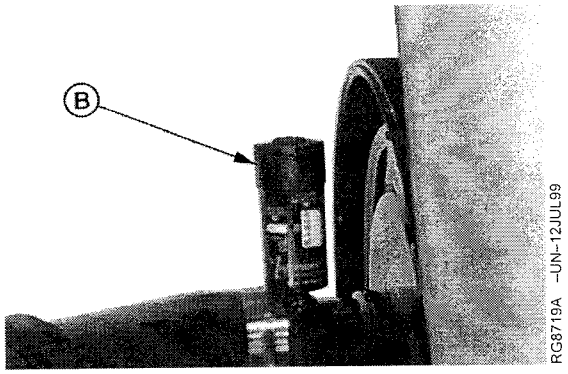
IMPORTANT: ALWAYS REPLACE primary air cleaner element when air restriction indicator is torn or visibly dirty, or when it exceeds specifications or service interval. A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine.

5. Remove and inspect primary air cleaner element. Service as necessary. (See REPLACING AIR CLEANER FILTER ELEMENTS in Service as Required section.)

   If equipped with air intake restriction indicator gauge (B), check gauge and service air cleaner if it exceeds specifications.

Specification	
Maximum Air Intake Restriction— Vacuum	25 in. (625 mm) H_2O (6.25 kPa) (0.06 bar) (1.0 psi)

If not equipped with air restriction indicator, replace air cleaner elements at 500 hours or 12 months, whichever occurs first.



Air Restriction Indicator

B—Air Restriction Indicator

RG,RG34710,7569 –19–04SEP02–3/3

Check Engine Ground Connection

Check engine ground connection to ensure it is tight and clean. See ELECTRICAL SYSTEM LAYOUT in Troubleshooting Section for ground location.

This inspection is necessary to prevent electrical arc, which can result in engine damage.

OUO1004,0000C2F –19–12DEC00–1/1

Checking Belt Tensioner Spring Tension and Belt Wear

Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioners are designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.

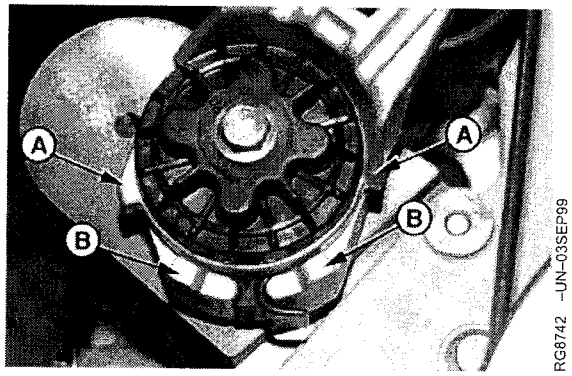
RG,RG34710,7573 –19–30JUN97–1/4

Checking Belt Wear

The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops (A and B) when correct belt length and geometry is used.

Visually inspect cast stops (A and B) on belt tensioner assembly.

If the tensioner stop on swing arm (A) is hitting the fixed stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see REPLACING FAN/ALTERNATOR V-BELTS in Service as Required section).



Upper Tensioner Shown, Lower Tensioner Similar

A—Swing Arm Cast Stops
B—Fixed Cast Stops

Continued on next page

RG,RG34710,7573 –19–30JUN97–2/4

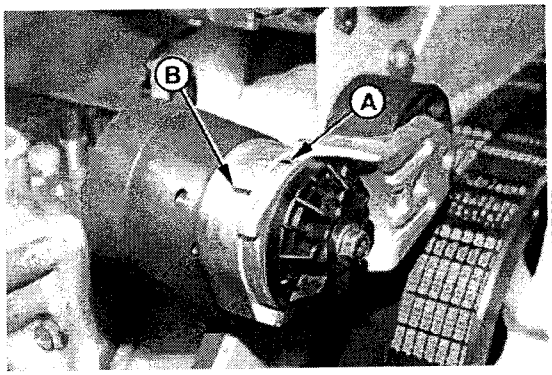
Checking Upper Tensioner Spring Tension

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

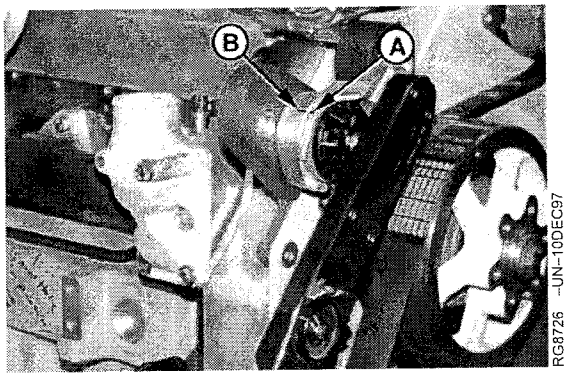
1. Release tension on belt using a long-handle 1/2-in. breaker bar in tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from first mark (A) and put a second mark (B) on tensioner mounting base.
5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Specification

Upper Spring Tension—Torque ..... 18–23 N•m (13–17 lb-ft)



Marks on Tensioner



Align Marks

A—Mark on Swing Arm
B—Mark on Tensioner Mounting Base

Continued on next page

RG,RG34710,7573 –19–30JUN97–3/4

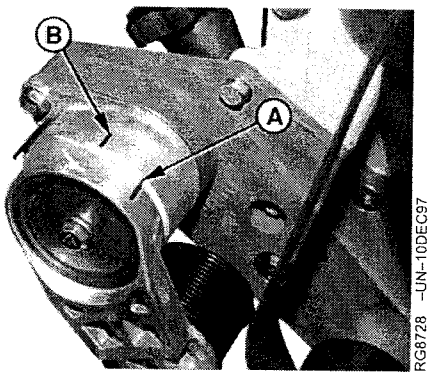
Checking Lower Tensioner Spring Tension

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

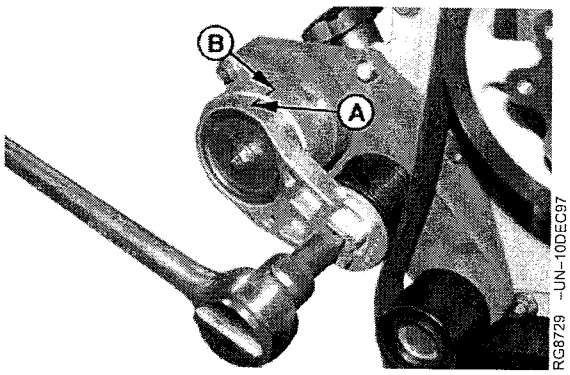
1. Release tension on belt using a long-handle 3/4-in. breaker bar in tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 25 mm (1.0 in.) from first mark (A) and put a second mark (B) on tensioner mounting base.
5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Specification

Lower Spring Tension—Torque ..... 81–99 N•m (60–73 lb-ft)



Marks on Tensioner



Align Marks

A—Mark on Swing Arm
B—Mark on Tensioner Mounting Base

RG,RG34710,7573 –19–30JUN97–4/4

Checking Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

IMPORTANT: Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.

1. Visually check entire cooling system for leaks. Tighten all clamps securely.
2. Thoroughly inspect all cooling system hoses for hard, flimsy, or cracked condition. Replace hoses if any of the above conditions are found.



High-Pressure Fluids

TS281 –UN–23AUG88

RG,RG34710,7576 –19–30JUN97–1/1

Testing Diesel Engine Coolant

Maintaining adequate concentrations of glycol and inhibiting additives in the coolant is critical to protect the engine and cooling system against freezing, corrosion, and cylinder liner erosion and pitting.

Test the coolant solution at intervals of 12 months or less and whenever excessive coolant is lost through leaks or overheating.

Coolant Test Strips

Coolant test strips are available from your John Deere dealer. These test strips provide a simple, effective method to check the freeze point and additive levels of your engine coolant.

Compare the results to the supplemental coolant additive (SCA) chart to determine the amount of inhibiting additives in your coolant and whether more John Deere COOLANT CONDITIONER should be added.

COOLSCAN

For a more thorough evaluation of your coolant, perform a COOLSCAN analysis. See your John Deere dealer for information about COOLSCAN.

DX,COOL9 -19-17FEB99-1/1

Supplemental Coolant Additives

The concentration of coolant additives is gradually depleted during engine operation. For all recommended coolants, replenish additives between drain intervals by adding a supplemental coolant additive every 12 months or as determined necessary by coolant testing.

John Deere COOLANT CONDITIONER is recommended as a supplemental coolant additive in John Deere engines.

IMPORTANT: Do not add a supplemental coolant additive when the cooling system is drained and refilled with John Deere COOL-GARD.

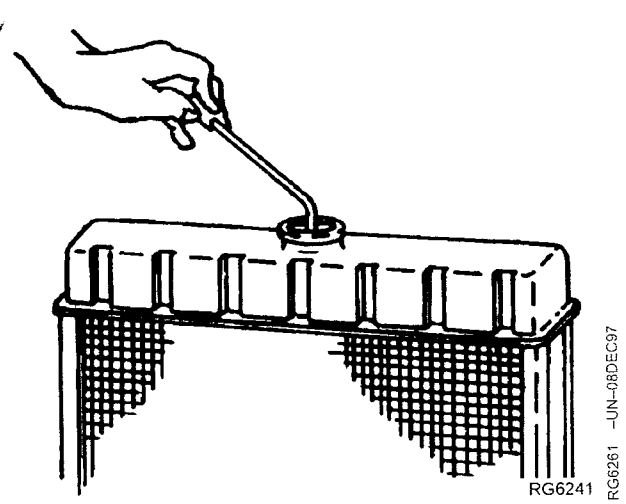
If other coolants are used, consult the coolant supplier and follow the manufacturer's recommendation for use of supplemental coolant additives.

The use of non-recommended supplemental coolant additives may result in additive drop-out and gelation of the coolant.

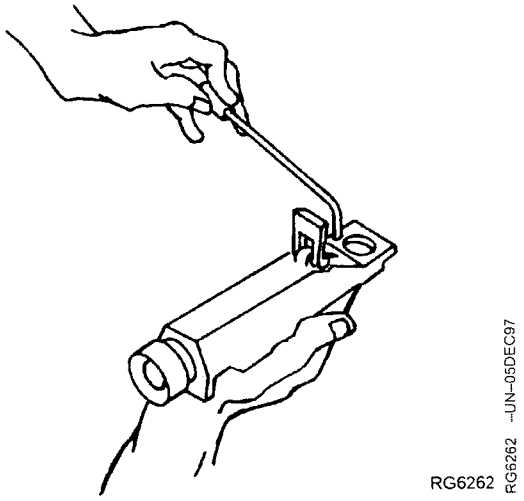
Add the manufacturer's recommended concentration of supplemental coolant additive. DO NOT add more than the recommended amount.

DX,COOL4 -19-15JUN00-1/1

Replenishing Supplemental Coolant Additives (SCAs) Between Coolant Changes



Radiator Coolant Check



JT07298 Coolant/Battery Tester

IMPORTANT: Do not add supplemental coolant additives when the cooling system is drained and refilled with John Deere ANTIFREEZE/SUMMER COOLANT or John Deere COOL-GARD®.

NOTE: If a system is to be filled with coolant that does not contain SCAs, the coolant must be precharged. Determine the total system capacity and premix with 3% John Deere Coolant Conditioner.

Through time and use, the concentration of coolant additives is gradually depleted during engine operation. Periodic replenishment of inhibitors is required, even when John Deere ANTIFREEZE/SUMMER COOLANT is used. The cooling system must be recharged with additional supplemental coolant additives available in the form of liquid coolant conditioner.

Maintaining the correct coolant conditioner concentration (SCAs) and freeze point is essential in your cooling system to protect against rust, liner pitting and corrosion, and freeze-ups due to incorrect coolant dilution.

John Deere LIQUID COOLANT CONDITIONER is recommended as a supplemental coolant additive in John Deere engines.

DO NOT mix one brand of SCA with a different brand.

Test the coolant solution at 500 hours or 12 months of operation using either John Deere coolant test strips or a COOLSCAN® analysis. If a COOLSCAN® analysis is not available, recharge system per instructions printed on label of John Deere Liquid Coolant Conditioner.

COOL-GARD is a registered trademark of Deere & Company
COOLSCAN is a registered trademark of Deere & Company.

Continued on next page

RG,01,DT7035 –19–04SEP02–1/2

IMPORTANT: ALWAYS maintain coolant at correct level and concentration. DO NOT operate engine without coolant for even a few minutes.

If frequent coolant makeup is required, the glycol concentration should be checked with JT07298 Coolant/Battery Tester to ensure that the desired freeze point is maintained. Follow manufacturer's instructions provided with refractometer.

Add the manufacturer's recommended concentration of supplemental coolant additive. DO NOT add more than the recommended amount.

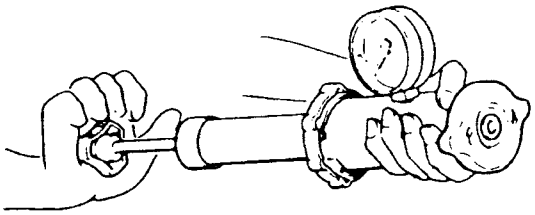
The use of non-recommended supplemental coolant additives may result in additive drop-out and gelation of the coolant.

If other coolants are used, consult the coolant supplier and follow the manufacturer's recommendation for use of supplemental coolant additives.

See DIESEL ENGINE COOLANTS AND SUPPLEMENTAL ADDITIVE INFORMATION earlier in this group for proper mixing of coolant ingredients before adding to the cooling system.

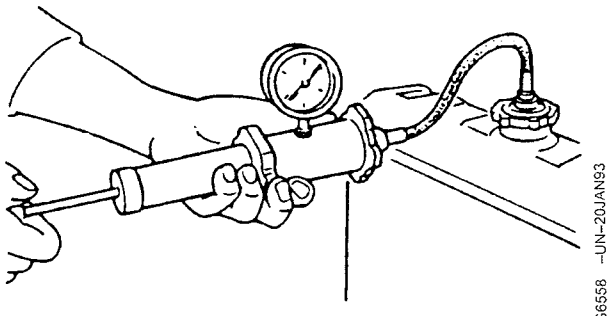
RG,01,DT7035 –19–04SEP02–2/2

Pressure Testing Cooling System



RG6557 –UN–20JAN93

D05104ST Tester



RG6558 –UN–20JAN93

Connect Gauge and Adapter to Filler Neck

A pressurized cooling system is required to protect engine from cavitation and oxidizing of coolant.

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Test Radiator Cap

1. Remove radiator cap and attach to D05104ST Tester as shown.
2. Pressurize cap to following specifications.[1]

Specification	
Radiator Cap—Test Pressure	48 kPa (0.48 bar) (7 psi)

Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable. If gauge does not hold pressure, replace radiator cap.

3. Remove the cap from gauge, turn it 180°, and retest cap. This will verify that the first measurement was accurate.

Test Cooling System

NOTE: Engine should be warmed up to test overall cooling system.

1. Allow engine to cool; carefully remove radiator cap.
2. Fill radiator with coolant to normal operating level.

IMPORTANT: DO NOT apply excessive pressure to cooling system. Doing so may damage radiator and hoses.

3. Connect gauge and adapter to filler neck. Pressurize cooling system to the following specifications.[1].

Specification	
Cooling System—Test Pressure	48 kPa (0.48 bar) (7 psi)

4. With pressure applied, check all cooling system hose connections, radiator, and engine for leaks.

   If leakage is detected, correct as necessary and pressure test system again. If no leakage is detected, but the gauge indicated a drop in pressure, contact your engine distributor or servicing dealer for further diagnostics.

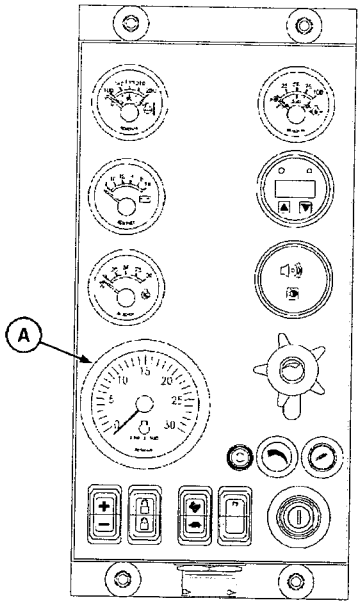
[1]Test pressures recommended are for Deere OEM cooling system for 10.5 L/12.5 L engines. On specific vehicle applications, test cooling system and pressure cap according to the recommended pressure for that vehicle.

RG,RG34710,7581 –19–05SEP02–1/1

Checking and Adjusting Engine Speeds

Observe tachometer reading (A) on the instrument panel to verify engine speeds while running engine. (Refer to FUEL SYSTEM SPECIFICATIONS in Specifications section later in this manual for engine speed specifications.)

A—Tachometer



RG9921 –UN–16NOV99

Observe Tachometer Reading

RG,RG34710,7579 –19–30JUN97–1/1

Checking Crankshaft Vibration Damper

1. Remove belts (shown removed).

IMPORTANT: The vibration damper assembly is not repairable and should be replaced every 4500 hours or 60 months, whichever occurs first.

ALWAYS replace vibration damper whenever crankshaft is replaced and at major engine overhaul. Also replace damper when a short block, complete block, or reman basic engine is installed.

2. Carefully inspect vibration damper for torn or split rubber protruding from front and back of assembly.

3. Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.

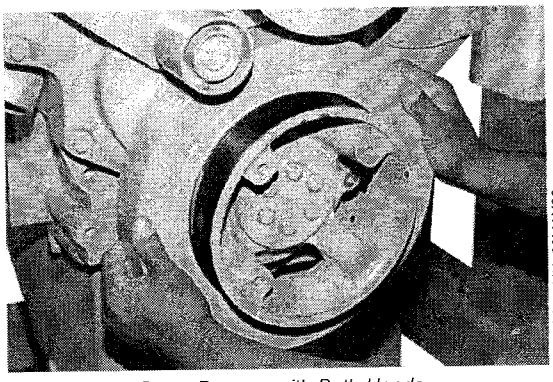
4. Check vibration damper radial runout by positioning a dial indicator so probe (A) contacts damper outer diameter.

5. With engine at operating temperature, rotate crankshaft using JDG820 Flywheel Rotation Tool.

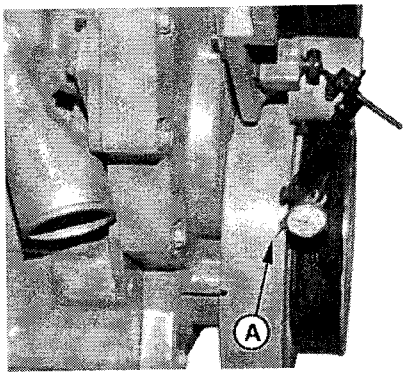
6. Note dial indicator reading. Replace vibration damper if radial runout exceeds 0.76 mm (0.030 in.).

Specification

Vibration Damper—Maximum Radial Runout	0.76 mm (0.030 in.)



Grasp Damper with Both Hands



Probe Contacts Damper Outer Diameter

A—Dial Indicator Probe

RG,RG34710,7580 –19–05SEP02–1/1

Flushing and Refilling Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



TS281 –UN–23AUG88

High-Pressure Fluids

NOTE: When John Deere COOL-GARD is used, the drain interval is 3000 hours or 36 months. The drain interval may be extended to 5000 hours or 60 months of operation, **provided that the coolant is tested annually AND additives are replenished, as needed, by adding a supplemental coolant additive (SCA).**

If COOL-GARD is not used, the flushing interval remains at 2000 hours or 24 months of operation.

Drain old coolant, flush the entire cooling system, test thermostats, and fill with recommended clean coolant.

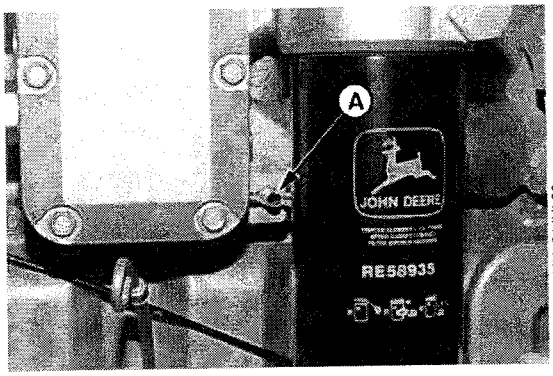
1. Pressure test entire cooling system and pressure cap if not previously done. (See PRESSURE TESTING COOLING SYSTEM, in Lubrication and Maintenance/500 Hour/12 Month section.)
2. Slowly open the engine cooling system filler cap or radiator cap to relieve pressure and allow coolant to drain faster.

Continued on next page

RG,RG34710,7582 –19–05SEP02–1/6

3. Open oil cooler housing drain valve (A) on right side of engine. Drain all coolant from engine block.

A—Drain Valve

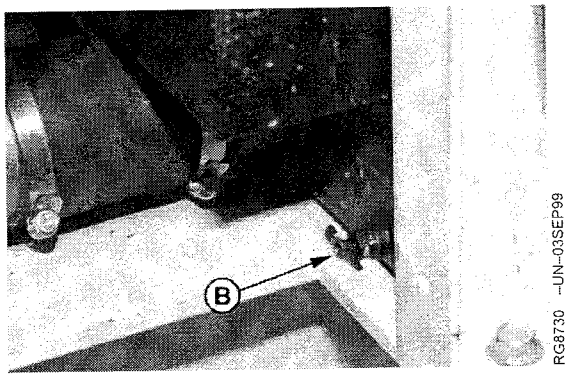


Oil Cooler Housing Drain Valve

RG,RG34710,7582 –19–05SEP02–2/6

4. Open radiator drain valve (B) and drain all coolant from radiator.

B—Drain Valve



Radiator Drain Valve

Continued on next page

RG,RG34710,7582 –19–05SEP02–3/6

5. Remove thermostats (A) at this time, if not previously done. Install cover (without thermostats) using old gasket and tighten short cap screws to specifications. Tighten three long cap screws to specifications.

Specification	
Thermostat Cover Short Cap Screws—Torque	35 N•m (26 lb-ft)
Thermostat Cover Long Cap Screws—Torque	50 N•m (37 lb-ft)

6. Test thermostat opening temperature. (See TESTING THERMOSTATS OPENING TEMPERATURE later in this section.)

7. Close all drain valves after coolant has drained.

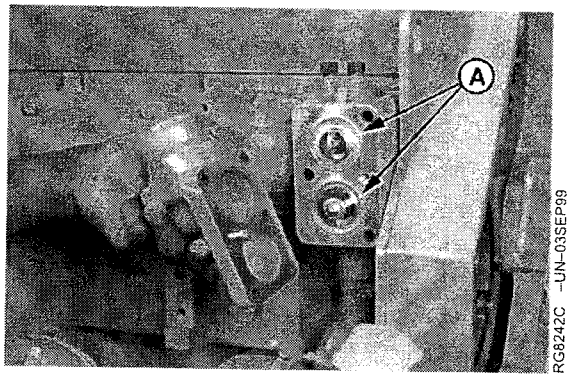
CAUTION: Do not run engine longer than 10 minutes. Doing so may cause engine to overheat which may cause burns when radiator water is draining.

8. Fill the cooling system with clean water. Run the engine about 10 minutes to stir up possible rust or sediment.

9. Stop engine, pull off lower radiator hose and remove radiator cap. Immediately drain the water from system before rust and sediment settle.

10. After draining water, close drain valves. Reinstall radiator cap and radiator hose and clamp. Fill the cooling system with clean water and a heavy duty cooling system cleaner such as FLEETGUARD® RESTORE™ and RESTORE PLUS™. Follow manufacturer's directions on label.

11. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run the engine about 10 minutes, remove radiator cap and pull off lower radiator hose, then drain out flushing water.



Remove Thermostats

A—Thermostats

FLEETGUARD is a registered trademark of Cummins Engine Company, Inc.
RESTORE is a trademark of Fleetguard Inc.
RESTORE PLUS is a trademark of Fleetguard Inc.

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RG,RG34710,7582 –19–05SEP02–4/6

12. Close all drain valves on engine and radiator. Reinstall radiator hose and tighten clamps securely. Install thermostats using a new gasket. (See TESTING THERMOSTATS OPENING TEMPERATURE later in this section.)

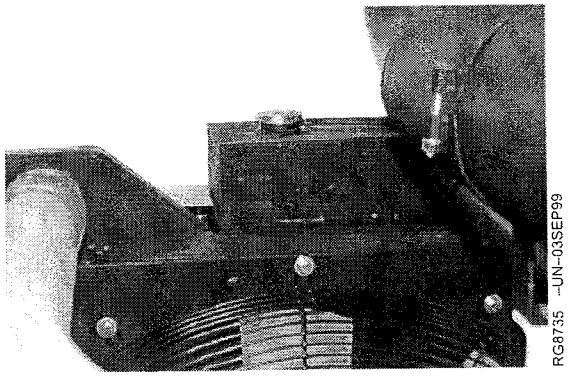
RG,RG34710,7582 -19-05SEP02-5/6

IMPORTANT: Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug after filling cooling system.

13. Add coolant to radiator until coolant touches bottom of filler neck. (See ADDING COOLANT in Service as Required section.) Install radiator cap.

14. Run engine until it reaches operating temperature. This mixes the solution uniformly and circulates it through the entire system. The normal engine coolant temperature range is 82°—94°C (180°—202°F).

15. After running engine, check coolant level and entire cooling system for leaks.



Flush Cooling System

RG,RG34710,7582 -19-05SEP02-6/6

Testing Thermostats Opening Temperature

To Remove Thermostats

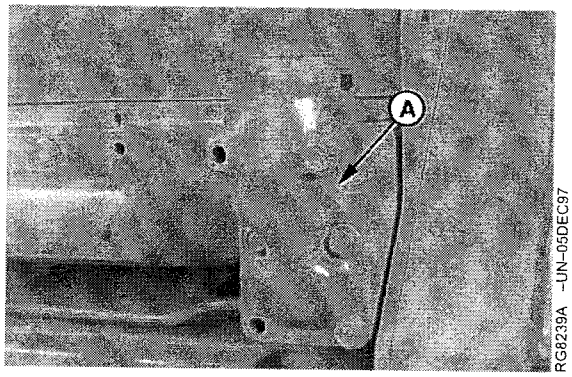
CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. DO NOT drain coolant until it has cooled below operating temperature. Always loosen radiator pressure cap or drain valve slowly to relieve pressure.

1. Visually inspect area around thermostat housing for leaks.
2. Remove radiator pressure cap and partially drain cooling system.

RG,RG34710,7588 –19–30JUN97–1/5

3. Remove four cap screws securing thermostat cover (A) to housing and remove cover.

A—Thermostat Cover



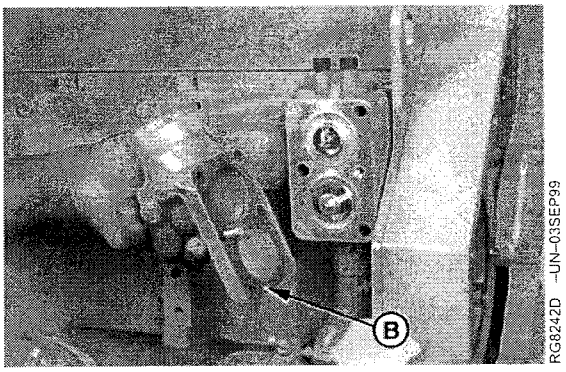
Thermostat Cover

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RG,RG34710,7588 –19–30JUN97–2/5

4. Remove gasket (B) and remove both thermostats.
5. Test each thermostat for proper opening temperature.

B—Gasket



Remove Gasket and Thermostats

Continued on next page

RG,RG34710,7588 –19–30JUN97–3/5

Testing Thermostats Opening Temperature

1. Remove thermostats.
2. Visually inspect thermostats for corrosion or damage. Replace thermostats as a matched set as necessary.
3. Inspect thermostat with wiggle wire in vent notch. If wire movement is restricted, replace thermostat if cleaning does not free movement.

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

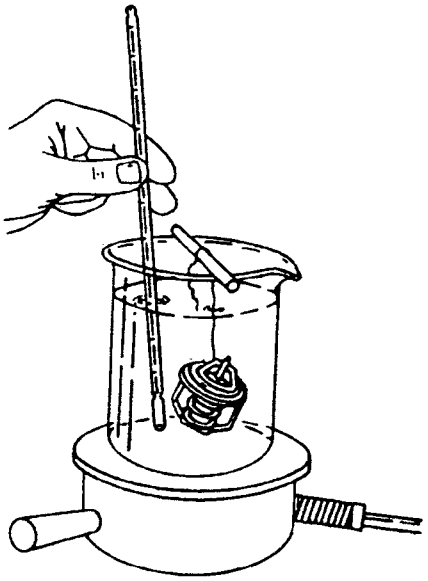
4. Suspend thermostat and a thermometer in a container of water.
5. Stir the water as it heats. Observe opening action of thermostat and compare temperatures with specification given in chart below.

NOTE: Due to varying tolerances of different supplies, initial opening and full open temperatures may vary slightly from specified temperatures.

THERMOSTAT TEST SPECIFICATIONS

Rating	Initial Opening (Range)	Full Open (Nominal)
82°C (180°F)	80—84°C (175—182°F)	94°C (202°F)

6. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.
7. If any one thermostat is defective, replace both thermostats.



RG5971 –UN–23NOV97

Thermostat and Thermometer in Water

Continued on next page

RG,RG34710,7588 –19–30JUN97–4/5

To Install Thermostats

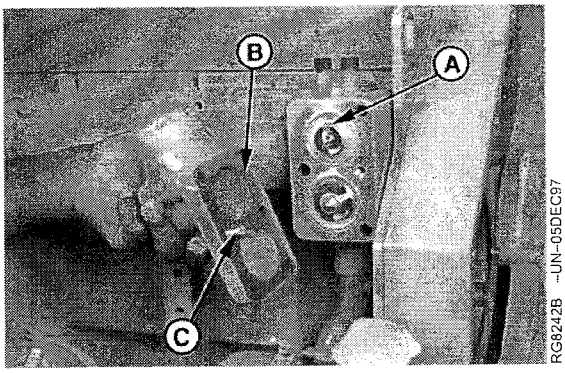
IMPORTANT: Top thermostat has a vent notch with wiggle wire (A) for air bleeding. Wiggle wire MUST BE installed at 12 o'clock position. Bottom thermostat has a blocking poppet that opens passage to radiator when coolant warms.

1. Clean all gasket material from thermostat cover and housing mounting surfaces.
2. Install smaller (non-blocking) thermostat in top position with vent (wiggle wire) (A) at 12 o'clock position as shown. Install larger blocking thermostat in bottom position.
3. Install thermostat cover using a new gasket (B).
4. Install shorter cap screw (C) securing thermostat cover-to-housing and tighten to specifications.

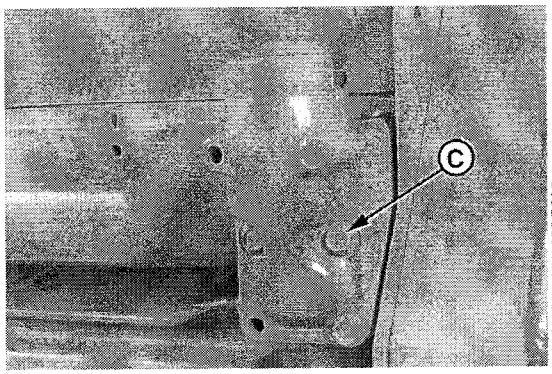
Specification	
Thermostat Cover Short Cap Screws—Torque	35 N•m (26 lb-ft)

5. Install and tighten three longer cap screws to specifications.

Specification	
Thermostat Cover Long Cap Screws—Torque	50 N•m (37 lb-ft)



Wiggle Wire for Air Bleeding



Install Shorter Cap Screw First

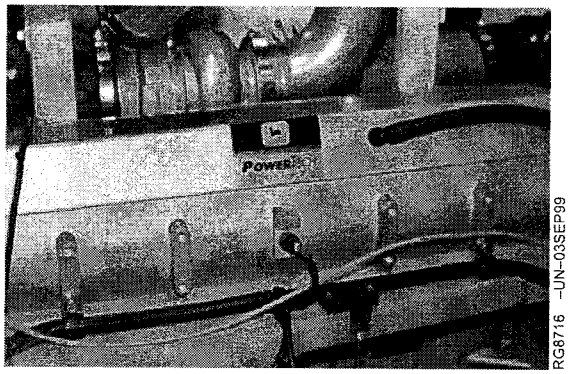
A—Wiggle Wire
B—Gasket
C—Cap Screw

RG,RG34710,7588 –19–30JUN97–5/5

Checking and Adjusting Engine Valve Clearance and Electronic Unit Injector Preload

Have your John Deere engine distributor or servicing dealer adjust intake and exhaust valve clearance and electronic unit injector (EUI) preload.

This **one-time adjustment** is required for all new and overhauled 6105 and 6125 ***POWERTECH***® OEM engines after first 2500 hours of operation.



Check Valve Clearance

POWERTECH *is a registered trademark of Deere & Company.*

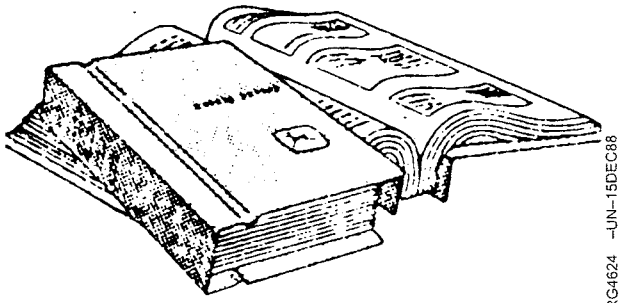
RG,RG34710,7585 –19–30JUN97–1/1

Service as Required

Additional Service Information

RG,RG34710,7586 –19–03OCT02–1/2

This is not a detailed service manual. If you want more detailed service information, refer to JOHN DEERE SERVICE LITERATURE AVAILABLE in the back of this manual to order component technical manuals, parts catalogs or extra operator's manuals.



RG4624 –UN–15DEC88

Component Technical Manual

RG,RG34710,7586 –19–03OCT02–2/2

Adding Coolant

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



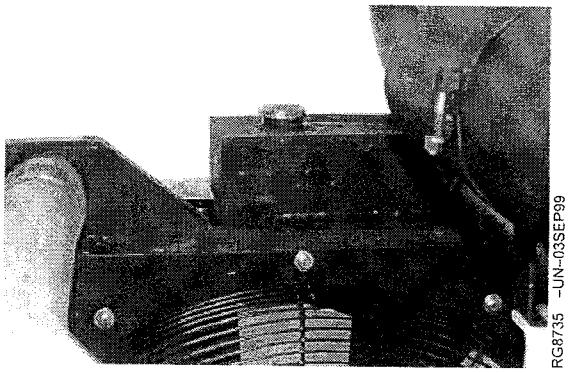
TS281 –UN–23AUG88

High-Pressure Fluid

IMPORTANT: Never pour cold liquid into a hot engine, as it may crack cylinder head or block. DO NOT operate engine without coolant for even a few minutes.

John Deere TY15161 Cooling System Sealer may be added to the radiator to stop leaks on a temporary or emergency basis only. DO NOT use any other stop-leak additives in the cooling system. Leaks should be permanently repaired as quickly as possible.

Air must be expelled from cooling system when coolant is added.



RG8735 –UN–03SEP99

Fill Cooling System

1. Loosen temperature sending unit fitting or plug in thermostat housing to allow air to escape when filling system.

IMPORTANT: When adding coolant to the system, use the appropriate coolant solution. (See DIESEL ENGINE COOLANTS, SUPPLEMENTAL ADDITIVE INFORMATION in Fuels, Lubricants, and Coolant section for mixing of coolant ingredients before adding to cooling system.)

Do not overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of radiator.

2. Fill until coolant level touches bottom of radiator filler neck.

Continued on next page

RG,RG34710,7587 –19–30JUN97–1/2

3. Check freeze temperature protection.
4. Tighten plugs and fittings after filling cooling system.
5. Run engine for 10 minutes to remove any air from system. Top off coolant level if required.

RG,RG34710,7587 –19–30JUN97–2/2

Replacing Air Cleaner Filter Elements

IMPORTANT: ALWAYS REPLACE primary air cleaner element when air restriction indicator shows a vacuum of 625 mm (25 in.) H_2O, is torn, or visibly dirty.

NOTE: This procedure applies to John Deere air cleaner kits. Refer to manufacturer's instructions for servicing air cleaners not supplied by John Deere.

1. Remove wing nut (A) and remove canister cover and primary filter assembly (B) from canister.

IMPORTANT: Remove secondary (safety) air cleaner element (E) ONLY for replacement. DO NOT attempt to clean, wash, or reuse secondary element. Replacement of secondary element is usually necessary ONLY when primary element has a hole in it or restriction indicator green dot (•) has disappeared from window.

2. Thoroughly clean all dirt from inside canister.

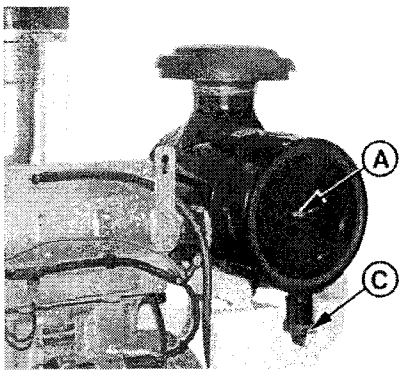
3. Squeeze dust unloader valve (C) on canister to remove all dust.

4. Observe secondary (safety) element restriction indicator/retaining nut (D). If green dot (•) has disappeared from window, replace secondary element.

5. To replace secondary element, remove restriction indicator/retaining nut and secondary element. Immediately replace secondary element with new element to prevent dust from entering air intake system. Tighten restriction indicator/retaining nut to specifications.

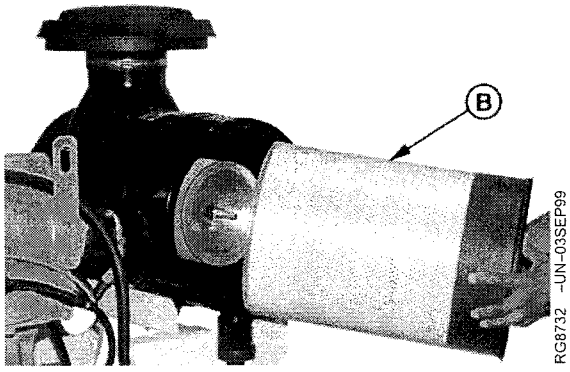
Specification

Air Filter Restriction Indicator/Retaining Nut—Torque	14 N•m (10 lb-ft)



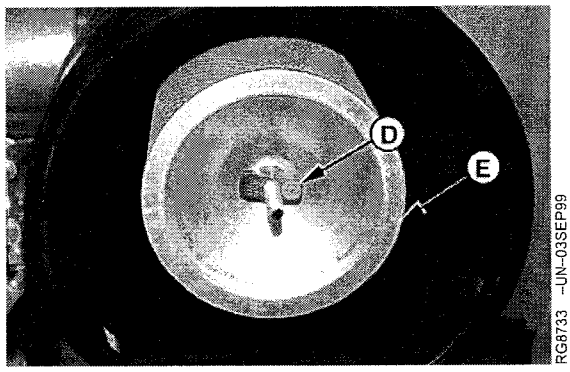
RG8731 –UN–03SEP99

Wing Nut and Unloader Valve



RG8732 –UN–03SEP99

Replacing Primary Air Filter Element



RG8733 –UN–03SEP99

Indicator/Retaining Nut for Replacing Secondary Air Filter Element

A—Wing Nut
B—Primary Filter Assembly
C—Unloader Valve
D—Restriction Indicator/Retaining Nut
E—Secondary Air Cleaner Element

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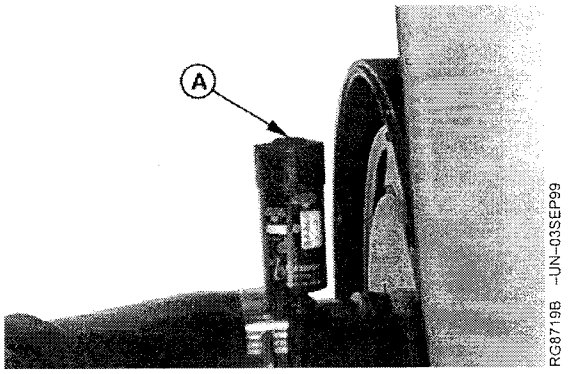
RG,RG34710,7591 –19–30JUN97–1/2

6. Install new primary assembly element and tighten wing nut securely.

IMPORTANT: Whenever the air cleaner has been serviced or had cover removed, ALWAYS fully depress the air restriction indicator reset button (if equipped) to assure accurate readings.

7. If equipped, fully depress air restriction indicator reset button (A) and release to reset indicator.

A—Air Restriction Indicator Reset Button

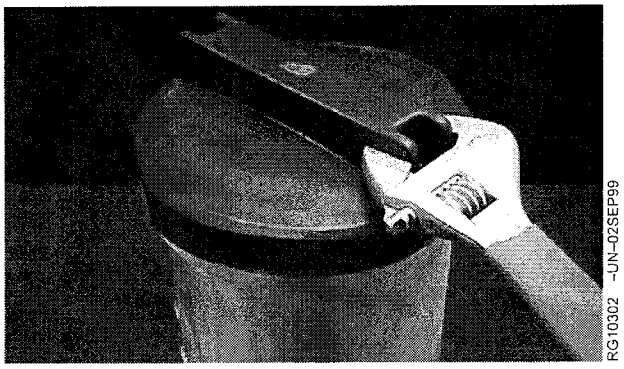


Air Restriction Indicator Reset Button

RG,RG34710,7591 –19–30JUN97–2/2

Replacing Fuel Filter/Cleaning Water Separator

IMPORTANT: Fuel filter must be replaced whenever audible alarm sounds and trouble code indicates plugged filter (fuel supply pressure moderately/extremely low). Replace fuel filter at 12-month intervals (or every 500 hours) if no alarm/code indications occur.



Remove Final Fuel Filter

Remove Old Fuel Filter Element

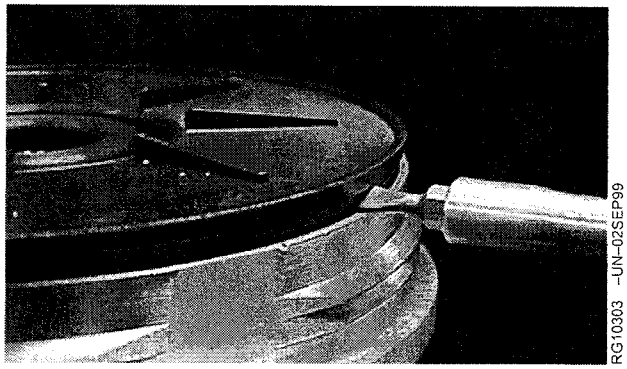
CAUTION: If engine has been running, engine and fuel filter housing may be hot.

1. Close fuel shut-off valve (if equipped).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Remove cap from fuel filter housing. If cap is too tight, a wrench or pliers may be used to loosen cap as shown.

Continued on next page

AG,OUOD007,2847 –19–04SEP02–1/5

4. Relieve vacuum in filter housing by operating hand primer until fuel filter "pops up". If filter does not "pop up" after about 30 strokes of primer, a small screwdriver may be used, as shown, to **carefully** pry under filter flange to relieve vacuum in the housing.



Relieve Vacuum

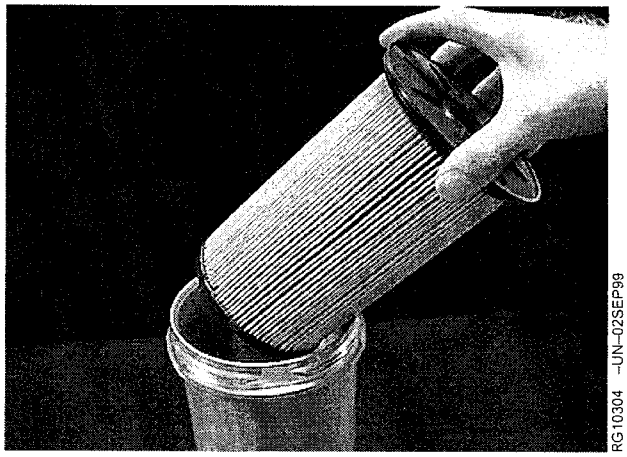
AG,OUOD007,2847 –19–04SEP02–2/5

5. Lift filter element up in housing until filter seal clears inlet tube inside housing. Continue to hold filter suspended straight up in top of housing to drain fuel from filter.

6. Allow fuel to drain completely from filter into housing. Carefully begin rotating filter from housing, as shown, until completely upside down to ensure minimum leakage from fuel filter.

7. Place filter in container suitable for diesel fuel.

IMPORTANT: Reusing fuel filter once removed from housing may result in trapped air in the filter. This may cause fuel to overflow from the filter housing during insertion of filter element, and/or cause the engine to stall and not restart without additional system purging.



Remove Filter Element

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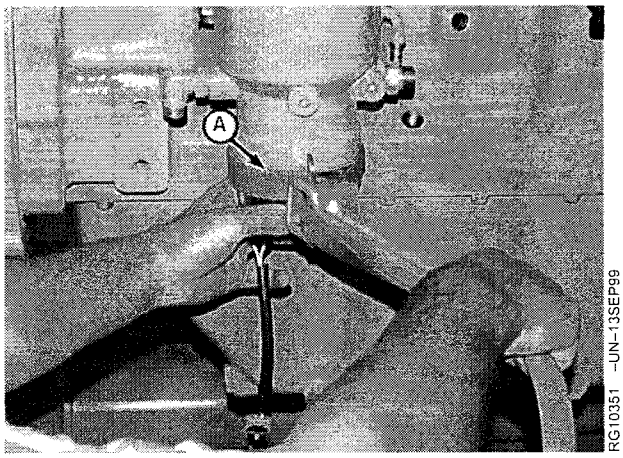
AG,OUOD007,2847 –19–04SEP02–3/5

REMOVE AND CLEAN WATER SEPARATOR BOWL

1. Disconnect wiring connector from water-in-fuel sensor.
2. Drain fuel from separator bowl.
3. Position a strap wrench (A) as close as possible to top edge of separator bowl. While applying pressure with strap wrench, grip bowl and twist with other hand as shown to remove bowl.
4. Clean separator bowl and dry it.
5. Install separator bowl and tighten by hand until seal makes contact. Hand tighten to the following specification:

Specification	
Water Separator Bowl-to-Filter Housing—Torque	5 N•m (44 lb-in.)

6. Connect wiring to water-in-fuel sensor.



Removing Water Separator Bowl

A—Strap Wrench

Continued on next page

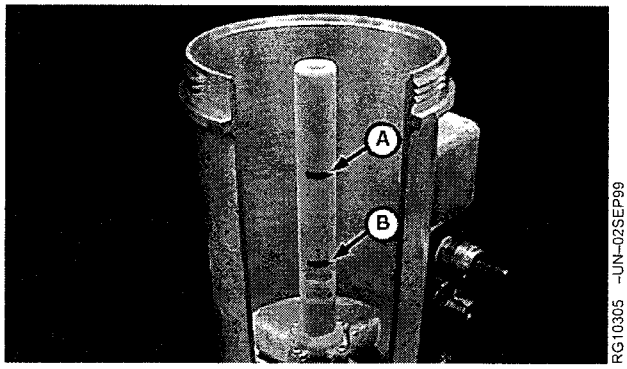
INSTALL NEW FUEL FILTER ELEMENT

1. Check to ensure that the fuel level in the filter housing is between the MIN (B) and MAX (A) fuel levels indicated on the outside of the housing and on the corresponding marks on the center tube. If the fuel is below the MIN level, carefully open the fuel supply shut-off valve a small amount (if equipped) to add fuel.

   Operate the hand primer to add more fuel if required or if the unit is not equipped with a fuel supply shut-off valve.

IMPORTANT: Fuel level below the MIN indication may result in trapped air in the filter causing the engine to stall and not restart without additional system purging. Fuel level above the MAX indication may cause fuel to overflow from the filter housing during insertion of filter element.

2. Insert new (dry) fuel filter into filter housing.
3. Reinstall fuel filter cap and tighten to "hand-tight" condition.
4. Open the fuel supply shut-off valve (if equipped).
5. Restart engine and allow to run for five minutes minimum.



Fuel Level In Filter Housing

A—Maximum Level (2-1/2 Inches from Top of Housing)
B—Minimum Level (5 Inches from Top of Housing)

AG,OUOD007,2847 –19–04SEP02–5/5

Draining Fuel Filter Water Separator Bowl

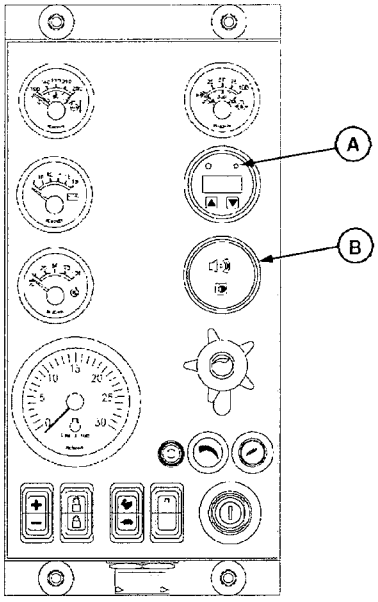
Your engine is equipped with a sensor that detects the presence of water in separator bowl mounted below fuel filter. This sensor will illuminate the red "STOP ENGINE" warning light (A) on instrument panel and also sound an audible alarm (B). A diagnostic trouble code (DTC) displayed on the diagnostic gauge will indicate that there is water in the fuel bowl (see LISTING OF DIAGNOSTIC TROUBLE CODES in Section 55).

ALWAYS STOP ENGINE IMMEDIATELY and drain water separator bowl when these warnings occur.

1. Drain water and contaminants from clear water separator sediment bowl by opening drain valve (C) and operating primer until bowl is clear of water.

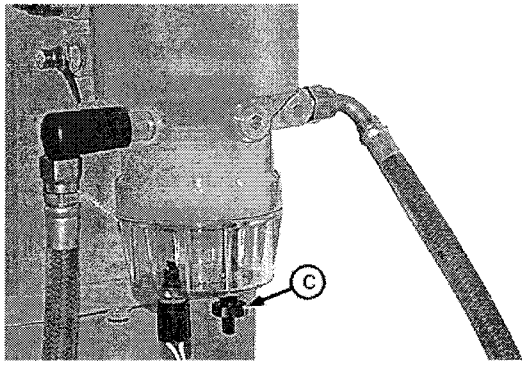
2. Close drain valve.

A—Warning Light
B—Audible Alarm
C—Drain Valve



RG9919 –UN–16NOV99

Warning Light And Audible Alarm



RG9925 –UN–10DEC99

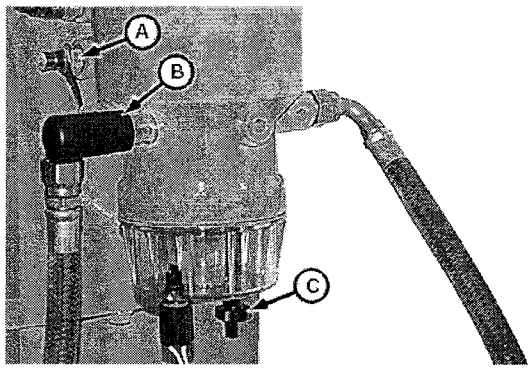
Draining Fuel Sediment Bowl

DPSG,OUOD007,2915 –19–15NOV99–1/1

Bleeding Fuel System

NOTE: Under normal conditions, fuel system bleeding is not required. Priming system with hand primer (B) is normally sufficient. If necessary to bleed the system, use the following procedure.

1. Drain water and contaminants from clear water separator sediment bowl by opening drain valve (C) and operating primer (B) until bowl is clear of water.
2. Attach an open line to diagnostic port (A) and place end of line in suitable container for diesel fuel.
3. Pump hand primer (B) until a steady flow of fuel (without bubbles) comes out of line.
4. Disconnect line from diagnostic port.
5. Start engine and run for five minutes.



RG10309 –UN–02SEP99

Bleeding Fuel System

A—Diagnostic Port
B—Hand Primer
C—Water Drain Valve

DPSG,OUOD007,2896 –19–04NOV99–1/1

Replacing Fan/Alternator V-Belts

Refer to CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR in Lubrication and Maintenance/500 Hour/12 Month section to determine if V-belts need replacing.

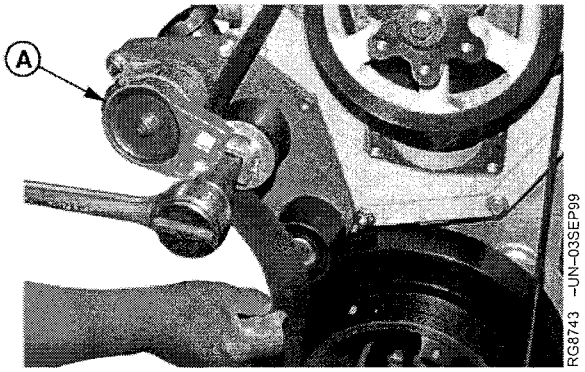
RG,RG34710,7593 –19–04SEP02–1/3

NOTE: This engine is equipped with automatic belt tensioners which do not require adjustment.

To Replace Lower V-Belt

IMPORTANT: ALWAYS replace belts as a matched set.

1. Release tension on lower belt using a 3/4-in. drive ratchet or breaker bar in lower tensioner (A).
2. Remove V-belt from pulleys and discard belt.
3. Install new belt; be sure that belt is correctly seated in all pulley grooves. (See V-BELT ROUTING, later in this section.)
4. Release belt tensioner to apply tension to belt. Remove ratchet.
5. Visually check belt alignment before starting engine.
6. Start engine and visually check belt alignment.



Lower Tensioner

A—Lower Tensioner

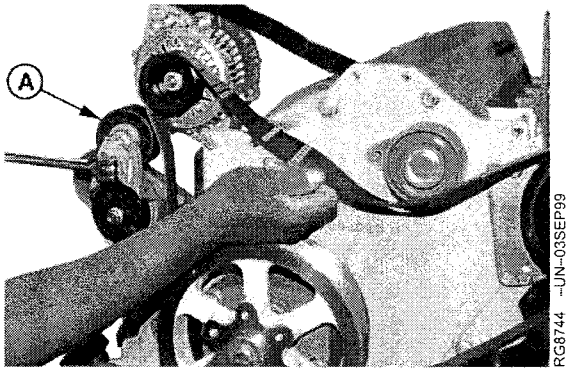
Continued on next page

RG,RG34710,7593 –19–04SEP02–2/3

To Replace Upper V-Belt

IMPORTANT: ALWAYS replace belts as a matched set.

1. Remove lower V-belt as detailed earlier.
2. Release tension on upper V-belt using a 1/2-in. drive ratchet or breaker bar in upper tensioner (A).
3. Remove V-belt from pulleys and discard belt.
4. Install new belt; be sure that belt is correctly seated in all pulley grooves. (See V-BELT ROUTING, later in this section.)
5. Slowly release belt tensioner to apply tension to belt. Remove ratchet.
6. Check belt alignment before starting engine.
7. Install lower V-belt as detailed earlier.
8. Start engine and visually check belt alignment.

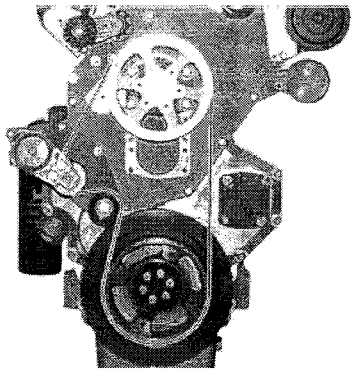


Upper Tensioner

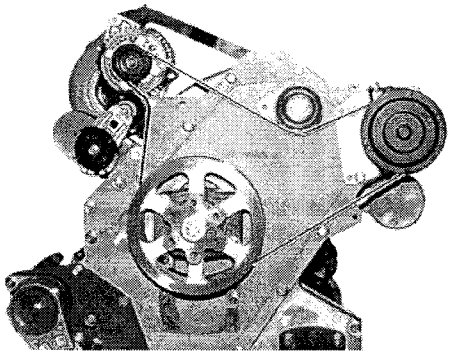
A—Upper Tensioner

RG,RG34710,7593 –19–04SEP02–3/3

V-Belt Routing



Lower V-Belt



Upper V-Belt

Lower V-belt MUST BE removed before removing upper V-belt. Reverse sequence for V-belt installation.

RG,RG34710,7595 –19–30JUN97–1/1

Checking Fuses

The following instructions apply to engines equipped with a John Deere instrument panel.

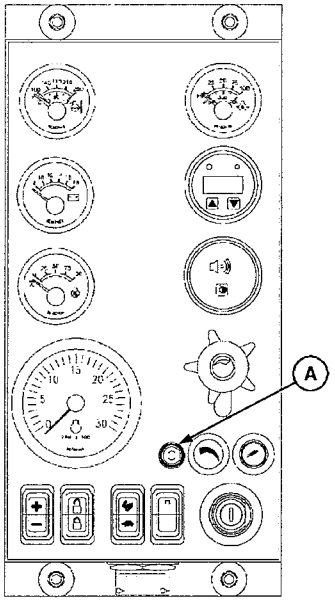
Main System Fuse (30-Amp)

This fuse is located in the engine wiring harness. See ELECTRICAL SYSTEM LAYOUT in the Troubleshooting section. (See item DD.)

1. Open fuse holder in wiring harness. (See item DD in ELECTRICAL SYSTEM LAYOUT diagram in Troubleshooting Section.)
2. Check fuse and replace as necessary with a 30-amp fuse.

Instrument Panel Fuse (5-Amp)

1. Remove fuse holder (A) on instrument panel.
2. Check fuse and replace as necessary with a 5-amp fuse.



RG9922 –UN–16NOV99

Checking Fuse

A—5-Amp Fuse Holder

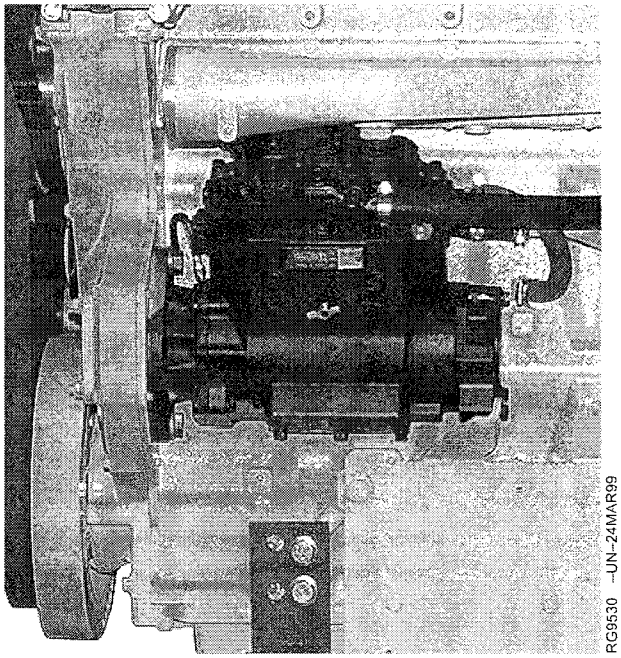
RG,RG34710,7596 –19–01DEC00–1/1

Air Compressors

Air compressors are offered as options with John Deere OEM engines to provide compressed air to operate air-powered devices like vehicle air brakes.

Air compressors are engine-driven piston types. They are either air cooled or cooled with engine coolant. The compressors are lubricated with engine oil. The compressor runs continuously as gear or spline driven by the auxiliary drive of the engine but has "loaded" and "unloaded" operating modes. This is controlled by the vehicle's air system (refer to vehicle technical manual for complete air system checks and services).

See your John Deere engine distributor or servicing dealer for diagnostic and troubleshooting information. If diagnosis leads to an internal fault in the compressor, replace the complete compressor as a new or remanufactured unit.



Air Compressor (Optional)

DPSG,RG34710,104 –19–05SEP02–1/1

Rear Power Take-Off (PTO)

CAUTION: Entanglement in rotating driveline can cause serious injury or death. Keep shield on PTO driveshaft between clutch housing and the engine driven equipment at all times during engine operation. Wear close fitting clothing. Stop the engine and be sure PTO driveline is stopped before making adjustments.

If option 9201 or 9207 is ordered to make the rear PTO compatible with other manufacturer's drivelines, be sure that proper shielding is in place before operation.



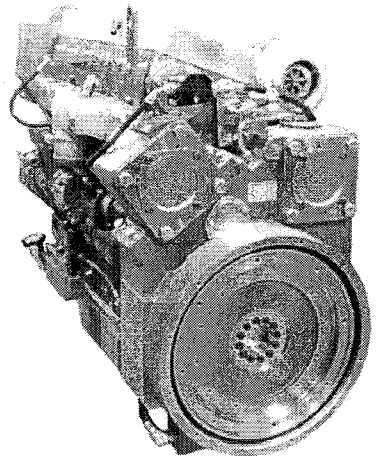
TS1644 –UN–22AUG95

Rotating Drivelines

CAUTION: Metal surfaces of PTO housing may be hot to the touch during operation or at shutdown.

The optional engine rear power take-off (PTO) from John Deere transfers engine power to auxiliary equipment or moving components which may be mounted on the vehicle or trailed behind. It is an engine-driven PTO which operates whenever the engine is running.

IMPORTANT: An additional 4.0 L (4.2 qt.) of oil must be added to the crankcase for lubrication of the rear PTO option. (See ENGINE CRANKCASE OIL FILL QUANTITIES in the Specifications section.)



RG12593 –UN–06SEP02

John Deere Rear PTO (Optional)

Proper performance of the power take-off unit will be related to the care it is given. Periodically check for any oil leaks that may occur.

If the power take-off does not work properly, contact your authorized servicing dealer or engine distributor.

OUOD006,0000065 –19–04SEP02–1/1

General Troubleshooting Information

Troubleshooting engine problems can be difficult. An engine wiring diagram is provided in this section to help isolate electrical problems on power units using John Deere wiring harness and instrument (gauge) panel.

Later in this section is a list of possible engine problems that may be encountered accompanied by possible causes and corrections. The illustrated diagrams and troubleshooting information are of a general nature; final design of the overall system for your engine application may be different. See your engine distributor or servicing dealer if you are in doubt.

The engine control unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any of the sensor input voltages are too high or too low, if the camshaft and crankshaft position sensor inputs are valid, and if the unit injector solenoids are responding properly.

If the ECU detects a problem with the electronic control system a diagnostic trouble code (DTC) specific to the failed system will be stored in the ECU's memory.

There are two types of DTC's:

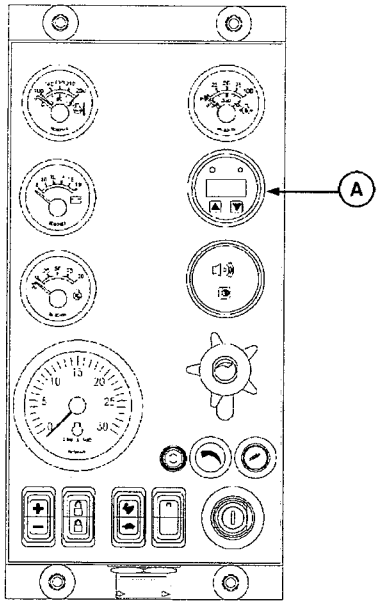
—Active

—Inactive (stored)

Active DTCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures. They can be accessed on the diagnostic gauge (A) on the instrument panel.

Inactive DTCs indicate that a failure has occurred in the past, but is not currently occurring. This type of "stored" DTC can be caused by an "intermittent" failure. These could be problems such as a bad connection or a wire intermittently shorting to ground.

If a sensor or wiring fails and a DTC is active for the sensor, the ECU will use a substitute "limp home" value in its calculations to continue engine operation.



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Diagnostic Gauge

A—Diagnostic Gauge

Continued on next page

A list of DTCs is given later in this section with a description of each. Contact your engine servicing dealer to correct any DTCs which are displayed on the instrument panel.

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Precautions for Welding on Vehicles Equipped with Electronic Engine Control Unit (ECU)

IMPORTANT: ALWAYS disconnect engine control unit (ECU) connectors and engine control system-to-vehicle ground before welding. High currents or electrostatic discharge in electronic components from welding may cause permanent damage.

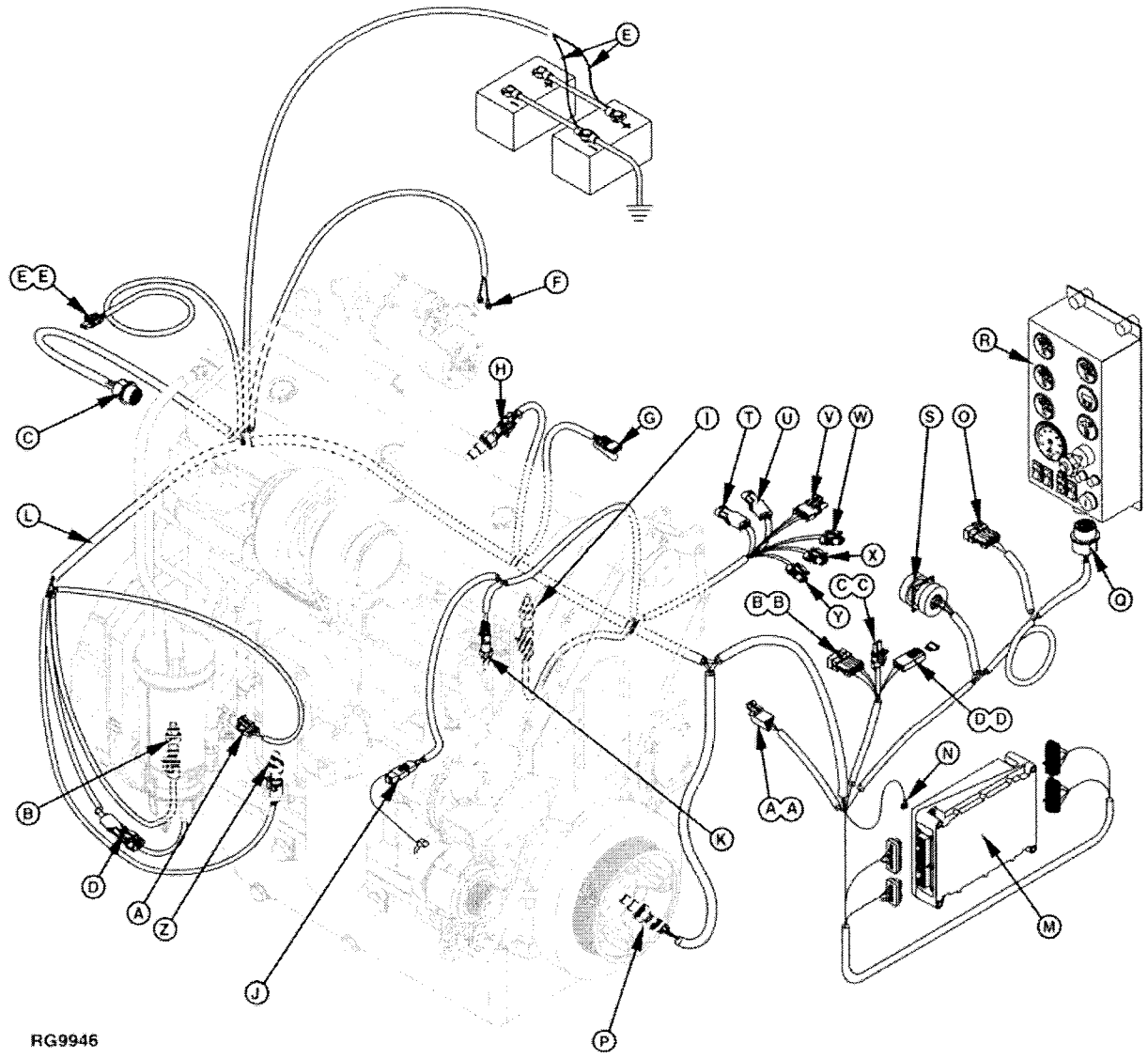


Welding Precautions

1. Remove the ground connection for the engine control system-to-vehicle frame.
2. Disconnect the connectors from the ECU.
3. Connect the welder ground close to the welding point and be sure ECU or other electronic components are not in the ground path.

