BRISBANE CITY COUNCIL

OPERATION and MAINTENANCE MANUALS

For

BRISBANE WATER

SEWAGE PUMP STATION
SP292 Wirriboot Court

Manuals Prepared by:

S E Power Equipment
47 Proprietary Street
Tingalpa, Qld 4173
Phone No. 07 3890 1744

Project No: 15016
REVISION A: May 2005

Revision Status

Revision	Date	Initials	Comments
A	06-05-05	JP	Issued for approval

Prepared by: Jim Pringle Date: _____/_____/_____

Reviewed
Project Manager: _____ Date: _____/_____/_____

LOCATION: SP292 Wirriboot Court			
ENGINE **JOHN DEERE:** CD4039 TF008 **SERIAL NO:** 460721		**ALTERNATOR** **STAMFORD:** 274E **SERIAL NO:** X04I360364/1	
SEPE SERIAL NO: 0505004		**TANK CAPACITY** 400	
kWm 61	**RUN kVA** 66.25	**START kVA** 154	**C/B FRAME** 160

TABLE OF CONTENTS

SP292

Section 1 - Instructions of Use

INSTRUCTIONS FOR USE

1. Units placed on concrete slab.
2. Cable pit to be under switchboard section of unit (rear).
3. Attach hold down / anti-theft chains to location points at rear of unit (beside switchboard).
4. Check engine lube oil level.
5. Check engine coolant level.
6. Check the battery is connected and the electrolyte level is correct.
7. Connect cables to plugs via colour-coded sequence.
8. Connect power inlet socket (240V).
9. Connect communication socket.
10. Connect pump station control socket.
11. Check fuel level (mechanical gauge beside fill point).
12. Refer to section 6, Functional Description for start/run and connection procedure.
13. Remember **SAFETY** is important **ALWAYS** wear your Personal Protection Equipment (PPE)

SP292

Section 2 - John Deere Operation Manual

POWER Units for Gensets (Saran) 2.9L/4039/4.5/6.8L (128/008/158/258)

OPERATOR'S MANUAL

John Deere Usine de Saran
OMCD16564 (03JAN00)
Printed in Germany
ENGLISH

Introduction

THIS MANUAL COVERS the following engines for generator sets:

ENGINE FAMILY	ENGINE MODEL
300-SERIES	CD3029DF128
	CD4039DF008
	CD4039TF008
POWERTECH®	CD4045DF158
	CD4045HF158
	CD4045TF158
	CD4045TF258
	CD6068HF158
	CD6068TF158
	CD6068TF258

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 metric. Use only correct replacement parts and fasteners. Metric and inch fasteners may require a specific metric or inch wrench.

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 or machine.

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.

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

Information relative to emissions regulations
Depending on final destination, this engine can meet the emissions regulations according to the US Environmental Protection Agency (EPA), California Air Resources Board (CARB) and for Europe, the Directive 97/68/EC relating the measures against the emissions of gaseous and particulates pollutants from internal combustion engines. In this case an emission label is stuck on the engine.

Emission regulations prohibit tampering with the emission-related components listed below which would render that component inoperative or to make any adjustment on the engine beyond published specifications. It is also illegal to install a part or component where the principal effect of that component is to bypass, defeat, or render inoperative any engine component or device which would affect the engine conformance to the emissions regulations. To summarize, it is illegal to do anything except return the engine to its original published specifications.

List of emission-related components:

- Fuel injection pump
- Intake manifold
- Turbocharger
- Charge air cooling system
- Piston

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.

POWERTECH is a trademark of Deere & Company

DPSG,CD03523,1 –19–01JUL99–1/1

112699
PN=2

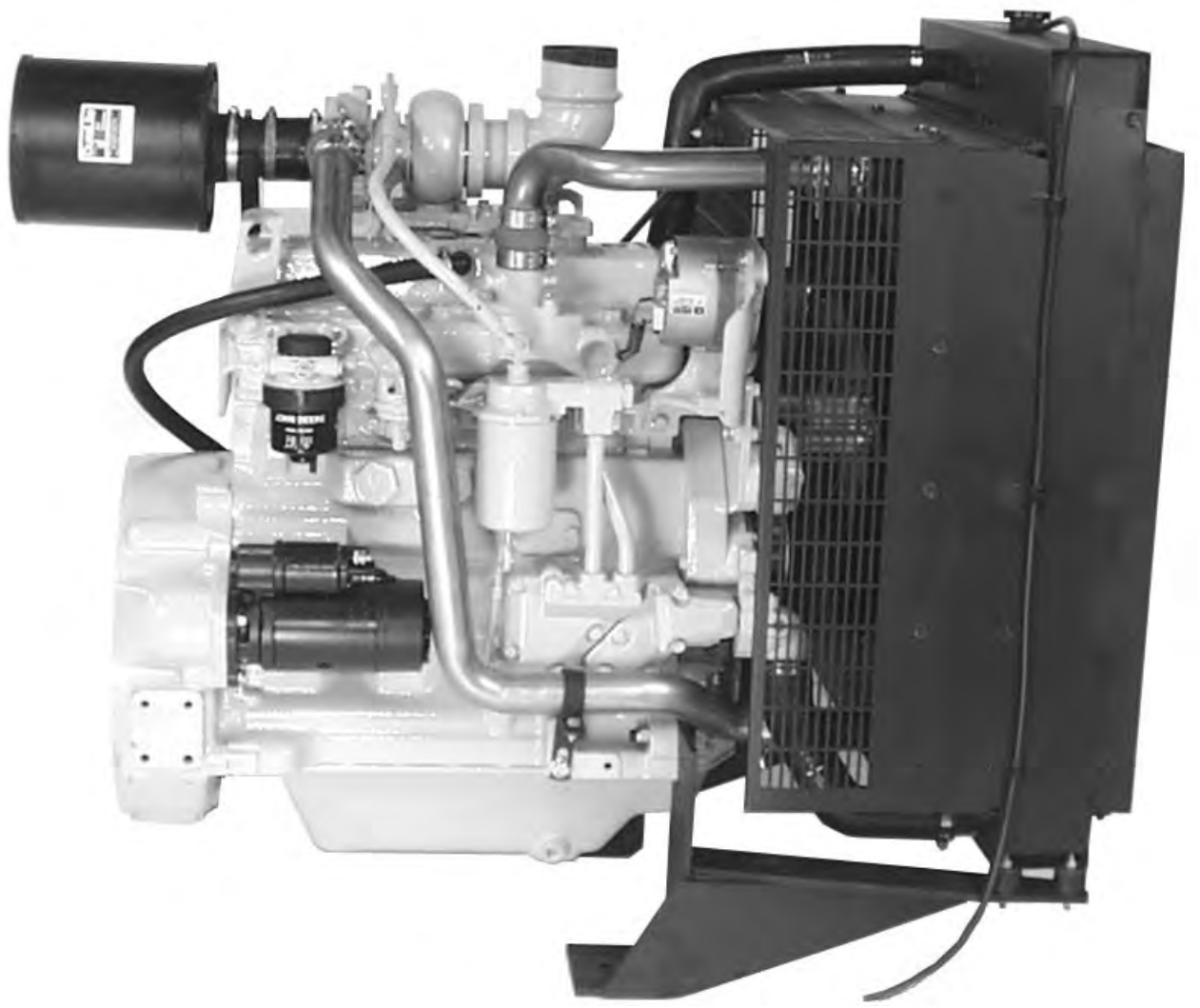
Contents

Continued on next page

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Identification Views

IDENTIFICATION VIEWS

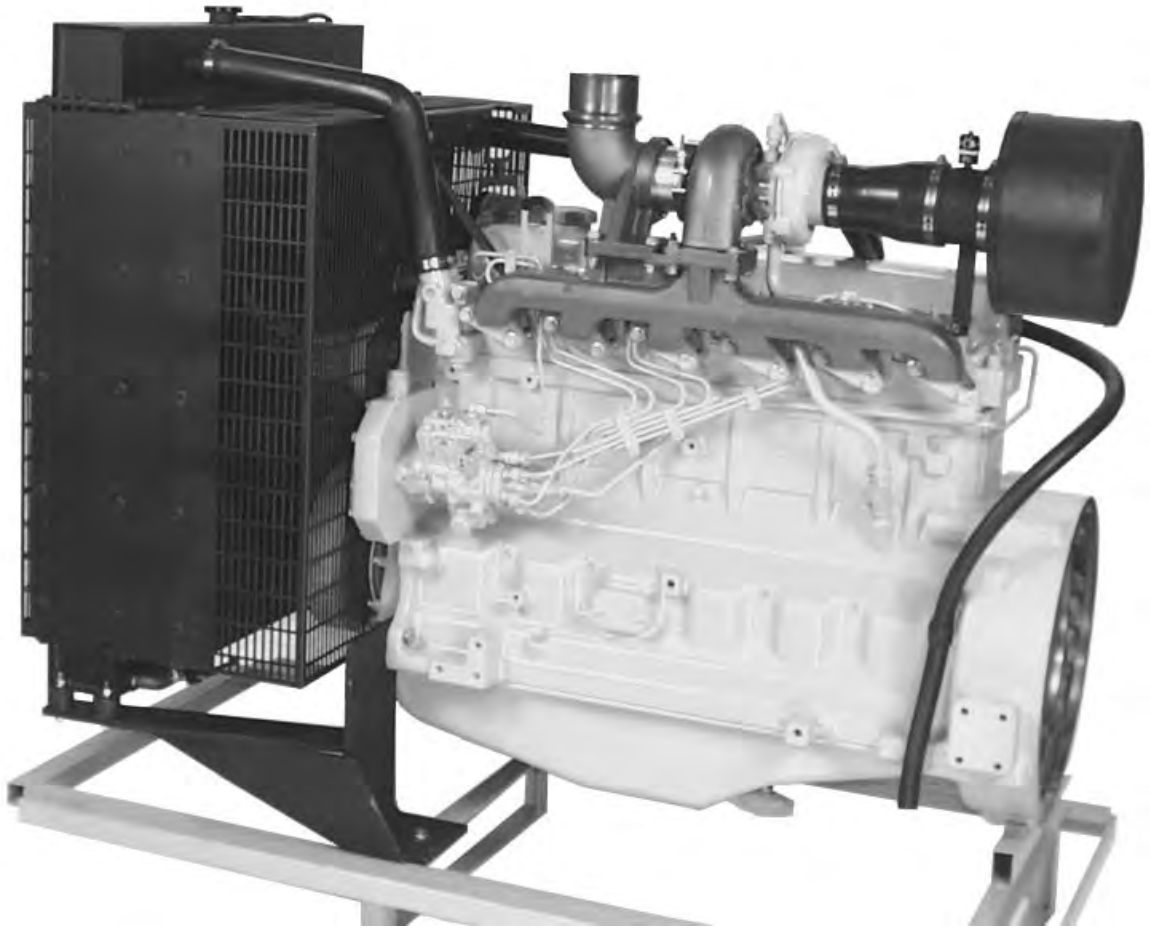


CD30744 –UN–23AUG99

4045HF158

Continued on next page

DPSG,CD03523,3 –19–05JUL99–1/2



CD30745 –UN–23AUG99

6068HF158

DPSG,CD03523,3 –19–05JUL99–2/2

Maintenance Records

USING MAINTENANCE RECORDS

To obtain the best performance, economy and service life from your engine, ensure service is carried out according to this present manual and recorded in the following pages. It is recommended that your engine Distributor or your Dealer carry out this service work and stamp the appropriate case.

Keeping an accurate account of all service performed on your engine will give more value to the machine when you resell it.

John Deere oils and coolants have been formulated to give maximum protection and performance to your engine. We recommend only genuine John Deere service products and replacement parts.

To protect your rights under the warranty ensure all scheduled services are carried out and recorded. If your engine is covered by extended warranty, it is important to maintain this record for the duration of the warranty.

DPSG,CD03523,6 –19–05JUL99–1/1

100 HOURS OF OPERATION

❒ Engine oil, replace ❒ Engine oil filter, replace ❒ Hose connections, check	

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,7 –19–05JUL99–1/1

500 HOURS OF OPERATION

❒ Engine oil, replace
❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,8 –19–05JUL99–1/1

1000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Air intake system, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,9 –19–05JUL99–1/1

1500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,10 –19–05JUL99–1/1

2000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Cooling system, drain and flush (if COOL-GARD is not used)

❒ Valve clearance, adjust (POWERTech)

❒ Air intake system, check

❒ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,59 –19–16AUG99–1/1

2500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

❒ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,60 –19–16AUG99–1/1

3000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Air intake system, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,61 –19–16AUG99–1/1

3500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,62 –19–16AUG99–1/1

4000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Cooling system, drain and flush (if COOL-GARD is not used)

❒ Valve clearance, adjust (POWERTech)

❒ Air intake system, check

❒ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,63 –19–16AUG99–1/1

4500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

❒ Vibration damper, replace (6 cyl.)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,64 –19–16AUG99–1/1

5000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Injection nozzles, replace

❒ Air intake system, check

❒ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,65 –19–16AUG99–1/1

5500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,66 –19–16AUG99–1/1

6000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Cooling system, drain and flush (if COOL-GARD is not used)

❒ Valve clearance, adjust (POWERTech)

❒ Air intake system, check

❒ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,67 –19–16AUG99–1/1

6500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,68 –19–16AUG99–1/1

7000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Air intake system, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,69 –19–16AUG99–1/1

7500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

❒ Cooling system, drain and flush (if COOL-GARD is used)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,70 –19–16AUG99–1/1

8000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Cooling system, drain and flush (if COOL-GARD is not used)

❒ Valve clearance, adjust (POWERTech)

❒ Air intake system, check

❒ Vibration damper, check

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,71 –19–16AUG99–1/1

8500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,72 –19–16AUG99–1/1

9000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Air intake system, check

❒ Vibration damper, replace (6 cyl.)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,73 –19–16AUG99–1/1

9500 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Belt, check tension and wear (300-Series and POWERTech with manual tensioner)

❒ Valve clearance, adjust (300-Series)

Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,74 –19–16AUG99–1/1

10000 HOURS OF OPERATION

❒ Engine oil, replace

❒ Engine oil filter, replace

❒ Fuel filter, replace

❒ Check belt and tensioning system

❒ Crankcase vent tube, clean

❒ Air intake system, check

❒ Cooling system, drain and flush

❒ Valve clearance, adjust (POWERTech)

❒ Thermostat, replace

❒ Vibration damper, check

❒ Injection nozzles, replace

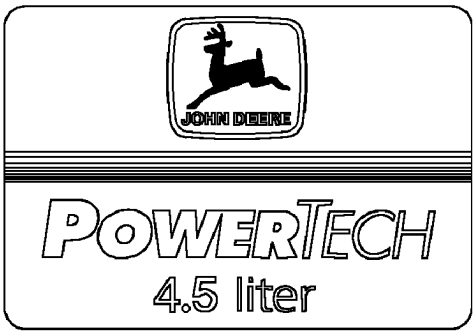
Number of hours: Date: Job done by:	Comments:	Dealer or distributor stamp

DPSG,CD03523,75 –19–16AUG99–1/1

Record Keeping

POWERTECH® MEDALLION

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

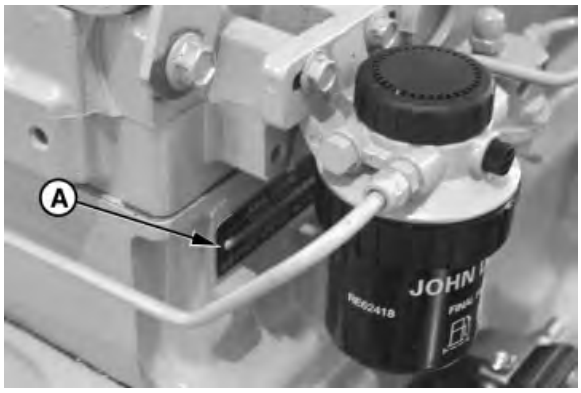


RG8041 –UN–15JAN99

POWERTECH is a trademark of Deere & Company

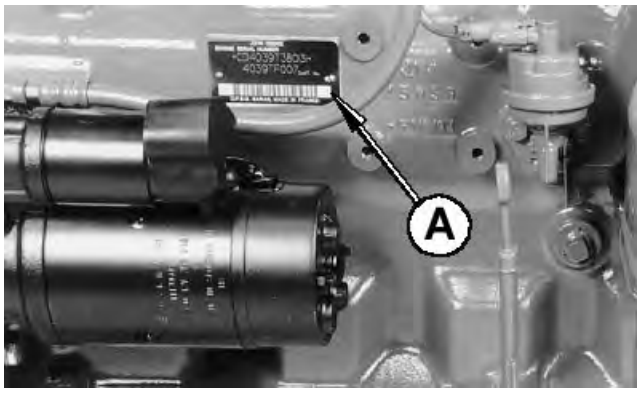
DPSG,CD03523,11 –19–05JUL99–1/1

ENGINE SERIAL NUMBER PLATE



RG8007 –UN–15JAN99

POWERTech engine



CD30746 –UN–24SEP99

300-Series engine

Each engine has a 13–digit John Deere serial number. The first two digits identify the factory that produced the engine:

“CD” indicates the engines was built in Saran, France.

Your engine’s serial number plate (A) is located on the right-hand side of cylinder block behind the fuel filter for POWERTech engines and near the fuel supply pump on 300–Series engines.

DPSG,CD03523,12 –19–05JUL99–1/1

RECORD ENGINE SERIAL NUMBER

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 (B)

_____

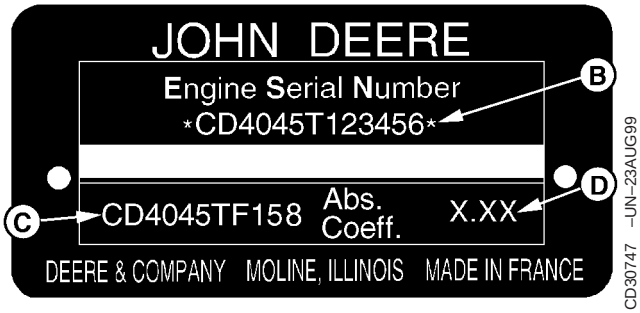
Engine Model Number (C)

_____

Coefficient of Absorption Value (D)

_____

300-Series engine plate



POWERTech engine plate

DPSG,CD03523,13 –19–05JUL99–1/1

ENGINE OPTION CODES

Engine option code label

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.

An additional sticker may be also delivered (in a plastic bag attached to the engine or inserted in the machine documentation). It is recommended to stick this option code list sticker either:

- On this page of your Operator's manual below this section.

or

- On the "Engine Owner's Warranty" booklet under the title OPTION CODES (Engine manufacturing configuration).

NOTE: The Machine Manufacturer may have already stuck it at a specific accessible place (inside the enclosure or close to a maintenance area).

The engine option code label includes an engine base code (A). This base code must also be recorded along with the option codes. At times it will be necessary to furnish this base code to differentiate two identical option codes for the same engine model.

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 12-volt, 55-amp alternator.

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.

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.

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

Continued on next page

DPSG,CD03523,14 –19–05JUL99–1/2

Option Codes	Description	Option Codes	Description
Engine Base Code:_____			
11____	Rocker Arm Cover	45____	Balancer Shaft
12____	Oil Filler Neck	46____	Cylinder Block With Liners and Camshaft
13____	Crankshaft Pulley	47____	Crankshaft and Bearings
14____	Flywheel Housing	48____	Connecting Rods and Pistons
15____	Flywheel	49____	Valve Actuating Mechanisms
16____	Fuel Injection Pump	50____	Oil Pump
17____	Air inlet	51____	Cylinder Head With Valves
18____	Air cleaner	52____	Auxiliary Gear Drive
19____	Oil pan	54____	Oil heater
20____	Coolant pump	55____	Shipping stand
21____	Thermostat Cover	56____	Paint Option
22____	Thermostat	57____	Coolant Inlet
23____	Fan Drive	59____	Oil Cooler
24____	Fan Belt	60____	Add-on Auxiliary Drive Pulley
25____	Fan	62____	Alternator Mounting
26____	Engine Coolant Heater	64____	Exhaust Elbow
27____	Radiator	65____	Turbocharger
28____	Exhaust Manifold	66____	Temperature Switch
29____	Ventilator System	67____	Electronic Tachometer Sensor
30____	Starting Motor	68____	Damper
31____	Alternator	69____	Engine Serial Number Plate
32____	Instrument Panel	74____	Air Conditioning System Compressor Mounting
35____	Fuel Filter	75____	Air Restriction Indicator
36____	Front Plate	76____	Oil Pressure Switch
37____	Fuel Transfer Pump	86____	Fan Pulley
39____	Thermostat Housing	87____	Automatic Belt Tensioner
40____	Oil Dipstick	88____	Oil Filter
41____	Belt Driven Front Auxiliary Drive	91____	Special Equipment (Factory Installed)
43____	Starting Aid	97____	Special Equipment (Field Installed)
44____	Timing Gear Cover with Gears	98____	Shipping

DPSG,CD03523,14 –19–05JUL99–2/2

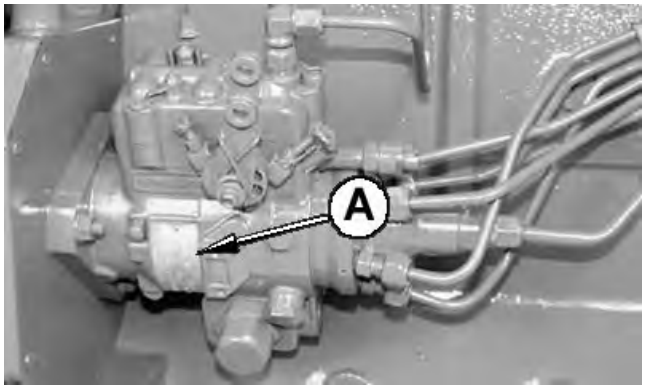
RECORD FUEL INJECTION PUMP MODEL NUMBER

Record the fuel injection pump model and serial information found on the serial number plate (A).

Model No. _____ RPM _____

Manufacturer's No. _____

Serial No. _____



CD30749 –UN–24SEP99

DPSG,CD03523,15 –19–07JUL99–1/1

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.

T81389 –UN–07DEC88

DX,ALERT –19–29SEP98–1/1

UNDERSTAND SIGNAL WORDS

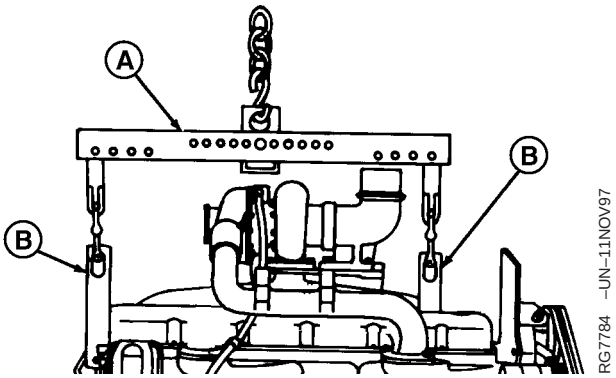
A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

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.

TS187 –19–30SEP88

DX,SIGNAL –19–03MAR93–1/1

ENGINE LIFTING PROCEDURE



CAUTION: The only recommended method for lifting the engine is with JDG23 Engine Lifting Sling (A) and safety approved lifting straps (B) that come with engine. Use extreme caution when lifting and NEVER permit any part of the body to be positioned under an engine being lifted or suspended.

Lift engine with longitudinal loading on lifting sling and lifting straps only. Angular loading greatly reduces lifting capacity of sling and straps.

NOTE: If engine does not have lifting straps, universal straps can be procured through service parts under part numbers JD-244-1 and JD-244-2.

1. If not equipped, install lifting straps and torque to 200 N•m (145 lb-ft).

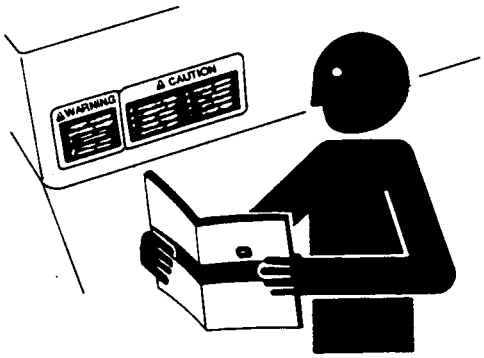
2. Attach JDG23 Engine Lifting Sling (A) to engine lifting straps (B) and overhead hoist.

IMPORTANT: Lifting straps are designed to lift the engine and accessories such as radiator, air filter and other small components. If larger components, such as power take-off, transmission, generator air compressor... etc, are attached to engine, the lifting straps provided with engine or through parts channel are not intended for this purpose. Technician is responsible for providing adequate lifting devices under these situations. See machine manuals for additional information on removing engine from machine.

3. Carefully move engine to desired location.

DPSG,CD03523,95 –19–06OCT99–1/1

FOLLOW SAFETY INSTRUCTIONS



TS201 –UN–23AUG88

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 machine and how to use controls properly. Do not let anyone operate without instruction.

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

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

DX,READ –19–03MAR93–1/1

PREVENT MACHINE RUNAWAY

TS177 –UN–11JAN89

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.

DX,BYPAS1 –19–29SEP98–1/1

HANDLE FUEL SAFELY—AVOID FIRES

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

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

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

TS202 –UN–23AUG88

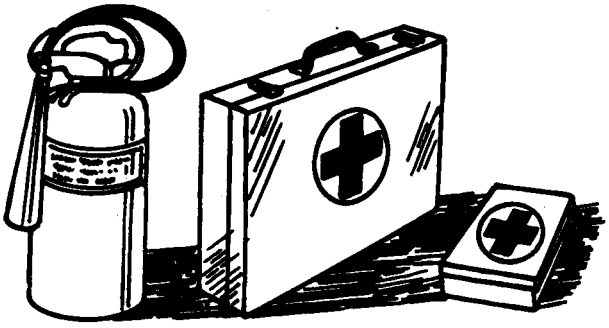
DX,FIRE1 –19–03MAR93–1/1

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

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

DX,FIRE3 –19–16APR92–1/1

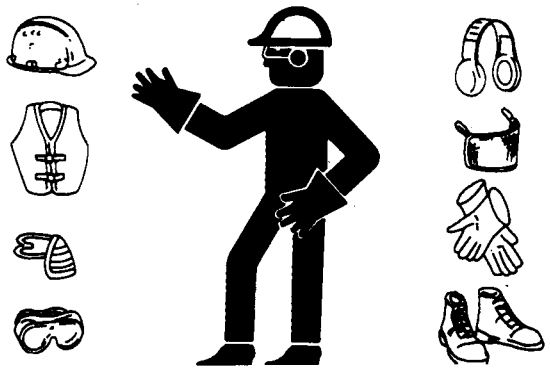
WEAR PROTECTIVE CLOTHING

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.



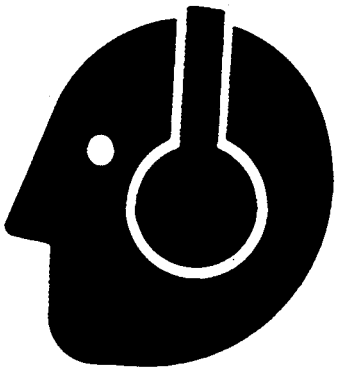
TS206 –UN–23AUG88

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

DX,NOISE –19–03MAR93–1/1

HANDLE CHEMICAL PRODUCTS SAFELY

TS1132 –UN–26NOV90

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.)

DX,MSDS,NA –19–03MAR93–1/1

STAY CLEAR OF ROTATING DRIVELINES

TS1644 –UN–22AUG95

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 the PTO driveline is stopped before making adjustments or performing any type service on the engine or PTO-driven equipment.

CD,PTO –19–12SEP95–1/1

PRACTICE SAFE MAINTENANCE

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

Never lubricate, service, or adjust machine 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 machine to cool.

Securely support any machine 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.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

TS218 –UN–23AUG88

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

DX,AIR –19–17FEB99–1/1

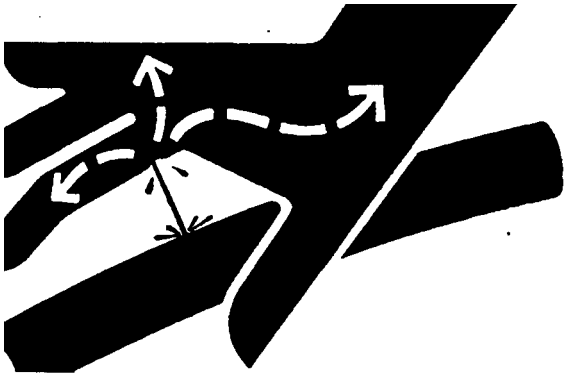
AVOID HIGH-PRESSURE FLUIDS

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

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

DX,TORCH –19–03MAR93–1/1

REMOVE PAINT BEFORE WELDING OR HEATING

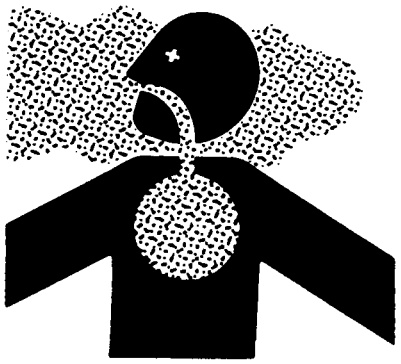
Avoid potentially toxic fumes and dust.

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

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- 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.



TS220 –UN–23AUG88

DX,PAINT –19–03MAR93–1/1

SERVICE COOLING SYSTEM SAFELY

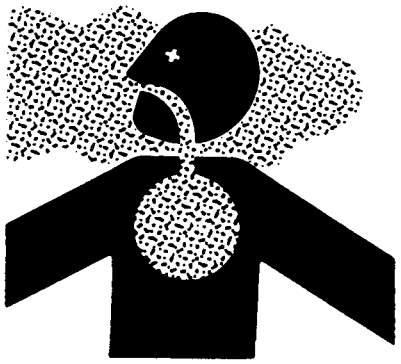
Explosive release of fluids from pressurized cooling system can cause serious burns.

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

DX,RCAP –19–04JUN90–1/1

AVOID HARMFUL ASBESTOS DUST



TS220 –UN–23AUG88

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

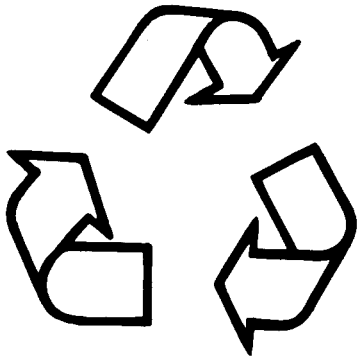
Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos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

DX,DUST –19–15MAR91–1/1

DISPOSE OF WASTE PROPERLY



TS1133 –UN–26NOV90

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.

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.

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

Cetane number of 40 minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1500 m (5,000 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 of 3100 gram load level as measured by the BOCLE scuffing test.

Sulfur content:

- Sulfur content should not exceed 0.5%. Sulfur content less than 0.05% is preferred.
- If diesel fuel with sulfur content greater than 0.5% sulfur content is used, reduce the service interval for engine oil and filter by 50%.
- DO NOT use diesel fuel with sulfur content greater than 1.0%.

Bio-diesel fuels may be used ONLY if the fuel properties meet DIN 51606 or equivalent specification.

DO NOT mix used engine oil or any other type of lubricant with diesel fuel.

DX,FUEL1 –19–17FEB99–1/1

HANDLING AND STORING 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 condensation and freezing during cold weather.

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.

DX,FUEL4 –19–18MAR96–1/1

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.

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 CE
- 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 API CG4, API CF4, ACEA E3, or ACEA E2 performance levels during the first 100 hours of operation of a new or rebuilt engine. These oils will not allow the engine to break-in properly.

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

DX,ENOIL4 –19–10OCT97–1/1

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 oil is also recommended:

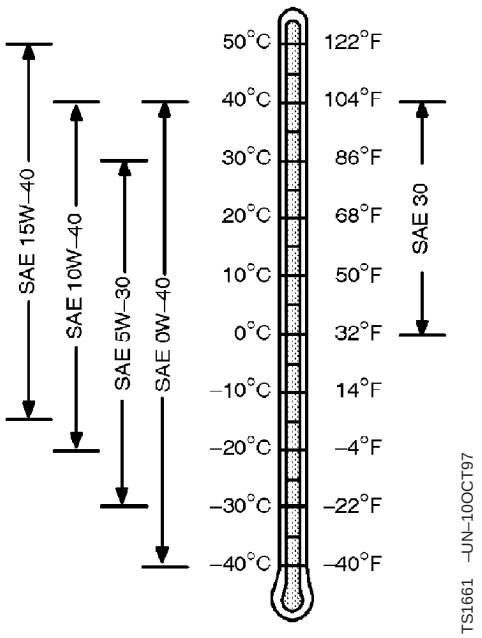
- John Deere TORQ-GARD SUPREME TORQ-GARD SUPREME®

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

- API Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2

Multi-viscosity diesel engine oils are preferred.

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



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

CD,ENOIL –19–10OCT97–1/1

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

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 dealer to obtain specific information and recommendations.

DX,LUBMIX –19–18MAR96–1/1

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 is preferred for service.

If John Deere COOL-GARD is not available, use a low silicate ethylene glycol base coolant concentrate in a 50% mixture of concentrate with quality water.

The coolant concentrate shall be of a quality that provides cavitation protection to cast iron and aluminum parts in the cooling system. John Deere COOL-GARD meets this requirement.

A 50% mixture of ethylene glycol engine coolant in water provides freeze protection to -37°C (-34°F). If protection at lower temperatures is required, consult your John Deere dealer for recommendations.

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.

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

COOLANT DRAIN INTERVALS

Drain the factory fill engine coolant, flush the cooling system, and refill with new coolant after the first 3 years or 3000 hours of operation. Subsequent drain intervals are determined by the coolant used for service. At each interval, drain the coolant, flush the cooling system, and refill with new coolant.

When John Deere COOL-GARD is used, the coolant drain interval is 3 years or 3000 hours of operation.

If COOL-GARD is not used, the drain interval is reduced to 2 years or 2000 hours of operation.

DX,COOL8 –19–12FEB99–1/1

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

Operating the Engine

BREAK-IN PERIOD

Within first 100 hours of operation
During the first 100 hours of operation, avoid overloading, excessive idling and no-load operation.

See ENGINE BREAK-IN OIL for eventual addition of oil.

NOTE: During the break-in period a higher-than-usual oil consumption should be considered as normal.

After first 100 hours of operation
After the first 100 hours, drain the crankcase and change the oil filter (see CHANGING ENGINE OIL AND FILTER). Fill crankcase with seasonal viscosity grade oil (see DIESEL ENGINE OIL).

Check tension of alternator belt.

Check connections of air intake hoses.

Check for proper tightening of cap screws all around the engine.

DPSG,CD03523,17 –19–09JUL99–1/1

STARTING THE ENGINE

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

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

1. Perform all prestarting checks outlined in Maintenance/Daily Section.
2. Open the fuel supply shut-off valve, if equipped.
3. Activate the starter motor switch to crank the engine and release it as soon as engine starts.

NOTE: Do not operate the starter motor more than 20 seconds at a time.

DPSG,CD03523,18 –19–09JUL99–1/1

COLD WEATHER OPERATION

Depending on equipment, various cold weather starting aids are available to assist in starting the engine at temperatures below 0°C (32°F).

Continued on next page

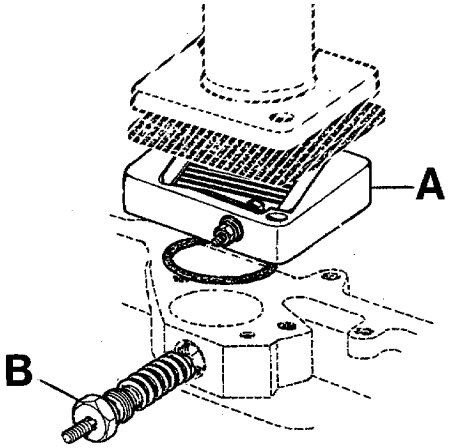
DPSG,CD03523,19 –19–09JUL99–1/4

Air intake heater

Air intake heater is either a grid-type (A) for POWERTech engines or a glow plug-type (B) for 300-Series engines installed in the air intake channel.

CAUTION: NEVER use Ether Starting Fluid when air intake heater is used to start the engine.

Activate the heating element (preheater position) for 30 seconds maximum then start the engine.



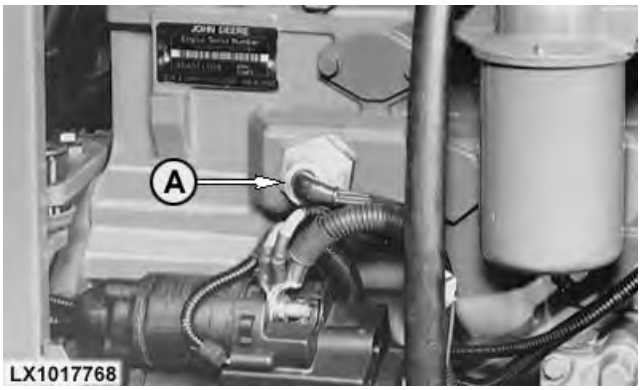
CD30750 –UN–03SEP99

DPSG,CD03523,19 –19–09JUL99–2/4

Coolant heater

Connect plug of coolant heater (A) to a power source (110 or 220 V).

At an ambient temperature of -15°C (5°F), the heating process takes approximatively 2 hours. Extend heating period if ambient temperature is lower.



LX1017768 –UN–24OCT97

DPSG,CD03523,19 –19–09JUL99–3/4

Fuel preheater

Fuel preheater (A) switches ON and OFF automatically in relation to the ambient temperature.

LX1017708 –UN–09OCT97

DPSG,CD03523,19 –19–09JUL99–4/4

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 batteries is explosive. Keep sparks and flames away from batteries. 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.

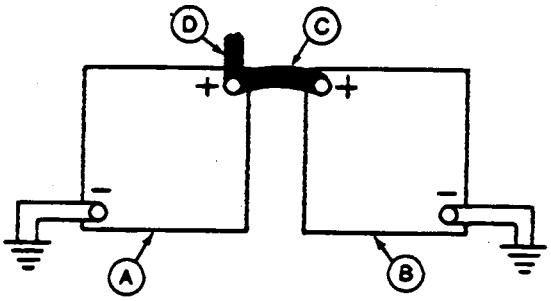
IMPORTANT: Be sure polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive to positive and negative to ground. Always use 12-volt booster battery for 12-volt electrical systems and 24-volt booster battery/ batteries for 24-volt electrical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

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.

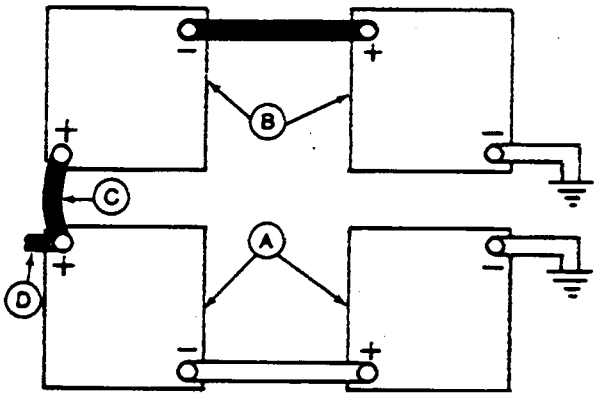
2. Connect one end of jumper cable to the POSITIVE (+) post of the booster battery.
3. Connect the other end of the jumper cable to the POSITIVE (+) post of battery connected to starter.
4. Connect one end of the other jumper cable to the NEGATIVE (–) post of the booster battery.
5. ALWAYS complete the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

TS204 –UN–23AUG88



RG4678 –UN–14DEC88

12-Volt System



RG4698 –UN–14DEC88

24-Volts System

A—12-Volt Machine battery/batteries
B—12-Volt Booster battery/batteries
C—Booster cable
D—Cable to starter motor

DPSG,CD03523,20 –19–09JUL99–1/1

ENGINE OPERATION

Warming engine
Operate engine at high idle for 1 to 2 minutes before applying the load.

NOTE: This procedure does not apply to standby generator sets where the engine is loaded immediately upon reaching rated speed.

Normal engine operation
Compare engine coolant temperature and engine oil pressure with specifications below:

Minimum oil pressure at full load rated speed[1]—Specification

Pressure..... 275 kPa (2.75 bar; 40 psi)

Coolant temperature range—Specification

Temperature ..... 82°—94°C (180°—202°F)

Stop engine immediately if coolant temperature is above or oil pressure below specifications or if there are any signs of part failure. Symptoms that may be early signs of engine problems could be:

- Sudden loss of power
- Unusual noise or vibration
- Excessive black exhaust fumes
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

Recommendation for turbocharger engines
Should the engine stall when operating under load, IMMEDIATELY restart it to prevent overheating of turbocharger components.

Idling engine
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. If an engine will be idling for more than 5 minutes, stop and restart later.

NOTE: Generator set applications have the governor locked at a specified speed and do not have a slow idle function. These engines idle at no load governed speed (fast idle).

[1]Oil at normal operating temperature of 115°C (240°F).

DPSG,CD03523,21 –19–09JUL99–1/1

STANDBY POWER UNITS

To assure 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 an extended period of time with no load.

DPSG,CD03523,22 –19–09JUL99–1/1

STOPPING THE ENGINE

1. Before stopping, run engine for at least 2 minutes at fast idle and no load.

2. Stop the engine.

DPSG,CD03523,23 –19–09JUL99–1/1

Maintenance

OBSERVE SERVICE INTERVALS

Using hour meter 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 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.

DPSG,CD03523,24 –19–09JUL99–1/1

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

DPSG,CD03523,25 –19–09JUL99–1/1

MAINTENANCE INTERVAL CHART

Item	10 H / daily	500 H	1000 H / 1 year	2000 H / 2 years	2500 H / 3 years	As required
Check engine oil and coolant level	•					
Check air filter restriction indicator[a]	•					
Change engine oil and filter[b]		•				
Replace fuel filter element		•				
Check belt tension and automatic tensioner[c]		•	•			
Check and adjust valve clearance[d]			•	•		
Clean crankcase vent tube			•			
Check air intake hoses, connections and system			•			
Check vibration damper (6 cyl.)[e]				•		
Check engine speed and speed droop governor				•		
Drain and flush cooling system[f]				•	•	
Drain water and sediment from fuel filter						•
Clean filter element (see note a)						•
Test thermostat and injection nozzles (see your dealer)[g]						•

[a]Clean air filter element when restriction indicator is red. Replace filter element after 6 cleanings or once a year.

[b]Change oil and filter after the first 100 hours of operation, then every 500 hours thereafter. Change oil and filter at least once a year.

[c]Check belt tension every 500 hours on 300-Series engines and on POWERTech engines with manual tensioner. Check automatic belt tensioner every 1000 hours/1 year on POWERTech engines when equipped.

[d]Have your authorized servicing dealer or engine distributor adjust valve clearance as follows. After the first 500 hours of operation then every 1000 hours thereafter on 300-Series engines. Every 2000 hours on POWERTech engines.

[e]Have your authorized dealer or engine distributor replace the vibration damper every 4500 hours/5 years.

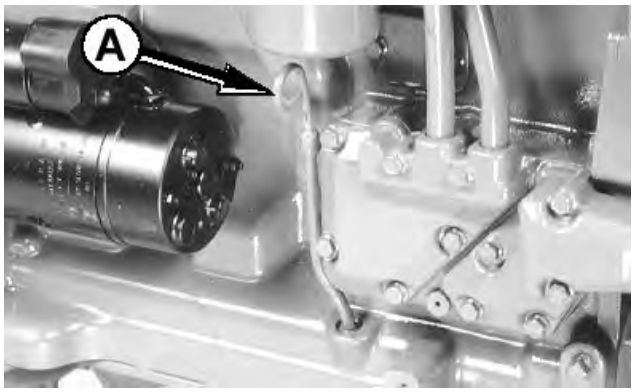
[f]Drain and flush cooling system every 2500 hours/3 years when John Deere COOL-GARD coolant is used. Otherwise every 2000 hours/2 years.

[g]Contact your dealer when thermostat or injection nozzles are suspected to be defective. Replace injection nozzles every 5000 hours and thermostat every 10000 hours.

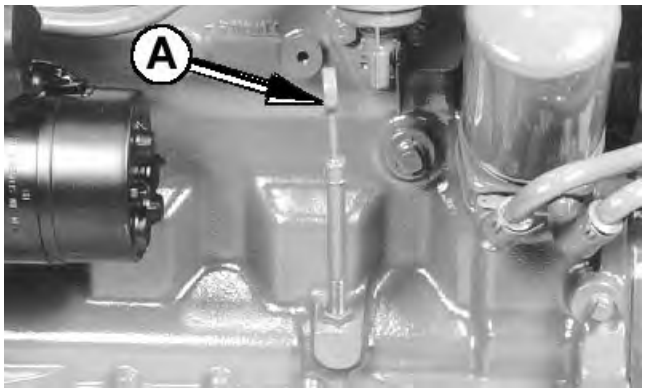
DPSG,CD03523,26 –19–09JUL99–1/1

Maintenance/Daily or every 10 hours

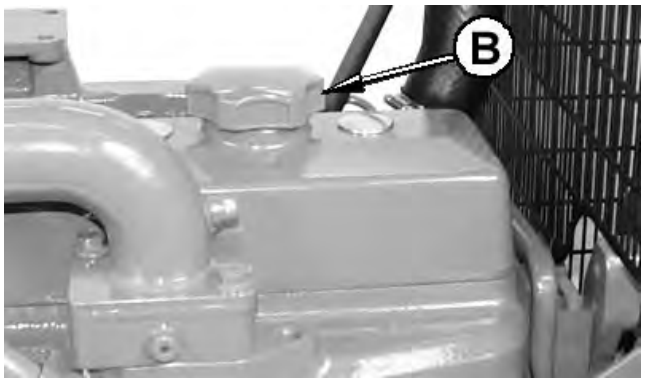
DAILY PRESTARTING CHECKS

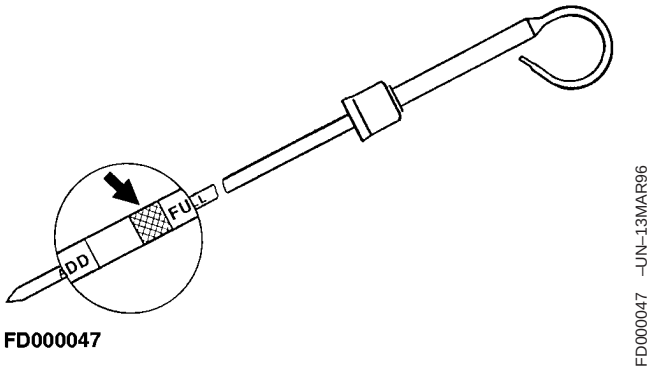


POWERTech engine



300-Series engine





FD000047

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

IMPORTANT: DO NOT top up with fresh oil until the oil level is BELOW the add mark.

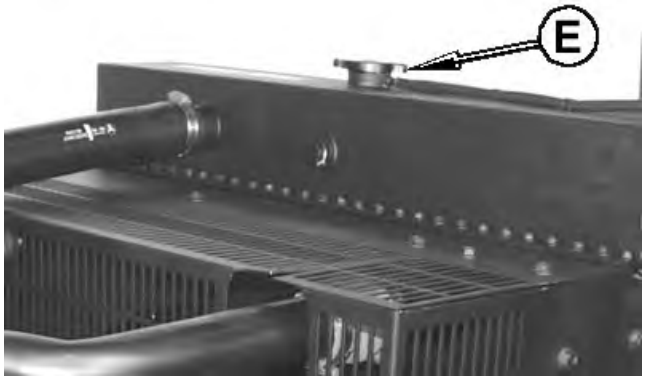
1. Check engine oil level on dipstick (A). Add as required, using seasonal viscosity grade oil. (See DIESEL ENGINE OIL). Add oil at rocker arm cover filler cap (B).

IMPORTANT: DO NOT fill above the crosshatch area. Oil levels anywhere within crosshatch are considered in the acceptable operating range.

Continued on next page

DPSG,CD03523,27 –19–12JUL99–1/3

TS281 –UN–23AUG88



CD30756 –UN–26AUG99

2. **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.

Remove radiator cap (E) and check coolant level which should be at bottom of filler neck. Fill radiator with proper coolant solution if level is low. (See DIESEL ENGINE COOLANT). Check overall cooling system for leaks.

DPSG,CD03523,27 –19–12JUL99–2/3

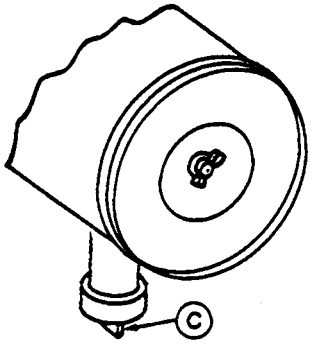
3. If air filter has a dust unloading valve (C), squeeze valve tip to release any trapped dirt particles.

4. Check air intake restriction indicator (D). When indicator is red, air filter needs to be cleaned.

IMPORTANT: Maximum air intake restriction is 6.25 kPa (0.06 bar; 1.0 psi) (25 in. H_2O). A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine.

5. Make a thorough inspection of the engine compartment.

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



RG4687 –UN–20DEC88

CD30757 –UN–26AUG99

DPSG,CD03523,27 –19–12JUL99–3/3

Maintenance/500 hours

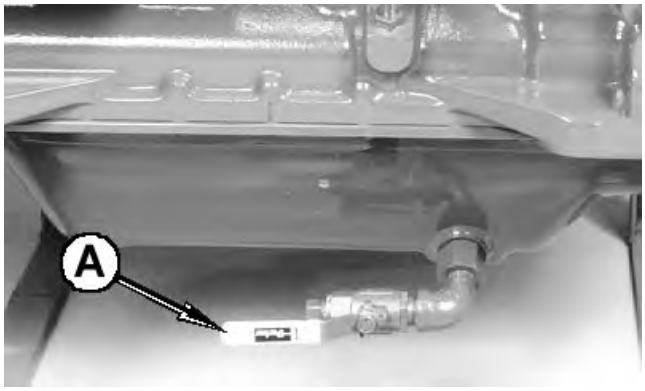
CHANGING ENGINE OIL AND FILTER

NOTE: Change engine oil and filter for the first time after 100 hours maximum of operation, then every 500 hours thereafter. Change oil and filter at least once a year.

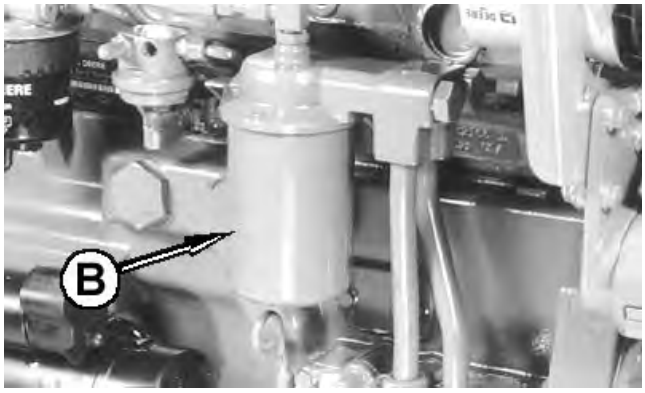
1. Run engine approximately 5 minutes to warm up oil. Shut engine off.
2. Open oil pan drain valve (A).
3. Drain crankcase oil from engine while warm.
4. Remove and discard oil filter element (B) using a suitable filter wrench.
5. Remove oil filter packing and clean filter mounting pad.

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

6. Oil the new packing and install a new filter element. Hand tighten element according to values printed on filter element. If values are not provided, tighten element approximately 3/4 — 1-1/4 turn after packing contacts filter housing. DO NOT overtighten filter element.
7. Close oil pan drain valve.

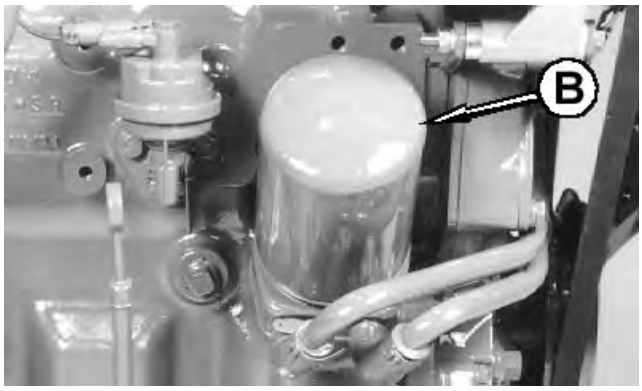


CD30758 –UN–26AUG99



CD30759 –UN–26AUG99

POWERTEch engine



CD30760 –UN–26AUG99

300-Series engine

Continued on next page

DPSG,CD03523,29 –19–12JUL99–1/2

8. Fill engine crankcase with correct John Deere engine oil through rocker arm cover opening (C); see DIESEL ENGINE OIL.

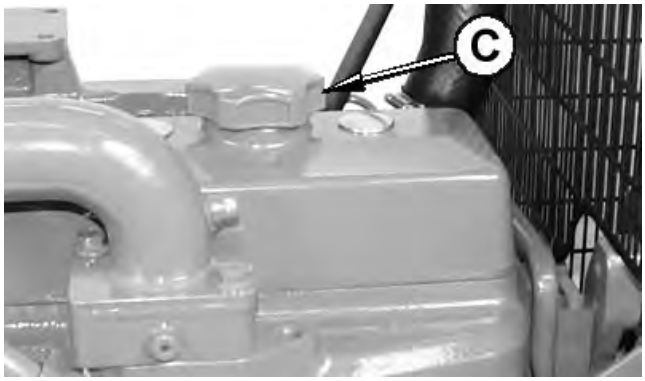
   To determine the correct oil fill quantity for your engine, see “Engine Oil Quantities” in Specifications Section.

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

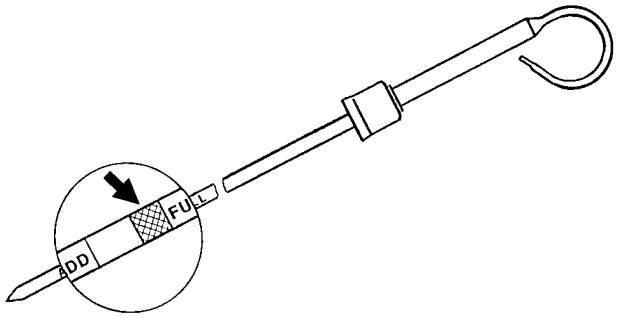
IMPORTANT: Immediately after completing any oil change, crank engine for 30 seconds without permitting engine to start. This will help insure adequate lubrication to engine components before engine starts.

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

10. Stop engine and check oil level after 10 minutes. If necessary, top up.



CD30761 –UN–24SEP99

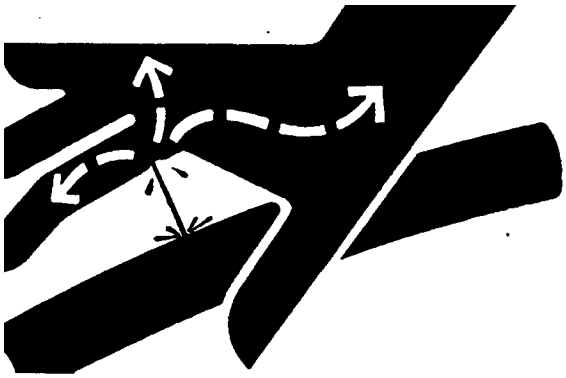


FD000047

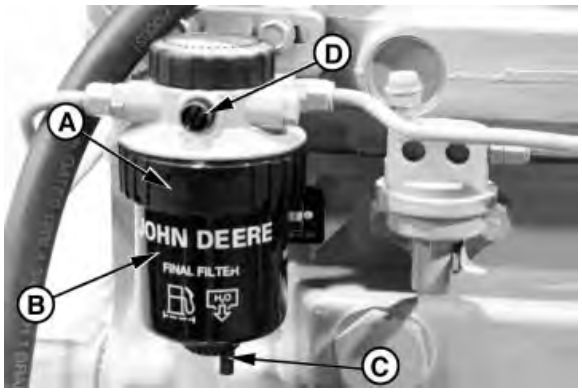
FD000047 –UN–13MAR96

DPSG,CD03523,29 –19–12JUL99–2/2

REPLACING FUEL FILTER ELEMENT



X9811 –UN–23AUG88



RG7721 –UN–15JAN99

A—Retaining ring **B—Filter element** **C—Drain plug** **D—Bleed plug**

CAUTION: CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Thoroughly clean fuel filter assembly and surrounding area.

2. Loosen drain plug (C) and drain fuel into a suitable container.

NOTE: Lifting up on retaining ring as it is rotated helps to get it past raised locators.

3. Firmly grasp the retaining ring (A) and rotate it clockwise 1/4 turn. Remove ring with filter element (B).

IMPORTANT: Do not dump the old fuel into the new filter element. This could cause fuel injection problem.

A plug is provided with the new element for plugging the used element.

4. Inspect filter mounting base for cleanliness. Clean as required.

NOTE: Raised locators on fuel filter canister must be indexed properly with slots in mounting base for correct installation.

5. Install new filter element dry onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate filter for correct alignment.

6. Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about 1/3 turn) until it “snaps” into the detent. DO NOT overtighten retaining ring.

NOTE: The proper installation is indicated when a "click" is heard and a release of the retaining ring is felt.

7. Bleed the fuel system.

DPSG,CD03523,30 –19–12JUL99–1/1

CHECKING BELT (300-SERIES ENGINES)

1. Inspect belt for cracks, fraying, or stretched out areas. Replace as necessary.

2. Check belt tension using one of following methods:

   a) Use of JDG529 Tension Gauge (A)

   Belt tension—Specification

New belt..... 578—622 N (130—140 lb-force)
Used belt ..... 378—423 N (85—94 lb-force)

NOTE: Belt is considered used after 10 minutes of operation.

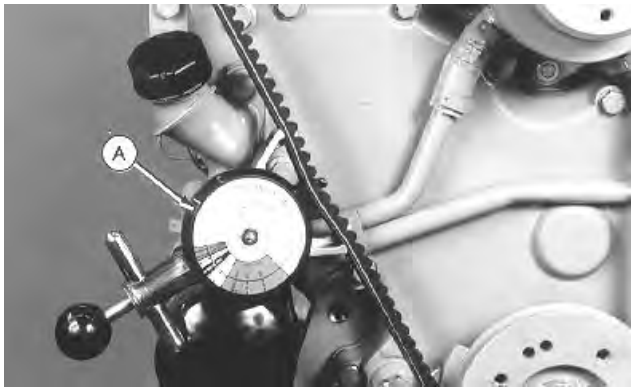
b) Use of tension tester (B) and straight edge (C)
A 89 N (20 lb) force applied halfway between pulleys should deflect belt by 19 mm (0.75 in.).

3. If adjustment is necessary, loosen alternator nuts (D) and (E). Pull alternator frame outward until belt is correctly tensioned.

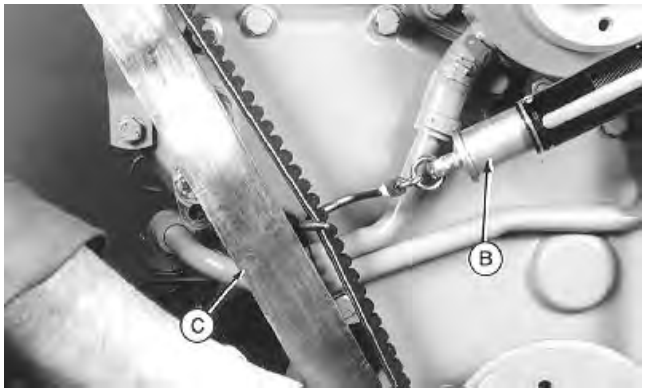
IMPORTANT: Do not pry against the alternator rear frame. Do not tighten or loosen belts while they are hot.

4. Tighten alternator bracket nuts firmly.

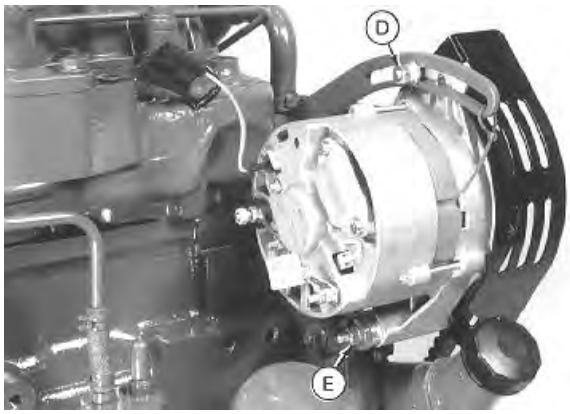
5. Run engine for 10 minutes then recheck belt tension.



CD30644 –UN–04MAY98



CD30645 –UN–04MAY98



CD30646 –UN–04MAY98

DPSG,CD03523,31 –19–12JUL99–1/1

CHECKING BELT (POWERTECH ENGINES WITH MANUAL TENSIONER)

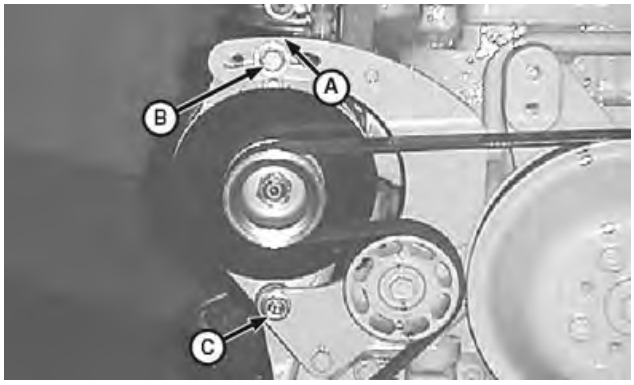
Inspect belt for cracks, fraying, or stretched out areas. Replace if necessary.

NOTE: Belt adjustment is measured using a gauge stamped on the top edge of the alternator bracket.

1. Loosen cap screws (B) and (C).
2. Slide alternator in slot by hand to remove all excess slack in belt.

IMPORTANT: Do not pry against alternator rear frame.

3. Using the gauge (A) on the alternator bracket, stretch belt by prying outward on alternator front frame. Stretch the belt 1 gauge unit for a used belt and 1.5 gauge units for a new belt.
4. Tighten cap screws (B) and (C).



RG9132 –UN–04OCT99

A—Belt gauge
B—Cap screw
C—Cap screw

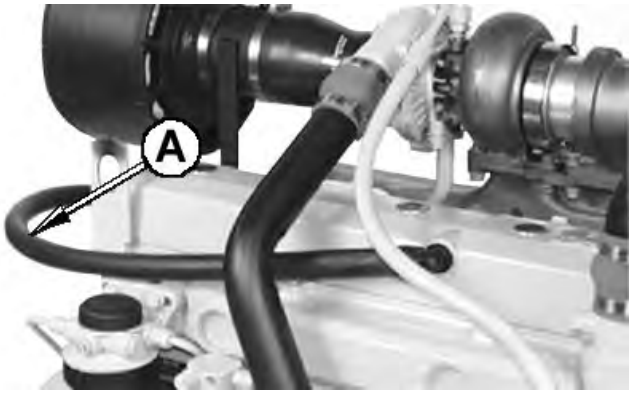
DPSG,CD03523,57 –19–16AUG99–1/1

Maintenance/1000 hours/1 year

CLEANING CRANKCASE VENT TUBE

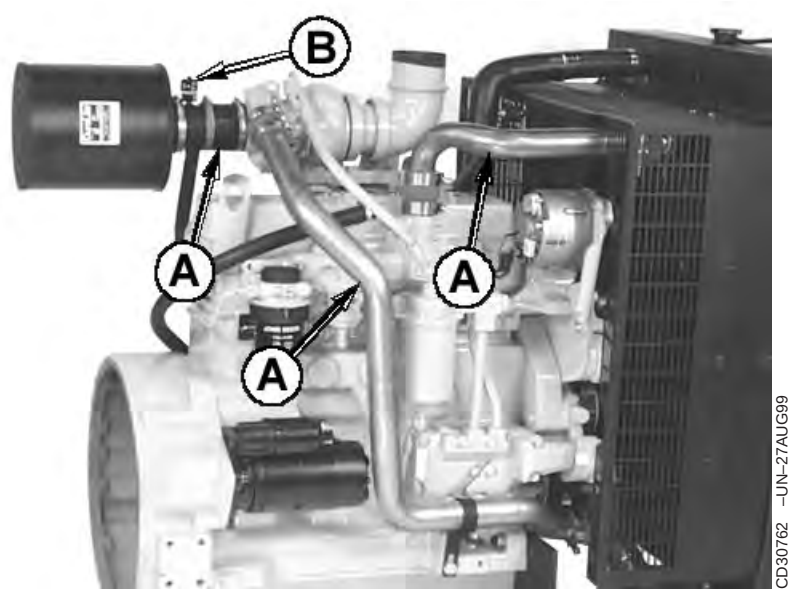
If you operate the engine in dusty conditions, clean the tube at shorter intervals.

1. Remove and clean crankcase vent tube (A).
2. Install the vent tube. Be sure the O-ring fits correctly in the rocker arm cover bore for elbow adapter. Tighten hose clamp securely.



DPSG,CD03523,32 –19–12JUL99–1/1

CHECKING AIR INTAKE SYSTEM



IMPORTANT: The air intake system must not leak. Any leak, no matter how small, may result in engine failure due to abrasive dirt and dust entering the intake system.

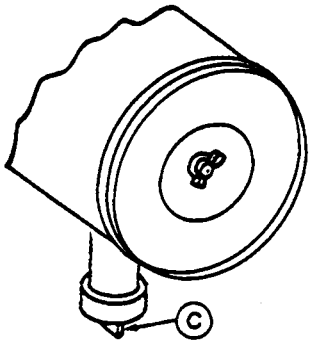
1. Inspect all intake hoses (piping) for cracks. Replace as necessary.
2. Check clamps on piping (A) which connect the air filter, engine and, if present, turbocharger and air-to-air radiator. Tighten clamps as necessary.
3. Test air restriction indicator (B) for proper operation. Replace indicator as necessary.

Continued on next page

DPSG,CD03523,33 –19–12JUL99–1/2

4. If engine has a rubber dust unloading valve (C), inspect the valve on bottom of air filter for cracks or plugging. Replace as necessary.

5. Service air filter as necessary.



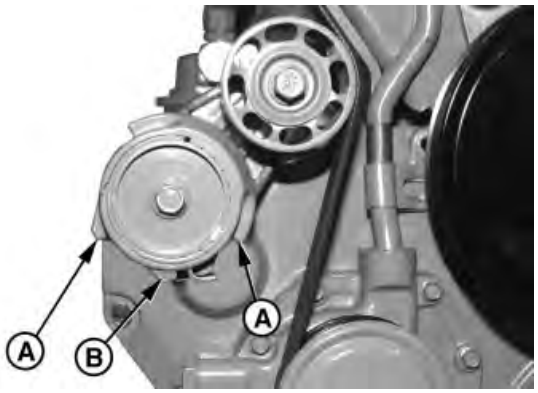
RG4687 –UN–20DEC88

DPSG,CD03523,33 –19–12JUL99–2/2

CHECKING AUTOMATIC BELT TENSIONER (POWERTECH ENGINES)

Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.

- **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. 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 AND ALTERNATOR BELTS).

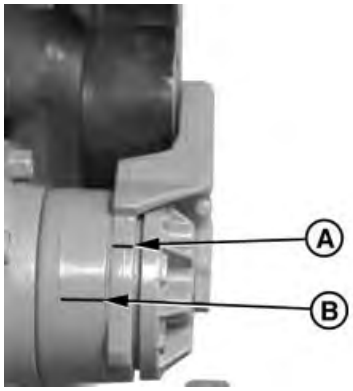


RG8098 –UN–18NOV97

Continued on next page

DPSG,CD03523,34 –19–13JUL99–1/2

- **Checking 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:
  a. Release tension on belt using a breaker bar and socket on tension arm. Remove belt from pulleys.
  b. Release tension on tension arm and remove breaker bar.
  c. Put a mark (A) on swing arm of tensioner as shown.
  d. Measure 21 mm (0.83 in.) from (A) and put a mark (B) on tensioner mounting base.
  e. Rotate the swing arm using a torque wrench until marks (A) and (B) are aligned.
  f. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.



RG7977 –UN–14NOV97

Spring—Specification

Force..... 18—22 N•m (13—16 lb-ft)

DPSG,CD03523,34 –19–13JUL99–2/2

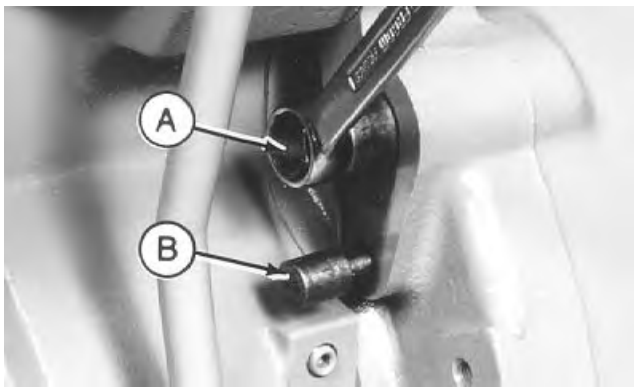
CHECK AND ADJUST ENGINE VALVE CLEARANCE (300-SERIES ENGINES)

NOTE: Valve clearance must be adjusted after the first 500 hours of operation, then every 1000 hours thereafter.

Adjust engine valve clearance as follows or have your authorized servicing dealer or engine distributor adjust the engine valve clearance.

1. Remove rocker arm cover and crankcase vent tube.

2. Using JDE83 or JDG820 Flywheel Turning Tool (A), rotate engine flywheel in running direction (clockwise viewed from water pump) until No.1 piston (front) has reached top dead center (TDC) on compression stroke. Insert timing pin JDE81-4 (B) into flywheel bore.



CD30544 –UN–19MAY98

Continued on next page

DPSG,CD03523,35 –19–13JUL99–1/4

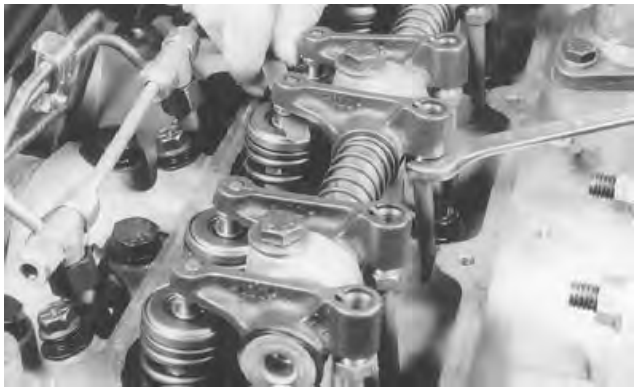
3. Check and adjust valve clearance to specifications according to following procedures.

Valve clearance (engine cold)—Specification

Intake	0.35 mm (0.014 in.)
Exhaust	0.45 mm (0.018 in.)

NOTE: If rocker arm is equipped with adjusting screw and lock nut (A), tighten lock nut to 27 N•m (20 lb-ft) after adjusting valve clearance.

4. Reinstall rocker arm cover and crankcase vent tube.



CD30545 –UN–19MAY98

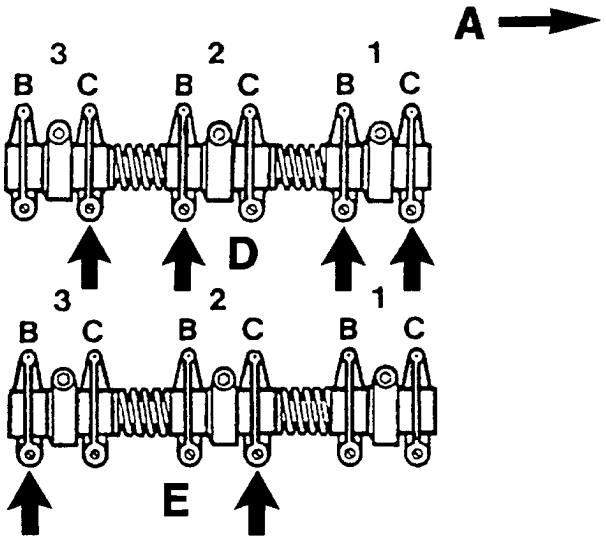
RG6307 –UN–03AUG92

DPSG,CD03523,35 –19–13JUL99–2/4

- **3-Cylinder Engine:**

NOTE: Firing order is 1-2-3.

a. Lock No. 1 piston at TDC compression stroke (D).
b. Adjust valve clearance on No. 1 and 2 exhaust valves and No.1 and 3 intake valves.
c. Rotate flywheel 360°. Lock No. 1 piston at TDC exhaust stroke (E).
d. Adjust valve clearance on No. 3 exhaust valve and No. 2 intake valve.