DPSG,RG34710,102 –19–29SEP99–1/1

Electrical System Layout



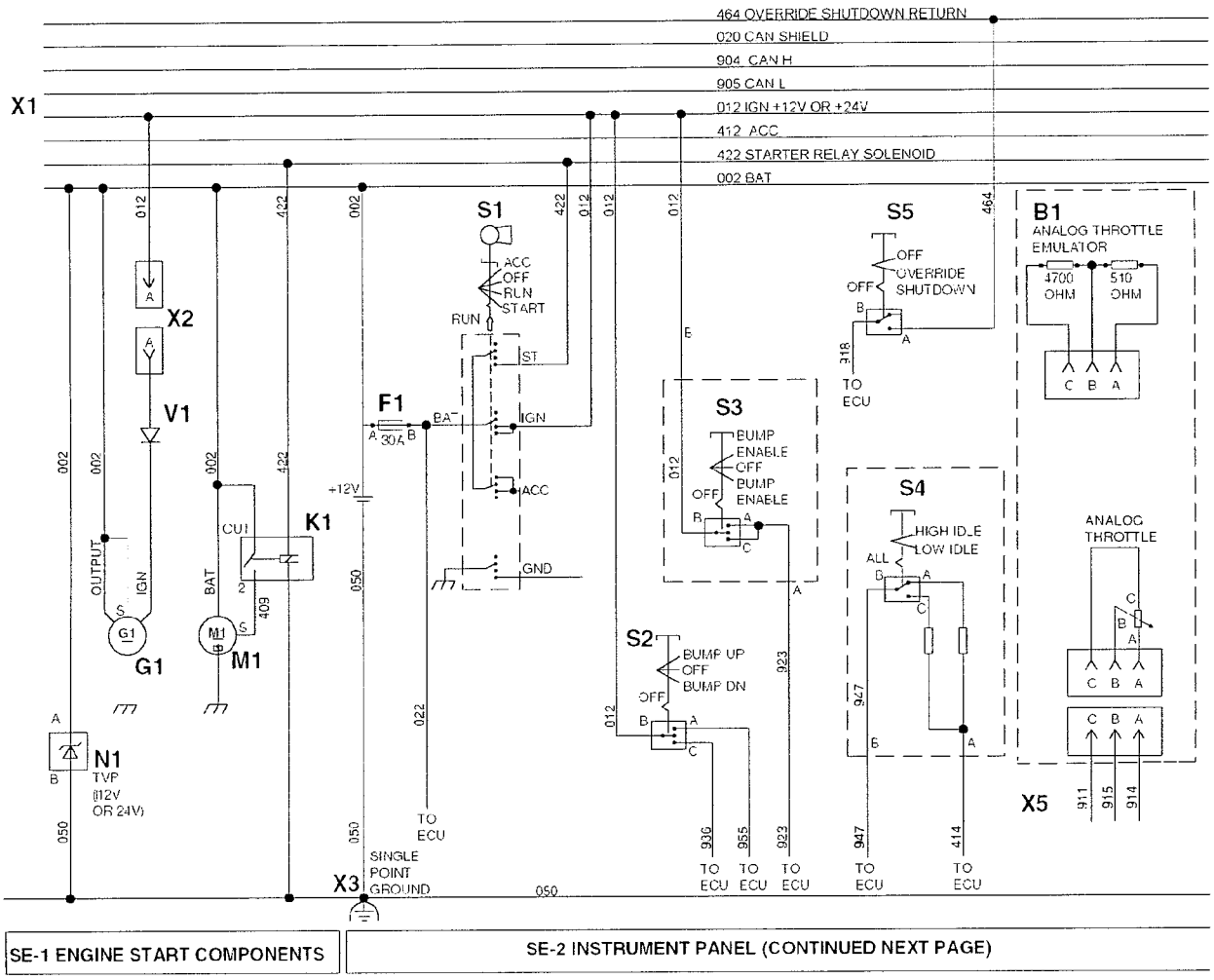
Electrical System Layout

Continued on next page

A—Fuel Pressure Sensor
B—Fuel Temperature Sensor
C—Unit Injection Connector
D—Water-in-Fuel Switch
E—Power and Ground Connections
F—Starter Relay Connections
G—Manifold Air Pressure (MAP) Sensor
H—CAM Position Sensor
I—Manifold Air Temperature (MAT) Sensor (Not Used on "A" Engines)
J—Alternator
K—Coolant Temperature Sensor
L—Engine Wire Harness
M—Engine Control Unit (ECU)—Deere
N—System Ground (ECU Must Also Be Grounded to Frame)
O—Cruise Control Connector (Not Used)
P—Crankshaft Position Sensor
Q—Instrument Panel Connector
R—Instrument Panel (Deere)
S—Diagnostic Connector
T—Auxiliary Warning Lamp Connector
U—Auxiliary Stop Engine Lamp Connector
V—Secondary Analog Throttle
W—Low Coolant Level Switch Connector
X—External Derate Switch Connector
Y—External Engine Shut Down Switch Connector
Z—Oil Pressure Sensor
AA—SAE CAN Network Connector
BB—Performance Program Connector
CC—Transient Voltage Protection (TVP) Connector
DD—Main System Fuse (30 Amp)
EE—Air Cleaner Restriction Switch Connector

DPSG,OUOD007,3449 –19–01DEC00–2/2

Engine Wiring Diagram



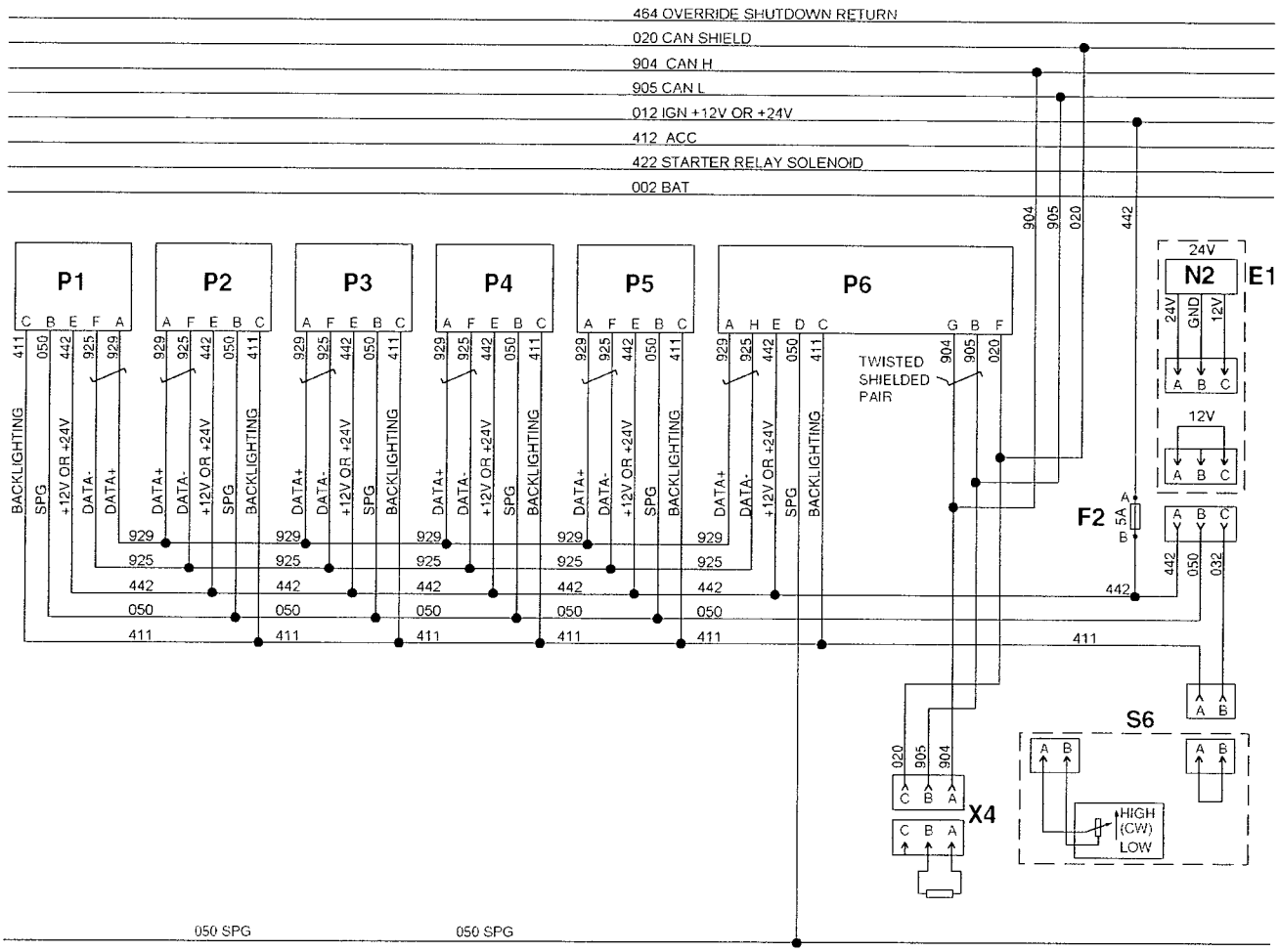
SE-1 ENGINE START COMPONENTS | SE-2 INSTRUMENT PANEL (CONTINUED NEXT PAGE)

RG9948 –19–04DEC00

B1—Analog Throttle or Emulator
E1—Back Light Regulator (24 V) or Plug (12 V)
F1—Fuse (30 Amp) (Harness)
F2—Fuse (5 Amp) (Panel)
G1—Alternator
K1—Starter Relay
M1—Starter Motor
N1—Transient Voltage Protector
N2—Voltage Regulator (for 24 V Operation)
P1—Optional Gauge
P2—Optional Gauge
P3—Oil Pressure Gauge
P4—Coolant Temperature Gauge
P5—Tachometer Display
P6—Hour Meter/Diagnostic Meter
S1—Ignition Key Switch
S2—Speed Select Switch (Momentary)
S3—Bump Enable Switch (Momentary)
S4—High-Low Speed Select Switch
S5—Override Shutdown Switch (Momentary)
S6—Dimmer Control or Jumper Plug
V1—Diode
X1—Vehicle Harness Connector
X2—Alternator Harness Connector
X3—Single Point Ground
X4—CAN Terminator
X5—Analog Throttle Connector

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Engine Wiring Diagram (Continued)



SE-2 INSTRUMENT PANEL (CONTINUED)

B1—Analog Throttle or Emulator
E1—Back Light Regulator (24 V) or Plug (12 V)
F1—Fuse (30 Amp) (Harness)
F2—Fuse (5 Amp) (Panel)
G1—Alternator
K1—Starter Relay
M1—Starter Motor
N1—Transient Voltage Protector
N2—Voltage Regulator (for 24 V Operation)
P1—Optional Gauge
P2—Optional Gauge
P3—Oil Pressure Gauge
P4—Coolant Temperature Gauge
P5—Tachometer Display
P6—Hour Meter/Diagnostic Meter
S1—Ignition Key Switch
S2—Speed Select Switch (Momentary)
S3—Bump Enable Switch (Momentary)
S4—High-Low Speed Select Switch
S5—Override Shutdown Switch (Momentary)
S6—Dimmer Control or Jumper Plug
V1—Diode
X1—Vehicle Harness Connector
X2—Alternator Harness Connector
X3—Single Point Ground
X4—CAN Terminator
X5—Analog Throttle Connector

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Engine Troubleshooting

Symptom	Problem	Solution
Engine Will Not Crank	Weak battery	Replace battery.
	Corroded or loose battery connections	Clean battery terminals and connections.
	Defective main switch or start safety switch	Repair switch as required.
	Starter solenoid defective	Replace solenoid.
	Starter defective	Replace starter.
Hard to Start or Will Not Start	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Slow cranking speed	Check for problem in the charging/starting system.
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic control system problem or basic engine problem	See your John Deere engine distributor or servicing dealer.
Engine Misfiring or Runs Irregularly	Electronic control system problem or basic engine problem	See your John Deere engine distributor or servicing dealer.
Lack of Engine Power	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Improper crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic control system problem or basic engine problem	See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
Black or Gray Exhaust Smoke	Engine overloaded	Reduce engine load.
	Engine burning oil	See LUBRICATION SYSTEM TROUBLESHOOTING, later in this section.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Defective muffler/exhaust piping (causing back-pressure)	Replace muffler or defective piping.
	Electronic control system problem or basic engine problem	See your John Deere engine distributor or servicing dealer.
White Exhaust Smoke	Engine compression too low	Determine cause of low compression and repair as required. See your John Deere engine distributor or servicing dealer.
	Defective thermostat(s) (does not close)	Test thermostats; replace thermostats as required. (See Service as Required section.)
	Coolant entering combustion chamber (failed cylinder head gasket or cracked cylinder head)	Repair or replace as required. See your John Deere engine distributor or servicing dealer.
	Failed water-to-air aftercooler (6105AF & 6125AF engines only)	Remove and inspect water-to-air aftercooler. See your John Deere engine distributor or servicing dealer.
Engine Idles Poorly	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Air leak on suction side of air intake system	Check hose and pipe connections for tightness; repair as required.
	Electronic control system problem or basic engine problem	See your John Deere engine distributor or servicing dealer.

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Engine Troubleshooting (Continued)

Symptom	Problem	Solution
Excessive Fuel Consumption	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Compression too low	Determine cause of low compression and repair as required.
	Leaks in fuel supply system	Locate source of leak and repair as required.
Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See your John Deere engine distributor or servicing dealer.
	Excessive crankshaft end play	Check crankshaft end play. See your John Deere engine distributor or servicing dealer.
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See your John Deere engine distributor or servicing dealer.
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See your John Deere engine distributor or servicing dealer.
	Scored pistons	Inspect pistons. See your John Deere engine distributor or servicing dealer.
	Worn timing gears or excess backlash	Check timing gear backlash. See your John Deere engine distributor or servicing dealer.
	Excessive valve clearance	Check and adjust valve clearance. See your John Deere engine distributor or servicing dealer.

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Symptom	Problem	Solution
Abnormal Engine Noise	Worn camshaft lobes	Inspect camshaft. See your John Deere engine distributor or servicing dealer.
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See your John Deere engine distributor or servicing dealer.
	Insufficient engine lubrication	See LUBRICATION SYSTEM TROUBLESHOOTING, later in this section.
	Turbocharger noise	See AIR INTAKE SYSTEM TROUBLESHOOTING, later in this section.

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Lubrication System Troubleshooting

Symptom	Problem	Solution
Low Oil Pressure	Low crankcase oil level	Fill crankcase to proper oil level.
	Clogged oil cooler or filter	Remove and inspect oil cooler. See your John Deere engine distributor or servicing dealer.
	Excessive oil temperature	Remove and inspect oil cooler. See your John Deere engine distributor or servicing dealer.
	Defective oil pump	Remove and inspect oil pump. See your John Deere engine distributor or servicing dealer.
	Incorrect oil	Drain crankcase and refill with correct oil.
	Oil pressure regulating valve failure	Remove and inspect oil pressure regulating valve. See your John Deere engine distributor or servicing dealer.
	Broken piston spray jet	Replace piston spray jet. See your John Deere engine distributor or servicing dealer.
	Clogged oil pump screen or cracked pick-up tube	Remove oil pan and clean screen/replace pick-up tube.
	Excessive main or connecting rod bearing clearance	Determine bearing clearance. See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
High Oil Pressure	Improper oil classification	Drain crankcase and refill with correct oil.
	Oil pressure regulating valve bushing loose (wanders)	Remove and inspect oil pressure regulating valve. See your John Deere engine distributor or servicing dealer.
	Improperly operating regulating valve	Remove and inspect oil pressure regulating valve. See your John Deere engine distributor or servicing dealer.
	Plugged piston spray jet	Replace piston spray jet. See your John Deere engine distributor or servicing dealer.
	Stuck or damaged filter bypass valve	Remove and inspect filter bypass valve. See your John Deere engine distributor or servicing dealer.
	Stuck or damaged oil cooler bypass valve	Remove and inspect oil cooler bypass valve. See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
Excessive Oil Consumption	Too low viscosity crankcase oil	Drain crankcase and refill with correct viscosity oil.
	Crankcase oil level too high	Drain oil until oil level is correct.
	External oil leak(s)	Determine source of oil leak(s) and repair as required.
	Oil control rings worn or broken	Replace piston rings. See your John Deere engine distributor or servicing dealer.
	Scored cylinder liners or pistons	Remove and inspect cylinders and liners; replace as required. See your John Deere engine distributor or servicing dealer.
	Worn valve guides or stems	Inspect and measure valve stems and valve guides; repair as required. See your John Deere engine distributor or servicing dealer.
	Excessive oil pressure	See High Oil Pressure above.
	Piston ring grooves excessively worn	Remove and inspect pistons. See your John Deere engine distributor or servicing dealer.
	Piston rings sticking in ring grooves	Remove and inspect pistons. See your John Deere engine distributor or servicing dealer.
	Insufficient piston ring tension	Remove and inspect pistons. See your John Deere engine distributor or servicing dealer.
	Piston ring gaps not staggered	Remove and inspect pistons. See your John Deere engine distributor or servicing dealer.
	Front and/or rear crankshaft oil seal faulty	Replace oil seals. See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
		See LOW PRESSURE FUEL SYSTEM TROUBLESHOOTING later in this section.
Fuel in Oil		See LOW PRESSURE FUEL SYSTEM TROUBLESHOOTING later in this section.
Coolant in Oil		See COOLING SYSTEM TROUBLESHOOTING later in this section.

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Cooling System Troubleshooting

Symptom	Problem	Solution
Engine Overheats	Lack of coolant in cooling system	Fill cooling system to proper level.
	Radiator core and/or side screens dirty	Clean radiator as required.
	Engine overloaded	Reduce engine load.
	Too low crankcase oil level	Fill crankcase to proper oil level.
	Loose or defective fan belt	Replace fan belt as required. Check belt tensioner. (See Lubrication and Maintenance 500 Hour/12 Month section.)
	Defective thermostat(s)	Test thermostat opening temperature; replace thermostats as required. (See Service as Required section.)
	Damaged cylinder head gasket	Replace cylinder head gasket. See your John Deere engine distributor or servicing dealer.
	Defective coolant pump	Replace coolant pump. See your John Deere engine distributor or servicing dealer.
	Defective radiator cap	Replace radiator cap as required.

Continued on next page

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Symptom	Problem	Solution
Coolant in Crankcase	Cylinder head gasket defective	Replace cylinder head gasket. See your John Deere engine distributor or servicing dealer.
	Cylinder head or block cracked	Locate crack, repair/replace components as required.
	Cylinder liner seals leaking	Remove and inspect cylinder liners. See your John Deere engine distributor or servicing dealer.
	Leaking oil cooler	Pressure test oil cooler; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Defective oil cooler O-rings	Remove and inspect oil cooler O-rings; replace as required. See your John Deere engine distributor or servicing dealer.
	Faulty coolant pump seal; weep hole plugged; coolant leaking through bearing	Replace coolant pump seals. See your John Deere engine distributor or servicing dealer.
	Inadequate swage on injector sleeve	Replace injector sleeve. See your John Deere engine distributor or servicing dealer.
	Faulty injector sleeve O-ring and EUI O-rings faulty	Remove suspected EUI; replace O-rings as required. See your John Deere engine distributor or servicing dealer.
Coolant Temperature Below Normal	Defective thermostat(s)	Test thermostats; replace thermostats as required. (See Service as Required section.)

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Air Intake System Troubleshooting

If turbocharger requires replacement, determine what caused the failure of the defective unit, and correct the condition. This will prevent an immediate repeat failure of the replacement unit.

Symptom	Problem	Solution
Hard to Start or Will Not Start		See ENGINE TROUBLESHOOTING earlier in this section.
Engine Misfiring or Runs Irregularly		See ENGINE TROUBLESHOOTING earlier in this section.
Black or Grey Exhaust Smoke		See ENGINE TROUBLESHOOTING earlier in this section.
Lack of Engine Power		See ENGINE TROUBLESHOOTING earlier in this section.
Turbocharger "Screams"	Air leak in intake manifold.	Check intake manifold gasket and manifold; repair as required. See your John Deere engine distributor or servicing dealer.
Turbocharger Noise or Vibration *NOTE: Do not confuse the whine heard during run down with noise which indicates a bearing failure.*	Bearings not lubricated (insufficient oil pressure)	Determine cause of lack of lubrication; repair as required. See your John Deere engine distributor or servicing dealer.
	Air leak in engine intake or exhaust manifold	Check intake and exhaust manifold gaskets and manifolds; repair as required. See your John Deere engine distributor or servicing dealer.
	Improper clearance between turbine wheel and turbine housing	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Broken blades (or other wheel failures)	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
Oil on Turbocharger Compressor Wheel or in Compressor Housing (Oil Being Pushed or Pulled through Center Housing)	Excessive crankcase pressure.	Determine cause of excessive crankcase pressure; repair as required. See your John Deere engine distributor or servicing dealer.
	Air intake restriction	Determine cause of intake restriction; repair as required. See your John Deere engine distributor or servicing dealer.
	Drain tube restriction	Determine cause of drain tube restriction; repair as required. See your John Deere engine distributor or servicing dealer.
Oil in Intake Manifold or Dripping from Turbocharger Housing	Excessive crankcase pressure	Determine cause of excessive crankcase pressure; repair as required. See your John Deere engine distributor or servicing dealer.
	Air intake restriction	Determine cause of intake restriction; repair as required. See your John Deere engine distributor or servicing dealer.
	Drain tube restriction	Determine cause of drain tube restriction; repair as required. See your John Deere engine distributor or servicing dealer.
	Damaged or worn housing bearings	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Unbalance of rotating assembly	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Damage to turbine or compressor wheel or blade	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Dirt or carbon build-up on wheel or blade	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.

Continued on next page

Symptom	Problem	Solution
	Bearing wear	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Oil starvation or insufficient lubrication	Determine cause of lack of lubrication; repair as required. See your John Deere engine distributor or servicing dealer.
	Shaft seals worn	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
Turbocharger Turbine Wheel Drag	Carbon build-up behind turbine wheel caused by coked oil or combustion deposits	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Dirt build-up behind compressor wheel caused by air intake leaks	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.
	Bearing seizure or dirty, worn bearings	Inspect turbocharger; repair/replace as required. See your John Deere engine distributor or servicing dealer.

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Low Pressure Fuel System Troubleshooting

Symptom	Problem	Solution
Fuel in Oil	Cracked or worn electronic unit injector (EUI) O-ring	Remove suspected EUI; replace EUI O-ring as required. See your John Deere engine distributor or servicing dealer.
	Cracked cylinder head	Locate crack; repair/replace components as required. See your John Deere engine distributor or servicing dealer.
Fuel Aeration	EUI hold-down clamp loose	Tighten hold-down clamp cap screw to proper torque. See your John Deere engine distributor or servicing dealer.
	Cracked or worn electronic unit injector (EUI) O-ring	Remove suspected EUI; replace EUI O-ring as required. See your John Deere engine distributor or servicing dealer.
Fuel Pressure Low	Plugged fuel filter	Replace fuel filter.
	Restricted fuel line	Locate restriction; repair as required.
	Faulty fuel transfer pump	Remove fuel transfer pump; repair/replace pump as required. See your John Deere engine distributor or servicing dealer.

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Trouble Code Diagnostic Procedure

IMPORTANT: Care should be used during diagnostic procedures to avoid damaging the terminals of connectors, sensors, and actuators. Probes should not be poked into or around the terminals or damage will result. Probes should only be touched against the terminals to make measurements.

Diagnosis of the electronic control system should be performed according to the following procedure:

1. Make sure all engine mechanical and other systems not related to the electronic control system are operating properly.

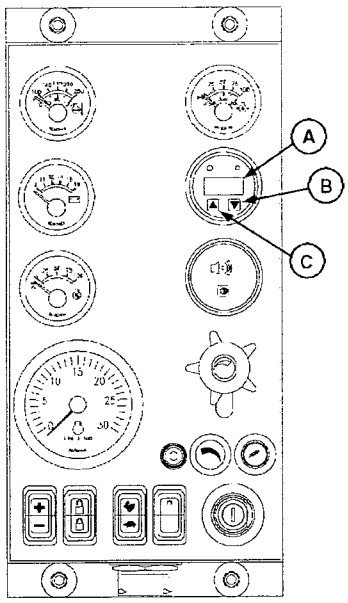
NOTE: Liquid crystal display [LCD] (A) will always default to last menu item. If an active DTC is present, display will alternately flash from the normal display to "SrvcCode".

The SPN number will appear on the first line and the FMI number on the second line. Active DTC(s) can be viewed by selecting "SrvcCode" on the menu and pressing both touch switches at the same time. Pressing touch switches (B) and (C) scrolls through various engine parameters and diagnostic trouble codes.

2. Read and record DTC(s) displayed on LCD of diagnostic gauge. (See VIEWING ACTIVE ENGINE SERVICE CODES (DTCs), earlier in this manual.

3. Go to the LISTING OF DIAGNOSTIC TROUBLE CODES (DTCs) later in this section, to interpret to the DTC(s) present.

4. Contact your nearest engine distributor or servicing dealer with a list of DTC(s) so that necessary repairs can be made.



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Diagnostic Trouble Code Display and Touch Switches

A—Liquid Crystal Display
B—Touch Switch
C—Touch Switch

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Listing of Diagnostic Trouble Codes (DTC)

The diagnostic trouble codes (DTCs) are output on the diagnostic gauge according to the J1939 Standard as a two-part code. The first part is a two-to-four-digit suspect parameter number (SPN) code followed by a one- or two-digit failure mode identifier (FMI) code. When a trouble code appears, it will be on the first line of the gauge readout. (The second line will read "SrvcCode".)

Following is a list of SPNs, FMIs, and a description of diagnostic trouble codes (DTCs) that can occur in the electronic control system. Not all of these codes will be present in all engine applications.

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Listing Of Diagnostic Trouble Codes (DTC) (Continued)

SPN	FMI	Description
28	03	Throttle # 3 Input High
28	04	Throttle # 3 Input Low
29	03	Throttle # 2 Input High
29	04	Throttle # 2 Input Low
91	03	Throttle # 1 Input High
91	04	Throttle # 1 Input Low
91	08	Throttle # 1 Abnormal Pulse Width
91	09	Throttle # 1 CAN Invalid
94	01	Fuel Supply Pressure Extremely Low
94	03	Fuel Supply Pressure Input Voltage High
94	04	Fuel Supply Pressure Input Voltage Low
94	16	Fuel Supply Pressure Moderately High
94	18	Fuel Supply Pressure Moderately Low
97	00	Water in Fuel Continuously Detected
97	03	Water in Fuel Signal Voltage High
97	04	Water in Fuel Signal Voltage Low
97	16	Water in Fuel Detected
97	31	Water in Fuel Detected
100	01	Engine Oil Pressure Extremely Low
100	03	Engine Oil Pressure Input Voltage High
100	04	Engine Oil Pressure Input Voltage Low
100	18	Engine Oil Pressure Moderately Low
102	03	Manifold Air Pressure Input Voltage High
102	04	Manifold Air Pressure Input Voltage Low
105	03	Manifold Air Temperature Input Voltage High
105	04	Manifold Air Temperature Input Voltage Low
105	16	Manifold Air Temperature Moderately High
107	00	Air Filter Restriction High
107	31	Air Filter Restriction High
110	00	Engine Coolant Temperature Extremely High
110	03	Engine Coolant Temperature Input Voltage High
110	04	Engine Coolant Temperature Input Voltage Low
110	15	Engine Coolant Temperature High (Least Severe)
110	16	Engine Coolant Temperature Moderately High
111	01	Engine Coolant Level Low
158	17	ECU Power Down Error
174	03	Fuel Temperature Input Voltage High
174	04	Fuel Temperature Input Voltage Low
611	03	Injector Wiring Shorted to Power Source
611	04	Injector Wiring Shorted to Ground
620	03	Sensor Supply Voltage High
620	04	Sensor Supply Voltage Low

(continued on next page)

Listing of Diagnostic Trouble Codes (DTCs) (Continued)

SPN	FMI	Description
627	01	Injector Supply Voltage Problem
629	12	ECU Error
629	13	ECU Error
636	02	Cam Position Input Noise
636	08	Cam Position Input Missing
636	10	Cam Position Input Pattern Error
637	02	Crank Position Input Noise
637	07	Crank Position/Cam Position Out of Sync
637	08	Crank Position Input Missing
637	10	Crank Position Input Pattern Error
639	13	CAN (Network) Error
651	05	Cylinder # 1 EUI Circuit Open
651	06	Cylinder # 1 EUI Circuit Shorted
652	05	Cylinder # 2 EUI Circuit Open
652	06	Cylinder # 2 EUI Circuit Shorted
653	05	Cylinder # 3 EUI Circuit Open
653	06	Cylinder # 3 EUI Circuit Shorted
654	05	Cylinder # 4 EUI Circuit Open
654	06	Cylinder # 4 EUI Circuit Shorted
655	05	Cylinder # 5 EUI Circuit Open
655	06	Cylinder # 5 EUI Circuit Shorted
656	05	Cylinder # 6 EUI Circuit Open
656	06	Cylinder # 6 EUI Circuit Shorted
970	02	Auxiliary Engine Shutdown Switch Signal Invalid
970	31	Auxiliary Engine Shutdown Switch Active
971	31	External Fuel Derate Switch Active
1109	31	Engine Shutdown Warning
1110	31	Engine Shutdown
1569	31	Fuel Derate
2000	13	Security Violation

NOTE: The diagnostic gauge can have communication problems that result in error codes being shown on its LCD display window. The following error codes all indicate that there is a diagnostic gauge communication error with the ECU. Contact your servicing dealer for help in correcting these codes.

EE — Error	XXXXX — EP No Data
ACP — Err No Addr	XXXXX — BO No Data
ACP — Err BUS — EP	XXXXX — BR No Data

RG,RG34710,7607 –19–27SEP02–1/1

Intermittent Fault Diagnostics

Intermittent faults are problems that periodically "go away". A problem such as a terminal that intermittently doesn't make contact can cause an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors, since a high percentage of intermittent problems originate here. Check for loose, dirty or disconnected connectors. Inspect the wiring routing, looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity, looking for wires that have pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged splices and terminals. Look for broken wires, damaged splices, and wire-to-wire shorts. Use good judgement if component replacement is thought to be required.

NOTE: The engine control unit (ECU) is the component LEAST likely to fail.

Suggestions for diagnosing intermittent faults:

- If diagnostic charts on preceding pages indicate that the problem is intermittent, try to reproduce the operating conditions that were present when the diagnostic trouble code (DTC) set. When a DTC sets, the ECU stores a freeze frame of the data parameter values the instant the DTC sets. Observing these values on the diagnostic gauge can help determine the operating conditions when the fault occurred. In addition, the diagnostic gauge includes a function called Snap Shot. The Snap Shot function permits the recording of data parameter values during a diagnostic session. The Snap Shot mode can be set up so that its recording is "triggered" by the setting of a fault code.
- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DTCs, then check the connection or wire by wiggling it while watching the diagnostic gauge to see if the fault resets.

Possible causes of intermittent faults:

- Faulty connection between sensor or actuator harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc., can cause faulty signals to be sent to the ECU.

NOTE: Refer to wiring diagrams earlier in this section as a guide to connections and wiring.

OUO1004,0000BB5 –19–02OCT00–1/1

Storage

Engine Storage Guidelines

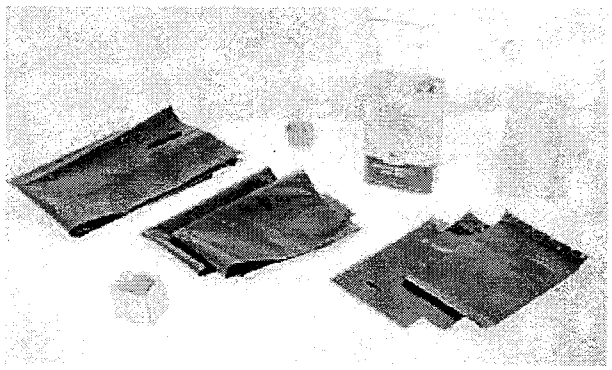
1. John Deere engines can be stored outside for up to three (3) months with no long-term preparation IF COVERED BY WATERPROOF COVERING.
2. John Deere engines can be stored in a standard overseas shipping container for up to three (3) months with no long-term preparation.
3. John Deere engines can be stored inside, warehoused, for up to six (6) months with no long-term preparation.
4. For John Deere engines expected to be stored more than six (6) months, long-term storage preparation MUST BE taken. (See PREPARING ENGINE FOR LONG-TERM STORAGE, later in this section.)
5. For John Deere engines not yet installed in machines, run a line from a container of AR41937 Nucle Oil to the fuel transfer pump intake, and another line from the fuel return manifold to the tank, so that Nucle Oil is circulated through the injection system during cranking.

RG,RG34710,7611 –19–30JUN97–1/1

Use AR41785 Engine Storage Kit

See your John Deere servicing dealer or engine distributor for an AR41785 Engine Storage Kit. Closely follow instructions provided with this kit.

IMPORTANT: Inhibitors can easily change to gas. Seal or tape each opening immediately after adding inhibitor.



AR41785 Engine Storage Kit

RG,RG34710,7612 –19–30JUN97–1/1

Preparing Engine for Long-Term Storage

The following storage preparations are good for long-term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

IMPORTANT: Any time your engine will not be used for over six (6) months, the following recommendations for storing it and removing it from storage will help to minimize corrosion and deterioration. Use the AR41785 Engine Storage Kit. Follow recommended service procedure included with storage kit.

1. Change engine oil and replace filter. Used oil will not give adequate protection. (See CHANGING ENGINE OIL AND REPLACING OIL FILTER in Lubrication and Maintenance/250 Hour section.)
2. Service air cleaner. (See REPLACING AIR CLEANER FILTER ELEMENTS in Service as Required section.)
3. Draining and flushing of cooling system is not necessary if engine is to be stored only for several months. However, for extended storage periods of a year or longer, it is recommended that the cooling system be drained, flushed, and refilled. Refill with appropriate coolant. (See DIESEL ENGINE COOLANT in Fuels, Lubricants, and Coolant section. See ADDING COOLANT in Service as Required section.)
4. Drain fuel tank and add 30 ml (1 oz) of inhibitor to the fuel tank for each 15 L (4 U.S. gal) of tank capacity. Completely drain fuel filter and close fuel valve, if equipped.
5. Add 30 ml (1 oz) of inhibitor to the engine crankcase for each 0.95 L (1 qt) of crankcase oil.
6. Disconnect air intake piping from the manifold. Pour 90 ml (3 oz) of inhibitor into intake system and reconnect the piping.
7. Crank the engine several revolutions with starter (do not allow the engine to start).
8. Remove fan/alternator V-belts, if desired.
9. Remove and clean batteries. Store them in a cool, dry place and keep them fully charged.
10. Disengage any engine drivelines (if equipped).
11. Clean the exterior of the engine with salt-free water and touch up any scratched or chipped painted surfaces with a good quality paint.
12. Coat all exposed (machined) metal surfaces with grease or corrosion inhibitor if not feasible to paint.
13. Seal all openings on engine with plastic bags and tape supplied in storage kit. Follow instructions supplied in kit.
14. Store the engine in a dry protected place. If engine must be stored outside, cover it with a waterproof canvas or other suitable protective material and use a strong waterproof tape.

DPSG,OUOD007,2851 –19–04SEP02–1/1

Removing Engine from Long-Term Storage

Refer to the appropriate section for detailed services listed below or have your authorized servicing dealer or engine distributor perform services that you may not be familiar with.

1. Remove all protective coverings from engine. Unseal all openings in engine and remove covering from electrical systems.
2. Remove the batteries from storage. Install batteries (fully charged) and connect the terminals.
3. Install fan/alternator V-belts if removed.
4. Fill fuel tank.
5. Perform all appropriate prestarting checks. (See DAILY PRESTARTING CHECKS in Lubrication and Maintenance/Daily section.)
6. Open fuel valve, fill fuel filter/water separator with clean fuel and bleed the fuel system. (See BLEEDING THE FUEL SYSTEM in Service as Required section.)

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

7. Crank engine for 20 seconds with starter (do not allow the engine to start). Wait 2 minutes and crank engine an additional 20 seconds to ensure bearing surfaces are adequately lubricated.
8. Start engine and run at slow idle and no load for several minutes. Warm up carefully and check all gauges before placing engine under load.
9. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

RG,RG34710,7614 –19–30JUN97–1/1

Specifications

General OEM Engine Specifications

ITEM	UNIT OF MEASURE	6105AF	6105HF	6125AF	6125HF (—29999)	6125HF (30000—)
Number of Cylinders	——	6	6	6	6	6
Fuel	——	Diesel	Diesel	Diesel	Diesel	Diesel
Stroke	mm (in.)	138 (5.43)	138 (5.43)	165 (6.50)	165 (6.50)	165 (6.50)
Bore	mm (in.)	127 (5.00)	127 (5.00)	127 (5.00)	127 (5.00)	127 (5.00)
Displacement	L (cu in.)	10.5 (640)	10.5 (640)	12.5 (766)	12.5 (766)	12.5 (766)
Compression Ratio	——	16:1	16:1	16:1	16:1	17:1
Aspiration	——	Turbocharged	Turbocharged	Turbocharged	Turbocharged	Turbocharged
Engine Firing Order	——	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Valves Per Cylinder	——	2 Intake 2 Exhaust	2 Intake 2 Exhaust	2 Intake 2 Exhaust	2 Intake 2 Exhaust	2 Intake 2 Exhaust
Max. Crank Pressure	kPa (in. H_2O)	0.5 (2)	0.5 (2)	0.5 (2)	0.5 (2)	0.5 (2)
Vibration Damper Maximum Radial Output	mm (in.)	0.76 (0.030)	0.76 (0.030)	0.76 (0.030)	0.76 (0.030)	0.76 (0.030)
Battery Capacities						
12-Volt System 24-Volt System	CCA CCA	800 570	800 570	800 570	800 570	800 570
Maximum Air Intake Restriction	in. H_2O (kPa) (bar) (psi)	25 (6.25) (0.06) (1.0)	25 (6.25) (0.06) (1.0)	25 (6.25) (0.06) (1.0)	25 (6.25) (0.06) (1.0)	25 (6.25) (0.06) (1.0)
Thermostat Start To Open Temperature	°C (°F)	80—84 (175—182)	80—84 (175—182)	80—84 (175—182)	80—84 (175—182)	80—84 (175—182)
Engine Coolant Temperature Range	°C (°F)	82—94 (180—202)	82—94 (180—202)	82—94 (180—202)	82—94 (180—202)	82—94 (180—202)

Continued on next page

ITEM	UNIT OF MEASURE	6105AF	6105HF	6125AF	6125HF (—29999)	6125HF (30000—)
Engine Coolant System Pressure	kPa (bar) (psi)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)
Recommended Radiator Pressure Cap	kPa (bar) (psi)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)	48 (0.48) (7)
Engine Oil Pressure (Full Load Rated Speed)	kPa (bar) (psi)	310±103 (3.10±1.03) (45±15)	310±103 (3.10±1.03) (45±15)	310±103 (3.10±1.03) (45±15)	310±103 (3.10±1.03) (45±15)	310±103 (3.10±1.03) (45±15)
Engine Oil Pressure (Low Idle) (Minimum)	kPa (bar) (psi)	138 (1.38) (20)	138 (1.38) (20)	138 (1.38) (20)	138 (1.38) (20)	138 (1.38) (20)
Physical Dimensions:						
Width	mm (in.)	741 (29.2)	808 (31.8)	741 (29.2)	808 (31.8)	808 (31.8)
Height	mm (in.)	1224 (48.2)	1239 (48.8)	1224 (48.2)	1239 (48.8)	1239 (48.8)
Length	mm (in.)	1326 (52.2)	1326 (52.2)	1326 (52.2)	1326 (52.2)	1326 (52.2)
Basic Dry Weight	kg (lb)	1211 (2665)	1200 (2640)	1216 (2675)	1205 (2650)	1205 (2650)

RG,RG34710,7615 –19–11SEP02–2/2

Fuel System Specifications—Industrial Applications

ENGINE MODEL	FUEL SYSTEM OPTION CODES	INTERMITTENT POWER RATING @ RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED (rpm)	SLOW IDLE (rpm)	FAST IDLE (rpm)
6105AF	1601, 1602, 1603, 1604	224 (300)	2100	850	2225
6105HF	1609, 1610, 1620, 1621	242 (325)	2100	850	2225
	1601, 1602, 1611, 1612	261 (350)	2100	850	2225
6125AF	1610, 1620, 1631, 1641	242 (325)	2100	850	2225
	1601, 1611, 1621, 1622, 1632	261 (350)	2100	850	2225
	1602, 1612, 1623, 1633	280 (375)	2100	850	2225
	1603, 1613, 1624, 1634	298 (400)	2100	850	2225
6125HF (— 29999)	1601, 1611, 1621, 1631	317 (425)	2100	850	2225
	1602, 1612, 1622, 1632	336 (450)	2100	850	2225
	1603, 1613, 1623, 1633	354 (475)	2100	850	2225
	1604, 1614, 1624, 1634	373 (500)	2100	850	2225
6125HF (30000—)	16A1, 16A2, 16A3, 16A4	224 (300)	2100	900	2225
	16B1, 16B2, 16B3, 16B4	242 (325)	2100	900	2225
	16C1, 16C2, 16C3, 16C4	261 (350)	2100	900	2225
	16D1, 16D2, 16D3, 16D4	280 (375)	2100	900	2225
	16E1, 16E2, 16E3, 16E4	298 (400)	2100	900	2225
	16F1, 16F2, 16F3, 16F4	317 (425)	2100	900	2225
	16G1, 16G2, 16G3, 16G4	336 (450)	2100	900	2225
	16H1, 16H2, 16H3, 16H4	354 (475)	2100	900	2225
	16J1, 16J2, 16J3, 16J4	373 (500)	2100	900	2225

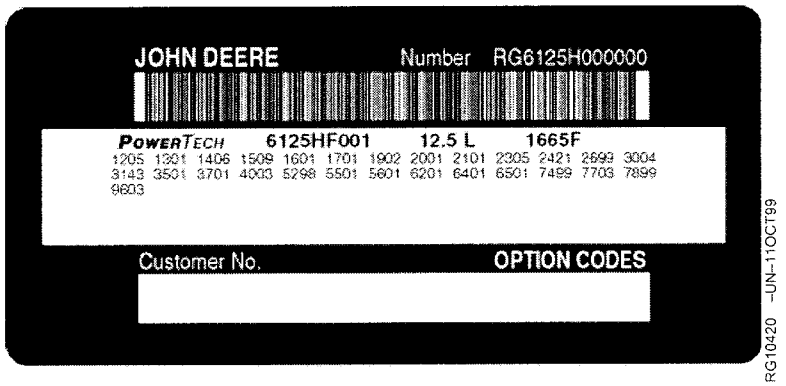
RG,RG34710,7616 –19–30OCT00–1/1

Fuel System Specifications—Generator Set (Standby) Applications

ENGINE MODEL	FUEL SYSTEM OPTION CODES	STANDBY POWER RATING @ RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED (rpm)	SLOW IDLE (rpm)	FAST IDLE (rpm)
6125AF	1607, 1617, 1628, 1638	233 (312)	1500	900	1550
	1608, 1618, 1629, 1639	254 (341)	1500	900	1550
	1609, 1619, 1630, 1640	277 (371)	1500	900	1550
	1604, 1614, 1625, 1635	280 (375)	1800	900	1850
	1605, 1615, 1626, 1636	300 (402)	1800	900	1850
	1606, 1616, 1627, 1637	330 (442)	1800	900	1850
6125HF (— 29999)	1607, 1617, 1627, 1637	302 (405)	1500	900	1550
	1608, 1618, 1628, 1638	352 (472)	1500	900	1550
	1606, 1616, 1626, 1636	360 (483)	1800	900	1850
	1605, 1615, 1625, 1635	420 (563)	1800	900	1850
	1639, 1640, 1641, 1642	460 (616)	1800	900	1850
6125HF (30000—)	164J, 164K, 164L, 164M	300 (402)	1500	900	1550
	163A, 163B, 163C, 163D	330 (442)	1800	900	1850
	165J, 165K, 165L, 165M	350 (469)	1500	900	1550
	164A, 164B, 164C, 164D	360 (483)	1800	900	1850
	166J, 166K, 166L, 166M	387 (519)	1500	900	1550
	165A, 165B, 165C, 165D	420 (563)	1800	900	1850
	166A, 166B, 166C, 166D	460 (617)	1800	900	1850

RG,RG34710,7617 –19–30OCT00–1/1

Engine Crankcase Oil Fill Quantities



Option Code Label

Each engine has a 13-digit John Deere engine serial number. The first two digits identify the factory that produced the engine:

"RG" indicates the engine was built in Waterloo, Iowa.

In addition to the serial number plate, OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

To determine the option code for the oil fill quantity of your engine, refer to the engine option code label affixed to the rocker arm cover. The first two digits of the code (19) identify the oil pan group. The last two digits of each code identify the specific oil pan on your engine.

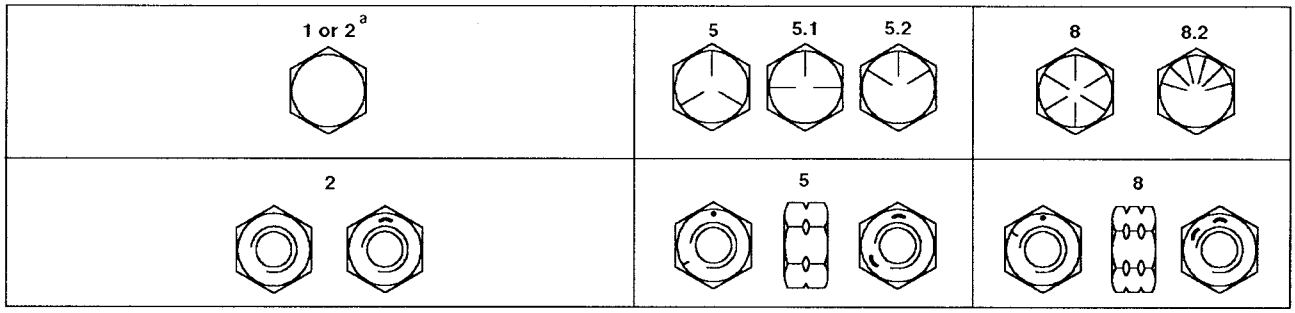
Listed below are engine crankcase oil fill quantities with filter change:

Engine Model	Oil Pan Option Codes	Crankcase Oil Capacity [a]
6105AF, 6105HF, 6125AF, 6125HF (Without John Deere Rear PTO)	1901, 1902, 1903	40.0 L (42.3 qt.)
6105AF, 6105HF, 6125AF, 6125HF (With John Deere Rear PTO)	1901, 1902, 1903	44.0 L (46.5 qt.)

[a]Crankcase oil capacity may vary slightly from amount shown. ALWAYS fill crankcase to within crosshatch area on dipstick. DO NOT overfill.

RG,RG34710,7618 –19–05SEP02–1/1

Unified Inch Bolt and Cap Screw Torque Values



TORQ1A –UN–27SEP99

Top, SAE Grade and Head Markings; Bottom, SAE Grade and Nut Markings

	Grade 1 (No Mark)		Grade 2[a] (No Mark)		Grade 5, 5.1 or 5.2		Grade 8 or 8.2	
Size	Lubricated[b] N·m(lb-ft)	Dry[c] N·m(lb-ft)	Lubricated[b] N·m(lb-ft)	Dry[c] N·m(lb-ft)	Lubricated[b] N·m(lb-ft)	Dry[c] N·m(lb-ft)	Lubricated[b] N·m(lb-ft)	Dry[c] N·m(lb-ft)
1/4	3.8 (2.8)	4.7 (3.5)	6 (4.4)	7.5 (5.5)	9.5 (7)	12 (9)	13.5 (10)	17 (12.5)
5/16	7.7 (5.7)	9.8 (7.2)	12 (9)	15.5 (11.5)	19.5 (14.5)	25 (18.5)	28 (20.5)	35 (26)
3/8	13.5 (10)	17.5 (13)	22 (16)	27.5 (20)	35 (26)	44 (32.5)	49 (36)	63 (46)
7/16	22 (16)	28 (20.5)	35 (26)	44 (32.5)	56 (41)	70 (52)	80 (59)	100 (74)
1/2	34 (25)	42 (31)	53 (39)	67 (49)	85 (63)	110 (80)	120 (88)	155 (115)
9/16	48 (35.5)	60 (45)	76 (56)	95 (70)	125 (92)	155 (115)	175 (130)	220 (165)
5/8	67 (49)	85 (63)	105 (77)	135 (100)	170 (125)	215 (160)	240 (175)	305 (225)
3/4	120 (88)	150 (110)	190 (140)	240 (175)	300 (220)	380 (280)	425 (315)	540 (400)
7/8	190 (140)	240 (175)	190 (140)	240 (175)	490 (360)	615 (455)	690 (510)	870 (640)
1	285 (210)	360 (265)	285 (210)	360 (265)	730 (540)	920 (680)	1030 (760)	1300 (960)
1-1/8	400 (300)	510 (375)	400 (300)	510 (375)	910 (670)	1150 (850)	1450 (1075)	1850 (1350)
1-1/4	570 (420)	725 (535)	570 (420)	725 (535)	1280 (945)	1630 (1200)	2050 (1500)	2600 (1920)
1-3/8	750 (550)	950 (700)	750 (550)	950 (700)	1700 (1250)	2140 (1580)	2700 (2000)	3400 (2500)
1-1/2	990 (730)	1250 (930)	990 (730)	1250 (930)	2250 (1650)	2850 (2100)	3600 (2650)	4550 (3350)

[a] *Grade 2 applies for hex cap screws (not hex bolts) up to 6 in. (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.*

[b] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.*

[c] *"Dry" means plain or zinc plated without any lubrication.*

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

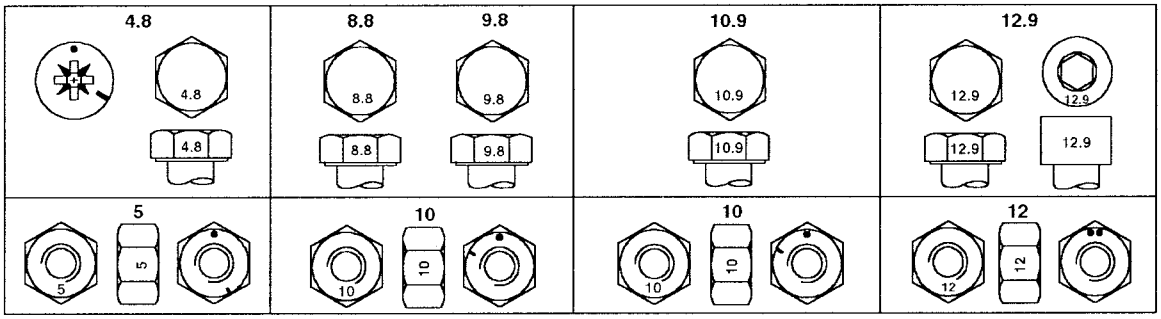
Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

DX,TORQ1 –19–01OCT99–1/1

Metric Bolt and Cap Screw Torque Values



TORQ2 -UN-07SEP99

Top, Property Class and Head Markings; Bottom, Property Class and Nut Markings

	Class 4.8		Class 8.8 or 9.8		Class 10.9		Class 12.9	
Size	**Lubricated[a] N·m(lb-ft)**	**Dry[b] N·m(lb-ft)**	**Lubricated[a] N·m(lb-ft)**	**Dry[b] N·m(lb-ft)**	**Lubricated[a] N·m(lb-ft)**	**Dry[b] N·m(lb-ft)**	**Lubricated[a] N·m(lb-ft)**	**Dry[b] N·m(lb-ft)**
M6	4.7 (3.5)	6 (4.4)	9 (6.6)	11.5 (8.5)	13 (9.5)	16.5 (12.2)	15.5 (11.5)	19.5 (14.5)
M8	11.5 (8.5)	14.5 (10.7)	22 (16)	28 (20.5)	32 (23.5)	40 (29.5)	37 (27.5)	47 (35)
M10	23 (17)	29 (21)	43 (32)	55 (40)	63 (46)	80 (59)	75 (55)	95 (70)
M12	40 (29.5)	50 (37)	75 (55)	95 (70)	110 (80)	140 (105)	130 (95)	165 (120)
M14	63 (46)	80 (59)	120 (88)	150 (110)	175 (130)	220 (165)	205 (150)	260 (190)
M16	100 (74)	125 (92)	190 (140)	240 (175)	275 (200)	350 (255)	320 (235)	400 (300)
M18	135 (100)	170 (125)	265 (195)	330 (245)	375 (275)	475 (350)	440 (325)	560 (410)
M20	190 (140)	245 (180)	375 (275)	475 (350)	530 (390)	675 (500)	625 (460)	790 (580)
M22	265 (195)	330 (245)	510 (375)	650 (480)	725 (535)	920 (680)	850 (625)	1080 (800)
M24	330 (245)	425 (315)	650 (480)	820 (600)	920 (680)	1150 (850)	1080 (800)	1350 (1000)
M27	490 (360)	625 (460)	950 (700)	1200 (885)	1350 (1000)	1700 (1250)	1580 (1160)	2000 (1475)
M30	660 (490)	850 (625)	1290 (950)	1630 (1200)	1850 (1350)	2300 (1700)	2140 (1580)	2700 (2000)
M33	900 (665)	1150 (850)	1750 (1300)	2200 (1625)	2500 (1850)	3150 (2325)	2900 (2150)	3700 (2730)
M36	1150 (850)	1450 (1075)	2250 (1650)	2850 (2100)	3200 (2350)	4050 (3000)	3750 (2770)	4750 (3500)

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.*

[b] *"Dry" means plain or zinc plated without any lubrication.*

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

DX,TORQ2 -19-01OCT99-1/1

Lubrication and Maintenance Records

Using Lubrication and Maintenance Records

Refer to specific Lubrication and Maintenance section for detailed service procedures.

1. Keep a record of the number of hours you operate your engine by regular observation of hour meter.

2. Check your record regularly to learn when your engine needs service.

3. DO ALL the services within an interval section. Write the number of hours (from your service records) and the date in the spaces provided. For a complete listing of all items to be performed and the service intervals required, refer to the quick-reference chart near the front of the Lubrication and Maintenance section.

IMPORTANT: The service recommendations covered in this manual are for the accessories that are provided by John Deere. Follow manufacturer's service recommendations for servicing engine-driven equipment not supplied by Deere.

RG,RG34710,7621 -19-30JUN97-1/1

Daily (Prestarting) Service

NOTE: Refer to DAILY PRESTARTING CHECKS in Lubrication and Maintenance/Daily section.

- Check engine oil level.
- Check coolant level.
- Check fuel filter/water separator.
- Check air cleaner dust unloader valve and air restriction indicator, if equipped.
- Visual walkaround inspection.

RG,RG34710,7622 -19-30JUN97-1/1

250 Hour/6 Month Service

- Change engine oil and oil filter.[1]
- Service battery.
- Service fire extinguisher.
- Check coolant pump weep hole foam filter.
- Check engine mounts on generator-set applications.

Hours									
Date									
Hours									
Date									
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[1] If John Deere PLUS-50 or ACEA-E4/E5 oil is used along with the specified John Deere oil filter, the oil change interval may be extended by 50 percent to 375 hours.

RG,RG34710,7623 –19–24SEP02–1/1

500 Hour/12 Month Service

- Clean crankcase ventilation assembly.
- Check air intake hoses, connections, and system.
- Check engine ground connection.
- Check automatic belt tensioner and belt wear.
- Check cooling system.
- Coolant solution analysis—add SCAs as needed.
- Pressure test overall cooling system and radiator cap.

Hours									
Date									
Hours									
Date									
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Date									
Hours									
Date									

RG,RG34710,7624 –19–04SEP02–1/1

2000 Hour/24 Month Service

- Check and adjust engine speeds.
- Check crankshaft vibration damper.
- Flush and refill cooling system.[1]
- Test thermostats.

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

[1] When John Deere COOL-GARD is used, the flushing interval is 3000 hours or 36 months. The drain interval may be extended to 5000 hours or 60 months of operation provided that the coolant is tested annually AND additives are replenished, as needed, by adding a supplemental coolant additive.

RG,RG34710,7625 –19–04DEC00–1/1

2500 Hour Service

- Have your authorized servicing dealer or engine distributor check and adjust valve clearance and electronic unit injector (EUI) preload. (This is a one-time service on a new or overhauled engine.)

Hours									
Date									
Hours									
Date									
Hours									
Date									
Hours									
Date									

RG,RG34710,7626 –19–30JUN97–1/1

Service as Required

- Add coolant.
- Replace air cleaner filter elements.
- Replace fuel filter element.
- Clean fuel filter water separator bowl.
- Bleed fuel system.
- Replace fan/alternator V-belts.
- Check fuses.
- Service air compressor. (See your John Deere dealer.)
- Service rear PTO (See your John Deere dealer.)

Hours									
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RG,RG34710,7627 –19–04SEP02–1/1

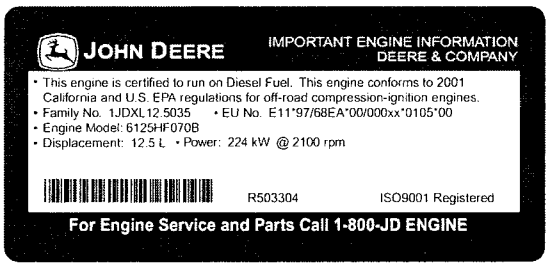
Emission System Warranty

Emissions Control System Certification Label

CAUTION: Statutes providing severe penalties for tampering with emissions controls may apply at the user's location.

The emissions warranty described below applies only to those engines marketed by John Deere that have been certified by the United States Environmental Protection Agency (EPA) and/or California Air Resources Board (CARB); and used in the United States and Canada in non-road mobile (self-propelled or portable/transportable[1]) equipment. The presence of an emissions label like the one shown signifies that the engine has been certified with the EPA and/or CARB. The EPA and CARB warranties only apply to new engines having the certification label affixed to the engine and sold as stated above in the geographic areas. The presence of an EU number in the third line of the label signifies that the engine has been certified with the European Union countries per Directive 97/68/EC. The emissions warranty does not apply to the EU countries.

NOTE: The hp/kW rating on the engine emissions certification label specifies the gross engine hp/kW, which is flywheel power without fan. In most applications this will not be the same rating as the advertised vehicle hp/kW rating.



Emissions Label

RG11176 --19--29NOV00

[1]*Equipment moved at least once every 12 months.*

RG,RG34710,7628 –19–30JUN97–1/1

U.S. EPA Emissions Control Warranty Statement

Emissions control-related parts and components are warranted by John Deere for five years or 3000 hours of operation, whichever occurs first. John Deere further warrants that the engine covered by this warranty was designed, built, and equipped so as to conform at the time of sale with all U.S. emissions standards at the time of manufacture, and that it is free of defects in materials and workmanship which would cause it not to meet these standards within the period of five years or 3000 hours of operation, whichever occurs first.

Warranties stated in this manual refer only to emissions-related parts and components of your engine. The complete engine warranty, less emissions-related parts and components, is provided separately as the "John Deere New Off-Highway Engine Warranty".

RG,RG34710,7629 -19-30JUN97-1/1

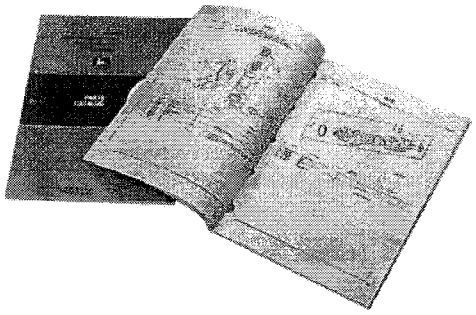
John Deere Service Literature Available

Technical Information

Technical information is available from John Deere. Some of this information is available in electronic as well as printed form. Order from your John Deere dealer or call **1-800-522-7448**. Please have available the model number, serial number, and name of the product.

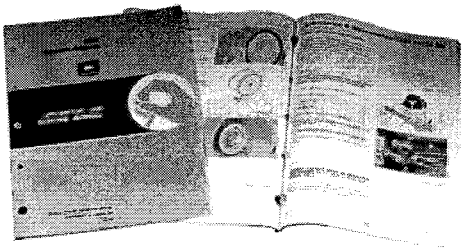
Available information includes:

- PARTS CATALOGS list service parts available for your machine with exploded view illustrations to help you identify the correct parts. It is also useful in assembling and disassembling.
- OPERATOR'S MANUALS providing safety, operating, maintenance, and service information. These manuals and safety signs on your machine may also be available in other languages.
- OPERATOR'S VIDEO TAPES showing highlights of safety, operating, maintenance, and service information. These tapes may be available in multiple languages and formats.
- TECHNICAL MANUALS outlining service information for your machine. Included are specifications, illustrated assembly and disassembly procedures, hydraulic oil flow diagrams, and wiring diagrams. Some products have separate manuals for repair and diagnostic information. Some components, such as engines, are available in separate component technical manuals
- FUNDAMENTAL MANUALS detailing basic information regardless of manufacturer:
  - Agricultural Primer series covers technology in farming and ranching, featuring subjects like computers, the Internet, and precision farming.
  - Farm Business Management series examines "real-world" problems and offers practical solutions in the areas of marketing, financing, equipment selection, and compliance.
  - Fundamentals of Services manuals show you how to repair and maintain off-road equipment.
  - Fundamentals of Machine Operation manuals explain machine capacities and adjustments, how to improve machine performance, and how to eliminate unnecessary field operations.



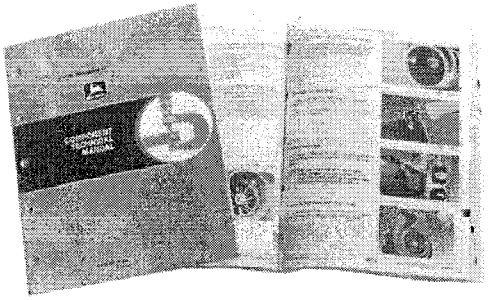
RG9262 –UN–16MAR98

Parts Catalogs



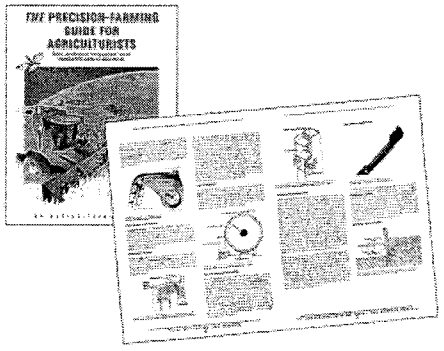
RG9260 –UN–16MAR98

Operator Manuals



RG9261 –UN–16MAR98

Component Technical Manuals



TS1663 –UN–10OCT97

Fundamental Manuals

DX,SERVLIT –19–11NOV97–1/1

Publications for This Engine

Technical information is available from John Deere in support of our products. Some of this information is available in electronic as well as printed form. Order from your John Deere dealer or call **1-800-522-7448.** Please have available the model number, and name of the product.

Title	Order Number
POWERTECH 10.5 L and 12.5 L OEM Diesel Engines:	
Operation and Maintenance Manual (English)	OMRG29968
Parts Catalog 10.5 L Engines and 12.5 L Engines (—29999)	PC2581
Parts Catalog 12.5 L Engines (30000—)	PC2875
Component Technical Manuals:	
Base Engine John Deere Level 6 Electronic Fuel Systems	CTM100 CTM188
OEM Engine Accessories	CTM67
Alternators and Starter Motors	CTM77

DPSG,RG34710,105 –19–30OCT00–1/1

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John Deere Service Keeps You on the Job

John Deere Parts

We help minimize downtime by putting genuine John Deere parts in your hands in a hurry.

That's why we maintain a large and varied inventory—to stay a jump ahead of your needs.



TS100 –UN–23AUG88

DX,IBC,A –19–04JUN90–1/1

The Right Tools

Precision tools and testing equipment enable our Service Department to locate and correct troubles quickly . . . to save you time and money.



TS101 –UN–23AUG88

DX,IBC,B –19–04JUN90–1/1

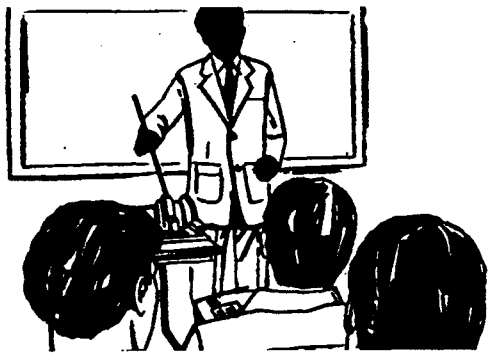
Well-Trained Technicians

School is never out for John Deere service technicians.

Training schools are held regularly to be sure our personnel know your equipment and how to maintain it.

Result?

Experience you can count on!



TS102 –UN–23AUG88

DX,IBC,C –19–04JUN90–1/1

Prompt Service

Our goal is to provide prompt, efficient care when you want it and where you want it. We can make repairs at your place or at ours, depending on the circumstances: see us, depend on us.

JOHN DEERE SERVICE SUPERIORITY: We'll be around when you need us.



TS103 –UN–23AUG88

DX,IBC,D –19–04JUN90–1/1

GE Industrial Systems

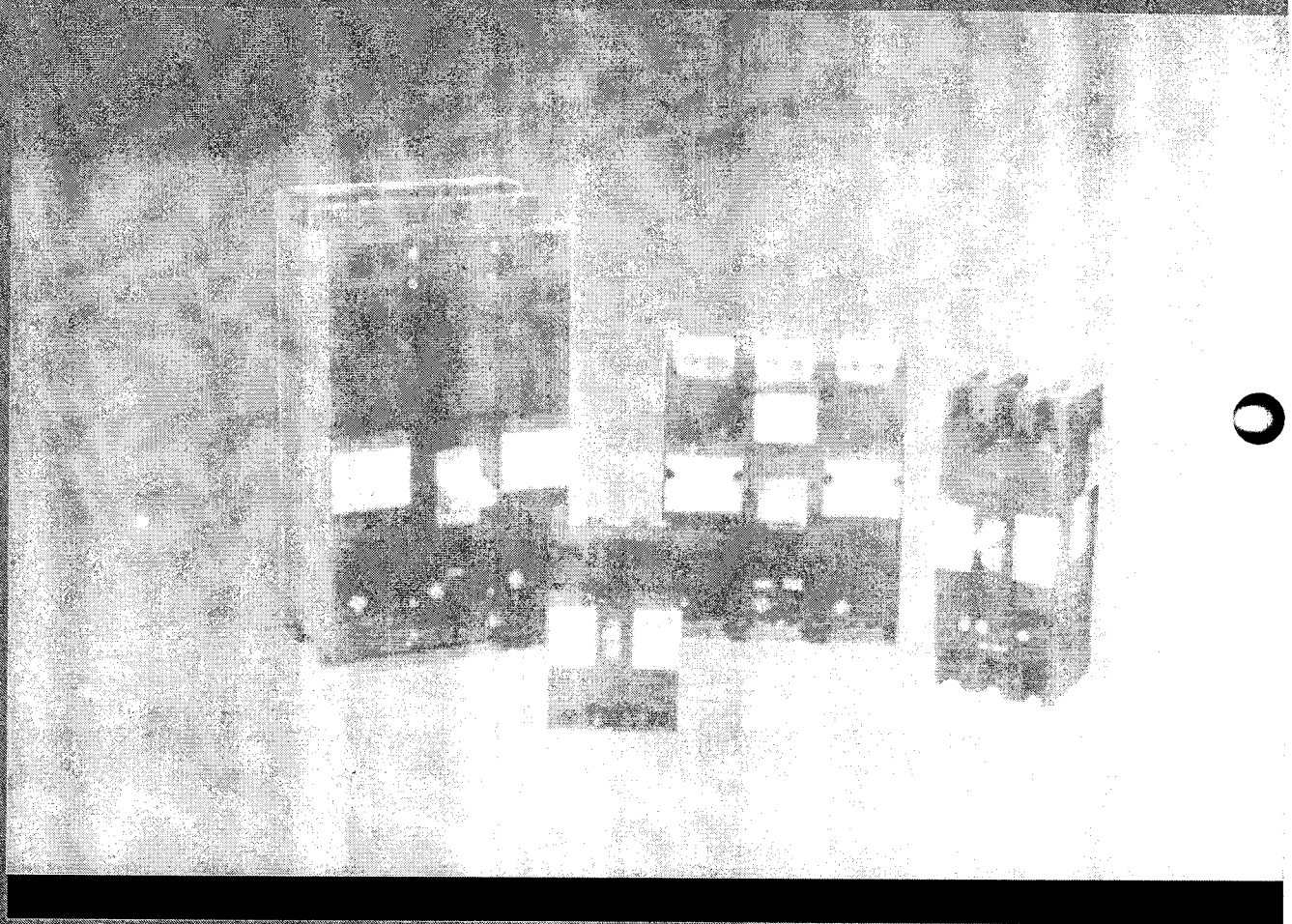
General Electric **TJK** Circuit Breaker Manual Packet

Packet includes:

- Instructions.....GET-2279K
- Accessories (Optional)
  - Shunt Trip.....GEH-3435
  - Aux. Contacts.....GEH-3321
  - Bell Alarm.....GEH-3320

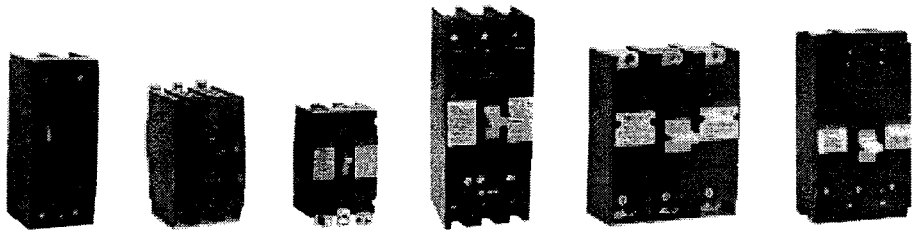
Molded Case Circuit Breakers

Application and Selection



The GE Family of Molded Case Circuit Breakers

From 10-1200 Amperes



O-Line *TEY* *E150* *F225* *J600* *K1200*

Application Flexibility

In switchboards, motor control centers and lighting, power and customized control panelboards, General Electric molded case circuit breakers are used to provide reliable circuit protection. Molded case circuit breakers in individual enclosures are also used in numerous applications.

Minimum Downtime

Downtime is reduced and fuse replacement is eliminated with circuit breakers. In case of overload or short circuit, the breaker trips, opening the circuit and protecting the conductors. When normal conditions are restored, the breaker can be closed ("ON") again.

Trip-Free Mechanism

The breaker's trip-free mechanism opens the breaker contacts under overload or short circuit conditions, even with the breaker handle held in the ON position.

Eliminates Single-Phasing

Circuit breakers eliminate single-phasing. When an overload or short circuit occurs on any one conductor, a common trip bar simultaneously disconnects all three conductors of a three-phase circuit.

Easy System Upgrading

With General Electric circuit breakers, the circuit can be uprated, even after the breaker has been installed. Interchangeable trips provide a wide range of ratings within the same frame size.

Accessory Functions

Application flexibility of molded case circuit breakers is enhanced by a breaker accessory line. Remote closing or opening, undervoltage protection, indication of "tripped" condition at a remote location, electrical or mechanical interlocking, automatic reclosing, and primary or sequential operation are some of the functions practical with accessories.

Space Savings

Space savings can be an important factor in selecting General Electric molded case circuit breakers as equipment components. Higher rated breakers in particular, offer major space economies over fused switches.

Interrupting Ability

Interrupting ratings of General Electric molded case circuit breakers are based on actual short circuit tests. Breakers are rated for RMS symmetrical ac amperes and for maximum dc amperes.

Standards and Specifications

General Electric molded case circuit breakers meet standards established by Underwriters' Laboratories, National Electric Manufacturers Association, Federal Specifications, Institute of Electronic Engineers, National Electric Code and General Electric Company's own high quality standards.

Rugged, Dependable Construction

Circuit Breaker Frame

- **Molded case** is molded from high-mechanical and high-dielectric strength engineered plastic.
- **Trip indication** is shown by handle position midway between ON and OFF. To reset the trip mechanism, move the handle to extreme OFF, then to ON position.
- **Quick-make, quick-break, trip-free mechanism** minimizes arcing during breaker operation. Contacts cannot be "teased" into position. Trip-free mechanism is independent of manual handle control. The breaker trips under short circuit or overload, even though the operating handle is held in ON position.
- **Verifier "Twist-to-Trip" and "Push-to-Trip"** mechanically simulates over-current tripping through actuation of linkages not operated by the ON-OFF handle. Experience has shown that thermal magnetic circuit breakers in industrial applications better maintain their original protective characteristics when regularly exercised.
- **Common-trip bar** assures instant disconnect of all conductors when an overload or short circuit occurs on any one conductor in the circuit, or an accessory trip device operates.
- **Silver alloy contacts** combine the conductive properties of silver with other elements for clean, positive electrical contacting. Pitting and burning are minimized for longer contact life.
- **Arc chutes** of heat-absorbing, insulating material and metal grid plates quickly "extinguish" arcs.
- **UL listed lugs** for copper or aluminum cable, at full frame rating. Easy access and simple, straight-in wiring.

Thermal Magnetic Trip System

- **Front-adjustable magnetic trip** provides instantaneous trip in event of short circuit. Any current surge above the trip setting produces a magnetic field which instantly actuates the trip mechanism and opens the circuit.
- **Thermal trip** provides protection against sustained overloads. A bi-metallic element reacts time-wise in inverse proportion to the current. If a circuit is overloaded, heat resulting from excessive current flow causes the bi-metal to bend, actuating the trip mechanism to open the circuit.
- **Interchangeable trip units** (for frames over 150 ampere rating) simplify stocking and reduce inventory requirements. Field interchangeability assures maximum flexibility.

Electronic Trip System

- **Front adjustable programming functions (Power+ 4, MicroVersaTrip Plus)** provide a high degree of flexibility and convenience in making and checking settings.
- **Long-time pick up indication** is illuminated whenever the breaker is experiencing an overload condition. The light is extinguished by removing the overload or tripping the breaker.
- **Glass epoxy printed circuit boards with epoxy conformal coating** over all assembled components provide long life with error free operation.
- **Switch contacts and board interconnectors** provide corrosion resistance and long product life.
- **Neutral current sensor connections** located between the breaker lugs allow panelboard mounting of breakers without special fillers or increased panel space.
- **Fault trip indicators** for overload, short circuit, and ground fault are available for local indication.

Thermal Magnetic and Solid State Trip Types

Spectra RMS™ circuit breakers with digital rms-sensing electronic trip units provide many features and benefits not offered by thermal magnetic breakers (refer to GET-7002).

Thermal magnetic trip units are available in all GE molded case circuit breakers from Q Line through K frame. Solid state trip units may be alternatively selected for J and K frame circuit breakers. Additionally, non-automatic circuit interrupters, or molded case switches, are available. These interrupters have no automatic overload or short circuit trip elements. They are used for manual switching and isolation.

Enclosure Compensated Thermal Trip: 40°C

An enclosure compensated thermal trip is constructed to permit an enclosed circuit breaker in a 25°C room ambient to carry 100% of its nameplate current *intermittently* and 80% of its nameplate current *continuously* when cabled with conductor sized per the UL 489 standard (see Figure 29.1).

The thermal trip action is accomplished by a bimetallic strip. The movement of the bimetal and thus tripping is proportional to the current — high current fast response, low current slow response. This action provides a time delay which prevents service interruptions from normal inrush currents or temporary overloads. Continuous overloads will cause the bimetal to deflect sufficiently to release the latch and open the breaker contacts. However, the bimetal is also sensitive to ambient temperatures. If the room ambient is above or below 25°C, or the enclosure is warmer than normal, the breaker rating will vary inversely to the temperature: higher ambient-lower current, lower ambient-higher current. Enclosure compensation is furnished on Q-Line, TEB, TEY, TB-1, TED 277 volt and TED 480 volt circuit breakers.

Ambient Temperature Compensated Thermal Trip: 10° TO 50°C

An ambient compensating or "Ambient Compensated" thermal trip is the same as an enclosure compensated trip with one notable exception. It has a reduced sensitivity to changes in ambient temperature. In an ambient compensating thermal trip an additional bimetal is added to the circuit breaker. This bimetal responds to breaker ambient and modifies the characteristics of the current sensing bimetal to compensate for ambient temperature changes.

Ambient compensating thermal trips are provided as standard in all 600 volt thermal-magnetic molded case circuit breakers.

Adjustable Magnetic Trip — F225, J600, K1200 and TEC, TEML, TFC, TJC, TKC, TFL, THLC-2, THLC-4, TLB4

An electromagnet which partially surrounds the bimetal is used to provide instantaneous trip in the event of a short circuit. The high current creates a strong magnetic field attracting the armature and instantaneously releasing the trip latch in the same manner as the bimetal does on overload.

For short circuit protection, the adjustable magnetic trip provides high, low and intermediate trip settings.

Solid State Trip: -20° TO +55°C

Solid state MicroVersaTrip® Plus trip units meet the same standards as thermal trip units. Complete circuit breakers equipped with MicroVersaTrip Plus trip units are rated to carry 100% of their current sensor rating intermittently and 80% continuously in a 40°C breaker ambient. Some MicroVersaTrip Plus equipped breakers are rated to carry 100% continuously and are so marked.

In addition to the protection of conductors as required by codes and standards, MicroVersaTrip Plus can be set to provide protection for equipment such as motors, generators, or transformers and provide improved distribution system selectivity.

Figure 4.1
Operation of Thermal-Mag Trip Units

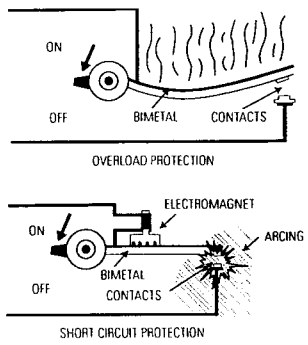


Table 5.1
Breaker Trip Types

	Breaker Type	Trip Type
Q-Line	All	Non-Interchangeable
TEY-100	TEY	Non-Interchangeable
E150	TEB	Non-Interchangeable
	TED	Non-Interchangeable
	THED Hi-Break	Non-Interchangeable
F225	TFJ	Non-Interchangeable
	TFK	Interchangeable
	THFK Hi-Break	Interchangeable
J600	TJJ	Non-Interchangeable
	TJK	Interchangeable
	THJK Hi-Break	Interchangeable
	TJ4V	Non-Interchangeable
	TJH4V Hi-Break	Non-Interchangeable
	TJH Hi-Break MVT Plus	Interchangeable (Rating Plug ①)
K1200	TKM-800	Interchangeable
	TKM-1200	Interchangeable
	THKM Hi-Break	Interchangeable
	TK4V	Non-Interchangeable
	TKH Hi-Break MVT Plus	Interchangeable (Rating Plug ①)
Hi-I.C.	TEL, TEML②	Non-Interchangeable
	TFL②	Non-Interchangeable
	TJL4V Hi-I.C.	Non-Interchangeable
	TJL Hi-I.C. MVT Plus	Interchangeable (Rating Plug ①)
	TKL4V Hi-I.C.	Non-Interchangeable
	TKL Hi-I.C. MVT Plus	Interchangeable (Rating Plug ①)
	TLB-2②	Non-Interchangeable
	TLB-4②	Non-Interchangeable
Current Limiting	THLC-1②	Non-Interchangeable
	THLC-2②	Non-Interchangeable
	THLC-4②	Non-Interchangeable
Tri-Break (fused)	TB-1	Non-Interchangeable
	TB-4	Non-Interchangeable
	TB-6	Non-Interchangeable
	TB-8	Non-Interchangeable

① *MicroVersaTrip® Plus incorporates trip units with field replaceable rating plugs providing ease of changing ratings within frame size and sensor rating, with minimum downtime. See Table 5.2 for rating plug selection.*

② *Obsolete type.*

Table 5.2
J/K Rating Plug Selection

Frame Type	Sensor Rating (Amps)	Current Rating (Amps)
J400	150	60, 80, 100, 125, 150
J400	400	150, 200, 225, 250, 300, 400
J600	600	300, 400, 450, 500, 600
K800	800	300, 400, 500, 600, 700, 800
K1200	1200	600, 800, 1000, 1200

Trip Unit Ratings Molded Case Circuit Breakers

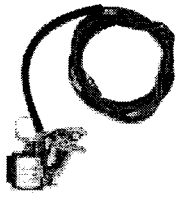
Table 6.1
Trip Unit Ratings

Type	Reverse Feed		Trip Unit Type	Trip Unit Ratings (Amperes)	Instantaneous Type
Q-Line (THQB, L, C)	Yes		Non-interchangeable	10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110①, 125①	Fixed
TEY	Yes		Non-interchangeable	15, 20, 30, 40, 50, 60, 70, 80, 90, 100	Fixed
E150	Yes		Non-interchangeable	10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 110, 125, 150	Fixed
TEL②	Yes		Non-interchangeable	15, 20, 25, 30, 35, 40, 50, 50, 60, 70, 80, 90, 100, 125, 150	Fixed
THLC-1②	Yes		Non-interchangeable	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150	Fixed
TB-1	No		Non-interchangeable	15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100	Fixed
TQD	Yes		Non-interchangeable	100, 125, 150, 175, 200, 225	Fixed
F225	TFJ	Yes	Non-interchangeable	70, 80, 90, 100, 110, 125, 150, 175, 200, 225	Adjustable
	TFK	No	Interchangeable		
TFL②	Yes		Non-interchangeable	70, 80, 90, 100, 125, 150, 175, 200, 225	Adjustable
THLC-2②	Yes		Non-interchangeable	125, 150, 175, 200, 225	Adjustable
TJD	Yes		Non-interchangeable	250, 300, 350, 400	Fixed
J400	TJJ	Yes	Non-interchangeable	125, 150, 175, 200, 225, 250, 300, 350, 400	Adjustable
	TJK	No	Interchangeable		
J600	No		Interchangeable	250, 300, 350, 400, 450, 500, 600	Adjustable
TLB-4②	Yes		Non-interchangeable	250, 300, 350, 400	Adjustable
THLC-4②	Yes		Non-interchangeable	250, 300, 350, 400	Adjustable
TB-4	No		Non-interchangeable	125, 150, 175, 200, 225, 250, 300, 350, 400	Adjustable
TB-6	No		Non-interchangeable	300, 350, 400, 500, 600	Adjustable
K800	No		Interchangeable	300, 350, 400, 450, 500, 600, 700, 800	Adjustable
K1200	No		Interchangeable	600, 700, 800, 1000, 1200	Adjustable
TB-8	No		Non-interchangeable	600, 700, 800	Adjustable

① *THQL only (2 pole).*
② *Obsolete type.*

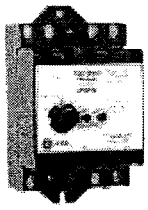
Accesories

Undervoltage Protection



The Undervoltage Release instantaneously trips the breaker when voltage drops to 35-70% of normal rating. The device retrips the breaker if it is closed before normal voltage is restored.

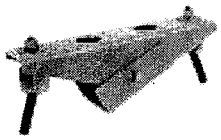
Standard duty and heavy-duty types are available.



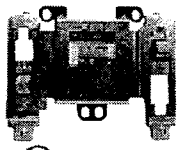
Time Delay Unit — for use with UVR. This unit prevents nuisance tripping due to momentary loss of voltage.

A separate, externally mounted unit has 120 volt ac input and 125 volt dc output with delay adjustable from .1 to .5 seconds. It is used in conjunction with 125-volt dc undervoltage release, which must be ordered separately.

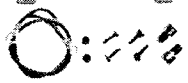
Mechanical Interlocking



Mechanical interlocks permit only one of two interconnected circuit breakers in a switchboard to be on at a time. Both circuit breakers can be OFF at the same time.

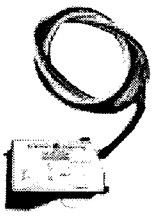


The walking beam interlock interconnects two circuit breakers from the rear, making it ideal for use in applications where a dead front would make it impossible to mount a mechanism on the face of the breaker.



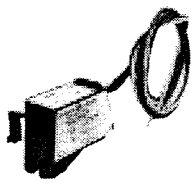
The face mounted interlock interconnects the handles of two circuit breakers. This makes it possible to use the interlock with a motor operator.

Auxiliary Switch



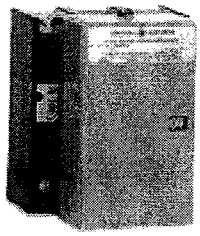
An auxiliary switch can be used to operate other accessories, indicating lights, relays, automatic reset, etc. It is available with one to four SPDT (form C) elements for flexibility. Switches open and close as the breaker is either manually or remotely tripped or turned OFF.

Bell Alarm



A bell alarm actuates a warning signal or other circuitry when the breaker is tripped under overload, short circuit, shunt trip, undervoltage trip, and 3 coil shunt trip conditions. Not actuated during normal ON-OFF operation.

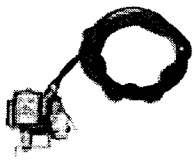
Motor Operator for Remote "On-Off"



A motor-operated mechanism can open, close, or reset a breaker remotely. This convenient attachment mounts integrally with the breaker, without modification to the breaker or its handle. Just lift the cover of the accessory mechanism to operate the breaker manually. Breaker ON-OFF is indicated in the operating mechanism cover.

Shunt Trip for Remote Tripping

Standard



A Shunt Trip Device can be used to trip and open a breaker by remote control. When the breaker opens, the shunt trip coil circuit is de-energized by means of an auxiliary switch. They meet UL requirements for operation at 55% of rated voltage for use on ground fault systems.

Three-coil (Blown Fuse Detector)
(not illustrated)

This provides single-phase protection for fused circuit breaker combinations, factory installed only.

It mounts in right pole for TEB, TED, and in left pole for TFK, TJK, TKM. Installed internally similar to standard shunt trip with leads connected across the fuses, it trips the breaker when a fuse blows or if the breaker is closed under load with a fuse open and fits all breaker types including molded case switches. Suitable for system voltages 208 to 600 volts ac.

Accessory Data

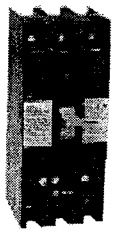
Breaker Type	Bell Alarm Switch				Auxiliary Switch③ or Shunt Trip			Undervoltage Release			Blown Fuse Trip Device			Combination Accessories			Total Number of Accessories
	Mounting Pole			Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Mounting Pole		Inst. Sheet	Within Any One Circuit Breaker
	L	C	R	GEH-	L	R	GEH-	L	R	GEH-	L	R	GEH-	L	R	GEH-	
Q-Line					UL⑧		N/A										One only
TQD, THQD						UL											One only
E150, TEB, TEC, TED, THED, TEL, TEML, TB1②, THLC-1	UL①	—	UL	4576 5402	UL①	UL	3418 Aux. 3416 S.T. 5403 Aux. 5401 S.T.	—	UL	3417 5400	—	UL⑤	3434	—	—	—	2-pole circuit breaker – any one 3-pole circuit breaker – any two except UVR and 3-coil shunt trip
F225⑥, TFC, TFJ, TFK, THFK, TFL, TLB-2, TLB-4 THLC-4	—	—	UL⑤ ⑥	4620 5406	UL	UL	4653 5406	UL	UL	4653 5406	UL⑤	—	4622	—	—		Any two
J600 TJC, TJD, TJJ, TJK, THJK, TB4②, TBC4②	—	UL⑤	—	3320	UL	UL	3321 Aux. 3435 S.T.		UL	5407	UL⑤	—	3346	—	—	—	Any two plus bell alarm
K1200 TKC, TKM. THKM, TB6②, TBC6②, TB8, TBC8		UL⑤	—	4305	UL	UL	3321 Aux. 3344 S.T.		UL	5408	UL⑤	—	3346	—	—	—	Any two plus bell alarm
MicroVersaTrip™ 4 and RMS-9, TJ4V, THJ4V, TJL4V, TK4V, TKL4V, TJH, TJL, TKH, TKL	—	UL	—	4626 4663	—	UL	4623 Aux. 4623 S.T.	—	UL	4623	—	UL	4624⑦	—	UL	4323	Any one plus bell alarm. UL Listed for field installation except bell alarm
Accessory Lead⑨ Color Coding	Purple, Yellow, Brown — Bell Alarm Switch				Auxiliary Switch: Red, White, Brown/White④; Shunt Trip: Black, Black			Blue, Blue — Undervoltage Release			Red, Brown/White; Blue, White; Yellow, Black			Same as individual accessories			All accessory contacts shown with the circuit breaker in tripped position.⑩

① *Left pole mounting not available for 2 pole TEB, TED.*
② *UL listed at 200,000 AIC without internal accessories. 100,000 AIC with internally mounted accessories.*
③ *600 volts AC auxiliary switches are not UL listed.*
④ *Formerly green.*
⑤ *Not available with lead exit from the back of breaker.*
⑥ *UL listed interrupting capacity with accessories: 10K AIC at 600 volts, AC, 22K AIC at 480 volts AC, 22K AIC at 240 volts AC.*
⑦ *Maximum available short circuit application is 85,000 sym rms A.*
⑧ *Accessory mounts in a one-inch frame and increases overall breaker size by one pole added to left side.*
⑨ *Leads are #18 AWG 125°C Vulkene® insulated.*
⑩ *Auxiliary switch is activated in both OFF and tripped positions.*

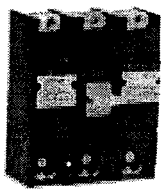
Application Data – Molded Case Circuit Breakers



E150
10-150 Amperes



F225
70-225 Amperes



J600
125-600 Amperes



K1200
300-1200 Amperes

Molded case circuit breakers are circuit protective devices that primarily perform two functions: (1) manual switching operation to open and close a circuit by means of a toggle handle and (2) automatic opening of the circuit under sustained overload and/or short circuit conditions. Circuit breakers inherently provide the automatic protective function of opening the circuit under abnormal sustained overload, or short circuit conditions, without the use of fuses. When a circuit breaker opens to clear a fault, the toggle handle goes to a TRIPPED position midway between the ON and OFF positions, thus clearly indicating that a circuit breaker has opened. When the cause of the fault has been removed, the circuit breaker can again be closed simply by moving the toggle handle to the RESET position, and then moving the handle to the ON position.

Circuit breakers have an advantage over fusible elements. A fault on one pole of a multi-pole breaker actuates a common trip bar that opens all poles simultaneously, thus avoiding single phasing a motor circuit, as could occur in a fusible device. Molded case circuit breakers are "trip free" in construction. This means that the circuit breaker contacts cannot be held closed against a fault condition. Molded case circuit breakers are designed to protect insulated conductors against unsafe overheating that would ultimately damage the insulation and conductor.

Thermal-magnetic molded case circuit breakers are not designed to provide motor running overload protection. This function is normally performed by overload relays supplied in manual or magnetic motor starters. However, for infrequently started motors, MicroVersaTrip Plus equipped molded case circuit breakers can be used to provide motor overload, overcurrent, and ground fault protection.

Molded case circuit breakers meet UL Standard 489 covering "Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures."

UL Standard 489 makes provision for two classes of products — UL Standard rated and UL 100 percent rated. The basis of these ratings for molded case and insulated case circuit breakers is as follows:

A. Standard rated under UL 489

1. Circuit breakers are rated to carry 100 percent of their nameplate current continuously in free air at 25°C when cabled per Table 31.1.
2. Enclosed circuit breakers are rated to carry 100 percent of their nameplate current intermittently (up to 3 hours maximum) and 80 percent continuously, with the enclosure in a 25°C ambient, and cabled per Table 32.1.
3. Group mounted circuit breakers may require derating of the circuit breaker and cable in room ambient temperatures other than 25°C and with cable other than specified in Table 32.1.

B. 100-percent rated under UL489

1. Circuit breakers are rated to carry 100 percent of their nameplate current continuously in an enclosure with ventilation and volume as specified on the device in a room ambient of 25°C when cabled as specified in Table 31.1 using 90°C insulation, sized to 75°C ampacity.
2. Room ambient temperatures other than 25°C, cable other than specified in Table 31.1, or enclosure volume and/or ventilation other than specified on the devices may require derating of the system.

100% Rated Circuit Breakers

Frame Type	Catalog Number	
	100% 65kAIC	100% Hi-Break®
J600	TJL1SS	TJH1SS
	TJL3SS	TJH3SS
	TJL4SS	TJH4SS
	TJL6SS	TJH6SS
K1200	TKL8SS	TKH8SS
	TKL12SS	TKH12SS

Standards and References

Underwriters Laboratories
UL 489 Branch Circuit and Service Circuit Breakers
Order from UL Publications Stock, 333 Pfingsten Road, Northbrook, Illinois 60062.

Federal Specifications
WC-375 Circuit Breaker, Molded Case; Branch Circuit and Service

National Electrical Code (NEC) (NFPA 70)
Latest Issue
Order from National Fire Protection Association, One Batterymarch Park, Quincy, Ma. 02269.

Inspection and Testing

The need for inspection of molded case breakers will vary depending on operating conditions. Suggested inspection and testing is defined in NEMA AB 4-1996, "Guidelines for inspection and preventive maintenance of molded case circuit breakers used in commerical and industrial applications."

In Making Connections with Aluminum Wire Refer to GEH-3445.

NOTE: When using aluminum wire, use a joint compound recommended by the wire manufacturer.

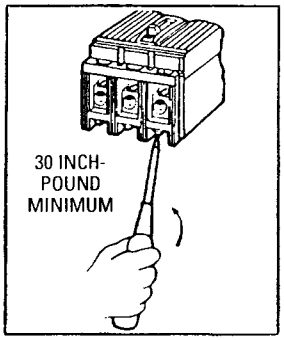
Lug Mounting Torque Values

GEJ-4654

TCAL12, 12A, 15, TC012

Mounting Lugs for E150 Line

Lugs must be securely fastened to terminal straps. Lugs are mounted at the factory with a torque wrench set at 30 inch-pounds minimum.



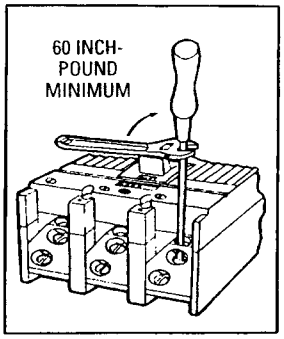
GEJ-4655

TCAL43, TCAL63, TC043, TC063, TCAL47

Mounting Lugs for J600 Line

Lugs must be securely fastened to terminal straps. Lugs are mounted at the factory torqued to 60 inch-pounds minimum.

Suggested method for attachment or removal is illustrated.



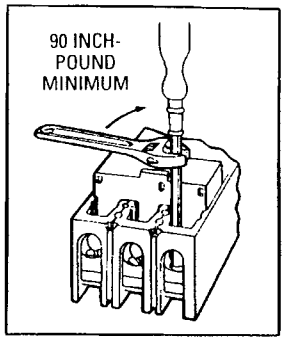
GEJ-4639

TCAL24, TC024, TCAL25, TC026, TCAL27

Mounting Lugs for F225 Line

Lugs must be securely fastened to terminal straps. Lugs are mounted at the factory torqued to 90 inch-pounds minimum.

Suggested method for attachment or removal is illustrated.



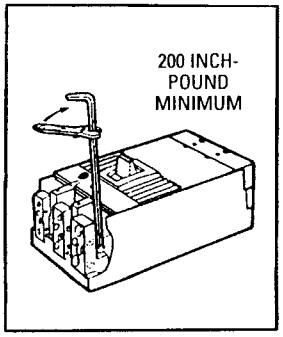
GEJ-4656

TCAL41, TCAL61, TCAL81, TCAL91, TCAL121, TCAL131, TCAL122, TC041, TC061, TC081A, TC0121, TC0131, TC091

Mounting Lugs for K1200 Line

Lugs must be securely fastened to terminal straps. Lugs, when factory installed, are torqued to 200 inch-pounds minimum.

Suggested method for attachment or removal is illustrated.



Cable Connector (Wiring Lug) Torque Values

All Type THQP, THQL, THQB, THQC (including ground fault circuit breakers) and all TEB, TEC, TED, THED and TB1 circuit breakers and molded case switches are marked with the appropriate lug tightening torque values.

All other circuit breakers employ lugs with screws having an internal hexaagonal socket with dimesnion "across the flats" of 1/4, 5/16 or 3/8 inch. The following table gives the recommended cable tightening torque for these lugs.

Socket Size (Across Flats)	Recommended Tightening Torque (inch-pounds)	Circuit Breaker Types
1/4	200	TQD, TQDL
5/16	275	TFJ/K, TJJ/K/D/C, TJ-V, TB4
3/8	375	TKM/C-TK0V, TB6/TB8

Molded-Case Circuit Breakers

Shunt Trip Accessory for Types TJC, TJD, TJJ, TJK, THJK, TB4, & TBC4

NOTE: UL listing is voided when the circuit breaker is modified to add an accessory.

Description

A Shunt Trip accessory is installed in a circuit breaker to allow electrical tripping of the breaker from a remote location. As shown in Figure 1, it consists of a solenoid whose core is attached to a spring-biased latch. When the control circuit is closed at the remote contacts, the solenoid is energized, which releases the latch. This allows the shaft and plunger to move the breaker trip bar and trip the breaker. A cut-off switch opens the solenoid coil electrical circuit when the breaker contacts open. The solenoid coil carries only momentary current and is not rated for continuous duty.

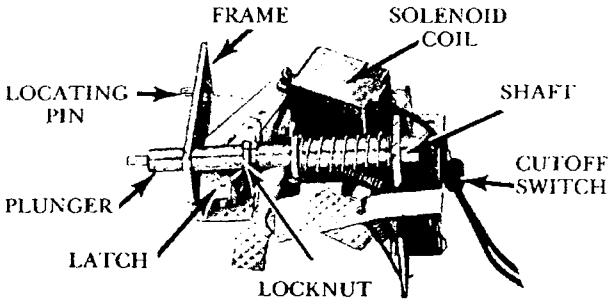


Figure 1. Shunt Trip accessory (unit shown for right pole installation.

The Shunt Trip must be ordered for either right pole or left pole installation. The catalog numbers for the various voltage applications are listed in Tables 1 and 2.

Catalog Number	Voltage Rating	Peak Inrush Current, A
TJKSTA7R or L	12 Vdc	4.8
TJKSTA8R or L	24 Vdc	4.6
TJKSTA9R or L	48 Vdc	2.4
TJKSTA12R or L	120 Vac	1.0
	125 Vdc	1.0
	240 Vac	1.9
TJKSTA11R or L	250 Vdc	0.4
TJKSTA13R or L	480 Vac	1.5
	600 Vac	1.9

Table 1. Catalog numbers and electrical ratings for the Shunt Trip accessory for breaker types TJC, TJD, TJJ, TJJK, and THJK..

Catalog Number	Voltage Rating	Peak Inrush Current, A
TB4STA7R or L	12 Vdc	4.3
TB4STA8R or L	24 Vdc	4.6
TB4STA9R or L	48 Vdc	2.4
TB4STA12R or L	120 Vac	1.9
	125 Vdc	1.0
	240 Vac	1.9
TB4STA11R or L	250 Vdc	0.4
TB4STA13R or L	480 Vac	1.9
	600 Vac	1.9

Table 1. Catalog numbers and electrical ratings for the Shunt Trip accessory for breaker types TB4 and TBC4.

The Shunt Trip fastens to the breaker base and occupies the space next to the operating mechanism of the breaker, as shown in Figure 2. The spring-loaded plunger extends through a knockout in the trip unit case to operate the trip bar and does not interfere with the normal tripping action of the trip unit.

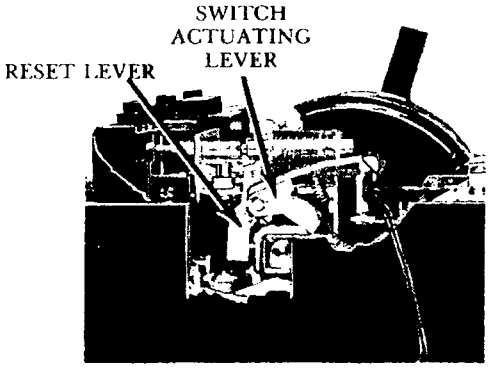


Figure 2. Shunt Trip installed in breaker (cutaway view of right pole installation).

A different style of plunger is used in the Shunt Trip, beginning with breakers and trip units built in week 49, 1996 (date code J649=). For breakers and trip units built before this date, use plunger style "A" in Figure 3. For breakers and trip units built during or after week 49, use plunger style "B." Refer to the breaker bar-code label or the trip unit face to determine the date of manufacture. The date code appears as a letter followed by three digits and an additional symbol. For instance, J649= indicates the manufacturing plant (J), the year (6), the week (49), and the decade (= indicates 90s).

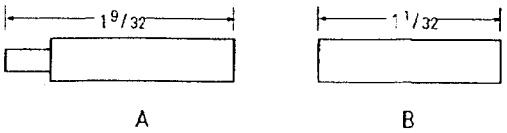


Figure 3. New- and old-style Shunt Trip plungers.

After installation, two leads (minimum of 24 inches long) are brought out through the side of the breaker case. (Accessories with leads brought out through the back of the breaker are available factory installed.) The external control circuit, consisting of normally open switch or relay contacts and connections to a control power source, must be supplied by the user.

Installation

CAUTION: The circuit breaker must be completely de-energized and disconnected from the electrical circuit before the Shunt Trip accessory is installed in the breaker. This is mandatory, since the breaker must be in the ON position to install these accessories.

ATTENTION: Il faut que le disjoncteur soit complètement désamorcé et débranché du circuit électrique avant que l'accessoire du déclenchement shunt soit installé dans le disjoncteur. Ceci est obligatoire, étant donné que le disjoncteur doit être en position "On" pour faire l'installation de ces accessoires.

CAUTION: Circuit breakers and accessories should be handled, inspected, installed, and removed by qualified personnel only and in accordance with these instructions and with accepted safety precautions.

ATTENTION: Seul un personnel qualifié et suivant ces directives ainsi que les mesures de précautions nécessaires devrait manipuler, inspecter installer et enlever les disjoncteurs et les accessoires.

Use the following procedure to install the Shunt Trip accessory in a circuit breaker.

1. **De-energize breaker.** Ensure that the circuit breaker is de-energized and disconnected from the circuit.
2. **Remove cover.** Remove the four cover mounting screws, then remove the cover from the breaker. Do not remove the trip unit.
3. **Drill hole in breaker.** From the back of the breaker, drill a 0.125-inch hole on the pole where the Shunt Trip is to be installed, as illustrated in Figure 4. Use the spotting hole closest to the trip unit for locating the drill.
4. **Remove knockout.** Being careful not to eject chips into the trip unit case, drive a small screwdriver through the knockout groove, shown in Figure 4, in several places. Gently pry outward to remove the knockout. Clean all chips from the breaker case. Move the breaker handle to the ON position. Note that some trip units may have rectangular knockouts that are removed by inserting a screwdriver in the slot and prying upward.

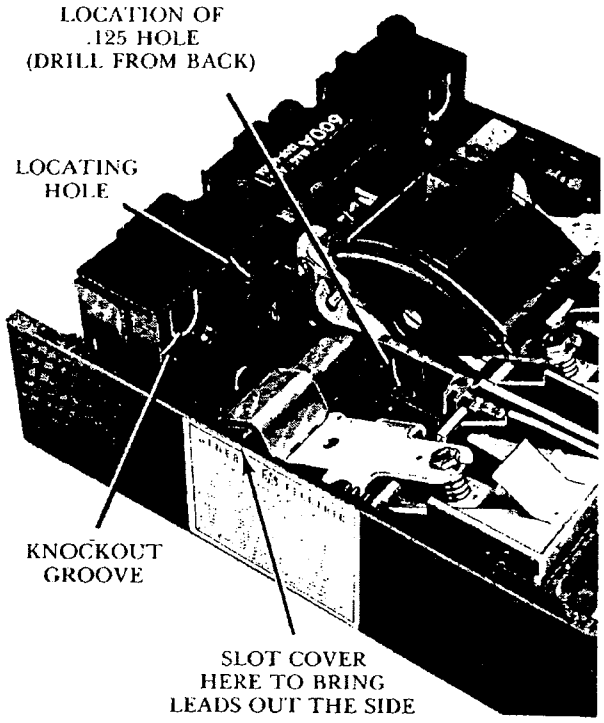


Figure 4. Inside of the breaker, showing the locations of the knockout, locating hole, drilled hole, and wire slot.

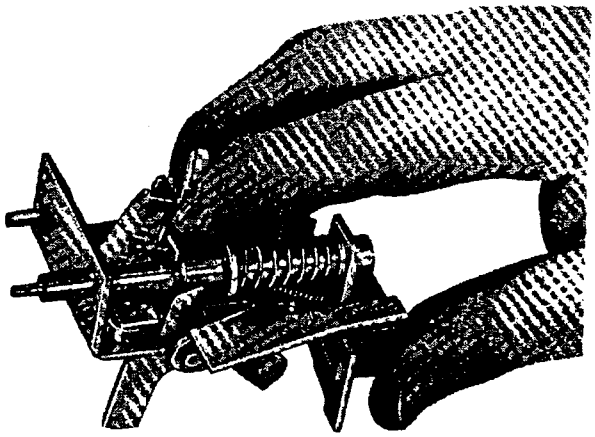


Figure 5. Holding the Shunt Trip for assembly (unit shown for right pole installation).

5. **Ready unit for installation.** Ensure that the threaded portion of the shaft is screwed all the way into the plunger. Grasp the Shunt Trip as shown in Figure 5, pulling the plunger back beyond the latching point.
6. **Install the Shunt Trip.** Holding the Shunt Trip accessory as shown in Figure 5, insert the

plunger through the knockout removed in Step 4, and the locating pin, shown in Figure 1, into the locating hole, shown in Figure 4. Set the unit in place so that the accessory mounting hole is on top of the hole drilled in Step 3. The actuating lever of the Shunt Trip and the reset lever of the trip unit must be positioned with respect to the circuit breaker crossbar as shown in Figure 2.

7. **Secure unit.** Fasten the Shunt Trip accessory firmly in place using the 1-inch self-tapping screw and lock washer supplied, as shown in Figure 6.

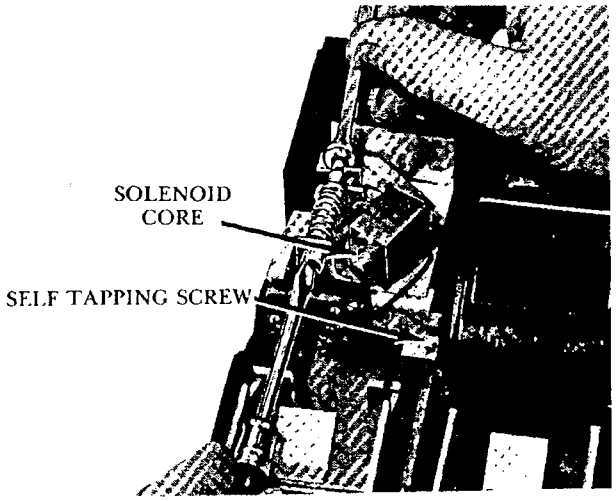


Figure 6. Shunt Trip accessory installed in the breaker (right pole installation shown).

8. **File slot for leads.** To bring the accessory leads out the side of the breaker, file openings in the breaker cover at any point between $3^{21}/_{32}$" to $5^{3}/_{4}$" from the trip end of the breaker, as shown in Figure 4. Note that accessories with leads brought out the back of the breaker are available factory installed.

9. **Installation in Type TB4 Circuit Breakers.** When installing a Shunt Trip in a Type TB4 breaker, place barrier A, illustrated in Figure 7, between the phase barrier and the rib in the base, as shown in Figure 8. Place barrier B in the slots next to the handle.

CAUTION: The circuit breaker and accessory must be completely de-energized and disconnected from electrical circuits before adjustments are made. To ensure optimum performance, it is necessary to adjust the Shunt Trip to compensate for manufacturing variations in the breaker. These adjustments were already made if the Shunt Trip was installed at the factory.



Figure 7. Two barriers installed with the Shunt Trip in Type TB4 circuit breakers.

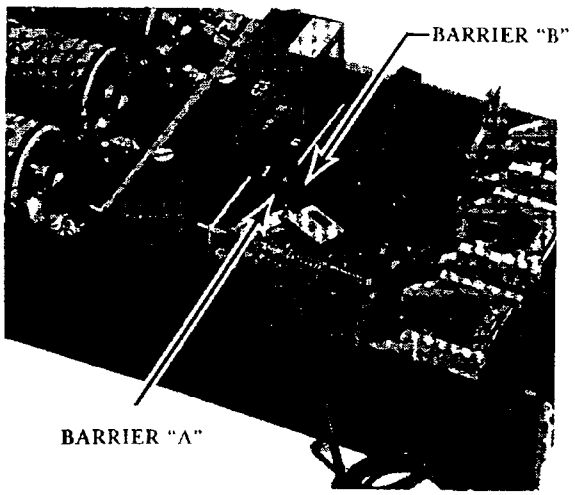


Figure 8. Installing the barriers in a Type TB4 breaker.

ATTENTION: Il faut que le disjoncteur et l'accessoire soient complètement désamorcés et débranchés des circuits électriques avant que ne soient apportés des ajustements. Afin d'assurer une performance optimale, il faut ajuster le déclenchement shunt pour compenser les variations de fabrications du disjoncteur. Ces ajustements ont déjà été faits si le déclenchement shunt a été installé à l'usine.

10. **Adjustments.** With the circuit breaker in the ON position and the accessory de-energized, unlatch the Shunt Trip by pushing the core through the solenoid. Turn the slotted end of the plunger, while holding the other end with a wrench, as shown in Figure 6. Turn the screwdriver counter-clockwise until the breaker trips, then continue for two additional turns.

    To prevent loss of adjustment due to vibration, tighten the lock nut, shown in Figure 1, against the plunger to 6 in-lb torque.

11. **Mechanical Checkout.**
    - Relatch the Shunt Trip and turn the breaker ON.

- Check the cutoff switch actuator to ensure that it does not touch the switch button. The actuator should depress the switch button completely with the breaker in the OFF position.
- Being careful to keep fingers clear of the breaker contact arms, depress the solenoid core completely into the solenoid. The breaker should trip; if it does not, repeat the adjustment.

12. **Replace cover.** Replace the breaker cover, taking care that the strain-relief ties or disks are placed one on each side of the hole in the cover.

These instructions do not cover all details or variations in equipment nor do they provide for every possible contingency that may be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE Company.



GE Electrical Distribution & Control

General Electric Company
41 Woodford Ave., Plainville, CT 06062

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Installation
Instructions

Auxiliary Switch Accessories

For J 600 Line (TJK), K 1200 Line (TKM) And TB4, TB6 And TB8 Circuit Breakers

General

Circuit breakers and components should be handled, inspected, installed or removed by qualified personnel in accordance with accepted safety procedures.

Auxiliary switch accessories are installed in circuit breakers to operate relay, control, or indicating light circuits simultaneously with the operation of the breaker.

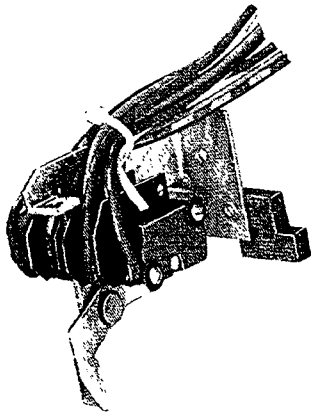
The position of the circuit breaker main contacts is indicated by closed or open auxiliary switch contacts as follows:

Normally-open, "A" contacts—open when the breaker is open or tripped, closed when the breaker is closed.

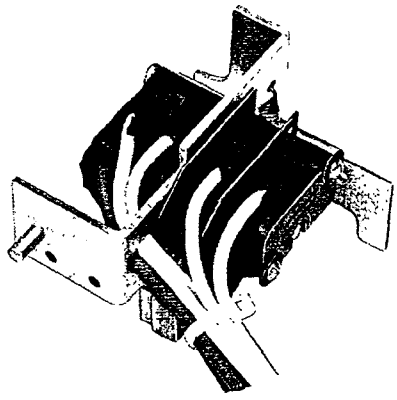
Normally-closed, "B" contacts—closed when the breaker is open or tripped, open when the breaker is closed.

Auxiliary switches for TJK or TKM circuit breaker consist of one to four "AB" elements (Figure 1). Each "AB" element is one 3-terminal, single-pole, double-throw switch with 3 color-coded wire leads connected to the switch terminals and brought out through the circuit breaker case, extending a minimum of 24 inches outside the breaker. An "AB" switch element can be used in an auxiliary circuit as a single "A" contact, using only the red and white leads, or a single "B" contact, using only the brown/white and white leads. It can also be used as both an "A" contact and a "B" contact, using all three leads, provided a common connection in the auxiliary circuit wiring between the "A" and "B" contacts is permissible.

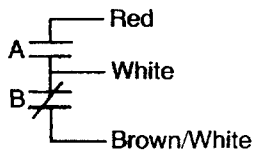
The auxiliary switch assembly is left- or right-pole mounted. It is fastened to the circuit breaker base and occupies the space adjacent to the operating mechanism. An auxiliary switch does not interfere with the operation of the trip unit or operating mechanism.



K 1200 Line Breaker



J 600 Line Breaker



Elements Schematic

Figure 1 Auxiliary Switch With Four AB Elements

GENERAL ELECTRIC

Auxiliary Switch Accessories

Installation—J 600 Line Breaker Figure 2

CAUTION: The breaker must be completely de-energized and disconnected from the electrical circuit, when the auxiliary switch is being installed. This is mandatory because the breaker must be in the ON position while the accessory is being installed.

Auxiliary Switch Kits

Cat No Add L or R suffix for left or right-pole mounting		Number of Switch Elements	Maximum Ampere Rating Switch Element
For 240 volts AC	For 600 volts AC		
FOR J 600 LINE BREAKERS			
TJKASA2AB1	TJKASA6AB1	1	6A at rated voltage ¼A at 250 volts DC ½A at 125 volts DC
TJKASA2AB2	TJKASA6AB2	2	
TJKASA2AB3	TJKASA6AB3	3	
TJKAST2AB4	TJKASA6AB4	4	
FOR K 1200 LINE BREAKERS			
TKMAAS2AB1	TKMAAS6AB1	1	6A at rated voltage ¼A at 250 volts DC ½A at 125 volts DC
TKMAAS2AB2	TKMAAS6AB2	2	
TKMAAS2AB3	TKMAAS6AB3	3	
TKMAAS2AB4	TKMAAS6AB4	4	

Keep hands clear of mechanism at all times.

1. Remove cover from breaker by unscrewing eight cover screws. Do not remove the trip unit.

2. Be sure the circuit breaker is de-energized or removed from the circuit. With 0.125 diameter drill, drill through hole on the pole where accessory is to be installed. This hole should be drilled from the front or back of the breaker; use one of the spotting holes between pole units which is located 5⅜" from the load end of the breaker (See Figure 3.)

3. Set switch in place, inserting locating pin into locating hole. Align the accessory mounting hole with hole drilled in step 2.

4. Fasten the accessory firmly in place with 1" × #6 self-tapping screw and lock washer (supplied).

5. To bring the accessory leads out the side of the breaker, file necessary openings in the breaker cover at any point 2½" to 3¼" from the load end of the breaker.

NOTE: UL listing is voided when the circuit breaker is modified to add an accessory.

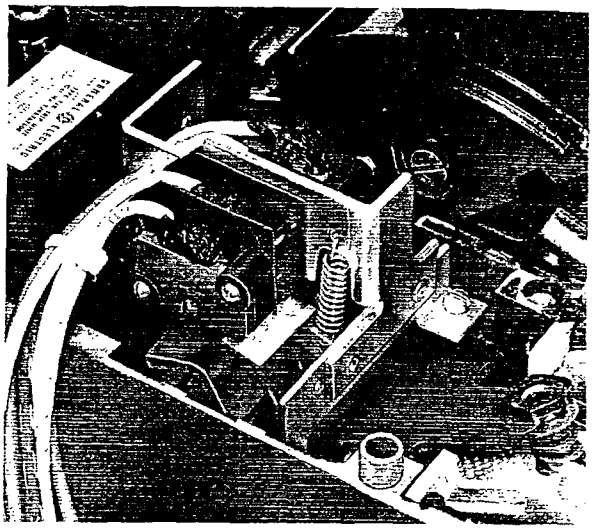


Figure 2 Auxiliary Switch installed in J 600 Case Breaker

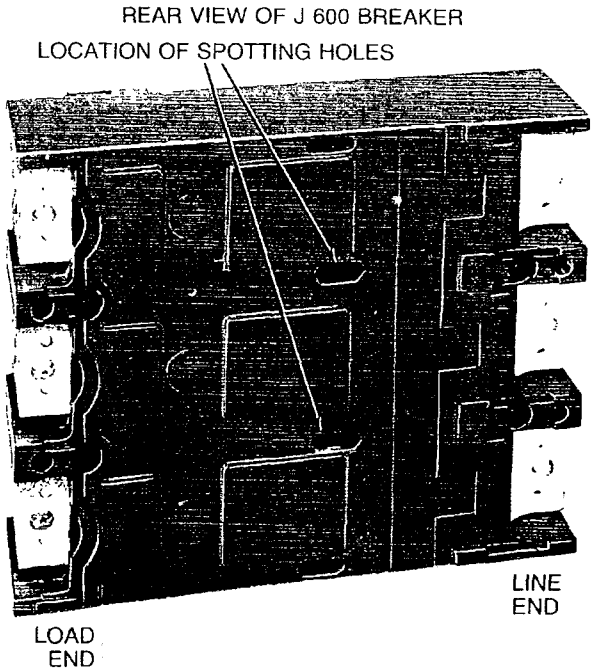


Figure 3 Spotting Holes Location

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Installation—K 1200 Line Breaker Figure 4

Keep hands clear of mechanism at all times.

1. Remove the breaker cover by unscrewing the four cover screws. (Cover screws are those closest to the breaker handle.)

2. Locate the mounting bracket on the trip unit case. Fasten firmly in place (See Figure 5).

3. With ¼ × 8-32 accessory mounting screw in mounting hole, set the accessory in place. Phenolic support must sit in groove in the circuit breaker's molded base. Fastern firmly in place.

4. To bring the accessory leads out of the side of the breaker, file the necessary openings on accessory pole of the breaker cover, 4¾ to 5¼ inches from the load end of the cover. Care should be taken in forming the bundle of leads so that no wires interfere with the white trip button. Remove the load lug cover when making the measurement.

NOTE: UL listing is voided when the circuit breaker is modified to add an accessory.

Check for proper operation of The accessory after installation.

Mechanical Check:
With the breaker open, check to be sure that the switch actuator does not depress the switch buttons. Switch buttons are depressed when the breaker is closed.

Electrical Check:
Check for continuity to see that:

"A" contacts (red and white leads) are open when the breaker is open or tripped, and closed when the breaker is closed; "B" contacts (brown/white and white leads) are closed when the breaker is open or tripped; and open when the breaker is closed.

For future identification of the respective "AB" elements after the breaker cover is replaced, the leads associated with each "AB" switch element should be marked or taped together during the continuity check.

Replace the circuit breaker cover (arrange leads through the side opening), taking care that loops and ties or restraining discs are inside the breaker cover, and wire tie or disc is outside the breaker cover. Tighten the cover screw. The breaker is now ready for mounting.

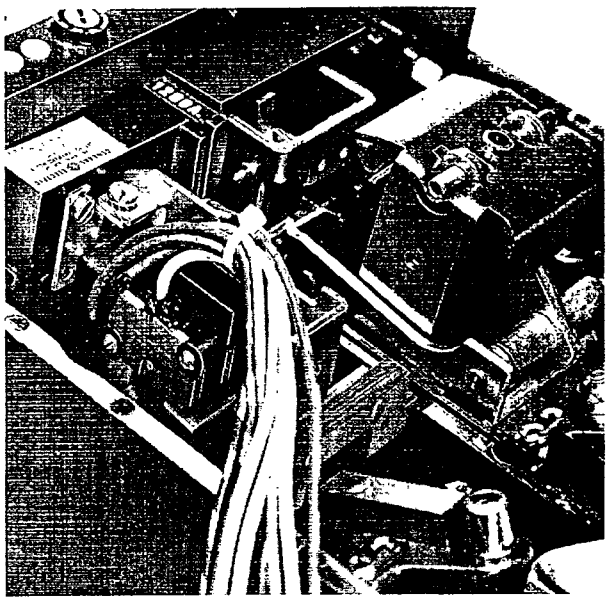


Figure 4 Auxiliary Switch installed in K 1200 Molded Case Breaker.

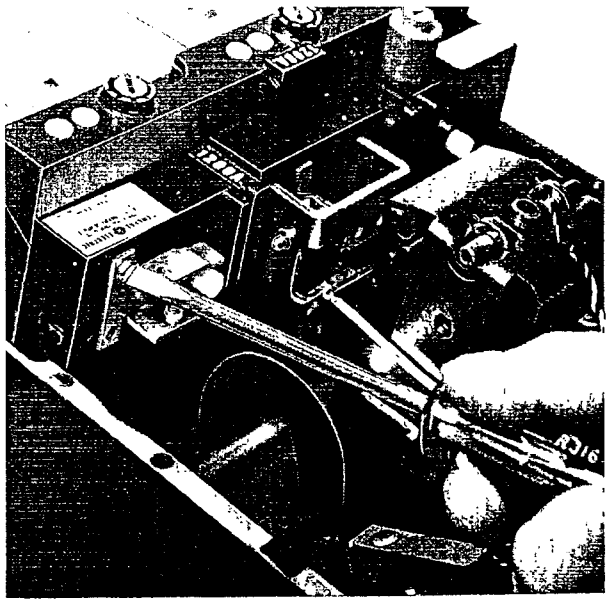


Figure 5 Mounting Bracket on TKMA trip unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company

For further information call or write your local General Electric Sales Office or . . .

General Electric Company
41 Woodford Avenue
Plainville, CT 06062 U.S.A.

Outside the U.S. write Construction Equipment Export Operation
411 Theodore Fremd Ave., Rye, NY 10580

GEH-3321G 1185 PSA

GENERAL ELECTRIC

Bell Alarm Switch Accessory

For Types TJJ, TJK, THJK, TJS, TJSS, TJR, THJR, TB4

NOTE: UL listing is voided when the circuit breaker is modified to add an accessory. UL label must be destroyed.

Breaker Type	Bell Alarm Kit Cat. No.	Max. Volts	Max. Amperes
J 600 Line	TJKBAAL	240 VAC	5A

DESCRIPTION

The bell alarm device contains a single pole, double-throw switch which is actuated by the breaker trigger. Thus, only when the breaker is tripped due to over current condition, will this switch function and either close or open a circuit as desired. *For center pole mounting only.*

INSTALLATION

WARNING: The circuit breaker must be completely de-energized and disconnected from the circuit when accessories are installed.

1. Remove the circuit breaker cover (Figure 2).
2. With the breaker *tripped*, hold the handle as far as possible toward ON and install the breaker mounting bracket on the *right-hand* breaker mechanism frame (Figure 3).

KIT

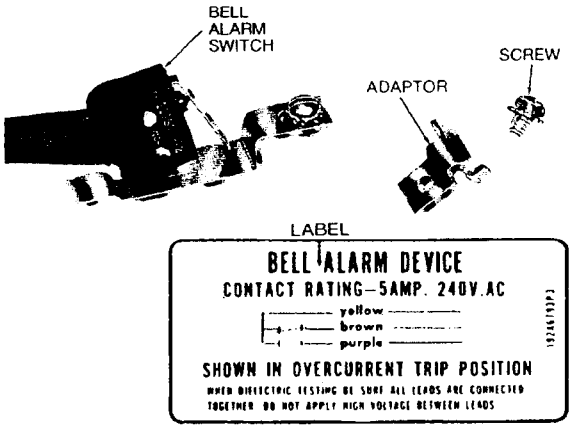


Figure 1

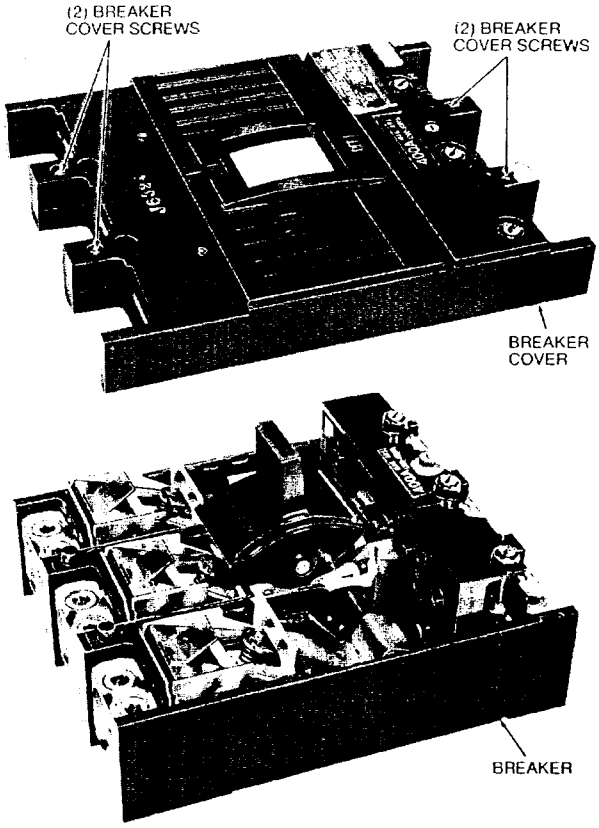


Figure 2

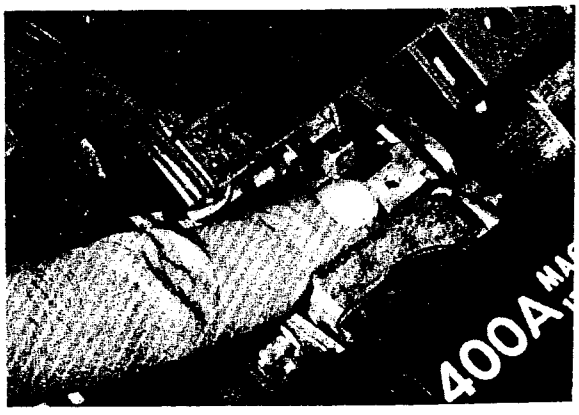


Figure 3

3. Hold the breaker handle toward ON *(breaker tripped)*, and insert the bell alarm tab into the slot of the breaker mechanism frame (Figure 4).

4. Hold the breaker handle toward ON and start the screw in the bell alarm switch base into the tapped hole in the mounting bracket. DO NOT TIGHTEN SCREW.

5. Reset the breaker, and move handle to ON.

6. Use a screwdriver to slide the bell alarm switch against the breaker trigger, until the switch actuator is depressed to within 1/64 to 1/16 inch of the switch body (Figure 5). Tighten the screw.

7. Leads can be brought out through the left side of the breaker. File lead-out slots in the left side of the breaker cover approximately 3½ inches from the load end of the breaker. (Figure 6)

8. Bring bell alarm switch leads over latch pin through the lead-out slots. Be careful to avoid wedging leads in the breaker mechanism.

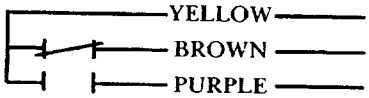
9. *Trip the breaker, using "twist-to-trip" button.*

10. Replace the breaker cover, taking care that strain relief ties or discs are placed one on each side of hole in cover. Proceed with electrical-mechanical check.

ELECTRO-MECHANICAL TESTS

With breaker still in the tripped position, circuit between accessory leads colored YELLOW and BROWN should be CLOSED, and between YELLOW and PURPLE should be OPEN. If it is not, check to see that switch actuator has been sufficiently depressed. If not, correct as follows:

a. Reset breaker mechanism.
b. Readjust switch per step 6.
c. Trip breaker to check adjustment.



Bell Alarm Device
(Shown in breaker, tripped condition)

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE Company.

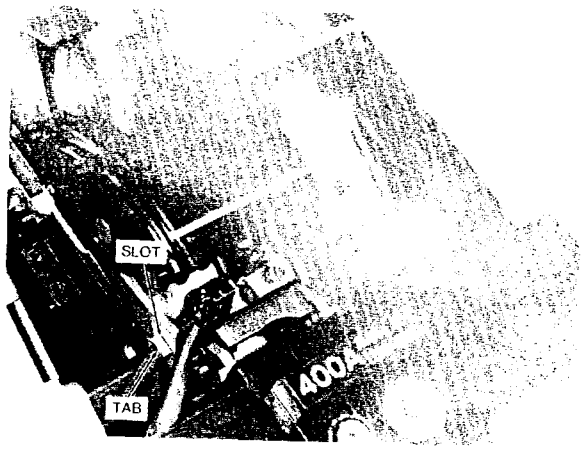


Figure 4

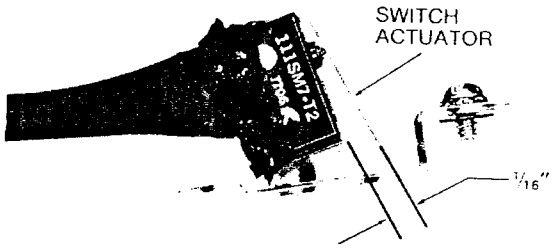


Figure 5

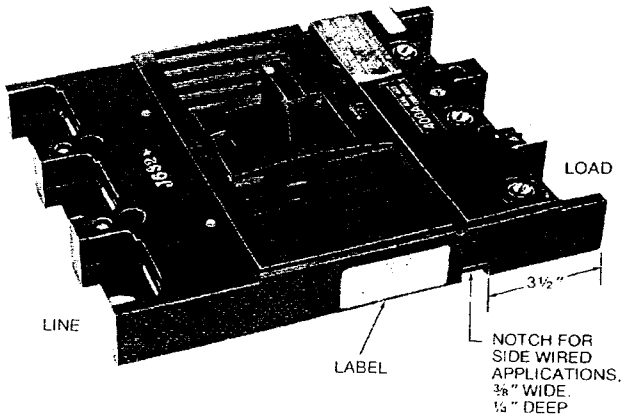


Figure 6

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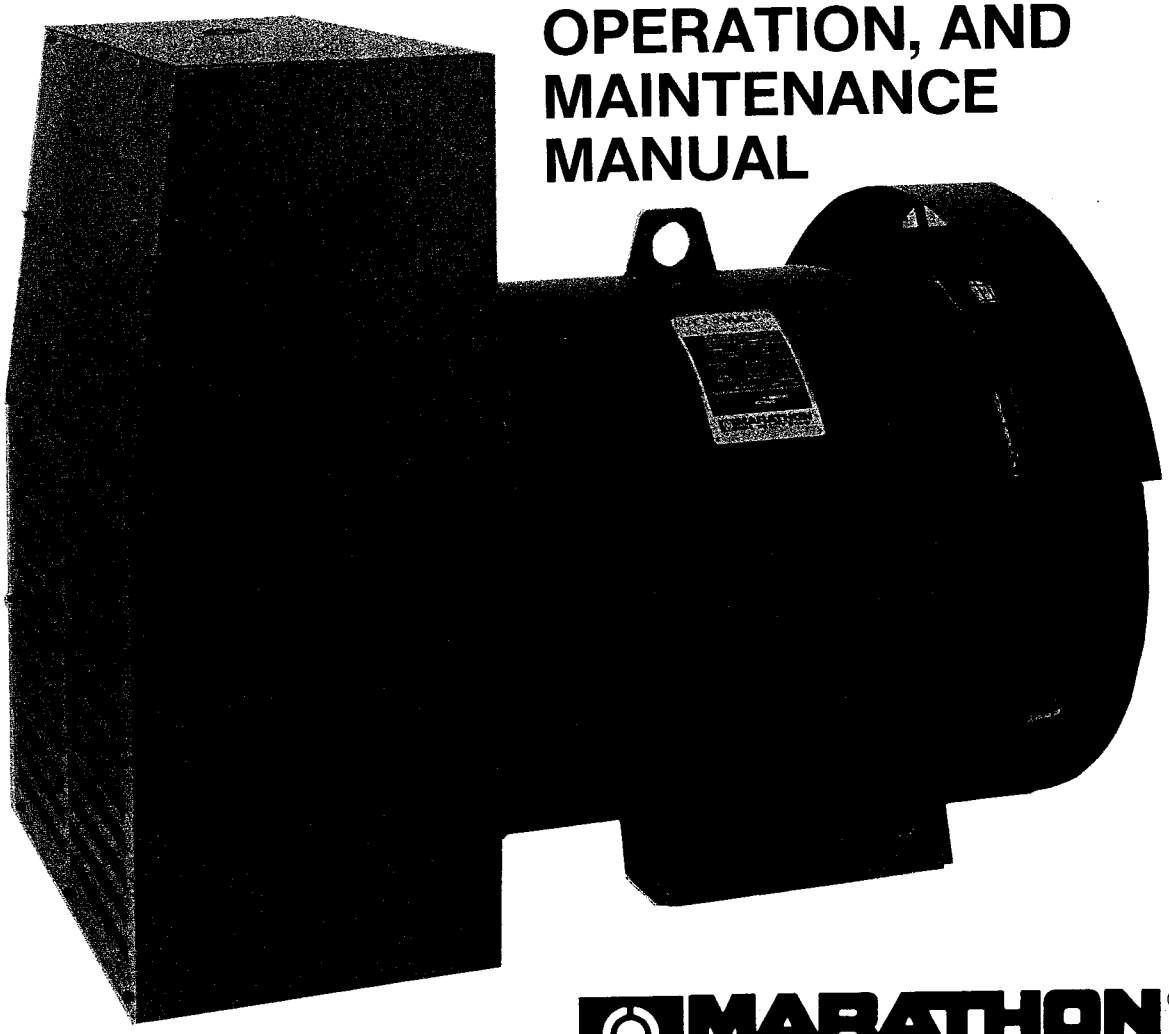
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MAGNAMAX DVR®
GENERATOR

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL



MARATHON® ELECTRIC

WAUSAU, WISCONSIN 54401

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A FEW WORDS ABOUT SAFETY

PLEASE REMEMBER SAFETY FIRST. If you are not sure of the instructions or procedures, seek qualified help before continuing.

This service manual emphasizes the safety precautions necessary during the installation, operation, and maintenance of the MagnaMAX^{DVR} generator.

Each section has caution and warning messages. These messages are for your safety and the safety of the equipment involved. If any of the cautions or warnings are not readily understood, seek clarification from qualified personnel before proceeding.

Before any service work is done, disconnect all power sources and, where appropriate, lock out all controls, to prevent an unexpected start-up of the generator set. Proper grounding in compliance with local and national electrical codes must be provided. These safety precautions are necessary to prevent potential serious personal injury, or even death.

The hazards associated with lifting or moving the MagnaMAX^{DVR} generator are pointed out in the installation and service sections; incorrect lifting or moving can result in personal injury or property damage.

Whenever the generator is running, always assume and proceed as if voltage is present. Residual voltage is present at the generator leads and at the regulator panel connections, even with the regulator fuse removed. Caution must be observed, or serious personal injury or death can result.

Whenever solvents, cleaners, or flammable liquids are present, adequate ventilation must be available to avoid fire, explosion, and health hazards. Always avoid breathing vapors and use suitable personal protective equipment to prevent personal injuries. (Such as eyes, face, and hand protection.)

This manual is not intended to be a substitute for properly trained personnel. Repairs should only be attempted by qualified trained people. The cautions and warnings point out known conditions that are potentially dangerous. Each installation will create its own set of circumstances. No manual can cover every possible situation.

When in doubt, ask. Don't be embarrassed to ask "dumb questions". Remember, dumb questions are much easier to handle than dumb mistakes.

GENERAL INFORMATION

SECTION 2

MECHANICAL DESIGN

General

All single and two bearing units are manufactured with cast iron end brackets and adapters, and fabricated steel frames. Flexible drive discs and SAE adapters are machined to SAE standards. Prelubricated, regreasable, shielded ball bearings are used on MagnaMAX^{DVR} generators. Standard units are fully guarded. Dripproof shields are available as an option.

Conduit Box

The large front end mounted conduit box is constructed of formed sheet steel which will allow the addition of top mounted control packages. Refer to Marathon Electric for top mounted controls of more than 240 lbs. There is ample room inside the conduit box for a circuit breaker (through 800A Frame) and other options. The conduit box cover properly directs outside ventilating air through the generator.

MagnaMAX^{DVR} Unirotor™ Construction

An aluminum die cast rotor core affords high mechanical integrity and low vibration at operating speeds. Amortisseur winding and coil supports are die cast as an integral part of the rotor. Laminations are 4-pole, one piece laminations which are shrunk fit and keyed to the shaft. No dovetails, cross bolts or other pole to shaft connecting devices are used. The cast unidirectional aluminum alloy ventilating fan provides even air distribution to maximize cooling and generator efficiency.

Adapters and Drive Discs

All single bearing units are available with several adapter and drive disc arrangements. These can be shipped to order or can be changed in the field with standard shop tools. When changing flexible drive discs, spacers are used between the discs and the cast iron hub to maintain SAE standard dimensions.

ELECTRICAL DESIGN

General

All standard products have 2/3 pitch main windings to eliminate the third harmonic. This serves to lower operating temperatures, give lower harmonic content and better wave form, and extend the overall life of the generator. The phase sequence is ABC, when rotated counter clockwise viewing exciter end.

Temperature Rise

All ratings and frame sizes are based on NEMA and CSA Class F and Class H temperature rises on both the rotor and stator windings. Ratings for British, German, French, IEC, and all popular marine agencies are available.

Standby Generator

Synchronous generators used on emergency backup power can have temperature rises up to 25°C above those for continuous operation. (NEMA MG1-22.40 and MG 1-22.84).