CD30549 –UN–16JUN98

A—Front of engine
B—Exhaust valve
C—Intake valve
D—No.1 Piston at TDC compression stroke
E—No.1 Piston at TDC exhaust stroke

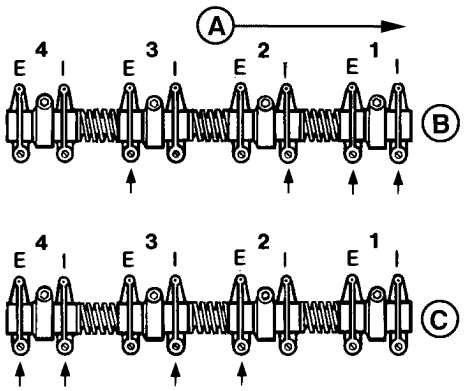
Continued on next page

DPSG,CD03523,35 –19–13JUL99–3/4

- **4-Cylinder Engine:**

NOTE: Firing order is 1-3-4-2.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1 and 3 exhaust valves and No.1 and 2 intake valves.
c. Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2 and 4 exhaust valves and No. 3 and 4 intake valves.



RG4776 –UN–31OCT97

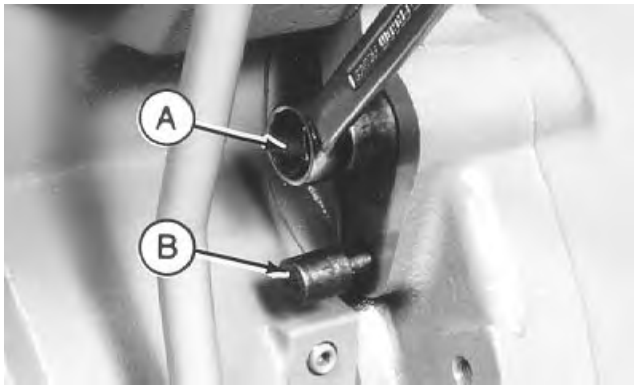
A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.4 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,35 –19–13JUL99–4/4

CHECK AND ADJUST ENGINE VALVE CLEARANCE (POWERTECH ENGINE)

Adjust engine valve clearance as follows or have your authorized servicing dealer or engine distributor adjust the engine valve clearance.

1. Remove rocker arm cover and crankcase vent tube.
2. Using JDE83 or JDG820 Flywheel Turning Tool (A), rotate engine flywheel in running direction (clockwise viewed from water pump) until No.1 piston (front) has reached top dead center (TDC) on compression stroke. Insert timing pin JDE81-4 (B) into flywheel bore.



CD30544 –UN–19MAY98

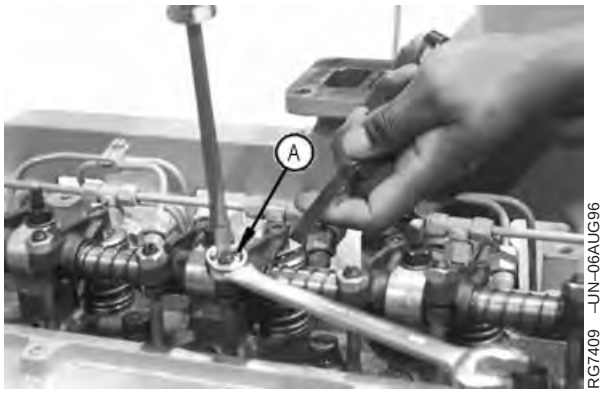
DPSG,CD03523,36 –19–13JUL99–1/4

3. Check and adjust valve clearance to specifications according to following procedures.

Valve clearance (engine cold)—Specification

Intake	0.35 mm (0.014 in.)
Exhaust	0.45 mm (0.018 in.)

4. If valves need adjusting, loosen the lock nut on rocker arm adjusting screw. Turn adjusting screw until feeler gauge slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten lock nut to 27 N•m (20 lb-ft). Recheck clearance again after tightening lock nut. Readjust clearance as necessary
5. Reinstall rocker arm cover and crankcase vent tube.



RG7409 –UN–06AUG96

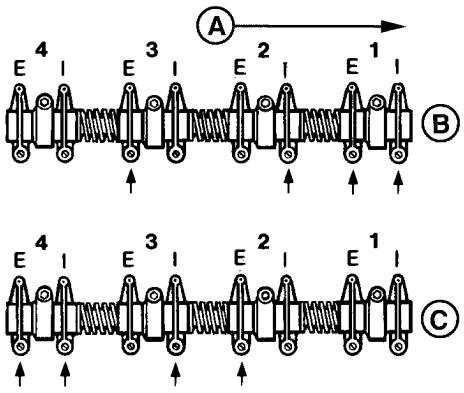
Continued on next page

DPSG,CD03523,36 –19–13JUL99–2/4

- **4-Cylinder Engine:**

NOTE: Firing order is 1-3-4-2.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1 and 3 exhaust valves and No.1 and 2 intake valves.
c. Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2 and 4 exhaust valves and No. 3 and 4 intake valves.



RG4776 –UN–31OCT97

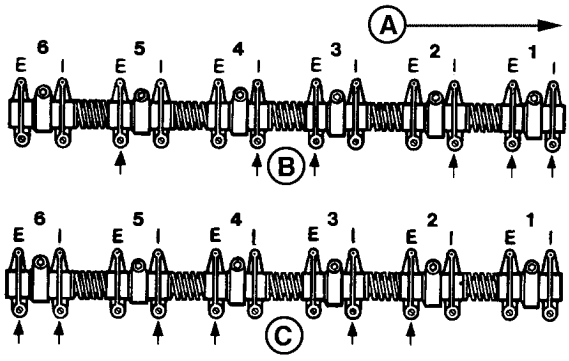
A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.4 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,36 –19–13JUL99–3/4

- **6-Cylinder Engine:**

NOTE: Firing order is 1-5-3-6-2-4.

a. Lock No. 1 piston at TDC compression stroke (B).
b. Adjust valve clearance on No. 1, 3, and 5 exhaust valves and No. 1, 2, and 4 intake valves.
c. Rotate flywheel 360°. Lock No. 6 piston at TDC compression stroke (C).
d. Adjust valve clearance on No. 2, 4, and 6 exhaust valves and No. 3, 5, and 6 intake valves.



RG4777 –UN–31OCT97

A—Front of engine
B—No.1 Piston at TDC compression stroke
C—No.6 Piston at TDC compression stroke
E—Exhaust valve
I—Intake valve

DPSG,CD03523,36 –19–13JUL99–4/4

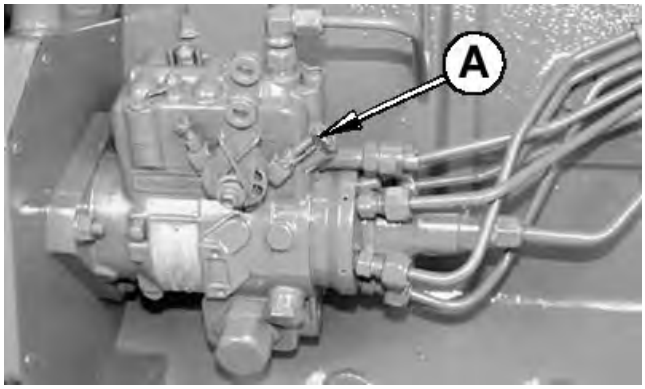
CHECKING ENGINE SPEED

NOTE: Most engines for generator set application (1500 rpm for 50 Hz or 1800 rpm for 60 Hz) run only at fast idle and therefore they do not have slow idle.

Fast idle—Specification

50 Hz Generator set	1550—1580 rpm
60 Hz Generator set	1865—1890 rpm

NOTE: Fast idle is settled by the factory then the idle adjusting screw (A) is sealed to prevent from tampering. Fast idle adjustment can only be done by an authorized fuel system agent.



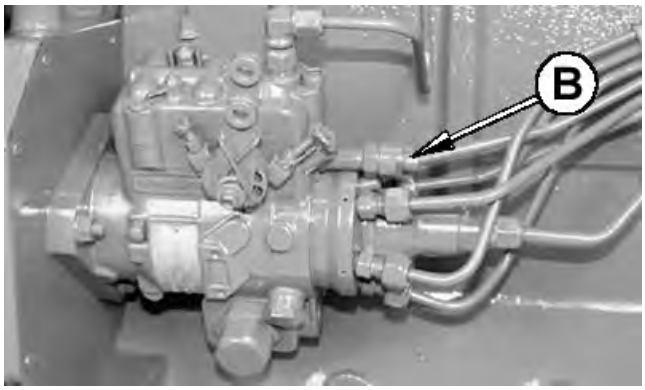
CD30763 –UN–24SEP99

DPSG,CD03523,38 –19–13JUL99–1/1

ADJUST SPEED DROOP GOVERNOR

1. Warm engine to normal operating temperature.
2. Run engine at fast idle.
3. Apply full load.
4. If specified power cannot be obtained, turn screw (B) to adjust droop until the requested power is reached.

NOTE: If surging exists upon removing the load, turn screw (B) clockwise to eliminate.



CD30764 –UN–24SEP99

DPSG,CD03523,39 –19–13JUL99–1/1

CHECKING CRANKSHAFT VIBRATION DAMPER (6-CYLINDER ENGINE ONLY)

1. Remove belts (shown removed).
2. 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.

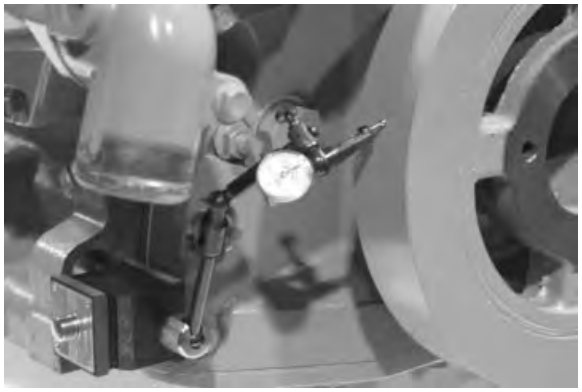
IMPORTANT: The vibration damper assembly is not repairable and should be replaced every 4500 hours or 5 years, whichever occurs first.

3. Check vibration damper radial runout by positioning a dial indicator so probe contacts damper outer circumference.
4. With engine at operating temperature, rotate crankshaft using JDG820 or JDE83 Flywheel Turning Tool.
5. Note dial indicator reading. If runout exceeds specifications given below, replace vibration damper.

Damper—Specification

Maximum radial runout..... 1.50 mm (0.060 in.)

RG8018 –UN–15JAN99



RG7508 –UN–23NOV97

DPSG,CD03523,40 –19–13JUL99–1/1

Maintenance/2500 hours/3 years

DRAIN AND FLUSH COOLING SYSTEM

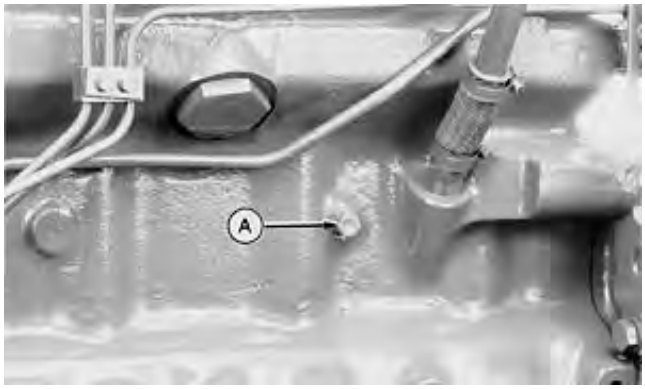
NOTE: Drain and flush cooling system every 2500 hours/3 years when John Deere COOL-GARD coolant is used. Otherwise every 2000 hours/2 years.

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

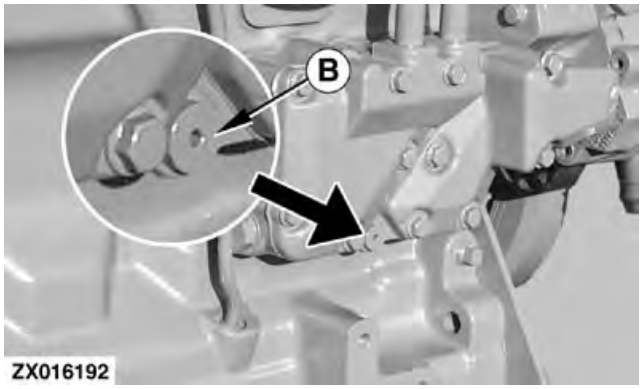
Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

1. Slowly open the radiator cap.
2. Remove engine block drain plug (A).
3. On POWERTech engines, remove oil cooler housing drain plug (B).
4. Open radiator drain valve (C). Drain all coolant from radiator.
5. Close all drain orifices after coolant has drained.
6. Fill the cooling system with clean water. Run engine until water passes through the thermostat to stir up possible rust or sediment.
7. Stop engine and immediately drain the water from system before rust and sediment settle.
8. After draining water, close all drain orifices and fill the cooling system with clean water and TY15979 John Deere Heavy Duty Cooling System Cleaner or equivalent cleaner. Follow manufacturer's directions on label.
9. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run engine until water passes through the thermostat, then drain out flushing water.

TS281 –UN–23AUG88



RG4894 –UN–14DEC88



ZX016192 –UN–11JAN99

CD30765 –UN–27AUG99

Continued on next page

DPSG,CD03523,41 –19–13JUL99–1/3

10. Check cooling system hoses for proper condition. Replace as necessary.

11. Close all drain orifices and fill the cooling system with specified coolant (see DIESEL ENGINE COOLANT).

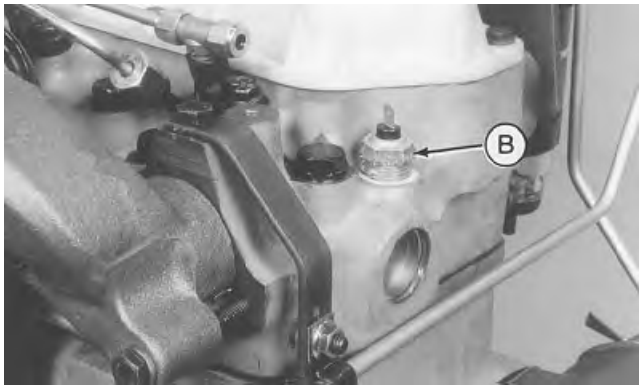
Cooling system capacity—Specification

CD3029DF128	14.5 L (15.5 qt)
CD4039DF008	16.5 L (17.5 qt)
CD4039TF008	16.5 L (17.5 qt)
CD4045DF158	20 L (21 qt)
CD4045HF158	25 L (26.5 qt)
CD4045TF158	25 L (26.5 qt)
CD4045TF258	25 L (26.5 qt)
CD6068HF158	29 L (30.5 qt)
CD6068TF158	26 L (27.5 qt)
CD6068TF258	26 L (27.5 qt)

DPSG,CD03523,41 –19–13JUL99–2/3

12. When refilling cooling system, loosen temperature sensor (B) or plug at the rear of cylinder head to allow air to escape.

13. Run engine until it reaches operating temperature then check coolant level and entire cooling system for leaks.



CD30643 –UN–04MAY98

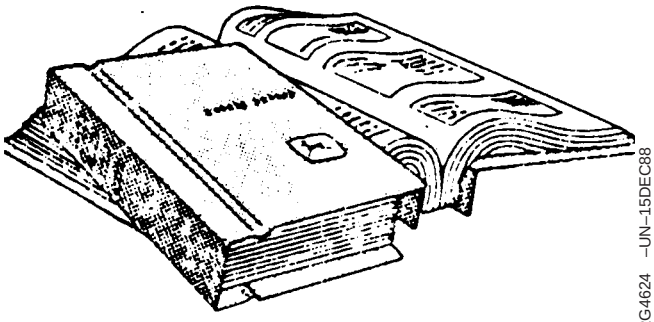
DPSG,CD03523,41 –19–13JUL99–3/3

Maintenance/As required

ADDITIONAL SERVICE INFORMATION

This manual does not allow a complete repair of your engine. If you want want more detailled service information the following publications are available from your regular parts channel.

- PC2451 — Parts Catalog
- CTM3274 — Component Technical Manual for 300-Series engines (English)
- CTM104 — Component Technical Manual for POWERTech engines (English)
- CTM67 — Component Technical Manual for OEM Engine accessories (English only)
- CTM77 — Component Technical Manual for Alternators and Starter Motors (English only)



RG4624 –UN–15DEC88

DPSG,CD03523,42 –19–15JUL99–1/1

DO NOT MODIFY FUEL SYSTEM

IMPORTANT: Modification or alteration of the injection pump, the injection pump timing, or the fuel injectors in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

Do not attempt to service injection pump or fuel injectors yourself. Special training and special tools are required (see your authorized servicing dealer or engine distributor).

CD30768 –UN–24SEP99

DPSG,CD03523,43 –19–15JUL99–1/1

CLEAN OR REPLACE AIR FILTER (ONE-PIECE)

Clean air filter when restriction indicator (A) is red. Air filter can be cleaned up to six times. Thereafter, or at least once a year, it must be replaced.

Proceed as follows:

1. Thoroughly clean all dirt around air filter area.

2. Loosen clamp (B) then remove air filter.

IMPORTANT: Never reinstall an air filter which shows evidence of bad condition (punched, dented...) allowing no filtered air to enter the engine.

3. Clean air filter with compressed air working from "clean" to "dirty" side.

NOTE: Compressed air must not exceed 600 kPa (6 bar; 88 psi).

4. Mark air filter to keep track of each cleaning operation.

5. Fully depress air restriction indicator reset button and release to reset indicator.

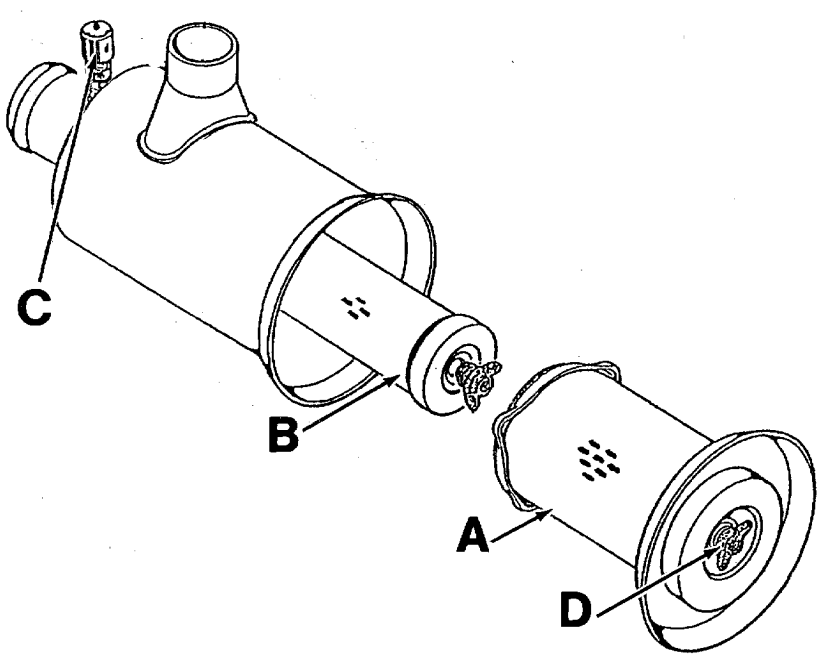
6. Check air system entirely for proper condition (see CHECKING AIR INTAKE SYSTEM).

CD30766 –UN–06SEP99

RG9912 –UN–25FEB99

DPSG,CD03523,44 –19–15JUL99–1/1

CLEAN OR REPLACE AIR FILTER ELEMENT



CD30772 –UN–27AUG99

A—Primary element
B—Secondary (safety) element
C—Air restriction indicator
D—Wing nut

Clean air filter when restriction indicator (C) is red. Replace both primary (A) and secondary (B) filter elements every 6 primary element cleaning or at least once a year.

Proceed as follows:

1. Thoroughly clean all dirt around air filter area.

2. Remove wing nut (D) and remove primary element (A) from canister.

IMPORTANT: Do not attempt to clean the secondary (safety) element (B). It must be only replaced as recommended.

3. Thoroughly clean all dirt from inside canister.

IMPORTANT: If primary element shows evidence of bad condition (punched, dented...), replace both the primary and the secondary elements.

4. Clean primary element with compressed air working from “clean” to “dirty” side.

NOTE: Compressed air must not exceed 600 kPa (6 bar; 88 psi).

5. Mark air filter to keep track of each cleaning operation.

6. Fully depress air restriction indicator reset button and release to reset indicator.

7. Check air system entirely for proper condition (see CHECKING AIR INTAKE SYSTEM).

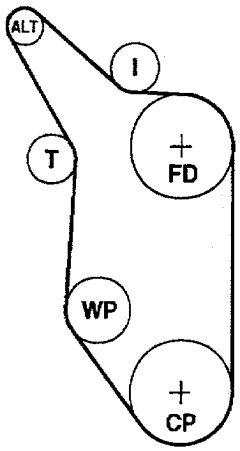
DPSG,CD03523,58 –19–16AUG99–1/1

REPLACING FAN AND ALTERNATOR BELT (POWERTECH ENGINES)

NOTE: Refer to CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR for additional information on the belt tensioner.

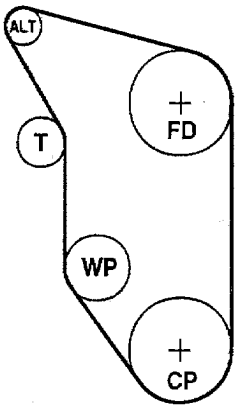
1. Inspect belts for cracks, fraying, or stretched out areas. Replace if necessary.
2. On engines with automatic belt tensioner, release tension on belt using a breaker bar and socket on tension arm.

   On engines with manual tensioner, loosen cap screws holding the alternator.
3. Remove poly-vee belt from pulleys and discard belt.
4. Install new belt, making sure belt is correctly seated in all pulley grooves. Refer to belt routing at right for your application.
5. Apply tension to belt (see CHECKING BELT).
6. Start engine and check belt alignment.



CD30769 –UN–01SEP99

Installation on 4 cyl. engines



CD30770 –UN–01SEP99

Installation on 6 cyl. engines

ALT—Alternator
CP—Crankshaft Pulley
FD—Fan Drive
I—Idler Pulley
T—Tensioner
WP—Water Pump

DPSG,CD03523,45 –19–15JUL99–1/1

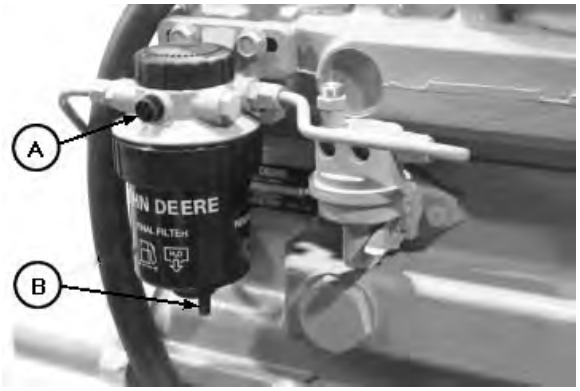
CHECKING FUEL FILTER

Periodically the fuel filter should be checked for water or debris.

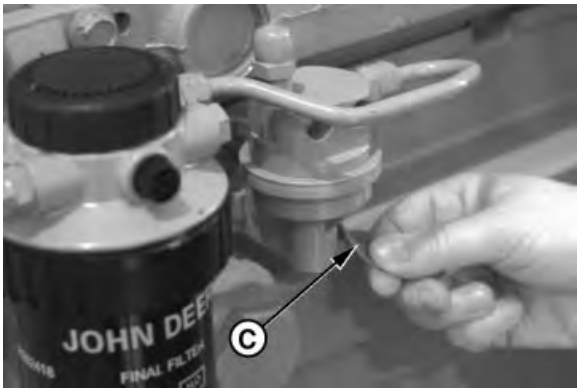
IMPORTANT: Drain water into a suitable container and dispose of properly.

1. Loosen drain plug (B) at bottom of fuel filter two or three turns.
2. Loosen air bleed plug two full turns (A) on fuel filter base and drain water from bottom until fuel starts to drain out.
3. When fuel starts to drain out, tighten drain plug securely.
4. After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system. Operate primer lever of the fuel supply pump (C) until fuel flow is free from air bubbles.
5. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

If the fuel system needs further bleeding of air, see BLEEDING THE FUEL SYSTEM.



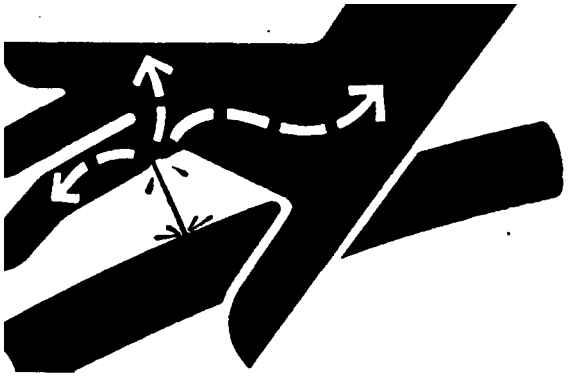
RG9868 –UN–15JAN99



RG8013B –UN–15JAN99

DPSG,CD03523,28 –19–12JUL99–1/1

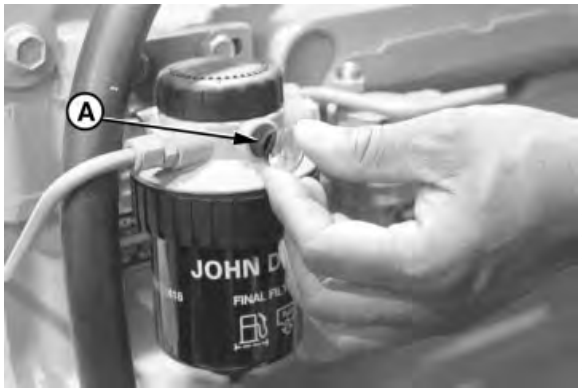
BLEEDING THE FUEL SYSTEM



X9811 –UN–23AUG88

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.



RG7947 –UN–13NOV97

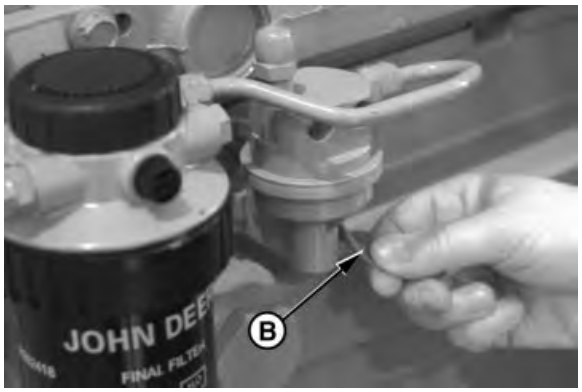
Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

1. Loosen the air bleed screw (A) two full turns by hand on fuel filter base.

2. Operate supply pump primer lever (B) until fuel flow is free from air bubbles.

3. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

4. Start engine and check for leaks.



RG8013A –UN–15JAN99

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles as explained next.

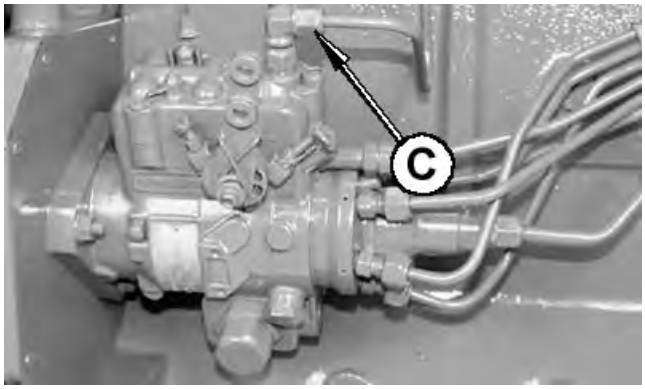
Continued on next page

DPSG,CD03523,46 –19–10AUG99–1/2

- **At Fuel Injection Pump:**
  a. Slightly loosen fuel return line connector (C) at fuel injection pump.
  b. Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
  c. Tighten return line connector to 16 N•m (12 lb-ft).
  d. Leave hand primer in the inward position toward cylinder block.

- **At Fuel Injection Nozzles:**
  a. Using two open-end wrenches, loosen fuel line connection at injection nozzle.
  b. Crank engine over with starting motor (but do not start engine), until fuel free from bubbles flows out of loosened connection. Retighten connection to 27 N•m (20 lb-ft).
  c. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.

  If engine still will not start, see your authorized servicing dealer or engine distributor.



CD30771 –UN–24SEP99

RG7725 –UN–08JAN97

DPSG,CD03523,46 –19–10AUG99–2/2

Troubleshooting

ENGINE TROUBLESHOOTING

Symptom	Problem	Solution
Engine cranks but will not start	Incorrect starting procedure.	Verify correct starting procedure.
	No fuel.	Check fuel in tank and manual shut-off valve.
	Exhaust restricted.	Check and correct exhaust restriction.
	Fuel filter plugged or full of water.	Replace fuel filter or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Check fuel flow at supply pump or bleed fuel system.
	Faulty injection pump or nozzles.	Consult authorized diesel repair station for repair or replacement.
Engine hard to start or will not start	Engine starting under load.	Remove load.
	Improper starting procedure.	Review starting procedure.
	No fuel.	Check fuel tank.
	Air in fuel line.	Bleed fuel line.
	Cold weather.	Use cold weather starting aids.
	Slow starter speed.	See “Starter Cranks Slowly”.
	Crankcase oil too heavy.	Use oil of correct viscosity.
	Improper type of fuel.	Consult fuel supplier; use proper type fuel for operating conditions.
	Water, dirt or air in fuel system.	Drain, flush, fill and bleed system.
	Clogged fuel filter.	Replace filter element.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.

Continued on next page

Symptom	Problem	Solution
	Injection pump shut-off not reset.	Turn key switch to “OFF” then to “ON”.
Engine knocks	Low engine oil level.	Add oil to engine crankcase.
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Low coolant temperature.	Remove and check thermostat.
	Engine overheating.	See “Engine Overheats”.
Engine runs irregularly or stalls frequently	Low coolant temperature.	Remove and check thermostat.
	Clogged fuel filter.	Replace fuel filter element.
	Water, dirt or air in fuel system.	Drain, flush, fill and bleed system.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
Below normal engine temperature	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check gauge, sender and connections.
Lack of power	Engine overloaded.	Reduce load.
	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace filter element.
	Improper type of fuel.	Use proper fuel.
	Overheated engine.	See “Engine Overheats”.
	Below normal engine temperature.	Remove and check thermostat.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.

Continued on next page

Symptom	Problem	Solution
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
	Leaking exhaust manifold gasket.	See your authorized servicing dealer or engine distributor.
	Defective aneroid control line.	See your authorized servicing dealer or engine distributor.
	Restricted fuel hose.	Clean or replace fuel hose.
	Low fast idle speed.	See your authorized servicing dealer or engine distributor.
Low oil pressure	Low oil level.	Add oil.
	Improper type of oil.	Drain and fill crankcase with oil of proper viscosity and quality.
High oil consumption	Crankcase oil too light.	Use oil of correct viscosity.
	Oil leaks.	Check for leaks in lines, gaskets, and drain plug.
	Restricted crankcase vent tube.	Clean vent tube.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
Engine emits white smoke	Improper type of fuel.	Use proper fuel.
	Low engine temperature.	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
	Defective injection nozzles.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.

Continued on next page

Symptom	Problem	Solution
Engine emits black or grey exhaust smoke	Improper type of fuel.	Use proper fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
Engine overheats	Engine overloaded.	Reduce load.
	Low coolant level.	Fill radiator to proper level, check radiator and hoses for loose connections or leaks.
	Faulty radiator cap.	Have serviceman check.
	Stretched poly-vee belt or defective belt tensioner.	Check automatic belt tensioner and check belts for stretching. Replace as required.
	Low engine oil level.	Check oil level. Add oil as required.
	Cooling system needs flushing.	Flush cooling system.
	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check coolant temperature with thermometer and replace, if necessary.
	Incorrect grade of fuel.	Use correct grade of fuel.
High fuel consumption	Improper type of fuel.	Use proper type of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.

Continued on next page

Symptom	Problem	Solution
	Engine overloaded.	Reduce load.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
	Low engine temperature.	Check thermostat.

DPSG,CD03523,49 –19–10AUG99–5/5

ELECTRICAL TROUBLESHOOTING

Symptom	Problem	Solution
Undercharged system	Excessive electrical load from added accessories.	Remove accessories or install higher output alternator.
	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connections on battery, ground strap, starter or alternator.	Inspect and clean as necessary.
	Defective battery.	Test battery.
	Defective alternator.	Test charging system.
Battery uses too much water	Cracked battery case.	Check for moisture and replace as necessary.
	Defective battery.	Test battery.
	Battery charging rate too high.	Test charging system.
Battery will not charge	Loose or corroded connections.	Clean and tighten connections.
	Sulfated or worn-out battery.	See your authorized servicing dealer or engine distributor.
	Stretched poly-vee belt or defective belt tensioner.	Adjust belt tension or replace belts.
Starter will not crank	Engine under load	Remove load
	Loose or corroded connections.	Clean and tighten loose connections.
	Low battery output voltage.	See your authorized servicing dealer or engine distributor.
	Faulty start circuit relay.	See your authorized servicing dealer or engine distributor.
	Blown fuse.	Replace fuse.

Continued on next page

Symptom	Problem	Solution
Starter cranks slowly	Low battery output.	See your authorized servicing dealer or engine distributor.
	Crankcase oil too heavy.	Use proper viscosity oil.
	Loose or corroded connections.	Clean and tighten loose connections.
Entire electrical system	Faulty battery connection.	Clean and tighten connections.
	Sulfated or worn-out battery.	See your authorized servicing dealer or engine distributor.
	Blown fuse.	Replace fuse.

DPSG,CD03523,50 –19–10AUG99–2/2

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. 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).
5. For John Deere engines not yet installed in machines, run a line from a container of AR41937 Nucle Oil (from AR41785 Engine Storage Kit) 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.

DPSG,CD03523,51 –19–10AUG99–1/1

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.

T85452 –UN–06DEC88

DPSG,CD03523,52 –19–10AUG99–1/1

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 FILTER).
2. Service air cleaner. (See CLEAN OR REPLACE AIR FILTER).
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).
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 belt, if desired.
9. Remove and clean battery. Store them in a cool, dry place and keep them fully charged.
10. Clean the exterior of the engine with salt-free water and touchup any scratched or chipped painted surfaces with a good quality paint.
11. Coat all exposed (machined) metal surfaces with grease or corrosion inhibitor if not feasible to paint.
12. Seal all openings on engine with plastic bags and tape supplied in storage kit. Follow instructions supplied in kit.
13. 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,CD03523,53 –19–10AUG99–1/1

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 battery from storage. Install battery (fully charged) and connect the terminals.
3. Install fan/alternator belt if removed.
4. Fill fuel tank.
5. Perform all appropriate prestarting checks. (See DAILY PRESTARTING CHECKS).