Premium Insulation System

All MagnaMAX^{DVR} generators are built with Class H or better insulation materials. All standard generators are suitable for continuous duty at Class F temperature rise and will give equivalent or better winding life expectancy to generators supplied with Class A or B insulation systems operated within their temperature limits. The varnishes and epoxies used are synthetic, non-hygroscopic. Multiple dip and bake cycles of the main winding, plus a final coat of epoxy, make the standard winding moisture and fungus resistant. The MagnaMAX^{DVR} rotor is wet wound with thermo-setting epoxy applied between each layer, plus a final coating of epoxy for moisture and abrasion resistance. MagnaMAX^{DVR} generators can be ordered with an epoxy vacuum pressure impregnated insulation system as an option. (MagnaMAX^{DVR} generators with form wound coils include VPI as standard.)

Power Factor

All standard generators are designed for operation at rated kVA at 0.8 lagging power factor but can be operated at rated kVA over the 0.8 to 1.0 power factor range.

MagnaMAX^{DVR} Voltage Regulator

The standard voltage regulator is a fully encapsulated, static type with a solid state build up circuit. Standard features include 3 phase RMS sensing, paralleling, adjustable underfrequency protection, and overexcitation protection. The regulator meets EMI suppression to Mil Std-461C, part 9. An optional feature is adjustable armature current limiting. See the regulator manual for more information.

HOW TO READ A MODEL NUMBER

It is extremely important to properly identify the machine when requesting parts or service.

Always have the generator model number and serial number when requesting information from the factory. We cannot help you without this information.

AN EXAMPLE FOR MAGNAMAX^{DVR} GENERATORS

Example:	431	RSL	4000	AA -	000
	①	②③④	⑤⑥⑦	⑧⑨	⑩

① Frame Number

② R–Random Wound
F–Form Wound

③ S–1 Bearing
D–2 Bearings

④ L–Up to 480 volts
M–1000-6600 volts
S–600 volts

⑤ Style
4-Magna

⑥ Type

⑦ WK² Code

⑧ Electrical/mechanical modification–minor modification, used in sequence A, B, C, etc.

⑨ Mounting arrangement–indicates adapter size and drive disc size. (Figure 2-1)

⑩ Modification Number (for internal use)

Figure 2-1

Arrangement	Adapter SAE Size	Drive Disc SAE Size
A	3	11-1/2
B	2	11-1/2
C	4	8
D	3	10
E	1	11-1/2
F	1	14
G	4	7-1/2
H	1	Delco
J	1/2	14
K	2	10
L	1/2	Delco
M	0	14
N	2	Small Delco
O	None	None
P	0	18
S	0	Delco
U	00	18
V	4	6-1/2
W	00	21
Y	4	10

INSTALLATION

SECTION 3

RECEIVING YOUR MagnaMAX^{DVR} GENERATOR

Upon receipt of the generator, it is recommended that it be carefully examined for possible damage incurred in shipment. The generator was given to the freight company in good condition, and they are responsible for the product from our dock to yours. Any damage should be noted on the freight bill before accepting the shipment. Claims for damages must be promptly filed with the freight company.

UNPACKING AND HANDLING

Read all instruction cards carefully. When lifting, attach an overhead crane to the lifting lugs on the generator frame. Apply lifting forces in a vertical direction.

WARNING

THE LIFTING LUGS ON THE GENERATOR ARE DESIGNED TO SUPPORT THE GENERATOR ONLY. DO NOT LIFT COMPLETE GENERATOR SET BY MEANS OF LIFTING LUGS ON GENERATOR. PERSONAL INJURY OR EQUIPMENT DAMAGE MAY RESULT.

STORAGE

In the event that the generator is not to be installed on the prime mover immediately, it is recommended that it be stored in a clean, dry area which is not subject to rapid changes in temperature and humidity. See Section 11 for more information.

PREPARATION FOR USE

Although the generator is carefully inspected and tested in operation before it leaves the factory, it is recommended the unit be thoroughly inspected. The insulation on the wire should be inspected and all bolts should be checked for tightness.

Remove all shipping tapes, bags, blocks, and skids which are used to prevent vibration and rotor movement during shipment. Dry, low-pressure compressed air of approximately 30 PSI (206 KPA) can be used to blow out the interior of the generator. In the case of two bearing machines, it is possible to turn the rotor by hand to make sure that it rotates smoothly without binding.

If the machine has been in storage for a year or longer, it is recommended that it be lubricated according to the lubrication instructions and chart found in section 5.

If the machine has been exposed to damp, humid conditions the insulation resistance should be checked. Refer to section 8.

GENERATOR MOUNTING - SINGLE BEARING

Single bearing generators are provided with an SAE flywheel adapter and flexible drive discs. Very close tolerances are maintained in the manufacture of the generator so that the alignment procedure is extremely simple. A coupling hub of nodular iron is shrunk on the shaft and special steel drive discs are bolted to the hub. Holes are provided in the periphery of the coupling disc which correspond to tapped holes in the flywheel. The outside diameter of the discs fits in a rabbet in the flywheel so that concentricity is assured in all cases.

WARNING

DO NOT APPLY ANY FORCE TO GENERATOR FAN FOR LIFTING OR ROTATING GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

CAUTION: GRADE 8 CAPSCREWS AND HEAVY SERIES LOCKWASHERS OR GRADE 8 PLACEBOLTS AND HARDENED WASHERS ARE RECOMMENDED TO MOUNT THE DRIVE DISCS TO THE FLYWHEEL.

The SAE adapter and the flywheel housing are designed to match each other with no further alignment necessary. Shims may be necessary under the feet of the generator to insure a solid mounting. See section 6 for more information.

GENERATOR MOUNTING-TWO BEARING

Two bearing generators are provided with a shaft extension and keyway. For direct-coupled units, the assembler furnishes a flexible coupling which is installed between the driver and the generator shaft.

IMPORTANT: Aligning the two machines as accurately as possible will reduce the vibration, increase bearing life, and insure minimum coupling wear. It may be necessary to shim the generator feet for proper support and alignment. Consult the coupling manufacturer's instructions for alignment specifications and procedures.

BELT DRIVE

430 Frame, two bearing generators can be belt driven. Please refer to Marathon Electric for application assistance involving belt driven installations. Sheave diameters should be chosen according to the table below.

MagnaMAX^{DVR} Sheave Application for Two Bearing Units ①

Model	Min. Sheave Dia. in Inches @ 10,000 Hr. B-10 Life③		Min. Sheave Dia. in Inches @ 20,000 Hr. B-10 Life③		Max. Sheave Width Inches
	60 Hz	50 Hz	60 Hz	50Hz	
431RDL4005	13.0②	10.9	16.9②	14.2	8.5
431RDL4007	15.2②	13.3	19.8②	17.3②	8.5
431RDL4009	17.0②	14.8	22.5②	19.5②	8.5

① Assumptions:
- A. Belting factor is 1.3.
- B. The drive and the driven sheaves are the same diameter.
- C. The sheave load is located at the center of the shaft extension.
- D. Based upon continuous kW ratings.

② These sheave diameters exceed the maximum recommended belt speed of 6000 ft/min.

③ B-10 Life means 90% of the bearing will last this long or longer.

ENVIRONMENTAL CONSIDERATIONS

Dirt, moisture, heat, and vibration are enemies of electrical equipment. Excessive exposure to the elements will shorten the life of the generator. The ambient temperature should not exceed the value shown on the generator nameplate. The MagnaMAX^{DVR} is built in a NEMA open type enclosure. Generators for outdoor application should be protected from the elements by housings with proper openings for ventilation. This protection should be designed to prevent the direct contact of wind driven rain, snow, or dust with the generator. In moist or humid areas, such as the Tropics and marine service, additional protection is recommended. Although the standard windings are humidity and moisture resistant, special insulations and accessories such as space heaters can increase generator life significantly. In extremely dirty and dusty environments, a means of providing filtered cooling air to the generator is recommended. Refer to Marathon Electric for more information.

ELECTRICAL CONNECTIONS

The generator conduit box construction allows conduit to enter the top, bottom, or either side of the box. A hole-saw or any suitable tool can be used to provide for the conduit entrance. Protect the interior of the generator from shavings when drilling or sawing. An approved connector must be used in conjunction with the conduit.

To minimize the transmission of vibration, it is essential that flexible conduit be used for all electrical entrance to the generator.

Refer to the connection diagram supplied with the generator and/or the proper diagrams shown in this section. Install all intercomponent and external wiring in accordance with the regulations of the national and local electrical codes. Clean all contact surfaces to assure good electrical bonding with the generator lugs or bus bars. Use heavy duty terminal lugs or good quality clamps for making all connections. Insulate all connections in accordance with national and local regulations.

Be sure the generator frame is grounded to all the other components of the system with a ground wire in accordance with national and local regulations.

GENERATOR LEAD CONNECTIONS

The electrical connections in the conduit box should be made in accordance with the appropriate "connection diagram." Use the diagram appropriate for the number of leads and voltage range required. Refer to the drawings supplied with the generator and to drawings in this section.

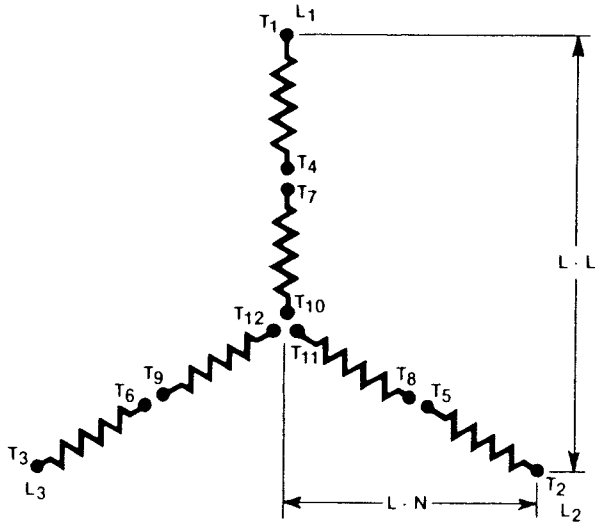
The final voltage setting is established within the selected range by an adjustment of the voltage regulator.

CAUTION: SOME GENERATORS HAVE MULTIPLE, IDENTICALLY MARKED, CABLES FOR EACH LEAD. CONNECT ALL IDENTICALLY MARKED CABLES TOGETHER WHEN MAKING CONNECTIONS.

INSTALLATION

SECTION 3

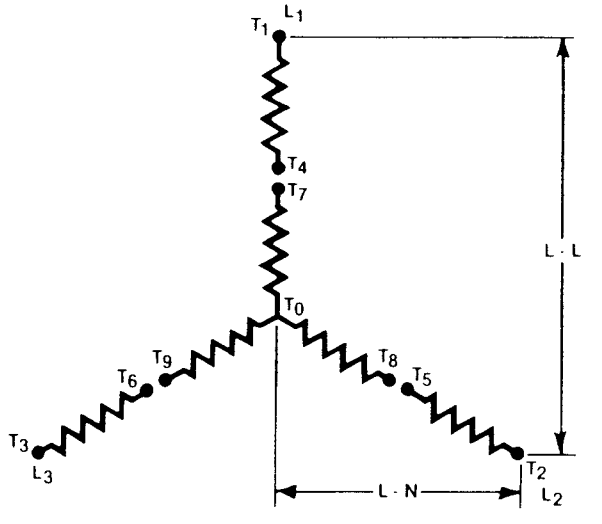
12 LEAD HI WYE



Twelve lead generators are dual voltage generators with six coils which don't have the connection of the three inner coils. There are 12 or 24 cables coming out of the generator.

VOLTAGE			CONNECT	L_1	L_2	L_3	NEUTRAL
	L-L	L-N					
60 HZ	380 416 440 460 480	219 240 254 266 277	T_{10} T_{11} T_{12}	T_1	T_2	T_3	T_{10} T_{11} T_{12}
			T_4 T_7				
			T_5 T_8				
50 HZ	380 400 416	219 231 240	T_6 T_9				

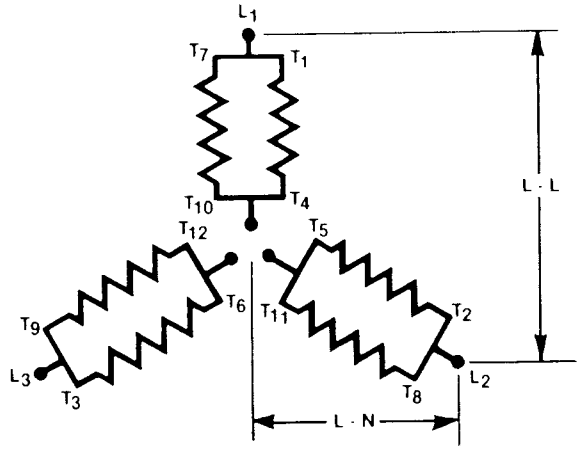
10 LEAD HI WYE



Ten lead generators are dual voltage generators with six coils. One end of the three inner coils is connected together. There are 10 or 20 cables coming out of the generator.

VOLTAGE			CONNECT	L_1	L_2	L_3	NEUTRAL
	L-L	L-N					
60 HZ	380 416 440 460 480	219 240 254 266 277	T_4 T_7	T_1	T_2	T_3	T_0
			T_5 T_8				
			T_6 T_9				
50 HZ	380 400 416	219 231 240					

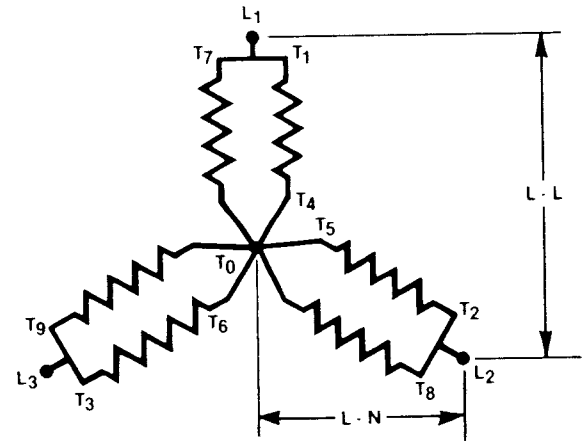
12 LEAD LOW WYE



Twelve lead generators are dual voltage generators with six coils which don't have the connection of the three inner coils. There are 12 or 24 cables coming out of the generator.

VOLTAGE			CONNECT	L_1	L_2	L_3	NEUTRAL
	L-L	L-N					
60 HZ	190 208 220 230 240	110 120 127 133 139	T_{10} T_{11} T_{12} T_4 T_5 T_6	T_1	T_2	T_3	T_{10} T_{11} T_{12} T_4 T_5 T_6
			T_1 T_7				
			T_2 T_8				
50 HZ	190 200 208	110 115 120	T_3 T_9				

10 LEAD LOW WYE



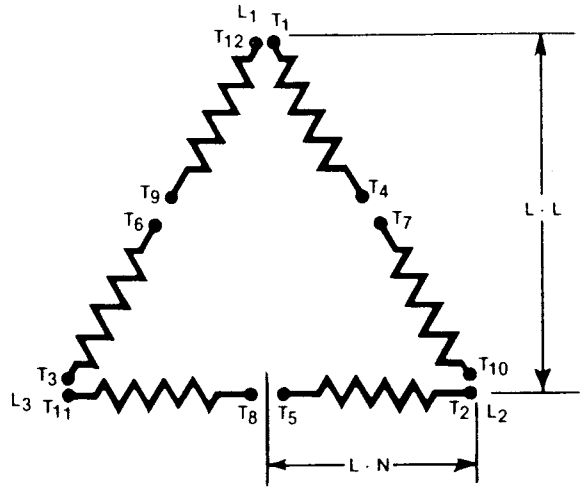
Ten lead generators are dual voltage generators with six coils. One end of the three inner coils is connected together. There are 10 or 20 cables coming out of the generator.

VOLTAGE			CONNECT	L_1	L_2	L_3	NEUTRAL
	L-L	L-N					
60 HZ	190 208 220 230 240	110 120 127 133 139	T_1 T_7	T_1	T_2	T_3	T_4 T_5 T_6 T_0
			T_2 T_8				
			T_3 T_9				
50 HZ	190 200 208	110 115 120	T_4 T_5 T_6 T_0				

INSTALLATION

SECTION 3

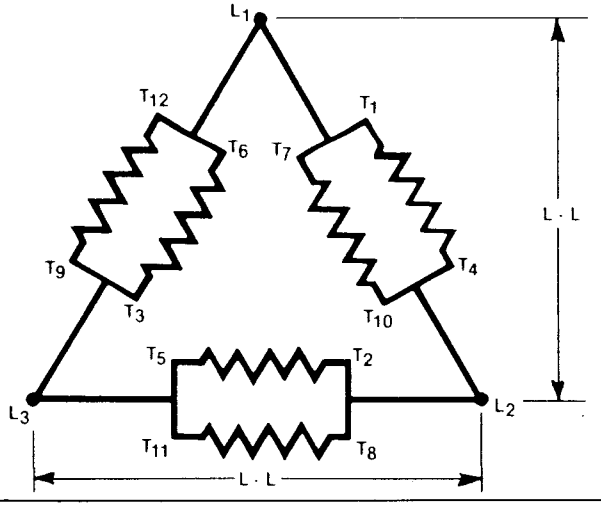
12 LEAD HI DELTA



Delta connection with 12 lead generators only.

VOLTAGE			CONNECT	L_1	L_2	L_3
	L-L	L-N				
60 HZ	240 277	120 139	T_4 T_7	T_1	T_2	T_3
			T_5 T_8			
50 HZ	200 220 240	100 110 220	T_6 T_9			
			T_1 T_{12}			
			T_2 T_{10}			
			T_3 T_{11}			

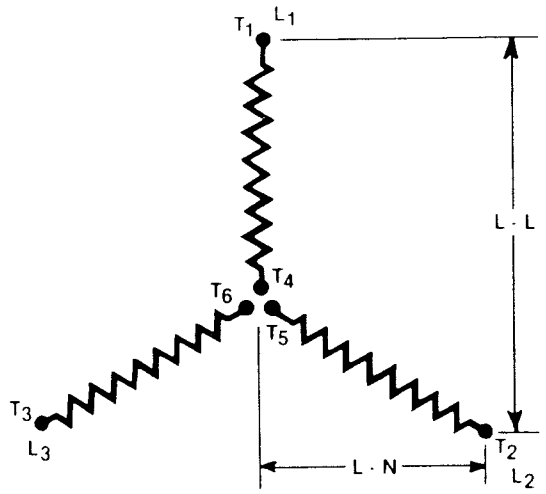
12 LEAD LOW DELTA



Delta connection with 12 lead generators only.

VOLTAGE		CONNECT	L_1	L_2	L_3
	L-L				
60 HZ	120 139	T_1 T_7 T_6 T_{12}	T_1	T_2	T_3
		T_2 T_8 T_4 T_{10}			
50 HZ	100 120	T_3 T_9 T_5 T_{11}			

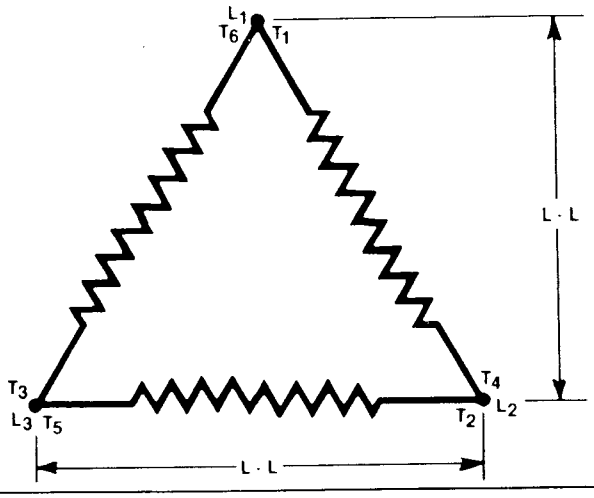
6 LEAD WYE



Six lead generators have 3 coil groups with 6 or 12 cables or bus bars coming out of the generator.

VOLTAGE			CONNECT	L_1	L_2	L_3	NEUTRAL
	L-L	L-N					
60 HZ	190	110	T_4 T_5 T_6	T_1	T_2	T_3	T_4 T_5 T_6
	203	120					
	220	127					
	230	133					
	240	139					
	3300	1905					
	4160	2400					
50 HZ	190	110					
	200	115					
	208	120					
	3300	1905					

6 LEAD DELTA



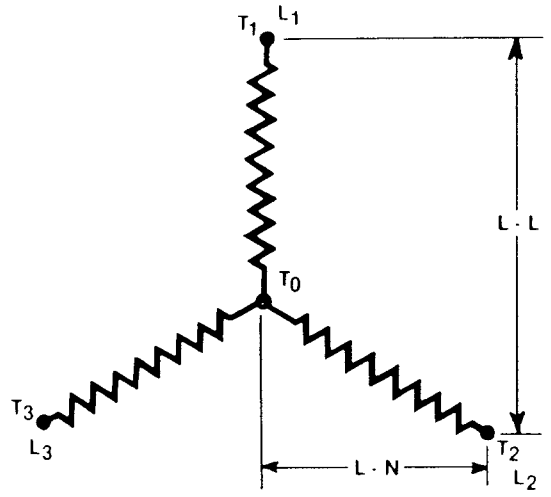
Six lead generators have 3 coil groups with 6 or 12 cables coming out of the generator.

VOLTAGE		CONNECT	L_1	L_2	L_3
	L-L				
60 HZ	2400	T_1 T_6	T_1	T_2	T_3
		T_2 T_4			
50 HZ	1905	T_3 T_5			

INSTALLATION

SECTION 3

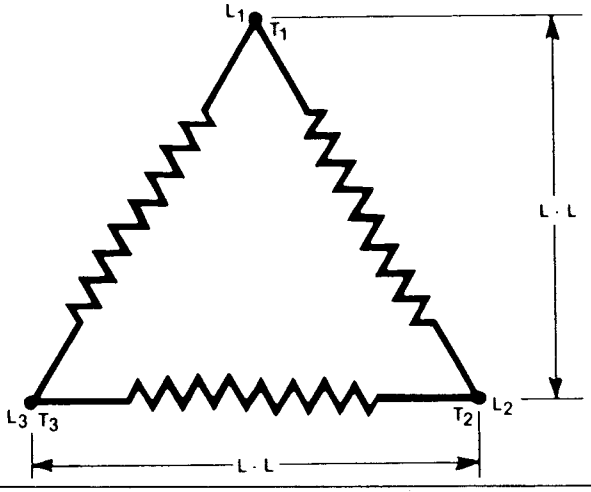
4 LEAD WYE



Four lead generators have 3 coil groups with one end of each group connected together. There are 4, 8 or 16 cables or 4 bus bars coming out of the generator.

VOLTAGE			L_1	L_2	L_3	NEUTRAL
	L-L	L-N				
60 HZ	380	219	T_1	T_2	T_3	T_0
	416	240				
	440	254				
	460	266				
	480	277				
	600	346				
50 HZ	380	219				
	400	231				
	416	240				
	480	277				

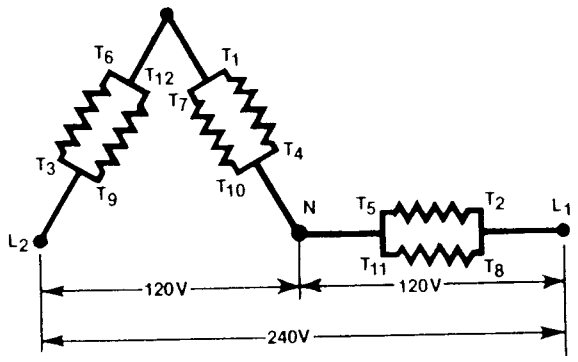
3 LEAD DELTA



Three lead generators have 3 coil groups with one end of each group connected into a Delta internally. There are 3, 6, or 12 cables or 3 bus bars coming out of the generator.

VOLTAGE		L_1	L_2	L_3
	L-L			
60 HZ	480	T_1	T_2	T_3

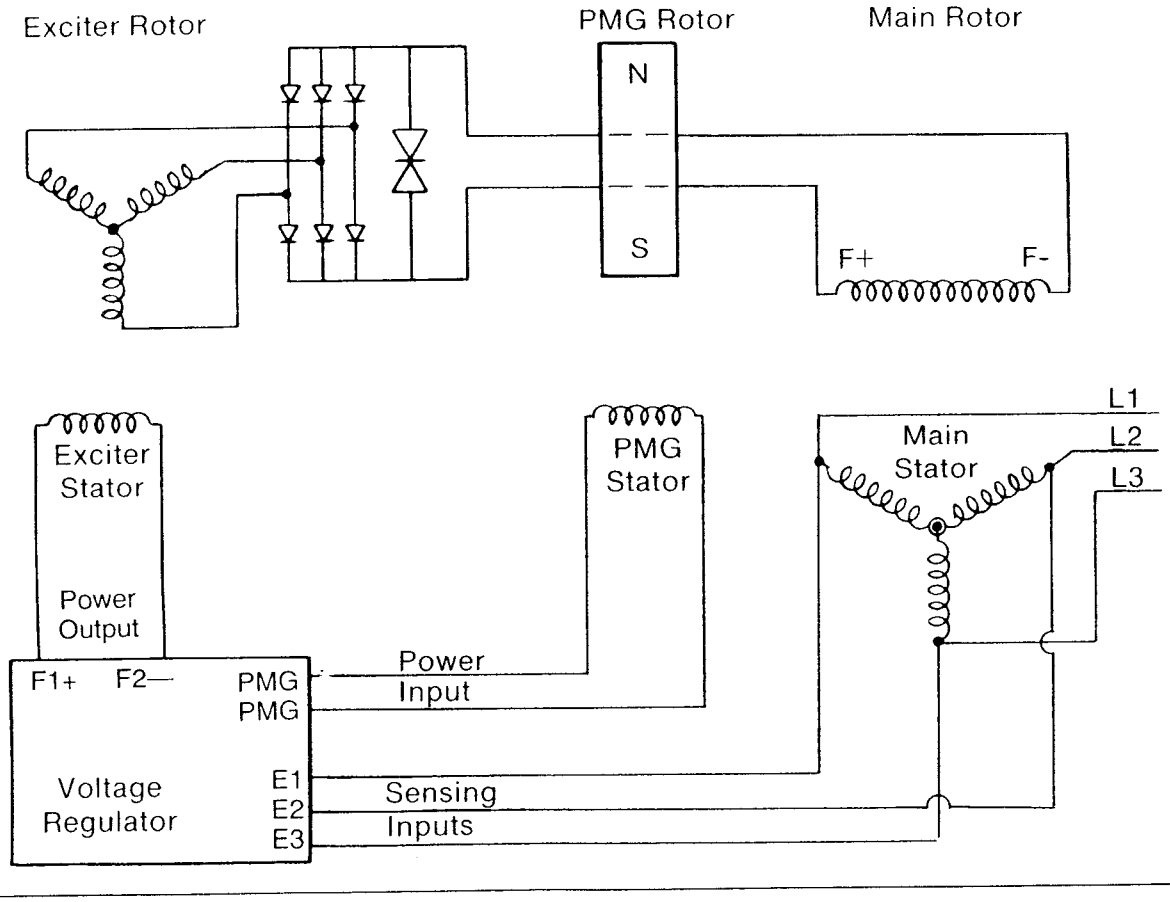
12 LEAD ZIG-ZAG



ZIG-ZAG connection with 12 lead machine only.

VOLTAGE		CONNECT	L_1	L_2	NEUTRAL
	L-L				
60 HZ	120/240	T_3 T_9	T_2	T_3	T_4
		T_2 T_8			
		T_1 T_6 T_7 T_{12}			
		T_4 T_{10} T_5 T_{11}			

TYPICAL SYSTEM DIAGRAM



INSTALLATION

SECTION 3

PARALLELING OPERATIONS

MagnaMAX^{DVR} generators come standard with amortisseur windings die cast as an integral part of the rotor. This exclusive Unirotor construction makes all MagnaMAX^{DVR} generators suitable for paralleling operations when the proper control equipment is added. Paralleling with other generator sets and/or with the utility power grid offers a number of advantages. Multiple unit installations increase power capacity; they can be added or removed from the line depending on the load requirements; they can be better maintained and repaired (since single source breakdown would mean total loss of power), and they often provide more reliable, efficient, and economical operation.

Successful parallel operation means that the generators deliver power to the external system without delivering power to each other, or accepting power from the load bus or power grid. Additional equipment is necessary to insure safe and successful operation.

Prime Mover

The prime mover provides the speed and torque which will be necessary to keep the machines in synchronized operation. The governor will directly control the watt or kW load and frequency of the unit. The prime mover speed is controlled by a governor. The governor must have special paralleling provisions to permit parallel operation with the other machines.

Voltage Regulator

The voltage regulator controls the generator output voltage and the reactive power supplied by the generator. When two or more ac generators operate in parallel, the voltage regulator must have paralleling provisions (either internally or external to the regulator) to permit to control the reactive or VAR load while it is in parallel operation. A separate paralleling current transformer is required to sense the reactive current and signal the voltage regulator. This additional paralleling circuitry is absolutely necessary to control the reactive current flowing between the generator sets.

Switchgear

There are additional relays and breaker controls which are necessary to insure safe, trouble free operation of paralleled units. Reverse power relays monitor the direction of power flow to insure that the generator is delivering power, not accepting it. These power relays control breakers, which are a means of connecting and disconnecting the generator from the load. The total system can include over-voltage, over-current protection, under frequency protection, power factor correction provision and various associated control equipment from manual switchgear to micro-processors. The amount of control gear and level of sophistication will be determined by the needs and requirements of the particular application.

Paralleling Basics

The following points are basic criteria which mustbe met before two units can be paralleled. THIS IS NOT MEANT TO BE SPECIFIC INSTRUCTIONS FOR PARALLELING OPERATION.

1. Additional paralleling circuitry
   - A. Voltage regulator-paralleling provisions
   - B. Paralleling current transformer(s)
   - C. Paralleling provisions on governor con trols
   - D. Switchgear
2. The voltage and frequency must be the same for all sets with voltages in phase.
3. The voltage regulation characteristics of the individual generators should be similar.
4. The generators must have the same phase rotation.
5. The driving engines should have the same speed regulation characteristics and the governors should be adjusted to give the same speed regulation.

Before operating generator sets in parallel, each set should be checked by starting, operating, and adjusting the sets as individual units before attempting paralleling.

Reactive Load Control

When two identical generators are operating together in parallel and an unbalance occurs in field excitation, circulating currents begin to flow between the generators. This current will appear as a lagging power factor or inductive load to the highly

excited generator, and as a leading power factor or capacitive load to the generator with the lower field current. This is known as the reactive circulating current and there are two methods of controlling it in parallel operation:

1. Reactive droop compensation. (Formerly known as parallel droop compensation.)

   The bus voltage droops, or decreases, as the reactive lagging power factor load is increased.

2. Reactive differential compensation. (Formerly known as cross current compensation.)

   The reactive differential compensation circuit allows parallel generators to share reactive loads with no decrease or droop in generator voltage. The circuit must meet the following criteria:

   A. All paralleling current transformers for all the generators being paralleled must be included in the secondary interconnection loop.

   B. When different size generators are paralleled, all paralleling current transformers must have the same or proportional ratios that give approximately the same secondary current.

   C. Voltage regulator paralleling circuitry must be the same.

   D. Current transformer secondaries and the generator lines must be isolated electrically.

      Because of the above criteria, reactive differential compensation cannot be used when paralleling with the utility power grid. There is no limit, however, in the number of generators that can be included in this type of circuit.

   E. It is also desirable to have an auxiliary contact on the main generator breaker to short the parallel CT secondary when that breaker is open (not connected to the load bus).

Paralleling Circuitry

Because of the number of variables involved in paralleling generator sets, every installation will have its own circuitry and methods or procedure of bringing paralleled units on line. There are numerous ways of connecting paralleled units and an almost unlimited variety of applications and associated equipment.

SECTION 3

When parallel operation is desired, it is important that the control manufacturer, the generator manufacturer, and the systems engineer work together to insure the proper selection of all components. Please refer to Marathon Electric for application assistance.

THYRISTOR OR SCR LOADING

Solid state electronic control devices which utilize thyristors or SCR firing circuits (such as variable frequency induction motor controls, precision motor speed controls, no-break powered battery chargers, etc.) can introduce high frequency harmonics which adversely affect or destroy the normal waveform of the generator. This creates additional heat in the generator stator and rotor, and can cause overheating. These devices can and do present problems to non-utility power generating equipment or any limited power bus system. The problems which can occur are not limited to the generator itself, but can effect the solid state control device, the equipment it controls, other associated loads, monitoring devices or a number of combinations over the entire system.

MagnaMAX^{DVR} generators can supply power to thyristor or SCR loads when properly applied. When SCR loads are more than 25% of the total load, select the generator based on the 80°C R/R rating. The standard voltage regulator is PMG powered and senses 3 phase RMS voltages for maximum stability against severely distorted wave forms. SCR type applications such as cranes, shovels, etc., require special consideration of the generator insulation system due to greater dielectric stress and severe environmental conditions. It is important that the control manufacturer, the generator manufacturer, and the systems engineer work together to insure the proper selection of all components. Please refer to Marathon Electric for application assistance.

OPERATION

SECTION 4

PRE-START INSPECTION

Before operating the generator for the first time, the following checks are recommended.

1. A visual inspection should be made to check for any loose parts, connections, or foreign materials. Refer to section 8.

2. Check for clearance in the generator and exciter air gap. Be sure the generator set turns over freely. Bar the generator over by hand at least 2 revolutions to be sure there is no interference.

WARNING

DO NOT APPLY ANY FORCE TO GENERATOR FAN WHEN ROTATING GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

3. Check all wiring against the proper connection diagrams and make sure all connections are properly insulated. Support and tie leads to keep them from being damaged by rotating parts or by chafing on sharp corners.

4. Be sure the equipment is properly grounded.

5. Inspect for any remaining packing materials and remove any loose debris, building materials, rags, etc., that could be drawn into the generator.

6. Check fasteners for tightness.

7. Check to be sure no tools or other hardware have been left inside or near the machine.

8. Install and check to be sure all covers and guards are in place and secure.

WARNING

RESIDUAL VOLTAGE IS PRESENT AT THE GENERATOR LEADS AND AT THE REGULATOR PANEL CONNECTIONS, EVEN WITH THE REGULATOR FUSE REMOVED. CAUTION MUST BE OBSERVED OR SERIOUS PERSONAL INJURY OR DEATH CAN RESULT. CONSULT QUALIFIED PERSONNEL WITH ANY QUESTIONS.

STARTING-UP THE GENERATOR

The following procedure should be followed for starting-up the generator for the first time:

1. The generator output must be disconnected from the load. Be certain that the main circuit breaker is open.

2. Disable the voltage regulator by removing the fuse.

WARNING

DO NOT OVERSPEED THE GENERATOR. EXCESSIVE CENTRIFUGAL FORCES COULD DAMAGE THE ROTATING FIELDS. BE PREPARED FOR AN EMERGENCY SHUTDOWN.

3. Follow the manufacturers instructions and start the prime mover. Check the speed and adjust to the RPM shown on the generator nameplate.

4. Replace the regulator fuse and adjust the voltage to the required value (Figure 4-2). Check all line to line and line to neutral voltages to be sure they are correct and balanced. If the voltages are not correct, shut down immediately and recheck all connections. See Section 3.

5. Close the main circuit breaker and apply the load.

6. Monitor the generator output current to verify it is at or below nameplate amps.

7. Adjust engine speed at full load to 1800 rpm for 60 hertz, 1500 rpm for 50 hertz. (Refer to prime mover/governor instruction manuals.)

8. Before stopping the engine, remove the load by tripping the main circuit breaker.

VOLTAGE ADJUSTMENTS

The generator output voltage is controlled by the voltage regulator. There is a cover to access the control panel on the side of the generator conduit box (Figure 4-2). Refer to the regulator manual for detailed information. In cases where special or remote mounted regulators are used, refer to instructions supplied by the generator set assembler and to the voltage regulator manual.

OTHER ADJUSTMENTS

Depending upon application, adjustments to other protective and control gear may be required. Refer to instructions supplied by the generator set manufacturer.

The standard MagnaMAX^{DVR} voltage regulator also has many protective and control circuits built in. Refer to the regulator manual for further details.

FIELD FLASHING

The standard MagnaMAX^{DVR} generator is supplied with a PMG (permanent magnet generator). It will never require field flashing.

In rare cases where a special generator may be furnished without a PMG, refer to the factory for more detailed information. Include the complete generator model and serial number.

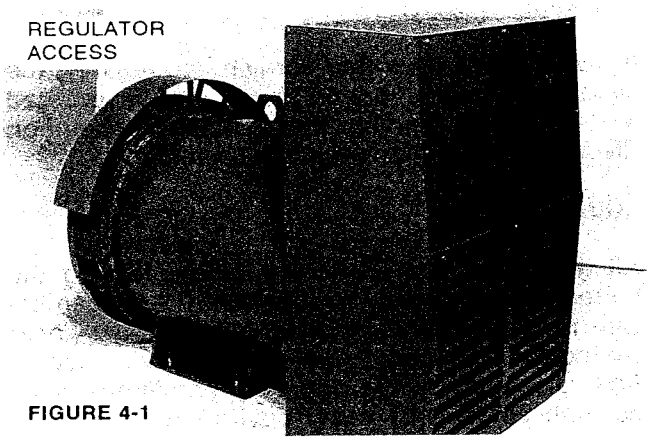


FIGURE 4-1

STANDARD MARATHON ELECTRIC REGULATOR

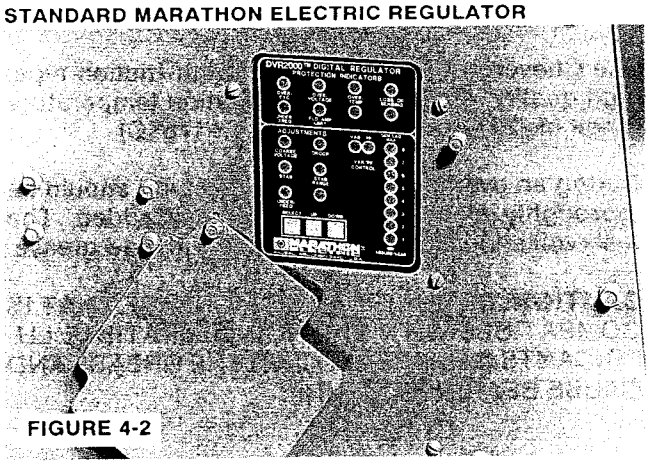


FIGURE 4-2

MAINTENANCE

SECTION 5

MAINTENANCE - GENERAL INFORMATION

Dirt, heat, moisture, and vibration are common enemies of a generator. Keeping the generator clean and dry, maintaining proper alignment of the generator and its prime mover, and preventing overloads will result in efficient operation and long life.

Generators that are outdoors should be protected from the elements by suitable houses or enclosures.

Dirt and dust will conduct electricity between points of different electrical potential. Moisure will aggrevate the problem further. Insulation system failure can result if corrective action is not taken. The condition of the insulation system can be tested by measuring insulation resistance. (See section 8 - Generator Testing.)

Insulation resistance should be checked when putting the generator into service after it has been in storage and anytime contamination by moisture and dirt is suspected. Normally, moisture buildup is not a problem when the generator is running since heat produced internally will tend to keep it dry. Moisture can collect in the generator when it is shut down. The problem will be worse in humid environments or in areas where extreme temperature changes cause condensation (dew) to form inside the generator. Space heaters, air filters, and premium insulation systems, such as our VPI process, should be considered in difficult environments.

Accumulations of dust and dirt not only contribute to insulation breakdown, but they can also increase temperature by restricting ventilation and by blocking the dissipation of heat. Some machines are exposed to accumulations of materials such at talc, lint, rock dust, or cement dust, which may obstruct the ventilation. The most harmful types of foreign materials include carbon black, metallic dust and chips, and similar substances which not only impede the ventilation, but also form a conductive film over the insulation, increasing the possibility of insulation failure. Machines operating in dirty places should be disassembled and cleaned periodically.

AIR INTAKE AND EXHAUST

Check the area around the air intake and exhaust openings to be sure they are clean and unobstructed. Remove all foreign material and clean all screens (Figure 5-1).

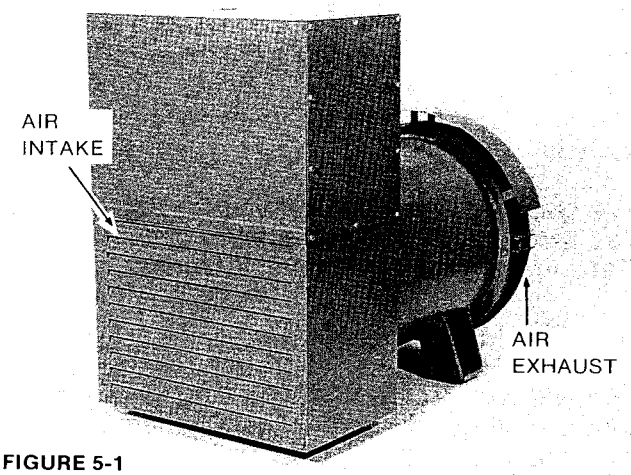


FIGURE 5-1

ELECTRICAL CONNECTIONS AND WINDINGS

Inspect for loose or contaminated connections. Check wires for cracked or frayed insulation. Tighten connections and replace defective or oil soaked insulation.

If inspection shows that varnish coatings on the windings have deteriorated, they should be recoated with insulating varnish. Please refer to Marathon Electric for insulation system requirements.

LUBRICATION

All generators are lubricated before leaving the factory and are ready for operation. As a general rule, bearings should be relubricated annually or at the indicated intervals in table 5-3, whichever occurs first. Unusually severe operating conditions, such as high ambient or dusty environments, require more frequent lubrication (every six months or one-half the table intervals, whichever occurs first).

Use Cheveron SRI or equivalent anti-friction type, high quality, grease with a lubrication temperature range of -22° to +350° F (-30° to +175° C).

During an overhaul, the grease reservoir should be thoroughly cleaned and new grease added. The reservoir should be 1/3 to 1/2 filled with new grease.

CAUTION: BE SURE TO USE A GREASE THAT IS COMPATIBLE WITH SRI. NONCOMPATIBLE LUBRICANTS CAN BREAKDOWN THE GREASE AND CAUSE BEARING FAILURE.

LUBRICATION

To add or renew grease, proceed as follows:

1. Stop unit.
2. Wipe clean the grease plugs and surrounding parts.
3. Remove fill and drain plugs. (Figure 5-2.)

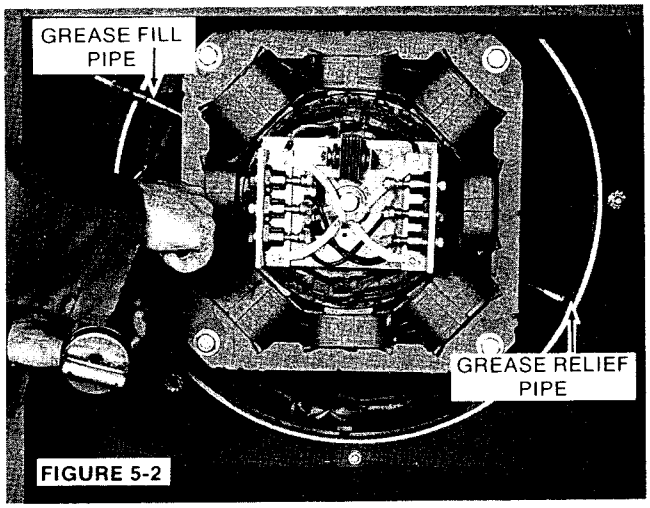


FIGURE 5-2

4. Insert 1/8" N.P.T. grease fitting in fill pipe.
5. Free drain hole of any hard grease, using a piece of wire if necessary.
6. Using a low pressure grease gun, add grease according to the amounts in table 5-3.
7. Start unit with drain plug removed - fill pipe may be open or closed. Allow unit to run 15 minutes to allow excess grease to drain.
8. Stop unit, wipe off any drained grease, and replace filler and drain plugs.

CAUTION: USE ONLY CLEAN GREASE FROM CLEAN, CLOSED CONTAINERS AND KEEP IT FROM BEING CONTAMINATED WHILE RE-GREASING.

SECTION 5

The amount of grease added is very important! Only enough grease should be added to replace the grease used by the bearing.

CAUTION: TO MUCH GREASE CAN BE AS HARMFUL AS INSUFFICIENT GREASE - USE THE PROPER AMOUNT.

TABLE 5-3

Type	Frame Size	Bearing Size	Amount of Grease			Intervals①	
			Ounces	Cubic Inches	Teaspoons	60 Hz	50 Hz
Single Bearing Units	431,432 433	314	1.2	2.1	7.0	6500	8400
	571, 572, 573, 574	316	1.5	2.6	8.3	5600	7200
	741, 742, 743, 744	322	2.4	4.2	14.0	3000	4500
Double Bearing Units	431, 432	318	1.7	3.0	9.9	4600	6200
	571, 572, 573, 574	318	1.7	3.0	9.9	4600	6200
	741, 742, 743, 744	322	2.4	4.2	14.0	3000	4500

① Hours of running time or annually, whichever occurs first.

MAINTENANCE

SECTION 5

DRYING ELECTRICAL INSULATION

Electrical components must be dried before placing in operation if tests indicate that the insulation resistance is below a safe value. (See section 8 - generator testing for test procedure.)

Machines that have been idle for sometime in unheated and damp locations, may have absorbed moisture. Sudden changes in temperature can cause condensation or the generator may have become wet by accident. Windings should be dried out thoroughly before being put into service. The following are recommended drying methods.

Space Heaters

Electric space heaters can be installed inside of the generator. When energized (from a power source other than the generator) they will heat and dry the inside of the generator. If an alternate source of electricity is not available, enclose the generator with a covering and insert heating units to raise the temperature 15-18 degrees F (8-10 degrees C) above the temperature outside of the enclosure. Leave a hole at the top of the enclosure to permit the escape of moisture.

Oven

Place the machine in an oven and bake it at a temperature not to exceed 194° F (90° C). The voltage regulator and any electronic component accessories must be removed from the generator when using this method.

Forced Air

A portable forced air heater can be used by directing heat into the air intake (conduit box) and running the generator with no load and without excitation (this can be accomplished by removing the regulator fuse). Heat at point of entry should not exceed 150° F (66° C).

"Short Circuit" Method

The generator can be dried out quickly and thoroughly by using this method.

WARNING:

BE SURE THAT ALL OF THE FOLLOWING STEPS ARE PERFORMED AND ALL PRECAUTIONS TAKEN AS PERSONAL INJURY OR SERIOUS DAMAGE TO THE GENERATOR COULD RESULT.

1. Disconnect exciter leads F1 and F2 from the regulator.
2. Connect a battery or other dc power source of approximately 20-35 volts to the exciter leads F1 and F2. An adjustable voltage source is desirable, however, a rheostat (rated approximately 2 amps) in series with the dc power source will work.
3. Short circuit the generator output lead wires to each other (L1 to L2 to L3). If using jumpers, be sure they are large enough to carry full load amp.
4. Start the generator and measure the current through the output leads with a clip-on ammeter.
5. Adjust the voltage source to produce approximately 80% of the rated ac nameplate current, but in no case exceed nameplate amps. If an adjustable source is not available and current is excessive, use a lower dc source voltage or a larger resistor in series with the source.

   Running time will be determined by the amount of moisture present in the machine. Insulation resistance checks should be taken every one to four hours until a fairly constant value is obtained. (See section 8 - generator testing for instructions on measuring insulation resistance.)
6. After the generator is dry and the insulation resistance is brought up to specifications, remove the short circuit from the line leads, disconnect the dc source and reconnect the F1 and F2 leads at the regulator. Be sure all connections are tight and correct before attempting to run the generator.

CLEANING METHODS

When electrical components get dirty, the insulation must be cleaned. There are a number of acceptable methods for cleaning the generator, each of which will necessitate disassembly of the unit. The method of cleaning will be determined by the kind of dirt, and when the unit must be returned to service. Drying after cleaning is necessary.

Whenever the generator is disassembled, the windings should be given a thorough inspection and the insulation cleaned, if necessary. The inspection should include the connection of the windings, insulation, and varnish coverage. Check the winding ties and coil supports. Look for any signs of coil movement or looseness and repair as required.

An electric motor repair shop in your area can normally assist with the proper cleaning of the generator windings. They may also be experienced in special problems (such as seacost, marine, oil rig, mining, etc.) that may be peculiar to a certain area.

SOLVENTS

A solvent is usually required to remove accumulated soil containing oil or grease.

Only petroleum distillates should be used for cleaning electrical components.

Petroleum solvents of the safety type with a flash point greater than 100° F (38° C) are recommended.

CAUTION: WINDING VARNISHES ARE EPOXY OR POLYESTER BASED. A SOLVENT THAT DOES NOT ATTACK THESE MATERIALS SHOULD BE USED.

WARNING

ADEQUATE VENTILATION MUST BE AVAILABLE TO AVOID FIRE, EXPLOSION AND HEALTH HAZARDS WHERE SOLVENTS ARE USED. AVOID BREATHING SOLVENT VAPORS. RUBBER GLOVES OR OTHER SUITABLE PROTECTION FOR THE HANDS SHOULD BE USED. WEAR EYE PROTECTION.

Apply the solvent with a soft brush or rag. Be careful not to damage the magnet wire or insulation on the windings.

Dry components thoroughly with moisture-free, low pressure compressed air.

CLOTH AND COMPRESSED AIR

Cleaning with a dry cloth may be satisfactory when componets are small, the surfaces are accessible and only dry dirt is removed.

Blowing dirt out with compressed air is usually effective particularly when the dirt has collected in places which cannot be reached with a cloth. Use clean dry air at 30 PSI (206 KPA).

BRUSHING AND VACUUM CLEANING

Dry dust and dirt may be removed by brushing with bristle brushes followed by vacuum cleaning. Do not use wire brushes. Vacuum cleaning is an effective and desirable method of removing dry and loose dirt.

SHELL BLASTING

Air blasting with ground nut shells may be satisfactory for removal of hard dirt deposits from insulation. Use mild abrasives such as 12-20 mesh ground walnut shells.

STEAM CLEANING

If the generator is completely disassembled, including bearings and electronic components, steam cleaning of the major parts and windings is very effective. However, the machine must be thoroughly dried in an oven to remove all moisture before the generator can be put back into service.

REMOVAL FROM PRIME MOVER

WARNING

BE SURE ALL POWER IS OFF BEFORE SERVICING. FAILURE TO FOLLOW ALL SAFETY INSTRUCTIONS CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

NOTE: Before disconnecting any electrical wiring, be sure it is marked and can be identified for reinstallation. Remark as required.

1. Remove conduit box covers (Figure 6-1 and 6-2).

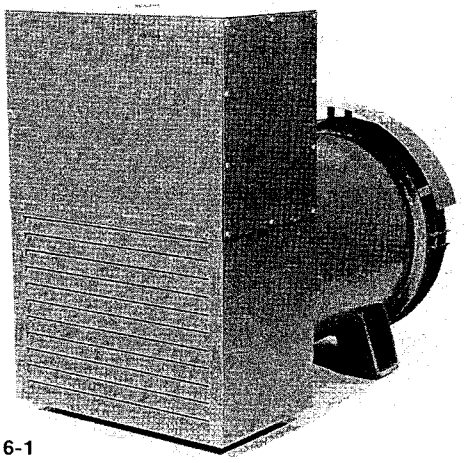


FIGURE 6-1

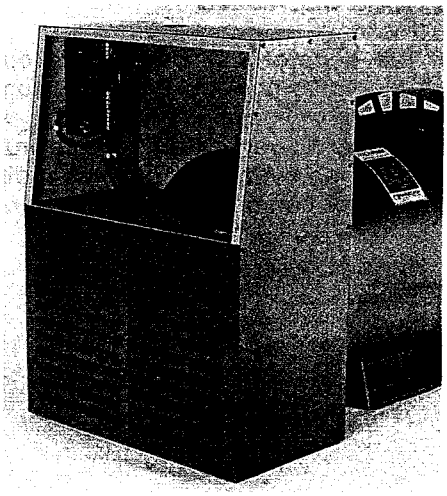


FIGURE 6-2

2. Disconnect all external wiring from the generator leads (or bus bars) inside the conduit box.
3. Remove all conduit or ducting from the conduit box.
4. Attach a suitable hoist to the generator lifting lugs.
5. a. For single bearing generators, remove the bolts mounting the screen assembly to the SAE adapter and remove the screen. (Figure 6-3.) (NOTE: Do not remove the dripcover from the screen assembly if so equipped.) Remove the capscrews attaching the drive discs to the flywheel and remove the capscrews attaching the SAE adapter to the flywheel housing.

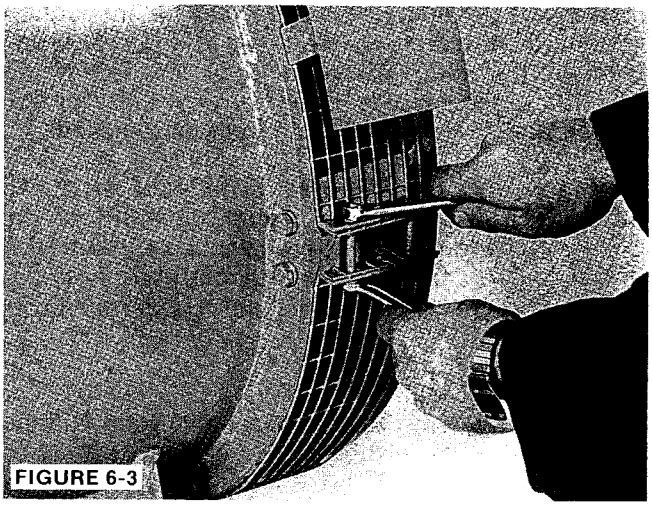


FIGURE 6-3

b. For two-bearing generators, disconnect the coupling or sheave and belts between the generator and prime mover. (Follow the coupling manufacturer's instructions for disconnection.)

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

6. Remove the mounting bolts which secure the generator to the base. To make reinstallation easier, note the position of and save any shims that were used under the feet for alignment.
7. Raise the generator slightly and move the generator away from the prime mover. Raise or lower the generator to take pressure off of the drive discs so they slide easily out of the flywheel.
8. On single bearing generators, if generator is to be shipped, see Shipping Instructions Section 11 for proper rotor support.

CONDUIT BOX REMOVAL

1. Note the location and markings (re-mark as required) and remove connections from voltage regulator, capacitor, and any other conduit box mounted control. (Figure 6-4 and 6-5.)

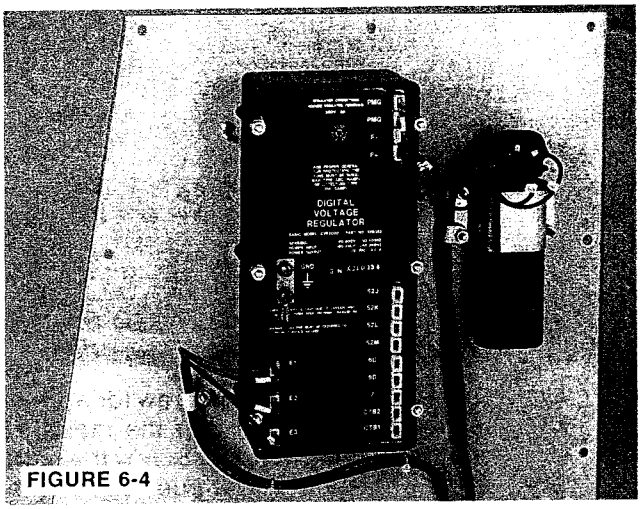
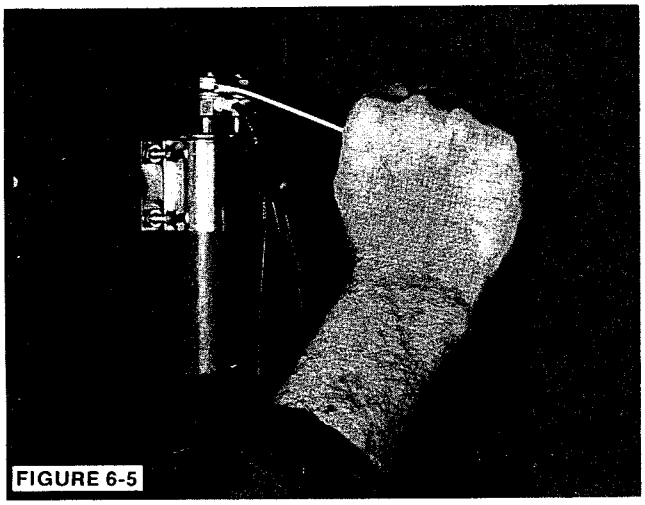
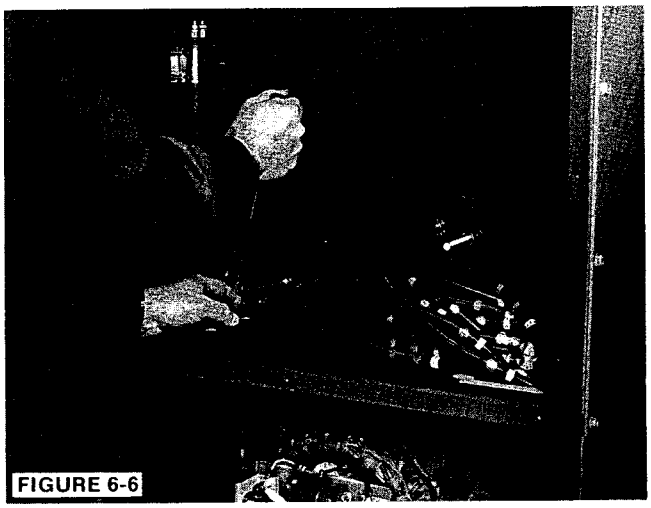


FIGURE 6-4

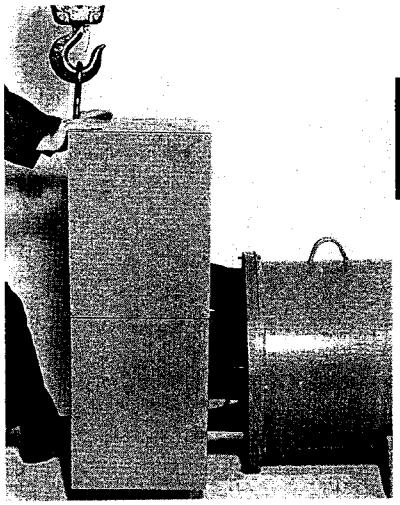

FIGURE 6-5

2. On generators equipped with bus bars, mark all connections and disassemble main stator (power) leads from the generator side of the bus bars.

3. Remove bolts holding conduit box in place. (Figure 6-6.)


FIGURE 6-6

4. Remove conduit box. (Figure 6-7).


FIGURE 6-7

EXCITER STATOR (FIELD) REMOVAL

1. Disconnect F1 and F2 leads from the corresponding F1 and F2 terminals on the regulator.

2. Remove all cableties so the F1 and F2 leads can be removed with the exciter stator. Remove the four capscrews and belleville washers holding the exciter stator in place. (Figure 6-8.) Remove the exciter stator. Using a lifting strap or fixture. (Figure 6-9.)

SECTION 6

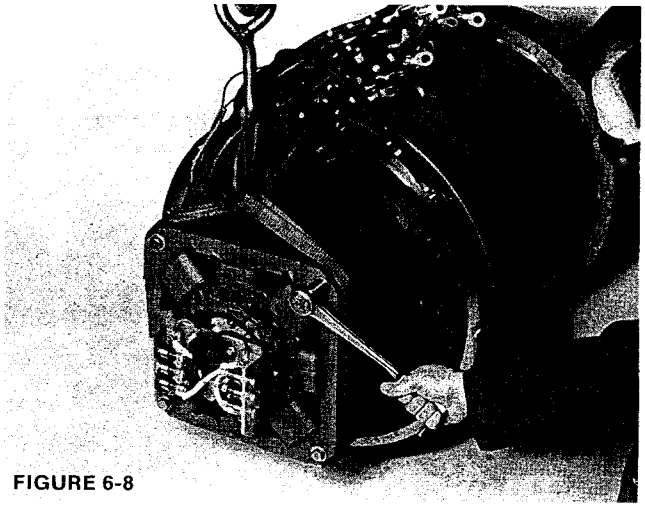


FIGURE 6-8

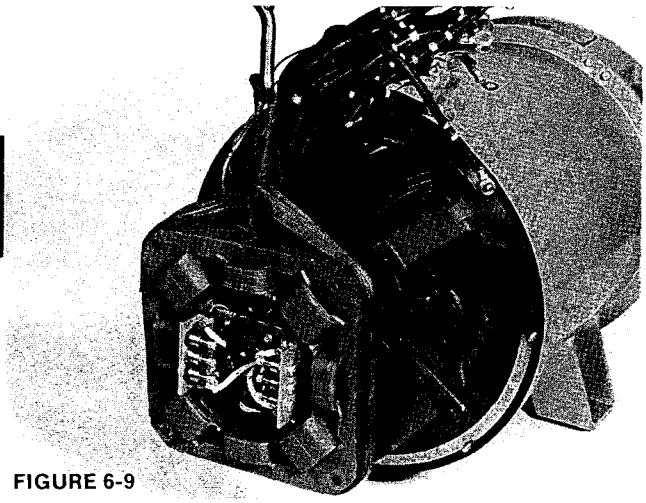


FIGURE 6-9

SECTION 6

EXCITER ARMATURE (ROTOR) REMOVAL

1. Note markings and disconnect the main rotor leads coming out of the aluminum standoff plate lead hole from the rectifier aluminum angle. (Figure 6-10.)

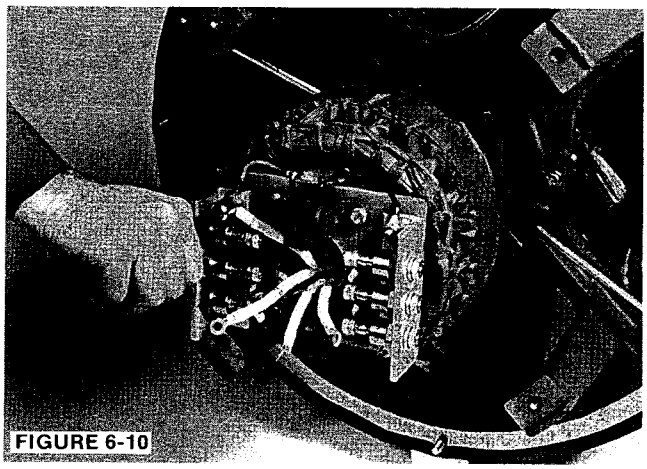


FIGURE 6-10

2. Remove the capscrew and belleville washer which holds the exciter (rotor) armature to the generator shaft. (Figure 6-11.)

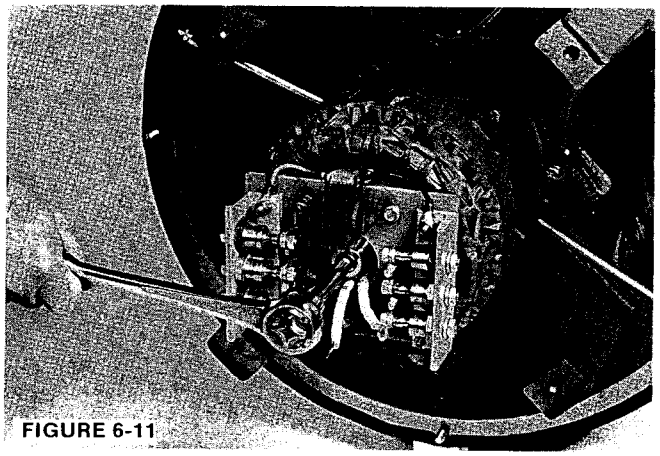


FIGURE 6-11

3. Use a six inch, 3/4-16NF, capscrew for a puller. (See section 9.) The hole that the mounting bolt goes through is threaded. Screw the puller bolt into the hole and it will push against the end of the shaft. (Figure 6-12.) Carefully feed the main rotor leads through the hole as the exciter armature is removed. (Figure 6-13.)

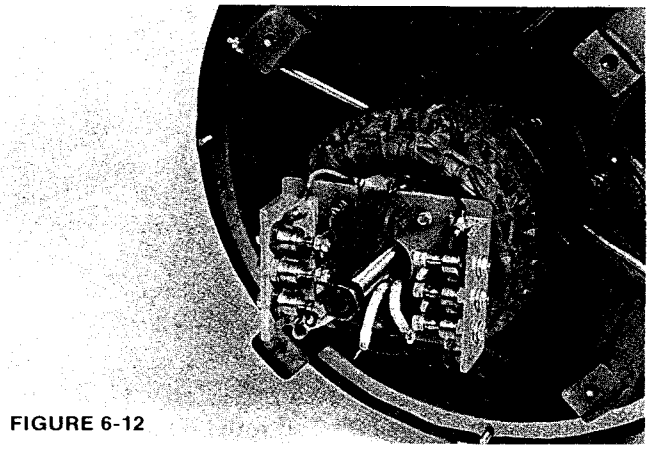


FIGURE 6-12

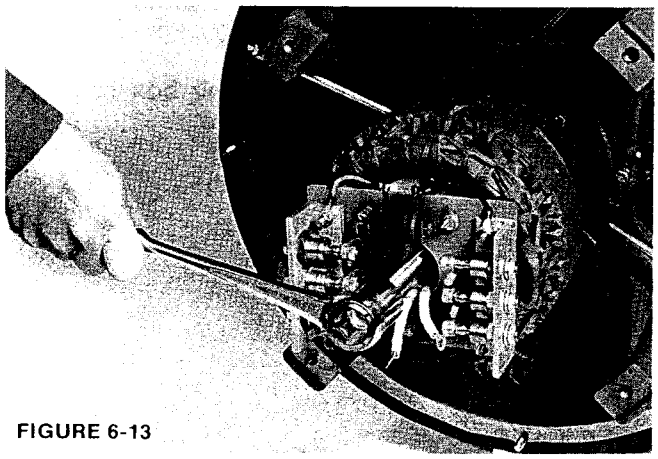


FIGURE 6-13

CAUTION: DO NOT TIGHTEN THE PULLER BOLT BEYOND THE END OF THE THREADS. IF A BOLT WITH SUFFICIENT THREAD LENGTH CANNOT BE FOUND, USE A PIECE OF THREADED ROD WITH A NUT WELDED ON THE END.

PMG STATOR REMOVAL

1. Remove exciter armature. (Follow instructions found earlier in this section.)
2. Remove the PMG output leads from the capacitor (Figure 6-14) and loosen all cable ties so the leads can be removed with the PMG stator.
3. Note the position of the PMG stator leads which exit at the left inboard side or mark the stator so it can be reinstalled in the same position.

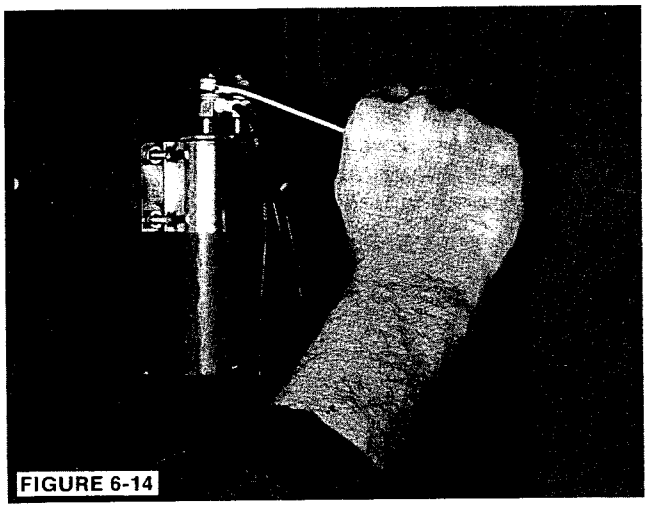


FIGURE 6-14

4. Remove the four mounting capscrews. (See Figure 6-15.)

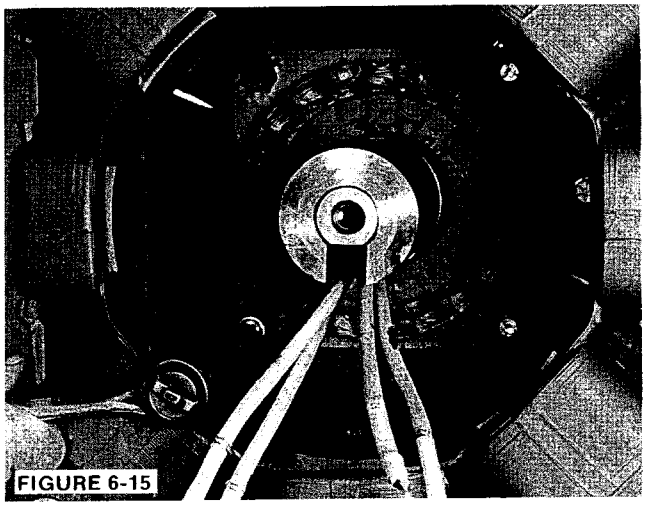


FIGURE 6-15

5. Carefully remove the PMG stator from its mounting pads and slide over the PMG rotor. The magnets used in the PMG are very strong. They will resist removal of the PMG stator. (Figure 6-16.)