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

6. 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 assure bearing surfaces are adequately lubricated.
7. Start engine and run at no load for several minutes. Warm up carefully and check all gauges before placing engine under load.
8. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

DPSG,CD03523,54 –19–10AUG99–1/1

Specifications

GENERAL ENGINE SPECIFICATIONS

ITEM	UNIT OF MEASURE	3029DF128	4039DF008	4039TF008
Number of Cylinders		3	4	4
Fuel		Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5
Stroke	mm	110	110	110
Displacement	L	2.9	3.9	3.9
Compression Ratio		17.8:1	17.8:1	17.8:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	26 (35)	35 (48)	55 (75)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	30 (41)	38 (52)	61 (83)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	30 (41)	41 (56)	67 (91)
POWER[a] @ 1800 rpm (Standby)	kW (hp)	34 (46)	47 (64)	73 (99)
Width (overall)	mm	582	588	588
Length (overall)	mm	888	1016	1016
Height (overall)	mm	931	960	979
Weight (dry)[b]	kg	345	410	455
Engine oil quantity	L	6	12	12
Engine coolant quantity	L	14.5	16.5	16.5

[a]With Fan
[b]Approximate

Continued on next page

DPSG,CD03523,55 –19–10AUG99–1/3

ITEM	UNIT OF MEASURE	4045HF158	4045TF158	4045TF258	4045DF158
Number of Cylinders		4	4	4	4
Fuel		Diesel	Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5	106.5
Stroke	mm	127	127	127	127
Displacement	L	4.5	4.5	4.5	4.5
Compression Ratio		17.0:1	17.0:1	17.0:1	17.6:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	88 (120)	61 (83)	72 (98)	41 (56)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	96 (131)	68 (92)	80 (109)	42 (57)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	108 (147)	72 (98)	80 (109)	48 (65)
POWER[a] @ 1800 rpm (Standby)	kW (hp)	120 (163)	79 (107)	88 (120)	51 (69)
Width (overall)	mm	798	668	668	668
Length (overall)	mm	1356	1219	1219	1219
Height (overall)	mm	1136	1010	1010	1010
Weight (dry)[b]	kg	446	436	436	391
Engine oil quantity	L	12	12	12	8
Engine coolant quantity	L	25	25	25	20

[a]With Fan
[b]Approximate

Continued on next page

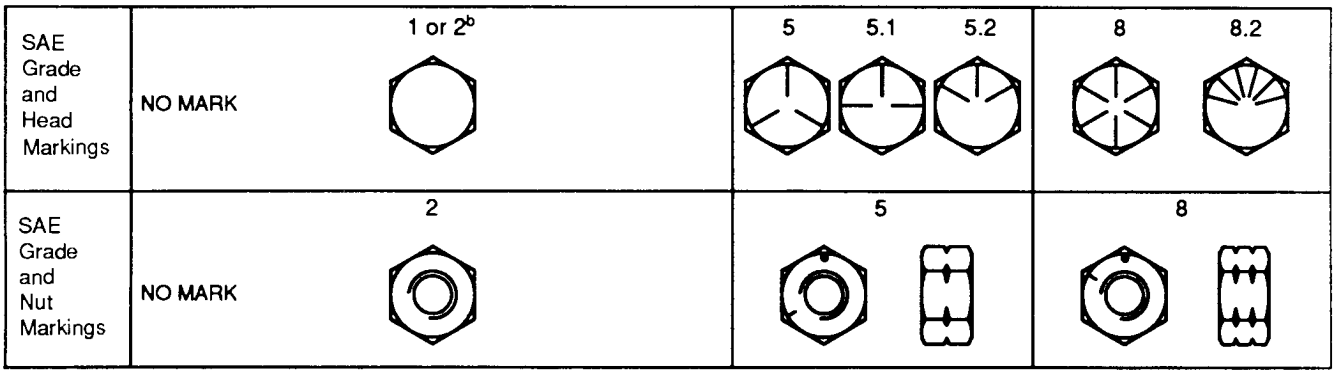
DPSG,CD03523,55 –19–10AUG99–2/3

ITEM	UNIT OF MEASURE	6068HF158	6068TF158	6068TF258
Number of Cylinders		6	6	6
Fuel		Diesel	Diesel	Diesel
Bore	mm	106.5	106.5	106.5
Stroke	mm	127	127	127
Displacement	L	6.8	6.8	6.8
Compression Ratio		17.0:1	17.0:1	17.0:1
POWER[a] @ 1500 rpm (Prime)	kW (hp)	134 (182)	92 (125)	105 (143)
POWER[a] @ 1500 rpm (Standby)	kW (hp)	148 (201)	101 (137)	116 (158)
POWER[a] @ 1800 rpm (Prime)	kW (hp)	164 (223)	108 (147)	124 (169)
POWER[a] @1800 rpm (Standby)	kW (hp)	187 (254)	119 (162)	137 (186)
Width (overall)	mm	798	668	668
Length (overall)	mm	1476	1383	1383
Height (overall)	mm	1136	1032	1032
Weight (dry)[b]	kg	613	593	593
Engine oil quantity	L	19.5	19.5	19.5
Engine coolant quantity	L	29	26	26

[a]With Fan
[b]Approximate

DPSG,CD03523,55 –19–10AUG99–3/3

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES



Size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

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 fasteners 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.

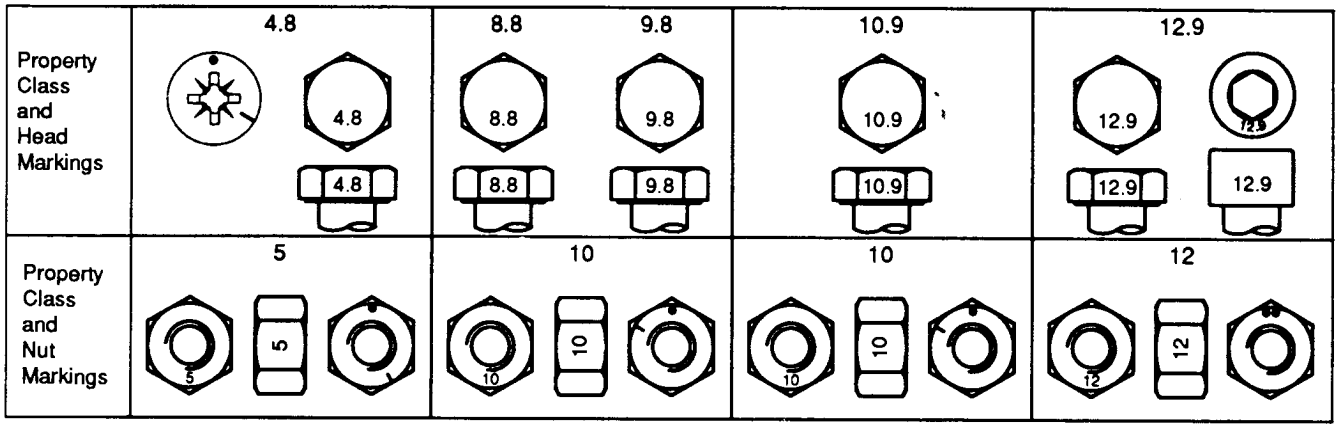
[a] "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

[b] Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.

TS1656 –19–02APR97

DX,TORQ1 –19–20JUL94–1/1

METRIC BOLT AND CAP SCREW TORQUE VALUES



Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

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 fasteners 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.

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

TS1657 –19–02APR97

DX,TORQ2 –19–20JUL94–1/1

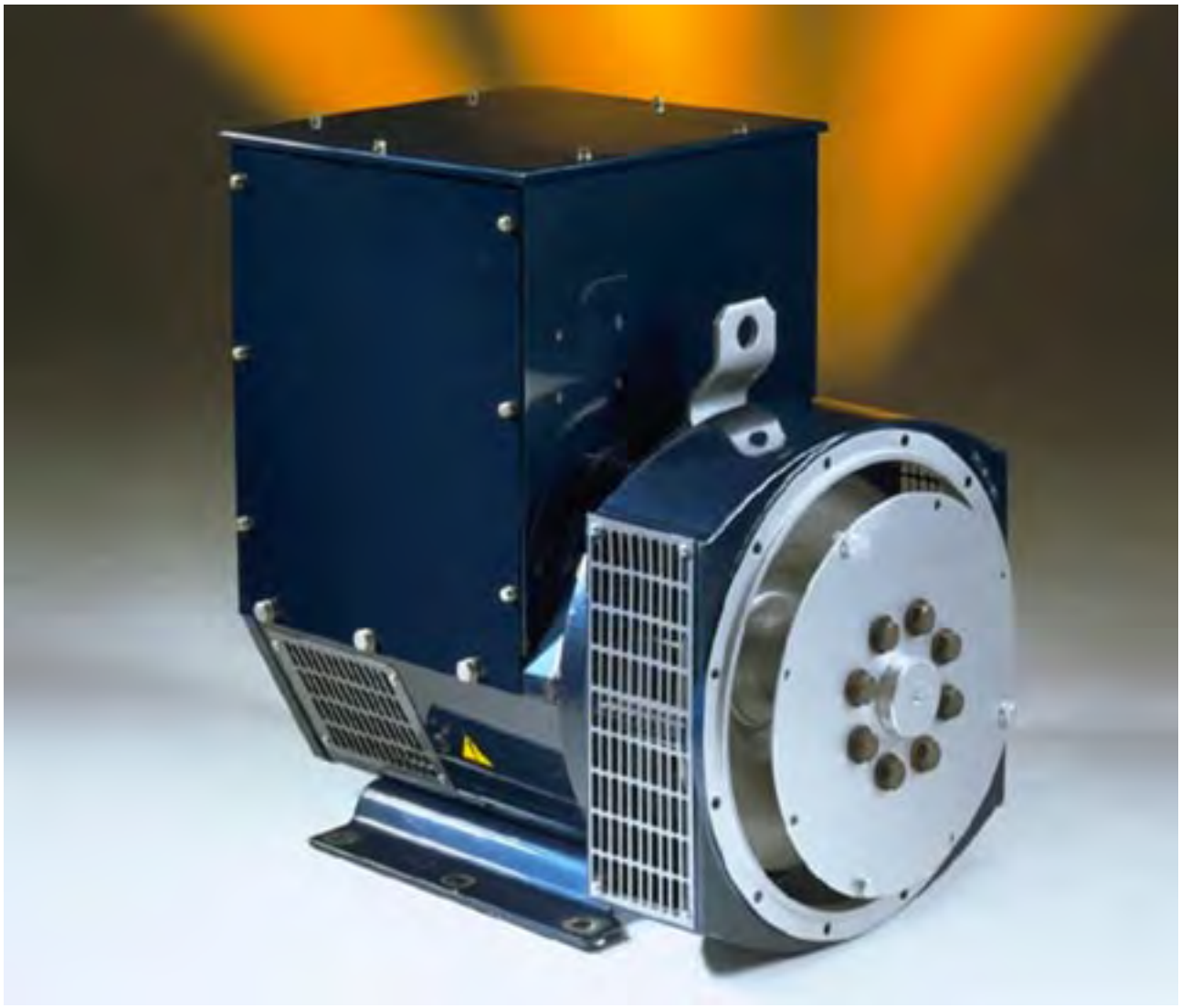
Index

SP292

Section 3 - Stamford Installation, Service & Maintenance Manual

Publication No: UCH-027
27th Edition
2/001

STAMFORD
AC GENERATORS FROM
NEWAGE INTERNATIONAL



Installation, Service & Maintenance Manual

for AC generators with the following prefixes:

UCI; UCM; UCD 224 & 274 .

SAFETY PRECAUTIONS

Before operating the generating set, read the generating set operation manual and this generator manual and become familiar with it and the equipment.

SAFE AND EFFICIENT OPERATION CAN ONLY BE ACHIEVED IF THE EQUIPMENT IS CORRECTLY OPERATED AND MAINTAINED.

Many accidents occur because of failure to follow fundamental rules and precautions.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

- Ensure installation meets all applicable safety and local electrical codes. Have all installations performed by a qualified electrician.
- Do not operate the generator with protective covers, access covers or terminal box covers removed.
- Disable engine starting circuits before carrying out maintenance.
- Disable closing circuits and/or place warning notices on any circuit breakers normally used for connection to the mains or other generators, to avoid accidental closure.

Observe all **IMPORTANT, CAUTION, WARNING,** and **DANGER** notices, defined as:

Important ! **Important refers to hazard or unsafe method or practice which can result in product damage or related equipment damage.**

Caution ! **Caution refers to hazard or unsafe method or practice which can result in product damage or personal injury.**

Warning ! **Warning refers to a hazard or unsafe method or practice which CAN result in severe personal injury or possible death.**

Danger ! **Danger refers to immediate hazards which WILL result in severe personal injury or death.**

Due to our policy of continuous improvement, details in this manual which were correct at time of printing, may now be due for amendment. Information included must therefore not be regarded as binding.

FOREWORD

The function of this book is to provide the user of the Stamford generator with an understanding of the principles of operation, the criteria for which the generator has been designed, and the installation and maintenance procedures. Specific areas where the lack of care or use of incorrect procedures could lead to equipment damage and/or personal injury are highlighted, with **WARNING** and/or **CAUTION** notes, and it is **IMPORTANT** that the contents of this book are read and understood before proceeding to fit or use the generator.

The Service, Sales and technical staff of Newage International are always ready to assist and reference to the company for advice is welcomed.

Warning !

Incorrect installation, operation, servicing or replacement of parts can result in severe personal injury or death, and/or equipment damage.
Service personnel must be qualified to perform electrical and mechanical service.

EC DECLARATION OF INCORPORATION

All Stamford generators are supplied with a declaration of incorporation for the relevant EC legislation, typically in the form of a label as below.

EC DECLARATION OF INCORPORATION

IN ACCORDANCE WITH THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1992 AND THE SUPPLY OF MACHINERY (SAFETY) (AMENDMENT) REGULATIONS 1994 IMPLEMENTING THE EC MACHINERY DIRECTIVE 89/392/EEC AS AMENDED BY 91/368/EEC.

THIS **STAMFORD A.C. GENERATOR** WAS MANUFACTURED BY OR ON BEHALF OF
NEWAGE INTERNATIONAL LTD
BARNACK ROAD STAMFORD LINCOLNSHIRE ENGLAND.

THIS COMPONENT MACHINERY MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORATED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF THE SUPPLY OF MACHINERY (SAFETY) REGULATIONS 1995/MACHINERY DIRECTIVE.

FOR AND ON BEHALF OF NEWAGE INTERNATIONAL LIMITED

NAME: LAWRENCE HAYDOCK
POSITION: TECHNICAL DIRECTOR
SIGNATURE:

THIS COMPONENT MACHINERY CARRIES THE CE MARK FOR COMPLIANCE WITH THE STATUTORY REQUIREMENTS FOR THE IMPLEMENTATION OF THE FOLLOWING DIRECTIVES

WARNING! The EMC Directive 89/336/EEC
This Component Machinery shall not be used in the Residential, Commercial and Light Industrial environment unless it also conforms to the relevant standard (EN 50081 - 1) REFER TO FACTORY FOR DETAILS

ii) The Low Voltage Directive 73/23/EEC as amended by 93/68/EEC

Under the EC Machinery Directive section 1.7.4. It is the responsibility of the generator set builder to ensure the generator identity is clearly displayed on the front cover of this book.

CE

ELECTROMAGNETIC COMPATIBILITY

Additional Information

European Union
Council Directive 89/336/EEC

For installations within the European Union, electrical products must meet the requirements of the above directive, and Newage ac generators are supplied on the basis that:

- They are to be used for power-generation or related function.
- They are to be applied in one of the following environments:

  Portable (open construction - temporary site supply)
  Portable (enclosed - temporary site supply)
  Containerised (temporary or permanent site supply)
  Ship-borne below decks (marine auxiliary power)
  Commercial vehicle (road transport / refrigeration etc)
  Rail transport (auxiliary power)
  Industrial vehicle (earthmoving, cranes etc)
  Fixed installation (industrial - factory / process plant)
  Fixed installation (residential, commercial and light industrial - home / office / health)
  Energy management (Combined heat and power and/or peak lopping)
  Alternative energy schemes

- The standard generators are designed to meet the ‘industrial’ emissions and immunity standards. Where the generator is required to meet the residential, commercial and light industrial emissions and immunity standards reference should be made to Newage document reference N4/X/011, as additional equipment may be required.
- The installation earthing scheme involves connection of the generator frame to the site protective earth conductor using a minimum practical lead length.
- Maintenance and servicing with anything other than factory supplied or authorised parts will invalidate any Newage liability for EMC compliance.
- Installation, maintenance and servicing is carried out by adequately trained personnel fully aware of the requirements of the relevant EC directives.

CONTENTS

CONTENTS

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

The UC22/27 range of generators is of brushless rotating field design, available up to 660V/50Hz (1500 rpm) or 60Hz (1800 rpm), and built to meet BS5000 Part 3 and international standards.

All the UC22/27 range are self-excited with excitation power derived from the main output windings, using either the SX460/ SX440/SX421 AVR. The UC22 is also available with specific windings and a transformer controlled excitation system.

A permanent magnet generator (PMG) powered excitation system is available as an option using either the MX341 or MX321 AVR.

Detailed specification sheets are available on request.

1.2 DESIGNATION

U	C	·	I	2	2	4	C	2
U	C	·	M	2	7	4	C	2

GENERATOR TYPE UC

SPECIFIC TYPE

INDUSTRIAL = (I) OR MARINE = (M)

SHAFT HEIGHT IN CM ON BC/UC

NUMBER OF POLES 2, 4, OR 6

CORE LENGTH

NUMBER OF BEARINGS 1 OR 2

1.3 SERIAL NUMBER LOCATION AND IDENTITY NUMBER LOCATION

Each generator is metal stamped with it's own unique serial number, the location of this number is described below.

UCI and UCM generators have their serial number stamped into the upper section of the drive end frame to end bracket adaptor ring, shown as item 31 in the parts lists at the back of this book.

UCD generators have their serial number stamped into the top of the drive end adaptor /fan shroud casting. If for any reason this casting is removed, it is imperative that care is taken to refit it to the correct generator to ensure correct identification is retained.

Inside the terminal box two adhesive rectangular labels have been fixed, each carrying the generators unique identity number. One label has been fixed to the inside of the terminal box sheet metal work, and the second label fixed to the main frame of the generator.

1.4 RATING PLATE

The generator has been supplied with a self adhesive rating plate label to enable fitting after final assembly and painting.

It is intended that this label will be stuck to the outside of the terminal box on the left hand side when viewed from the N.D.E. To assist with squarely positioning the label, location protrusions have been made in the sheet metalwork.

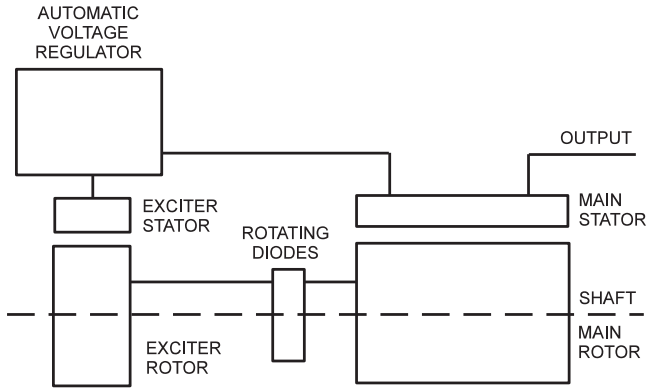
A CE Mark label is also supplied loose for fitment after final assembly and painting. This should be attached to an external surface of the Generator at a suitable location where it will not be obscured by the customer's wiring or other fittings.

The surface in the area where a label is to be stuck must be flat, clean, and any paint finish be fully dry before attempting to attach label. Recommended method for attaching label is peel and fold back sufficient of the backing paper to expose some 20 mm of label adhesive along the edge which is to be located against the sheet metal protrusions. Once this first section of label has been carefully located and stuck into position the backing paper can be progressively removed, as the label is pressed down into position. The adhesive will achieve a permanent bond in 24 hours.

SECTION 2

PRINCIPLE OF OPERATION

2.1 SELF-EXCITED AVR CONTROLLED GENERATORS

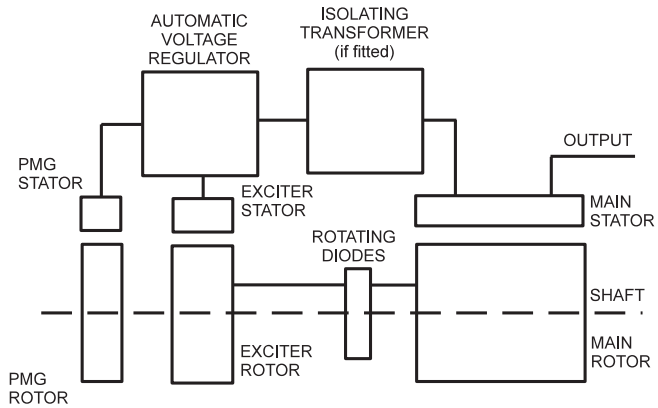


The main stator provides power for excitation of the exciter field via the SX460 (SX440 or SX421) AVR which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

The SX460 or SX440 AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine.

The SX421 AVR in addition to the SX440 features has three phase rms sensing and also provides for over voltage protection when used in conjunction with an external circuit breaker (switchboard mounted).

2.2 PERMANENT MAGNET GENERATOR (PMG) EXCITED - AVR CONTROLLED GENERATORS



The permanent magnet generator (PMG) provides power for excitation of the exciter field via the AVR (MX341 or MX321) which is the controlling device governing the level of excitation provided to the exciter field. The AVR responds to a voltage sensing signal derived, via an isolating transformer in the case of MX321 AVR, from the main stator winding. By controlling the low power of the exciter field, control of the high power requirement of the main field is achieved through the rectified output of the exciter armature.

The PMG system provides a constant source of excitation power irrespective of main stator loading and provides high motor starting capability as well as immunity to waveform distortion on the main stator output created by non linear loads, e.g. thyristor controlled dc motor.

The MX341 AVR senses average voltage on two phases ensuring close regulation. In addition it detects engine speed and provides an adjustable voltage fall off with speed, below a pre-selected speed (Hz) setting, preventing over-excitation at low engine speeds and softening the effect of load switching to relieve the burden on the engine. It also provides over-excitation protection which acts following a time delay, to de-excite the generator in the event of excessive exciter field voltage.

The MX321 provides the protection and engine relief features of the MX341 and additionally incorporates 3 phase rms sensing and over-voltage protection.
The detailed function of all the AVR circuits is covered in the load testing (subsection 4.7).

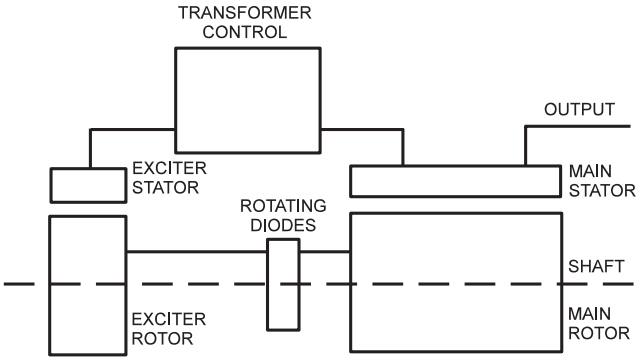
2.3 AVR ACCESSORIES

The SX440, SX421, MX341 and MX321 AVRs incorporate circuits which, when used in conjunction with accessories, can provide for parallel operation either with 'droop' or 'astatic' control, VAR/PF control and in the case of the MX321 AVR, short circuit current limiting.

Function and adjustment of the accessories which can be fitted inside the generator terminal box are covered in the accessories section of this book.

Separate instructions are provided with other accessories available for control panel mounting.

2.4 TRANSFORMER CONTROLLED GENERATORS



The main stator provides power for excitation of the exciter field via a transformer rectifier unit. The transformer combines voltage and current elements derived from the main stator output to form the basis of an open-loop control system, which is self regulating in nature. The system inherently compensates for load current magnitude and power factor and provides short circuit maintenance in addition to a good motor starting performance.

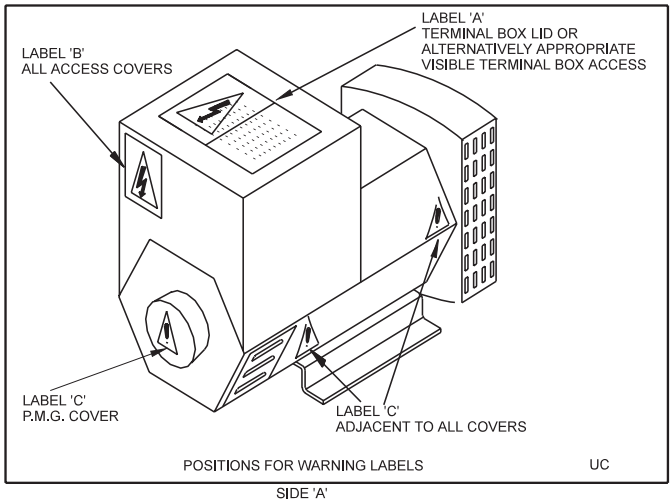
Three phase generators normally have a three phase transformer control for improved performance with unbalanced loads but a single phase transformer option is available.

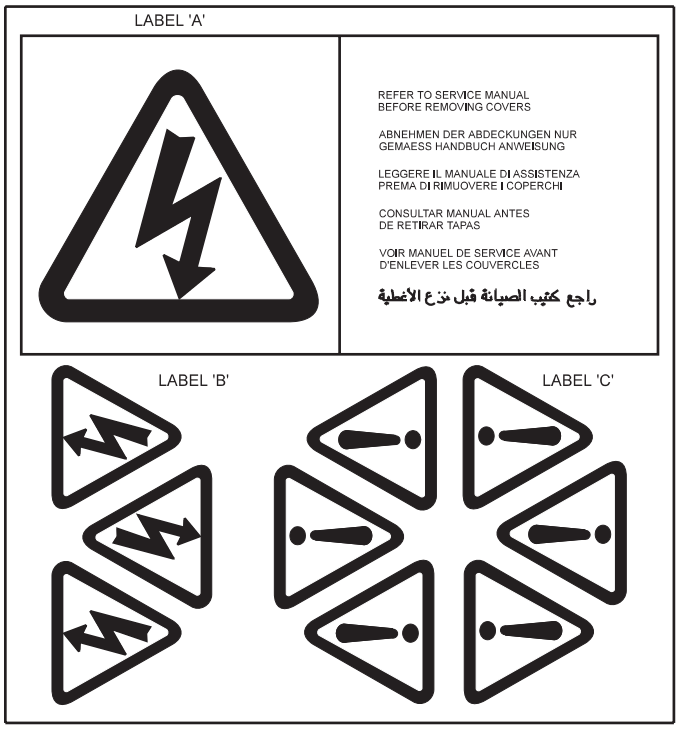
No accessories can be provided with this control system.

SECTION 3

APPLICATION OF THE GENERATOR

The generator is supplied as a component part for installation in a generating set. It is not, therefore, practicable to fit all the necessary warning/hazard labels during generator manufacture. The additional labels required are packaged with this Manual, together with a drawing identifying their locations. (See below).





It is the responsibility of the generating set manufacturer to ensure that the correct labels are fitted, and are clearly visible.

The generators have been designed for use in a maximum ambient temperature of 40°C and altitude less than 1000m above sea level in accordance with BS5000.

Ambients in excess of 40°C and altitudes above 1000m can be tolerated with reduced ratings - refer to the generator nameplate for rating and ambient. In the event that the generator is required to operate in an ambient in excess of the nameplate value or at altitudes in excess of 1000 metres above sea level, refer to the factory.

The generators are of air-ventilated screen protected drip-proof design and are not suitable for mounting outdoors unless adequately protected by the use of canopies. Anti-condensation heaters are recommended during storage and for standby duty to ensure winding insulation is maintained in good condition.

When installed in a closed canopy it must be ensured that the ambient temperature of the cooling air to the generator does not exceed that for which the generator has been rated.

The canopy should be designed such that the engine air intake to the canopy is separated from the generator intake, particularly where the radiator cooling fan is required to draw air into the canopy. In addition the generator air intake to the canopy should be designed such that the ingress of moisture is prohibited, preferably by use of a 2 stage filter.

The air intake/outlet must be suitable for the air flow given in the following table with additional pressure drops less than or equal to those given below:

Frame	Air Flow		Additional (intake/outlet) Pressure Drop
	50Hz	60Hz	
UC22	0.216m³/sec	0.281m³/sec	6mm water gauge
	458cfm	595cfm	0.25"
UCD22	0.25m³/sec	0.31m³/sec	6mm water gauge
	530cfm	657cfm	0.25"
UC27	0.514m³/sec	0.617m³/sec	6mm water gauge
	1090cfm	1308cfm	0.25"
UCD27	0.58m³/sec	0.69m³/sec	6mm water gauge
	1230cfm	1463cfm	0.25"

Important ! **Reduction in cooling air flow or inadequate protection to the generator can result in damage and/or failure of windings.**

Dynamic balancing of the generator rotor assembly has been carried out during manufacture in accordance with BS 6861 Part 1 Grade 2.5 to ensure vibration limits of the generator are in accordance with BS 4999 Part 142.

The main vibration frequencies produced by the generator are as follows:-

4 pole	1500 rpm	25 Hz
4 pole	1800 rpm	30 Hz

However, vibrations induced by the engine are complex and contain frequencies of 1.5, 3, 5 or more times the fundamental frequency of vibration. These induced vibrations can result in generator vibration levels higher than those derived from the generator itself. It is the responsibility of the generating set designer to ensure that the alignment and stiffness of the bedplate and mountings are such that the vibration limits of BS5000 Part 3 are not exceeded.

In standby applications where the running time is limited and reduced life expectancy is accepted, higher levels than specified in BS5000 can be tolerated, up to a maximum of 18mm/sec.

Two bearing generators open coupled require a substantial bedplate with engine/generator mounting pads to ensure a good base for accurate alignment. Close coupling of engine to generator can increase the overall rigidity of the set. For the purposes of establishing set design the bending moment at the engine flywheel housing to generator adaptor interface should not exceed 1000ft.lb. (140 kgm). A flexible coupling, designed to suit the specific engine/generator combination, is recommended to minimise torsional effects.

Belt driven applications of two bearing generators require the pulley diameter and design to be such that the side load or force applied to the shaft is central to the extension and does not exceed the values given in the table below:-

Frame	Side Load		Shaft extension mm
	kgf	N	
UC22	408	4000	110
UC27	510	5000	140

In instances where shaft extensions greater than specified in the table have been supplied reference must be made to the factory for appropriate loadings.

Alignment of single bearing generators is critical and vibration can occur due to the flexing of the flanges between the engine and generator. As far as the generator is concerned the maximum bending moment at this point must not exceed 1000ft.lb. (140 kgm). A substanial bedplate with engine/generator mounting pads is required.

It is expected that the generator will be incorporated into a generating set operating in an environment, where the maximum shock load experienced by the generator will not exceed 3g. in any plane. If shock loads in excess of 3g are to be encountered, anti-vibration mountings must be incorporated into the generating set to ensure they absorb the excess.

The maximum bending moment of the engine flange must be checked with the engine manufacturer.

Generators can be supplied without a foot, providing the option for customers own arrangement. See SECTION 4.2.1 for assembly procedure.

Torsional vibrations occur in all engine-driven shaft systems and may be of a magnitude to cause damage at certain critical speeds. It is therefore necessary to consider the torsional vibration effect on the generator shaft and couplings.

It is the responsibility of the generator set manufacturer to ensure compatibility, and for this purpose drawings showing the shaft dimensions and rotor inertias are available for customers to forward to the engine supplier. In the case of single bearing generators coupling details are included.

Important ! **Torsional incompatibility and/or excessive vibration levels can cause damage or failure of generator and/or engine components.**

The terminal box is constructed with removable panels for easy adaptation to suit specific glanding requirements. Within the terminal box there are insulated terminals for line and neutral connections and provision for earthing. Additional earthing points are provided on the generator feet.

The neutral is NOT connected to the frame.

The main stator winding has leads brought out to the terminals in the terminal box.

Warning ! **No earth connections are made on the generator and reference to site regulations for earthing must be made. Incorrect earthing or protection arrangements can result in personal injury or death.**

Fault current curves (decrement curves), together with generator reactance data, are available on request to assist the system designer to select circuit breakers, calculate fault currents and ensure discrimination within the load network.

Warning ! **Incorrect installation, service or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be qualified to perform electrical and mechanical service.**

SECTION 4

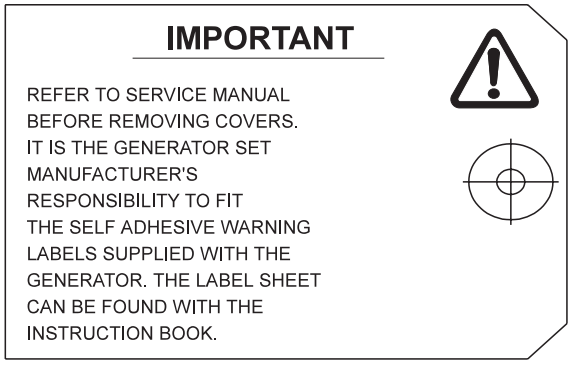
INSTALLATION - PART 1

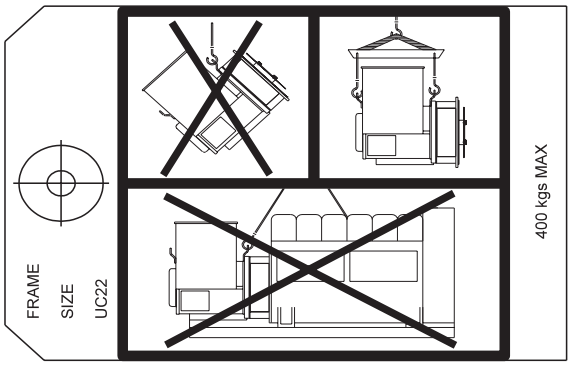
4.1 LIFTING

Warning !

Incorrect lifting or inadequate lifting capacity can result in severe personal injury or equipment damage. MINIMUM LIFTING CAPACITY REQUIRED IS 750Kg. Generator lifting lugs should NOT be used for lifting the complete generator set.

Two lifting lugs are provided for use with a shackle and pin type lifting aid. Chains of suitable length and lifting capacity must be used. Lifting points are designed to be as close to the centre of gravity of the generator as possible, but due to design restrictions it is not possible to guarantee that the generator frame will remain horizontal while lifting. Care is therefore needed to avoid personal injury or equipment damage. The correct lifting arrangement is shown on the label attached to the lifting lug. (See sample below).





Single bearing generators are supplied fitted with a rotor retaining bar at the non-drive end of the shaft.

To remove retaining bar:

1. Remove the four screws holding the sheet metal cover at the non drive end and remove cover

2. Remove central bolt holding the retaining bar to the shaft

3. Refit sheet metal cover.

Once the bar is removed, to couple the rotor to engine, the rotor is free to move in the frame, and care is needed during coupling and alignment to ensure the frame is kept in the horizontal plane.

Generators fitted with a PMG excitation system are not fitted with retaining bar. Refer to frame designation to verify generator type (subsection 1.2)

4.2 ASSEMBLY

During the assembly of the generator to the engine it will be necessary firstly to carefully align, then rotate, the combined generator rotor - engine crankshaft assembly, as part of the construction process, to allow location, insertion and tightening of the coupling bolts. This requirement to rotate the combined assemblies exists for both single and two bearing units.

During the assembly of single bearing units it is necessary to align the generator's coupling holes with the engine flywheel holes; it is suggested that two diametrically opposite location dowel pins are fitted to the engine flywheel, over which the generator coupling can slide into final location into the engine flywheel spigot recess. The dowels must be removed and replaced by coupling bolts before the final bolt tightening sequence.

While fitting and tightening the coupling bolts it will be necessary to rotate the engine crankshaft - generator rotor assembly. Care should be taken to ensure that rotation is carried out in an approved manner that ensures safe working practice when reaching inside the machine to insert or tighten coupling bolts, and that no component of the assembly is damaged by non-approved methods of assembly rotation.

Engine manufacturers have available a proprietary tool or facility designed to enable manual rotation of the crankshaft assembly. This must always be used, having been engineered as an approved method of assembly rotation, engaging the manually driven pinion with the engine flywheel starter ring-gear.

Caution ! **Before working inside the generator, during the aligning and fitting of coupling bolts, care should be taken to lock the assembly to ensure there is no possibility of rotational movement.**

4.2.1 NO FOOT OPTION

Generators can be supplied without a foot providing the option for customers own arrangement.

For details of mounting this arrangement, see the general arrangement drawing supplied with the generator. Alternatively refer to Newage International for a copy of the latest general arrangement drawing showing the 'NO FOOT OPTION' appropriate to your generator.

4.2.2 TWO BEARING GENERATORS

A flexible coupling should be fitted and aligned in accordance with the coupling manufacturer's instruction.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the generator up to the engine. Shim the generator feet if necessary. Ensure adaptor guards are fitted after generator/engine assembly is complete. Open coupled sets require a suitable guard, to be provided by the set builder.

In the case of belt driven generators, ensure alignment of drive and driven pulleys to avoid axial load on the bearings. Screw type tensioning devices are recommended to allow accurate adjustment of belt tension whilst maintaining pully alignment. Side loads should not exceed values given in SECTION 3.

Belt and pulley guards must be provided by the set builder.

Important ! **Incorrect belt tensioning will result in excessive bearing wear.**

Caution ! **Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.**

4.2.3 SINGLE BEARING GENERATORS

Alignment of single bearing generators is critical. If necessary shim the generator feet to ensure alignment of the machined surfaces.

For transit and storage purposes the generator frame spigot and rotor coupling plates have been coated with a rust preventative. This MUST BE removed before assembly to engine.

A practical method for removal of this coating is to clean the mating surface areas with a de-greasing agent based on a petroleum solvent.

Care should be taken not to allow any cleaning agent to come into prolonged contact with skin.

The sequence of assembly to the engine should generally be as follows:

1. On the engine check the distance from the coupling mating face on the flywheel to the flywheel housing mating face. This should be within +/-0.5mm of nominal dimension. This is necessary to ensure that a thrust is not applied to the a.c. generator bearing or engine bearing.

2. Check that the bolts securing the flexible plates to the coupling hub are tight and locked into position. Torque tightening is 24.9kgfm (244Nm; 180 lb ft).

2a. **UCD224 Only**
Torque tightening is 15.29 kgfm (150Nm; 110 lb ft).

3. Remove covers from the drive end of the generator to gain access to coupling and adaptor bolts.

4. Check that coupling discs are concentric with adaptor spigot. This can be adjusted by the use of tapered wooden wedges between the fan and adaptor. Alternatively the rotor can be suspended by means of a rope sling through the adaptor opening.

5. Offer the a.c. generator to engine and engage both coupling discs and housing spigots at the same time, finally pulling home by using the housing and coupling bolts. Use heavy gauge washers between bolt head and discs on disc to flywheel bolts.

6. Tighten coupling disc to flywheel. Refer to engine manual for torque setting of disc to flywheel bolts.

7. Remove wooden wedges.

Caution ! **Incorrect guarding and/or generator alignment can result in personal injury and/or equipment damage.**

4.3 EARTHING

The generator frame should be solidly bonded to the generating set bedplate. If antivibration mounts are fitted between the generator frame and its bedplate a suitably rated earth conductor (normally one half of the cross sectional area of the main line cables) should bridge across the antivibration mount.

Warning ! **Refer to local regulations to ensure that the correct earthing procedure has been followed.**

4.4 PRE-RUNNING CHECKS
4.4.1 INSULATION CHECK

Before starting the generating set, both after completing assembly and after installation of the set, test the insulation resistance of windings.

The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output lead terminal U, V or W to earth. The insulation resistance reading should be in excess of 5MΩ to earth. Should the insulation resistance be less than 5MΩ the winding must be dried out as detailed in the Service and Maintenance section of this Manual.

Important ! **The windings have been H.V. tested during manufacture and further H.V. testing may degrade the insulation with consequent reduction in operating life. Should it be necessary to demonstrate H.V. testing, for customer acceptance, the tests must be carried out at reduced voltage levels i.e. Test Voltage= 0.8 (2 X Rated Voltage + 1000)**

4.4.2 DIRECTION OF ROTATION

The generator is supplied to give a phase sequence of U V W with the generator running clockwise looking at the drive end (unless otherwise specified at the time of ordering). If the generator phase rotation has to be reversed after the generator has been despatched apply to factory for appropriate wiring diagrams.

UCI224, UCI274, UCM224, UCM274

Machines are fitted with bi-directional fans and are suitable for running in either direction of rotation.

UCD224, UCD274

Machines are fitted with uni-directional fans and are suitable for running in one direction only.

4.4.3 VOLTAGE AND FREQUENCY

Check that the voltage and frequency levels required for the generating set application are as indicated on the generator nameplate.

Three phase generators normally have a 12 ends out reconnectable winding. If it is necessary to reconnect the stator for the voltage required, refer to diagrams in the back of this manual.

4.4.4 AVR SETTINGS

To make AVR selections and adjustments remove the AVR cover and refer to 4.4.4.1, 4.4.4.2, 4.4.4.3, 4.4.4.4 or 4.4.4.5 depending upon type of AVR fitted. Reference to the generator nameplate will indicate AVR type (SX460, SX440, SX421, MX341 or MX321).

Most of the AVR adjustments are factory set in positions which will give satisfactory performance during initial running tests. Subsequent adjustment may be required to achieve optimum performance of the set under operating conditions. Refer to 'Load Testing' section for details.

4.4.4.1 TYPE SX460 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 1 for location of selection links.

1. Frequency selection

50Hz operation LINK C-50
60Hz operation LINK C-60

2. External hand trimmer selection

No external hand trimmer LINK 1-2
External hand trimmer required - REMOVE LINK 1-2 and connect trimmer across terminals 1 and 2.

3. AVR Input Selection

High voltage	(220/240V) Input	NO LINK
Low voltage	(110/120V) Input	LINK 3-4

Refer to diagram in the back of this manual to determine wiring.

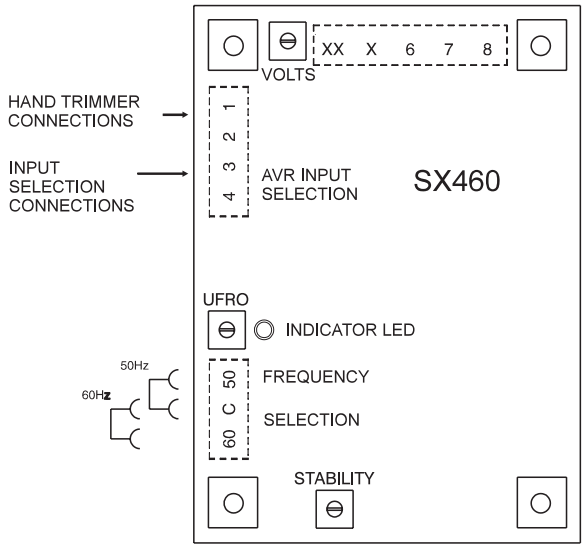


Fig. 1

4.4.4.2 TYPE SX440 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 2 for location of selection links.

1. Frequency selection terminals

50Hz operation LINK C-50
60Hz operation LINK C-60

2. Stability selection terminals

Frame UC22 LINK A-C
Frame UC27 LINK B-C

3. Sensing selection terminals

LINK 2-3
LINK 4-5
LINK 6-7

4. Excitation Interruption Link

LINK K1-K2

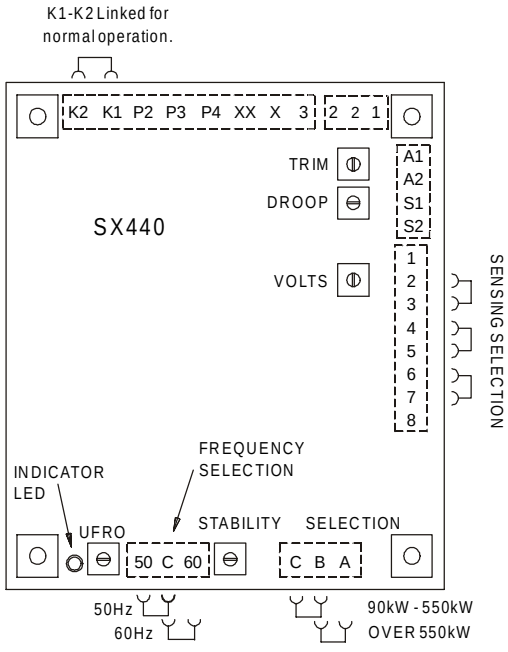


Fig. 2

4.4.4.3 TYPE SX421 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 3 for location of selection links.

1. Frequency selection terminals

50Hz operation LINK C-50
60Hz operation LINK C-60

2. Stability selection terminals

Depending upon kW output LINK B-D
or LINK A-C
or LINK B-C

3. Terminals K1 - K2

Excitation circuit breaker closed

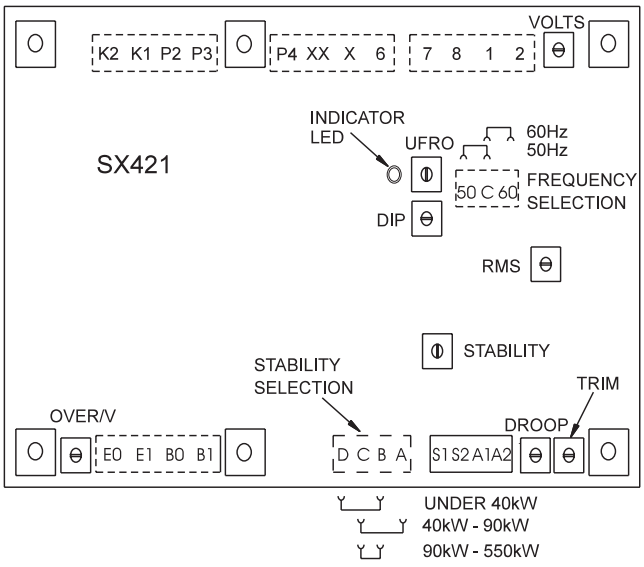


Fig. 3

4.4.4.4 TYPE MX341 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 4 for location of setting links.

1. Frequency selection terminals

50Hz operation LINK 2-3
60Hz operation LINK 1-3

2. Stability selection terminals

Frame UC22 LINK A-C
Frame UC27 LINK B-C

3. Sensing selection terminals *

LINK 2-3
LINK 4-5
LINK 6-7

4. Excitation Interruption Link

LINK K1-K2

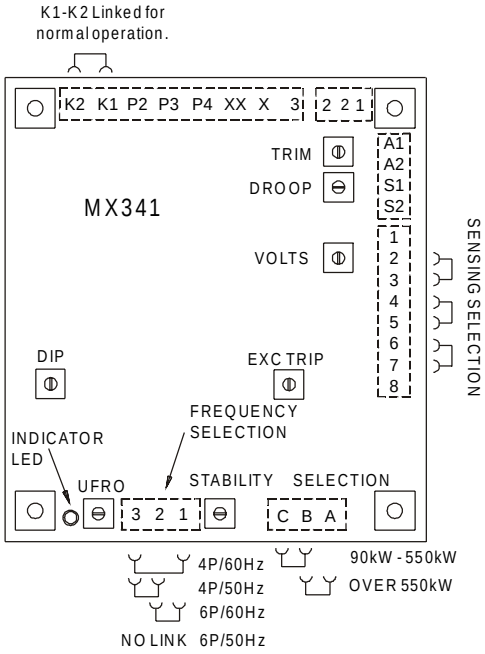


Fig. 4

4.4.4.5 TYPE MX321 AVR

The following 'jumper' connections on the AVR should be checked to ensure they are correctly set for the generating set application.

Refer to Fig. 5 for location of setting links.

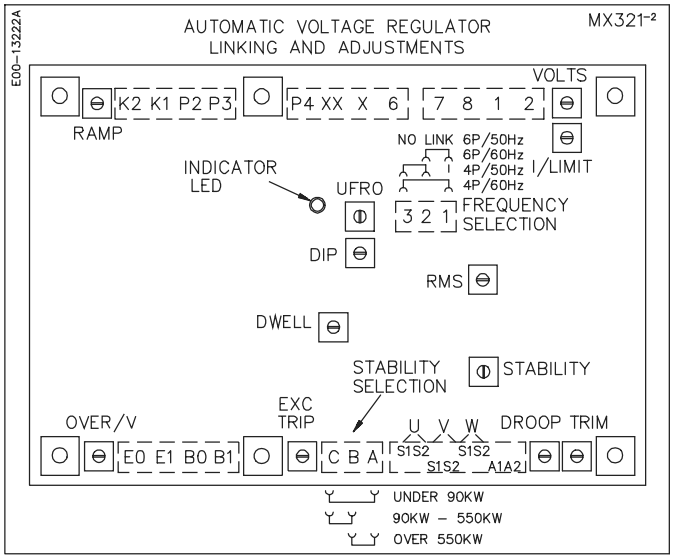


Fig. 5

1. Frequency selection terminals

50Hz operation LINK 2-3
60Hz operation LINK 1-3

2. Stability selection terminals

Frame UC22 LINK A-C
Frame UC27 LINK B-C

3. Terminals K1 - K2

Excitation circuit breaker closed.
If this option not fitted, K1 - K2 linked at auxiliary terminal block.

4.4.5 TRANSFORMER CONTROLLED EXCITATION SYSTEM (Series 5)

This control system is identified with the digit 5 as the last digit of the frame size quoted on the nameplate.

The excitation control is factory set for the specific voltage shown on the nameplate and requires no adjustment.

4.5 GENERATOR SET TESTING

Warning ! **During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments.**

4.5.1 TEST METERING/CABLING

Connect any instrument wiring and cabling required for initial test purposes with permanent or spring-clip type connectors.

Minimum instrumentation for testing should be line - line or line to neutral voltmeter, Hz meter, load current metering and kW meter. If reactive load is used a power factor meter is desirable.

Important ! **When fitting power cables for load testing purposes, ensure cable voltage rating is at least equal to the genrator rated voltage. The load cable termination should be placed on top of the winding lead termination and clamped with the nut provided.**

Caution ! **Check that all wiring terminations for internal or external wiring are secure, and fit all terminal box covers and guards. Failure to secure wiring and/or covers may result in personal injury and/or equipment failure.**

4.6 INITIAL START-UP

Warning ! **During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.**

On completion of generating set assembly and before starting the generating set ensure that all engine manufacturer's pre-running procedures have been completed, and that adjustment of the engine governor is such that the generator will not be subjected to speeds in excess of 125% of the rated speed.

Important ! **Overspeeding of the generator during initial setting of the speed governor can result in damage to the generator rotating components.**

In addition remove the AVR access cover (on AVR controlled generators) and turn VOLTS control fully anti-clockwise. Start the generating set and run on no-load at nominal frequency. Slowly turn VOLTS control potentiometer clockwise until rated voltage is reached. Refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer location.

Important ! **Do not increase the voltage above the rated generator voltage shown on the generator nameplate.**

The STABILITY control potentiometer will have been pre-set and should normally not require adjustment, but should this be required, usually identified by oscillation of the voltmeter, refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer location and proceed as follows:-

1. Run the generating set on no-load and check that speed is correct and stable
2. Turn the STABILITY control potentiometer clockwise, then turn slowly anti-clockwise until the generator voltage starts to become unstable.

The correct setting is slightly clockwise from this position (i.e. where the machine volts are stable but close to the unstable region).

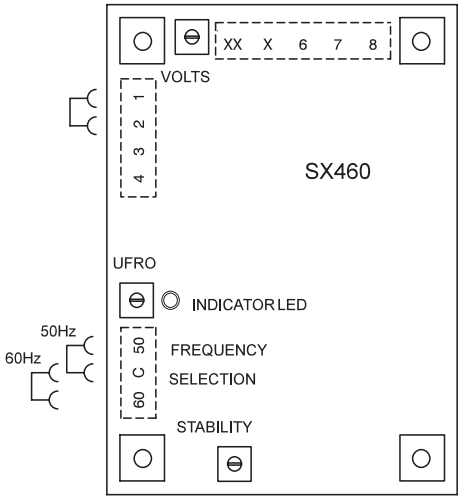


Fig. 6a

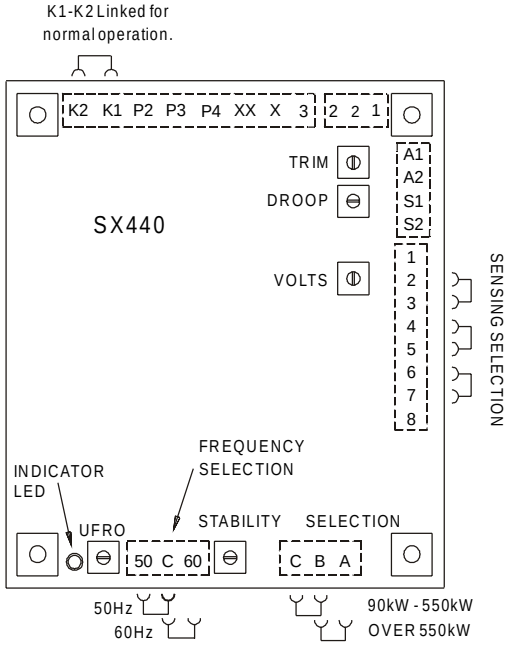


Fig. 6b

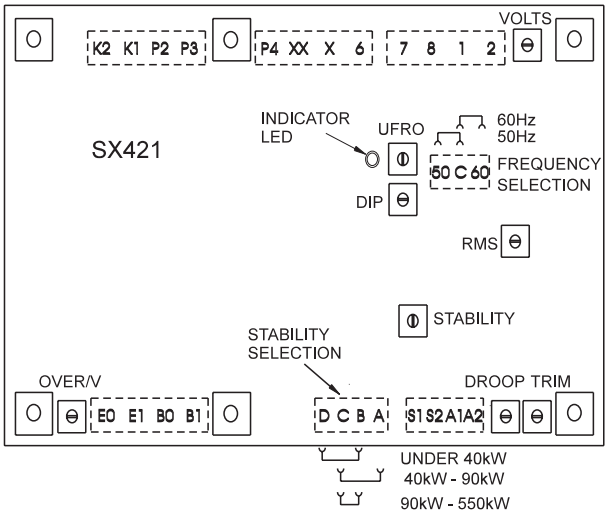


Fig. 6c

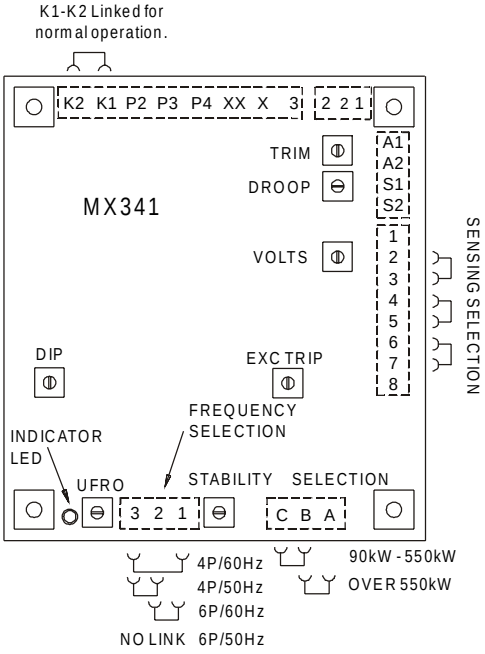


Fig. 6d

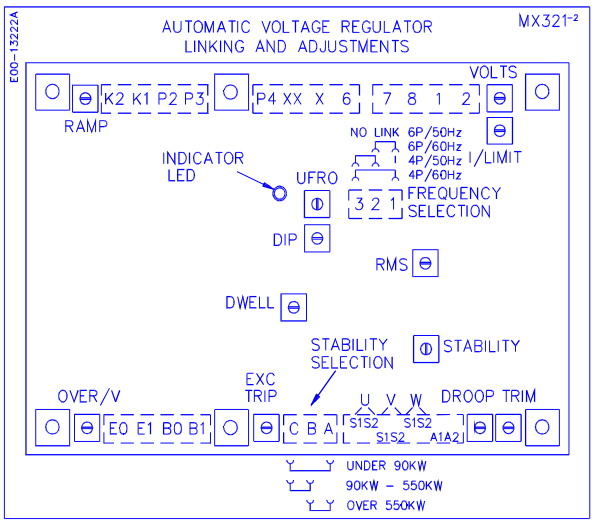


Fig. 6e

4.7 LOAD TESTING

Warning !

During testing it may be necessary to remove covers to adjust controls exposing 'live' terminals or components. Only personnel qualified to perform electrical service should carry out testing and/or adjustments. Refit all access covers after adjustments are completed.

4.7.1 AVR CONTROLLED GENERATORS - AVR ADJUSTMENTS

Refer to Fig. 6a, 6b, 6c, 6d or 6e for control potentiometer locations.

Having adjusted VOLTS and STABILITY during the initial start-up procedure, other AVR control functions should not normally need adjustment.

If however, poor voltage regulation on-load or voltage collapse is experienced, refer to the following paragraphs on each function to a) check that the symptoms observed do indicate adjustment is necessary, and b) to make the adjustment correctly.

4.7.1.1 UFRO (Under Frequency Roll Off) (AVR Types SX460, SX440, SX421, MX341 and MX321)

The AVR incorporates an underspeed protection circuit which gives a voltage/speed (Hz) characteristic as shown:

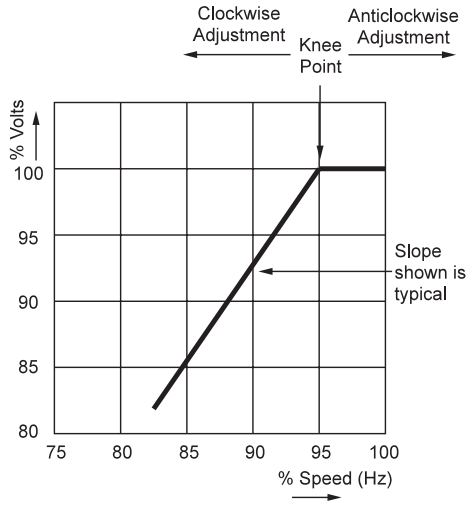


Fig. 7

The UFRO control potentiometer sets the "knee point".

Symptoms of incorrect setting are a) the light emitting diode (LED) indicator, just above the UFRO Control potentiometer, being permanently lit when the generator is on load, and b) poor voltage regulation on load, i.e. operation on the sloping part of the characteristic.

Clockwise adjustment lowers the frequency (speed) setting of the "knee point" and extinguishes the LED. For Optimum setting the LED should illuminate as the frequency falls just below nominal frequency, i.e. 47Hz on a 50Hz generator or 57Hz on a 60Hz generator.

Important ! **With AVR Types MX341 and MX321. If the LED is illuminated and no output voltage is present, refer to EXC TRIP and/or OVER/V sections below.**

4.7.1.2 EXC TRIP (Excitation Trip)
AVR Types MX341 and MX321

An AVR supplied from a permanent magnet generator inherently delivers maximum excitation power on a line to line or line to neutral short circuit or large overload. In order to protect the generator windings the AVR incorporates an over excitation circuit which detects high excitation and removes it after a pre-determined time, i.e. 8-10 seconds.

Symptoms of incorrect setting are the generator output collapses on load or small overload, and the LED is permanently illuminated.

The correct setting is 70 volts +/-5% between terminals X and XX.

4.7.1.3 OVER/V (Over Voltage)
AVR Type SX421, MX321

Over voltage protection circuitry is included in the AVR to remove generator excitation in the event of loss of AVR sensing input.

The MX321 has both internal electronic de-excitation and provision of a signal to operate an external circuit breaker.

The SX421 only provides a signal to operate an external breaker, which MUST be fitted if over voltage protection is required.

Incorrect setting would cause the generator output voltage to collapse at no-load or on removal of load, and the LED to be illuminated.

The correct setting is 300 volts +/-5% across terminals E1, E0. Clockwise adjustment of the OVER/V control potentiometer will increase the voltage at which the circuit operates.

4.7.1.4 TRANSIENT LOAD SWITCHING ADJUSTMENTS
AVR Types SX421, MX341 and MX321

The additional function controls of DIP and DWELL are provided to enable the load acceptance capability of the generating set to be optimised. The overall generating set performance depends upon the engine capability and governor response, in conjunction with the generator characteristics.

It is not possible to adjust the level of voltage dip or recovery independently from the engine performance, and there will always be a 'trade off' between frequency dip and voltage dip.

DIP
AVR Types SX421, MX341 and MX321

AVR Types SX421, MX341 and MX321
The dip function control potentiometer adjusts the slope of the voltage/speed (Hz) characteristic below the knee point as shown below:

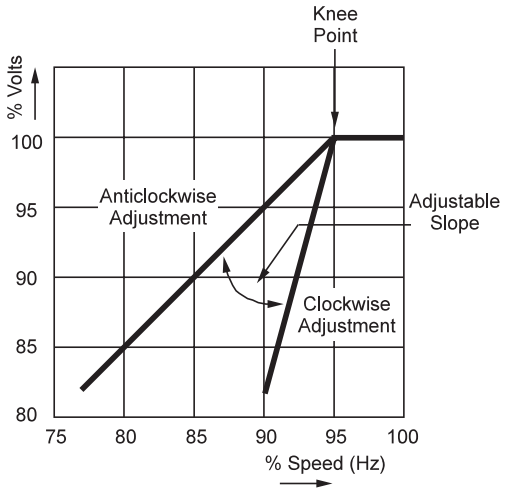


Fig. 8

DWELL
AVR Type MX321

The dwell function introduces a time delay between the recovery of voltage and recovery of speed.

The purpose of the time delay is to reduce the generator kW below the available engine kW during the recovery period, thus allowing an improved speed recovery.

Again this control is only functional below the "knee point", i.e. if the speed stays above the knee point during load switching there is no effect from the DWELL function setting.

Clockwise adjustment gives increased recovery time.

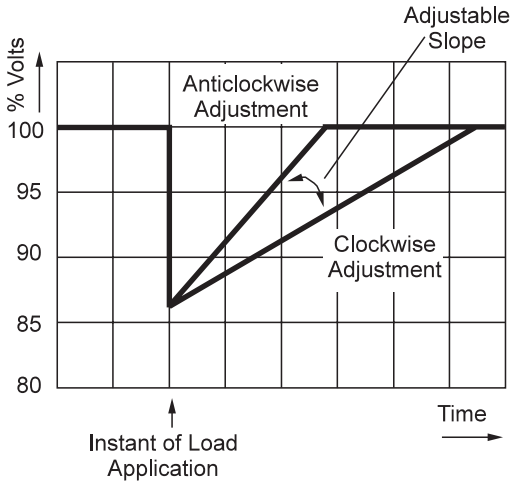


Fig. 9

The graphs shown above are representations only, since it is impossible to show the combined effects of voltage regulator and engine governor performance.

4.7.1.5 RAMP
AVR Type MX321

The RAMP potentiometer enables adjustment of the time taken for the generator's initial build up to normal rated voltage during each start and run up to speed. The potentiometer is factory set to give a ramp time of three seconds, which is considered to be suitable for most applications. This time can be reduced to one second by turning the pot. fully counter clockwise, and increased to eight seconds by turning the pot. fully clockwise.

4.7.2 TRANSFORMER CONTROLLED GENERATORS - TRANSFORMER ADJUSTMENT

Normally no adjustment is required but should the no-load voltage and/or on-load voltage be unacceptable, adjustment of the transformer air gap can be made as follows.

Stop the generator. Remove transformer cover box. (Normally left hand side of the terminal box when viewed from the non drive end).

Slacken the three transformer mounting bolts along the top of the transformer.

Start the set with a voltmeter connected across the main output terminals.

Adjust the air gap between the transformer top lamination section and the transformer limbs to obtain required voltage on no-load. Slightly tighten the three mounting bolts. Switch load 'on' and 'off' two or three times. Application of load will normally raise the voltage setting slightly. With the load 'off' recheck the no-load voltage.
Readjust air gap and finally tighten mounting bolts.

Refit the access cover.

Warning !

Failure to refit covers can result in operator personal injury or death.

4.8 ACCESSORIES

Refer to the "ACCESSORIES" - Section 6 of this Manual for setting up procedures related to generator mounted accessories.

If there are accessories for control panel mounting supplied with the generator refer to the specific accessory fitting procedures inserted inside the back cover of this book.

SECTION 5

INSTALLATION - PART 2

5.1 GENERAL

The extent of site installation will depend upon the generating set build, e.g. if the generator is installed in a canopied set with integral switchboards and circuit breaker, on site installation will be limited to connecting up the site load to the generating set output terminals . In this case reference should be made to the generating set manufacturer's instruction book and any pertinent local regulations.

If the generator has been installed on a set without switchboard or circuit breaker the following points relating to connecting up the generator should be noted.

5.2 GLANDING

The terminal box is most conveniently glanded on either the right or left hand side. Both panels are removable for drilling/punching to suit glands/or glanding boxes. If single core cables are taken through the terminal box side panel an insulated or non-magnetic gland plate should be fitted.

Incoming cables should be supported from either below or above the box level and at a sufficient distance from the centre line of the generating set so as to avoid a tight radius at the point of entry into the terminal box panel, and allow movement of the generator set on its anti-vibration mountings without excessive stress on the cable.

Before making final connections, test the insulation resistance of the windings. The AVR should be disconnected during this test.

A 500V Megger or similar instrument should be used. Should the insulation resistance be less than 5MΩ the windings must be dried out as detailed in the Service and Maintenance section of this manual.

When making connections to the terminals the incoming cable termination should be placed on top of the winding lead termination(s) and clamped with the nut provided.

Important ! **To avoid the possibility of swarf entering any electrical components in the terminal box, panels must be removed for drilling.**

5.3 EARTHING

The neutral of the generator is not bonded to the generator frame as supplied from the factory. An earth terminal is provided inside the terminal box adjacent to the main terminals. Should it be required to operate with the neutral earthed a substantial earth conductor (normally equivalent to one half of the section of the line conductors) must be connected between the neutral and the earth terminal inside the terminal box. Additional earth terminals are provided on the generator feet. These should be already bonded to the generating set bedplate by the generating set builder, but will normally be required to be connected to the site earth system.

Caution ! **Reference to local electricity regulations or safety rules should be made to ensure correct earthing procedures have been followed.**

5.4 PROTECTION

It is the responsibility of the end user and his contractors/sub-contractors to ensure that the overall system protection meets the needs of any inspectorate, local electricity authority or safety rules, pertaining to the site location.

To enable the system designer to achieve the necessary protection and/or discrimination, fault current curves are available on request from the factory, together with generator reactance values to enable fault current calculations to be made.

Warning !

Incorrect installation and/or protective systems can result in personal injury and/or equipment damage.
Installers must be qualified to perform electrical installation work.

5.5 COMMISSIONING

Ensure that all external cabling is correct and that all the generating set manufacturer's pre-running checks have been carried out before starting the set.

The generator AVR controls will have been adjusted during the generating set manufacturer's tests and should normally not require further adjustment.

Should malfunction occur during commissioning refer to Service and Maintenance section 'Fault Finding' procedure (subsection 7.4).

SECTION 6

ACCESSORIES

Generator control accessories may be fitted, as an option, in the generator terminal box. If fitted at the time of supply, the wiring diagram(s) in the back of this book shows the connections. When the options are supplied separately, fitting instructions are provided with the accessory.

The following matrix indicates availability of accessories with the differing AVRs.

Note the SX460 is not suitable for operation with accessories.

AVR Model	Parallel -ing Droop or Astatic	Manual Voltage Regulator	VAr/PF Control	Current Limit
SX440	✔	✘	✔	✘
SX421	✔	✘	✔	✘
MX341	✔	✔	✔	✘
MX321	✔	✔	✔	✔

6.1 REMOTE VOLTAGE ADJUST (ALL AVR TYPES)

A remote voltage adjust (hand trimmer) can be fitted.

SX460 — Remove link 1-2 on the AVR and connect adjuster to terminals 1 and 2.

SX440, SX421 MX341 and MX321 — Remove link 1-2 at the auxiliary terminals and connect adjuster to terminals 1 and 2.

6.2 PARALLEL OPERATION

Understanding of the following notes on parallel operation is useful before attempting the fitting or setting of the droop kit accessory. When operating in parallel with other generators or the mains, it is essential that the phase sequence of the incoming generator matches that of the busbar and also that all of the following conditions are met before the circuit breaker of the incoming generator is closed on to the busbar (or operational generator).

1. Frequency must match within close limits.

2. Voltages must match within close limits.

3. Phase angle of voltages must match within close limits.
   A variety of techniques, varying from simple synchronising lamps to fully automatic synchronisers, can be used to ensure these conditions are met.

Important ! **Failure to meet conditions 1, 2, and 3 when closing the cricuit breaker, will generate excessive mechanical and electrical stresses, resulting in equipment damage.**

Once connected in parallel a minimum instrumentation level per generator of voltmeter, ammeter, wattmeter (measuring total power per generator), and frequency meter is required in order to adjust the engine and generator controls to share kW in relation to engine ratings and kVAr in relation to generator ratings.

It is important to recognise that:

1. True kW are derived from the engine, and speed governor characteristics determine the kW sharing between sets

and

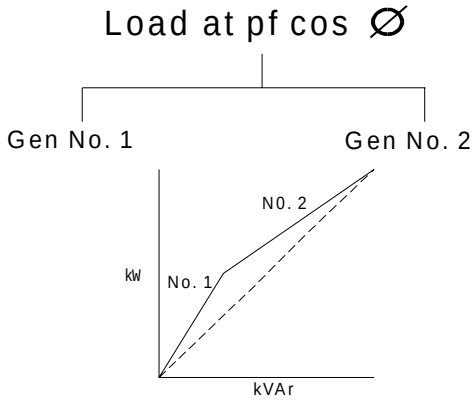
2. kVAr are derived from the generator, and excitation control characteristics determine the kVAr sharing.
   Reference should be made to the generating set manufacturer's instructions for setting the governor controls.

6.2.1 DROOP

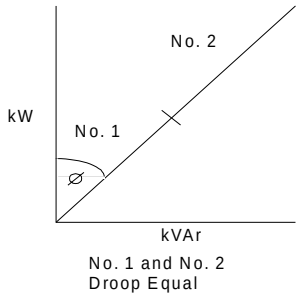
The most commonly used method of kVAr sharing is to create a generator voltage characteristic which falls with decreasing power factor (increasing kVAr). This is achieved with a current transformer (C.T.) which provides a signal dependent on current phase angle (i.e. power factor) to the AVR.

The current transformer has a burden resistor on the AVR board, and a percentage of the burden resistor voltage is summed into the AVR circuit. Increasing droop is obtained by turning the DROOP control potentiometer clockwise.

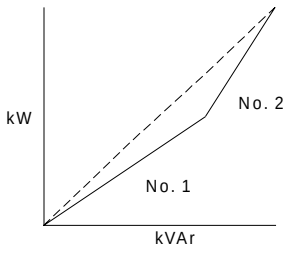
The diagrams below indicate the effect of droop in a simple two generator system:-



No. 1 Droop Greater than No. 2 Droop



No. 1 and No. 2 Droop Equal



No. 1 Droop less than No. 2 Droop

Generally 5% droop at full load current zero p.f. is sufficient to ensure kVAr sharing.

If the droop accessory has been supplied with the generator it will have been tested to ensure correct polarity and set to a nominal level of droop. The final level of droop will be set during generating set commissioning.

The following setting procedure will be found to be helpful.

6.2.1.1 SETTING PROCEDURE

Depending upon available load the following settings should be used - all are based on rated current level.

0.8 P.F. LOAD (at full load current) SET DROOP TO 3%
Zero P.F. LOAD (at full load current) SET DROOP TO 5%

Setting the droop with low power factor load is the most accurate. Run each generator as a single unit at rated frequency or rated frequency + 4% depending upon type of governor and nominal voltage. Apply available load to rated current of the generator. Adjust 'DROOP' control potentiometer to give droop in line with above table. Clockwise rotation increases amount of droop. Refer to Fig 9a, 9b, 9c or 9d for potentiometer locations.

Note 1)
Reverse polarity of the C.T. will raise the generator voltage with load. The polarities S1-S2 shown on the wiring diagrams are correct for clockwise rotation of the generator looking at the drive end. Reversed rotation requires S1-S2 to be reversed.

Note 2)
The most important aspect is to set all generators equal. The precise level of droop is less critical.

Note 3)
A generator operated as a single unit with a droop circuit set at rated load 0.8 power factor is unable to maintain the usual +/- 0.5% regulation. A shorting switch can be connected across S1-S2 to restore regulation for single running.