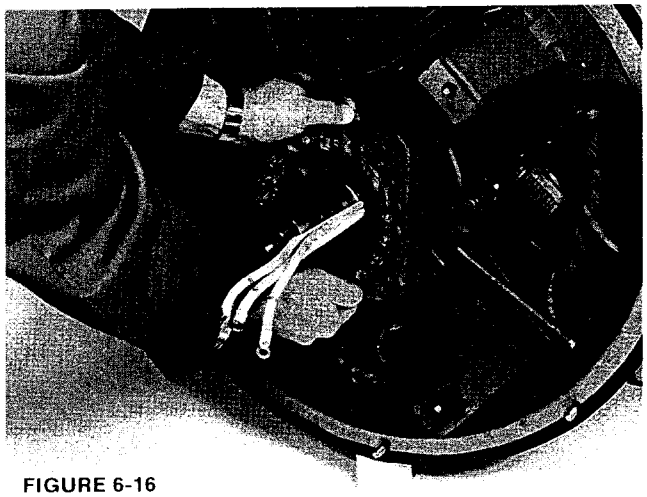


FIGURE 6-16

PMG ROTOR REMOVAL

1. Remove the exciter armature and PMG stator. (Follow instructions found earlier in this section.)
2. Remove the snap ring which holds the PMG rotor in place on the shaft. (Figure 6-17 and 6-18.)

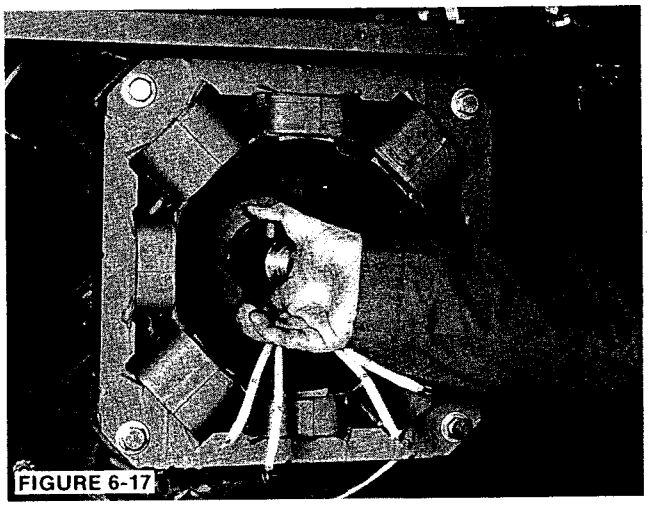
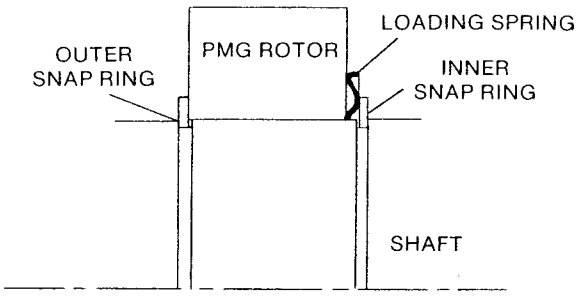


FIGURE 6-17

430 FRAME



570 AND 740 FRAME

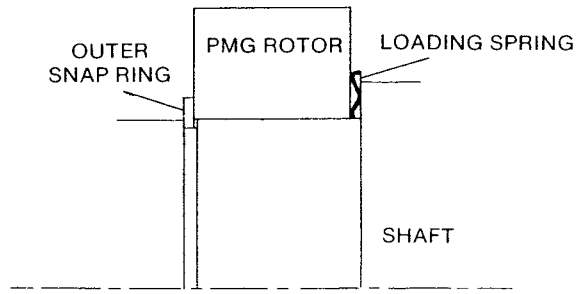


FIGURE 6-18

3. Slide the PMG rotor off of the shaft. (Figure 6-19.)

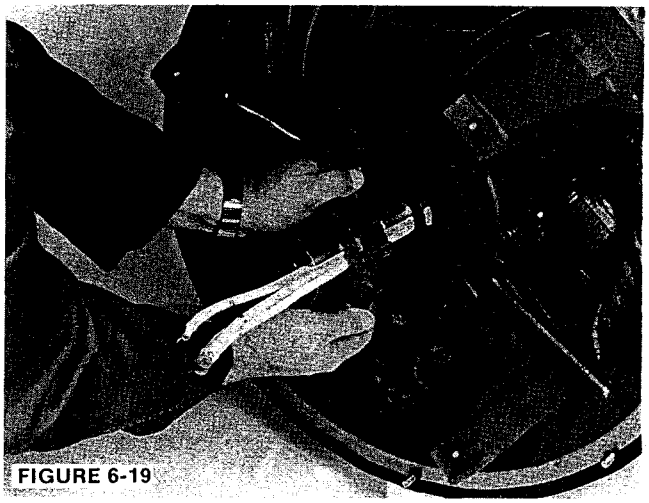


FIGURE 6-19

4. Remove the loading spring. (If the loading spring is not on the shaft, check to see if it is stuck on the back of the PMG rotor.).
5. On 430 frame generators a second snap ring is used inboard of the PMG rotor. (Larger generators have a step on the shaft.) This snap ring must be removed before the generator main rotor can be removed. (Figure 6-20.)

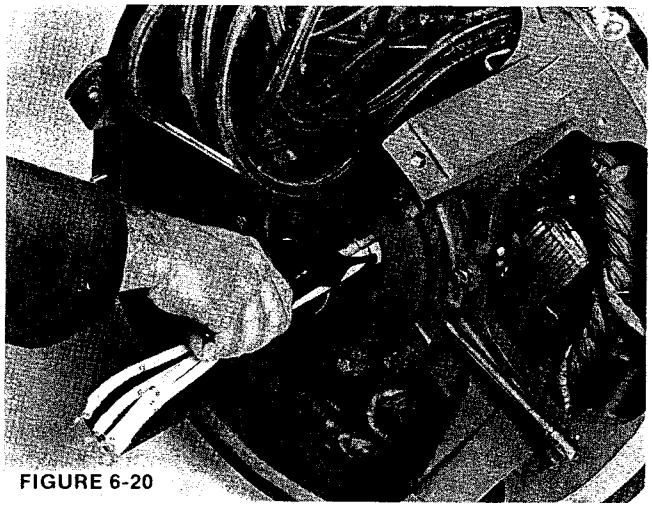


FIGURE 6-20

MAIN ROTOR REMOVAL

1. Remove the exciter armature and PMG. (Follow instructions found earlier in this section.)
2. a. For single bearing generators, remove the four capscrews holding the bearing caps to the front end bracket. (Figure 6-21.) Remove the outer cap. (Figure 6-22.)

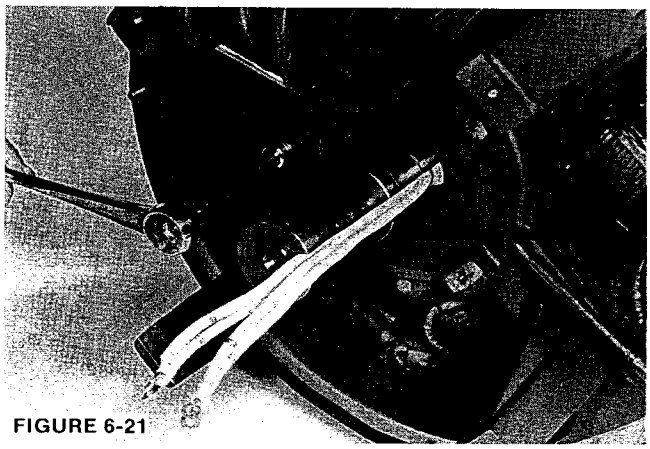


FIGURE 6-21

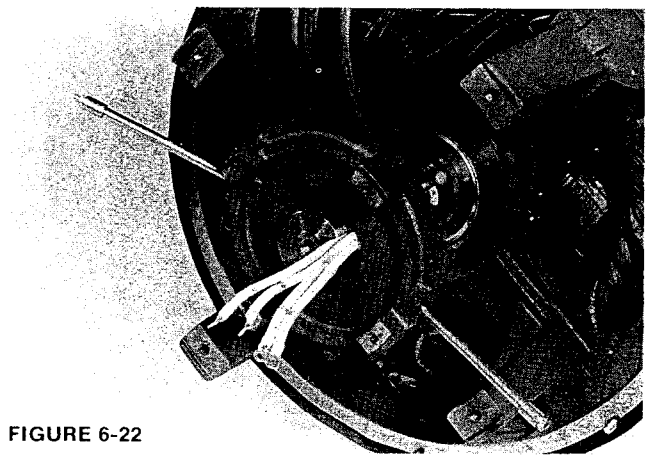


FIGURE 6-22

b. For two-bearing generators, remove the drive coupling or sheave and key from the shaft extension. Remove the four capscrews holding the bearing lock to the drive end bracket. (Figure 6-23.) Remove the four capscrews holding the bearing caps to the front end bracket. (Figure 6-21.) Remove the outer cap. (Figure 6-22.)

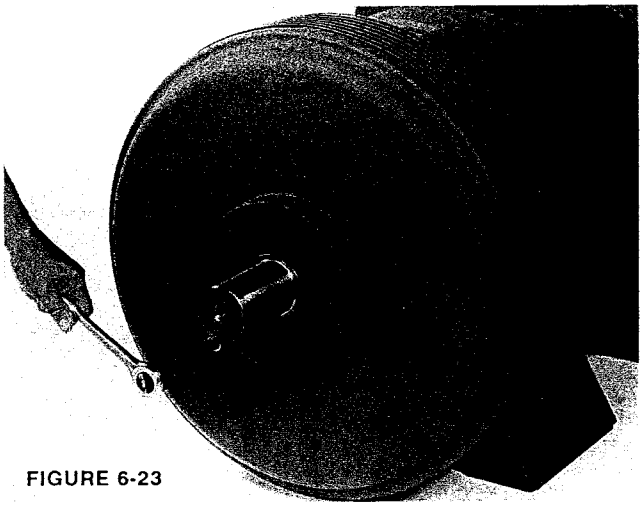


FIGURE 6-23

3. If the screen assembly is still mounted, remove ... bolts securing the screen assembly to the drive end bracket or the SAE adapter and remove the screen assembly. (Figure 6-24.) (NOTE: Do not remove the drip cover from the screen assembly if so equipped.)

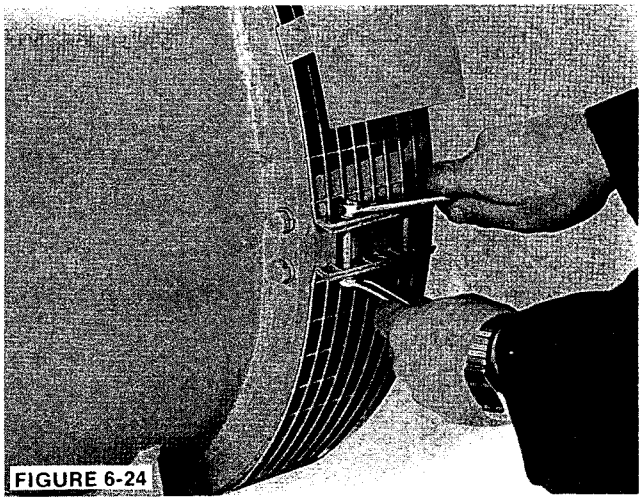


FIGURE 6-24

4. For single bearing generators, remove the capscrews and hardened washers holding the drive discs to the drive hub. (Figure 6-25.) Remove all drive discs (and spacers if any).

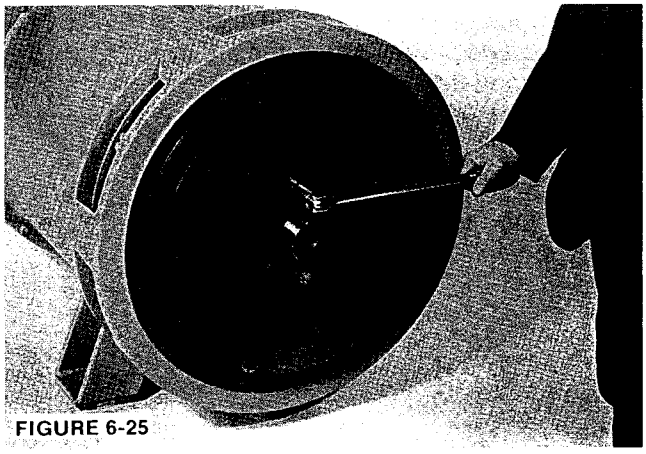


FIGURE 6-25

5. a. For single bearing generators, remove the capscrews holding the SAE adapter to the generator and remove the adapter. (Figure 6-26 and 6-27.)

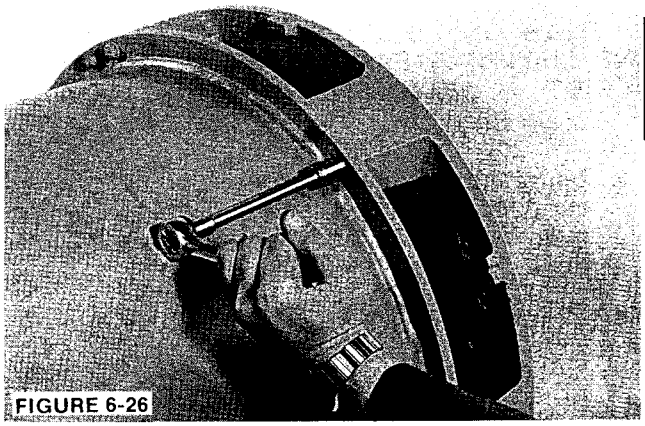


FIGURE 6-26

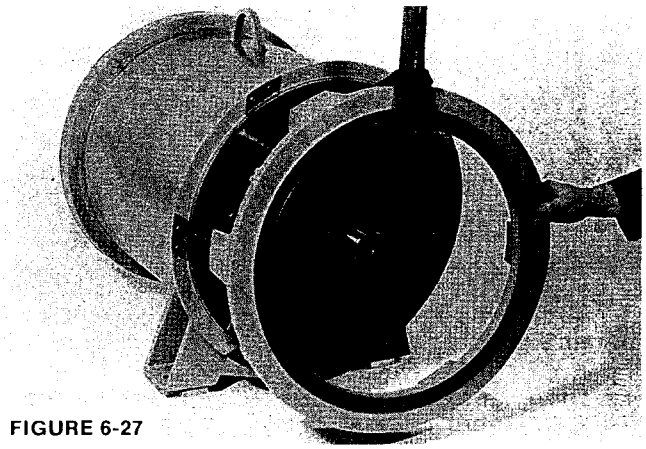


FIGURE 6-27

SECTION 6

b. For two-bearing generators, remove the capscrews holding the drive end bracket to the generator and remove the bracket. (Figure 6-26 and 6-28.)

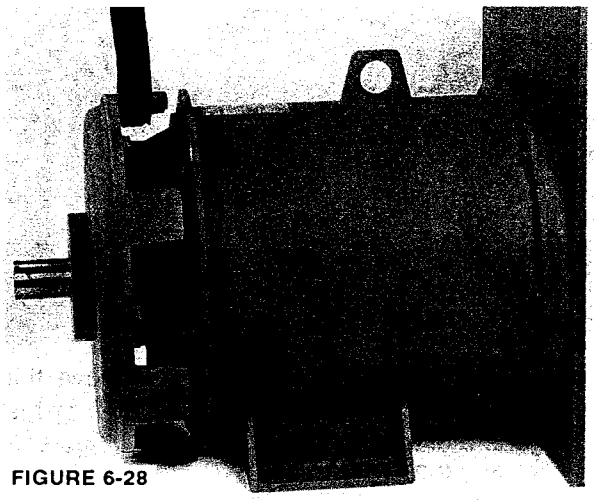


FIGURE 6-28

SECTION 6

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN DRIVE END BRACKET OR SAE ADAPTOR REMOVAL.

6. Using a rotor lifting fixture and a suitable hoist, carefully remove the rotor assembly from the main stator and frame assembly through the drive end. (Figure 6-29.)

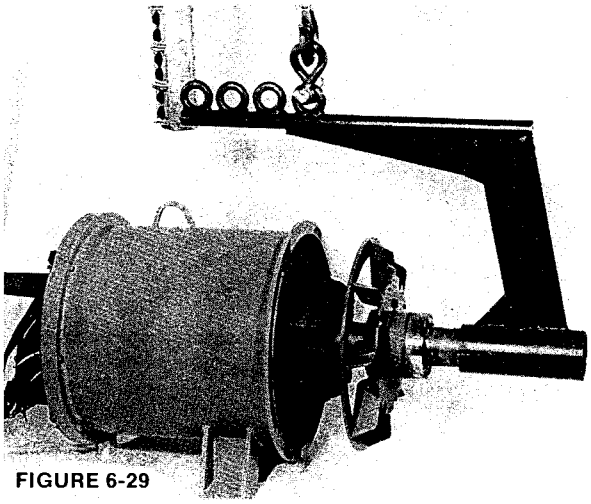


FIGURE 6-29

CAUTION: SPECIAL CARE SHOULD BE TAKEN WHEN REMOVING THE MAIN ROTOR, WINDING DAMAGE COULD RESULT IF THE ROTOR IS ALLOWED TO HIT THE MAIN STATOR.

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

FRONT END BRACKET REMOVAL

1. Remove front bracket mounting screws. (Figure 6-30.)

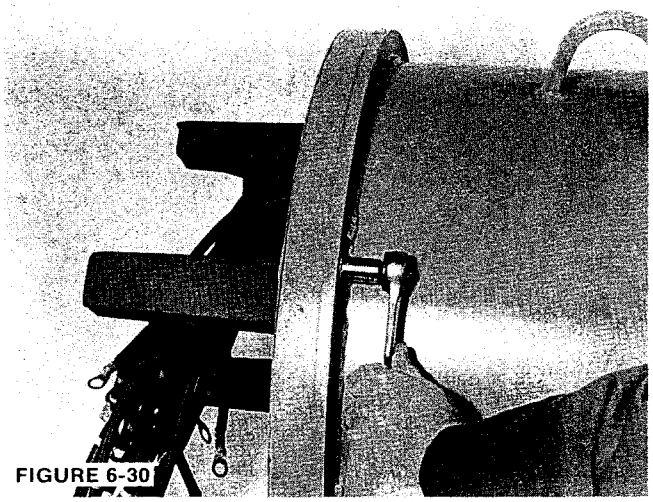


FIGURE 6-30

2. Remove the front end bracket from the main stator assembly. (Figure 6-31.)

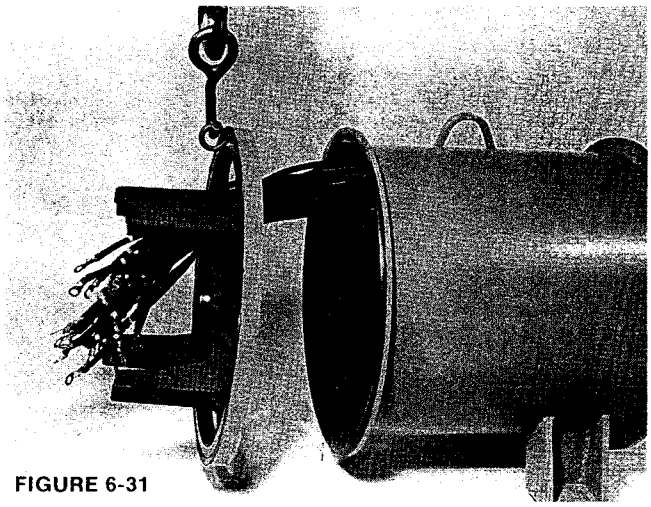


FIGURE 6-31

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE FRONT END BRACKET REMOVAL.

EXCITER INSPECTION

A. Exciter Stator

1. Clean dust and dirt from the stator winding. (Figure 6-32.) (See section 5.)

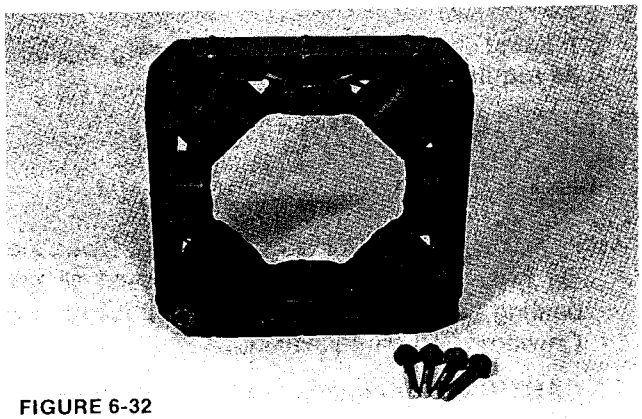


FIGURE 6-32

2. Check the exciter stator for a loose, frayed, or burnt winding. Measure winding resistance and insulation resistance. (See section 8.) Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for special winding procedures and materials.

3. Look for score marks in the bore of the exciter core caused by rubbing. (This could indicate bearing or assembly problems and should be investigated.)

B. Exciter (Rotor) Armature

1. Clean dust and dirt from the exciter armature and rectifier assembly. (Figure 6-33.) (See section 5.)

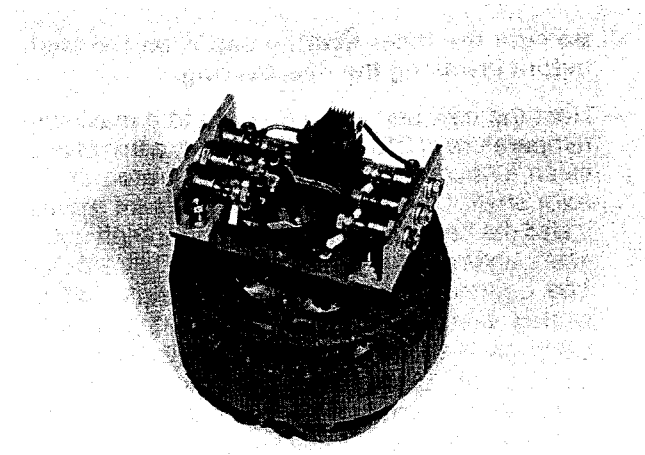


FIGURE 6-33

2. Check the exciter armature for burrs on the mating surfaces.

3. Check the rectifiers and surge protector for proper operation. (See section 8.) Replace defective parts.

CAUTION: THREE FORWARD POLARITY AND THREE REVERSE POLARITY DIODES ARE USED. BE SURE YOU HAVE THE CORRECT PART INSTALLED IN THE CORRECT LOCATION. THE SURGE SUPRESSOR IS POLARIZED. OBSERVE POLARITY MARKINGS WHEN CHANGING THE SURGE SUPRESSOR. (Figure 6-34.)

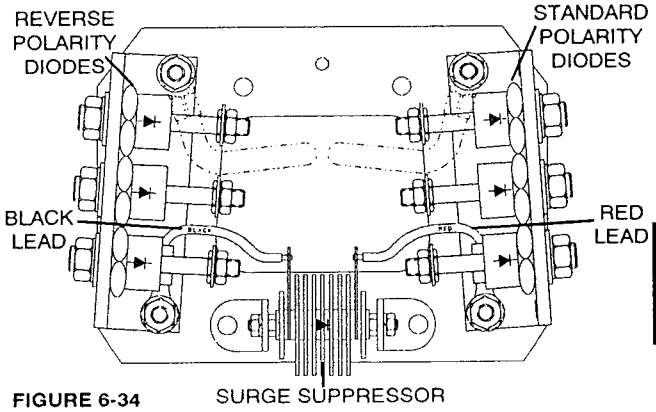


FIGURE 6-34

Torque mounting nuts to 80 in-lb.
Torque lead terminal nuts to 25 in-lb.
Never torque against the diode terminal - use a 7/16 in. wrench to support the terminal. (Figure 6-35.)

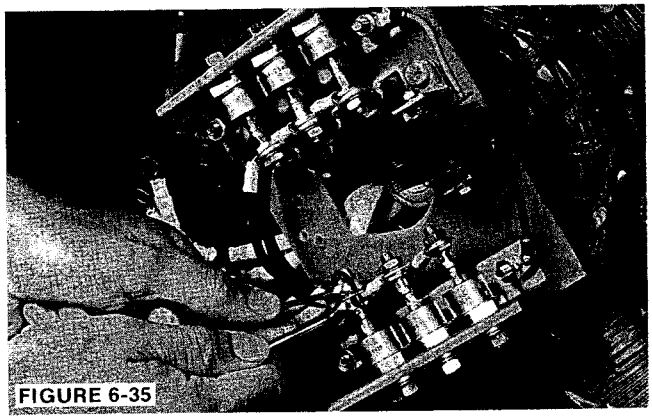


FIGURE 6-35

4. Check the exciter armature and rectifier assembly for a loose, frayed, or burnt winding or loose connections. Measure winding resistance and insulation resistance. (See section 8.) DO NOT megger diodes or surge suppressor. Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for special winding procedures and materials.

SECTION 6

5. Look for score marks on the outside diameter of the armature core caused by rubbing. (This could indicate bearing or assembly problems and should be investigated.)

PMG INSPECTION

A. PMG Stator (Figure 6-36.)

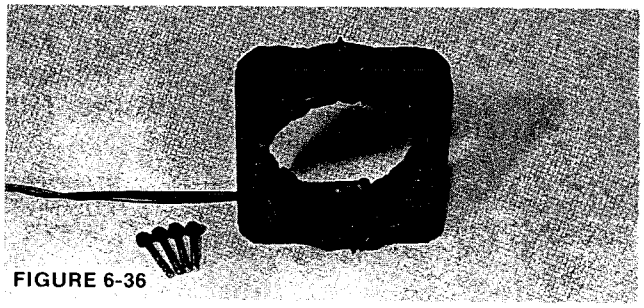


FIGURE 6-36

1. Clean dust and dirt from the PMG stator winding. (See section 5.)

SECTION 6

2. Check PMG stator for a loose, frayed, or burnt winding. Measure winding resistance and insulation resistance. (See section 8.) Repair or replace as necessary. Contact Marathon Electric for special winding procedures and materials.

3. Look for score marks in the bore caused by rubbing. (This could indicate bearing or assembly problems and should be investigated.)

B. PMG Rotor (Figure 6-37.)

WARNING

THE PMG ROTOR USES VERY STRONG MAGNETS. KEEP AWAY FROM IRON AND STEEL PARTS THAT COULD BE DRAWN TO THE MAGNETS. KEEP AWAY FROM OTHER COMPONENTS THAT CAN BE DAMAGED BY STRONG MAGNETIC FIELDS.

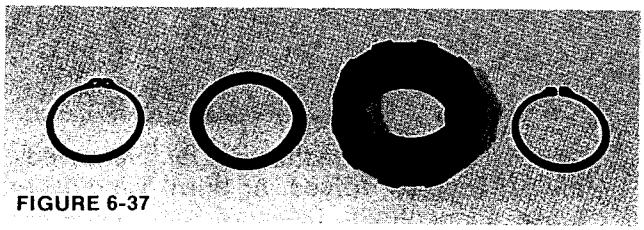


FIGURE 6-37

1. Clean dust and dirt from the PMG rotor. (See section 5.)

2. Check to be sure all magnets are tightly bonded to the PMG rotor.

3. Check for burrs or corrosion in the bore and keyway where the rotor mounts to the shaft.

4. Look for score marks on the outside diameter caused by rubbing. (This could indicate bearing or assembly problems and should be investigated.)

5. Inspect snap rings and loading spring, replace as required.

MAIN ROTOR INSPECTION

A. Bearing

1. Check the bearing for damge or wear. Clean the old grease from the bearing cap, and fill the bearing cap grease cavity 1/3 to 1/2 full of new Cheveron SRI (or equivalent).

   CAUTION: If the bearing needs to be removed, for any reason, always install a new bearing.

2. If the bearing is to be repalced, remove with a suitable puller. (Figure 6-38.)

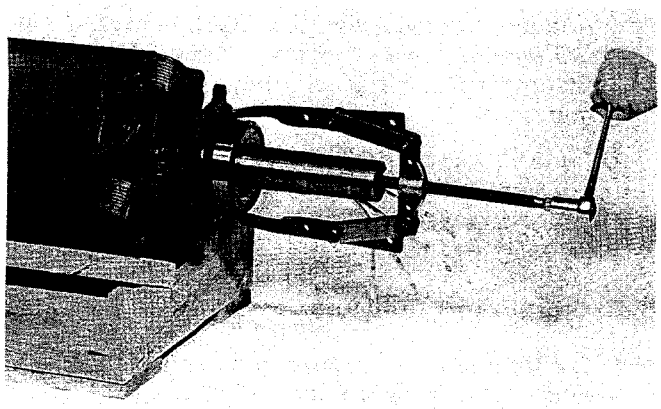


FIGURE 6-38

3. **Be sure the inner bearing cap is on the shaft before installing the new bearing.**

4. Heat the new bearing in an oven to a maximum temperature of 212°F (100°C). Apply a thin coat of clean lubricating oil to the press-fit area of the rotor shaft. Using suitable heat resistant gloves, install the bearing over the end of the shaft until it seats against the shaft shoulder. (Figure 6-39.) The bearing should slide on the shaft and be seated without excessive force. If the bearing binds on the shaft before being fully seated, a piece of tubing, slightly larger than the press-fit area, can be used to drive the bearing into place. Using light taps with a soft mallet, apply pressure to the inner race only.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD PRESSURE BE APPLIED TO THE OUTER RACE OF THE BEARING, AS PERMANENT BEARING DAMAGE COULD RESULT.

Allow the bearing to cool for one hour before attempting to assemble the generator.

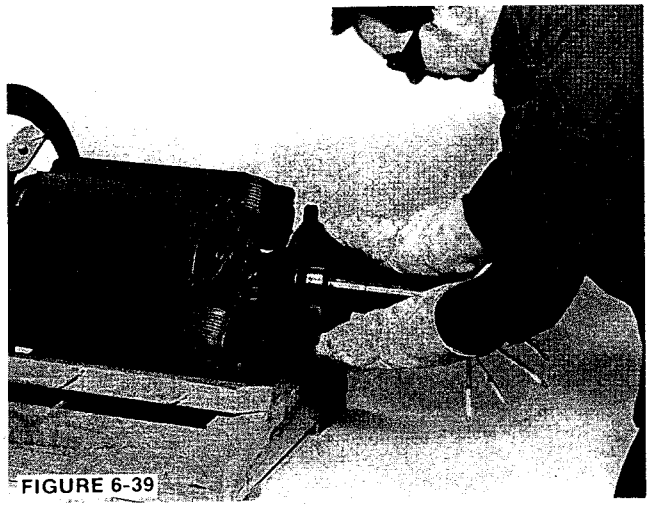


FIGURE 6-39

B. Fan

1. Check the fan for cracks or broken blades. Replace the fan if defective.
2. Mark the hub and fan for alignment. this is necessary to be sure the balance weights will be in the same position when the fan is re-installed.
3. a. For single bearing generators. Remove the fan mounting capscrews (Figure 6-40) and slide the fan off the shaft. (Figure 6-41.)

   b. For two-bearing generators, remove the drive end bearing and bearing cap. (See bearing removal instructions.) Remove the fan mounting capscrews and slide fan off the shaft. (Figure 6-40 and 6-41.)

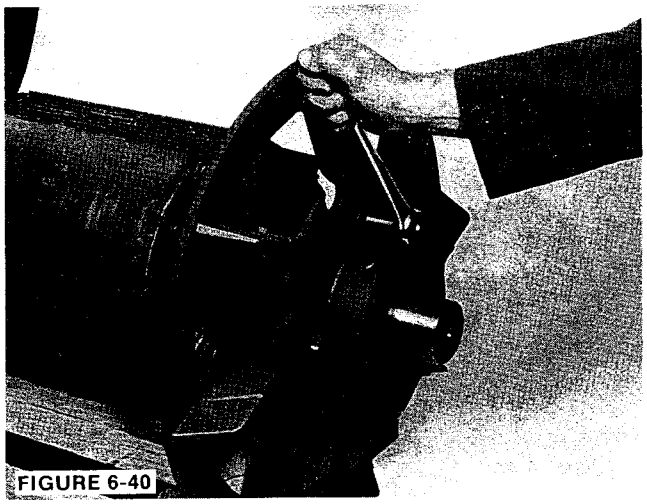


FIGURE 6-40

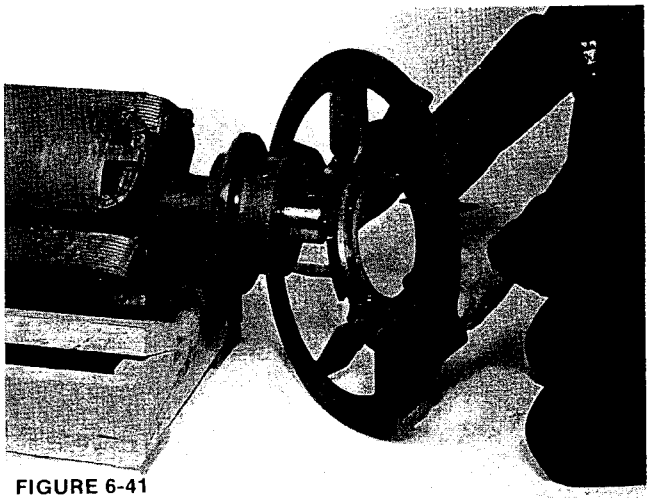


FIGURE 6-41

4. To reinstall, slide the fan on the shaft making sure the fan mounting surface is toward the drive hub. Align reference marks (this is important for assembly balance) and mount the fan to the drive hub with the capscrews and belleville washers. (Figure 6-42.) Torque the capscrews to 60 ft-lb. (81 N-m).

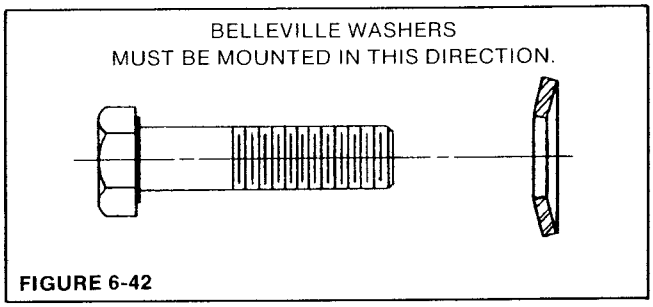
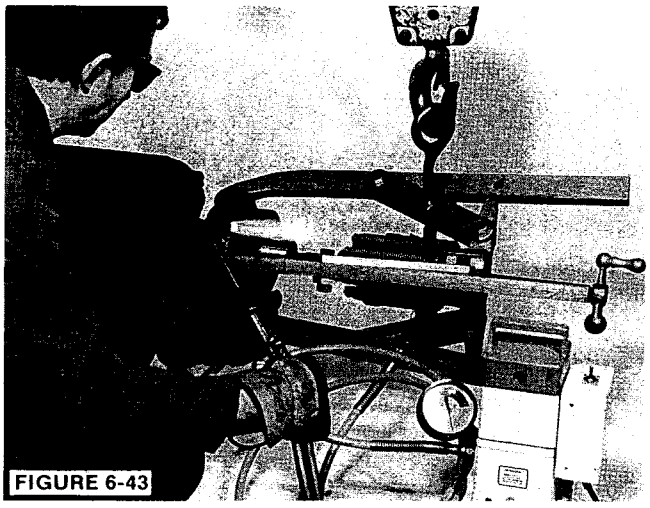


FIGURE 6-42

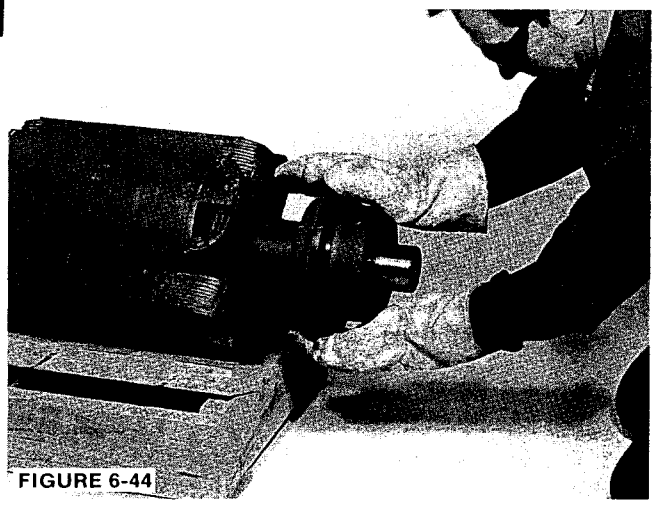
5. **NOTE:** Balance weights on the fan are for balance of the complete rotor assembly. The rotor assembly should be rebalanced if a new fan has been installed.
6. On two-bearing generators, install bearing cap and new bearing according to the bearing assembly instructions. (Item A.)

C. Drive Hub (Single Bearing Generators Only)

1. Check the drive hub for cracks or stripped drive disc mounting holes. Replace the hub if defective.
2. If the hub is to be replaced, remove the fan (See Item B) and install a suitable puller to the hub. Remove the two setscrews in the hub over the key. Using a torch, rapidly heat the hub at the outer diameter while tightening the puller. (This must be done rapidly before the heat can expand the shaft.) Remove the hub. (Figure 6-43.)


FIGURE 6-43

3. To insure proper fan location, mark the new hub in the same place as the old hub relative to the keyway. Install key in shaft. Heat the new hub in an oven to 500°-600°F (260°-316°C). Use suitable heat resistant gloves, slide the hub over the key in the shaft until it seats against the shaft shoulder. (Figure 6-44.)


FIGURE 6-44

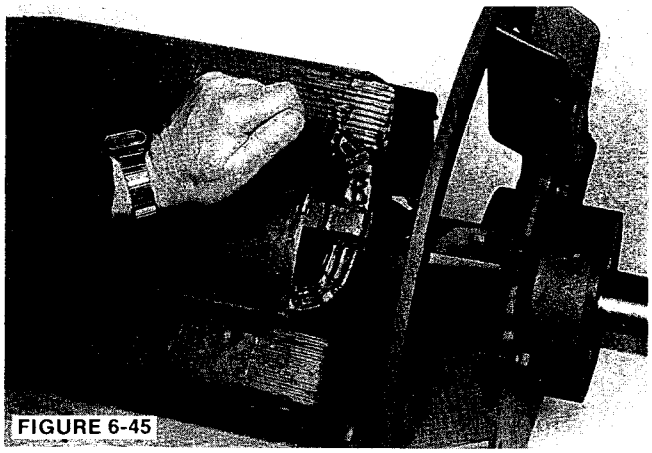
4. Allow the hub to cool for one hour. After the hub has cooled, tighten the setscrews in the hub to 50 ft-lbs (68 N.m) torque. Match the alignment marks on the fan and hub and mount the fan. (See item B.)

5. Rebalancing the rotor assembly is not necessary if only the hub is replaced and the fan is mounted in the same location relative to the hub and shaft.

D. Main Rotor Core and Windings

1. Clean all parts. Remove dust and dirt from the rotor windings. (See section 5.)

   Remove any accumulated dust or dirt in the winding air passages with a piece of wire or with low-pressure, moisture-free air. (Figure 6-45.)

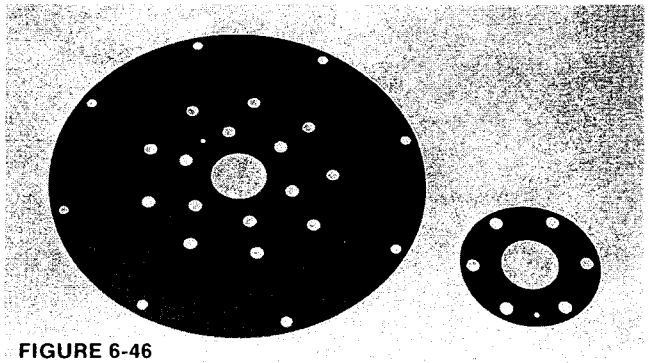

FIGURE 6-45

CAUTION: IF A PIECE OF WIRE IS USED FOR CLEANING THE AIR PASSAGES: CARE MUST BE TAKEN NOT TO SCRATCH THE WINDING AS THIS COULD CAUSE AN INSULATION FAILURE.

2. Check the rotor for loose, frayed, or burnt windings. Measure winding resistance and insulation resistance. (See section 8.) Test for shorted turns using an A-C impedance test. (See section 8.) A defective rotor winding must be rewound by Marathon Electric. The rotor assembly must be rebalanced after any rework or repair has been completed.

E. Drive Discs (Single Bearing Generators Only)

1. Inspect the drive discs for distorted or bent edges. (Figure 6-46) Inspect for worn mounting holes. Replace all defective discs as necessary.


FIGURE 6-46

2. Inspect the drive disc mounting capscrews for damaged threads. Replace capscrews if damaged.

FRONT (EXCITER) END BRACKET INSPECTION

1. Remove the filler and drain grease pipes and the grease plugs from outer bearing cap. (Figure 6-47.)

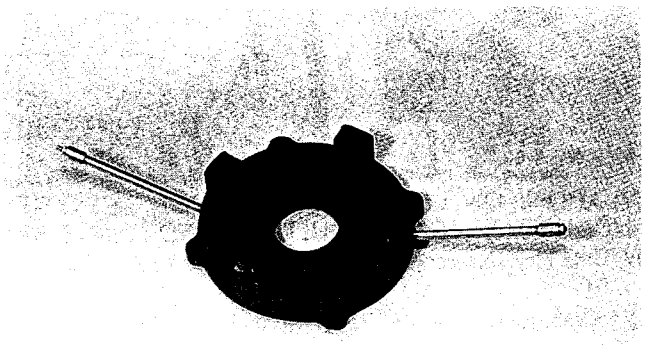


FIGURE 6-47

2. Clean the end bracket, outer bearing cap, grease pipes, and capscrews to remove all dust, dirt, and grease.
3. Inspect the capscrews for stripped threads and replace if defective.
4. Inspect the end bracket for stripped threads, cracks, and burred or rough mating surfaces. Inspect the bearing bore for burrs or wear. If the bracket shows excessive bearing bore wear, it should be repaired or replaced. (Figure 6-48.)

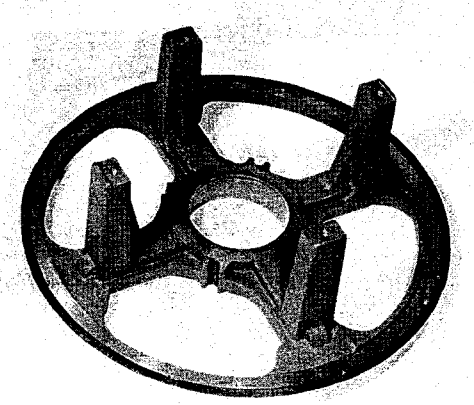


FIGURE 6-48

5. Inspect the mounting pads for the PMG stator and exciter stator. Be sure they are smooth, clean, and free of any burrs or rust. That could interfere with proper alignment. (Figure 6-47 and 6-48.)
6. Re-assemble the grease pipes and fittings to the bearing cap.

DRIVE END BRACKET OR SAE ADAPTER INSPECTION

1. For two-bearing generators, remove the grease plugs from the bracket.
2. Clean the bracket or adapter, capscrews and screen assembly to remove all dust, dirt, and grease.
3. Inspect the capscrews for stripped threads and replace if defective.
4. Inspect the bracket or adapter for stripped threads, cracks, and burred or rough mating surfaces. (Figure 6-49 and 6-50.)

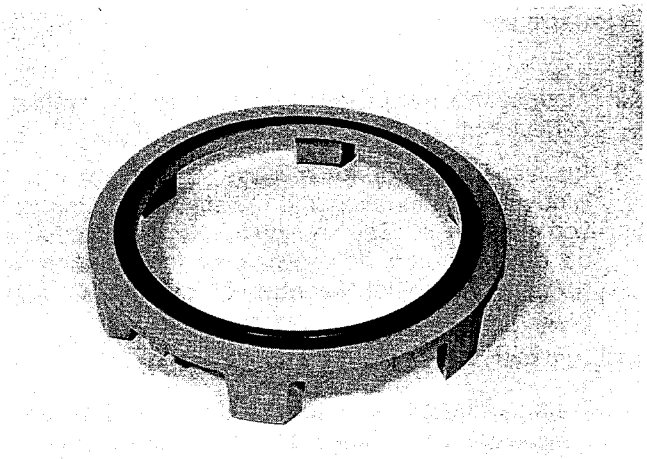


FIGURE 6-49

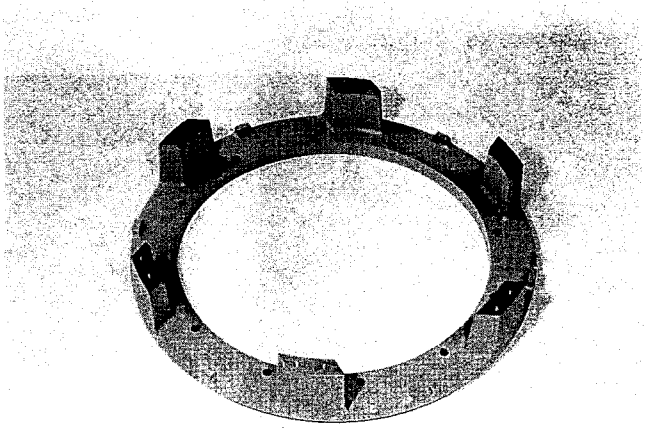


FIGURE 6-50

5. For two-bearing generators, inspect the bearing bore for burrs or wear. If the drive end bracket shows excessive bearing bore wear, it should be repaired or replaced.

MAIN STATOR INSPECTION

1. Clean dust and dirt from the stator frame and winding. (Figure 6-51.) (See section 5.)

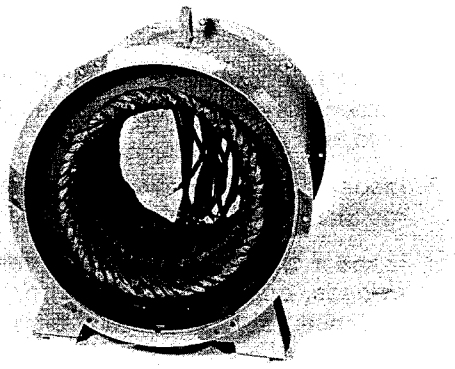


FIGURE 6-51

SECTION 6

2. Inspect the frame for stripped threads, cracks, burred mating surfaces, or other damage.
3. Inspect the stator for a loose, frayed, or burnt winding. Measure winding resistance and insulation resistance. (See section 8.) Repair or replace as necessary. If field repair of the winding is necessary, contact Marathon Electric for winding data.

FRONT END BRACKET INSTALLATION

1. Install two guide pins (threaded rod can be used) into the generator side of the end bracket mounting holes. Align the guide pins with the holes in the generator frame and slide the bracket onto the frame. (Figure 6-52.) Install bracket mounting capscrews. (Figure 6-53.)

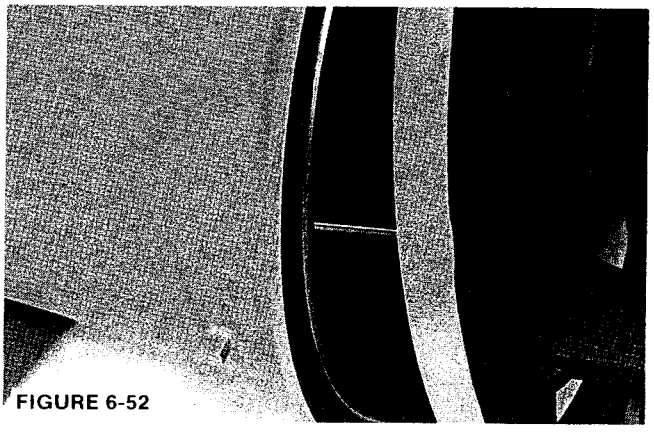


FIGURE 6-52

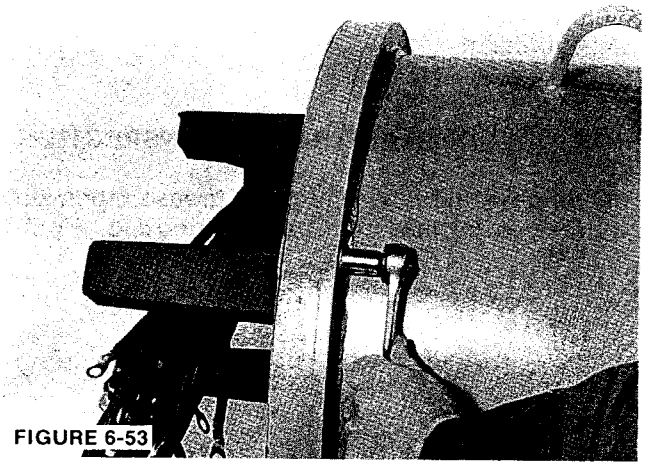


FIGURE 6-53

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE FRONT END BRACKET INSTALLATION.

2. Remove the two guide pins and insert the remaining capscrews and torque to specifications given in section 12.

MAIN ROTOR INSTALLATION

1. Grease bearing cavity and bearing with Cheveron SRI (or equivalent) grease.
2. Using a rotor lifting fixture and a suitable hoist, carefully install the rotor assembly into the main stator assembly through the drive end. (Figure 6-54.) Carefully feed the rotor leads through the front end bracket shaft hole as the rotor is installed.

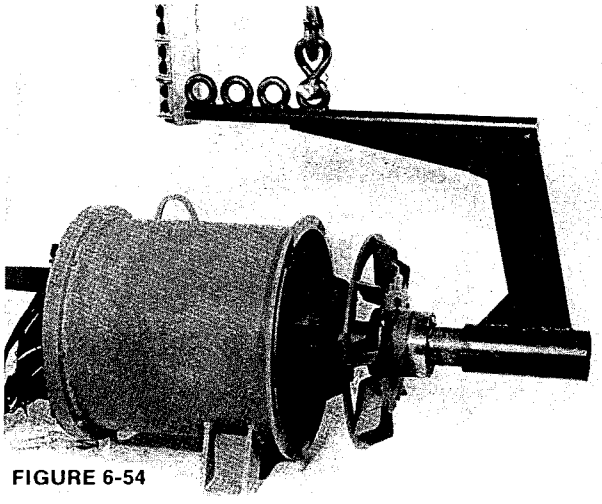


FIGURE 6-54

CAUTION: SPECIAL CARE SHOULD BE TAKEN WHEN INSTALLING THE ROTOR ASSEMBLY. WINDING DAMAGE COULD RESULT IF THE ROTOR IS ALLOWED TO HIT THE MAIN STATOR.

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

3. a. For single bearing generators, slide the SAE adapter over the fan and secure to the main stator and frame assembly with capscrews torqued per section 12. (Figure 6-55 and 6-56.) It may be necessary to raise the rotor assembly slightly to allow the mounting of the SAE adapter.

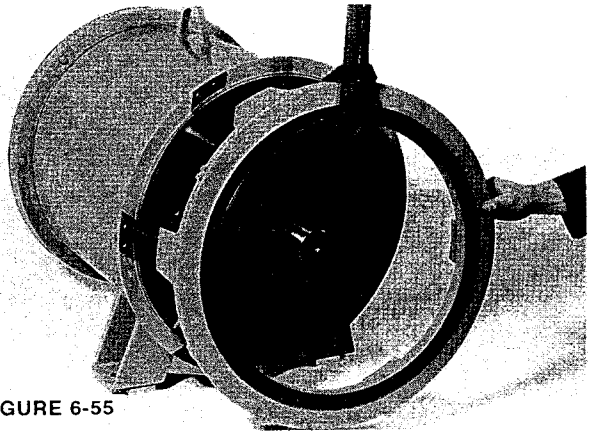


FIGURE 6-55

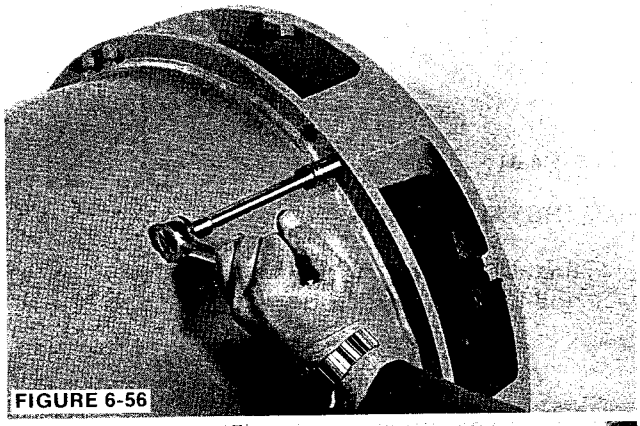


FIGURE 6-56

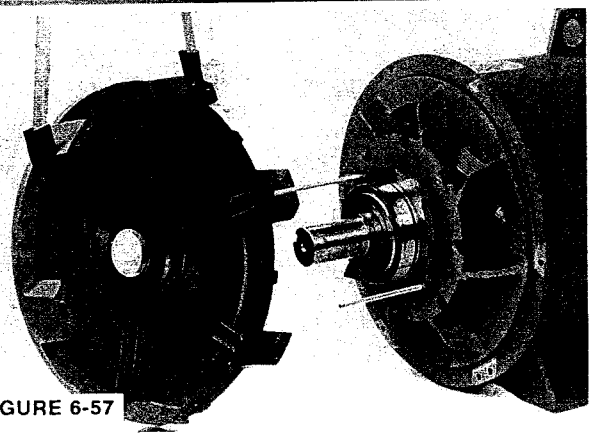


FIGURE 6-57

b. For two-bearing generators, insert two guide pins in the rear bearing lock holes. (Figure 6-57.) Fill the grease cavity of the drive end bracket 1/3 to 1/2 full of Cheveron SRI (or equivalent) grease. Assemble all grease plugs in the bracket. Mount the bracket on the bearing and guide the bearing lock pins through the bracket holes. (Figure 6-58.) Align the drive end bracket and mount with the capscrews. (Figure 6-59.) Insert two capscrews with lockwashers into the bearing lock and tighten. Remove the guide pins and replace with the remaining two capscrews with lock washers. Torque bearing cap screws to 25 lb-ft (34 N-m). Torque bracket mounting capscrews per specifications given in section 12.

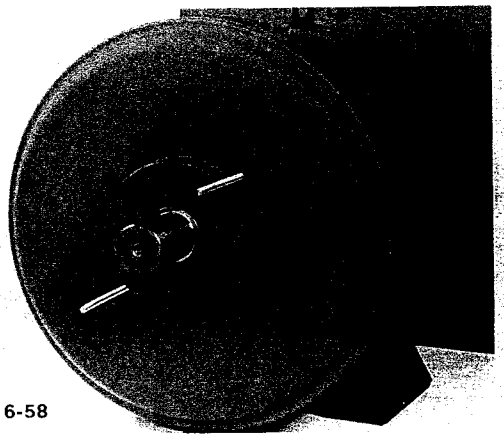


FIGURE 6-58

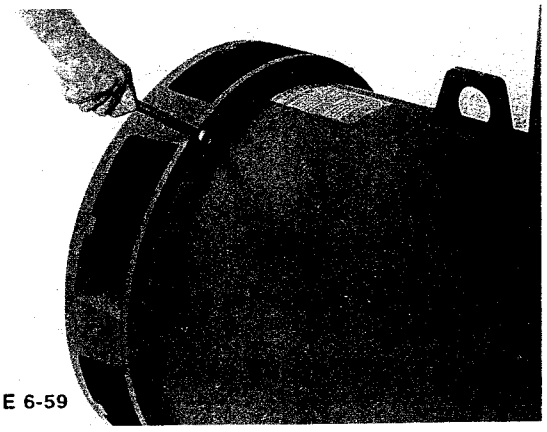


FIGURE 6-59

SECTION 6

CAUTION: ON LARGE GENERATORS, A HOIST AND LIFTING STRAP SHOULD BE USED TO ASSIST IN THE DRIVE END BRACKET OR THE SAE ADAPTER ASSEMBLY.

4. a. For single bearing generators, insert a guide stud into the drive hub. Position all spacers (if any), then all drive discs, one at a time until all discs are installed. (Figure 6-61.) Make sure that all disc mounting holes at the inner and outer diameter are properly aligned. Secure the discs with the grade 8 5/8-18 capscrews and hardened washers. Torque to 192 ft-lb (260 N-m). (See Figure 6-62 for torquing sequence.)

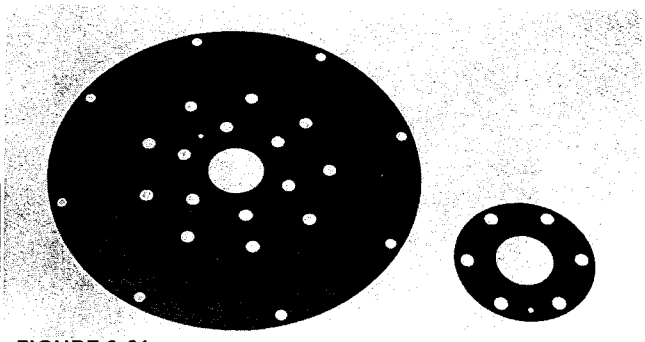
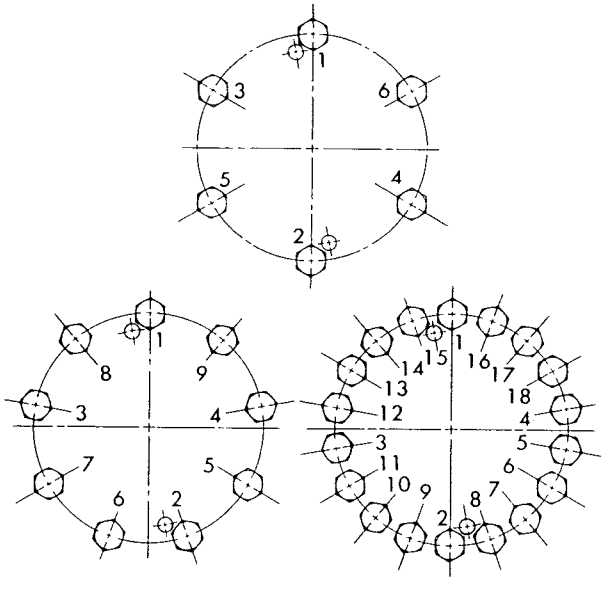


FIGURE 6-61



Torque the bolts in the above sequence according to the correct bolt pattern.

Then check the torque in each bolt in a clockwise direction around the bolt circle to insure that all the bolts are properly torqued.

FIGURE 6-62

5. Install the outer bearing cap on the exciter end. (Figure 6-63.) Align holes in inner and outer bearing cap and install cap screws. Torque to 25 lb-ft (34 N-m) (Figure 6-64.)

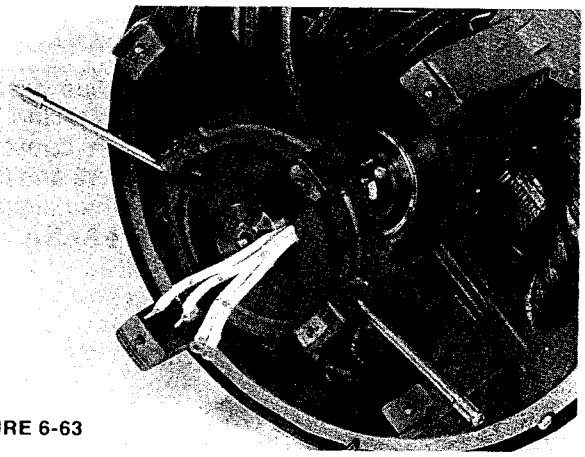


FIGURE 6-63

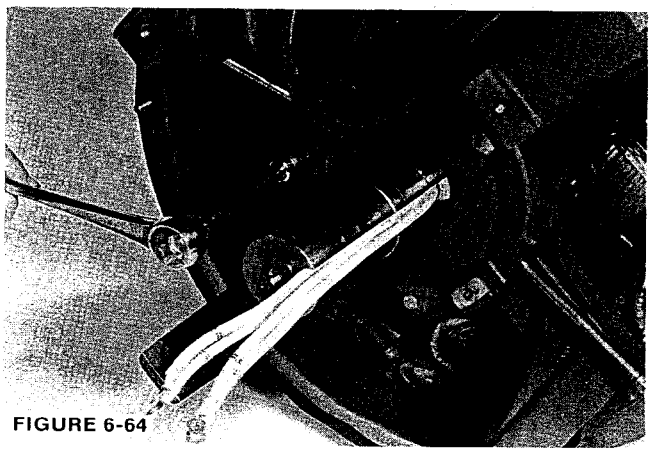


FIGURE 6-64

PMG INSTALLATION

1. Install inboard snap ring (430 frame generators) and loading spring on shaft. (Figure 6-65.)

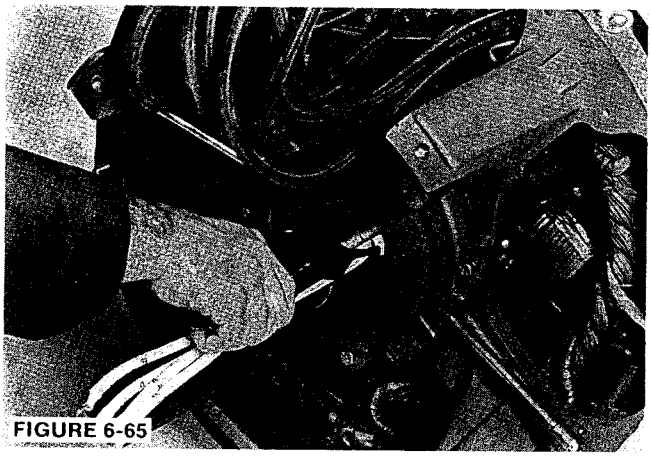


FIGURE 6-65

2. Slide PMG rotor onto shaft. (Figure 6-66.)

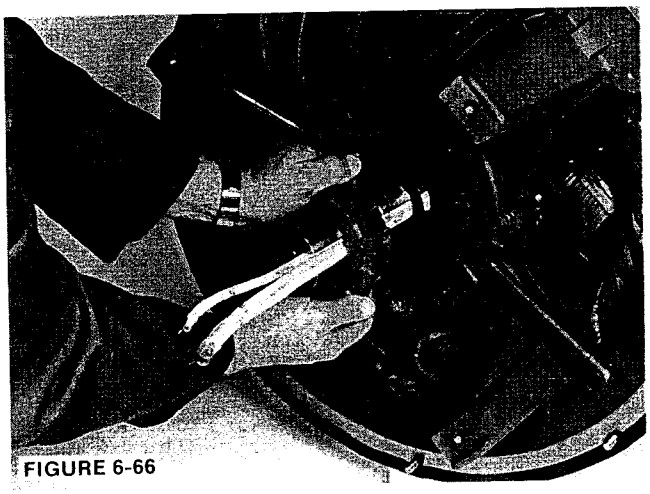


FIGURE 6-66

3. Install snap ring. (Figure 6-67.) Use a piece of pipe slightly larger than the shaft (2-3/4 inches) to push the rotor back against the loading spring until the snap ring seats in the slot. (Figure 6-68.)

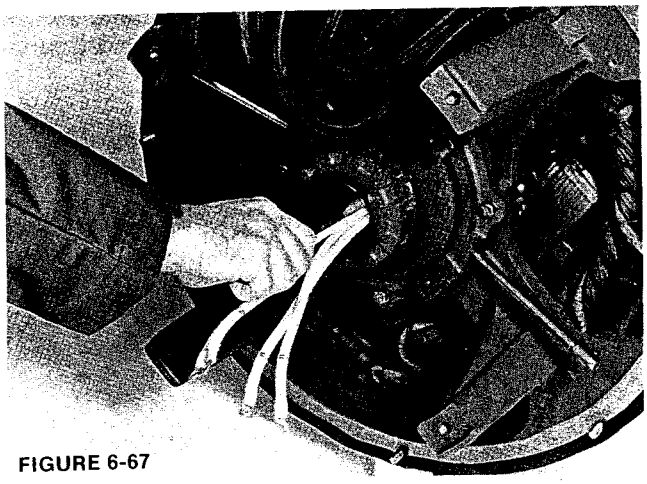


FIGURE 6-67

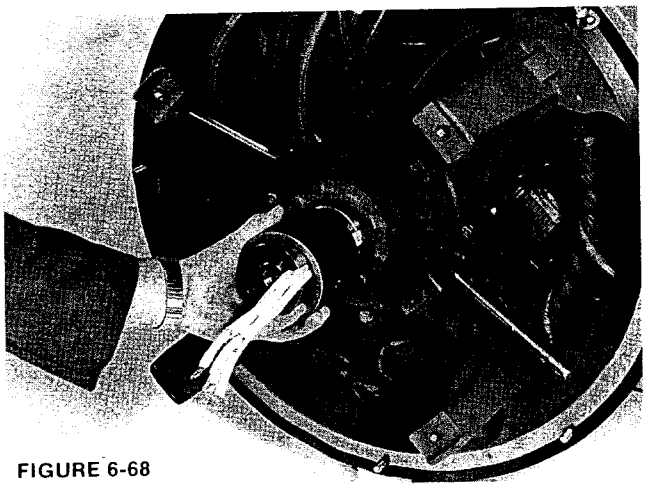


FIGURE 6-68

4. Install the PMG stator on its mounting pads, with the leads in the left (9:00 o'clock) inboard position, and secure with the four mounting capscrews and belleville washers. (Figure 6-69 and 6-72.) Torque to 4 ft-lb (5 N-m).

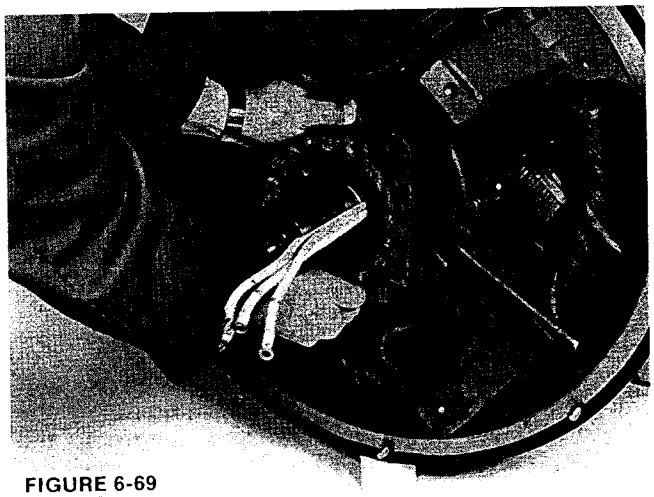


FIGURE 6-69

5. Route and secure PMG stator leads away from moving parts.

SECTION 6

EXCITER INSTALLATION

1. Attach a wire to the main rotor leads and feed the wire through the armature bore and out the lead hole in the aluminum standoff plate. On larger exciters, it will be helpful to install a guide pin in the end of the shaft to support the armature while fishing the rotor leads through. (Figure 6-70.) Align the key in the armature bore to the keyway in the shaft. Slide the armature on the shaft while feeding the main rotor leads through the lead hole in the aluminum standoff plate. (Figure 6-71.)

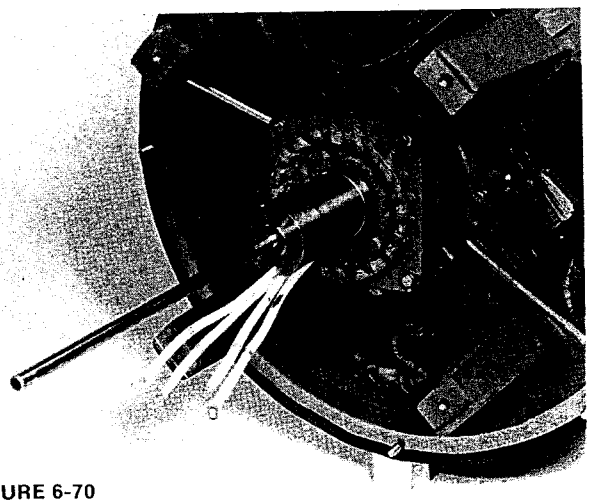


FIGURE 6-70

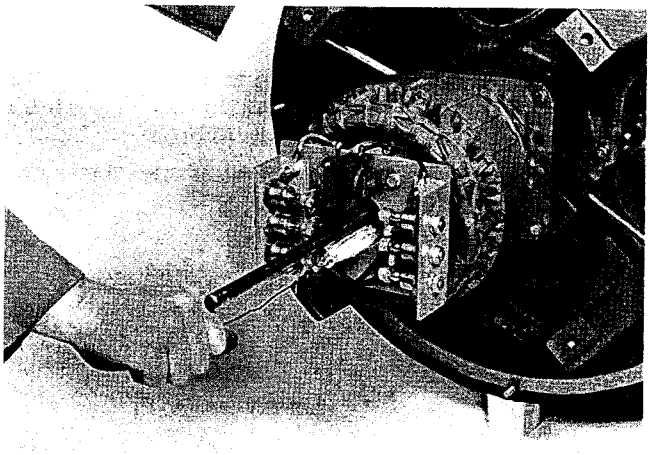


FIGURE 6-71

Insert the capscrew and belleville washer (Figure 6-72.) through the mounting hole in the aluminum standoff plate and secure to the shaft (Figure 6-73). Tighten the capscrew until the armature seats on the shaft. Torque to 84 lb-ft (114 N-m).