Important ! **LOSS OF FUEL to an engine can cause its generator to motor with consequent damage to the generator windings. Reverse power relays should be fitted to trip main circuit breaker. LOSS OF EXCITATION to the generator can result in large current oscillations with consequent damage to generator windings. Excitation loss detection equipment should be fitted on trip main circuit breaker.**

6.2.2 ASTATIC CONTROL

The 'droop' current transformer can be used in a connection arrangement which enables the normal regulation of the generator to be maintained when operating in parallel.

This feature is only supplied from the factory as a fitted droop kit, however, if requested at the time of order, the diagrams inside the back cover of this book will give the necessary site connections. The end user is required to provide a shorting switch for the droop current transformer secondary.

Should the generator be required to be converted from standard droop to 'astatic' control, diagrams are available on request.

The setting procedure is exactly the same as for DROOP. (Subsection 6.2.1.1)

Important ! **When using this connection arrangement a shorting switch is required across each C.T. burden (terminals S1 and S2.)The switch must be closed a) when a generating set is not running and b) when a generating set is selected for single running.**

6.3 MANUAL VOLTAGE REGULATOR (MVR) - MX341 and MX321 AVR

This accessory is provided as an 'emergency' excitation system, in the event of an AVR failure.

Powered from the PMG output the unit is manually set, but automatically controls the excitation current, independent of generator voltage or frequency.

The unit is provided with 'MANUAL', 'OFF', 'AUTO' switching facility.

'MANUAL'
- position connects the exciter field to the MVR output. Generator output is then controlled by the operator adjusting the excitation current.

'OFF'
- disconnects the exciter field from both MVR and the normal AVR.

'AUTO'
- connects the exciter field to the normal AVR and the generator output is controlled at the pre-set voltage under AVR control.

Switching mode of operation should be carried out with the generator set stationary to avoid voltage surges on the connected load, although neither the MVR nor AVR will be damaged should the switching be carried out with the set running.

6.4 OVERVOLTAGE DE-EXCITATION BREAKER SX421 and MX321 AVR

This accessory provides positive interuption of the excitation power in the event of overvoltage due to loss of sensing or internal AVR faults including the output power device.

With the MX321 AVR this accessory is supplied loose for fitting in the control panel.

In the case of the SX421 the cricuit breaker is always supplied and will normally be fitted in the generator.

Important ! **When the circuit breaker is supplied loose, the AVR is fitted with a link on terminals K1-K2 to enable operation of the AVR. When connecting the circuit breaker this link must be removed.**

6.4.1 RESETTING THE BREAKER

In the event of operation of the circuit breaker, indicated by loss of generator output voltage, manual resetting is required. When in the "tripped" state the circuit breaker switch lever shows "OFF". To reset move the switch lever to the position showing "ON".

When fitted in the generator, access to the breaker is gained by removal of the AVR access cover.

Danger !

Terminals which are LIVE with the generating set running are exposed when the AVR access cover is removed. Resetting of the circuit breaker MUST be carried out with the generating set stationary, and engine starting circuits disabled.

The circuit breaker is mounted on the AVR mounting bracket either to the left or to the right of the AVR depending upon AVR poistion. After resetting the circuit breaker replace the AVR access cover before restarting the generating set. Should resetting of the circuit breaker not restore the generator to normal operation, refer to subsection 7.5.

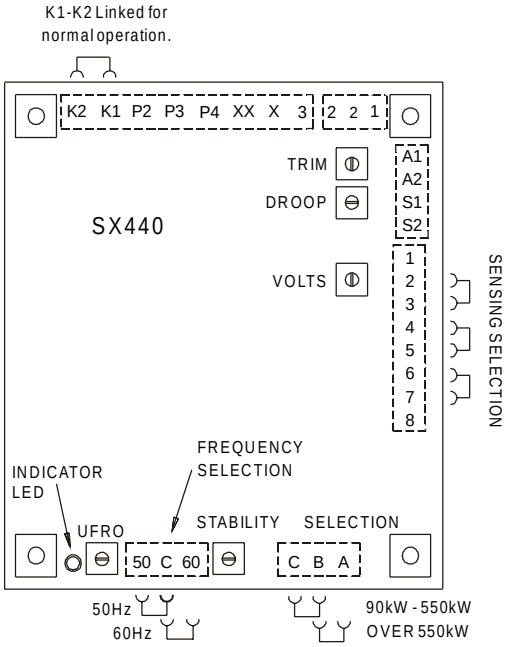


Fig. 9a

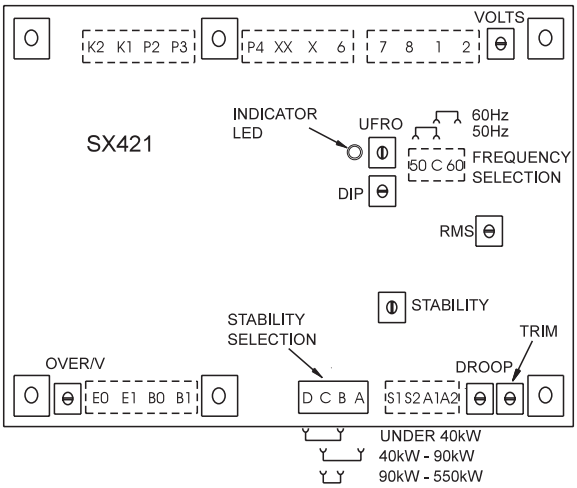


Fig. 9b

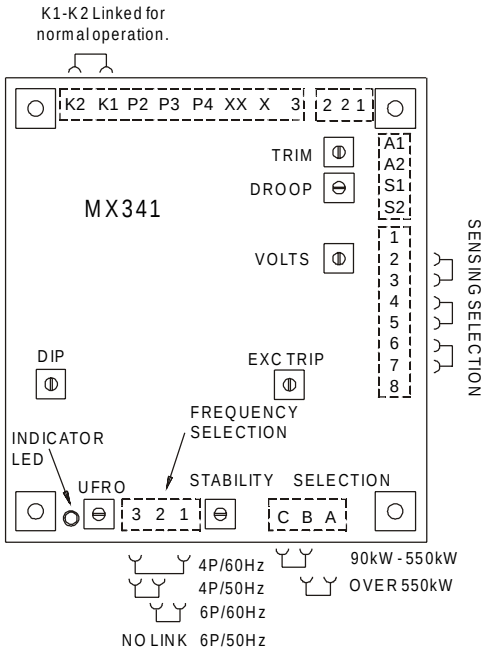


Fig. 9c

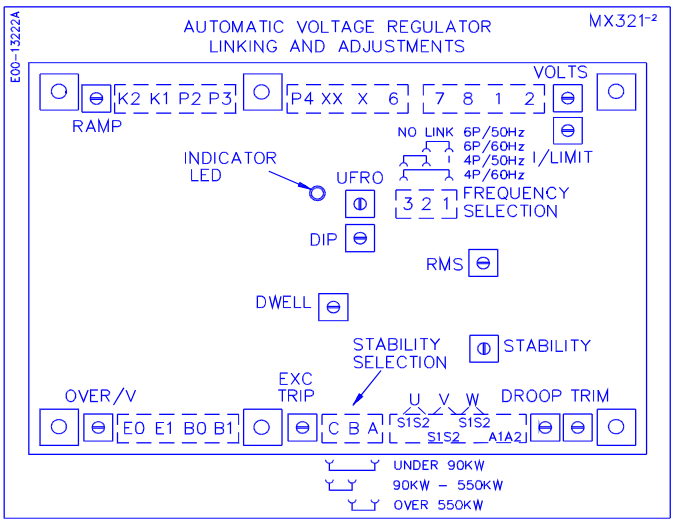


Fig. 9d

6.5 CURRENT LIMIT - MX321 AVR

These accessories work in conjunction with the AVR circuits to provide an adjustment to the level of current delivered into a fault. One current transformer (CT) per phase is fitted to provide current limiting on any line to line or line to neutral fault.

Note: The W phase CT can also provide "DROOP". Refer to 6.2.1.1 for setting droop independent of current limit.

Adjustment means is provided with the "I/LIMIT" control potentiometer on the AVR. Refer to Fig. 9d for location. If current limit transformers are supplied with the generator the limit will be set in accordance with the level specified at the time of order, and no further adjustment will be necessary. However, should the level need to be adjusted, refer to the setting procedure given in 6.5.1.

6.5.1 SETTING PROCEDURE

Run the generating set on no-load and check that engine governor is set to control nominal speed.

Stop the generating set. Remove the link between terminals K1-K2 at the auxiliary terminal block and connect a 5A switch across the terminals K1-K2.

Turn the "I/LIMIT" control potentiometer fully anticlockwise. Short circuit the stator winding with a bolted 3 phase short at the main terminals. An AC current clip-on ammeter is required to measure the winding lead current.

With the switch across K1-K2 open start the generating set.

Close the switch across K1-K2 and turn the "I/LIMIT" control potentiometer clockwise until required current level is observed on the clip-on ammeter. As soon as correct setting is achieved open the K1-K2 switch.

Should the current collapse during the setting procedure, the internal protective circuits of the AVR will have operated. In this event shut down the set and open the K1-K2 switch. Restart the set and run for 10 minutes with K1-K2 switch open, to cool the generator windings, before attempting to resume the setting procedure.

Important ! **Failure to carry out the correct COOLING procedure, may cause overheating and consequent damage to the generator windings.**

6.6 POWER FACTOR CONTROLLER (PFC3)

This accessory is primarily designed for those generator applications where operation in parallel with the mains supply is required.

Protection against loss of mains voltage or generator excitation is not included in the unit and the system designer must incorporate suitable protection.

The electronic control unit requires both droop and kVAr current transformers. When supplied with the generator, wiring diagrams inside the back cover of this manual show the conections and the additional instruction leaflet provided gives details of setting procedures for the power factor controller (PFC3).

The unit monitors the power factor of the generator current and adjusts excitation to maintain the power factor constant.

This mode can also be used to control the power factor of the mains if the point of current monitoring is moved to the mains cables. Refer to the factory for appropriate details.

It is also possible to operate the unit to control kVAr of the generator if required. Refer to the factory for appropriate details.

SECTION 7

SERVICE AND MAINTENANCE

As part of routine maintenance procedures, periodic attention to winding condition (particularly when generators have been idle for a long period) and bearings is recommended. (Refer to subsections 7.1 and 7.2 respectively).

When generators are fitted with air filters regular inspection and filter maintenance is required. (Refer to subsection 7.3).

7.1 WINDING CONDITION

Warning !

Service and fault finding procedures present hazards which can result in severe personal injury or death. Only personnel qualified to perform electrical and mechanical service should carry out these procedures.
Ensure engine starting circuits are disabled before commencing service or maintenance procedures. Isolate any anti-condensation heater supply.

Guidance of Typical Insulation Resistance [IR] Values

The following is offered as general information about IR values and is aimed at providing guidance about the typical IR values for generators from new through to the point of refurbishment.

New Machines

The generators Insulation Resistance, along with many other critical factors, will have been measured during the alternator manufacturing process. The generator will have been transported with an appropriate packaging suitable for the method of delivery to the Generating Set assemblers works. Where we expect it to be stored in a suitable location protected from adverse environmental conditions.

However, absolute assurance that the generator will arrive at the Gen-set production line with IR values still at the factory test levels of above 100 MΩ cannot be guaranteed.

At Generating Set Manufacturers Works

The generator should have been transported and stored such that it will be delivered to the assembly area in a clean dry condition. If held in appropriate storage conditions the generator IR value should typically be 25 MΩ.

If the unused/new generators IR values fall below 10 MΩ then a drying out procedure should be implemented by one of the processes outlined below before being despatched to the end customer's site. Some investigation should be undertaken into the storage conditions of the generator while on site.

Generators in Service

Whilst It is known that a generator will give reliable service with an IR value of just 1.0 MΩ. For a relatively new generator to be so low it must have been subjected to inappropriate operating or storage conditions.

Any temporarily reduction in IR values can be restored to expected values by following one of the drying out procedures.

7.1.1 WINDING CONDITION ASSESSMENT

Caution ! **The AVR should be disconnected and the Resistance Temperature Detector (R.T.D.) leads grounded during this test.**

The condition of the windings can be assessed by measurement of insulation resistance [IR] between phase to phase, and phase to earth.

Measurement of winding insulation should be carried out: -

1. As part of a periodic maintenance plan.
2. After prolonged periods of shutdown.
3. When low insulation is suspected, e.g. damp or wet windings.

Care should be taken when dealing with windings that are suspected of being excessively damp or dirty. The initial measurement of the [IR] Insulation Resistance should be established using a low voltage (500V) megger type instrument. If manually powered the handle should initially be turned slowly so that the full test voltage will not be applied, and only applied for long enough to very quickly assess the situation if low values are suspected or immediately indicated.

Full megger tests or any other form of high voltage test should not be applied until the windings have been dried out and if necessary cleaned.

Procedure for Insulation Testing

Disconnect all electronic components, AVR, electronic protection equipment etc. Ground the [RTD's] Resistance Temperature Detection devices if fitted. Short out the diodes on the rotating diode assembly. Be aware of all components connected to the system under test that could cause false readings or be damaged by the test voltage.

Carry out the insulation test in accordance with the 'operating instructions for the test equipment.

The measured value of insulation resistance for all windings to earth and phase to phase should be compared with the guidance given above for the various 'life stages' of a generator. The minimum acceptable value must be greater than 1.0 MΩ.

If low winding insulation is confirmed use one or more of the methods, given below, for drying the winding should be carried out.

7.1.2 METHODS OF DRYING OUT GENERATORS

Cold Run

Consider a good condition generator that has not been run for some time, and has been standing in damp, humid conditions. It is possible that simply running the gen set unexcited - AVR terminals K1 K2 open circuit - for a period of say 10 minutes will sufficiently dry the surface of the windings and raise the IR sufficiently, to greater than 1.0 MΩ , and so allow the unit to be put into service.

Blown Air Drying

Remove the covers from all apertures to allow the escape of the water-laden air. During drying, air must be able to flow freely through the generator in order to carry off the moisture.

Direct hot air from two electrical fan heaters of around 1 – 3 kW into the generator air inlet apertures. Ensure the heat source is at least 300mm away from the windings to avoid over heating and damage to the insulation.

Apply the heat and plot the insulation value at half hourly intervals. The process is complete when the parameters covered in the section entitled, 'Typical Drying Out Curve', are met.

Remove the heaters, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest prior to running.

Short Circuit Method

NOTE: This process should only be performed by a competent engineer familiar with safe operating practices within and around generator sets of the type in question.

Ensure the generator is safe to work on, initiate all mechanical and electrical safety procedures pertaining to the genset and the site.

Bolt a short circuit of adequate current carrying capacity, across the main terminals of the generator. The shorting link should be capable of taking full load current.

Disconnect the cables from terminals "X" and "XX" of the AVR.

Connect a variable dc supply to the "X" (positive) and "XX" (negative) field cables. The dc supply must be able to provide a current up to 2.0 Amp at 0 - 24 Volts.

Position a suitable ac ammeter to measure the shorting link current.

Set the dc supply voltage to zero and start the generating set. Slowly increase the dc voltage to pass current through the exciter field winding. As the excitation current increases, so the stator current in the shorting link will increase. This stator output current level must be monitored, and not allowed to exceed 80% of the generators rated output current.

After every 30 minutes of this exercise:

Stop the generator and switch off the separate excitation supply, and measure and record the stator winding IR values, and plot the results. The resulting graph should be compared with the classic shaped graph. This drying out procedure is complete when the parameters covered in the section entitled 'Typical Drying Out Curve' are met.

Once the Insulation Resistance is raised to an acceptable level - minimum value 1.0 MΩ – the dc supply may be removed and the exciter field leads "X" and "XX" re-connected to their terminals on the AVR.

Rebuild the genset, replace all covers and re-commission as appropriate.

If the set is not to be run immediately ensure that the anti-condensation heaters are energised, and retest the generator prior to running.

TYPICAL DRYING OUT CURVE

Whichever method is used to dry out the generator the resistance should be measured every half-hour and a curve plotted as shown. (fig 6.)

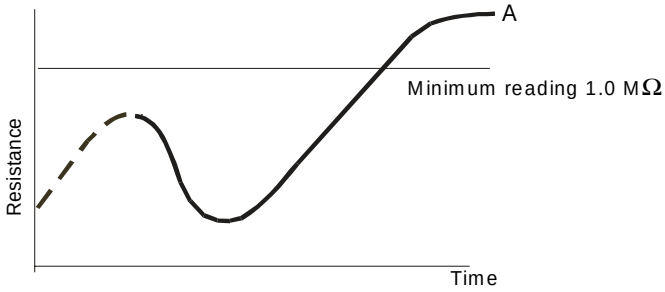


Fig. 9

The illustration shows a typical curve for a machine that has absorbed a considerable amount of moisture. The curve indicates a temporary increase in resistance, a fall and then a gradual rise to a steady state. Point 'A', the steady state, must be greater than 1.0 MΩ. (If the windings are only slightly damp the dotted portion of the curve may not appear).

For general guidance expect that the typical time to reach point 'A' will be:

1 hour for a BC16/18,
2 hours for a UC22/27
3 hours for an HC4,5,6&7
Drying should be continued after point "A" has been reached for at least one hour.

It should be noted that as winding temperature increases, values of insulation resistance may significantly reduce. Therefore, the reference values for insulation resistance can only be established with windings at a temperature of approximately 20°C.

If the IR value remains below 1.0 MΩ, even after the above drying methods have been properly conducted, then a Polarisation Index test [PI] should be carried out.

If the minimum value of 1.0 MΩ for all components cannot be achieved rewinding or refurbishment of the generator will be necessary.

The generator must not be put into service until the minimum values can be achieved.

Important ! The short circuit must not be applied with the AVR connected in circuit. Current in excess of the rated generator current will cause damage to the windings.

After drying out, the insulation resistances should be rechecked to verify minimum resistances quoted above are achieved.
On re-testing it is recommended that the main stator insulation resistance is checked as follows:-
Separate the neutral leads

Ground	V and W	phase and megger	U phase to ground
Ground	U and W	phase and megger	V phase to ground
Ground	U and V	phase and megger	W phase to ground

If the minimum value of 1.0MΩ is not obtained, drying out must be continued and the test repeated.

7.2 BEARINGS

All bearings are supplied sealed for life and are, therefore, not regreasable.

Important ! **The life of a bearing in service is subject to the working conditions and the environment**.

Important ! **Long stationary periods in an environment where there is vibration can cause false brinnelling which puts flats on the ball and grooves on the races.**
Very humid atmospheres or wet conditions can emulsify the grease and cause corrosion.

Important ! **High axial vibration from the engine or misalignment of the set will stress the bearing.**

The bearing, in service, is affected by a variety of factors that together will determine the bearing life. We recommend that the health of the bearings be monitored, using 'spike energy' vibration monitoring equipment. This will allow the timely replacement of bearings, that exhibit a deteriorating trend, during a major engine overhaul.

If excessive heat, noise or vibration is detected, change the bearing as soon as practicable. Failure to do so could result in bearing failure.

In the event that 'spike energy' vibration monitoring equipment is not available, it is strongly recommend that consideration be given to changing the bearing during each 'major engine overhaul'.

Belt driven application will impose an additional load on bearings. The bearing life will therefore be significantly affected. It is important that the side load limits given in SECTION 3 are not exceeded and the health of the bearing is monitored more closely.

7.3 AIR FILTERS

The frequency of filter maintenance will depend upon the severity of the site conditions. Regular inspection of the elements will be required to establish when cleaning is necessary.

7.3.1 CLEANING PROCEDURE

Danger !

Removal of filter elements enables access to LIVE parts.
Only remove elements with the generator out of service.

Remove the filter elements from the filter frames. Immerse or flush the element with a suitable detergent until the element is clean. Dry elements thoroughly before refitting.

7.4 FAULT FINDING

Important ! **Before commencing any fault finding procedure examine all wiring for broken or loose conections.**

Four types of excitation control system, involving four types of AVR, can be fitted to the range of generators covered by this manual. The systems can be identified by a combination of AVR type, where applicable, and the last digit of the generator frame size designation. Refer to the generator nameplate then proceed to the appropriate subsection as indicated below:-

DIGIT	EXCITATION CONTROL	SUBSECTION
6	SX460 AVR	7.4.1
4	SX440 AVR	7.4.2
4	SX421 AVR	7.4.3
5	Transformer control	7.4.4
3	MX341 AVR	7.4.5
3	MX321 AVR	7.4.6

7.4.1 SX460 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check speed 2. Check residual voltage. Refer to subsection 7.4.7. 3. Follow Separate Excitation Test Procedure to check generator and AVR.
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation Procedure to check generator and AVR. Refer to subsection 7.5.

7.4.2 SX440 AVR - FAULT FINDING

No voltage build-up when starting set.	1. Check link K1-K2 on auxiliary terminals. 2. Check speed. 3. Check residual voltage. Refer to subsection 7.4.7. 4. Follow Separate Excitation Test Procedure to check generator and AVR. Refer to subsection 7.5.
Unstable voltage either on no-load or with load.	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation Procedure to check generator and AVR. Refer tosubsection 7.5.

7.4.3 SX421 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check circuit breaker 'ON'. Refer to subsection 6.4.1. 2. Check speed. 3. Check residual voltage. Refer to subsection 7.4.7. 4. Follow Separate Excitation Procedure to check generator and AVR. Refer to subsection 7.5.
Unstable voltage either on no-load or with load	1. Check speed stability. 2. Check stability setting. Refer to subsection 4.6.
High voltage either on no-load or with load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity. Check continuity of leads 7-8 and P3-P2 for continuity. 3. Check that generator load is not capacitive (leading power factor).
Low voltage no-load	1. Check speed. 2. Check link 1-2 or external hand trimmer leads for continuity.
Low voltage on-load	1. Check speed. 2. Check UFRO setting. Refer to subsection 4.7.1.1. 3. Follow Separate Excitation to check generator and AVR. Refer to subsection 7.5.
Excessive voltage/speed dip on-load switching	1. Check governor response. 2. Refer to generating set manual. Check 'DIP' setting. Refer to subsection 4.7.1.4.

7.4.4 TRANSFORMER CONTROL - FAULT FINDING

No voltage build-up when starting set	1. Check transformers rectifiers. 2. Check transformer secondary winding for open circuit.
Low volatge	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2.
High voltage	1. Check speed. 2. Check transformer air gap setting. Refer to subsection 4.7.2. 3. Check transformer secondary winding for short circuited turns.
Excessive voltage drop on-load	1. Check speed drop on-load. 2. Check transformer rectifiers. Check transformer air gap setting. Refer to subsection 4.7.2.

7.4.5 MX341 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check link K1-K2 on auxiliary terminals. 2. Follow Separate Excitation Test Procedure to check machine and AVR. Refer to subsection 7.5.
Loss of voltage when set running	1. First stop and re-start set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure. Refer to subsection 7.5.
Generator voltage high followed by collapse	1. Check sensing leads to AVR. 2. Refer to Separate Excitation Test Procedure. Refer to subsection 7.5.
Voltage unstable either on no-load or with load	1. Check speed stability. 2. Check "STAB" setting. Refer to Load Testing section for procedure. Refer to subsection 4.6.
Low voltage on-load	1. Check speed. 2. If correct check "UFRO" setting. Refer to subsection 4.7.1.1.
Excessive voltage/speed dip on load switching	1. Check governor response. Refer to generating set manual. Check "DIP" setting. Refer to subsection 4.7.1.4.
Sluggish recovery on load switching	1. Check governor response. Refer to generating set manual.

7.4.6 MX321 AVR - FAULT FINDING

No voltage build-up when starting set	1. Check link K1-K2 on auxiliary terminals. Follow Separate Excitation Test Procedure to check machine and AVR. Refer to subsection 7.5.
Voltage very slow to build up	1. Check setting of ramp potentiometer. Refer to 4.7.1.5.
Loss of voltage when set running	1. First stop and re-start set. If no voltage or voltage collapses after short time, follow Separate Excitation Test Procedure. Refer to subsection 7.5.
Generator voltage high followed by collapse	1. Check sensing leads to AVR. 2. Refer to Separate Excitation Test Procedure. Refer to subsection 7.5.
Voltage unstable either on no-load or with load	1. Check speed stability. 2. Check "STAB" setting. Refer to Load Testing section for procedure. Refer to subsection 4.6.
Low voltage on-load	1. Check speed. 2. If correct check "UFRO" setting. Refer to subsection 4.7.1.1.
Excessive voltage/speed dip on load switching	1. Check governor responses. Refer to generating set manual. Check "DIP" setting. Refer to subsection 4.7.1.4.
Sluggish recovery on load switching	1. Check governor response. Refer to generating set manual. Check "DWELL" setting. Refer to Load Testing section 4.7.1.4.

7.4.7 RESIDUAL VOLTAGE CHECK

This procedure is applicable to generators with either SX460 or SX440 or SX421 AVR.

With the generator set stationary remove AVR access cover and leads X and XX from the AVR.

Start the set and measure voltage across AVR terminals 7-8 on SX460 AVR or P2-P3 on SX440 or SX421 AVR.

Stop the set, and replace leads X and XX on the AVR terminals.If the measured voltage was above 5V the generator should operate normally.

If the measured voltage was under 5V follow the proceedure below.

Using a 12 volt d. c. battery as a supply clip leads from battery negative to AVR terminal XX, and from battery positive through a diode to AVR terminal X. See Fig. 10.

Important ! **A diode must be used as shown below to ensure the AVR is not damaged.**

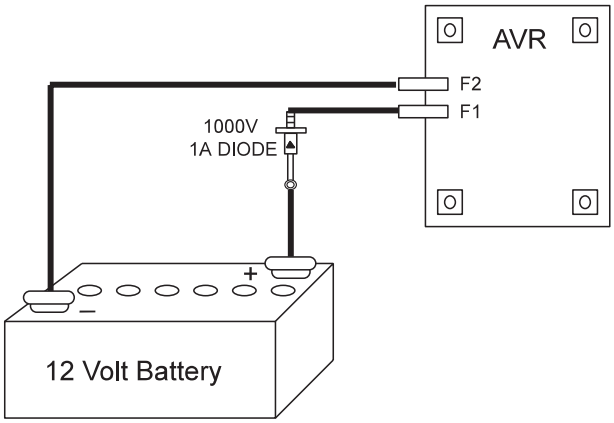


Fig. 11

Important ! **If the generating set battery is used for field flashing the generator main stator neutral must be disconnected from earth.**

Restart the set and note output voltage from main stator, which should be approximately nominal voltage, or voltage at AVR terminals 7 and 8 on SX460, P2-P3 on SX440 or SX421 which should be between 170 and 250 volts.

Stop the set and unclip battery supply from terminals X and XX. Restart the set. The generator should now operate normally. If no voltage build-up is obtained it can be assumed a fault exists in either the generator or the AVR circuits. Follow the SEPARATE EXCITATION TEST PROCEDURE to check generator windings, rotating diodes and AVR. Refer to subsection 7.5.

7.5 SEPARATE EXCITATION TEST PROCEDURE

The generator windings, diode assembly and AVR can be checked using the appropriate following section.

7.5.1 GENERATOR WINDINGS, ROTATING DIODES and PERMANENT MAGNET GENERATOR (PMG)

7.5.2 EXCITATION CONTROL TEST.

7.5.1 GENERATOR WINDINGS, ROTATING DIODES and PERMANENT MAGNET GENERATOR (PMG)

Important ! **The resistances quoted apply to a standard winding. For generators having windings or voltages other than those specified refer to factory for details. Ensure all disconnected leads are isolated and free from earth.**

Important ! **Incorrect speed setting will give proportional error in voltage output.**

CHECKING PMG

Start the set and run at rated speed.

Measure the voltages at the AVR terminals P2, P3 and P4. These should be balanced and within the following ranges:-

50Hz generators - 170-180 volts
60Hz generators - 200-216 volts

Should the voltages be unbalanced stop the set, remove the PMG sheet metal cover from the non drive endbracket and disconnect the multipin plug in the PMG output leads. Check leads P2, P3, P4 for continuity. Check the PMG stator resistances between output leads. These should be balanced and within +/-10% of 2.3 ohms. If resistances are unbalanced and/or incorrect the PMG stator must be replaced. If the voltages are balanced but low and the PMG stator winding resistances are correct - the PMG rotor must be replaced.

CHECKING GENERATOR WINDINGS AND ROTATING DIODES

This procedure is carried out with leads X and XX disconnected at the AVR or transformer control rectifier bridge and using a 12 volt d.c. supply to leads X and XX.

Start the set and run at rated speed.

Measure the voltages at the main output terminals U, V and W. If voltages are balanced and within +/-10% of the generator nominal voltage, refer to 7.5.1.1.

Check voltages at AVR terminals 6, 7 and 8. These should be balanced and between 170-250 volts.

If voltages at main terminals are balanced but voltage at 6, 7 and 8 are unbalanced, check continuity of leads 6, 7 and 8. Where an isolating transformer is fitted (MX321 AVR) check transformer windings. If faulty the transformer unit must be replaced.

If voltages are unbalanced, refer to 7.5.1.2.

7.5.1.1 BALANCED MAIN TERMINAL VOLTAGES

If all voltages are balanced within 1% at the main terminals, it can be assumed that all exciter windings, main windings and main rotating diodes are in good order, and the fault is in the AVR or transformer control. Refer to subsection 7.5.2 for test procedure.

If voltages are balanced but low, there is a fault in the main excitation windings or rotating diode assembly. Proceed as follows to identify:-

Rectifier Diodes

The diodes on the main rectifier assembly can be checked with a multimeter. The flexible leads connected to each diode should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions.

On an electronic digital meter a healthy diode will give a low reading in one direction, and a high reading in the other.

Replacement of Faulty Diodes

The rectifier assembly is split into two plates, the positive and negative, and the main rotor is connected across these plates. Each plate carries 3 diodes, the negative plate carrying negative biased diodes and the positive plate carrying positive biased diodes. Care must be taken to ensure that the correct polarity diodes are fitted to each respective plate. When fitting the diodes to the plates they must be tight enough to ensure a good mechanical and electrical contact, but should not be overtightened. The recommended torque tightening is 4.06 - 4.74Nm (36-42lb in).

Surge Suppressor

The surge suppressor is a metal-oxide varistor connected across the two rectifier plates to prevent high transient reverse voltages in the field winding from damaging the diodes. This device is not polarised and will show a virtually infinite reading in both directions with an ordinary resistance meter. If defective this will be visible by inspection, since it will normally fail to short circuit and show signs of disintegration. Replace if faulty.

Main Excitation Windings

If after establishing and correcting any fault on the rectifier assembly the output is still low when separately excited, then the main rotor, exciter stator and exciter rotor winding resistances should be checked (see Resistance Charts), as the fault must be in one of these windings. The exciter stator resistance is measured across leads X and XX. The exciter rotor is connected to six studs which also carry the diode lead terminals. The main rotor winding is connected across the two rectifier plates. The respective leads must be disconnected before taking the readings.

Resistance values should be within +/-10% of the values given in the table below:-

Frame Size	Main Rotor	Exciter Stator			Exciter Rotor
		Type 1	Type 2*	Type 3**	
UC22C	0.59	21	28	138	0.142
UC22D	0.64	21	28	138	0.142
UC22E	0.69	20	30	155	0.156
UC22F	0.83	20	30	155	0.156
UC22G	0.94	20	30	155	0.156
UC27C	1.12	20	-	-	0.156
UC27D	1.26	20	-	-	0.156
UC27E	1.34	20	-	-	0.182
UC27F	1.52	20	-	-	0.182
UC27G	1.69	20	-	-	0.182
UC27H	1.82	20	-	-	0.182
UCD27J	2.08	20	-	-	0.182
UCD27K	2.08	20	-	-	0.182

* Used with 1 phase transformer controlled 3 phase or 1 phase generators.

** Used with 3 phase transformer controlled 3 phase generators.

7.5.1.2 UNBALANCED MAIN TERMINAL VOLTAGES

If voltages are unbalanced, this indicates a fault on the main stator winding or main cables to the circuit breaker. NOTE: Faults on the stator winding or cables may also cause noticeable load increase on the engine when excitation is applied. Disconnect the main cables and separate the winding leads U1-U2, U5-U6, V1-V2, V5-V6, W1-W2, W5-W6 to isolate each winding section. (U1-L1, U2-L4 on single phase generators).

Measure each section resistance - values should be balanced and within +/-10% of the value given below:-

AVR CONTROLLED GENERATORS				
Frame Size	SECTION RESISTANCES			
	Winding 311	Winding 17	Winding 05	Winding 06
UC22C	0.09	0.14	0.045	0.03
UC22D	0.065	0.1	0.033	0.025
UC22E	0.05	0.075	0.028	0.02
UC22F	0.033	0.051	0.018	0.012
UC22G	0.028	0.043	0.014	0.01
UC27C	0.03	0.044	0.016	0.011
UC27D	0.019	0.026	0.01	0.007
UC27E	0.016	0.025	0.009	0.008
UC27F	0.012	0.019	0.007	0.005
UC27G	0.01	0.013	0.006	0.004
UC27H	0.008	0.014	0.004	0.004
UCD27J	0.006	0.009	-	-
UCD27K	0.006	0.009	-	-

TRANSFORMER CONTROLLED GENERATORS					
Frame Size	SECTION RESISTANCES, 3 PHASE WINDINGS				
	380V	400V	415V	416V	460V
	50Hz	50Hz	50Hz	60Hz	60Hz
UC22C	0.059	0.078	0.082	0.055	0.059
UC22D	0.054	0.056	0.057	0.049	0.054
UC22E	0.041	0.05	0.053	0.038	0.041
UC22F	0.031	0.032	0.033	0.025	0.031
UC22G	0.022	0.026	0.028	0.021	0.022

Measure insulation resistance between sections and each section to earth.

Unbalanced or incorrect winding resistances and/or low insulation resistances to earth indicate rewinding of the stator will be necessary. Refer to removal and replacement of component assemblies subsection 7.5.3.

7.5.2 EXCITATION CONTROL TEST

7.5.2.1 AVR FUNCTION TEST

All types of AVR's can be tested with this procedure:

1. Remove exciter field leads X & XX (F1 & F2) from the AVR terminals X & XX (F1 & F2).
2. Connect a 60W 240V household lamp to AVR terminals X & XX (F1 & F2).
3. Set the AVR VOLTS control potentiometer fully clockwise.
4. Connect a 12V, 1.0A DC supply to the exciter field leads X & XX (F1 & F2) with X (F1) to the positive.

5. Start the generating set and run at rated speed.

6. Check that the generator output voltage is within +/-10% of rated voltage.

Voltages at AVR terminals 7-8 on SX460 AVR or P2-P3 on SX440 or SX421 AVR should be between 170 and 250 volts. If the generator output voltage is correct but the voltage on 7-8 (or P2-P3) is low, check auxiliary leads and connections to main terminals.

Voltages at P2, P3, P4 terminals on MX341 and MX321 should be as given in 7.5.1.

The lamp connected across X-XX should glow. In the case of the SX460, SX440 and SX421 AVRs the lamp should glow continuously. In the case of the MX341 and MX321 AVRs the lamp should glow for approximately 8 secs. and then turn off. Failure to turn off indicates faulty protection circuit and the AVR should be replaced. Turning the "VOLTS" control potentiometer fully anti-clockwise should turn off the lamp with all AVR types.

Should the lamp fail to light the AVR is faulty and should be replaced.

Important ! **After this test turn VOLTS control potentiometer fully anti-clockwise.**

7.5.2.2 TRANSFORMER CONTROL

The transformer rectifier unit can only be checked by continuity, resistance checks and insulation resistance measurement.

Two phase transformer

Separate primary leads T1-T2-T3-T4 and secondary leads 10-11. Examine windings for damage. Measure resistances across T1-T3 and T2-T4. These will be a low value but should be balanced. Check that there is resistance in the order of 8 ohms between leads 10 and 11. Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary resistance, open or short circuited winding sections, indicates the transformer unit should be replaced.

Three phase transformer

Separate primary leads T1-T2-T3 and secondary leads 6-7-8 and 10-11-12.

Examine windings for damage. Measure resistances across T1-T2, T2-T3, T3-T1. These will be low but should be balanced. Check that resistances are balanced across 6-10, 7-11 and 8-12 and in the order of 18 ohms.

Check insulation resistance of each winding section to earth and to other winding sections.

Low insulation resistance, unbalanced primary or secondary winding resistances, open or short circuited winding sections indicates the transformer unit should be replaced.

Rectifier units - Three phase and single phase

With the leads 10-11-12-X and XX removed from the rectifier unit (lead 12 is not fitted on single phase transformer rectifier units), check forward and reverse resistances between terminals 10-X, 11-X, 12-X, 10-XX, 11-XX and 12-XX with a multimeter.

A low forward resistance and high reverse resistance should be read between each pair of terminals. If this is not the case the unit is faulty and should be replaced.

7.5.3 REMOVAL AND REPLACEMENT OF COMPONENT ASSEMBLIES

METRIC THREADS ARE USED THROUGHOUT

Caution ! **When lifting single bearing generators, care is needed to ensure the generator frame is kept in the horizontal plane. The rotor is free to move in the frame and can slide out if not correctly lifted. Incorrect lifting can cause serious personal injury.**

7.5.3.1 REMOVAL OF PERMANENT MAGNET GENERATOR (PMG)

1. Remove 4 screws holding the sheet metal cylindrical cover at the non-drive end and remove the cover.

2. Disconnect the in line connector from the PMG stator (3 wires go to this connector). It may be necessary to cut off the nylon cable tie first.

3. Remove the 4 threaded pillars and clamps holding the PMG stator onto the end bracket.

4. Tap the stator out of the 4 spigots and withdraw. The highly magnetic rotor will attract the stator. Take care to avoid contact which may damage the windings.

5. Remove the bolt in the centre from the rotor shaft and pull off the rotor. It may be necessary to gently tap the rotor away. Take care to tap gently and evenly - the rotor has ceramic magnets which are easily broken by shock.

Important ! **The rotor assembly must not be dismantled.**

Replacement is a reversal of the above procedure.

7.5.3.2 REMOVAL OF BEARINGS

Important ! **Position the main rotor so that a full pole face of the main rotor core is at the bottom of the stator bore.**

NOTE: Removal of the bearings may be effected either after the rotor assembly has been removed OR more simply by removal of endbracket(s). Refer to 7.5.3.3. and 7.5.3.4.

The bearings are pre-packed with grease and sealed for life.

The bearing(s) are a press fit and can be removed from the shaft with 3 leg or 2 leg manual or hydraulic bearing pullers.

SINGLE BEARING ONLY: Before trying to pull off the bearing remove the small circlip retaining it.

When fitting new bearings use a bearing heater to expand the bearing before fitting to the shaft. Tap the bearing into place ensuring that it contacts the shoulder on the shaft.

Refit the retaining circlip on single bearing generators.

7.5.3.3 REMOVAL OF ENDBRACKET AND EXCITER STATOR

1. Remove exciter leads X+, XX- at the AVR.

2. Slacken 4 bolts (2 each side) situated on horizontal centre line holding the terminal box.

3. Remove 2 bolts holding lifting lug, at the non-drive end, and remove lug.

4. Remove sheet metal cylindrical cover (4 screws) over PMG (if fitted)
   or
   Remove shallow sheet metal cover (4 screws) at the non-drive end.

5. Ease up the terminal box and support clear of the non-drive endbracket.

6. Remove 6 bolts holding the non-drive endbracket to the stator bar assembly. The endbracket is now ready for removal.

7. Replace the lifting lug onto the endbracket and sling the endbracket on a hoist to facilitate lifting.

8. Tap the endbracket around its perimeter to release from the generator. The endbracket and exciter stator will come away as a single assembly.

9. Remove the 4 screws holding the exciter stator to the endbracket and gently tap the exciter stator to release it. Replacement is a reversal of the above procedure.

7.5.3.4 REMOVAL OF THE ROTOR ASSEMBLY

Remove the permanent magnet generator. Refer to 7.5.3.1
or
Remove the four screws holding the sheet metal cover at the non drive end and remove cover.

Caution !	**With the PMG rotor removed single bearing generator rotors are free to move in the frame. Ensure frame is kept in the horizontal plane when lifting.**

TWO BEARING GENERATORS

1. Remove 2 screws holding the sheet metal cover around the adaptor at the drive end and remove the cover.

2. Remove the bolts holding the adaptor to the endbracket at the drive end.

3. Tap off the adaptor. It may be preferred to sling the adaptor first depending on its size and weight.

4. Remove the screens and louvres (if fitted) at each side on the drive end.

Now ensure that the rotor is positioned with a full pole face at the bottom centre line. This is to avoid damage to the bearing exciter, or rotor winding, by limiting the possible rotor downward movement to the air gap length.

5. Remove 6 bolts holding drive endbracket onto adaptor ring DE. The boltheads face towards the non-drive end. The top bolt passes through the centre of the lifting lug.

6. Tap the drive endbracket away from the adaptor ring DE and withdraw the endbracket.

7. Ensure the rotor is supported at the drive end on a sling.

8. Tap the rotor from the non-drive end to push the bearing clear of the endbracket and its position within an 'O' ring.

9. Continue to push the rotor out of the stator bore, gradually working the sling along the rotor as it is withdrawn, to ensure that it is fully supported all the time.

SINGLE BEARING GENERATORS

1. Remove the screws, screens and louvres (if fitted) at each side on drive end adaptor.

2. **UCI224, UCI274, UCM224, UCM274, UCD274 Only**

   Remove 6 bolts holding the adaptor at the drive end. It may be preferred to sling the adaptor on a hoist. The bolt heads face towards the non-drive end. The top bolt passes through the centre of the lifting lug.

2a. **UCD224 Only**

   Remove 6 bolts holding the adaptor at the drive end. It may be preferred to sling the adaptor on a hoist.

3. **UCI224, UCI274, UCM224, UCM274, UCD274 Only**

   Tap the adaptor away from stator bar adaptor ring.

3a. **UCD224 Only**

   Tap the adaptor away from stator bar assembly.

ALL SINGLE BEARING GENERATORS

4. Ensure the rotor is supported at drive end on a sling.

5. Tap the rotor from the non-drive end to push the bearing clear of the endbracket and its position within an 'O' ring.

6. Continue to push the rotor out of the stator bore, gradually working the sling along the rotor as it is withdrawn, to ensure that it is fully supported at all times.

Replacement of rotor assemblies is a reversal of the procedures above.

Before commencing re-assembly, components should be checked for damage and bearing(s) examined for loss of grease.

Fitting of new bearing(s) is recommended during major overhaul.

Before replacement of a single bearing rotor assembly, check that the drive discs are not damaged, cracked or showing other signs of fatigue. Also check that the holes in the discs for drive fixing screws are not elongated.

Damaged or worn components must be replaced.

Caution !	**When major components have been replaced, ensure that all covers and guards are securely fitted, before the generator is put into service.**

7.6 RETURNING TO SERVICE

After rectification of any faults found, remove all test connections and reconnect all control system leads.
Restart the set and adjust VOLTS control potentiometer on AVR controlled generators by slowly turning clockwise until rated voltage is obtained.

Refit all terminal box covers/access covers and reconnect heater supply.

Caution !	**Failure to refit all guards, access covers and terminal box covers can result in personal injury of death.**

SECTION 8

SPARES AND AFTER SALES SERVICE

8.1 RECOMMENDED SPARES

Service parts are conveniently packaged for easy identification. Genuine parts may be recognised by the Nupart name.

We recommend the following for Service and Maintenance. In critical applications a set of these service spares should be held with the generator.

AVR Controlled Generators

1.	Diode Set (6 diodes with surge suppressor)		**RSK**	**2001**
2.	AVR SX440		**E000**	**24030**
	AVR SX460		**E000**	**24602**
	AVR SX421		**E000**	**24210**
	AVR MX321		**E000**	**23212**
	AVR MX341		**E000**	**23410**
3.	Non drive end Bearing	**UC22**	**051**	**01032**
		UC27	**051**	**01049**
4.	Drive end Bearing	**UC22**	**051**	**01044**
		UC27	**051**	**01050**

Transformer Controlled Generators (UC22 Only)

1.	Diode Set (6 diodes with surge suppressor)		**RSK**	**2001**
2.	Diode Assembly		**E000**	**22006**
3.	Non drive end Bearing	**UC22**	**051**	**01032**
4.	Drive end Bearing	**UC22**	**051**	**01044**

When ordering parts the machine serial number or machine identity number and type should be quoted, together with the part description. For location of these numbers see paragraph 1.3.

Orders and enquiries for parts should be addressed to:

Newage International Limited
Nupart Department
PO Box 17, Barnack Road
STAMFORD
Lincolnshire
PE9 2NB
ENGLAND

Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 766074

Or any of our subsidiary companies listed on the back cover.

8.2 AFTER SALES SERVICE

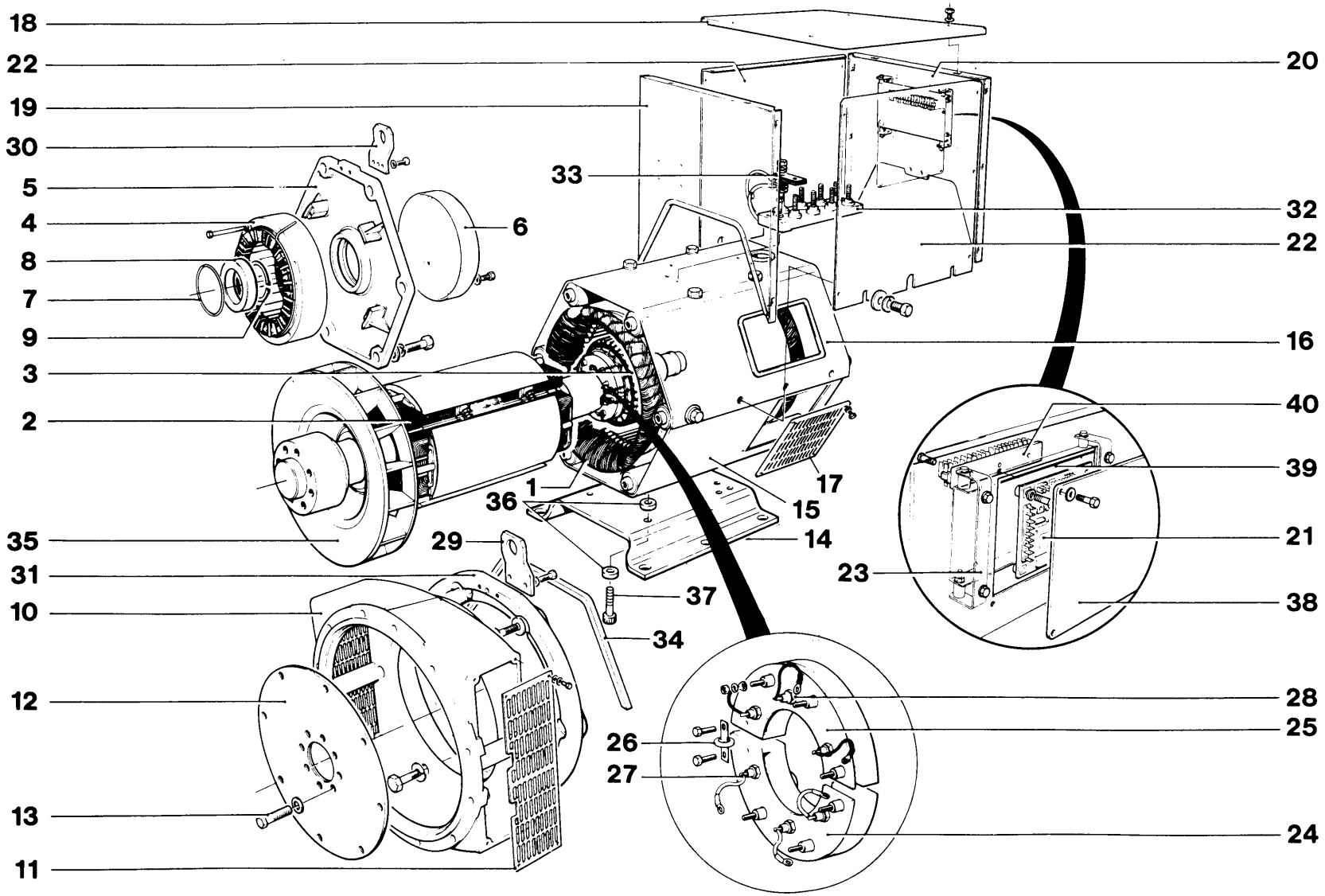
A full technical advice and on-site service facility is available from our Service Department at Stamford or through our Subsidiary Companies. A repair facility is also available at our Stamford Works.

PARTS LIST
TYPICAL SINGLE BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Circlip N.D.E.	33	Terminal Link
10	D.E. Bracket/Engine Adaptor	34	Edging Strip
11	D.E. Screen	35	Fan
12	Coupling Disc	36	Foot Mounting Spacer
13	Coupling Bolt	37	Cap Screw
14	Foot	38	AVR Access Cover
15	Frame Cover Bottom	39	AVR Anti-Vibration Mounting Assembly
16	Frame Cover Top	40	Auxiliary Terminal Assembly
17	Air Inlet Cover		
18	Terminal Box Lid		
19	Endpanel D.E.		
20	Endpanel N.D.E.		
21	AVR		
22	Side Panel		
23	AVR Mounting Bracket		
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
PMG	Permanent Magnet Generator
AVR	Automatic Voltage Regulator

Fig. 11.
TYPICAL SINGLE BEARING GENERATOR

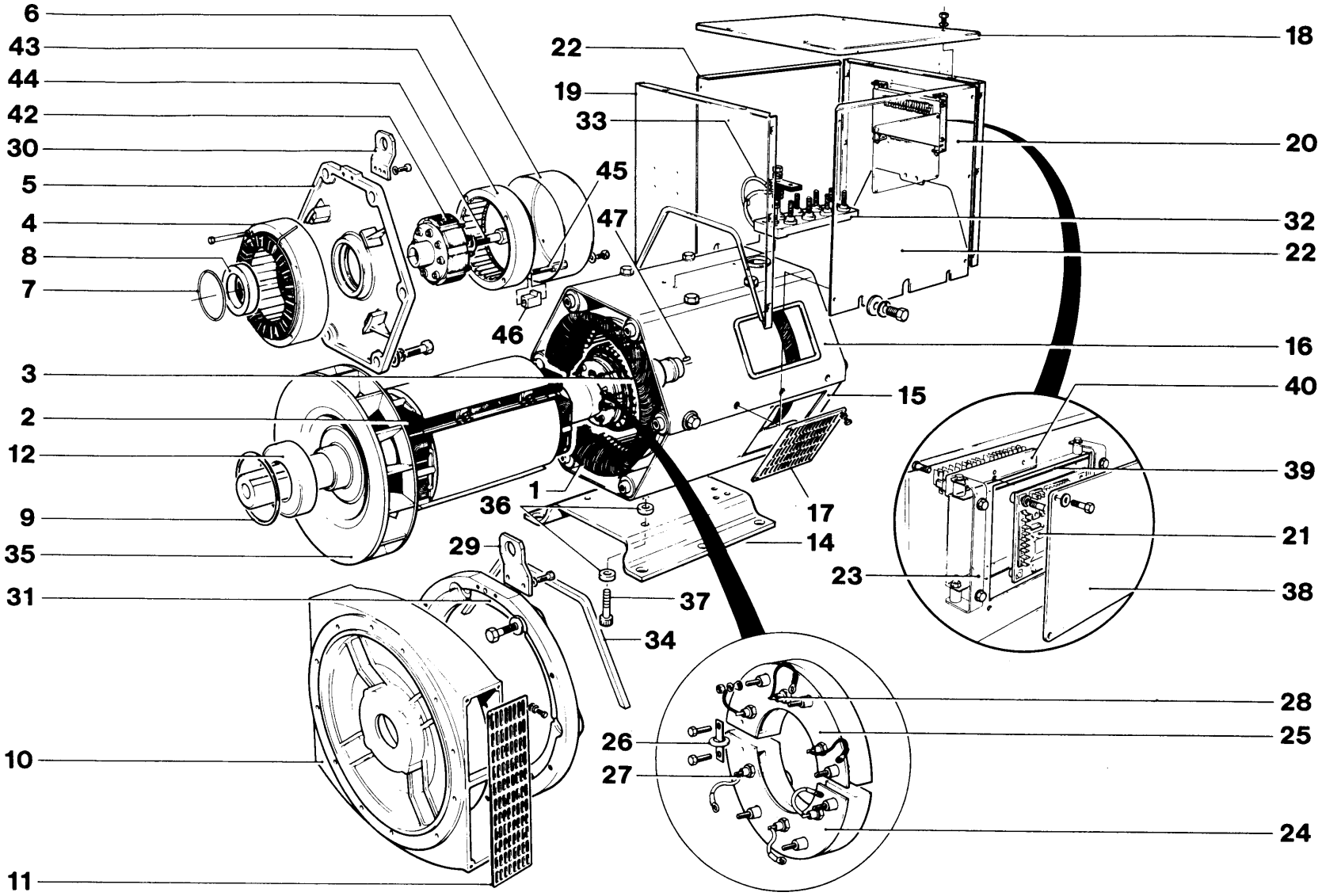


PARTS LIST
TYPICAL TWO BEARING GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Wave Washer D.E.	33	Terminal Link
10	D.E. Bracket	34	Edging Strip
11	D.E. Screen	35	Fan
12	Bearing D.E.	36	Foot Mounting Spacer
14	Foot	37	Cap Screw
15	Frame Cover Bottom	38	AVR Access Cover
16	Frame Cover Top	39	AVR Anti-Vibration Mount
17	Air Inlet Cover	40	Auxiliary Terminal Assembly
18	Terminal Box Lid	42	PMG Exciter Rotor
19	Endpanel D.E.	43	PMG Exciter Stator
20	Endpanel N.D.E.	44	PMG Bolt
21	AVR	45	PMG Pillar
22	Side Panel	46	PMG Clamp
23	AVR Mounting Bracket	47	PMG Dowel
24	Main Rectifier Assembly - Forward		

N.D.E.	Non Drive End
D.E.	Drive End
PMG	Permanent Magnet Generator
AVR	Automatic Voltage Regulator

Fig. 12.
TYPICAL TWO BEARING GENERATOR



PARTS LIST
TYPICAL TWO BEARING (SERIES 5) GENERATOR

Plate Ref.	Description	Plate Ref.	Description
1	Stator	25	Main Rectifier Assembly - Reverse
2	Rotor	26	Varistor
3	Exciter Rotor	27	Diode - Forward Polarity
4	Exciter Stator	28	Diode - Reverse Polarity
5	N.D.E. Bracket	29	Lifting Lug - D.E.
6	Cover N.D.E.	30	Lifting Lug - N.D.E.
7	Bearing 'O' Ring N.D.E.	31	Frame to Endbracket Adaptor Ring
8	Bearing N.D.E.	32	Main Terminal Panel
9	Bearing Wave Washer D.E.	33	Terminal Link
10	D.E. Bracket	34	Edging Strip
11	D.E. Screen	35	Fan
12	Bearing D.E.	36	Foot Mounting Spacer
13		37	Cap Screw
14	Foot		
15	Frame Cover Bottom		
16	Frame Cover Top		
17	Air Inlet Cover		
18	Terminal Box Lid		
19	Endpanel D.E.		
20	Endpanel N.D.E.		
21	Series 5 Control Gear		
22	Side Panel		
23			
24	Main Rectifier Assembly - Forward		

N.D.E. Non Drive End
D.E. Drive End

Fig. 13.
TYPICAL TWO BEARING (SERIES 5) GENERATOR

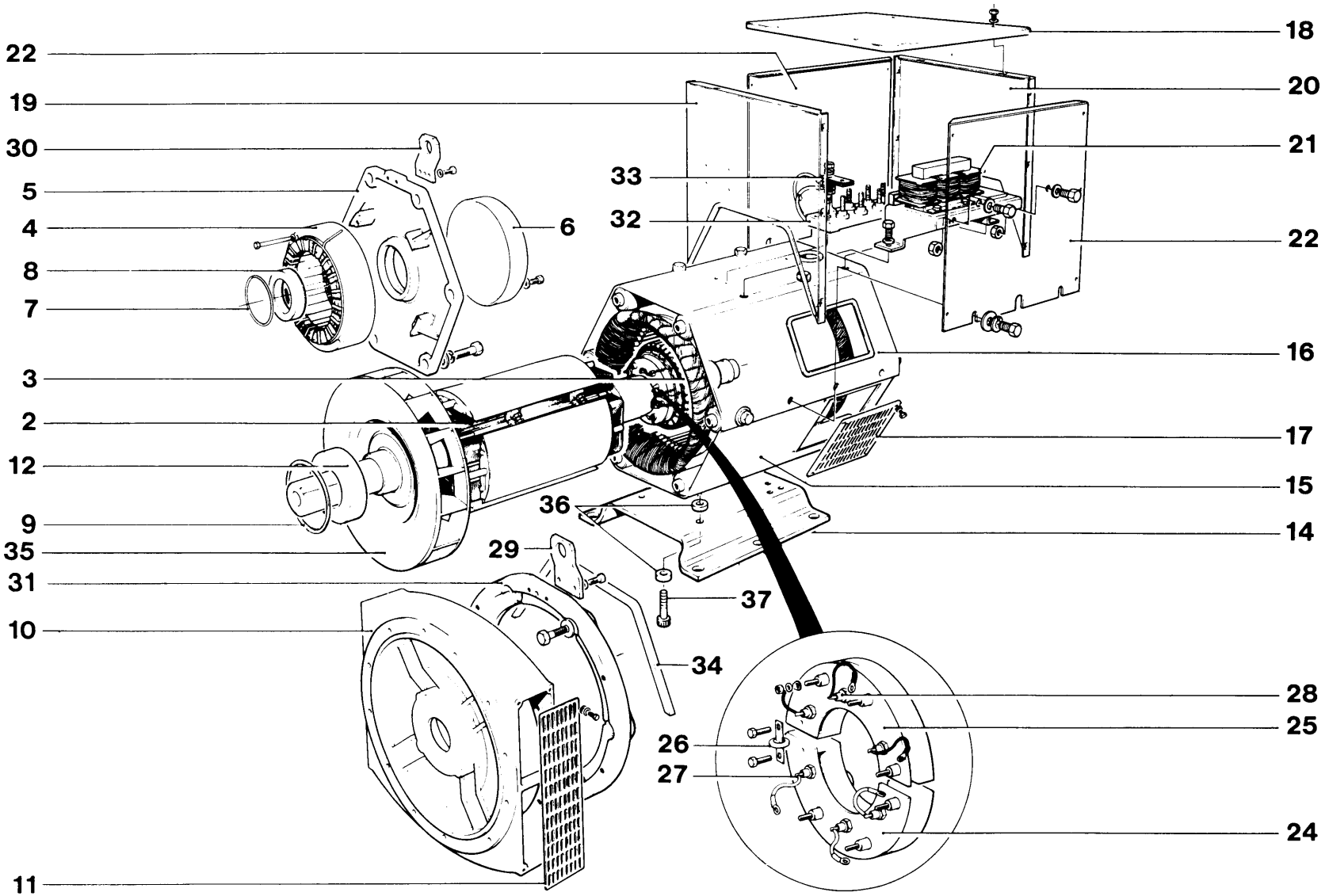
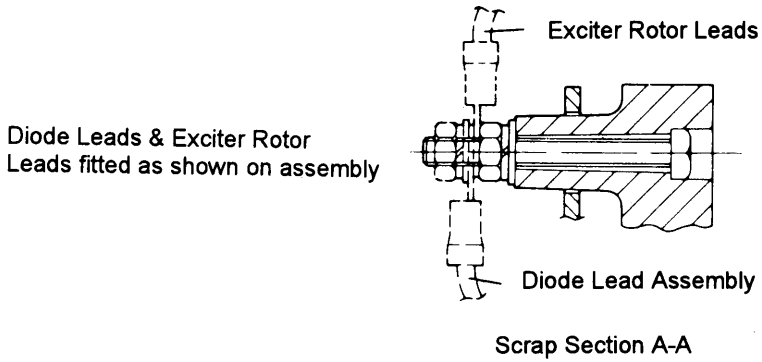


Fig. 14.
ROTATING RECTIFIER ASSEMBLY



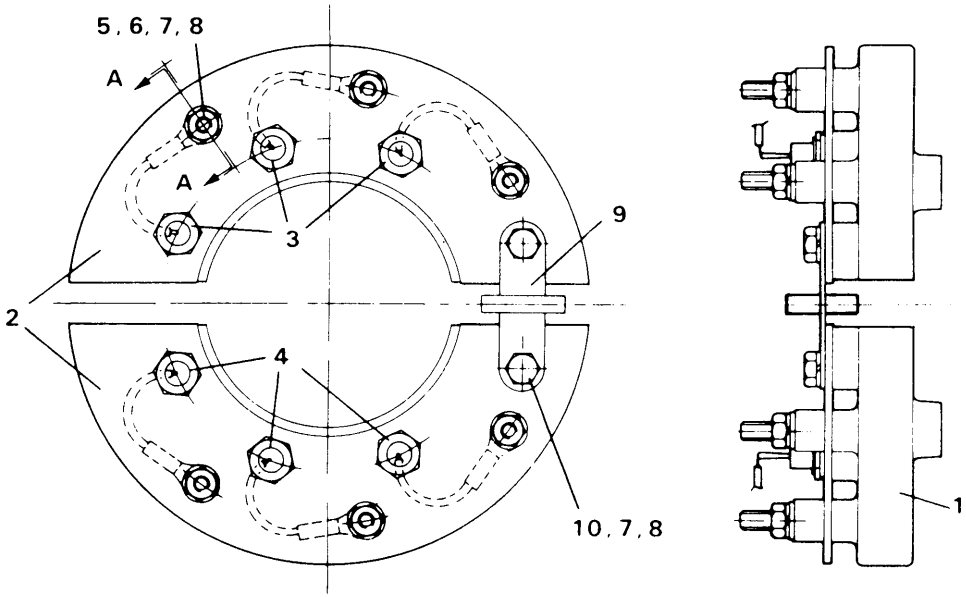


Plate Ref.	Description	Qty
1	Hub	1
2	Fin	2
3	Diode (fwd)	3
4	Diode (rev)	3
5	Hx. Screw	6
6	Hx. Nut	6
7	Pl. Washer	8
8	SC. L/Washer	8
9	Varistor	1
10	Hx. Screw	2

NOTES:
Fitting of Diodes.

1. Underside of diodes to be smeared with Midland Silicone 'Heat Sink' compound type MS2623. This compound **must not** be applied to the diode threads.

2. Diodes to be tightened to a torque of 2.03 - 2.37 Nm.

3. For Nupart rectifier service kit see page 28.

This manual is available in the following languages on request:
English, French, German, Italian and Spanish.

Denne manual er til rådighed på følgende sprog: engelsk, fransk, tysk, italiensk og spansk.

Denne håndboken er tilgjengelig på de følgende språkene: engelsk, fransk, tysk, italiensk og spansk.

Sur simple demande, ce manuel vous sera fourni dans l'une des langues suivantes: anglais, français, allemand, italien, espagnol.

Dieses Handbuch ist auf Anfrage in den folgenden Sprachen erhältlich: Englisch, Französisch, Deutsch, Italienisch, Spanisch.

Deze handleiding is op verzoek leverbaar in de volgende talen: Engels, Frans, Duits, Italiaans, Spaans.

Este manual pode também ser obtido nas seguintes línguas: inglês, francês, alemão, italiano e espanhol.

Tämä käsikirja on saatavissa pyynnöstä seuraavilla kielillä: Englanti, ranska, saksa, italia, espanja.

Il presente manuale è disponibile, su richiesta, nelle seguenti lingue: inglese, francese, tedesco, italiano e spagnolo.

Este manual también puede solicitarse en los siguientes idiomas: inglés, francés, alemán, italiano e español.

Αυτό το εγχειρίδιο οδηγιών χρήσεως διατίθεται στις ακόλουθες γλώσσες κατόπιν αιτήσενς: Αγγλικά, Γαλλικά Γερμανικά, Ιταλικά, Ισπανικά.

A.C. GENERATOR WARRANTY

WARRANTY PERIOD

A.C. Generators

In respect of a.c. generators the Warranty Period is eighteen months from the date when the goods have been notified as ready for despatch by N.I. or twelve months from the date of first commissioning (whichever is the shorter period).

DEFECTS AFTER DELIVERY

We will make good by repair or, at our option, by the supply of a replacement, any fault which under proper use appears in the goods within the period specified on Clause 12, and is found on examination by us to be solely due to defective material and workmanship; provided that the defective part is promptly returned, carriage paid, with all identification numbers and marks intact, or our works or, if appropriate to the Dealer who supplied the goods.

Any part repaired or replaced, under warranty, will be returned by N.I. free of charge (via sea freight if outside the UK).

We shall not be liable for any expenses which may be incurred in removing or replacing any part sent to us for inspection or in fitting any replacement supplied by us. We shall be under no liability for defects in any goods which have not been properly installed in accordance with N.I. recommended installation practices as detailed in the publications 'N.I. Installation, Service and Maintenance Manual' and 'N.I. Application Guidelines', or which have been improperly stored or which have been repaired, adjusted or altered by any person except ourselves or our authorised agents, or in any second-hand goods, proprietary articles or goods not of our own manufacture although supplied by us, such articles and goods being covered by the warranty (if any) given by the separate manufacturers.

Any claim under this clause must contain fully particulars of the alleged defect, the description of the goods, the date of purchase, and the name and address of the Vendor, the Serial Number (as shown on the manufacturers identification plate) or for Spares the order reference under which the goods were supplied.

Our judgement in all cases of claims shall be final and conclusive and the claimant shall accept our decision on all questions as to defects and the exchange of a part or parts.

Our liability shall be fully discharged by either repair or replacement as above, and in any event shall not exceed the current list price of the defective goods.

Our liability under this clause shall be in lieu of any warranty or condition implied by law as to the quality or fitness for any particular purpose of the goods, and save as expressly provided in this clause we shall not be under any liability, whether in contract, tort or otherwise, in respect of defects in goods delivered or for any injury, damages or loss resulting from such defects or from any work undone in connection therewith.

MACHINE SERIAL NUMBER

NEWAGE INTERNATIONAL LIMITED

REGISTERED OFFICE AND ADDRESS:
PO BOX 17
BARNACK ROAD
STAMFORD
LINCOLNSHIRE
PE9 2NB ENGLAND

Telephone: 44 (0) 1780 484000
Fax: 44 (0) 1780 484100
Web site: www.newagestamford.com

SUBSIDIARY COMPANIES

1 AUSTRALIA: NEWAGE ENGINEERS PTY. LIMITED
PO Box 6027, Baulkham Hills Business Centre,
Baulkham Hills NSW 2153.
Telephone: Sydney (61) 2 9680 2299
Fax: (61) 2 9680 1545

2 CHINA: WUXI NEWAGE ALTERNATORS LIMITED
Plot 49-A, Xiang Jiang Road
Wuxi High - Technical Industrial Dev. Zone
Wuxi, Jiangsu 214028
PR of China
Tel: (86) 510 5216212
Fax: (86) 510 5217673

3 GERMANY: NEWAGE ENGINEERS G.m.b.H.
Rotenbrückenweg 14, D-22113 Hamburg.
Telephone: Hamburg (49) 40 714 8750
Fax: (49) 40 714 87520

4 INDIA: C.G. NEWAGE ELECTRICAL LIMITED
C33 Midc, Ahmednagar 414111, Maharashtra.
Telephone: (91) 241 778224
Fax: (91) 241 777494

5 ITALY: NEWAGE ITALIA S.r.l.
Via Triboniano, 20156 Milan.
Telephone: Milan (39) 02 380 00714
Fax: (39) 02 380 03664

6 JAPAN: NEWAGE INTERNATIONAL JAPAN
8 - 5 - 302 Kashima
Hachioji-shi
Tokyo, 192-03
Telephone: (81) 426 77 2881
Fax: (81) 426 77 2884

7 NORWAY: NEWAGE NORGE A/S
Økern Naeringspark, Kabeigt. 5
Postboks 28, Økern, 0508 Oslo
Telephone: Oslo (47) 22 97 44 44
Fax: (47) 22 97 44 45

8 SINGAPORE: NEWAGE ASIA PACIFIC PTE LIMITED
10 Toh Guan Road #05-03
TT International Tradepark
Singapore 608838
Telephone: Singapore (65) 794 3730
Fax: (65) 898 9065
Telex: RS 33404 NEWAGE

9 SPAIN: STAMFORD IBERICA S.A.
Ctra. Fuenlabrada-Humanes, km.2
Poligono Industrial "Los Linares"
C/Pico de Almanzor, 2
E-28970 HUMANES DE MADRID (Madrid)
Telephone: Madrid (34) 91 604 8987/8928
Fax: (34) 91 604 81 66

10 U.S.A.: NEWAGE LIMITED
4700 Main St, N.E.
Fridley
Minnesota 55421
Telephone: (1) 800 367 2764
Fax: (1) 800 863 9243

SP292

Section 4 - GE Fanuc

GE Fanuc Automation

Programmable Control Products

GE Fanuc Automation

P.O. Box 8106
Charlottesville, VA 22906

GFZ–0085

Series 90™–30 Programmable Controller

Troubleshooting Guide

FANUC

GE Fanuc Automation

Programmable Control Products

Series 90™–30 Programmable Controller

Troubleshooting Guide

GFZ–0085 *August 1993*

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained in this document does not purport to cover all details or variations in hardware and software, nor to provide for every contingency in connection with installation, operation and maintenance. This document may describe features not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

GE Fanuc Automation makes no representation or warranty, expressed, implied, or statutory with respect to, and assumes no responsibility for the accuracy, completeness or usefulness of the information contained in this document. No warranties of merchantability of fitness for purpose shall apply.

The following are trademarks of GE Fanuc Automation North America, Inc.

Alarm Master	CIMSTAR	Helpmate
PROMACRO	Series Six	CIMPLICITY
GEnet	Logicmaster	Series One
Series 90	CIMPLICITY 90–ADS	Genius
Modelmaster	Series Three	VuMaster
ProLoop	CIMPLICITY PowerTRAC	Series Five
Workmaster	Genius Power TRAC	

General Warnings When Troubleshooting

Stand clear of controlled equipment when power is applied. If the problem is intermittent, sudden unexpected machine motion could occur, causing injury. Also reference NFPA 70E Part II for additional guidelines for safety practices.

Never reach into a machine to operate a switch since unexpected motion could occur, causing injury.

Remove all electrical power at the Main Power Disconnect to ensure total power removal.

Always remove power before inserting or removing modules, or before connecting I/O cabling.

This guide describes a logical sequence for troubleshooting your Series 90–30 programmable controller. It includes the procedure for changing or adding a EPROM or EEPROM to your CPU. The Series 90–30 PLC is a member of the Series 90™ family of programmable logic controllers from GE Fanuc Automation.

Revisions to this Troubleshooting Guide

This is the first release of this Troubleshooting Guide. Included are models CPU 311, 313, 321, 323, 331 and 341.

Related Publications

Series 90™–30 Programmable Controller Installation Manual (GFK–0356).

Series 90™–30 and 90–20 PLC Hand–Held Programmer User's Manual (GFK–0402)

Logicmaster™ 90 Series 90–30 and 90–20 Programming Software User's Manual (GFK–0466)

Series 90™–30/90–20 Programmable Controllers Reference Manual (GFK–0467)

We Welcome Your Comments and Suggestions

At GE Fanuc Automation, we strive to produce quality technical documentation. After you have used this troubleshooting guide, please take a few moments to write us with your comments and suggestions. Our address is: Manager Technical Publications, GE Fanuc Automation. PO Box 8106, Charlottesville, VA 22906

Drake C. Fink

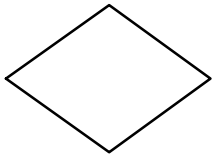
Sr. Staff Systems Engineer

SYMBOLS USED IN THIS GUIDE

BEGIN AT THIS SYMBOL ON THE FIRST CHART.