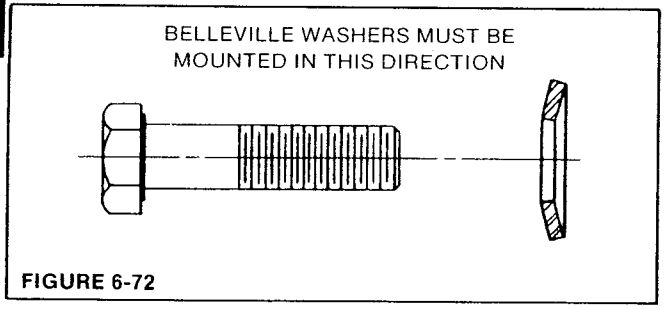


FIGURE 6-72

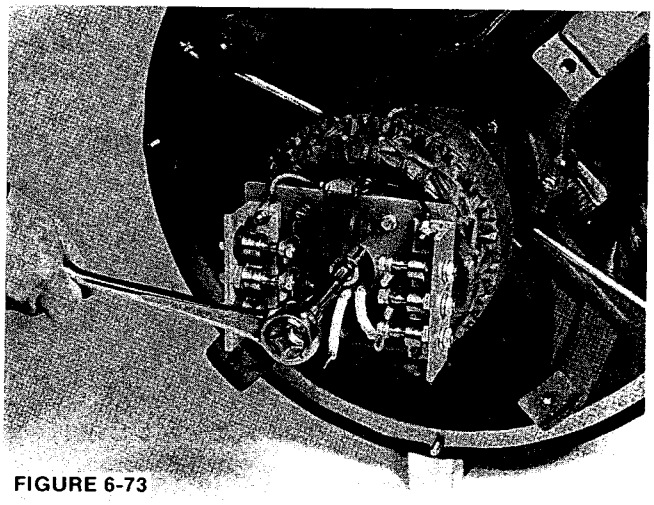


FIGURE 6-73

2. Observe the polarity markings and connect the main rotor leads to the rectifier assembly. (Figure 6-74.) Torque the nuts to 4 ft-lb (5.4 N-m).

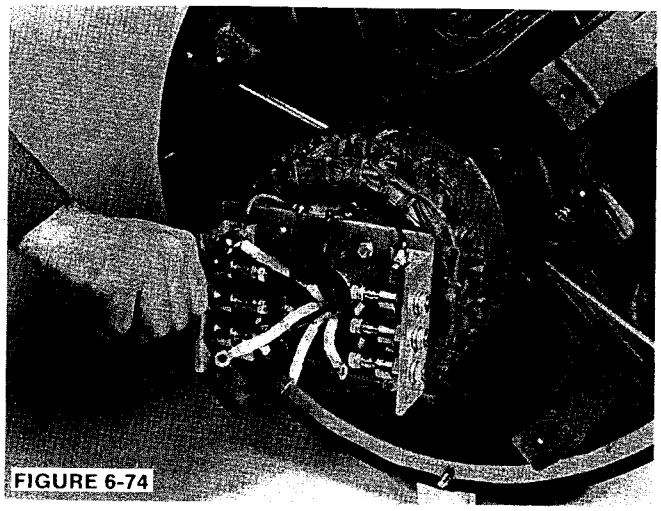


FIGURE 6-74

3. Position the exciter field leads at the left (9:00 o'clock) inboard position. Using a suitable lifting device, mount the exciter stator on the front end bracket mounting pads and align the mounting holes. (Figure 6-75.) Mount with the capscrews and belleville washers. (Figure 6-72.) Torque the capscrews to 60 ft-lb (81 N-m). Route and secure the exciter stator leads away from any moving parts.

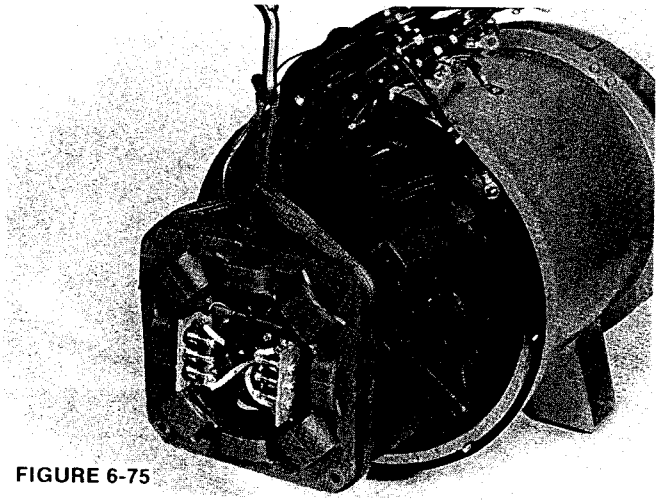


FIGURE 6-75

CONDUIT BOX INSTALLATION

1. Install the conduit box over the main stator leads (be sure leads are in upper compartment). Secure with bolts and lock washers. (Figure 6-76 and 6-77.)

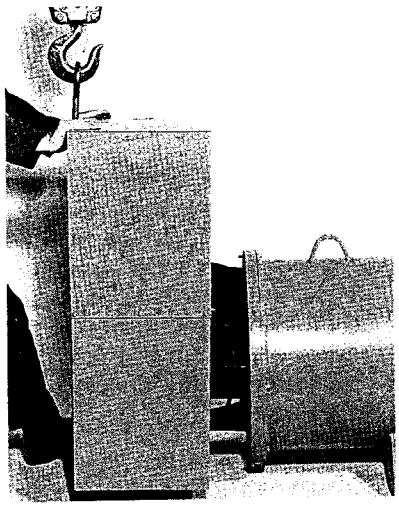


FIGURE 6-76

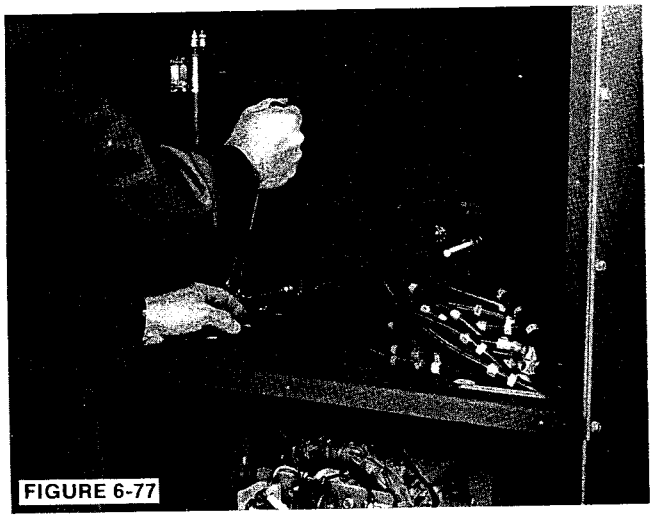


FIGURE 6-77

2. On generators with bus bar assemblies, re-assemble main stator leads and insulating blocks to bus bars. (Figure 6-78.)

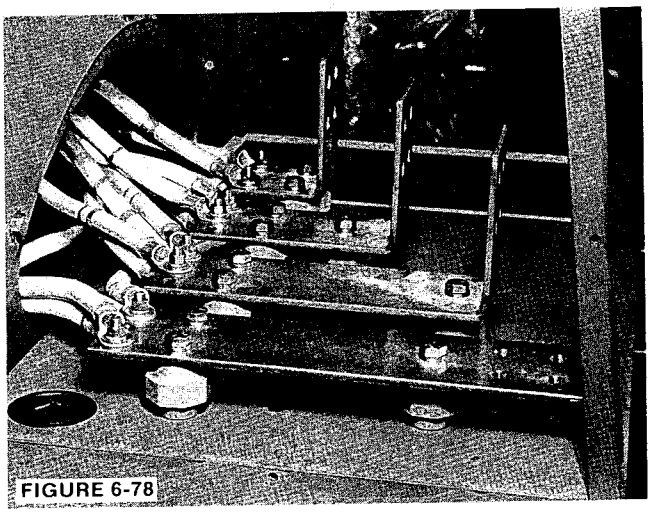


FIGURE 6-78

3. Reconnect exciter leads, PMG leads and other accessories according to the connection prints and markings installed before disassembly.

ASSEMBLY TO PRIME MOVER

1. Attach a suitable hoist to the generator lifting lugs, and move the generator until the generator foot mounting holes are aligned with the base and slightly above.

2. a. For single bearing generators, if the screen assembly is mounted on the adapter, remove the mounting bolts and remove the screen. (Figure 6-79.) (NOTE: Do not remove the drip cover from the screen assembly if so equipped.) Insert two guide pins in the flywheel and two in the flywheel housing. Adjust the generator position until the drive discs are piloted in the flywheel. Remove the guide pins and secure the discs with Grade 8 place bolts and hardened washers or Grade 8 capscrews and heavy series lockwashers. Torque per specifications given in section 12.

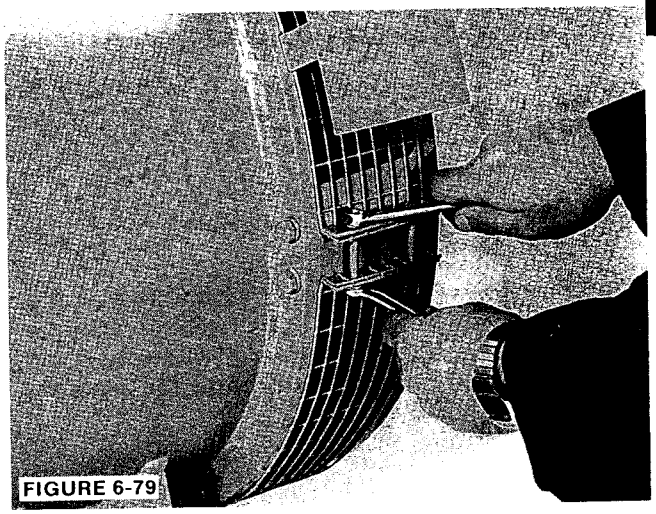


FIGURE 6-79

WARNING

DO NOT APPLY ANY FORCE TO THE GENERATOR FAN FOR LIFTING OR ROTATING THE GENERATOR ROTOR. DISREGARDING THESE INSTRUCTIONS MAY CAUSE PERSONAL INJUY OR EQUIPMENT DAMAGE.

Position the generator so that the SAE adapter mates with the flywheel housing.

CAUTION: DO NOT FORCE THE ALIGNMENT OF THE UNITS. SHIFT THE GENERATOR FROM SIDE TO SIDE OR RAISE OR LOWER WITH A LIFTING DEVICE AS NECESSARY.

It may be necessary to use shims under the mounting feet of either the generator or the prime mover to obtain proper alignment; use the same shims as removed under disassembly or proceed as follows: Using the extreme bottom four capscrews, mount the SAE adapter to the flywheel housing. With a .0015 to .002 inch feeler gauge at the extreme top adapter to flywheel housing to fit, raise the generator or lower the prime mover until the gauge is snug. Relieve just enough to release the feeler gauge and torque the remaining SAE adapter capscrews to the flywheel housing. (Torque specifications given in section 12.)

Mount the screen assembly and tighten the mounting bolts.

b. For two-bearing generators, align the coupling halves or sheaves between the generator and the prime mover by adding shims under the feet.

3. Shim under the generator feet for proper support, ensuring that the generator mounting surfaces are level.
4. Install the mounting bolts which secure the generator to the base.
5. For two bearing generators, assemble the coupling halves or sheave belts between the generator and the prime mover. (Follow the coupling manufacturer's instruction for assembly and alignment.)
6. Connect all existing conduit or ducting to the conduit box.
7. Connect all external wiring to the generator inside the conduit box.
8. Check the exciter air gap (gap between the exciter armature and stator) by inserting a .010 inch feeler gauge in the gap and rotating it around the armature diameter to ensure that a minimum air gap is available. (See Figure 6-80.) If the feeler gauge cannot be rotated one full revolution, then check for a "cocked" exciter stator or loose stator mounting capscrews.

NOTE: On single bearing units, the exciter air gap cannot be checked properly until the generator is mounted to the prime mover.

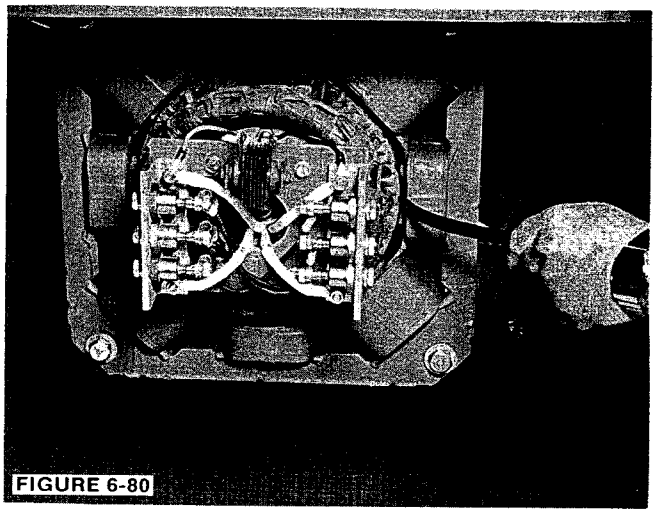


FIGURE 6-80

9. Install the conduit box covers.

TROUBLESHOOTING

INTRODUCTION

This section is intended to suggest a systematic approach to locating and correcting generator or regulator malfunctions. The sections are arranged according to the symptoms of the problem. The steps in each section have been arranged in an attempt to, 1. do the easy checks first, 2. prevent further damage when troubleshooting a disabled machine.

The first and perhaps most important step of troubleshooting should be to gather as much information as possible from personnel who may have been present during the failure. Information on how long the generator had been running, what loads were on the line, weather conditions, what protective equipment operated, etc., can help isolate the problem.

Always make a thorough visual inspection to check for any obvious problems before attempting to run the generator.

WARNING

HIGH VOLTAGES CAN BE PRESENT AT THE GENERATOR AND REGULATOR TERMINALS. HIGH RESIDUAL VOLTAGES CAN BE PRESENT EVEN WITH THE REGULATOR DISCONNECTED OR ITS FUSES REMOVED. SOME EQUIPMENT (SUCH AS SPACE HEATERS) MAY BE ENERGIZED WHEN THE GENERATOR IS OFF. TOOLS, EQUIPMENT, CLOTHING, AND YOUR BODY MUST BE KEPT CLEAR OF ROTATING PARTS AND ELECTRICAL CONNECTIONS.

SPECIAL CAUTION MUST BE TAKEN DURING TROUBLESHOOTING SINCE PROTECTIVE COVERS AND SAFETY DEVICES MAY BE DISABLED TO GAIN ACCESS AND MAKE TESTS.

BE CAREFUL. SERIOUS PERSONAL INJURY OR DEATH CAN RESULT FROM THESE HAZARDS. CONSULT QUALIFIED PERSONNEL WITH ANY QUESTIONS.

SYMPTOM: GENERATOR PRODUCES NO VOLTAGE OR RESIDUAL VOLTAGE

Regulator Fuse Blown	Check fuse with an ohmmeter. Replace bad fuse, refer to regulator manual.
Voltmeter Off	Check to be sure meter phase selector switch is not in the off position.
Incorrect Connections	Verify generator connections. Refer to drawings supplied with generator set and section 3.
Defective Connections/Wiring	Inspect all wiring for grounds, open circuits, short circuits. Refer to section 8.
Defective Voltmeter	Verify proper operation of panel meter with another meter that is known to be accurate. Refer to section 8.
No Regulator Input	Measure voltage at regulator input (PMG output) refer to section 8.
Defective Diodes, Surge Suppressor, or Generator Windings	Test generator with constant excitation (12 volt battery test) refer to section 8 and 12.
Voltage Regulator Protective Shutdown Circuits are Operating	Correct problem and adjust regulator. Refer to regulator manual.
Voltage Regulator Inoperative	Adjust or replace regulator. Refer to regulator manual.

TROUBLESHOOTING

SYMPTOM: GENERATOR PRODUCES LOW VOLTAGE - NO LOAD

Underspeed Operation	Check speed using tachometers and/or frequency meters.
Defective Voltmeter	Verify operation of panel meter with another meter that is known to be accurate. Refer to section 8.
Residual Voltage	Disconnect F1 and F2 leads at the voltage regulator. If voltage goes down continue on to next step, if voltage does not change refer to troubleshooting for symptoms of "No Voltage - Residual Voltage".
Incorrect Generator Connections	Verify generator connections refer to drawings supplied with generator set and section 3.
Defective Connections/Wiring	Inspect all wiring for grounds, open circuits, short circuits, loose connections, dirty connections.
Regulator Adjustments	Adjust regulator. Refer to regulator manual. Check exciter field volts. Refer to section 8 and 12.
Defective Diodes, Surge Suppressor, or Generator Windings	Test generator with constant excitation (12 volt battery test). Refer to section 8 and 12.
Voltage Regulator not Operating Properly	Adjust or replace regulator. Refer to regulator manual.

SECTION 7

SYMPTOM: GENERATOR PRODUCES LOW VOLTAGE WHEN LOAD IS APPLIED

Overload	Measure amps and verify that the load does not exceed the nameplate rating of the generator. Refer to section 8.
Overload - Defective Ammeter	Verify operation of ammeter by using a separate meter that is known to be accurate.
Droop Circuit	If the generator set is equipped for paralleling, some voltage droop is normal as load increases. Refer to the regulator instruction manual.

Continue troubleshooting for symptoms "Generator Produces Low Voltage - No Load".

SYMPTOM: GENERATOR PRODUCES HIGH VOLTAGE

Defective Voltmeter	Verify operation of panel meter with another meter that is known to be accurate. Refer to section 8.
Incorrect Operating Speed	Verify speed with tachometer or frequency meter.
Incorrect Connections	Verify generator connections. Refer to drawings supplied with generator set and section 3.
Defective Connections/Wiring	Inspect all wiring for grounds, open circuits, short circuits.
Regulator Adjustments	Adjust regulator. Refer to regulator manual.
Diode Polarity Incorrect	Check diodes, verify proper diodes are installed and polarity is correct. Refer to section 6.
Voltage Regulator not Operating Properly	Adjust or replace regulator. Refer to regulator instruction manual.

SYMPTOM: GENERATOR VOLTAGE IS FLUCTUATING

Incorrect Speed	Verify speed with tachometer or frequency meter.
Unstable Speed	Verify governor stability.
Voltage Regulator Stability	Adjust regulator stability. Refer to regulator manual.
Defective/Loose Connections	Inspect all wiring for loose or dirty connections.
Defective Diodes, Surge Suppressor, or Generator Windings	Test generator with constant excitation (12 volt battery test). Refer to section 8 and 12.
Remote Voltage Adjust (If used)	Check operation. Refer to regulator manual.
Defective Regulator	Replace regulator. Refer to regulator manual.

TROUBLESHOOTING

SYMPTOM: GENERATOR OPERATES SATISFACTORILY WHEN COLD, BUT SHUTS DOWN WHEN WARM

Regulator Shutdown on Over Temperature	Correct cooling problems. Refer to regulator manual.

SYMPTOM: GENERATOR BUILDS VOLTAGE FROM STARTUP, THEN GOES TO LOW (RESIDUAL) VOLTAGE

Regulator Protective Circuit is Operating	Check indicators on regulator. Correct problems and adjust regulator as required. Refer to regulator manual.

SYMPTOM: EQUIPMENT RUNS NORMALLY ON UTILITY POWER, BUT WILL NOT RUN ON GENERATOR SET

Voltage Waveform is Distorted	Analyze load. Excessive SCR (Thyristor) loading will cause distortion. Some equipment may be sensitve to distorted waveforms. Refer to Marathon Electric.

SECTION 7

VISUAL INSPECTION

Whenever testing and troubleshooting a generator set, it is always a good practice to make a thorough visual inspection. Remove covers and look for any obvious problems. Burnt windings, broken connectors, leads, mounting brackets, etc., can usually be identified. Look for any loose or frayed insulation, loose or dirty connections, broken wires. Be sure all wiring is clear of rotating parts.

Verify that the generator is connected for the voltage required, this is especially important on new installations.

Check for any foreign objects, loose nuts, bolts, and electrical connectors. Clear paper, leaves, building materials, etc., that could be sucked into the generator. (Generator is air cooled. Air enters the lower portion of the conduit box.) Check the air gap for clearance or obstructions (main generator and exciter).

If possible, rotate the generator rotor by hand to be sure it turns freely.

If serious problems can be identified before attempting to operate the machine, additional damage can be avoided.

CONSTANT EXCITATION (12V BATTERY) TEST

THEORY: The generator output voltage is dependent on generator speed, generator design, load, and exciter input current. If the generator speed and exciter input are known, the output voltage at no load can be measured and compared to the design value. Problems can be isolated to either the generator or regulator system by using this test.

TEST PROCEDURE:

1. Shut the generator set down.
2. Connect a voltmeter to the generator output.
3. Disconnect the F1 and F2 leads at the regulator.
4. Connect a 12 volt battery capable of supplying 1 amp to the F1 and F2 leads. F1 is plus (+), F2 is minus (—).

   CAUTION: Beware of arcing when connecting leads. Stay clear of battery vents. Escaping hydrogen gas can explode. If hazardous conditions exist - use a suitable switch to connect or disconnect the battery.
5. With no load on the generator, (main breakers open) run generator at rated speed (1800 rpm -60 Hz or 1500 rpm - 50 Hz).
6. Measure the generator output voltage.
7. Shut generator down.
8. Disconnect battery (see Caution - Step 3).
9. Compare voltage reading with value shown in section 12.

Conclusion: If voltage readings are normal, the main generator and exciter are operating properly. Troubleshooting should continue with the regulator. If readings are not normal the problem is in the generator. Continue testing diodes, surge suppressor, windings.

MEASURING VOLTAGES

When testing the generator and regulator, the most frequent (and usually easiest) measurement will be a voltage. The generator will need to be running at rated speed and may have some of the protective guards and covers removed. BE CAREFUL. Keep yourself and your test leads out of the way. It is best to shut the unit down when connecting meters. When using alligator clips or push on terminals, be sure the leads are supported so vibration does not shake them loose when running the generator set.

See figure 8-1 for measurement points and expected meter range settings. When in doubt, start with a higher range and work down.

Consult meter instruction manual to verify its operation and limitations.

GENERATOR TESTING

FIGURE 8-1: TYPICAL VOLTAGE MEASUREMENTS

Voltage Measurement	Test Point	Meter/Range Selection Requirement
Generator Output Voltage	Output "T" leads or bus bars, also main circuit breaker "line" side.	System voltage - volts A.C. See generator nameplate and connection diagram.
Regulator Output (Exciter Stator Input)	F1 and F2 terminals at the regulator.	200 volts D.C. range. F1 is plus (+), F2 if minus (—).
Regulator Sensing Voltage	E1, E2, E3 terminals at the regulator.	Usually the same as the system voltage (generator output volts). However, in some cases, sensing is taken from winding center taps or instrument potential transformers. Maximum 600 volts A.C. **Example:** Center tap of 480 volt system would give 240 volts at E1, E2, or E3. **Example:** A 4160 volt system must use a transformer to step voltage down below 600 volts. See the connection diagram supplied with generator set.
Regulator Input Volts (PMG Output Volts)	"PMG" leads at the regulator or capacitor.	200-240 VAC 300 Hz @ 1800 rpm 180-220 VAC 250 Hz @ 1500 rpm

CURRENT (AMP) MEASUREMENTS

SECTION 8

Current measurements (A.C.) can be easily taken with a clamp on type meter.

NOTE: Most clamp on ammeters will not measure D.C.

When measuring generator output current, be sure the clamp is around all cables **for each phase.** If the physical size of the conductors or the capacity of the meters will not permit all cables to be measured at once, each one can be measured individually. Add the individual readings together to get the total. Compare readings to the generator nameplate (nameplate ratings are always given per phase).

Amperage should never exceed the nameplate rating when running the intended load. (Amperage may go above nameplate momentarily when starting large motors.)

When measuring exciter field amps (F1 and F2 leads) a D.C. meter is required. The maximum field current under full regulator forcing is 6.5 amps D.C. Normal full load reading is approximately 3 amps D.C.

MEASURING RESISTANCE

The generator windings can be measured and compared to the values shown in the service specification section 12.

Main Stator

The main stator winding resistance is very low. A meter capable of readings in the milliohm range would be required. However, a standard V.O.M. can be used to check for continuity, shorts, or grounds.

Example: With leads disconnected, a measurement from T1 to T4 should be very low (continuity on most V.O.M's). Measured from T1 or T4 to any other lead should be infinite. Measure from the 'T' lead to the generator frame to check for grounds (reading should be infinite).

Exciter Stator

The exciter stator resistance is measured by disconnecting the F1 and F2 leads at the regulator. Measure the resistance between the leads (this value is 22-24 ohms on standard generators). Measure from the leads to the frame to check for grounds.

Main Rotor

Note markings and disconnect the main rotor leads (F1 leads and F2 leads) from the rectifier assembly. Measure the resistance of the main rotor winding. Compare reading to value shown in service specification section 12. Measure from the leads to the exciter mounting bolt to check for grounds.

Exciter Rotor

Disconnect the exciter rotor leads at the diodes (leave leads disconnected if proceeding to check diodes). Measure resistance between phases. Compare value to service specifications section 12. Measure from the leads to the exciter mounting bolt to check for grounds.

TESTING DIODES (RECTIFIERS)

Diodes perform the function of an "electrical check valve". They conduct in one direction only and are used to "rectify" ac current into dc current. To test, measure the resistance first in one direction and then reverse the leads and test in the other direction. The reading should be high in the reverse direction and low in the forward direction. A shorted diode will read low in both directions. An open diode will read high in both directions.

NOTES:

1. Two different polarities of diodes are used. The only difference is in the way the device is mechanically placed in the case. When changing diode, be sure the correct polarity is used. Refer to section 6 figure 6-34.

2. Some meters do not have enough voltage output from their internal batteries to turn the diode on (about 0.6 volts is required), and the voltage can change with different range settings. Consult the instruction manual for your meter.

3. Polarities supplied by the meters internal battery may or may not correspond to the (+) (—) markings on the meter.

INSULATION RESISTANCE - GENERAL

Insulation resistance is a measurement of the integrity of the insulating materials that separate the electrical windings from the generators steel core. This resistance can degrade over time or due to contaminants (dust, dirt, oil, grease, and especially moisure). Most winding failures are due to a breakdown in the insulation system. In many cases, low insulation resistance is caused by moisture collected when the generator is shut down. The problem can be corrected simply by drying out the windings. Section 5.

Normally the resistance of the insulation system is on the order of millions of ohms. It is measured with a device called a "megger" which is a megohm meter (meg is for million) and a power supply. The power supply voltage varies, but the most common is 500 volts. A megger voltage over 500 is not recommended, except for measuring medium voltage (2400/4160) stators only.

CAUTION: First disconnect any electronic components, regulators, diodes, surge protectors, protective relays, etc., will be destroyed if subjected to the high megger voltages.

To measure insulation resistance, connect the red or positive megger lead to the leads for the winding to be tested, connect the back or negative megger lead to the generator frame. Be sure the leads of the part being tested are not touching any metal parts of the generator. (If the neutral is grounded, it must be disconnected.) Take megger reading (refer to the manual for the megger).

INSULATION RESISTANCE - MAIN STATOR

CAUTION: Be sure the regulator, and any other electronic components, metering, protective relays, etc., are disconnected before meggering. High megger voltages will destroy these parts.

All stator leads must be isolated from ground and connected together (on most systems with grounded neutrals - the neutral can be isolated from ground and used as a test point). Connect the positive megger lead to the main stator leads. Connect the negative megger lead to the generator grounding stud. Take the megohm reading (refer to instructions for the megger).

GENERATOR TESTING

The minimum acceptable value can be calculated using the following formula.

$$\text{Minimum Insulation Resistance (Megohms)} = \frac{\text{Gen. Voltage}}{1000} + 1$$

Example: For a 480 volt generator

$$\frac{480}{1000} + 1 = 1.48 \text{ Megohms}$$

If the reading is below the recommended value, the winding must be dried out or repaired.

INSULATION RESISTANCE - MAIN ROTOR

Disconnect the main rotor leads from the diode bridge on the exciter rotor. Connect the leads together with the positive megger lead. Connect the negative megger lead to a good ground on the rotor assembly such as the exciter mounting bolt. Take the megohm reading (refer to instructions for the megger).

The minimum acceptable value is 1.5 megohms.

If the readings is low, the winding must be dried out or repaired.

INSULATION RESISTANCE - EXCITER STATOR

SECTION 8

Disconnect the exciter leads F1 and F2 from the regulator. Never subject the regulator to a megger. Connect F1 and F2 together with the positive megger lead. Connect the negative megger lead to the ground stud. Take the megohm reading (refer to instructions for the megger).

The minimum value is 1.5 megohms.

If the reading is low, the winding must be dried out or repaired.

INSULATION RESISTANCE - EXCITER ROTOR

Disconnect the exciter rotor windings (6 leads from the diodes). Connect all leads together with the positive megger lead. Connect he negative megger lead to a good ground on the rotor assembly such as the mounting bolt. Take the megohm reading (refer to the instructions for the megger).

The minimum acceptable value is 1.5 megohms.

If the reading is low, the winding must be dried out or repaired.

MAIN ROTOR FIELD AC IMPEDANCE TEST

THEORY: The main rotor resistance can be measured with a very accurate meter that is able to measure low (1 ohm) resistance but it is difficult to determine if there are turn to turn shorts in the field pole windings. One shorted turn would only change a resistance reading on the order of one half of one percent.

The ac impedance test measures the impedance (inductance and resistance) of the field pole coils. Shorted turns in the field pole windings change the coil inductance to a much greater degree than the resistance.

PROCEDURE:

Step 1: The rotor must be supported on a non-magnetic surface such as a wooden skid. Do not use a steel table that would create a magnetic "short circuit" between the poles.

Step 2: Apply 120 volts ac to disconnected main rotor leads F1 and F2.

Step 3: Measure and record voltages across each pole. Between points "A" and "B", "B" and "C", "C" and "D", "D" and "E" (Figure 8-1).

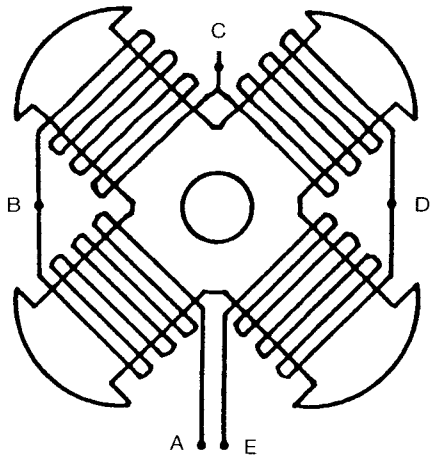


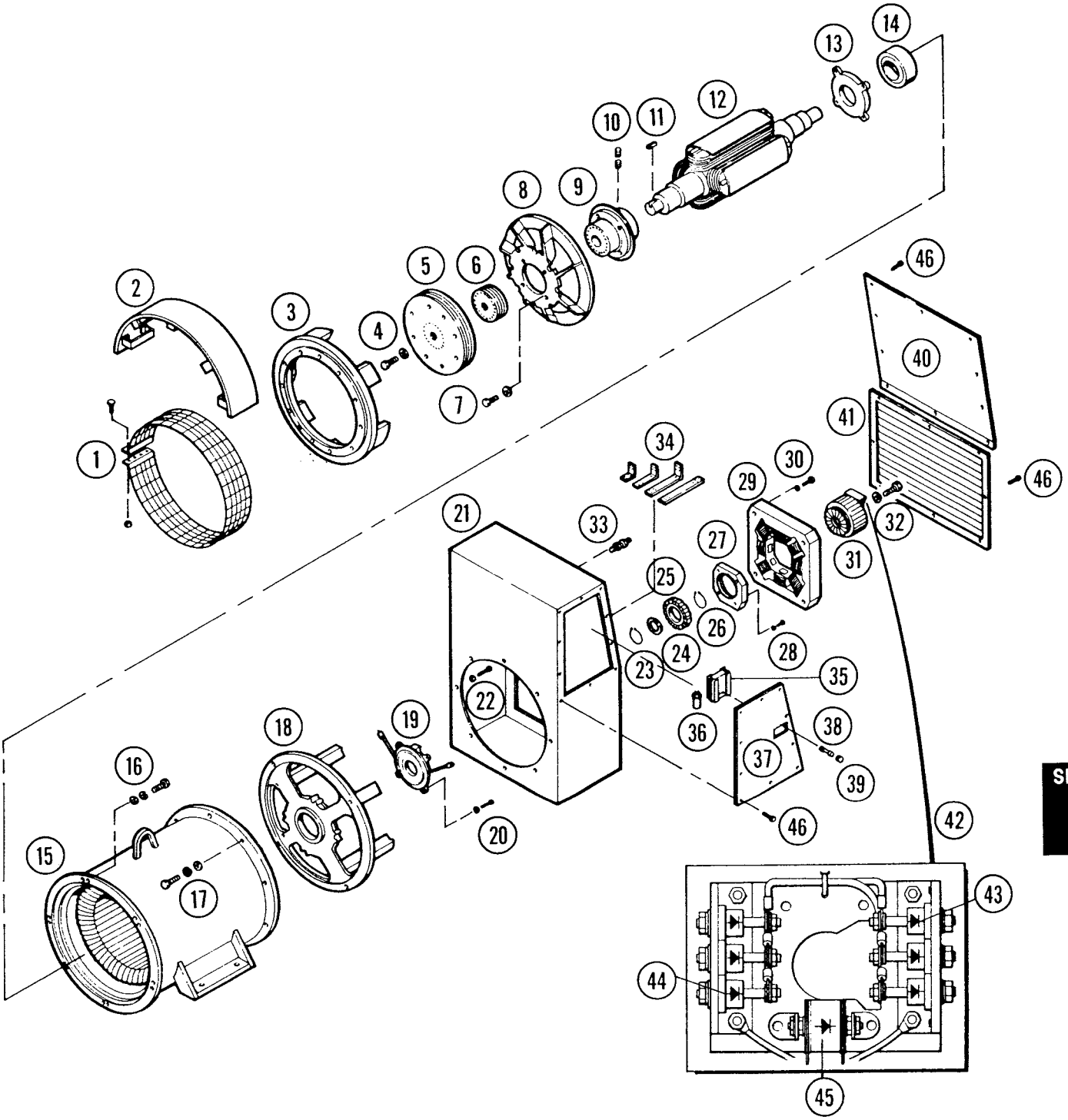
FIGURE 8-1

Step 4: The voltage readings should balance within one volt.

RESULTS: If the ac voltages are not balanced (30v ± 1v ac with 120v ac input) across each pole, the winding has shorted turns and should be rewound.

Refer to Marathon Electric for further information.

MagnaMAX Exploded View



PARTS

Note: This parts list is for reference only. Always give complete generator model and serial numbers when ordering parts.

TABLE 9-1:PARTS LIST

Item	Part Description	430 Frame Series		570 Frame Series		740 Frame Series	
		Part Number	Qty.	Part Number	Qty.	Part Number	Qty.
1	Screen Assembly						
	Screen	B-525565-1	1	B-525565-2	1	B-525565-3	1
	Screen Mounting Bolt	A-9646-200	2	A-9646-200	2	A-9646-200	2
	Screen Mounting Nut	A-7551-18	2	A-7551-18	2	A-7551-18	2
2	Drip Cover Assembly (Option)	B-525566-1	1	B-525566-2	1	B-525566-3	1
3	Adapter						
	#3 Adapter	B-525512A	1	—	—	—	—
	#2 Adapter	B-525512B	1	—	—	—	—
	#1 Adapter	B-525513A	1	B-525618A	1	—	—
	#1/2 Adapter	B-525514B	1	B-525616A	1	—	—
	#0 Adapter	B-525514A	1	B-525603A	1	B-525720A	1
	#00 Adapter (#18 Disc)	—	—	B-525617A	1	B-525721A	1
	#00 Adapter (#21 Disc)	—	—	B-526228A	1	B-525721A	1
4	Disc Mounting Fasteners						
	Capscrew for #11-1/2	A-9674-200	6	—	—	—	—
	Capscrew for #14	A-9674-150	6	A-9674-150	9	—	—
	Capscrew for #18	A-9674-150	6	A-9674-150	9	A-9674-200	18
	Capscrew for #21	—	—	—	—	A-9674-150	18
	Capscrew for Delco	A-9674-150	6	A-9674-150	9	A-9674-200	18
	Hardened Washer	A-9667-1	6	A-9667-1	9	A-9667-1	18
5	Drive Discs						
	#11-1/2 Disc	A-525506	5	—	—	—	—
	#14 Disc	A-525508	5	A-525508	5	—	—
	#18 Disc	B-525975	4	A-525579	5	A-525579	10
	#21 Disc	—	—	A-525580	5	A-525580	10
	Delco Disc (17.75" O.D.)	A-525507	5	A-525507	5	A-525507	10
6	Spacers						
	For #11-1/2 Disc	A-525567	14	—	—	—	—
	For #14 Disc	A-525567	5	A-525503	6	—	—
	For #18 Disc	—	—	—	—	A-525503	10
	For #21 Disc	—	—	—	—	—	—
	For Delco Disc	—	—	A-525503	1	A-525503	12
7	Fan Mounting Fasteners						
	Capscrew	A-9626-150	4	A-9626-150	8	A-9626-150	8
	Capscrew (2 Brg. Only)	A-9626-150	4	A-9626-200	8	A-9626-200	8
	Belleville Washer	A-9682-1	4	A-9682-1	8	A-9682-1	8
8	Fan	B-525510A	1	B-525604A	1	B-525719A	1
9	Hub						
	Drive Hub (Single Brg. Only)	B-525509A	1	B-525606A	1	B-525726A	1
	Fan Hub (2 Brg. Only)	A-525568A	1	B-525694A	1	B-525750A	1
10	Drive Hub Set Screws		—	A-9675-50	2	A-9675-50	2
11	Drive Hub Key	A-25658-30	1	A-25658-30	1	A-25658-46	1
12	Main Rotor Assembly with Windings	R.T.F.	1	R.T.F.	1	R.T.F.	1
13	Front Bearing Cap	B-525519A	1	B-525613A	1	B-525743A	1
14	Front Ball Bearing	A-7812R-70	1	A-7812R-80	1	A-7812R-110	1
15	Main Body Assembly	R.T.F.	1	R.T.F.	1	R.T.F.	1

R.T.F = Refer to Factory

SECTION 9

Note: This parts list is for reference only. Always give complete generator model and serial numbers when ordering parts.

TABLE 9-1:PARTS LIST

Item	Part Description	430 Frame Series		570 Frame Series		740 Frame Series	
		Part Number	Qty.	Part Number	Qty.	Part Number	Qty.
16	Adapter Mounting Fasteners						
	Capscrew	A-9680-125	12	A-9680-125	16	A-9626-150	16
	Lock Washer	A-7653-3	12	A-7653-3	16	A-7653-4	16
	Flat Washer	A-7656-8	12	A-7656-8	16	—	16
17	Bracket Mounting Fasteners						
	Capscrew	A-9680-125	8	A-9680-125	8	A-9626-150	8
	Lock Washer	A-7653-3	8	A-7653-3	8	A-7653-4	8
	Flat Washer	A-7656-8	8	A-7656-8	8	—	8
18	Front Bracket	B-525518A	1	B-525605A	1	B-525739A	1
19	PMG Bearing Cap	B-525520A	1	B-525612A	1	B-525742A	1
20	Bearing Cap Fasteners						
	Capscrew	A-9680-350	4	A-9680-400	4	A-9680-450	4
	Lock Washer	A-7653-3	4	A-7653-3	4	A-7653-3	4
21	Conduit Box	D-525673	1	D-525680	1	D-525771	1
22	Conduit Box Mounting Fasteners						
	Capscrew	A-9680-75	8	A-9680-75	8	A-9626-75	8
	Lock Washer	A-7675-2	8	A-7675-2	8	A-7675-4	8
23	Snap Ring - Inner	A-7610-275	1	—	—	—	—
24	Loading Spring	A-7661-45	1	A-7661-45	1	A-7661-45	1
25	PMG Rotor	A-526816	—	A-526816	—	A-526816	—
26	Snap Ring - Outer	A-7610-275	1	A-7610-275	1	A-7610-275	1
27	PMG Stator	A-525548-1	1	A-525548-1	1	A-525548-1	1
28	PMG Stator Mounting Fasteners						
	Capscrew	A-9812-200	4	A-9812-200	4	A-9812-200	4
	Belleville Washer	A-9682-2	4	A-9682-2	4	A-9682-2	4
29	Exciter Stator	A-400N-200A	1	A-400N-300A	1	See Table 9-2	1
30	Exciter Stator Fasteners						
	Capscrew	A-9626-300	4	A-9626-400	4	See Table 9-2	4
	Belleville Washer	A-9682-1	4	A-9682-1	4	A-9682-1	4
31	Exciter Rotor Assembly (Incl. 42)					See Table 9-2	1
	430 Frame - All	B-526483-2	1	—	—		
	570 Frame - Low Voltage	—	—	B-526483-3	1		
	570 Frame - Medium Voltage	—	—	B-526483-10	1		
32	Exciter Rotor Fastener						
	Capscrew	A-9670A-200	1	A-9670A-200	1	A-9670A-200	1
	Belleville Washer	A-9682-1	1	A-9682-1	1	A-9682-1	1
33	Grounding Stud Assembly						
	Stud	A-26937-300	1	A-26937-300	1	A-525574-400	1
	Washer	A-9787-1	2	A-9787-1	2	A-9787-3	2
	Nut	A-9786-1	1	A-9786-1	2	A-9786-3	2
34	Bus Bar Assembly	R.T.F.	1	R.T.F.	1	R.T.F.	1
35	Voltage Regulator						
	DVR2000	D-526352	1	D-526352	1	D-526352	1

R.T.F = Refer to Factory

SECTION 9

PARTS

Note: This parts list is for reference only. Always give complete generator model and serial numbers when ordering parts.

TABLE 9-1:PARTS LIST

Item	Part Description	430 Frame Series		570 Frame Series		740 Frame Series	
		Part Number	Qty.	Part Number	Qty.	Part Number	Qty.
36	Capacitor (DVR2000)	A-66377-45	1	A-66377-45	1	A-66377-45	1
37	Side Panels						
	Blank	B-525679A	1	B-525686A	1	B-525707A	1
	Machined for Regulator (DVR2000)	B-525679AE	1	B-525686AN	1	B-525707W	1
38	Fuse	A-525698-1	1	A-525698-1	1	A-525698-1	1
39	Fuse Holder Cap	A-525893	1	A-525893	1	A-525893	1
40	Solid Cover	B-525676	1	B-525687	1	B-525706	1
41	Louvered Cover	C-525562	1	C-525647	1	D-525670	1
42	Exciter Rect. Asy. (Incl. 43,44,45)	B-525528D	1	B-525528D	1	B-525528E	1
43	Diode Standard Polarity	B-525570-1	3	B-525570-1	3	B-525570-2	3
44	Diode Rev. Polarity	B-525571-1	3	B-525571-1	3	B525571-2	3
45	Surge Suppressor	B-526482-1	1	B-526482-1	1	B-526482-2	1
46	Cover Mtg. Screws	A-9646-75	33	A-9646-75	33	A-9646-75	52

TABLE 9-2:EXCITER ASSEMBLIES FOR 570 FRAME SERIES

Frame	Type	Insulation	Exciter Stator	Exciter Stator Mounting Capscrews	Exciter Rotor
572	RSL	Standard	A-400N-250A	A-9626-350	B-526483-24
573, 574	RSL	Standard	A-400N-300A	A-9626-400	B-526483-3
572	RSL	VPI	A-400N-250AA	A-9626-350	B-526483-25
573, 574	RSL	VPI	A-400N-300AA	A-9626-400	B-526483-9
573, 574	FSM	VPI	A-400N-300AA	A-9626-400	B-526483-10

SECTION 9

TABLE 9-2:EXCITER ASSEMBLIES FOR 740 FRAME SERIES

Frame	Type	Insulation	Exciter Stator	Exciter Stator Mounting Capscrews	Exciter Rotor
741, 742	RSL	Standard	A-400N-500A	A-9626-600	B-526483-5
741, 742, 743	RSL	VPI	A-400N-500AA	A-9626-600	B-526483-11
741, 742	FSM	VPI	A-400N-500AA	A-9626-600	B-526483-11
743	FSM	VPI	A-400N-600AA	A-9626-700	B-526483-12
744	RSL	VPI	A-400N-600AA	A-9626-700	B-526483-12
744	FSL	VPI	A-400N-650AA	A-9626-750	B-526483-13

STANDARD TOOLS

The MagnaMAX generator is assembled with American standard SAE hardware. Wrench sizes from 5/16 inch to 7/8 inch are used. A socket head set screw is used in the drive hub. A 1/4 inch allen type wrench is required to remove it.

All fasteners should be properly torqued (See section 12). Torque wrenches ranging from 25 in-lb through 200 ft-lb should be available.

Electrical test equipment should include a voltmeter or multimeter (VOM), clamp on ammeter, accurate frequency meter or tachometer, and a megohmmeter. See section 8, Generator Testing for more information.

SPECIAL TOOLS

In addition to the standard tools mentioned above, the following special tools will facilitate removal and installation of large and/or special parts. These tools can be obtained from the Marathon Electric parts department.

Exciter stator lifting fixture (Figure 10-1). In cases where the exciter stator is to be serviced without removing the generator conduit box this fixture can be used with overhead rigging to remove and reinstall the exciter stator.

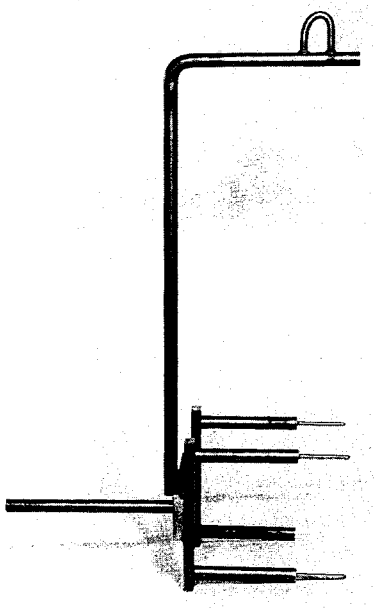


FIGURE 10-1

Exciter rotor puller bolt (Figure 10-2). The exciter rotor has a built in pulling system. With the use of this bolt, the rotor can be easily removed from the shaft without damage to the winding.



FIGURE 10-2

Snap ring pliers (Figure 10-3). The PMG rotor is installed to the generator shaft with a snap ring. The nominal shaft diameter is 2-3/4 inches and the ring must be spread approximately 3/4 inches for removal. To install the snap ring, use a piece of pipe with a 2-3/4 inch I.D. (Figure 10-4). Push the PMG rotor and snap ring onto the shaft until the ring snaps into the groove.

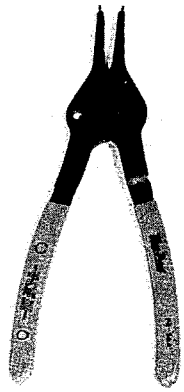


FIGURE 10-3

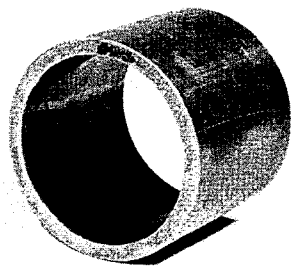


FIGURE 10-4

SECTION 10

Rotor lifting fixture (Figure 10-5). The main generator rotor is heavy (approximately 1/2 the weight of the generator) and difficult to handle. The proper fixture should be used whenever removing or installing the main rotor into the main stator. Without proper care and equipment, the windings can be easily damaged.

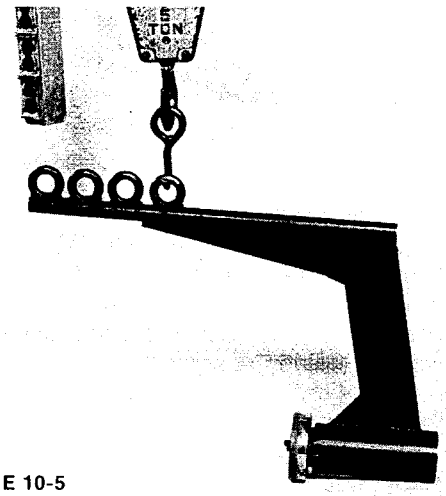


FIGURE 10-5

MISCELLANEOUS

A selection of wiring devices such as electric connectors, tape, cable ties, crimping and stripping tools, etc., should also be a part of the generator service tool kit. The standard regulator uses flat 1/4 inch female insulated terminals for AWG #14 wire.

PREPARATION FOR SHIPMENT OR EXTENDED STORAGE

SHIPPING INSTRUCTIONS

Shipping and handling will be much easier if the generator is fastened to a suitable shipping skid that will allow handling by a forklift. The skid should extend beyond the generator in all directions. If the original skid is available it should be used. Marathon Electric will supply shipping skid drawings upon request.

Overseas shipping may require special export crating. Check with your freight carrier.

When installed, single bearing generator rotors are supported on the drive end by the drive discs bolted to the engine flywheel. When the engine is removed, the rotor must be supported by an appropriate fixture to prevent main rotor, main stator or exciter damage (Figure 11-1). Before shipping any single bearing generator, the main rotor must be supported by the adapter using an appropriate fixture.

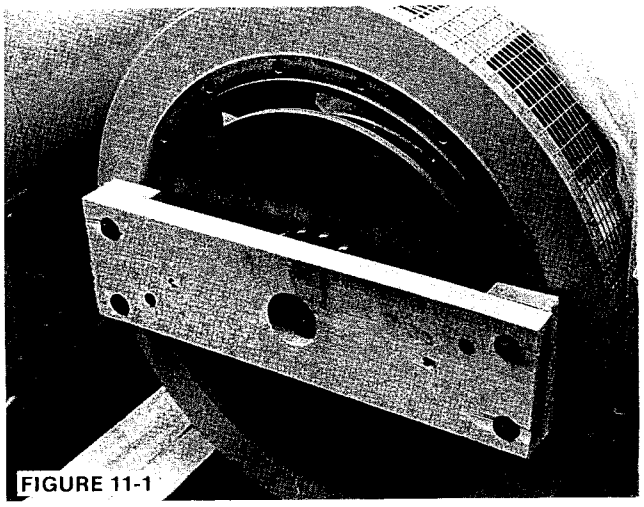


FIGURE 11-1

CAUTION

DO NOT ATTEMPT TO TRANSPORT ANY GENERATOR WITHOUT PROPER ROTOR SUPPORT, EXTENSIVE EQUIPMENT DAMAGE CAN OCCUR.

STORAGE INSTRUCTIONS

If the generator or gen-set is placed in storage, the following precautions should be taken to protect it:

A. Equipment must be kept clean.
   1. Store indoors.
   2. Keep covered to eliminate airborne dust and dirt.
   3. Cover openings for ventilation, conduit connections, etc. to prevent entry of rodents, snakes, birds, and insects, etc.

B. Equipment must be kept dry.
   1. Store in a dry area indoors.
   2. Temperature swings should be minimal to prevent condensation.
   3. If stored in an unheated or damp building, space heaters will be required to prevent internal condensation.
   4. Treat unpainted flanges, shafts, drive discs, and fittings with a rust inhibitor.
   5. Check insulation resistance of all windings **before** starting the generator. If readings are low, the windings must be dried. See Section 5.

C. Keep bearings lubricated.
   1. Every six months, rotate shaft several turns to distribute grease in bearings.
   2. If unit has been stored more than one year, add grease before start-up.

D. Review and follow instructions in Sections 3 and 4 before putting the gen-set into service.

SECTION 11

SPECIFICATIONS

TABLE 12-1: MAGNA MAX - FASTENER AND TORQUE SPECIFICATIONS

Part Description	Fastener Spec.③	430-570 Frames		740 Frames	
		Size① Dia.-Thread	Torque② Ft-Lb	Size① Dia.-Thread	Torque② Ft-Lb
Front Bracket	Grade 5 capscrews with flat and lock washers	3/8 - 16	25	1/2 - 13	60
Bearing Caps	Grade 5 capscrews with lock washers	3/8 - 16	25	3/8 - 16	25
Drive Disc	Grade 8 capscrews with hardened washers	5/8 - 18	192	5/8 - 18	192
Adapter (or rear bracket)	Grade 5 capscrews with flat and lock washers	3/8 - 16	25	1/2 - 13	60
Conduit Box	Grade 5 capscrew with star type lock washer	3/8 - 16	25	1/2 - 13	60
PMG Stator	Grade 5 capscrews with belleville washers	1/4 - 20	4	1/4 - 20	4
Exciter Stator	Grade 5 capscrews with belleville washers	1/2 - 13	60	1/2 - 13	60
Exciter Armature (rotor)	Grade 8 capscrew with belleville washer	1/2 - 13	84	1/2 - 13	84
Cooling Fan	Grade 5 capscrews with belleville washers	1/2 - 13	60	1/2 - 13	60
Main Rotor Coil Supports ④	Grade 8 capscrews with belleville washers	5/16 - 18	19	3/8 - 16	35
Rectifier Assembly Mounting	Grade 5 capscrews	1/4 - 20	.4	1/4 - 20	4
Drive Hub Set Screw	Socket head set screw - 1/4 in. hex key	1/2 - 13	50	1/2 - 13	50

NOTES:
① All fasteners are SAE (American) standard.
② All torque values are for plated hardware which is standard on the MagnaMAX. If hardware is replaced with non-plated, refer to Table 12-2.
③ Always use quality hardware of the grade specified.
④ 570 and 740 frame only. Not used on 430 frames.

TABLE 12-2: CAPSCREW TORQUE VALUES

Capscrew Diameter and Ultimate Tensile Strength (PSI)	To 1/2 - 69,000 PSI To 3/4 - 64,000 PSI To 1 - 55,000 PSI			To 3/4 - 120,000 PSI To 1 - 115,000 PSI			150,000 PSI		
SAE Grade Number	1 or 2			5			8		
Capscrew Head Markings									
Capscrew Body Size (Inches) - (Thread)	Torque① Ft-Lb (N-m)			Torque① Ft-Lb (N-m)			Torque① Ft-Lb (N-m)		
	Dry	Oiled	Plated	Dry	Oiled	Plated	Dry	Oiled	Plated
1/4 - 20	5 (7)	4.5 (6)	4 (5)	8 (11)	7 (9)	6 (8)	12 (16)	11 (15)	10 (14
- 28	6 (8)	5.4 (7)	4.8 (6)	10 (14)	9 (12)	8 (11)	14 (19)	13 (18)	11 (15)
5/16 - 18	11 (15)	10 (14)	9 (12)	17 (23)	15 (20)	14 (19)	24 (33)	22 (30)	19 (26)
- 24	13 (18)	12 (16)	10 (14)	19 (26)	17 (23)	15 (20)	27 (37)	24 (33)	22 (30)
3/8 - 16	18 (24)	16 (22)	14 (19)	31 (42)	28 (38)	25 (34)	44 (60)	40 (54)	35 (47)
- 24	20 (27)	18 (24)	16 (22)	35 (47)	32 (43)	28 (38)	49 (66)	44 (60)	39 (53)
7/16 - 14	28 (38)	25 (34)	22 (30)	49 (66)	44 (60)	39 (53)	70 (95)	63 (85)	56 (76)
-20	30 (41)	27 (37)	24 (33)	55 (75)	50 (68)	44 (60)	78 (106)	70 (95)	62 (84)
1/2 - 13	39 (53)	35 (47)	31 (42)	75 (102)	68 (92)	60 (81)	105 (142)	95 (129)	84 (114)
- 20	41 (56)	37 (50)	33 (45)	85 (115)	77 (104)	68 (92)	120 (163)	108 (146)	96 (130)
9/16 - 12	51 (69)	46 (62)	41 (56)	110 (149)	99 (134)	88 (119)	155 (210)	140 (190)	124 (168)
- 18	55 (75)	50 (68)	44 (60)	120 (163)	108 (146)	96 (130)	170 (230)	153 (207)	136 (184)
5/8 - 11	83 (113)	75 (102)	66 (89)	150 (203)	135 (183)	120 (163)	210 (285)	189 (256)	168 (228)
- 18	95 (129)	86 (117)	76 (103)	170 (230)	153 (207)	136 (184)	240 (325)	216 (293)	192 (260)
3/4 - 10	105 (142)	95 (130)	84 (114)	270 (366)	243 (329)	216 (293)	375 (508)	338 (458)	300 (407)
- 16	115 (156)	104 (141)	92 (125)	295 (400)	266 (361)	236 (320)	420 (569)	378 (513)	336 (456)
7/8 - 9	160 (217)	144 (195)	128 (174)	395 (535)	356 (483)	316 (428)	605 (820)	545 (739)	484 (656)
- 14	175 (237)	158 (214)	140 (190)	435 (590)	392 (531)	348 (472)	675 (915)	608 (824)	540 (732)
1 - 8	235 (319)	212 (287)	188 (255)	590 (800)	531 (720)	472 (640)	910 (1234)	819 (1110)	728 (987)
- 14	250 (339)	225 (305)	200 (271)	660 (895)	594 (805)	528 (716)	990 (1342)	891 (1208)	792 (1074)

NOTES:
① Capscrews threaded into aluminum may require reductions in torque of 30% or more.

SPECIFICATIONS

TABLE 12-3:EXCITATION DATA - 60 HZ - 1800 RPM

Model Number Low Volts	Exciter Field Resistance-Ohms @25°C	Exciter Field Volts F1 and F2 at Regulator No Load① 240/480 Volts	No Load Output Voltage With Fixed Excitation High Wye Connection②	
			12V DC	24V DC
431RSL4005	22.5	13.3	460	550
431RSL4007	22.5	14.2	450	545
432RSL4009	22.5	15.3	445	535
432RSL4011	22.5	13.5	460	550
432RSL4013	22.5	11.3	490	580
432RSL4015	22.5	13.1	440	530
432RSL4017	22.5	14.4	450	545
433RSL4019	22.5	16.9	430	525
433RSL4021	22.5	13.7	450	550
572RSL4024	23.0	16.1	440	520
572RSL4027	23.0	16.1	440	520
572RSL4028	23.0	17.5	425	510
572RSL4030	23.0	15.2	440	530
573RSL4032	23.0	15.0	445	530
573RSL4034	23.0	17.0	430	520
574RSL4036	23.0	18.2	420	510
574RSL4038	23.0	15.0	440	540
741RSL4042	22.0	14.8	445	540
741RSL4044	22.0	15.2	440	540
741RSL4046	22.0	15.6	430	540
742RSL4048	22.0	17.4	410	525
743RSL4050	22.0	13.7	460	565
743RSL4052	22.0	19.4	400	510
744RSL4054	22.1	18.6	400	510
744FSL4060	22.1	15.1	420	570
744FSL4062	22.1	16.6	410	535

Model Number Medium Volts	Exciter Field Resistance-Ohms @25°C	Exciter Field Volts F1 and F2 at Regulator No Load① 4160 Volts	No Load Output Voltage With Fixed Excitation Wye Connection③	
			12V DC	24V DC
573FSM4352	23.0	23.5	3100	4200
573FSM4354	23.0	20.3	3300	4400
574FSM4356	23.0	20.7	3200	4300
574FSM4358	23.0	17.3	3500	4600
741FSM4360	22.0	16.7	3600	4600
742FSM4364	22.0	15.4	3700	4700
742FSM4366	22.0	16.3	3600	4600
743FSM4368	22.1	17.7	3200	4600
743FSM4370	22.1	17.0	3500	4600

① For rated load exciter field volts - see generator nameplate.
② For low wye connection: divide value shown in table by 2.
For high delta connection: divide value shown in table by 1.732.
③ For delta connection: divide value shown in table by 1.732.

TABLE 12-4:EXCITATION DATA - 50 HZ - 1500 RPM

Model Number Low Volts	Exciter Field Resistance-Ohms @25°C	Exciter Field Volts F1 and F2 at Regulator No Load① 415 Volts	No Load Output Voltage With Fixed Excitation High Wye Connection②	
			12V DC	24V DC
431RSL4005	22.5	15.6	380	460
431RSL4007	22.5	17.1	370	450
432RSL4009	22.5	18.0	360	445
432RSL4011	22.5	16.0	380	455
432RSL4013	22.5	13.1	400	480
432RSL4015	22.5	18.7	360	440
432RSL4017	22.5	17.4	370	450
433RSL4019	22.5	20.7	340	430
433RSL4021	22.5	16.7	360	450
572RSL4024	23.0	19.8	360	430
572RSL4027	23.0	20.0	355	430
572RSL4028	23.0	21.2	370	430
572RSL4030	23.0	18.4	360	440
573RSL4032	23.0	18.9	360	440
573RSL4034	23.0	20.7	350	430
574RSL4036	23.0	21.6	345	425
574RSL4038	23.0	17.7	365	450
741RSL4042	22.0	17.8	360	450
741RSL4044	22.0	18.1	360	450
741RSL4046	22.0	18.7	350	445
742RSL4048	22.0	20.0	340	440
743RSL4050	22.0	16.1	370	470
743RSL4052	22.0	22.9	330	420
744RSL4054	22.1	22.6	320	420
744FSL4060	22.1	17.0	350	470
744FSL4062	22.1	19.5	330	440

Model Number Medium Volts	Exciter Field Resistance-Ohms @25°C	Exciter Field Volts F1 and F2 at Regulator No Load① 3300 Volts	No Load Output Voltage With Fixed Excitation High Wye Connection③	
			12V DC	24V DC
573FSM4352	23.0	21.2	2600	3400
573FSM4354	23.0	18.2	2700	3600
574FSM4356	23.0	18.4	2700	3600
574FSM4358	23.0	15.7	2800	3800
741FSM4360	22.0	15.4	3000	3800
742FSM4364	22.0	14.5	3000	3900
742FSM4366	22.0	15.6	2800	3800
743FSM4368	22.1	15.5	2800	3900
743FSM4370	22.1	15.5	2900	3800

① For rated load exciter field volts - see generator nameplate.
② For low wye connection: dviide value shown in table by 2.
For high delta connection: divide value shown in table by 1.732.
③ For delta connection: divide value shown in table by 1.732.

SPECIFICATIONS

TABLE 12-5:
RESISTANCE VALUES - MAIN WINDINGS
NOMINAL COLD (25°C) RESISTANCE IN OHMS

Base Model Low Voltage	Winding H-SG-	Main Stator①	Main Rotor
431RSL4005	430049	.0855	.153
431RSL4007	430048	.0648	.173
432RSL4009	430046	.0418	.190
432RSL4011	430018	.0410	.186
432RSL4013	430015	.0370	.189
432RSL4015	430017	.0260	.225
432RSL4017	430016	.0240	.226
433RSL4019	430042	.0140	.286
433RSL4021	430039	.0137	.297
572RSL4024	570078	.0132	.376
572RSL4027	570072	.0126	.398
572RSL4028	570080	.0092	.423
572RSL4030	570074	.0089	.426
573RSL4032	570075	.0074	.472
573RSL4034	570076	.0059	.507
574RSL4036	570077	.0049	.584
574RSL4038	570069	.0048	.601
741RSL4042	740040	.0045	.677
741RSL4044	740041	.0039	.708
742RSL4046	740042	.0036	.748
742RSL4048	740043	.0030	.776
743RSL4050	740051	.0023	.889
743RSL4052	740045	.0018	.979
744RSL4054	740046	.0015	1.100
744FSL4060	740306	.0026	.892
744FSL4062	740307	.0018	1.044

Base Model Medium Voltage	Winding H-SG-	Main Stator①	Main Rotor
573FSM4352	570213	1.030	.383
573FSM4354	570214	.854	.411
574FSM4356	570215	.568	.508
741FSM4360	740230	.277	.667
742FSM4364	740204	.233	.768
742FSM4366	740206	.151	.888
743FSM4368	740207	.127	.954
743FSM4370	740208	.101	1.053

① Main stator values shown are line to line on the high wye connection. For low wye connection divide value shown in table by 4.

TABLE 12-6:
RESISTANCE VALUES - EXCITER WINDINGS
NOMINAL COLD (25°C) RESISTANCE IN OHMS

Low Voltage	Exciter Stator (Field)	Exciter Rotor (Armature)	PMG Stator
430 Frames	22.5	0.022	2.1
570 Frames	23.0	0.045	2.1
741 Frames	22.0	0.043	2.1
742 Frames	22.0	0.043	2.1
743 Frames	22.0	0.043	2.1
744 Frames	22.1	0.048	2.1

Medium Voltage	Exciter Stator (Field)	Exciter Rotor (Armature)	PMG Stator
570 Frames	23.0	0.070	2.1
741 Frames	22.0	0.043	2.1
742 Frames	22.0	0.043	2.1
743 Frames	22.1	0.048	2.1

GENERATOR FORMULAS①

To Find	Known Values	Three Phase
KW	Volts, Current, Power Factor	$\frac{E \times I \times 1.73 \times PF}{1000} = kVA \times PF$
KVA	Volts, Current	$\frac{E \times I \times 1.73}{1000} = \frac{kW}{PF}$
RKVA	Volts, Current, Power Factor	$\frac{E \times I \times 1.73 \times \sqrt{1 - (PF)^2}}{1000}$
Hp—Engine Output	Generator kW, Generator Eff. Radiator Fan Horsepower Battery Charging Generator hp	$\frac{KW}{Efficiency \times .746} + \frac{Rad\ Cooling\ Fan}{hp} + Bat.\ Chg.\ Gen.\ hp$
KW—Required for Motor	Motor hp, Eff.	$\frac{Hp \times .746}{Efficiency}$
KVA—Required for Motor	Motor hp, Eff., Power Factor	$\frac{Hp \times .746}{Efficiency \times PF}$
Amps	Hp, Volts	$\frac{Hp \times 746}{1.73 \times E \times Efficiency \times PF}$
Amps	KW, Volts, Power Factor	$\frac{KW \times 1000}{E \times 1.73 \times PF}$
Amps	KVA, Volts	$\frac{KVA \times 1000}{E \times 1.73}$
Frequency	Rpm, Poles	$\frac{Rpm \times Poles}{2 \times 60}$
Poles	Frequency, rpm	$\frac{2 \times 60 \times Frequency}{rpm}$
Rpm	Frequency, Poles	$\frac{2 \times 60 \times Frequency}{Poles}$

① *E = Volts*
I = Current (Amps)
PF = Power Factor

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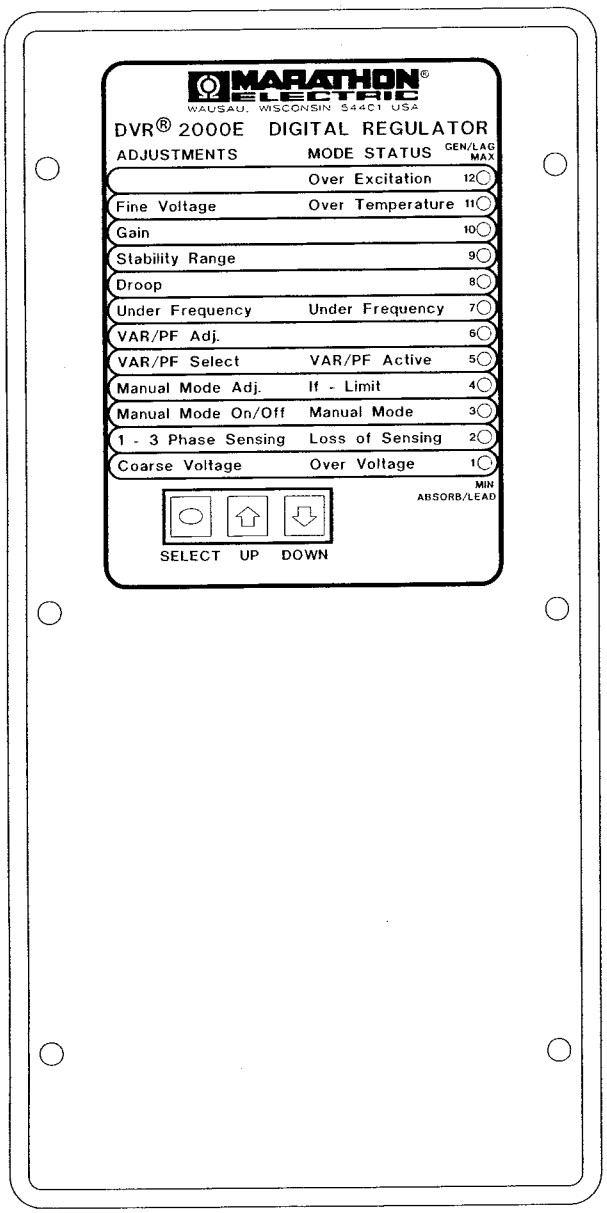


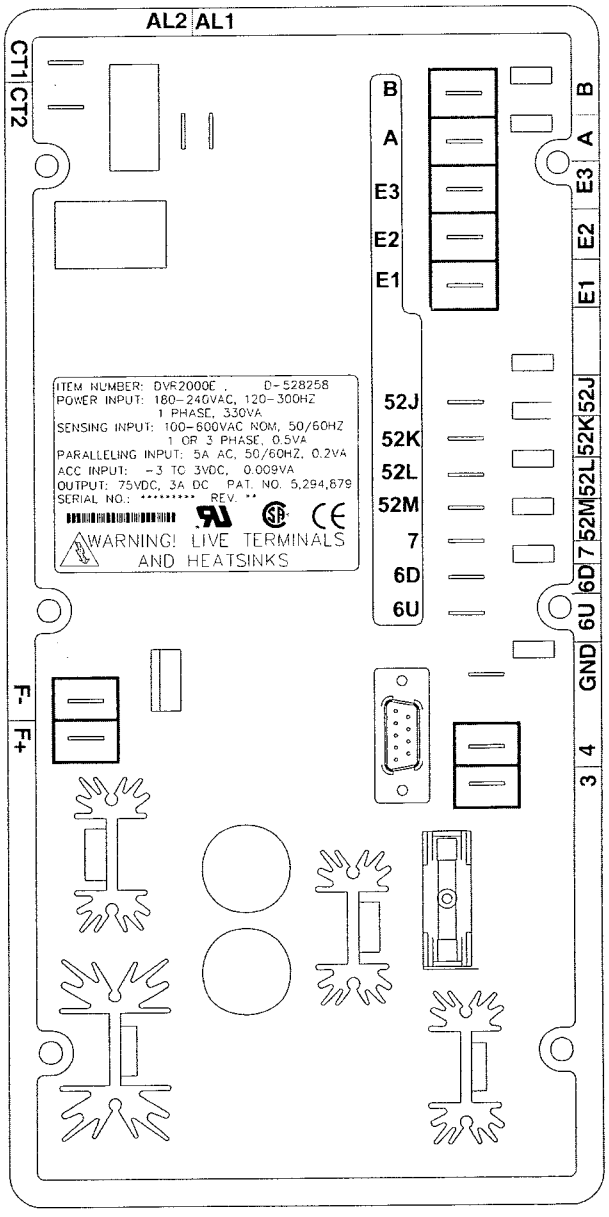
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DVR®2000E

Installation, Operation, and Maintenance Manual







MARATHON® ELECTRIC

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INTRODUCTION

This manual provides information concerning the operation and installation of the DVR2000E, Digital Voltage Regulator. To accomplish this, the following is provided:

- General Information and Specifications
- Human-Machine Interface
- Functional Description
- Installation
- Software for Windows Operating System
- Software for the Palm Operating System Platform
- Maintenance and Troubleshooting

WARNING!

DVR2000E presents an electric shock risk. Terminals and heat sinks are live at potentially lethal voltages. This high voltage may cause electrical shock that could result in injury or death.

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures presented in this manual.

CAUTION

Meggers and high potential test equipment should be used with extreme care. Incorrect use of such equipment could damage components contained in the device.

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice.

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SECTION 1 • GENERAL INFORMATION

Section 1

GENERAL

The DVR2000E is an electronic, solid-state, microprocessor-based control device. The DVR2000E regulates the output voltage of a brushless, ac generator by controlling the current into the generator exciter field. Input power to the DVR2000E is from a multi-pole, high-frequency, permanent magnet generator (PMG).

The DVR2000E is supplied in an encapsulated package designed for behind-the-panel mounting. The DVR2000E is held in place by thread-forming screws that thread into its plastic shell. Front panel indicators (LEDs) annunciate regulator status and system conditions. DVR2000E connections are made through quarter-inch, quick-connect terminals on the rear panel. A 9-pin DB-9 type connector on the rear panel provides communication between the DVR2000E and an IBM compatible PC.

FEATURES

DVR2000E units have the following features and capabilities.

- Four control modes: automatic voltage regulation (AVR), manual or field current regulation (FCR), power factor (PF) regulation, and reactive power (Var) regulation.
- Programmable stability settings.
- Soft start control with an adjustable time setting in AVR control mode.
- Overexcitation (OEL) limiting in AVR, Var, and PF control modes.
- Underfrequency (volts/hertz) regulation.
- Crowbar circuitry protects the field.
- Overtemperature protection.
- Three-phase or single-phase generator voltage (RMS) sensing/regulation in AVR mode.
- Single-phase generator current sensing for metering and regulation purposes.
- Field current and field voltage sensing.
- Four contact sensing inputs for system interface.
- One common output relay for alarm indication and trip functions.
- Six protection functions (overexcitation shutdown, generator overvoltage shutdown, DVR overtemperature shutdown, loss of generator sensing shutdown, overexcitation limiting and crowbar shutdown).
- Generator paralleling with reactive droop compensation and reactive differential compensation.
- Front-panel human-machine interface (HMI) indicates system and DVR2000E status and gives the ability to make setting changes at the front panel.
- Rear RS-232 communication port for personal computer communication using MARATHON-DVR2000E-32 Windows® based software for fast, user-friendly, setup and control.

SPECIFICATIONS

DVR2000E electrical and physical specifications are listed in the following paragraphs. The adjustment increments shown apply to the PC software. Adjustment increments for the Front Panel Controls are listed in Section 2.

Operating Power

Single-Phase:	180 to 240 Vac
Frequency Range:	200 to 360 Hz
Burden:	350 VA
Terminals:	3, 4

Generator Voltage Sensing

Type:	1-phase/3-phase, 4 ranges, 50/60 Hz
Terminals:	E1, E2, E3
Burden:	<1 VA per phase
Range 1:	120 Vac (100 to 140 Vac)
Range 2:	240 Vac (200 to 280 Vac)
Range 3:	480 Vac (400 to 560 Vac)
Range 4:	600 Vac

Generator Current Sensing

Type:	1-phase (BØ), 50/60 Hz
Rating:	5 Aac maximum continuous
Burden:	<0.1 VA
Terminals:	CT1, CT2

Contact Input Circuits

Type:	Dry Contact
Interrogation Voltage:	13 Vdc
Terminals	
Unit/Parallel Control:	52L, 52M
Raise:	6U, 7
Lower:	6D, 7
Var/PF Enable	52J, 52K

Common Alarm Output

Type:	Form A
Rated Load:	7 Aac/7 Adc continuous
Make:	30 Aac/30 Adc, carry for 0.2 sec
Break:	7 Aac/0.1 Adc
Operating Voltage:	240 Vac/250 Vdc maximum
Terminals:	AL1, AL2

Field Output

Continuous Rating:	75 Vdc, 3.0 Adc
10 Second Forcing Rating	
200 Vac Power Input:	150 Vdc, 7.5 Adc
Field Resistance:	18 Ω minimum
Terminals:	F+, F-

AVR Operating Mode

Adjustment Range:	See generator voltage sensing
Voltage Regulation:	±0.25% over load range at rated power factor and constant generator frequency.
Temperature Drift:	±0.5% for a 40°C change
Response Time:	≤1 cycle

Underfrequency (V/Hz)

Characteristic:	Slope from 1 to 3PU is adjustable in 0.01 increments.
Range:	40 to 65 Hz
Increment:	0.01 Hz

FCR (Manual) Operating Mode

Adjustment Range:	0 to 3 Adc
Increment:	0.01 A

Var Operating Mode (Optional)

Adjustment Range:	100% to –100%
Increment:	0.1%

PF Operating Mode (Optional)

Adjustment Range:	0.6 lead to 0.6 lag
Increment:	0.001

Parallel Compensation

Modes:	Reactive Droop and Reactive Differential (cross-current)*

Droop

Adjustment Range:	0 to 10%
Increment:	0.01%

*Burden can exceed 1 VA if external resistors are added to the CT circuit.

Communication Port

Interface:	Full Duplex RS-232
Connection:	DB-9 connector on rear panel
Baud:	4800
Data Bits:	8
Parity:	None
Stop Bit:	1

Field Overvoltage Protection

Pickup:	0 -250 Vdc
Time Delay:	15 seconds (fixed)

Field Overcurrent Protection

Pickup

Adjustment Range:	0 to 7.5 Adc
Increment:	0.001 Adc

Time Delay

Adjustment Range:	0 to 10 seconds
Increment:	1 second

Generator Overvoltage Protection

Pickup

Range:	105 to 120% of setpoint
Increment:	1.0%

Time Delay

Fixed Setting:	0.75 seconds

Section 1

Soft-Start Function

Time Adjust Range:	1 to 120 seconds
Increment:	1 second

Analog (Auxiliary) Input

Voltage Range:	-3 Vdc to +3 Vdc
Setpoint Range:	-30% to +30% shift
Burden:	1 kΩ
Terminals:	A, B

Metering

Accuracy of all metering values assumes 25°C, 50/60 Hz and less than 20% THD.

Generator Voltage	
Range:	10 V to 79 kV
Accuracy:	0.5%
Generator Current	
Range:	0.1 to 5,000 A (5 A CTs)
Accuracy:	0.5%
Frequency	
Range:	40 to 65 Hz
Accuracy:	0.2 Hz
Field Voltage	
Range:	0 to 200 Vdc
Accuracy:	5.0%
Field Current	
Range:	0 to 8.0 Adc
Accuracy:	0.5%
Power (Apparent, Real and Reactive)	
Range:	0 to 99 MVA, MW and MVar
Accuracy:	3.0%
Power Factor	
Range:	-1.0 to –0.6, +0.6 to +1.0
Accuracy:	0.02
Phase Angle	
Range:	0 to 360°
Accuracy:	2.0°

Environment

Operating Temp.:	-40°C to +70°C (-40°F to +158°F)
Storage Temp.:	-40°C to +85°C (-40°F to +185°F)

Type Tests

Shock:	20 Gs in 3 perpendicular planes
Vibration:	1 G at 5 to 26 Hz 0.036" double amplitude (27 to 52 Hz) 5 Gs at 53 to 500 Hz
Salt Fog:	Tested per MIL-STD-810E

Physical

Weight:	1.52 lb. (690 g)

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SECTION 2 • HUMAN-MACHINE INTERFACE

GENERAL

The DVR2000E human-machine interface (HMI) consists of front panel controls and indicators and a rear panel communication port.

FRONT PANEL CONTROLS AND INDICATORS

Section 2

DVR2000E front panel controls and indicators consist of 12 red LEDs and three pushbuttons. Figure 2-1 illustrates the front panel controls and indicators of the DVR2000E. The LEDs indicate control mode and status conditions and are also used when adjusting settings at the front panel.

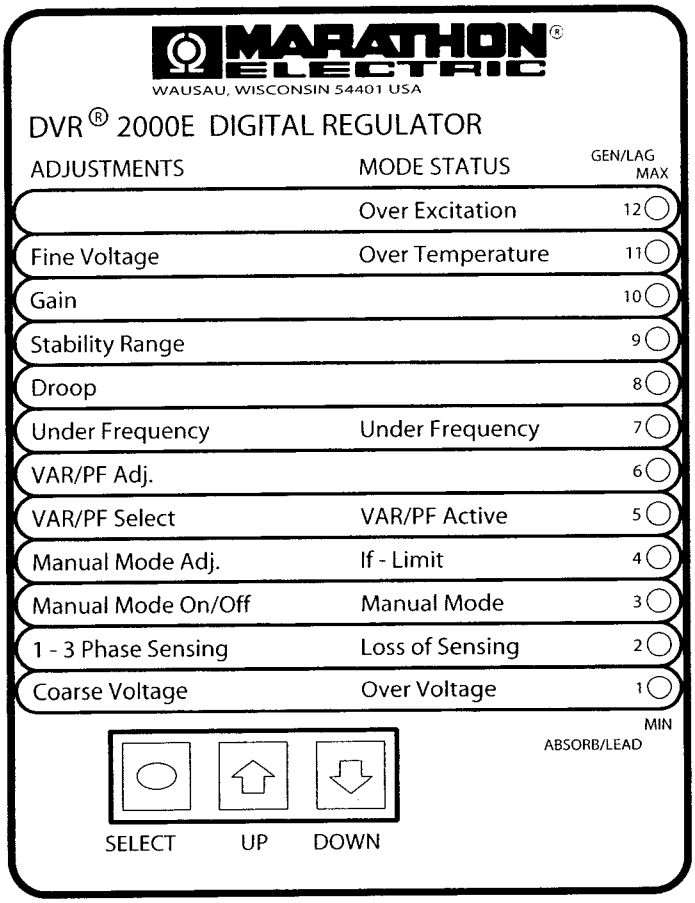


Figure 2-1. DRV2000E Front Panel Indicators

Table 2-1. DVR2000E Front Panel Control Descriptions

Control	Description
SELECT	This pushbutton selects a function for adjustment. Successive presses of the SELECT pushbutton scrolls through the list of DVR2000E functions to be adjusted.
UP	This pushbutton increases the setting level of the function being adjusted.
DOWN	This pushbutton decreases the setting level of the function being adjusted.

Table 2-2. DVR2000E Front Panel Mode Status Indicator Descriptions

Indicator	Description
Over Excitation LED #12	This LED blinks rapidly when the Overexcitation Protection feature is enabled and the field voltage exceeds the setpoint (80 V default) for 15 seconds. The DVR2000E will shut down when an overexcitation condition is detected. The Over Excitation LED blinks for 5 seconds when the DVR2000E is powered up following an overexcitation condition.
Over Temperature LED #11	This LED blinks rapidly when the internal temperature of the DVR2000E has exceeded its limit and causes the unit to shut down.
Under Frequency LED #7	This LED blinks rapidly during an under frequency condition.
Var/PF Active LED #5	This LED blinks rapidly when operating in Var or Power Factor mode.
If – Limit LED #4	This LED blinks rapidly when the field current exceeds the programmed overexcitation limit. It will continue to flash until the overexcitation condition ceases or the overexcitation time delay expires and the DVR2000E shuts down. The Overexcitation Limiting LED flashes for 5 seconds when the DVR2000E is powered up following an overexcitation limiting condition.
Manual Mode LED #3	This LED blinks rapidly when operating in Manual mode.
Loss of Sensing LED #2	This LED blinks rapidly when a loss of generator sensing voltage is detected. The DVR2000E will shut down. The Loss of (Generator) Sensing LED flashes for 5 seconds when the DVR2000E is powered up following shutdown for loss of generator sensing condition.
Over Voltage LED #1	This LED blinks rapidly when the generator output voltage exceeds the setpoint for 0.75 seconds. The DVR2000E will shut down when a generator overvoltage condition is detected. The (Generator) Overvoltage LED flashes for 5 seconds when the DVR2000E is powered up following a generator overvoltage condition.

INITIAL ADJUSTMENTS

CAUTION

Read and understand the operation of the individual adjustments before attempting any initial adjustments.

Before starting the generator, the procedures in the following paragraphs should be performed.

Remove the 5 ampere fuse before starting the generator for the first time. Perform all preliminary engine governor adjustments without the regulator energized.

After initial governor adjustments are complete, reinstall the 5 ampere fuse and connect only the power input leads or PMG leads to the regulator. Remove all other regulator connections that may be present and temporarily insulate them.

Start and run the generator at rated speed. The regulator will perform the self-test and enter a shutdown mode. At this time, initial adjustments can be made. To do this, step through each adjustment using the "SELECT" button. For each adjustment, press the "UP" or "DOWN" button to obtain the desired level on the LED bar graph.

After the initial adjustments are made, shut down the generator and connect the remaining regulator leads. The generator may be started and final adjustments may be performed on the regulator.

MAKING SETTINGS CHANGES

The following paragraphs describe how the HMI is used to make setting changes.

Front Panel Operation

The LEDs indicate control mode and status conditions and are also used when adjusting settings at the front panel. Repeatedly pressing the "SELECT" button steps through the various adjustments, starting with the "Course Voltage" adjustment and progressing through to the "Fine Voltage" adjustment. The next press of the "SELECT" button exits the adjustment mode.

When in the adjustment mode, only the adjustment LEDs will be lit. All mode status LEDs will be turned off. Adjustment LEDs are of two types. The first type is the LED that indicates the function being adjusted. This LED blinks slowly (approximately once per second). The second type is the LED that indicates the level of adjustment. This LED is on steady. The level of adjustment is changed by pressing the "UP" or "DOWN" button. When an adjustment level LED (on steady) overlaps the function LED (slow blinking), the LED will remain in the slow blinking mode. If no button is pressed for a period of one minute, the regulator saves the settings and exits the adjustment mode. If regulator power is interrupted before the automatic save feature is commanded, that level of adjustment will be lost.

When the regulator is not in the adjustment mode and either the "UP" or "DOWN" button is pressed, the regulator enters the "Fine Voltage" adjustment mode and changes the generator fine voltage set point by 0.1V. Successive presses of the "UP" or "DOWN" button shall continue to adjust the fine voltage setting. Pressing the "SELECT" button causes the regulator to exit the adjustment mode. Mode status LEDs blink approximately twice per second.

Table 2-3. DVR2000E Front Panel Adjustment Indicator Descriptions

Indicator	Description
Fine Voltage LED #11	This LED blinks slowly when the "Fine Voltage" level is selected for adjustment via the front panel push buttons.
Gain LED #10	This LED blinks slowly when the "Gain" adjustment is selected for fine tuning of loop gain via the front panel push buttons.
Stability Range LED #9	This LED blinks slowly when selecting the desired "Stability Range" via the front panel push buttons.
Droop LED #8	This LED blinks slowly when the "Droop" percentage level is selected for adjustment via the front panel push buttons.
Under Frequency LED #7	This LED blinks slowly when the "Under Frequency" knee point is selected for adjustment via the front panel push buttons.
VAR/PF Adjust LED #6	This LED blinks slowly when the level of the programmed mode (VAR or Power Factor) is selected for adjustment via the front panel push buttons (DVR2000EC only).
VAR/PF Select LED #5	This LED blinks slowly when selecting the programmed mode (VAR, Power Factor, or none(AVR)) via the front panel push buttons. When in this adjustment mode, LED #1 is on solid for none(AVR), LED #2 is on solid for Power Factor mode, and LED #3 is on solid for VAR mode (DVR2000EC only).
Manual Mode Adj. LED #4	This LED blinks slowly when the "Manual Mode" (field current) regulation set point is selected for adjustment via the front panel push buttons.
Manual Mode On/ Off LED #3	This LED blinks slowly when selecting or deselecting "Manual Mode" (field current regulation) as the active operating mode via the front panel pushbuttons. When in this adjustment mode, LED #1 is on if Manual Mode is off, LED #2 is on if Manual Mode is on.

1 - 3 Phase Sensing LED #2	This LED blinks slowly when selecting single or three phase sensing via the front panel push buttons. When in this adjustment mode, LED #1 is on if single phase sensing is selected, LED #3 is on if three phase sensing is selected.
Coarse Voltage LED #1	This LED blinks slowly when the "Coarse Voltage" level is selected for adjustment via the front panel push buttons.

Setting Level Indication

Indication of a setting level is provided by the 12 front panel LED indicators. The upper limit of a setting range is represented by the top LED which is labeled GEN/LAG and MAX. The lower limit of a setting range is represented by the bottom LED which is labeled MIN and ABSORB/LEAD. The setting range for each LED is summarized in Tables 2-4 through 2-15. LEDs in the tables are numbered from 1 to 12 with 1 being the lowermost LED (labeled MIN/ABSORB/LEAD) and 12 being the uppermost LED (labeled GEN /LAG/MAX.

Table 2-4. Coarse Voltage Adjust Setting Ranges

Coarse Voltage – LED 1 Blinking Slowly Maximum Adjustment Range Increment: 6 Vac				
	Increase		Decrease	
LED	Minimum Value	Maximum Value	Minimum Value	Maximum Value
12	563	600	558	600
11	521	557	516	552
10	479	515	474	510
9	437	473	432	468
8	395	431	390	426
7	353	389	348	384
6	311	347	306	342
5	269	305	264	300
4	227	263	222	258
3	185	221	180	216
2	143	179	138	174
1	95	137	95	132

Table 2-5. Sensing Mode (Single-phase/Three-phase) Select

Single-phase/Three-phase select – LED #2 Blinking Slowly	
LED	MODE
12	N/A
11	N/A
10	N/A
9	N/A
8	N/A
7	N/A
6	N/A
5	N/A
4	N/A
3	Three-phase
2	N/A
1	Single-phase

Table 2-6. Manual Mode (On/Off) Select

Manual Mode On/Off – LED 3 Blinking Slowly	
LED	MODE
12	N/A
11	N/A
10	N/A
9	N/A
8	N/A
7	N/A
6	N/A
5	N/A
4	N/A
3	N/A
2	ON
1	OFF

Table 2-7. Manual Mode (If – Limit) Adjustment Ranges

Manual Mode Adjust – LED 4 Blinking Slowly Adjustment Range: 0 to 3 Adc Increment: 0.01 Adc		
LED	Minimum Value	Maximum Value
12	2.75	3
11	2.50	2.74
10	2.25	2.49
9	2.00	2.24
8	1.75	1.99
7	1.50	1.74
6	1.25	1.49
5	1.00	1.24
4	0.75	0.99
3	0.50	0.74
2	0.25	0.49
1	0	0.24

Table 2-8. On-Line Operating Mode (AVR (OFF)/VAR/PF) Select *

AVR (OFF) / VAR / PF Select – LED #5 Blinking Slowly	
LED	MODE
12	N/A
11	N/A
10	N/A
9	N/A
8	N/A
7	N/A
6	N/A
5	N/A
4	N/A
3	Var
2	PF
1	AVR

* Var/PF control is available only on DVR2000EC.

Table 2-9. VAR Control Adjustment Ranges *

VAR Control Adjust – LED 6 Blinking Slowly Maximum Adjustment Range: –100% (absorb) to +100% (generate) Increment: 1.0%		
LED	Minimum Value †	Maximum Value †
12	84	100
11	67	83
10	51	66
9	34	50
8	17	33
7	1	16
6	-16	0
5	-33	-17
4	-49	-34
3	-66	-50
2	-83	-67
1	-100	-84

* Var/PF control is available only on DVR2000EC.

† Minimum and maximum values may differ from the Table 2-9 values if the value has been changed in MARATHON-DVR2000E-32 software. MARATHON-DVR2000E-32 software has 0.5 percent resolution compared to the 1.0 percent resolution of the HMI.

Table 2-10. Power Factor Control Adjustment Ranges *

Power Factor Control Adjust – LED 6 Blinking Slowly Maximum Adjustment Range: +0.6 (lag) to –0.6 (lead) Increment: 0.01		
LED	Minimum Value †	Maximum Value †
12	0.66	0.60
11	0.73	0.67
10	0.80	0.74
9	0.86	0.81
8	0.93	0.87
7	1.0	0.94
6	-0.94	-0.99
5	-0.87	-0.93
4	-0.80	-0.86
3	-0.74	-0.79
2	-0.67	-0.73
1	-0.60	-0.66

* Var/PF control is available only on DVR2000EC.

† Minimum and maximum values may differ from the Table 2-10 values if the value has been changed in MARATHON-DVR2000E-32 software. MARATHON-DVR2000E-32 software has 0.001 resolution compared to the 0.01 resolution of the HMI.

Table 2-11. Underfrequency Adjustment Ranges

Underfrequency Adjust – LED 7 Blinking Slowly Maximum Adjustment Range: 40 to 65 Hz Increment: 0.1 Hz		
LED	Minimum Value	Maximum Value
12	63.0	65.0
11	60.9	62.9
10	58.8	60.8
9	56.7	58.7
8	54.6	56.6
7	52.5	54.5
6	50.5	52.4
5	48.4	50.4
4	46.3	48.3
3	44.2	46.2
2	42.1	44.1
1	40.0	42.0

Table 2-12. Droop Adjustment Ranges

Droop Adjust – LED 8 Blinking Slowly Adjustment Range: 0 to 10% Increment: 0.25%		
LED	Minimum Value *	Maximum Value *
12	9.25	10.00
11	8.5	9.00
10	7.75	8.25
9	6.75	7.50
8	6.00	6.50
7	5.25	5.75
6	4.25	5.00
5	3.5	4.00
4	2.75	3.25
3	1.75	2.5
2	1	1.5
1	0	0.75

* Minimum and maximum values may differ from the Table 2-12 values if the value has been changed in MARATHON-DVR2000E-32 software. MARATHON-DVR2000E-32 software has 0.01% resolution compared to the 0.25 percent resolution of the HMI.

Table 2-13. Stability Range Selection Settings

Stability Range Select – LED 9 Blinking Slowly Adjustment Range per LED: 1		
Frame/Poles	LED	Range Selected
	12	N/A
	11	N/A
	10	N/A
	9	N/A
Programmable	8	21
1,000/6	7	7
740/6	6	6
1,000/4	5	5
740/4	4	4
570/4	3	3
430/4	2	2
360/4	1	1

Table 2-14. Gain Adjustment Ranges

Gain Adjust – LED 10 Blinking Slowly Maximum Adjustment Range: 0.5 to 4.5 kg for AVR and 0 to 100 kg for FCR				
When the unit is operating in AVR, PF, and var modes, gain adjustments are made to AVR kg. When in FCR mode, gain adjustments are made to FCR kg. Front Panel increments: AVR kg = 0.01 FCR kg = 0.1				
	Minimum Value *		Maximum Value *	
LED	AVR	FCR	AVR	FCR †
12	4.17	11.1	4.50	12
11	3.84	10.1	4.16	11
10	3.50	9.1	3.83	10
9	3.17	8.1	3.49	9
8	2.84	7.1	3.16	8
7	2.50	6.1	2.83	7
6	2.17	5.1	2.49	6
5	1.84	4.1	2.16	5
4	1.50	3.1	1.83	4
3	1.17	2.1	1.49	3
2	0.85	1.1	1.16	2
1	0.5	0	0.84	1

* Minimum and maximum values may differ from the Table 2-14 values if the gain value has been changed in MARATHON-DVR2000E-32 software.

† MARATHON-DVR2000E-32 software allows a maximum FCR kg setting of 1,000 kg. A kg setting of 12 or more entered in MARATHON-DVR2000E-32 software will be reduced to 12 with the first push of the HMI "DOWN" pushbutton when adjusting FCR kg via the front panel.

Table 2-15. Fine Voltage Adjust Setting Ranges

Fine Voltage Adjust – LED #11 Blinking Slowly Maximum Adjustment Range: -15% to +15% Increment: 0.1V
The adjustment range for Fine Voltage Adjust is based on the fine voltage adjustment band setting. The default adjustment range is –10% to +10%. See Section 5, MARATHON-DVR2000E-32 Software for Windows® OS, Setting Definitions, Setting Adjustments for information about the Fine Voltage Adjustment Band Setting.

COMMUNICATION PORT

A communication port is located on the rear panel and consists of a female RS-232 (DB-9) connector. The communication port serves as an interface for programming (setup) of the DVR2000E. Figure 2-2 illustrates the location of the communication port.

Programming requires a standard 9-pin serial communication cable connected between the DVR2000E and an IBM-compatible PC or handheld computer operating with MARATHON-DVR2000E-32 software. MARATHON-DVR2000E-32 is a Windows® 98/NT based communication software package that is supplied with the DVR2000E. A detailed description of MARATHON-DVR2000E-32 software is provided in Section 5, MARATHON-DVR2000E-32 Software.

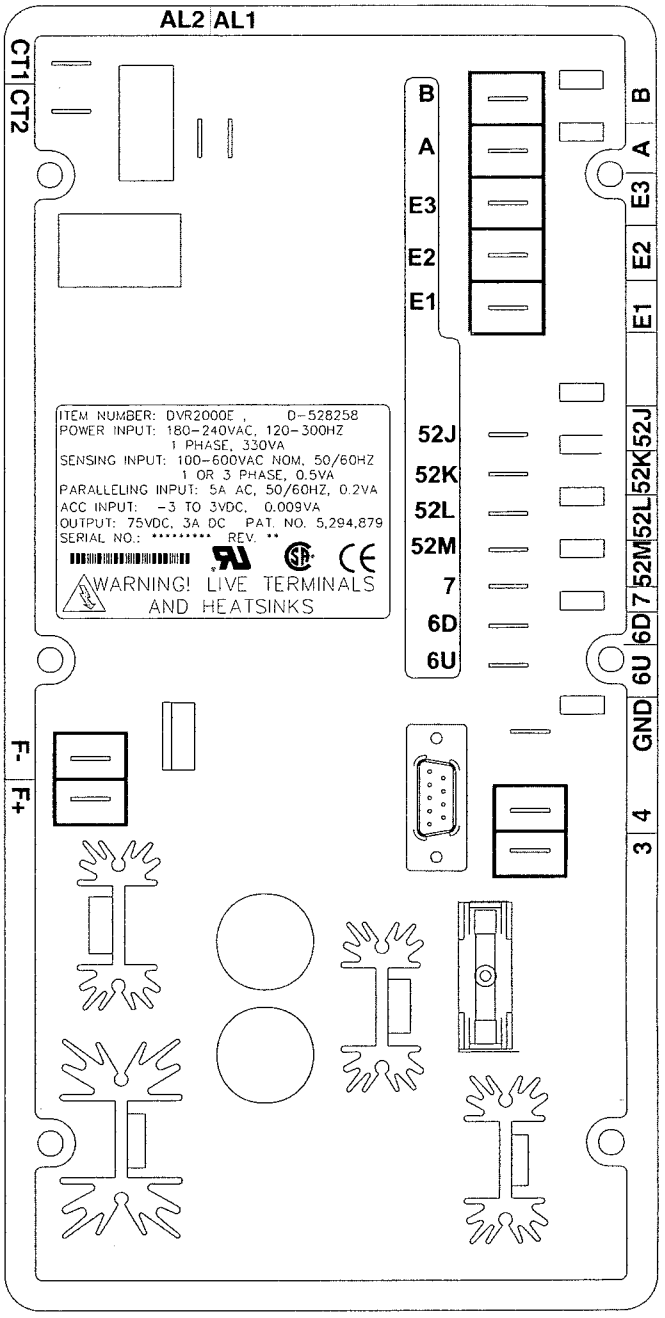


Figure 2-2. DVR2000E Communication Port Location

SECTION 3 • FUNCTIONAL DESCRIPTION

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Section 3

SECTION 3 • FUNCTIONAL DESCRIPTION

INTRODUCTION

This section describes how the DVR2000E functions and explains its operating features. To ease understanding, DVR2000E functions are illustrated in the block diagram of Figure 3-1. A detailed description of each function block is provided in the paragraphs under the heading of DVR2000E Function Blocks.

DVR2000E operating features include four operating modes, four protective functions, startup provisions, reactive droop compensation, underfrequency compensation, and an auxiliary analog input. A detailed description of each operating feature is provided in the paragraphs under the heading of DVR2000E Operating Features.

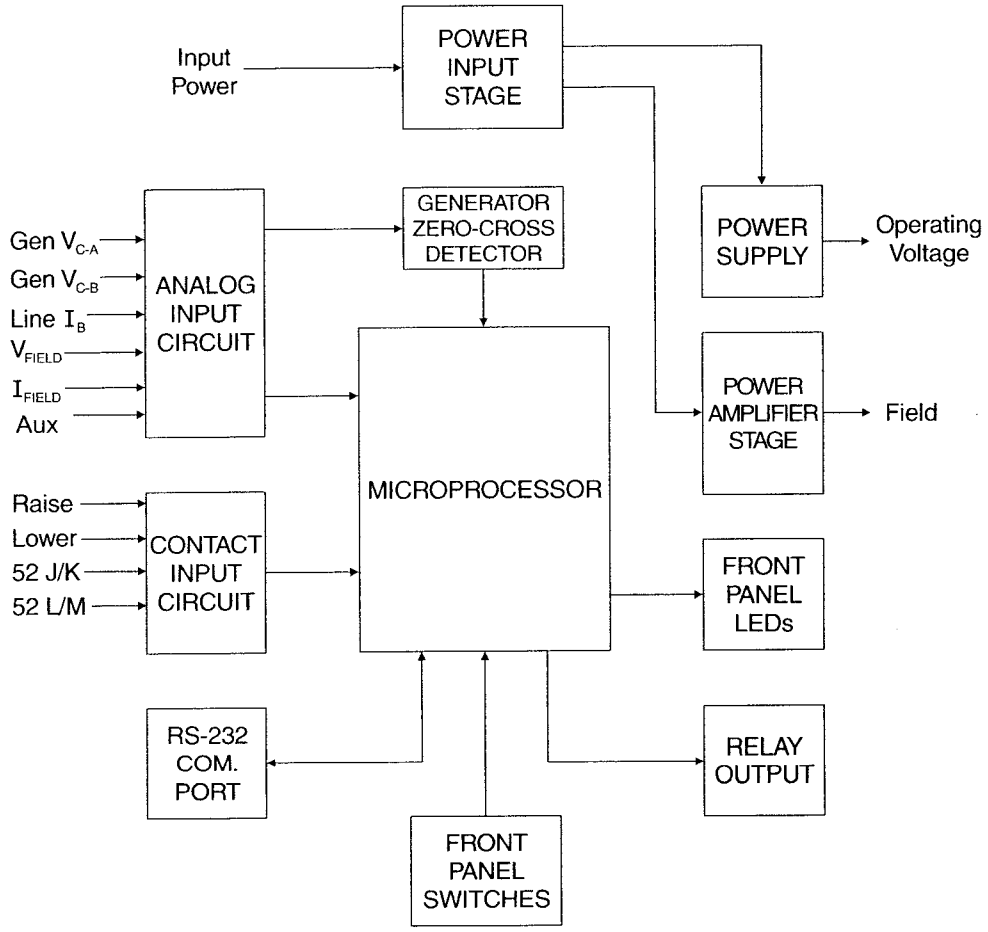


Figure 3-1. Simplified Block Diagram

DVR2000E FUNCTION BLOCKS

The following paragraphs describe each of the function blocks illustrated in Figure 3-1. The function of each block is explained along with the operation of all function block inputs and outputs.

Analog Inputs

Six analog voltage and current inputs may be sensed and brought to the DVR2000E input.

Generator Voltage

Generator voltage is monitored at terminals E1 (A-phase), E2 (B-phase), and E3 (C-phase). Nominal voltages of up to 600Vac may be sensed at these terminals. Voltage applied to these inputs is scaled and conditioned before being applied to the input of the ADC. The voltage signal from phase C and A (V_{C-A}) of the generator is used by the ADC to calculate the rms value of generator voltage across phases C and A. Likewise, the voltage signal from phase C and B (V_{C-B}) of the generator is used by the ADC to calculate the rms value of generator voltage across phases C and B. The rms value of generator phase B to phase A voltage (V_{B-A}) is calculated by the microprocessor from the phase C to phase A signal (V_{C-A})and the phase C to phase B (V_{C-B}) signal.

Additionally, the generator phase C to phase A (V_{C-A}) signal is applied to a filtered zero cross detector circuit. This signal is applied to the microprocessor and is used to calculate generator frequency.

Phase B Line Current

The phase B line current (I_B) signal is developed through a customer supplied current transformer (CT) and monitored through terminals CT1 and CT2. Current up to 5 amperes rms may be monitored at these terminals. The current monitored at these terminals is scaled and conditioned by an internal current transformer and active circuitry for use by the ADC. The signal applied to the ADC is used to calculate the rms value of phase B line current.

Additionally, the phase angle between phase B line current and phase C to phase A generator voltage is calculated for use during Droop and Var/Power Factor operation.

CAUTION

The DVR2000E CT connections are reversed from the DVR2000.

Field Voltage (V_{FIELD})

Voltage across the regulator field output terminals, F+ and F-, is monitored, scaled, and conditioned before being applied to the ADC. This signal is used to calculate the dc value of field voltage for use in system protection.

Field Current (I_{FIELD})

Current through the main power output switch is converted to a proportional voltage level. This voltage signal is scaled and conditioned before being applied to the input of the ADC. The result is used to calculate the dc value of field current for use in the Manual mode of operation as well as protection of the system.

Analog (Auxiliary) Input

CAUTION

If the DC voltage is removed from the Analog (Auxiliary) Input, the operating setpoint will return to the original value.

This input allows adjustment of the DVR-2000E regulation setpoint by the application of a positive or negative dc voltage across terminals A and B. Voltage up to +3 Vdc may be applied at this input. The circuit induces a 1,000-ohm burden on the dc source. The application of a +3 Vdc signal corresponds to a +30 percent change in setpoint.

Contact Input Circuits

Four contact input circuits powered from an internal 13 Vdc supply provide input control from user-supplied contacts.

Raise

Closing a contact across terminals 6U and 7 causes the active operating setpoint to increase. This function is active as long as the contact is closed.

Lower

Closing a contact across terminals 6D and 7 causes the active operating setpoint to decrease. This function is active as long as the contact is closed.

Var/Power Factor Control (52J/K) Option

Closing a contact across terminals 52J and 52K disables var/power factor control. An open contact enables the DVR2000E(C) to control the generator reactive power in either the var or the power factor mode. The contact has no effect when this option is not present. For more information, refer to the Parallel Generator Compensation (52L/M) contact input.

Parallel Generator Compensation (52L/M)

Closing a contact across terminals 52L and 52M disables parallel operation. An open contact enables parallel operation and the DVR2000E operates in reactive droop compensation mode.

If the Var/Power Factor Control option is present, the 52J/K input has priority. Therefore, if the 52J/K and the 52L/M inputs are both open, the system operates in var/power factor mode.

Communication Port

The communication port provides the interface for user programming (setup) of the DVR2000E. Connection is made to the female RS-232 (DB-9) connector with a user-supplied, standard 9-pin cable. The communication port is optically isolated and is powered from a transformer-isolated supply.

Microprocessor

The microprocessor is the heart of the DVR2000E and performs measurement, computation, control, and communication functions by the use of its embedded programming and the nonvolatile settings stored in its memory.

Power Input Stage

Input power is applied to terminals 3 and 4 from the PMG. It is rectified and filtered before being applied to the power amplifier and the power supply. Input power is single-phase in the range of 180 to 240 Vac at a frequency of 200 to 360 hertz.

Power Supply

The internal switch-mode power supply receives power from the power input stage and supplies power at the required dc voltage levels to the internal circuitry of the DVR2000E.

Power Amplifier Stage

The power amplifier receives power from the power input stage and supplies a controlled amount of power to the exciter field via terminals F+ and F-. The amount of power supplied to the exciter field is based on gating pulses received from the microprocessor. The power amplifier uses a solid state power switch to provide the required power to the exciter field. Power amplifier output to the field is rated up to 75 Vdc at 3 Adc continuous and 150 Vdc at 7.5 Adc for 10 seconds.

Front Panel Indicators

Twelve front panel LED indicators light to indicate various operating modes, protective functions, and adjustments. Section 2, Human-Machine Interface provides more information about the front panel indicators.

Front Panel Switches

Changes to settings can be made at the front panel using the three pushbutton switches. These push-buttons are labeled Select, Up, and Down. Section 2, Human-Machine Interface provides more in-formation about the front panel switches.

Relay Output

A common alarm output contact is provided through terminals AL1 and AL2. This normally open, form A contact annunciates alarm or generator trip conditions and closes in the event of a protective shutdown or transfer. The relay output is non-latching.

DVR2000E OPERATING FEATURES

The following paragraphs describe the characteristics of each DVR2000E operating feature.

Operating Modes

The DVR2000E provides up to four modes of operation selectable through Windows® or Palm OS® communication software. Automatic voltage regulation mode and Manual mode are standard features. Var and Power Factor modes are an option.

Automatic Voltage Regulation Mode

In Automatic Voltage Regulation (AVR) mode, the DVR2000E regulates rms generator output voltage. This is accomplished by sensing generator output voltage and adjusting dc output excitation current to maintain voltage at the regulation setpoint. The regulation setpoint is adjusted by the Raise and Lower contact inputs, front panel switches, or through Windows® or Palm OS® communication software. The regulation point may also be modified by the Droop function or the Underfrequency function under certain conditions.

Manual Mode

In Manual mode, also known as Field Current Regulation (FCR) mode, the DVR2000E maintains dc excitation current at a set level. The current-level setpoint is adjustable from 0 to 3 Adc by the Raise and Lower contact inputs, front panel switches, or through Windows® or Palm OS® communication software.

WARNING!

The Manual mode excitation level must be evaluated prior to enabling this feature. If the level of excitation current is inappropriate for the generator, severe damage to the generator may occur.

For initial startup, if the regulator is in Manual mode and set at 0.25 amperes, the generator should come up to approximately half-voltage. This allows wiring and sensing leads to be checked before the regulator is switched to AVR mode. Increasing the field current to 0.5 amperes will bring the generator up to approximately rated, no-load voltage.

Var Control Mode (Optional)

In Var Control mode, the DVR2000E(C) maintains generator vars (volt-amperes, reactive) at a set level when paralleling with an infinite bus. The DVR2000E(C) calculates generator vars using the sensed generator output voltage and current quantities and then adjusts the dc excitation current to maintain vars at the setpoint. Var control is enabled and disabled through the front panel switches, Windows® or Palm OS® communication software. When the software is turned on, var control is enabled or disabled through the Var/Power Factor Control (52J/K) contact input circuit. The var setpoint is adjustable from 100 percent absorb to 100 percent generate through the Raise and Lower contact inputs, front panel switches, or through Windows® or Palm OS® software.

Power Factor Control Mode (Optional)

In Power Factor Control mode, the DVR2000E(C) maintains generator power factor at a set level when paralleling

with an infinite bus. The DVR2000E(C) calculates generator power factor using the sensed generator output voltage and current quantities and then adjusts the dc excitation current to maintain power factor at the setpoint. Power factor control is enabled or disabled through the front panel switches, Windows® or Palm OS® software. When the software is turned on, it is enabled or disabled through the Var/Power Factor Control (52J/K) contact input circuit. The power factor setpoint is adjustable between 0.6 lag and 0.6 lead through the Raise and Lower contact inputs, front panel switches, or through Windows® or Palm OS® communication software.

Reactive Droop Compensation

The DVR2000E provides a reactive droop compensation feature to assist in the sharing of reactive load during parallel generator operation. When this feature is enabled, the DVR2000E calculates the reactive portion of the generator load using the sensed generator output voltage and current quantities and then modifies the voltage regulation setpoint accordingly. A unity power factor generator load results in almost no change in generator output voltage. A lagging power factor generator load (inductive) results in a reduction of generator output voltage. A leading power factor generator load (capacitive) results in an increase of generator output voltage. Droop is adjustable up to 10 percent with rated, nominal B-phase line current (5 amperes applied through terminals CT1 and CT2) and 0.8 power factor. The droop feature is enabled and disabled through the Parallel Generator Compensation contact input circuit (terminals 52L and 52M). If the Var/Power Factor option is present, the 52J/K input must also be closed to disable droop.

Section 3

Underfrequency

Generator Underfrequency

When generator frequency drops below the selected knee frequency setpoint, the voltage setpoint is automatically adjusted by the DVR2000E so that generator voltage follows the selected PU (per unit) V/Hz curve. When operating on the selected PU V/Hz curve, the Underfrequency Active indicator flashes on the front panel and in MARATHON-DVR2000E-32. The knee frequency is adjustable from 40 to 65 hertz and the PU V/Hz curve may be set to a slope from 1 to 3 in increments of 0.01 through the Windows® or Palm OS® communication software. The default is 59 Hz and a slope of 1.

Engine Unloading

The Engine Unloading feature modifies the underfrequency curve. This feature becomes active when the generator frequency decreases a programmable amount (Unloading Activation – Frequency) below the knee frequency setpoint, and when the speed change rate is greater than the Unloading Activation - Rate. The amount of droop while Engine Unloading is active is adjusted by the Unloading Droop - Percentage (%) setting. The amount of time Engine Unloading is active is set by Unloading Droop - Time (sec.).

Engine unloading adjustments are made through the Windows and Palm OS communication software.

Unloading Activation – Frequency (Hz) is entered as a value below the underfrequency corner where the engine unloading feature may be activated. A frequency value of 0.9 to 9.0 hertz can be entered in 0.1 hertz increments. The default value is 0.9 hertz.

Unloading Activation – Rate (Hz/25 msec) of 0 to 25.5 hertz per 25 milliseconds can be entered in 0.1 hertz per 25 millisecond increments. The engine unloading feature is activated when the frequency rate of change exceeds the setting of this field. The default value is 0.1.

Unloading Droop – Percentage (%) field defines the percent drop in generator output voltage for each 1.5 percent decrease in generator frequency when operating in the Engine Unloading mode. The Unloading Droop Percentage is adjustable from 1 to 20 percent in 1 percent steps. The default value is 10 percent.

Unloading Droop – Time (sec) value defines the length of time that the Engine Unloading mode may be active before control is passed to the normal Underfrequency mode of operation. Droop time is adjustable from 1 to 5 seconds in 1 second increments. The default value is 1 second.

Protection

The DVR2000E has the six protective functions listed below:

- Overexcitation shutdown
- Generator overvoltage shutdown
- DVR overtemperature shutdown
- Loss of generator sensing shutdown
- Overexcitation limiting
- Crowbar shutdown

Each function, except Crowbar Shutdown, has a corresponding front panel indicator that lights when the function is active. An active function (except Crowbar Shutdown) is also annunciated through the Windows® or Palm OS® communication software.

Overexcitation Shutdown (Field Voltage)

This function is enabled or disabled through MARATHON-DVR2000E-32 software. When enabled, if field voltage exceeds the setpoint (80 Vdc default), the Overexcitation Shutdown indicator flashes on the front panel and in the Windows® or Palm OS® communication software, the relay output closes after 15 seconds and the DVR2000E shuts down. When the DVR2000E is powered up following an over-excitation shutdown, the Overexcitation Shutdown indicator will flash for 5 seconds.

Generator Overvoltage Shutdown

The DVR2000E monitors the sensed generator output voltage. If it exceeds the overvoltage setpoint (a percent of nominal) for 0.75 seconds, the Generator Overvoltage indicator flashes on the front panel LED and in the Windows® and Palm OS® communication software, the relay output closes and the DVR2000E shuts down. When the DVR2000E is powered up following a generator overvoltage shutdown, the Generator Overvoltage indicator will flash for 5 seconds. The default setpoint is 120 percent of nominal.

DVR Overtemperature Shutdown

A temperature sensor within the DVR2000E continually monitors the temperature of the device. If the temperature exceeds 70°C (158°F), the DVR Overtemperature indicator flashes on the front panel and in the Windows® and Palm OS® communication software, the relay output closes and the DVR2000E shuts down.

Loss of Generator Sensing Shutdown

The DVR2000E monitors the sensed generator output voltage and takes protective action if a loss of sensing voltage is detected. For single-phase sensing, a sensed voltage of less than 50 percent of nominal is interpreted as a loss of sensing. For three-phase sensing, the total loss of a sensed phase or an imbalance between phases of more than 20 percent nominal is interpreted as a loss of sensing. When sensing input continuity is not lost, an adjustable time delay of 0 to 25 seconds is present when a loss of sensing condition is detected. If sensing input continuity is lost, the time delay is disabled.

If a loss of sensing occurs, the Loss of Generator Sensing indicator flashes on the front panel and in the Windows® and Palm OS® communication software, the relay output closes, and the DVR2000E shuts down. When the DVR2000E is powered up following a loss of generator sensing shutdown, the Loss of Sensing indication will flash for 5 seconds.

This function is disabled when a generator short circuit condition is detected or when sensed frequency drops below 12Hz. A generator short-circuit is determined when the phase B CT current exceeds 3PU (>15 Aac sensing current). Loss of sensing is not active during soft start time.

Overexcitation Limiting (Field Current)

The DVR2000E has a field current limit that is factory preset at 6.5 amperes. The limit is adjustable from 0 to 7.5 amperes with an adjustable time delay that has a range of 0 to 10 seconds. Both settings are made through the Windows® and Palm OS® communication software. When the overexcitation limit is exceeded, the Overexcitation Limiting indicator flashes on the front panel and in the Windows® and Palm OS® communication software. When the adjustable time delay expires, the relay output closes and the DVR2000E shuts down. When the DVR2000E is powered up following overexcitation limiting, the Overexcitation Limiting indicator will flash for 5 seconds.

Crowbar Shutdown

The Crowbar Shutdown Circuit protects the generator rotor from overcurrent damage resulting from a shorted DVR2000E power switch. During operation, if the field voltage exceeds the setpoint and the power stage receives no gating pulses for 1.5 seconds, the Crowbar Circuit activates and places a short-circuit across the DVR2000E input power terminals. This protects the generator by blowing the input power fuse and removing operating power from the device.

Generator Soft Start

The DVR2000E incorporates an adjustable soft start feature that controls the time for generator voltage to ramp to the regulation setpoint. The ramp rate is adjustable from 1 to 120 seconds in 1 second increments through the Windows® and Palm OS® communication software. The underfrequency feature is also active during soft start and takes priority in control of the generator voltage. The default setting is 7 seconds.

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SECTION 4 • INSTALLATION

GENERAL

The DVR2000E is delivered in a sturdy carton to prevent shipping damage. Upon receipt, check the part number against the requisition and packaging list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify your sales representative or a sales representative at Marathon Electric.

If the unit is not installed immediately, store it in the original shipping package in a moisture and dust free environment.

MOUNTING

The DVR2000E is normally located in the generator conduit box. It is designed for behind the panel mounting and requires a cutout for front panel viewing and access. Mounting hardware consists of six customer supplied, #12 thread-forming screws that pass through mounting holes in the conduit box and thread into the plastic shell of the DVR2000E. The unit must be mounted where the ambient temperature does not exceed the allowable environmental conditions called out in Section 1, General Information, Specifications. DVR2000E package dimensions are shown in Figure 4-1. Cutout and drilling dimensions are shown in Figure 4-2.

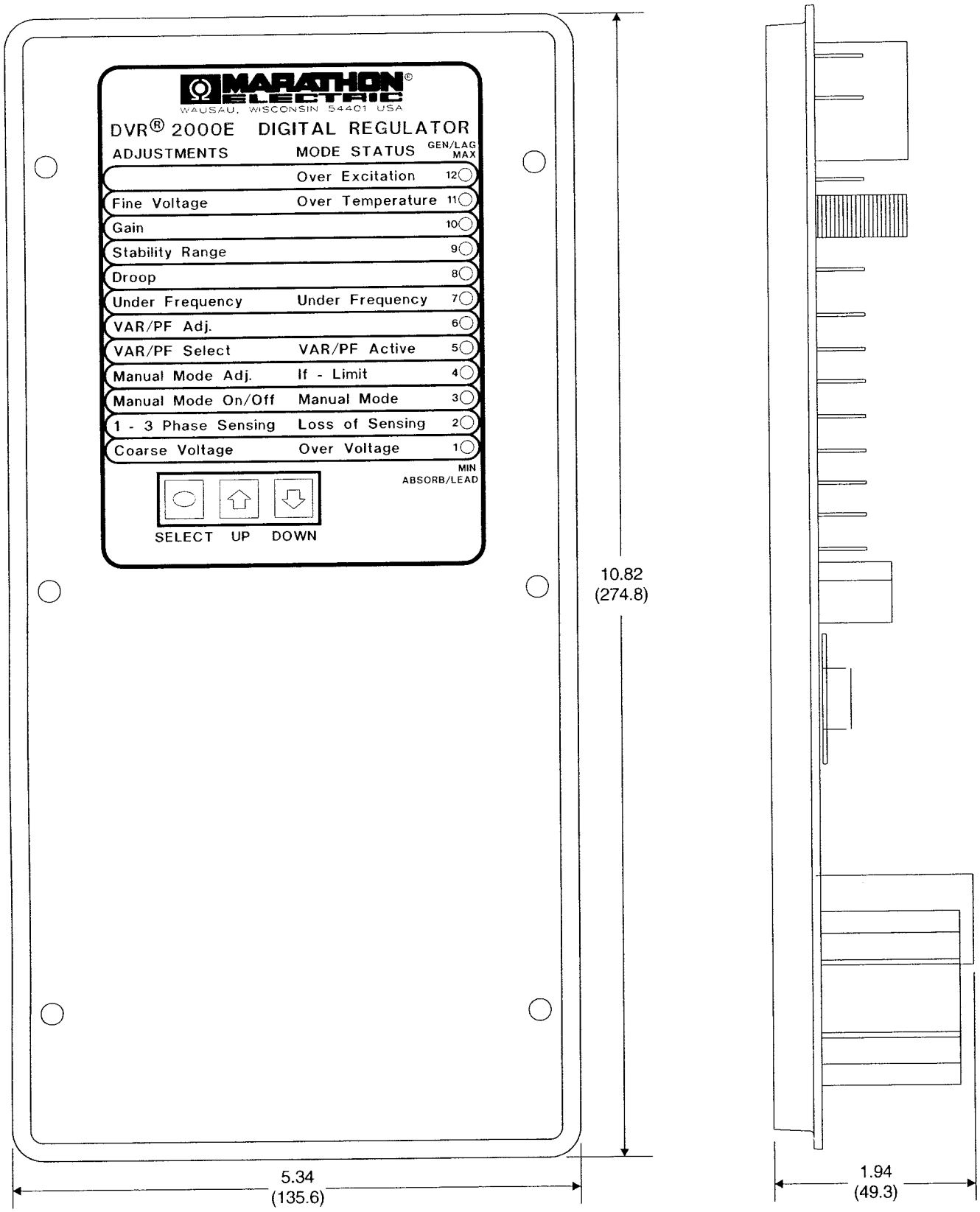


Figure 4-1. DVR2000E Dimensions

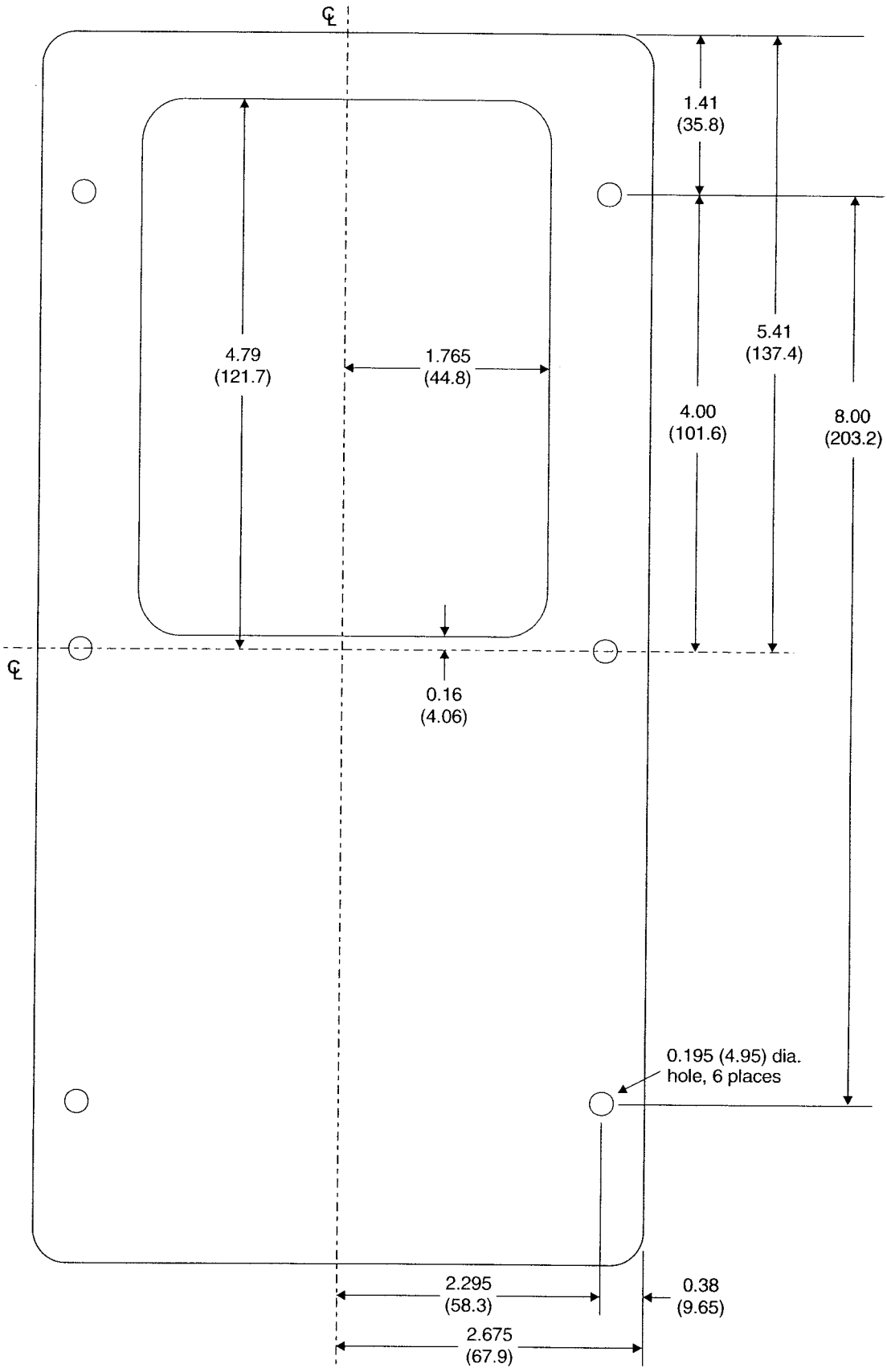


Figure 4-2. Cutout and Drilling Dimensions

CONNECTIONS

DVR2000E connections are dependent on the application. Incorrect wiring may damage the unit.

NOTE

Be sure that the DVR2000E is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the unit case. When the unit is configured in a system with other devices, it is recommended to use a separate lead to the ground bus from each device.

DVR2000E Terminations

DVR2000E units have two types of interface terminals (Figure 4-3). One type is quarter-inch, quick-connect terminals and the other is a 9-pin DB9 connector. All terminals are located on the rear of the unit. The quarter-inch, quick-connect terminal labels are located on the rear of the case. Wires performing common functions, such as voltage sensing leads, should be grouped together. The 9-pin DB-9 type connector is used for temporary interface with both IBM compatible PCs and hand-held computers.

Figure 4-3 shows the terminal connections located on the rear panel of the DVR2000E. Except as noted above, connections should be made with minimum wire size of 14 AWG.

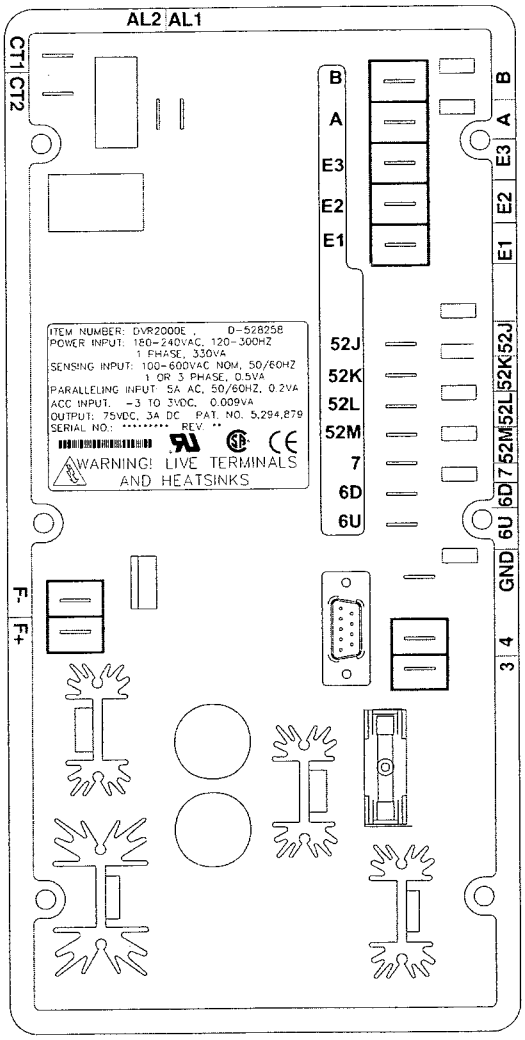


Figure 4-3. DVR2000E Rear Panel Terminals

Generator Voltage Sensing Inputs

The generator voltage sensing terminals are labeled E1, E2, and E3. A single-phase sensing connection is obtained by connecting the C-phase sensing input to terminals E2 and E3. Table 4-2 lists the terminal assignments for three-phase and single-phase generator voltage sensing.

Table 4-1. Generator Voltage Sensing Terminals

Sensing	GeneratorPhase	Terminal
3-Phase	A	E1
	B	E2
	C	E3
1-Phase	A	E1
	C	E2, E3

Phase B Line Current Sensing Input

Generator line current is stepped down through a user-supplied current transformer (CT). Secondary current from that transformer is applied to terminals labeled CT1 and CT2.

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Raise and Lower Contact Inputs

Remote setpoint adjustment may be accomplished by connecting a single-pole, double-throw (SPDT), spring return, center-off switch to the terminals labeled 6U, 7, and 6D. To connect this switch, the center pole, or common terminal, must be connected to terminal 7. The other two terminals are connected to terminals 6U and 6D. This remote adjust switch may be mounted up to 150 feet away from the DVR2000E when using twisted, shielded cable.

Var/Power Factor Control Contact Input

A customer supplied enable/disable contact for this function connects to the terminals labeled 52J and 52K. This function is disabled by a closed contact.

Parallel Generator Compensation

A customer supplied enable/disable contact for this function connects to the terminals labeled 52L and 52M. This function is disabled by a closed contact.

Analog (Auxiliary) Adjust

CAUTION
If the DC voltage is removed from the Analog (Auxiliary) Input, the operating setpoint will return to the original value.

This input allows adjustment of the DVR2000E regulation setpoint by the application of a positive or negative DC voltage across terminals A and B. Voltage up to +3 Vdc may be applied at this input. The circuit induces a 1,000-ohm burden on the dc source. The application of a +3 Vdc signal corresponds to a +30 percent change in setpoint.

Power Supply Inputs

Power input terminals are labeled 3, and 4.

Chassis Ground

The chassis ground terminal is labeled GND.

Power (Field) Output

The field output terminals for connection to the generator exciter field are labeled F+ and F-.

Relay Output

The common alarm relay output contact may be accessed at the terminals labeled AL1 and AL2. The relay output is normally open.

Communication Port

The RS-232 port on the rear panel uses a DB-9 female connector. Figure 4-4 Illustrates the pin assignments of the communication port and Table 4-3 identifies the RS-232 connector pin functions. A standard communication cable terminated with a DB-9 male connector is used for PC or hand-held computer interface with the DVR2000E as shown in Figure 4-5.

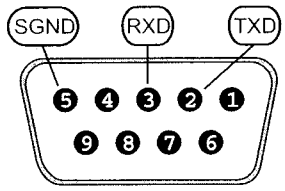


Figure 4-4. Communication Port Pin Assignments

Table 4-2. Communication Port Pin Functions

Pin	Function	Name	Direction
1	N/C	----	N/A
2	Transmit Data	TXD	From DVR2000E
3	Receive Data	RXD	To DVR2000E
4	N/C	----	N/A
5	Signal Ground	GND	N/A
6	N/C	----	N/A
7	N/C	----	N/A
8	N/C	----	N/A
9	N/C	----	N/A

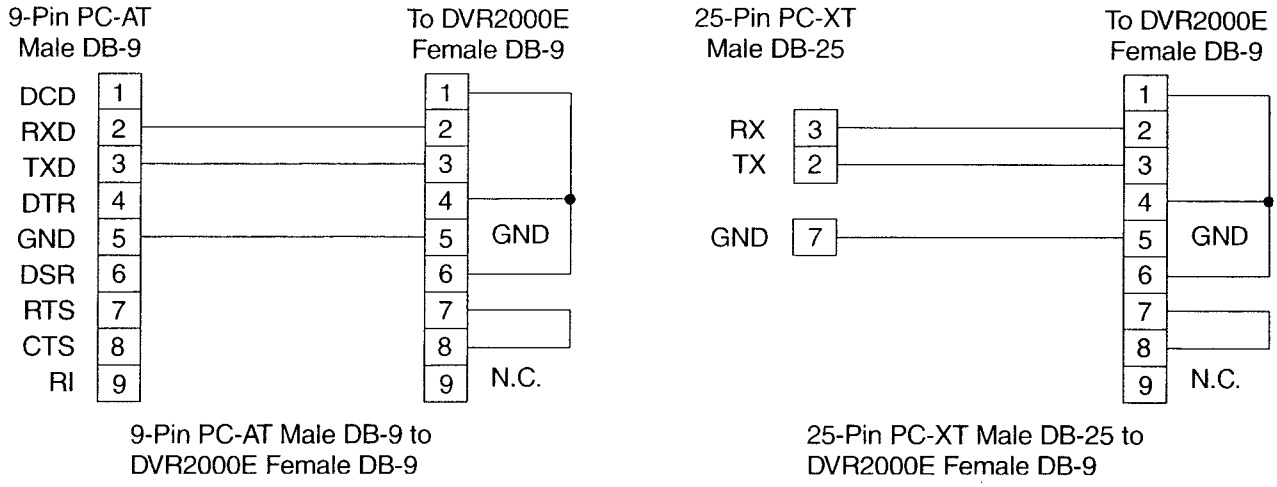


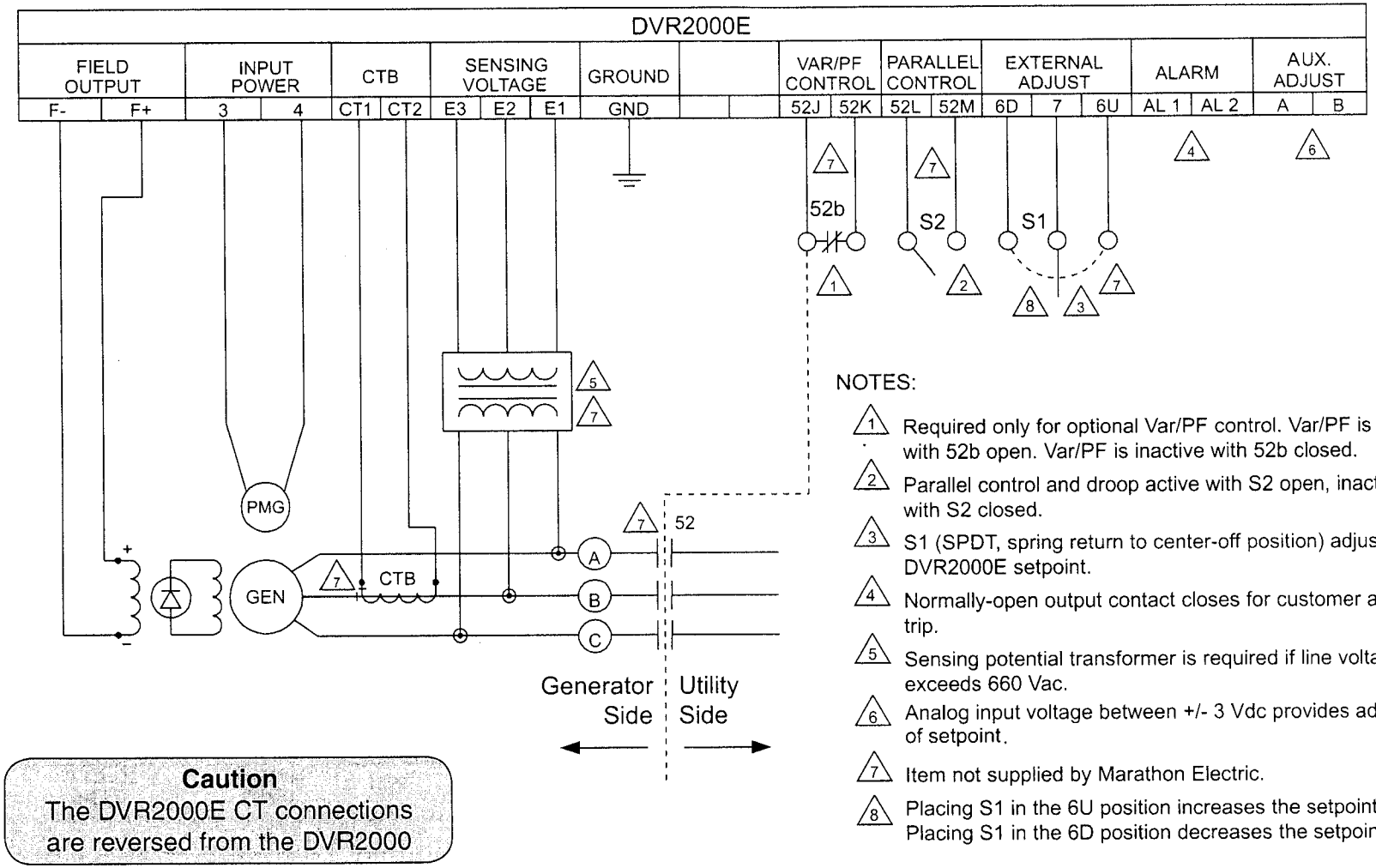
Figure 4-5. Personal Computer to DVR2000E Connections

DVR2000E Connections for Typical Applications

Figures 4-6 through 4-9 illustrate typical applications using the DVR2000E. Figure 4-6 shows an application where the DVR2000E is connected for three-phase voltage sensing. Figure 4-7 shows an application with single-phase voltage sensing while Figure 4-8 illustrates an application with a single-phase generator.

Section 4

Figure 4-9 illustrates the connection of two DVR2000E devices used in a Cross-Current (Reactive Differential) application. Note that the .1 ohm resistor shown may have to vary. When operating in parallel reactive differential mode (cross current), attention must be paid to the use of the burden resistor shown in Figure 4-9. The burden resistor should have a value approximately 10 times the cross current loop resistance for proper differential operation. The value of 0.1 ohm is a suggested value. The volt-ampere (VA) capacity of the paralleling current transformers should be considered after sizing the burden resistor.



Caution
The DVR2000E CT connections are reversed from the DVR2000

NOTES:

1. Required only for optional Var/PF control. Var/PF is active with 52b open. Var/PF is inactive with 52b closed.
2. Parallel control and droop active with S2 open, inactive with S2 closed.
3. S1 (SPDT, spring return to center-off position) adjusts DVR2000E setpoint.
4. Normally-open output contact closes for customer alarm or trip.
5. Sensing potential transformer is required if line voltage exceeds 660 Vac.
6. Analog input voltage between +/- 3 Vdc provides adjustment of setpoint.
7. Item not supplied by Marathon Electric.
8. Placing S1 in the 6U position increases the setpoint. Placing S1 in the 6D position decreases the setpoint.

Figure 4-6. Typical Connections with ABC Rotation and Three-Phase Sensing

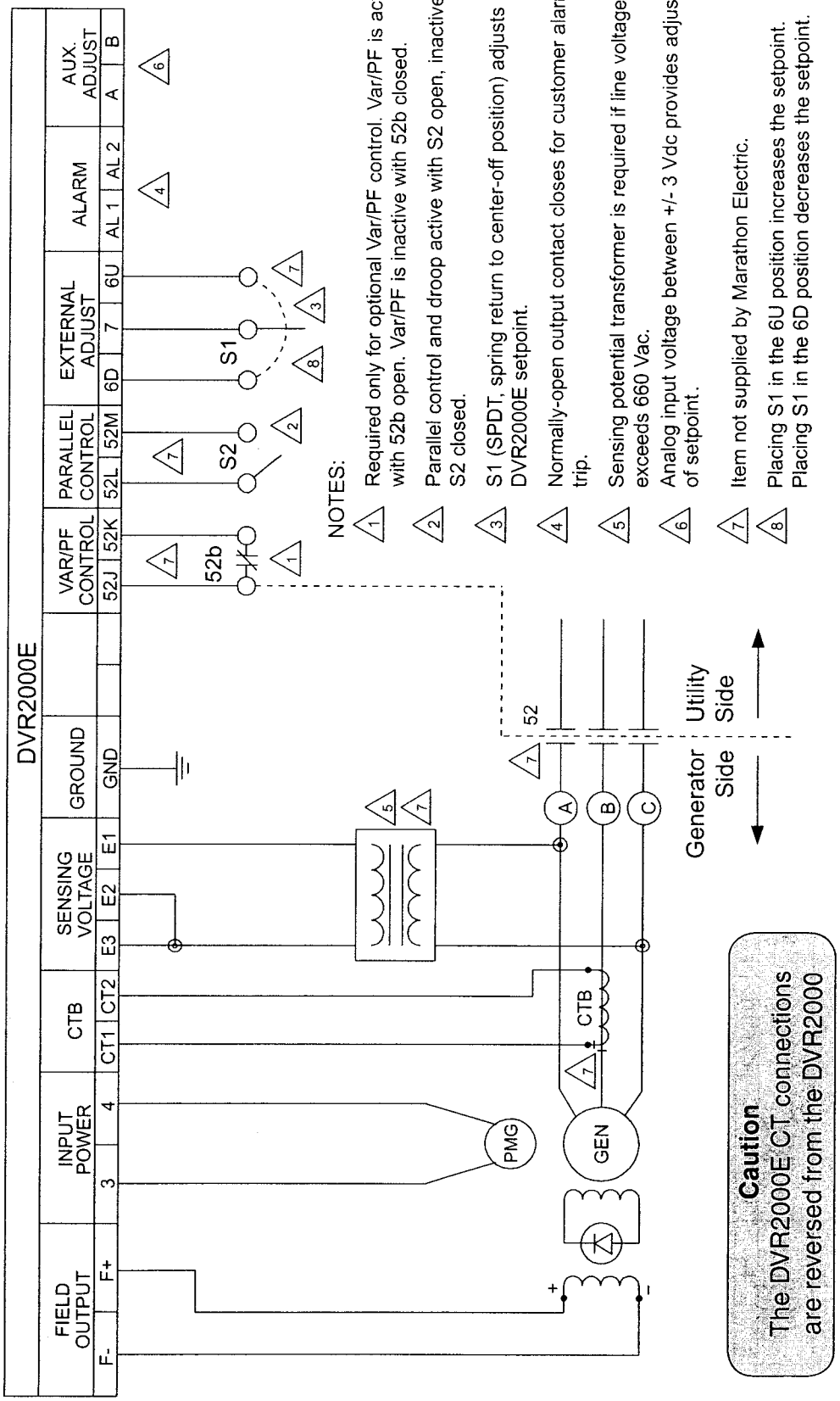


Figure 4-7. Typical Connections with ABC Rotation and Single-Phase Sensing

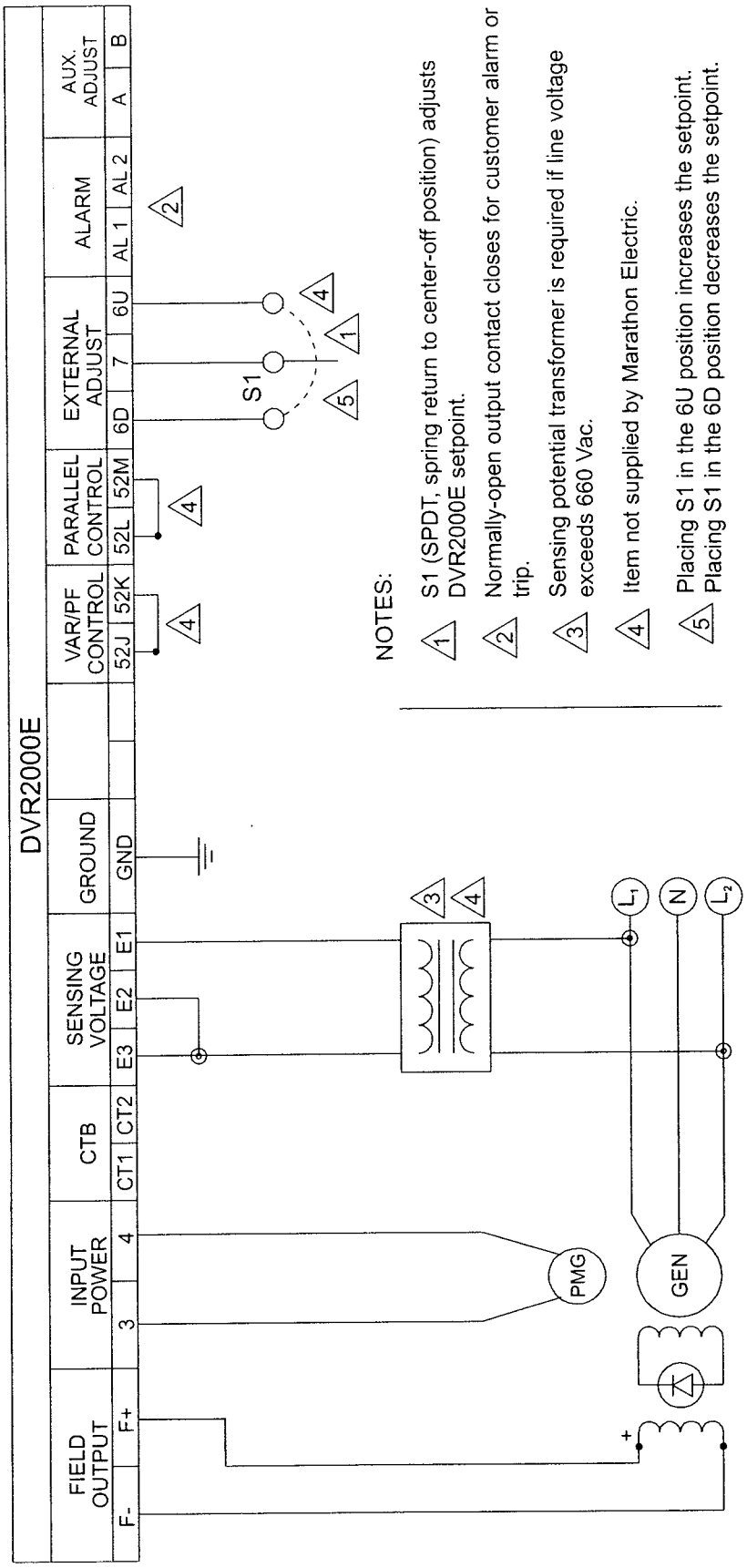


Figure 4-8. Typical Connections to a Single-Phase Generator

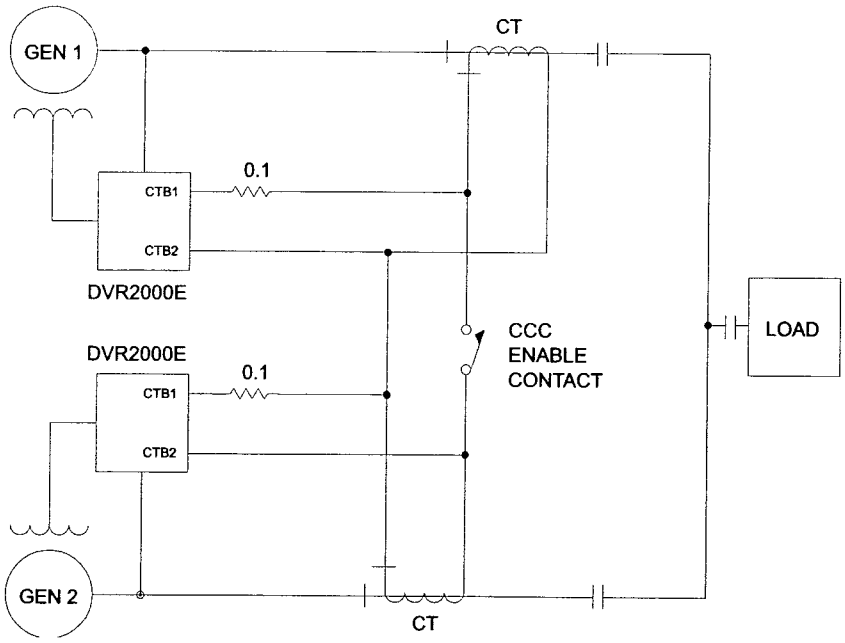


Figure 4-9. Cross-Current (Reactive Differential) Connections for Two Generators

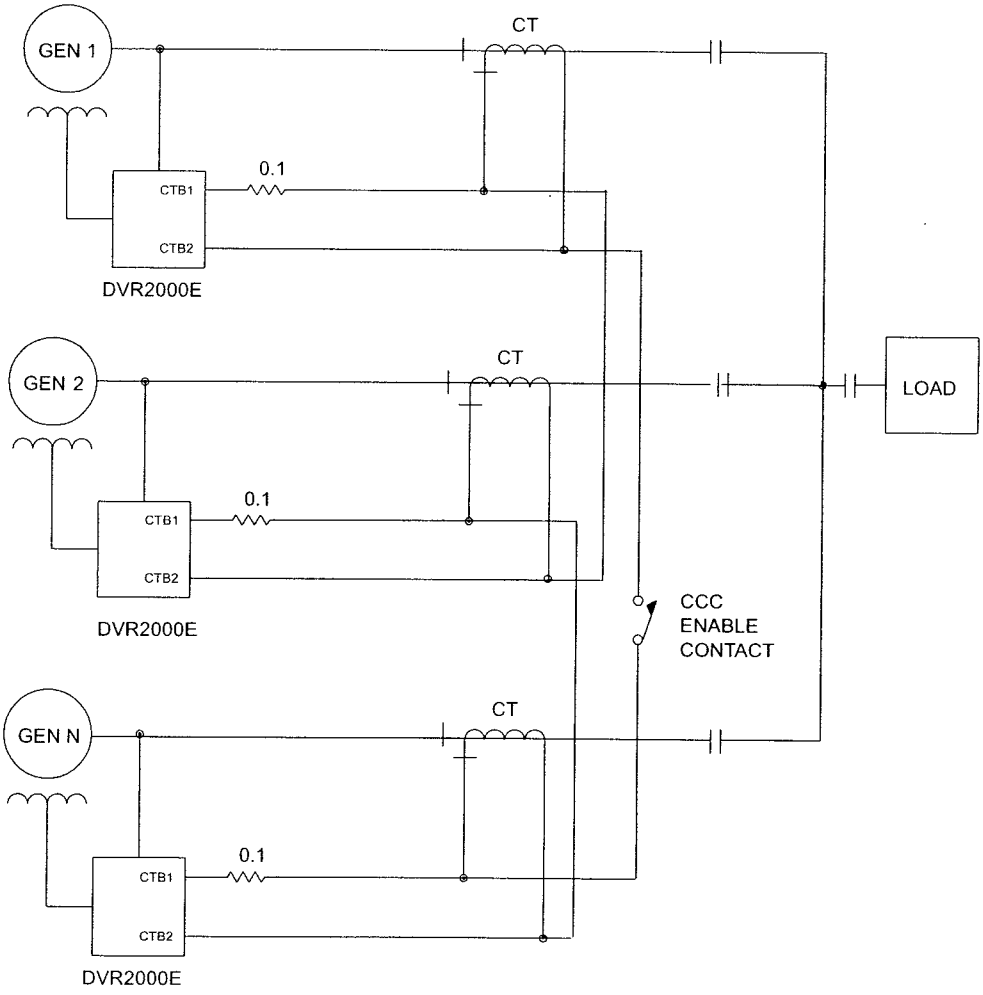


Figure 4-10. Cross-Current (Reactive Differential) Connections for Three or More Generators

PRELIMINARY SETUP

WARNING!

Use caution when working around the rear of the DVR2000E.
Dangerous voltage levels are present at the exposed heatsinks when the unit is energized.

Before starting the generator and DVR2000E for the first time, proceed as follows.

a. Tag and disconnect all wiring to the DVR2000E. Be sure to insulate the wire terminals to prevent a short.

b. Start the prime mover and perform all engine governor adjustments.

c. After all initial governor adjustments have been made, shut down the prime mover.

d. Connect only the power input terminals of the DVR2000E to an auxiliary power source in the specified power input range.

e. Perform all initial DVR2000E settings by using the front panel HMI, connecting a handheld operating with DVR2000E software, or connecting a PC operating with DVR2000E software to the rear commun-ications port of the DVR2000E.

f. Connect the rest of the DVR2000E leads using the tagged identification.

g. Start the prime mover/generator and perform the final adjustments at rated speed and load.

h. After the initial startup, the DVR2000E should not require any further adjustments unless there is a change in the system.

ADJUSTMENTS

All adjustments are made using external switching, the front panel HMI or with DVR2000E software via the rear panel communication port. See Section 5, MARATHON-DVR2000E-32 Software for Windows® OS for more information about making adjustments with DVR2000E software.

SECTION 5 • MARATHON-DVR2000E-32 SOFTWARE FOR WINDOWS® OS

Section 5 describes how to program the DVR®2000E with a PC, which requires special software. The software and instructions can be downloaded from the Marathon Electric website at www.marathonelectric.com. Section 5 of this manual appears in its entirety within the PDF file for this manual (Publication GPN019), which is also available from our website.

Section 5

SECTION 6 • MARATHON – DVR2000E SOFTWARE FOR THE PALM OS® PLATFORM

Section 6 describes how to program the DVR®2000E with a Palm® Pilot (PDA), which requires special software. The software and instructions can be downloaded from the Marathon Electric website at www.marathonelectric.com. Section 6 of this manual appears in its entirety within the PDF file for this manual (Publication GPN019), which is also available from our website.

SECTION 7 • MAINTENANCE AND TROUBLE-SHOOTING

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SECTION 7 • MAINTENANCE AND TROUBLE-SHOOTING

PREVENTATIVE MAINTENANCE

The only preventive maintenance required on the DVR2000E is to periodically check that the connections between the DVR2000E and the system are clean and tight. DVR2000E units are manufactured using state-of-the-art, surface-mount technology. As such, Marathon Electric recommends that no repair procedures be attempted by anyone other than Marathon Electric personnel.

TROUBLESHOOTING

If you do not get the results that you expect from the DVR2000E, first check the programmable settings for the appropriate function. Use the following troubleshooting procedures when difficulties are encountered in the operation of your excitation system.

Generator Voltage Does Not Build

Step 1. Verify that all wiring is properly connected. Refer to Figures 4-6 through 4-10.

If wiring is improperly connected or loose, reconnect wiring properly.

If wiring connections are correct, proceed to Step 2.

Step 2. Verify that the generator is spinning at rated speed.

If the generator is not up to rated speed, increase generator speed to the rated value.

If the generator is spinning at rated speed, proceed to Step 3.

Step 3. Check for correct input power to the DVR2000E. Refer to Section 1, General Information, Specifications for input power requirements.

If voltage is not present, refer to the generator manual for repair procedures.

If voltage is present, proceed to Step 4.

Step 4. Verify that the fuse is not open.

Replace any open fuse.

If no fuses are open, proceed to Step 4.

Step 5. Verify that the front panel OVEREXCITATION SHUTDOWN indicator is not lit.

If the front panel OVEREXCITATION SHUTDOWN indicator (field voltage) is lit, check the generator and/or load conditions. Interrupt input power or shut down the generator for a minimum of one minute.

If the front panel OVEREXCITATION SHUTDOWN indicator is not lit, proceed to Step 6.

Step 6. Verify that the front panel OVEREXCITATION LIMITING indicator is not lit.

If the front panel OVEREXCITATION LIMITING indicator is lit, check the generator and load conditions. Also check the field current limit setpoint for the correct level. Interrupt input power or shut down the generator for a minimum of 1 minute.

If the front panel OVEREXCITATION LIMITING indicator is not lit, proceed to Step 7.

Step 7. Verify that the DVR2000E soft start settings are correct. Too long of a soft start setting may give the appearance of no buildup.

If the soft start settings are incorrect, adjust the settings.

If the soft start settings have no effect, proceed to Step 8.

Step 8. Replace the DVR2000E unit.

If replacing the DVR2000E unit does not correct the malfunction, then the generator is defective. Consult with the generator manufacturer.

Low Generator Output Voltage

Step 1. Verify that the voltage adjustment is not set too low.

If the voltage adjustment is too low, adjust it to the correct setpoint.

If the voltage adjustment is correct, proceed to Step 2.

Step 2. Verify that the underfrequency knee setpoint is not greater than the generator frequency.

If the underfrequency setpoint is too high, adjust the setpoint below the rated generator frequency.

If the underfrequency setpoint is correct, proceed to Step 3.

Step 3. Verify that the generator is spinning at rated speed.

If the generator is not up to rated speed, increase the generator speed to the rated level.

If the generator is spinning at rated speed, proceed to Step 4.

Step 4. Check for correct input power to the DVR2000E. Refer to Section 1 (General Information, Specifications) for input power requirements.

If the DVR2000E input voltage is low, refer to the PMG manual for PMG.

If the voltage is at the required level, proceed to Step 5.

Step 5. Verify that the sensing potential transformer (if used) has the correct turns ratio and is operating correctly.

If the turns ratio of the sensing potential transformer is incorrect, replace the sensing potential transformer.

If the sensing potential transformer is operating correctly, proceed to Step 6.

Step 6. Verify that the front panel OVEREXCITATION LIMITING indicator is not lit.

If the front panel OVEREXCITATION LIMITING indicator is lit, check the generator and/or load conditions. Also check the field-current limit setpoint for the correct level. Interrupt input power or shut down the generator for a minimum of one minute.

If the front panel OVEREXCITATION LIMITING indicator is not lit, proceed to Step 7.

Step 7. Low generator output voltage may occur when operating in droop mode with an inductive load.

If the low voltage condition is not caused by the droop function, proceed to Step 8.

Step 8. Replace the DVR2000E unit.

High Generator Output Voltage

Step 1. Verify that the voltage adjustment is not set too high.

If the voltage adjustment is too high, adjust it to the correct setpoint.

If the voltage adjustment is correct, proceed to Step 2.

Step 2. Verify that the sensing potential transformer (if used) has the correct turns ratio.

If the turns ratio of the sensing potential transformer is incorrect, replace the sensing potential transformer with the correct one.

If the sensing potential transformer is correct, proceed to Step 3.

Step 3. High generator output voltage may occur when operating in droop mode with a capacitive load.

If the high voltage condition is not caused by the droop function, proceed to Step 4.

Step 4. Replace the DVR2000E unit.

Poor Voltage Regulation

Step 1. Verify that the case of the DVR2000E is properly grounded.

If the DVR2000E is not properly grounded, connect a dedicated ground wire to the quarter-inch fast-on connector labeled GND on the rear of the DVR2000E case.

If the DVR2000E is properly grounded, proceed to Step 2.

Step 2. Check for grounded field leads.

If the field leads are grounded, isolate them from ground.

If the field leads are not grounded, proceed to Step 3.

Step 3. Check for grounded PMG leads.

If the PMG leads are grounded, isolate them from ground.

If the PMG leads are not grounded, proceed to Step 4.

Step 4. Verify that the generator frequency is not dropping below the DVR2000E underfrequency setpoint when load is applied to the generator.

If the generator frequency is dropping below the underfrequency setpoint, reduce the setpoint if possible. Also check the prime mover and generator for proper sizing in relation to the applied load.

If poor regulation is not related to DVR2000E underfrequency operation, proceed to Step 5.

Step 5. Verify that regulation is not being affected by normal droop operation.

If droop operation is not affecting regulation, proceed to Step 6.

Step 6. Replace the DVR unit.

Generator Output Unstable (Hunting)

Step 1. Verify that the governor for the prime mover is operating properly.

If the governor is not operating properly, troubleshoot using the manufacturer's suggested procedures.

If the governor is operating properly, proceed to Step 2.

Step 2. Verify that the sensing and input power leads are connected securely.

If the sensing or input power leads are not connected securely, tighten the connections.

If the sensing or input power lead connections are secure, proceed to Step 3.

Step 3. Verify that the DVR2000E Stability Range is set to the proper range.

If the Stability Range setting is incorrect, reset the Stability Range.

If the Stability Range setting is correct, proceed to Step 4.

Step 4. Verify that the Stability Level is properly set.

If the Stability Level is not properly set, reset the Stability Level.

OVEREXCITATION SHUTDOWN Indicator Is Annunciating

Step 1. Verify that the field overvoltage setpoint is adjusted properly.

If not properly adjusted, readjust the field overvoltage setpoint.

If properly adjusted, proceed to Step 2.

Step 2. Check for generator overloading.

If the generator is operating with a larger than rated load, shed load.

If the generator is operating with a rated or less than rated load, proceed to Step 3.

Step 3. Replace the DVR2000E.

If replacing the DVR2000E does not correct the malfunction, proceed to Step 4.

Step 4. Refer to the generator manual. Generator is defective.

LOSS OF GENERATOR SENSING Indicator Is Annunciating

Step 1. Verify that the voltage sensing leads are properly connected.

If the sensing leads are not properly connected, correct the connections.

If the sensing lead connections are correct, proceed to Step 2.

Step 2. For single-phase sensing, verify that E2 and E3 are connected.

If E2 and E3 are not connected, connect them both to phase C sensing voltage.

If E2 and E3 are properly connected, proceed to Step 3.

Step 3. Verify that the sensing potential transformer (if used) has the correct turns ratio and is functioning properly.

If the sensing potential transformer has the wrong turns ratio or is malfunctioning, replace it.

If the sensing potential transformer is correct and functioning properly, proceed to Step 4.

Step 4. Verify that the generator output voltage is present on all phases.

If the generator is missing a phase, refer to the generator manual. Generator is defective.

If generator output voltage is balanced on all phases, proceed to Step 5.

Step 5 Replace the DVR2000E.

OVEREXCITATION LIMITING Indicator Is Annunciating

Step 1. Check for generator overloading.

If the generator is operating with a larger than rated load, shed load.

If the generator is operating with a rated or less than rated load, proceed to Step 2.

Step 2. Verify that the DVR2000E output (field) current limit is not set too low.

If the output current limit setpoint is too low, adjust for the proper setting.

If the output current limit is set properly, proceed to Step 3.

Step 3. Verify that the generator exciter field is not shorted.

If the generator exciter field is shorted, replace the generator.

If the generator exciter field is not shorted, proceed to Step 4.

Step 4. Replace the DVR2000E.

If replacing the DVR2000E does not correct the malfunction, proceed to Step 5.

Step 5. Refer to the generator manual. Generator is defective.

UNDERFREQUENCY ACTIVE Indicator Is Annunciating

Step 1. Verify that the generator is operating at rated speed.

If the generator is not operating at rated speed, adjust the generator speed.

If the generator is operating at the rated speed, proceed to Step 2.

Step 2. Verify that the underfrequency setpoint is correct.

If the underfrequency setpoint is incorrect, adjust it to the correct value.

No Droop

Step 1. Verify that the DVR2000E 52L/M contact input is open.

If the 52L/M contact input is not open, it must be opened to enable the droop function.

If the 52L/M contact input is open, proceed to Step 2.

Step 2. Verify that the DVR2000E 52J/K contact input (if present) is closed or the Var/PF function is disabled via the Windows® software. Var/PF operation must be disabled for droop operation. If Var/PF operation is disabled, proceed to Step 3.

Step 3. Verify that the DVR2000E droop setting is not adjusted to 0% droop.

If the droop setting is adjusted to 0% droop, increase the setpoint above 0%.

If the droop setting is adjusted to above 0%, proceed to Step 4.

Step 4. Check for an open in the circuit connected to DVR2000E CT1 and CT2.

If there is an open circuit, repair as necessary.

If there is no open circuit, proceed to Step 5.

Step 5. Verify that all connections are correct according to Figures 4-6 and 4-7.

If connections are incorrect, correct the problem.

If connections are correct, proceed to Step 6.

Step 6. Verify that the load being applied to the generator for droop testing is not purely resistive.

If only a resistive load is being applied to the generator, apply an inductive load and retest.

If the load being applied to the generator is inductive, proceed to Step 7.

Step 7. Verify that your DVR2000E is compatible with the current sensing transformer (5 A secondary) being used. For example, a current sensing transformer with a 1 ampere output rating would produce very little droop since your DVR2000E has a 5 ampere current transformer input.

If the current transformer input is incorrect, replace the current sensing transformer for compatibility.

If the current transformer input is correct, proceed to Step 8.

Step 8. If the above steps fail to correct the malfunction, replace the DVR2000E unit.

Marathon Electric Mfg. Corp.

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Printed in USA

GPN019 07/02



MARATHON® ELECTRIC

A Subsidiary of Regal-Beloit Corporation

SHOP ORDER STATUS DETAIL REPORT

www.katolight.com *Ph: 507-625-7973* *Fax: 507-625-2968*

100 POWER DRIVE
BOX 3229
MANKATO, MN 56002-3229

CUSTOMER: CJ'S SALES AND SERVICE
132 N.E. 17TH PLACE
OCALA FL 34470

SHOP ORDER: 16538-0	ITEM: 800740 D415F*J4	ORDER QTY	COMPLETED QTY	DATE STARTED	DUE
JOB #: 097232		1	0	02/10/2004	02/27/2004

USE STOCK SLOT S4473
PROCESSED BY JIM K 2-6-04
RPM: 1800
KW: 415.0
KVA: 518.8
FREQ: 60
PF: .8
TEMP RISE RATING: 150
****UNIT DRAWINGS:****
AC DRAWING: 819-B-13514
DC DRAWING: 819-C-6378
PP DRAWING: 819-B-14001
DIMENSION DRAWING: 100-2051-48
BASE DRAWING: 102-2633-A1
DUCT FLANGE DRAWING: N/A
ENCLOSURE DRAWING: CQE-704
INTAKE SCOOP DWG: N/A
EXHAUST SCOOP DWG: N/A
EXHAUST FLEX DWG: 105-1522-14
TANK DRAWING: 108-700
FUEL SYSTEM DWG: N/A
STANDARD UNIT ***ENGINE AND GENERATOR MTD ON VIB PADS***
SPECIFY OPTIONAL ENGINE
JOHN DEERE 6125HF 24V RCLR
VOLTAGE: 480 3 PHASE
SPECIFY OPTIONAL GENERATOR
433PSL6220 PMG/DVR 1&14 12W
ADD PMG KIT TO GENERATOR
13LT 50K CONTROL PANEL 24V RELAY SHUNT TRIP 24V 2P
FUEL LEAK LED
CONTROL PANEL UNIT MOUNTED
13LT FLUSH MTD ANNUNCIATOR 12W FUEL LEAK LED
AMMETER 0-800
VOLTMETER 0-300/0-600 240VAC
FREQUENCY METER 55-65HZ
CURRENT TRANSFORMER 800A 3X
STD ELECT GOVERNOR CONTROL JDEC
SPECIFY OPT CUSTOM HOUSING
CRYSTAL QUIET ENCL CQE-704
SOUND ATTENUATED
CONTROL PANEL MTD LEFT SIDE
BASE HSD STEEL FOR CQE-704
COOLING SYSTEM STANDARD
LOW WATER LEVEL SWITCH ONLY
BREAKER 600A 3P 600V W/ENC
W/24V SHUNT TRIP SHUNT TRIP WIRED TO SHUTDOWNS
600A BKR MTD RIGHT SIDE
STD BATTERY, RACK, & ACID
WATER HEATER 2250W 120VAC PHILLIPS 331-5025
INSTALL BALL VALVES W/HEATER
HEATER WIRED TO TERMINAL
SPECIFY VIBRATION ISOLATORS
PAD ISOLATORS HOUSED
OIL DRAIN EXTENSION REQUIRED
FC24-10-2011U BATTERY CHARGER
CHARGER MTD-DC & AC WIRED
CRITICAL GRADE EXHAUST MUFFLER MTD W/FLEX IN SCOOP
EXHAUST FLEX HOUSED
FUEL SYS DIESEL W/FUEL TANK
SPECIFY BASE TANK
TANK SB 400GL DW UL W/STUB-UP
CORNER STUB-UP: 45"L X 25"W
FUEL LEAK SWITCH
LOW FUEL LEVEL SWITCH
SPECIFY OPTIONAL REQUIRMENTS

INCLUDE 5" EMERGENCY VENT CAP
NO TRAILER REQUIRED
SWITCHES & SENDERS 50K PANEL
UNIT TO BE PAINTED KL TAN
SPECIFY MANUAL QTY&SHIP INS
(3) O&M MANUALS SEND WITH UNIT
STANDARD COMMERCIAL TEST
UNIT TO SHIP WET
2 YEAR WARRANTY 1500HR LIMIT
ANNUNCIATOR PANEL

SHOP ORDER #: 16538 ITEM #: 800740

ITEM #	DESCRIPTION	UM	QTY PER UNIT	QTY ISSUED
100151	COMPLETE CONTROL PANEL	EA	1	0
31075	ADAPTER MALE O-RING TO PIPE 3/4-14 PIPE X 1-1/16-12 2216-12-12	EA	1	0
35070	SWITCH TEMP 55F 1/2 NPT NC STD LWT SWITCH	EA	1	0
35198	VALVE BALL 3/4" NPT BRONZE W/TEFLON SEAT, USE AS STANDARD 28-8620	EA	2	0
35507	COVER BASE 4" LIFTING HOLE 5 X 5 14 GA 105-1142	EA	4	0
36285	CAP RAIN VERTICAL/HOR 8" FITS 8" TUBING FB 5420	EA	1	0
40123	FILTER AIR CLEANER (UL) VORTOX AN135C AN135Z	EA	1	0
40124	BRACKET MTG AIR CLEANER 13.59D BB135 FITS AN135	EA	1	0
40511	RACK BATTERY UNIT MTD 23" OAL HOLDS 4D & 8D BATTERIES**SP 204-169	EA	2	0
41171	BREAKER CIR 600A 600V 3P W/ACC 24VST TJK636600WL W/ 24VST	EA	1	0
41711	TRANSFORMER CURRENT 800:5 600V 12.5VA SEC**SP	EA	3	0
42239	CAP FUEL FILL 2" NPT FEMALE LOCKING STD TANK FILL CAP**SP #179 2" FEMALE	EA	1	0
42641	FLEX EXHAUST SS OAL 21" 5 1/16" SLV TO STD 8" FLG 105-1522-14	EA	1	0
42820	BLOCK FUSE 3P 600V FOR 13/32" X 1 1/2" FUSES	EA	1	0
42828	FUSE 10A 600V JX6-10 KTK-10	EA	3	0
43300	ELBOW HOSE RUBBER 5 1/2" 90DEG USED ON AIR CLEANER ASSYS 90L55	EA	2	0
43634	ELBOW TUBING 5" 90 DEG #320292**SP WALKER #42500	EA	1	0
44324	CLAMP MUFFLER 5" **SP WALKER #35757	EA	2	0
44984	ENCLOSURE BKR NEMA 1 TJ600S ORDER W/NEUTRAL BLOCK TNIA600 TJ600S	EA	1	0
45222	FLANGE ANGLE RING 7" I.D. **SP	EA	1	0
45973	SENDER TEMP 100-230 DEG F 3/8" NPT USE W/GAUGE 45974 STEWART-WARNER# 334P	EA	1	0
46001	SOLENOID START 24VDC	EA	1	0
46103	SWITCH LEVEL FLOAT .050A NO/NC 1/8" NPT STD LFL SWITCHES**SP N1000N-W042	EA	2	0
46110	SWITCH PRESSURE 20PSI 10A SPDT 1/8NPT STD OIL PSD SWITCH SM-2C-20F/309 (GOLD CONTACTS)	EA	1	0
46114	SWITCH TEMP 225F 6A NO 1/2NPT STD TEMP SHUTDOWN SWITCH TT-F1A-225R/GG	EA	1	0
46115	SWITCH PRESSURE 15PSI 10A SPDT 1/8" NPT STD OIL SHTDWN SWITCH SM-2C-15F/298 (GOLD CONTACTS)	EA	1	0
46900	MOUNT VIBE 1 1/4" ISOPRENE W/ 5/16-18 X 9/16" STUD FOR PANEL 310575I400	EA	4	0
46907	MOUNT VIB PAD 2 1/2 X 18 X 1/4 NEOPRENE 105-1661 MTD BETWEEN UNIT AND TANK	EA	12	0
46908	MOUNT VIB PAD 3 X 18 X 1/4 NEOPRENE **MTD BETWEEN ENGINE/GENERATOR AND BASE**	EA	8	0
46987	MOUNT VIBE 1" NEOPRENE W/ 1/4-20 X 1/2" STUDS FOR PANEL	EA	4	0

SHOP ORDER #: 16538 ITEM #: 800740

ITEM #	DESCRIPTION	UM	QTY PER UNIT	QTY ISSUED
	1352-162			
47556	NIPPLE PIPE 1 1/2"NPT X 6" LG SCHED 40 THREADED**SP	EA	1	0
48670	NIPPLE PIPE 2" NPT X 4" LG SCHED 40 THREADED**SP	EA	1	0
49274	GASKET 8" PIPE FLANGE 150# RING TYPE NON ASBESTOS	EA	1	0
52057	VALVE BALL 1/2" NPT BRASS USE AS STANDARD V500P-8	EA	2	0
52773	HEATER TANK 2250W 120VAC 1PH PHILLPS**SP 331-5025	EA	1	0
63015	MOUNT VIB PAD 3 X 8 X 1/4 **SP NEOPRENE 105-1661-1 SEND LOOSE	EA	12	0
65009	VALVE CHECK 1/2" NPT BALL CONE BRASS FOR 1/2" DIESEL SYSTEMS 61-103-01	EA	1	0
69054	BRACKET CONTROL PANEL MTG MTG PANEL EYE LEVEL OFF G.O.B. 105-1550	EA	1	0
70102	ELBOW TUBING 2 1/2 O.D. UPPER COOLANT ELBOW FOR LTA-10 105-1640	EA	1	0
71229	GENERATOR 433/6220 SE350 SAE 1 FLYWHEEL 14 12W	EA	1	0
71343	BRACKET AIR FILTER JD 6125A/HF 250-415KW JOHN DEERE 105-2134	EA	1	0
71452	CLAMP MUFFLER 8" 105-1798	EA	1	0
72928	BRACKET LIFTING HOUSED/OPU SMALL BRACKETS 105-1979	EA	2	0
72964	VENT TANK 1 1/2" MUSHROOM STYL USED AS NORMAL VENT ON TKS**SP	EA	1	0
73342	SWITCH TEMP 215F 6A NO 14MM TEMP SW PREALARM FOR DDEC TT-E11A-215R/108	EA	1	0
73390	FOAM INSULATION 1 1/2" THICK BLACK URETHANE FILM W/ADHESIVE	SF	675	0
73398	BRACKET BATTERY MTG 2)8-D RACK 5" CHANNEL 47" LONG	EA	1	0
73418	BRACKET OIL PRESSURE SW MTG FOR ALL GM & ALL JD 6125AF/HF 105-2241	EA	1	0
73464	ADAPTER 1/2" FEM PIPE SWIVEL TO 1/2" MALE PIPE -45DEG ELBOW 2049-8-8S **USED FOR WATER HEATER**	EA	1	0
73512	KIT PMG W/DVR2000 FOR NEW STYLE 430F GENERATORS	EA	1	0
73526	STRAP GROUND 4GA BRAIDED 10"L LUG TO LUG**SP	EA	1	0
73533	GAUGE LEVEL FUEL 8" VERTICAL FOR FUEL TANKS H8680L08 USED ON 10-12" TALL TANKS	EA	1	0
73568	ELBOW TUBING 3" OD USED ON LOWER RAD 6125AF/HF 105-2025	EA	1	0
73574	SPACER FAN JD 6125AF & 6125HF USED ON 250-300KW JD'S	EA	1	0
73581	HOSE CHARGED AIR 4"DIA USED ON 6125HF RE500365	EA	3	0
73604	RADIATOR 17FT 6R11L 6125HF *SP (W/CHARGED AIR COOLED) 375/415	EA	1	0
73605	FAN MULTI-WING 36" DIAMETER USED ON 6125HF JD - 375&415KW	EA	1	0
73651	ENGINE 6125HF 24V LESS RAD SAE 1 FLYWHEEL 14 ECU MODEL # 6125HF070	EA	1	0
73665	CHARGER BATTERY 24V 10A 120VAC SENS MODEL: FC24-10-2011UA FC24-10-2011UA	EA	1	0
74070	CAP VENT EMERGENCY 5"NPT FOR DEISEL TANKS 105-2095	EA	1	0
74367	BRACKET MUFFLER MTG 18" SPECIAL (3" TALL) 105-179-17	ST	1	0
74442	ELBOW TUBING FLARED 5" 90 DEG JOHN DEERE 12.5L EXHAUST ELBOW KL DWG# 105-2143	EA	1	0
74517	CLAMP V-BAND USED ON 12.5 JD	EA	1	0

ITEM #	DESCRIPTION	UM	QTY PER UNIT	QTY ISSUED
76718	LABEL "DANGER HIGH VOLTAGE" 1.125" X 1.875" (UL) 68417	EA	2	0
77123	BOOT INSULATOR FOR SCREW TERM. USED ON SCREW TERM. ON METERS 5102	EA	7	0
77365	PROTECTOR TERMINAL STRIP *SP* FOR 45/50K PANELS 105-2612	EA	1	0
90154	CONTROL ENG 24V KASSEC COMP STD ENGINE CONTROL	EA	1	0

LEA International Inc.
6520 Harney Road
Tampa Florida 33610

A70-38-0002 Rev-1

LEA International Inc.
6520 Harney Road
Tampa Florida 33610

CFS OWNER'S MANUAL



Installation - Operation - Maintenance

SURGE PROTECTION DEVICE

A70-38-0002 Rev-1

(813) 621 – 1324 Toll Free: (800) 654 – 8087 Fax: (813) 621 – 8980
E – Mail: info@leainternational.com URL http://www.leaintl.com

rior to calling LEA International for technical assistance or rdering parts, please have the following information available.

- Model number of the SPD
- Serial number of SPD
- Manufacture date of SPD
- Purchase date of SPD

TELEPHONE NUMBERS / E-MAIL

Main Office: (813) 621-1324
Toll Free: (800) 654-8087
Fax: (813) 621-8980
E-mail: info@leaintl.com

ADDRESS INFORMATION

LEA INTERNATIONAL
6520 Harney Road
Tampa, Florida 33760

http://www. leaintl.com

MATERIAL RETURN POLICY

No product may be returned without the seller's prior written approval. Transportation charges are to be prepaid by the buyer. Returned item(s) are subject to the seller's inspection and acceptance. Seller may, at its discretion, replace any or all return items within a reasonable time after seller determines that returned item(s) are not in accordance here within; and in such an event, seller shall not be liable for any damage arising from the defective delivery or delay caused thereby. When authorized by the seller in writing, unused products may be returned to the seller, subject to service handling, restocking charges and rebuilding charges to "as new" condition.

Call LEA International's customer service department at 1-800-654-8087 for a return material authorization (RMA) number. No items will be accepted without an RMA number.

Please have the following information on hand when calling for an RMA number:

MODEL NUMBER
PART NUMBER
PURCHASE DATE
INSTALLATION DATE
FAILURE DESCRIPTION
SYSTEM OPERATING VOLTAGE
LEA JOB NUMBER

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OVERVIEW

LEA was founded in 1971 to address lightning related voltage transients. Since that early beginning, LEA has developed many patents and related products that provide state-of-the-art protection against lightning, utility switching, facility or electrical equipment-generated transient voltages, surge currents, and electrical line noise.

Over the years, LEA has been a significant leader in the transient voltage surge suppression (TVSS) industry. We participate in efforts for TVSS standardization by contributing resources to NEMA, IEEE, NFPA, U.L., CSA, and other organizations. Through this leadership and experience we have developed a complete line of surge protection devices (SPD's).

LEA offers a complete line of SPD's which incorporate the most advanced surge suppression technology available today. The extensive LEA line ranges from large in-line series units that protect data centers and other critical loads to small AC outlet protection devices. LEA literally has a TVSS device for every application. For an overview of the LEA line of surge protection for device and a practical guide for choosing the proper SPD, visit the LEA website at www.leainternational.com.

Transient voltage surge suppression is our only market and total product focus. We are experts in our field. Through this singular commitment LEA International remains dedicated to providing total excellence and customer satisfaction in TVSS related products, service, and solutions.

LIMITATION OF LIABILITY

LEA International's sole liability and the Customer's sole remedy for a failure of this product to perform as warranted shall be limited to the repair or replacement thereof upon return to LEA International's factory at 6520 Harney Road, Tampa, Florida 33610, USA, or its authorized service center, transportation prepaid.

NOTICE OF CLAIM

All claims under this warranty must be brought to the attention of LEA International or its designated service center, in writing, within thirty (30) days after discovery of any defect in material or factory workmanship

UNCONDITIONAL WARRANTY

LEA International's **CFS FAMILY** Surge Protection Devices are unconditionally warranted for five (5) years as follows:

WARRANTY

LEA International, Inc. hereby extends, to the Customer of its products for use, LEA International's unlimited, unconditional warranty. LEA International warrants that its products are free from defects in material and/or factory workmanship, including acts of God. LEA International will repair or replace any device that fails to perform or ceases to operate during the warranty period. This warranty is effective after delivery of the product to the Customer. This warranty is not transferable. This warranty does not cover defects caused by or damages resulting from improper installation, misuse or alterations made to the product. Operation of the product under conditions exceeding LEA International's specifications or negligence in use of the product, or removal of the LEA International nameplate or serial number (where applicable) from the product will void this warranty in its entirety. Overhaul or modification of the product by other than LEA International or its authorized service center will void this warranty in its entirety.

There are no other warranties which extend beyond the description of the face of this warranty, and to the full extent permitted by law, and any and all implied warranties, including implied warranties of merchantability or fitness for a particular purpose or arising from any course of dealing or usage of trade, are hereby expressly disclaimed and excluded, as well as all other obligations or liabilities on the part of LEA International, its agents, representatives, distributors or designates not otherwise expressly covered under this warranty.

INTRODUCTION

Congratulations on selecting LEA International's *CFS FAMILY* surge protection device (SPD). The *CFS FAMILY* is UL 1449 listed as CFS (voltage configuration). This unit provides a high degree of protection from lightning, utility transients and other forms of surge currents, and transient voltages. The CFS is ideal where space at panel locations is limited. It is housed in a NEMA 4X enclosure. The protection modes are all high performance linear arrays of metal oxide varistors (MOV).

LEA International stresses a total facility protection concept that follows ANSI/IEEE C62.41 guidelines and recommends surge suppression at each possible entry point of a facility. Review carefully all of the equipment that needs protection in your facility. Do not let an unprotected path exist in your facility. Ensure yourself peace of mind from the destructive, degrading, and disruptive effects of surge currents and transient voltages with an adequate protection plan.

The use of a LEA International SPD at the service entrance on your critical load distribution panel is the first step in providing total facility protection. Other surge protection devices should be installed directly in front of sensitive electronic equipment and on data/communication lines to eliminate internal facility power transients.

Call your LEA International professional power representative for help in isolating these areas and providing total protection for your facility. For a directory of the LEA representatives in your area, visit our web site at www.leainternational.com.

SPECIFICATIONS

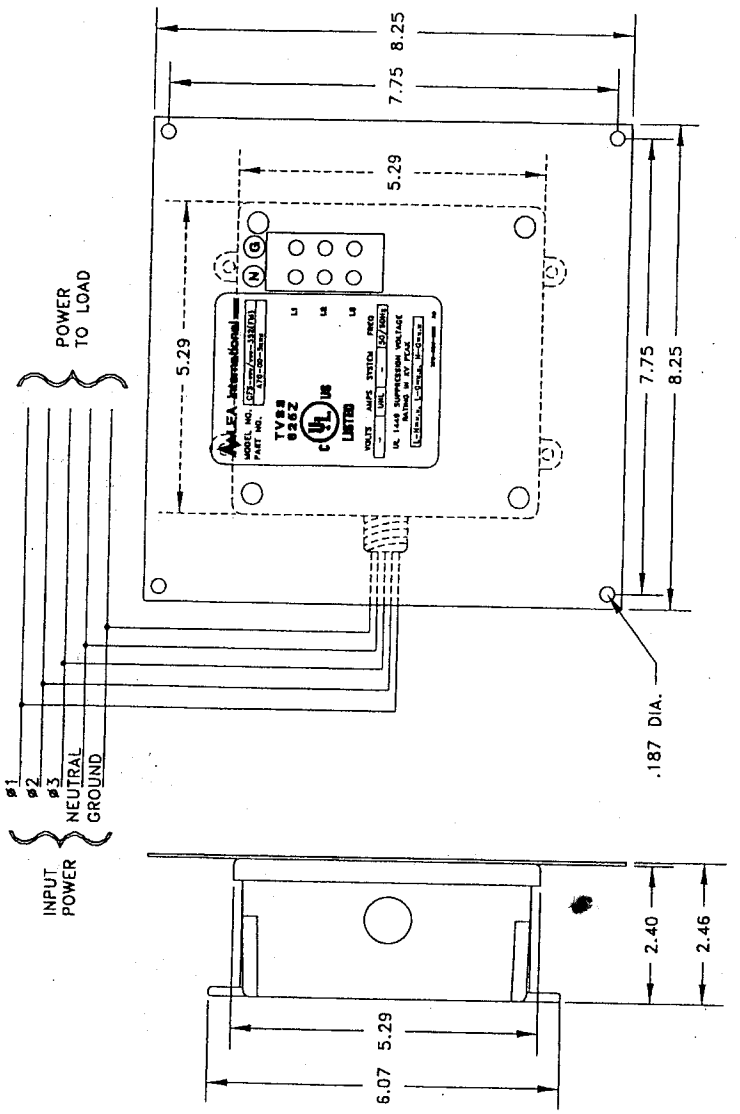
Protection Provided	**L-N; L-G; N-G; L-L**
Surge Current Dissipation per phase *	**120,000 Amps**
Maximum Load Current per phase	**Unlimited**
Total System Response Time	**<1Nano Second**
Certified Category @ Test ANSI/IEEE C62.41 & .45	**Yes**
UL 1449 Surge Suppression Rating	**Yes**
Life Cycle Testing Category C3, Operations (20,000 volts @ 1.2 x 50 uSec, 10,000 amps @ 8 x 20uSec)	**>1000**
Operating Temperature Range	**-40°C to +85°C**
Operating Humidity	**5% to 95% noncondensing**
Operating Altitude (Feet)	**Up to 12,000**

These devices feature internal protection that will disconnect the surge protective components at the end of their useful life but will maintain power to the load-now unprotected. If this situation is undesirable for the application, contact LEA International customer service.

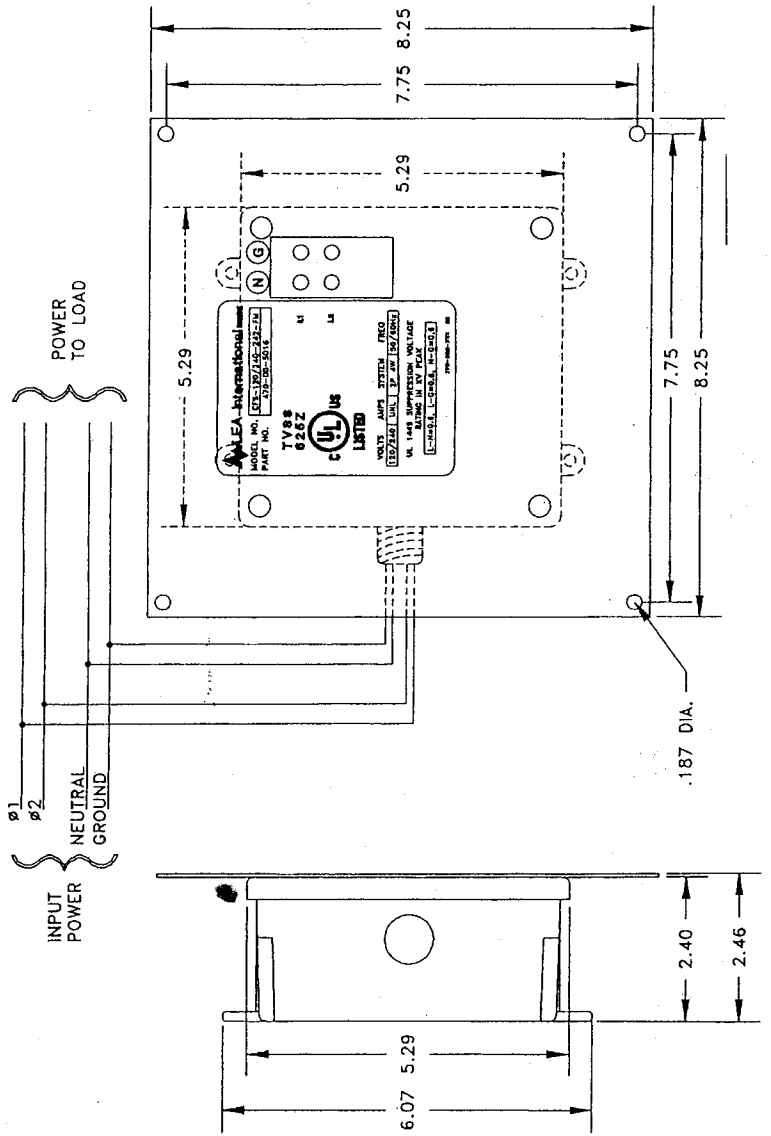
* 8 x 20 uSec I wave per ANSI/IEEE C62.41

0/208 3Wye / 277/480 3Wye (FLUSH MOUNT)

3-Pole 5-wire



120/240 Split Phase (FLUSH MOUNT)
2-Pole 4-wire



INSTALLATION PROCEDURES

The LEA International *CFS FAMILY* is intended for installation on AC power systems of unlimited KVA rating due to its parallel connection.

Read the entire installation and maintenance manual before installing this surge protection device (SPD).

Check to be certain that the voltage indicated by the model number on the front of the unit matches the AC nominal line voltage of your service. (Example: CFS-120/208-3Y)

"120" is the line to neutral voltage; "208" is the line to line voltage; "3Y" indicates 3 phase, W(Y)E. The *CFS FAMILY* voltage rating must be the same as the incoming supply voltage. Contact the LEA International's field service department with any questions concerning the voltage configuration prior to system power on.

****WARNING****

Before installing the LEA SPD, AC power must be OFF. Failure to do so could result in damage to the SPD as well as potential electrical shock hazard to personnel. Installation and service to performed by qualified personnel only.

INSTALLATION

The CFS is to be mounted on the side or the bottom of the panel utilizing the ½" nipple provided through a ½" knockout in the panel. Secure the locking ring onto the ½" nipple and proceed. Where no knockout is available the unit can be wall mounted via the mounting tabs provided on the unit. Also, a flush mount option is available.

GROUND

Connect the green ground wire to the ground bus in panel. A #12 AWG green wire is provided with unit.

NEUTRAL CONNECTION

Connect the white neutral wire to the neutral bus in panel. A #12 AWG white wire is provided with unit. Keep the lead length as short as possible and avoid sharp bends to ensure optimum performance.

PHASE CONDUCTOR CONNECTIONS

Connect the black hot wires to the phase lugs. #12 AWG black wires are provided with unit. In addition, the unit can be connected to a breaker with a minimum current rating of 20 amps. Keep the lead length as short as possible and avoid sharp bends to ensure optimum performance. LEA recommends a 20 amp breaker for the SP units.

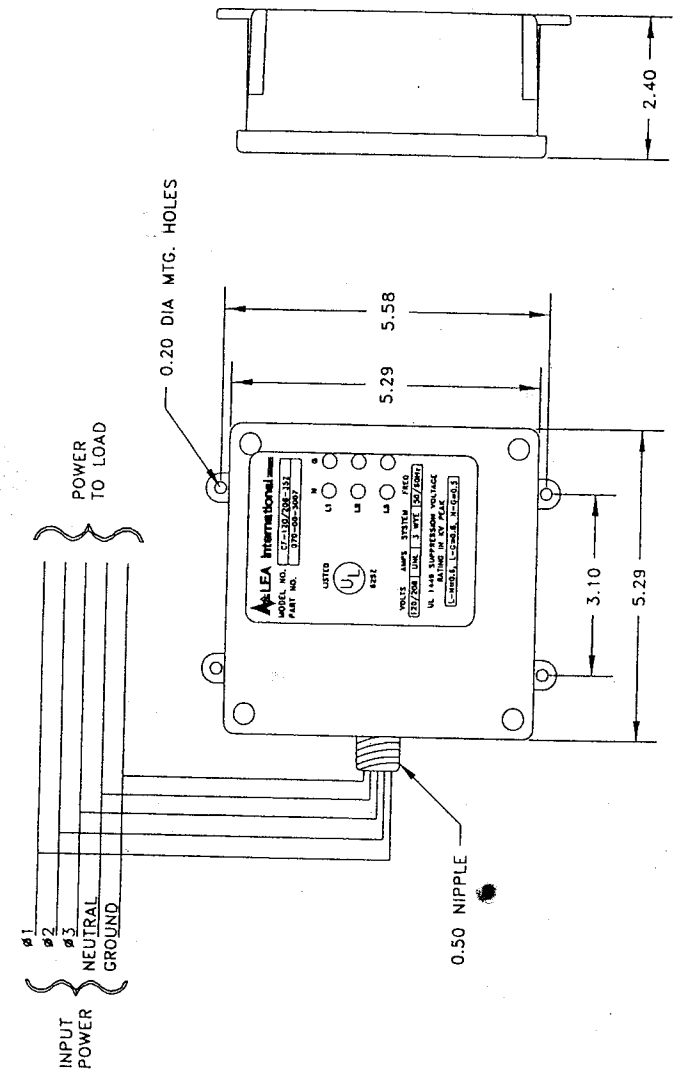
TYPICAL WIRING METHOD

The *CFS FAMILY* is connected in parallel with the power system to provide optimum protection.

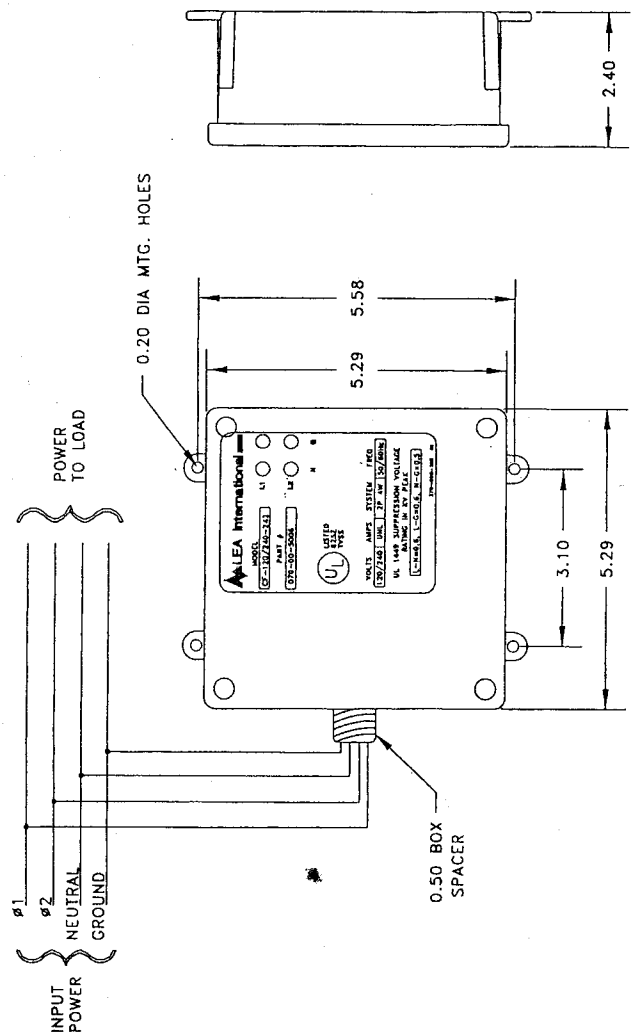
FINAL CHECK

Check installation of the SPD as indicated by the provided layout/installation drawing and verification of proper connection and voltages. Apply external AC power to the SPD. The unit is now operational. All green indicator lamps should be illuminated. If not, contact LEA International's field service department at 1-800-654-8087.

120/208 3Wye / 277/480 3Wye
3-Pole 5-wire



120/240 Split Phase
2-Pole 4-wire



INSTALLATION CHECKLIST

For proper performance of the *CFS FAMILY*, the qualified installing electrician shall use the following as a checklist to help ensure proper installation:

YES	NO		
[ ]	[ ]	1.	The voltage of the SPD matches actual system voltage.
[ ]	[ ]	2.	Ground resistance is less than 25 ohms.
[ ]	[ ]	3.	All wiring conforms to the national electric code (NEC).
[ ]	[ ]	4.	All conductors are in accordance with the appropriate layout/installation drawing.
[ ]	[ ]	5.	All lead lengths are as short as possible.
[ ]	[ ]	6.	The SPD is installed in parallel with the incoming phase conductors.
[ ]	[ ]	7.	After installation, all green lights are illuminated and the unit is functional.
[ ]	[ ]	8.	All critical loads are protected by the SPD. If not, additional SPD(s) may be required.

MAINTENANCE

FOREWORD

CFS FAMILY surge protection device (SPD) is designed for long life without the need for routine maintenance. The design is of a passive nature, with no degradation expected. LEA International's TVSS system will fail only if an undefined over voltage (a RMS rise in system voltage in excess of the SPD rating) or a transient in excess of its maximum surge current is experienced.

There are no moving parts. There are green indicators visible on the outside of the enclosure, which indicate protection is intact.

VISUAL INSPECTION

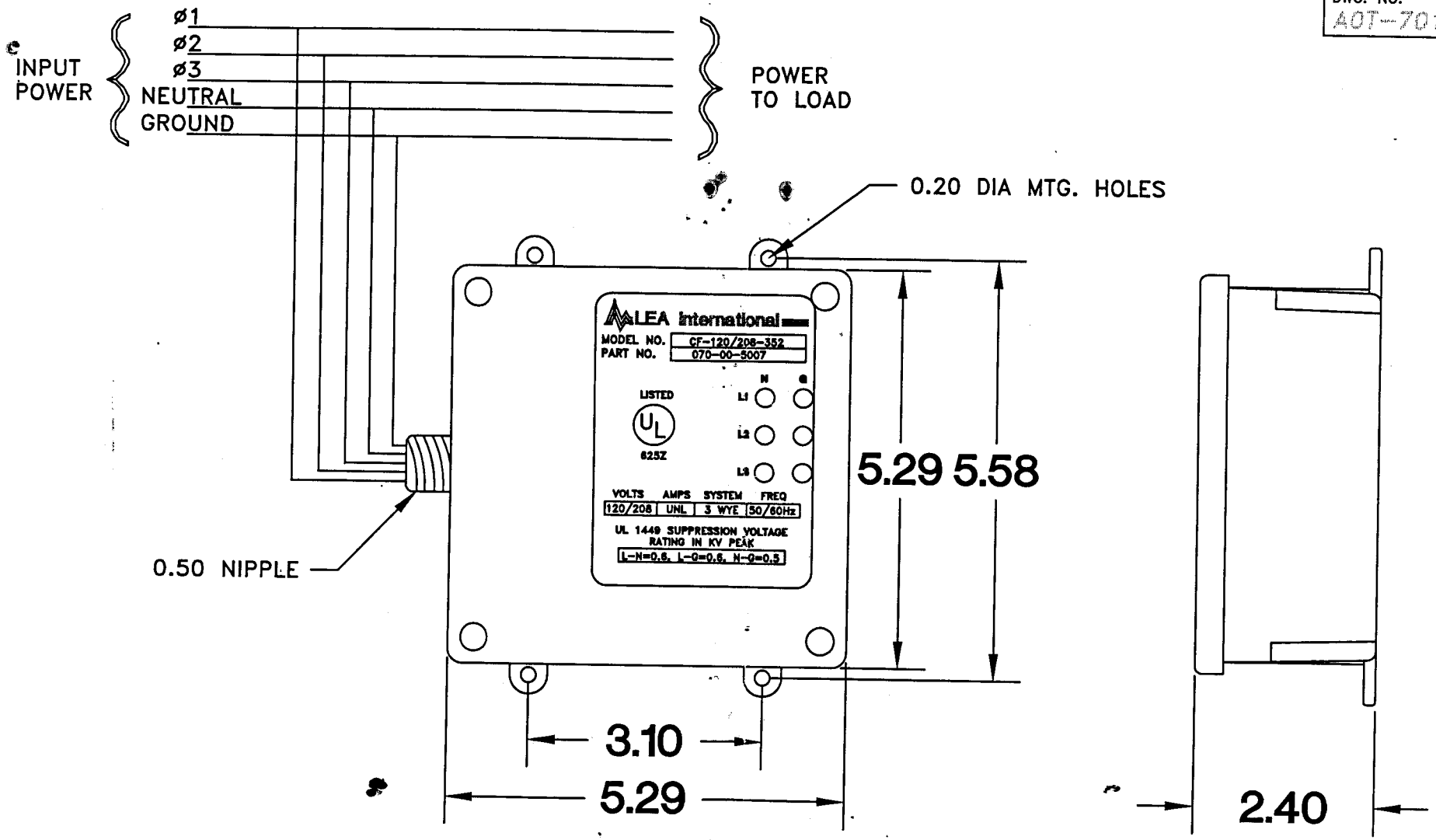
Operational status of the SPD is verified by observing the status indicator lamps. Green status lamps "ON" with input power applied indicates normal operation with all protection modes functioning. Any or all status lamps "OFF" with input power applied indicates failed or damaged device.

See page 14 for warranty information and page 16 for material return policy.

DRAWINGS

The following section contains all layout/installation drawings found within the *CFS FAMILY*. Locate the appropriate drawing based on the model number of your system.

DWG. NO.
AOT-701-311



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FORM 089-00-0006

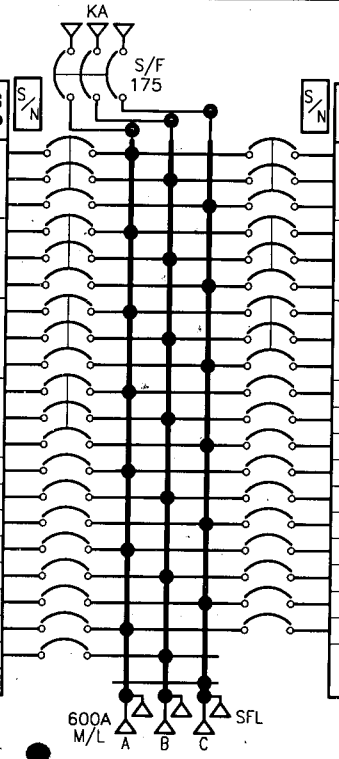
LEA International 6520 Harney Rd., Tampa, Florida 33610			
CFS 352 3ø WYE INSTALLATION/LAYOUT DRAWING			
DRAWN	SIEKIERSKI	DATE	7-18-00
APPROVED		DATE	
REV. 0	A	DWG. NO. AOT-701-311	SHEET 1 OF 1

REV	DESCRIPTION	BY	DATE				
–	----	--	--/--/--	–	----	--	--/--/--

CKT NO	ACCESSORIES	TYPE	RATING AMP/P
1		EGB	60/3
3			
5			
7		EGB	30/3
9			
11			
13		EGB	30/3
15			
17			
19		EGB	30/3
21			
23			
25		EGB	20/1
27		EGB	20/1
29		EGB	20/1
31		EGB	20/1
33		EGB	20/1
35		EGB	20/1
37		EGB	20/1
39		EGB	20/1
41			

BLANK

S/N



S/N

RATING AMP/P	TYPE	ACCESSORIES	CKT NO
30/3	EGB		2
			4
			6
30/3	EGB		8
			10
			12
30/3	EGB		14
			16
			18
30/1	EGB		20
20/1	EGB		22
20/1	EGB		24
20/1	EGB		26
20/1	EGB		28
20/1	EGB		30
20/1	EGB		32
20/1	EGB		34
20/1	EGB		36
20/1	EGB		38
			40
		BLANK	42

PHYSICAL DATA

- o ENCLOSURE: TYPE 1
  SURFACE WITH DOOR FRONT
  FRONT CAT#: NC86VSSPL
  BOX CAT#: MH86
  DIMENSIONS:
  86"H X 26"W X 5.75"D
  WIRE BENDING SPACE:
  TOP 12.2"
  BOTTOM 16.0"
  SIDE 7.1"
- o BUSSING: COPPER BUS
  STANDARD PLATING
- o SPECIAL:
  SHIP COMPLETELY ASSEMBLED
  COPPER SOLID NEUTRAL
  INCREASE LEFT SIDE GUTTER 3"
  INCREASE RIGHT SIDE GUTTER 3"
  COPPER GROUND BAR

ELECTRICAL DATA

- o SYSTEM: 480Y/277 VAC 3PH 4W 60 HZ
  22,000 AMPS SYMS. SCCR
- o MAIN: MAIN LUGS: 600A
  ACC.: SFL
  BOTTOM FEED
  22K AIC
  INCOMING CONDUCTOR(S) PER NEC:
  (2)4/0-500 kcmil
- o BRANCH MOUNTING TYPE: BOLT-ON

BRANCH SUMMATION

1-60A/3P EGB	6-30A/3P EGB
17-20A/1P EGB	1-30A/1P EGB
1-175A/3P KA	

JOB NAME:	SEARS	EQUIPMENT DESIGNATION:	dist
JOB LOCATION:	ORLANDO, FL	EQUIPMENT TYPE:	NF
DRAWN BY:	CAD	DRAWING TYPE:	ONE LINE DIAGRAM
ENGR:			SQUARE D Schneider Electric
DATE:	FEBRUARY 6 2004		
DRAWING STATUS:	RECORD	DWG# 018793207-017-01	PG 1 OF 1 REV –