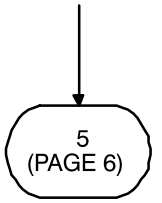
FOLLOW THE PATH WITH THE CORRECT ANSWER IN THE DIRECTION OF THE ARROW

SYMBOLS USED THROUGHOUT THE GUIDE ARE GEOMETRICALLY CODED

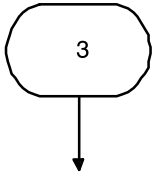


A DIAMOND ASKS A QUESTION

A RECTANGLE TELLS YOU TO DO SOMETHING



A NUMBERED BUBBLE WITH AN ARROW INTO THE BUBBLE INDICATES THAT THE PROCEDURE IS CONTINUED AT A CORRESPONDINGLY NUMBERED BUBBLE ON THE INDICATED PAGE NUMBER.



A NUMBERED BUBBLE WITH AN ARROW OUT OF THE BUBBLE INDICATES THE START OF A PROCEDURE ON THAT PAGE.I

Adding or Changing the EEPROM in the 90™–30

Application programs are normally developed in the CPU's RAM memory and executed from RAM memory. If additional program integrity is desired, or operation of the PLC without a battery is desired, an optional EEPROM or EPROM can be installed in a spare socket (labeled PROGRAM PROM) on the Model 311/313 backplane or in a socket on the model 331/341 CPU module. EEPROMs can be written to and read from. EPROMs can be read when installed in the PLC; however, they must be written to using an external PROM programming device.

Following is the procedure for adding or changing the EEPROM or EPROM. For clarity, the term PROM is used to refer to either an EEPROM or an EPROM.

1. Remove power from the system.
2. If 311/313
   - Remove all modules, including the power supply.
   - Remove the plastic cover.
3. If 331/341:
   - Remove CPU from backplane.
   - Remove front plate and bezel. Unsnap circuit board and remove from case.
4. If the socket is the type which has a screw near the top edge (some versions of 311/331), loosen screw at top of PROM socket (CCW twist;).
5. If present, remove old PROM from socket. Replace with or install new PROM. Orient the PROM so the end with a notch (the top of the prom) is toward the top edge of the backplane. Pin 1 of the prom is the first pin on the left as you move counter–clockwise from the notch. On the 311/331, correct installation orients the notch toward the screw.
6. When present, tighten screw at top of PROM socket (CW twist).
7. If 311/313:
   - Replace the plastic cover.
   - Replace all modules, including the power supply.
8. If 331 CPU:
   - Assure jumper JP1, located at the bottom of the PROM socket, is in the 1–2 position for EPROM and the 3–2 position for EEPROM. This informs the CPU firmware which type of device is present.
9. If 331/341 CPU:
   - Replace circuit board in case.
   - Reinstall front plate and bezel.
   - Replace CPU in backplane.

Changing the EEPROM (continued)

10. Apply power. The PLC follows the flowchart found in the ”Power–Up Sequence” figure in the Power–Up and Power–Down Section of the *Series 90–30/90–20 Programmable Controllers Reference Manual* (GFK–0467) to determine if a program will be loaded from PROM to RAM.

11. For the EEPROM to be used by the CPU, the CPU configuration must be set to use EEPROM as the ”Program Source”. You may use the LM90 Configuration software or the HHP to accomplish this.

12. To store the program in RAM, you may use either the Hand–Held Programmer or Logicmaster 90–30, Rev 3.5 or higher. Refer to the instructions in the *HHP User's Manual* (GFK–0402) for HHP. To use Logicmaster 90–30, follow these instructions:

- Start the LM90–30 Programmer Package
- Activate the Utilities Menu (F9)
- Select the EEPROM function (F10)
- Select the WRITE operation
- Verify the items you want to write to EEPROM are selected.
- Press ENTER to start the operation. Refer to the *Logicmaster 90 Series 90–30 and 90–20 Programming Software User's Manual* (GFK–0466) for more information.

Notes and Precautions

1. **WARNING**: Do not discard the lithium–manganese dioxide battery in fire. Do not attempt to discharge the battery. The battery may burst or burn or release hazardous materials. Dispose of the battery as you would any hazardous material.

2. **CAUTION**: After a power fault, the system will come back on in the mode (*STOP, RUN/ENABLED, RUN/DISABLED)* in which it was operating before power loss, unless the power up configuration specifies a particular mode.

3. Not having a battery installed will not prevent the PLC from running. It will generate a PLC fault on power cycle that prevents the PLC from entering *RUN* mode automatically. Clearing this fault will enable the PLC to be placed in *RUN* mode.

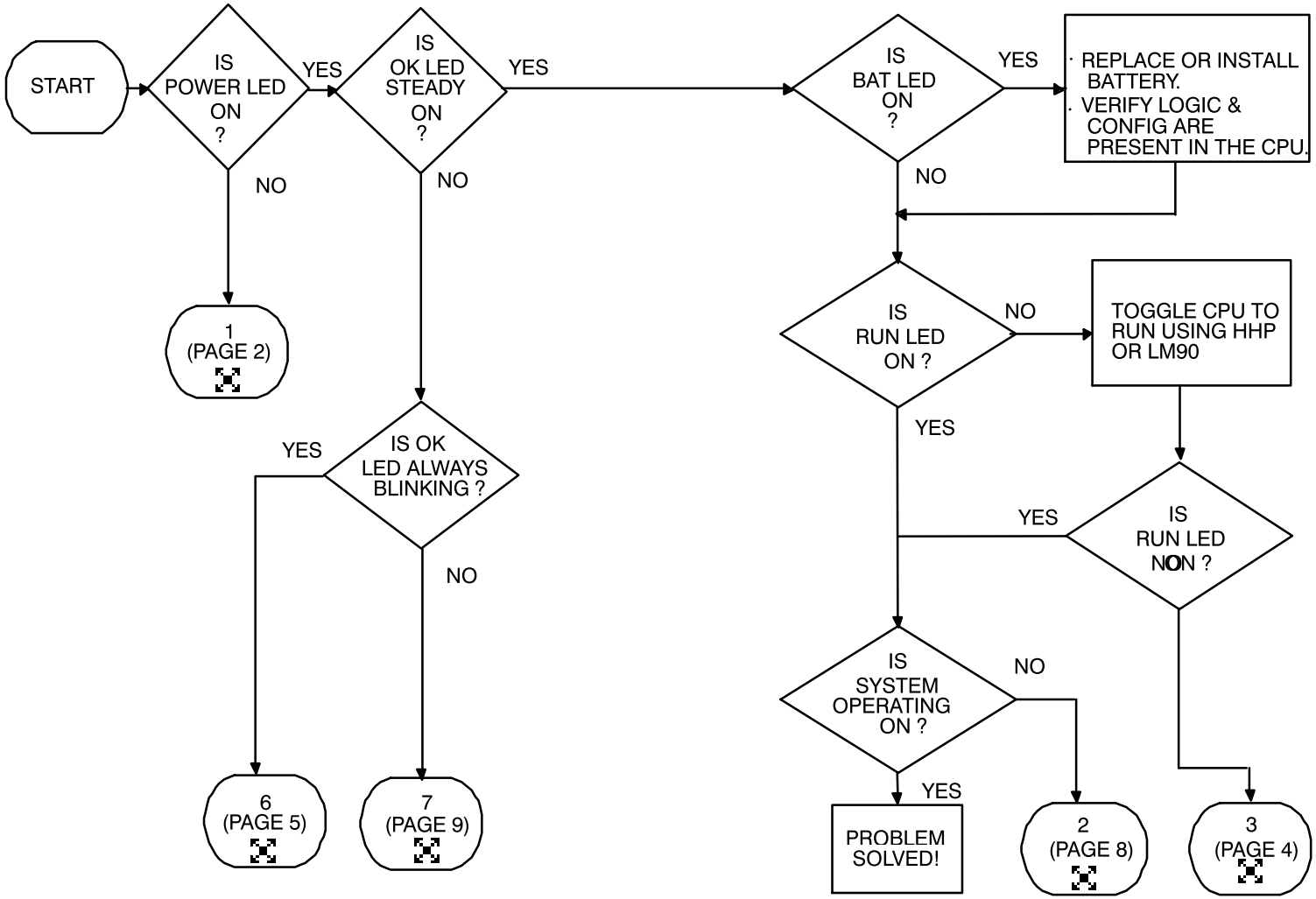
4. To short the 'super cap' on a 311/321 PLC:

   - Remove power from the system.
   - Remove all modules, including the power supply.
   - Remove the plastic face plate.
   - Find component C20 along the left edge of the module. This is the 'super cap'. Short the positive (+) and negative (–) leads of this device.
   - Replace the plastic face plate.
   - Replace all modules.
   - Restore power to the system.

5. Supply (input) voltage tolerances for Series 90–30 power supplies:

IC693PWR321:	100 to 240 VAC 100 to 250 VDC (125 VDC nominal)
IC693PWR322:	18 to 56 VDC, 21 VDC minimum to start 24 VDC OR 48 VDC nominal

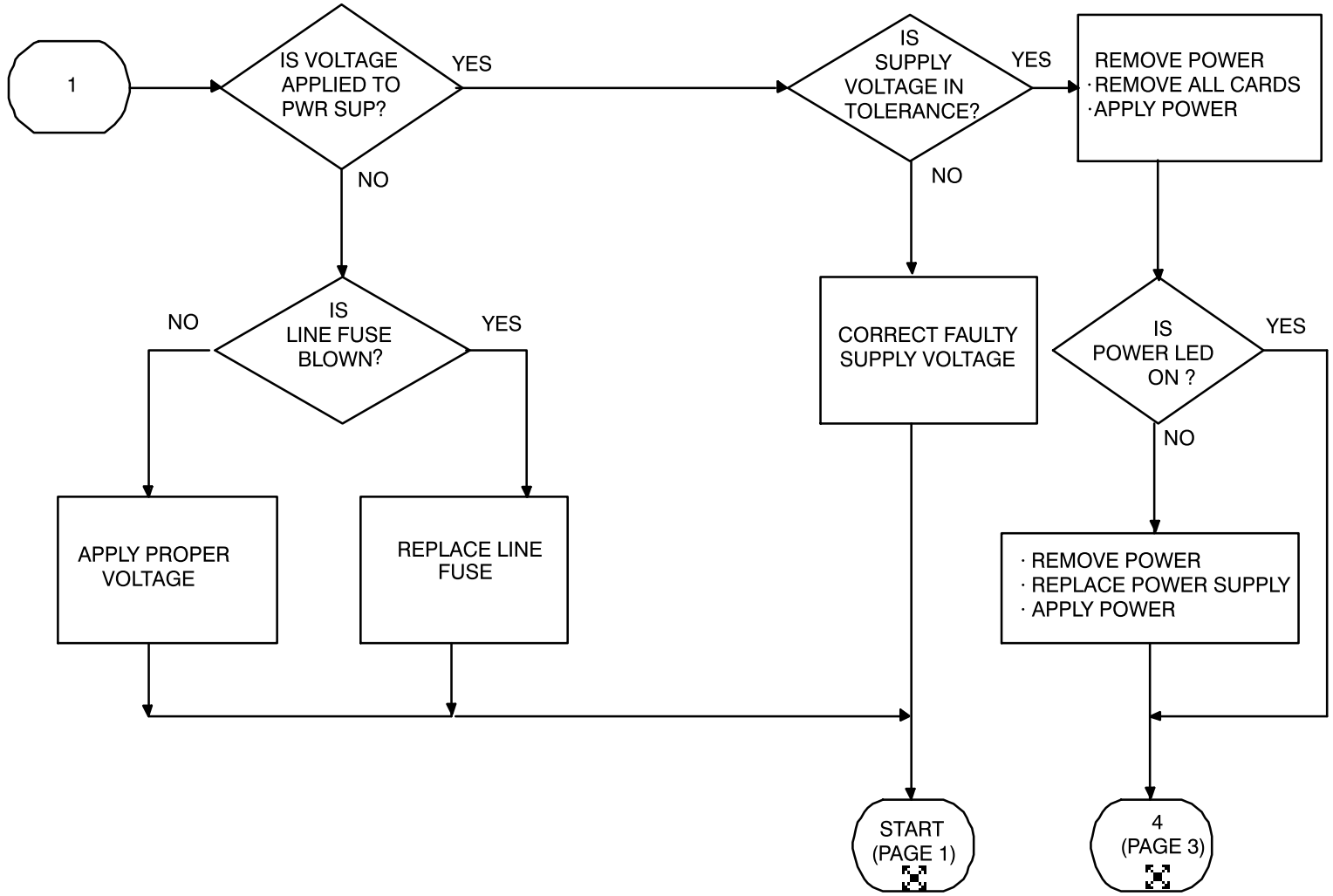
6. Total cable length must not exceed 50 feet between a CPU rack and an expansion rack. Length must not exceed 700 feet between a CPU rack and a remote rack. No termination plug is needed on a one–rack system.



PAGE 1

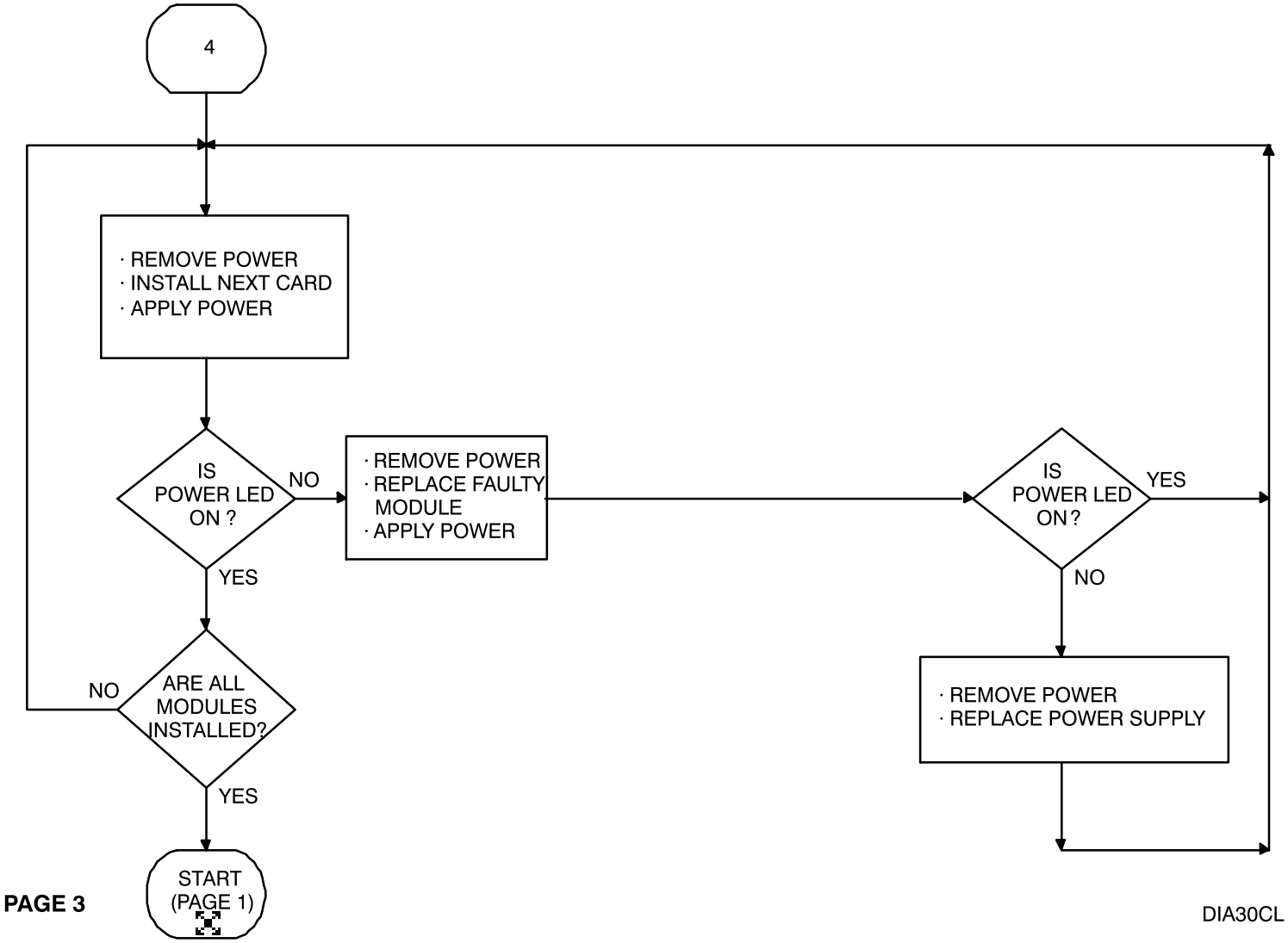
(Refer to the Preface for information on safety considerations, related publications and the symbols used in this guide.)

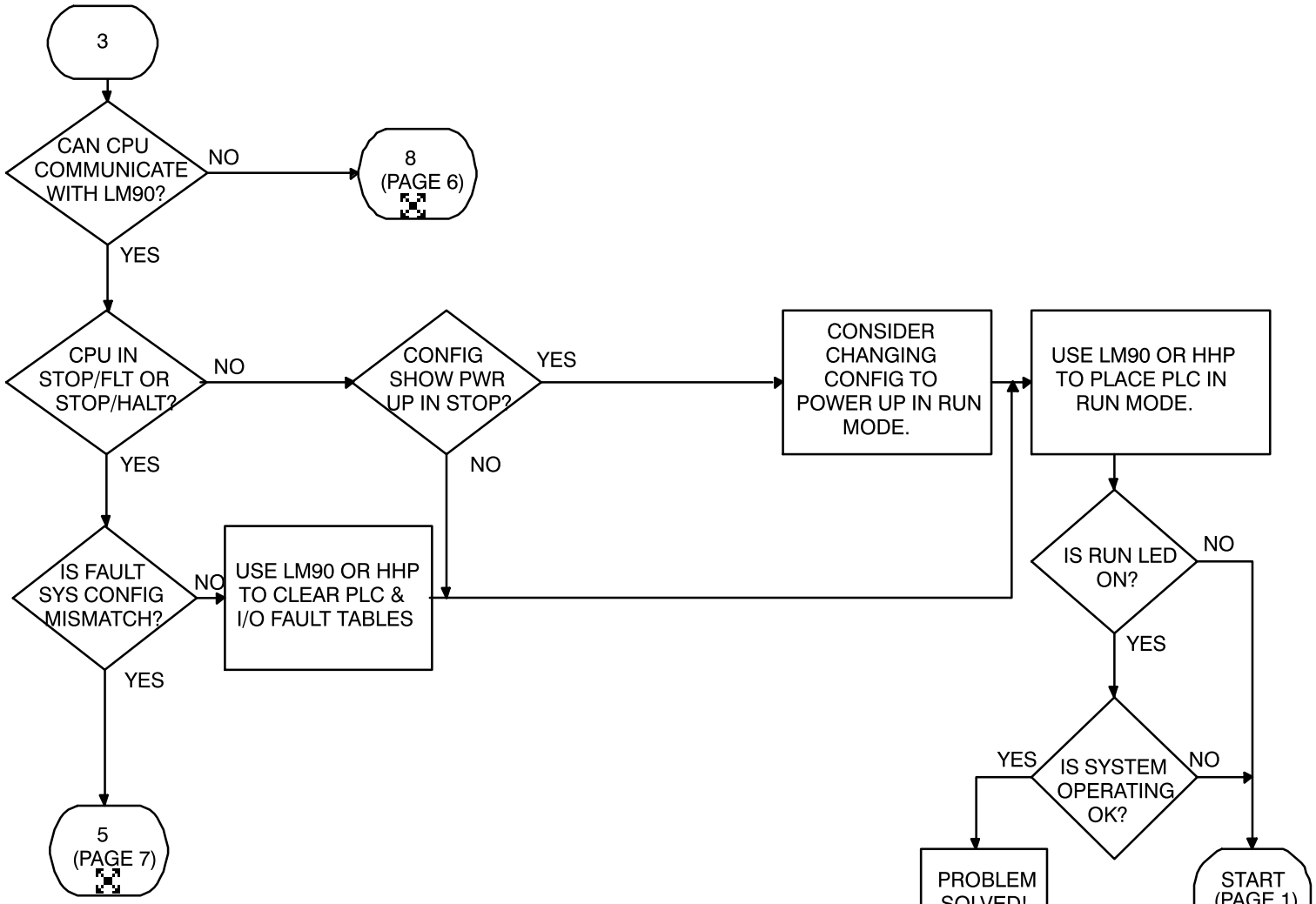
DIA30AL
GFZ-0085



PAGE 2

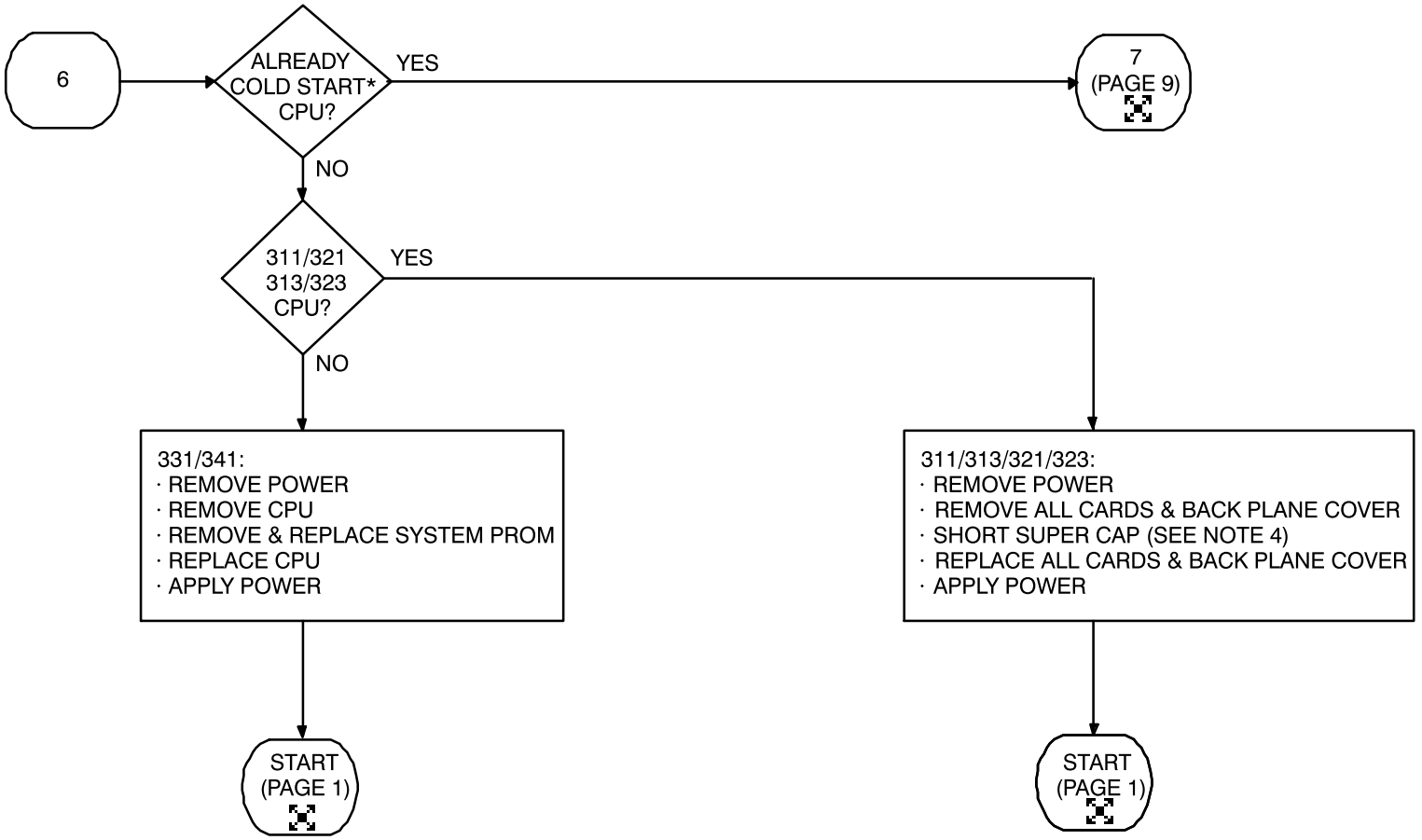
DIA30BL


4
· REMOVE POWER
· INSTALL NEXT CARD
· APPLY POWER
IS POWER LED ON ?
NO
· REMOVE POWER
· REPLACE FAULTY MODULE
· APPLY POWER
IS POWER LED ON?
YES
YES
NO
ARE ALL MODULES INSTALLED?
NO
YES
· REMOVE POWER
· REPLACE POWER SUPPLY
START (PAGE 1)
PAGE 3
DIA30CL



PAGE 4

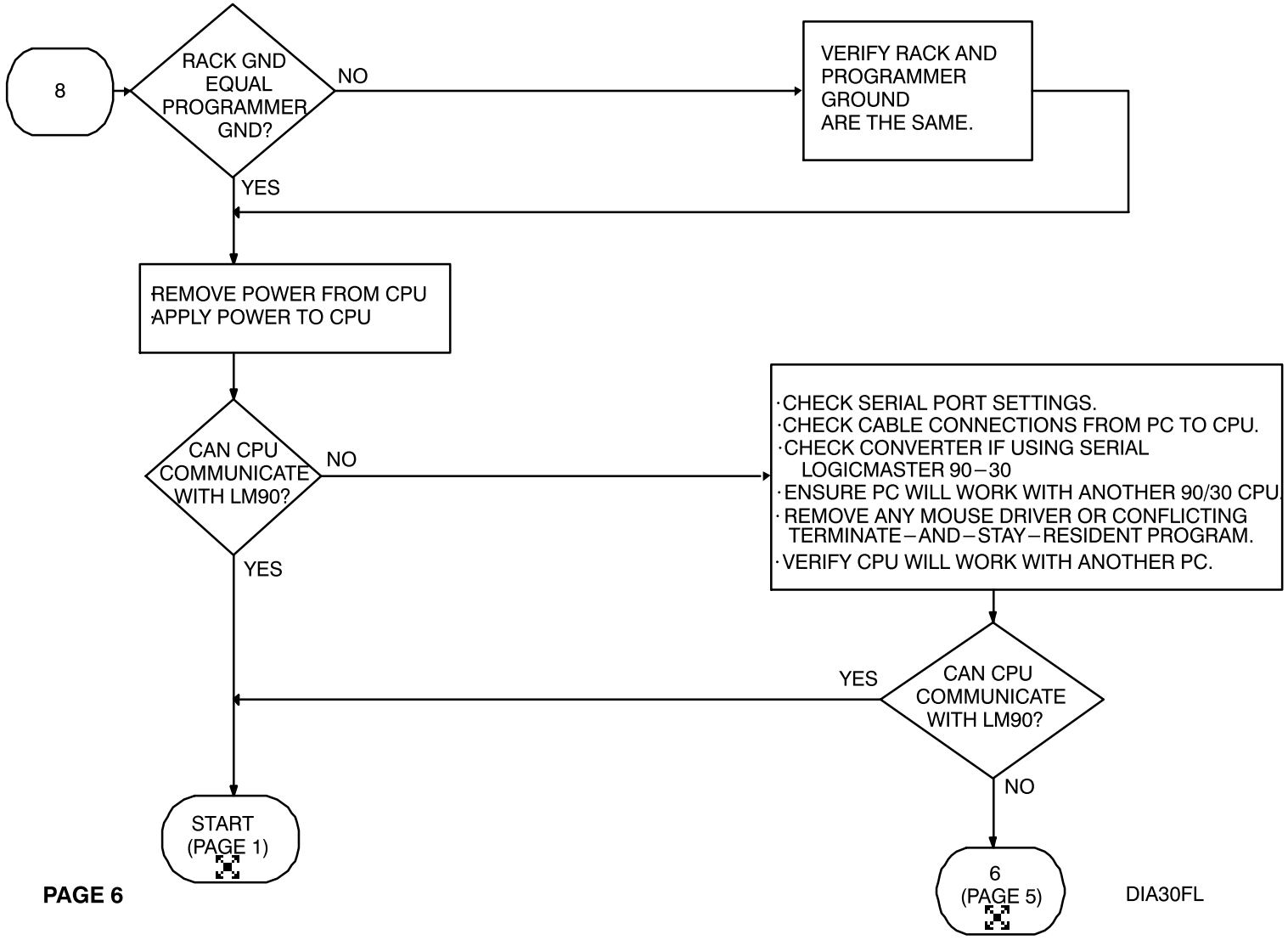
DIA30DL



*COLD START DELETES THE CONTENTS OF THE CPU'S MEMORY AND RESTORES COMMUNICATION PARAMETERS (BAUD RATE, PARITY, ETC.) TO THEIR DEFAULT VALUES.

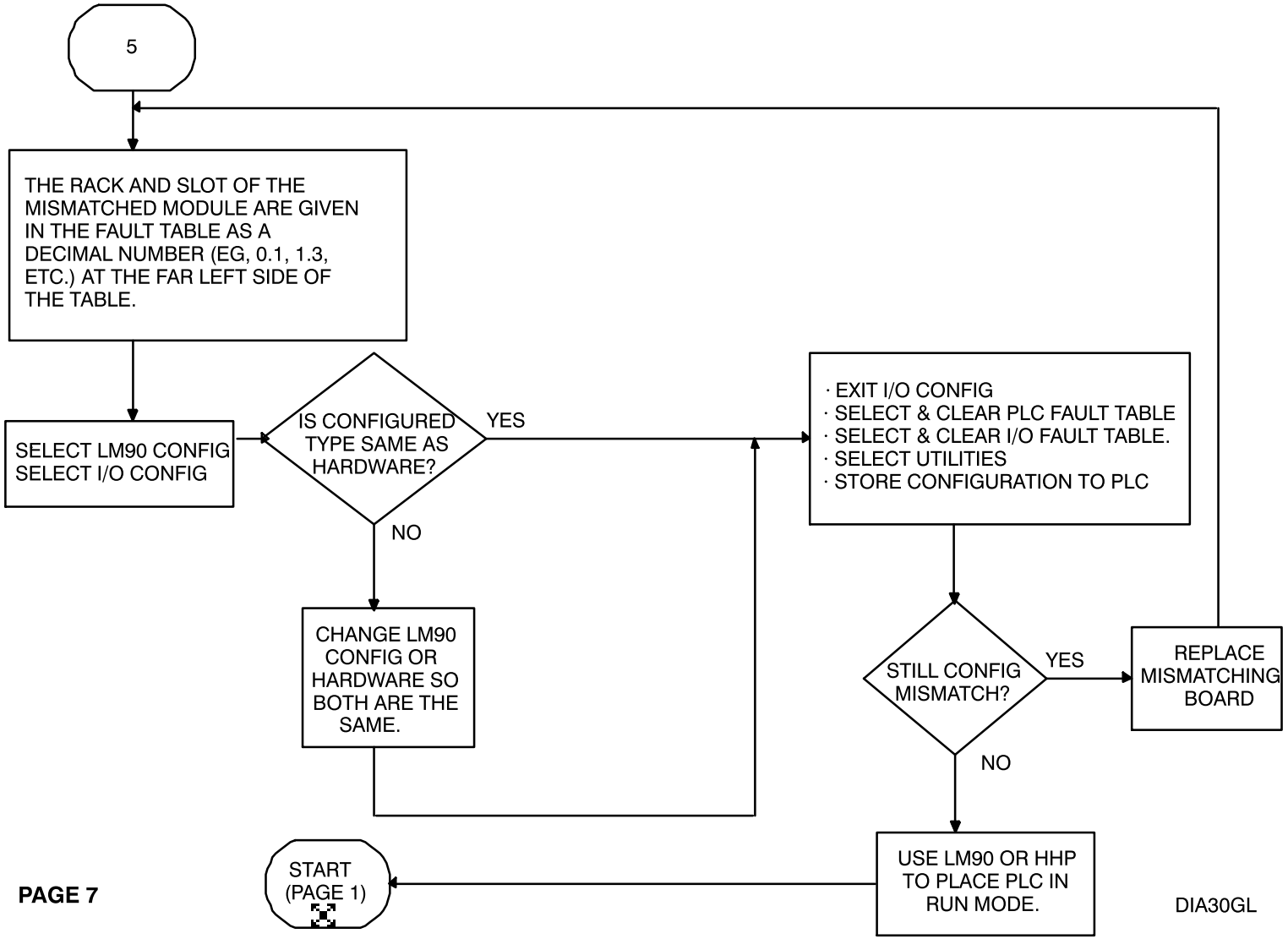
PAGE 5

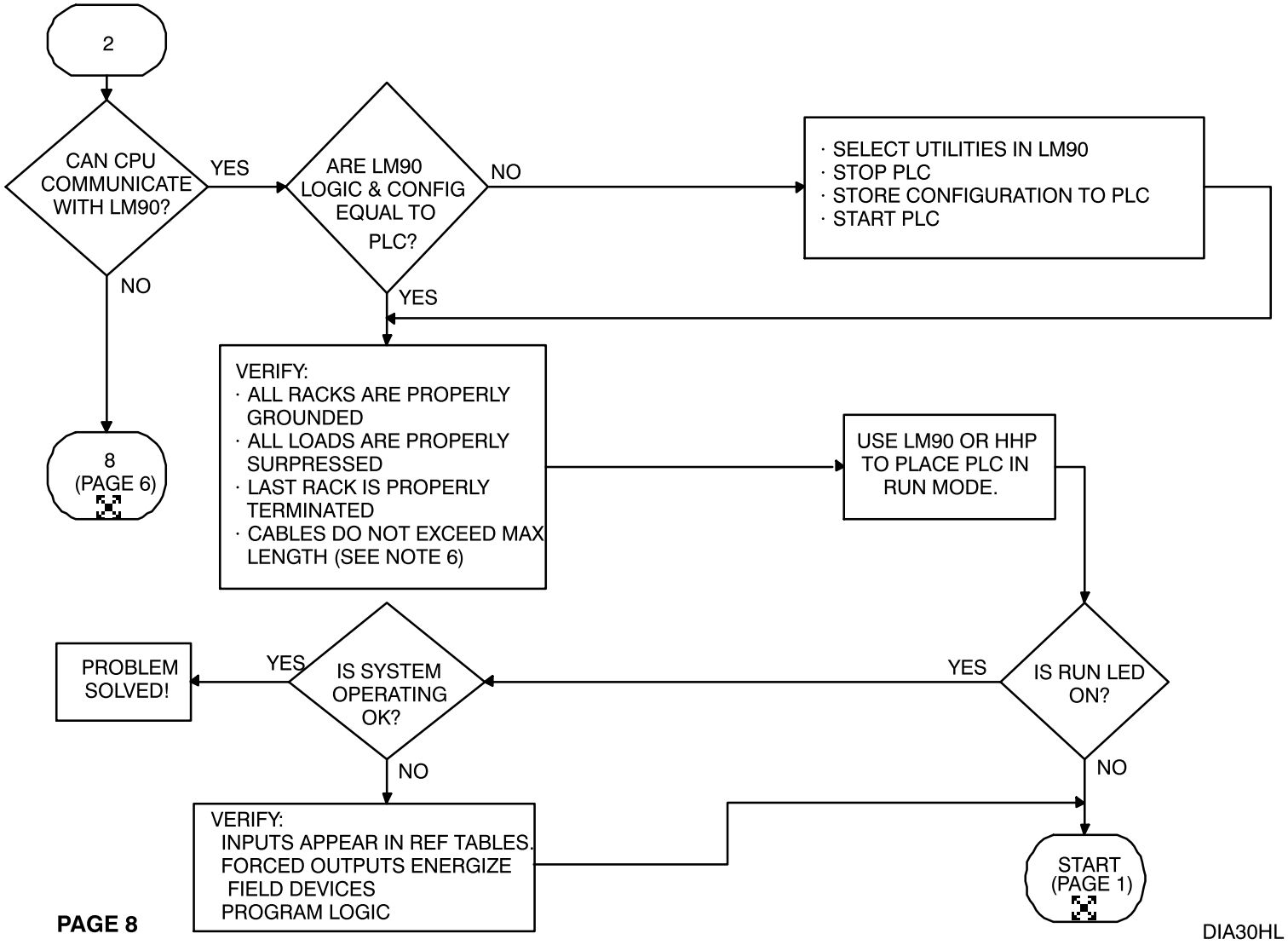
DIA30EL

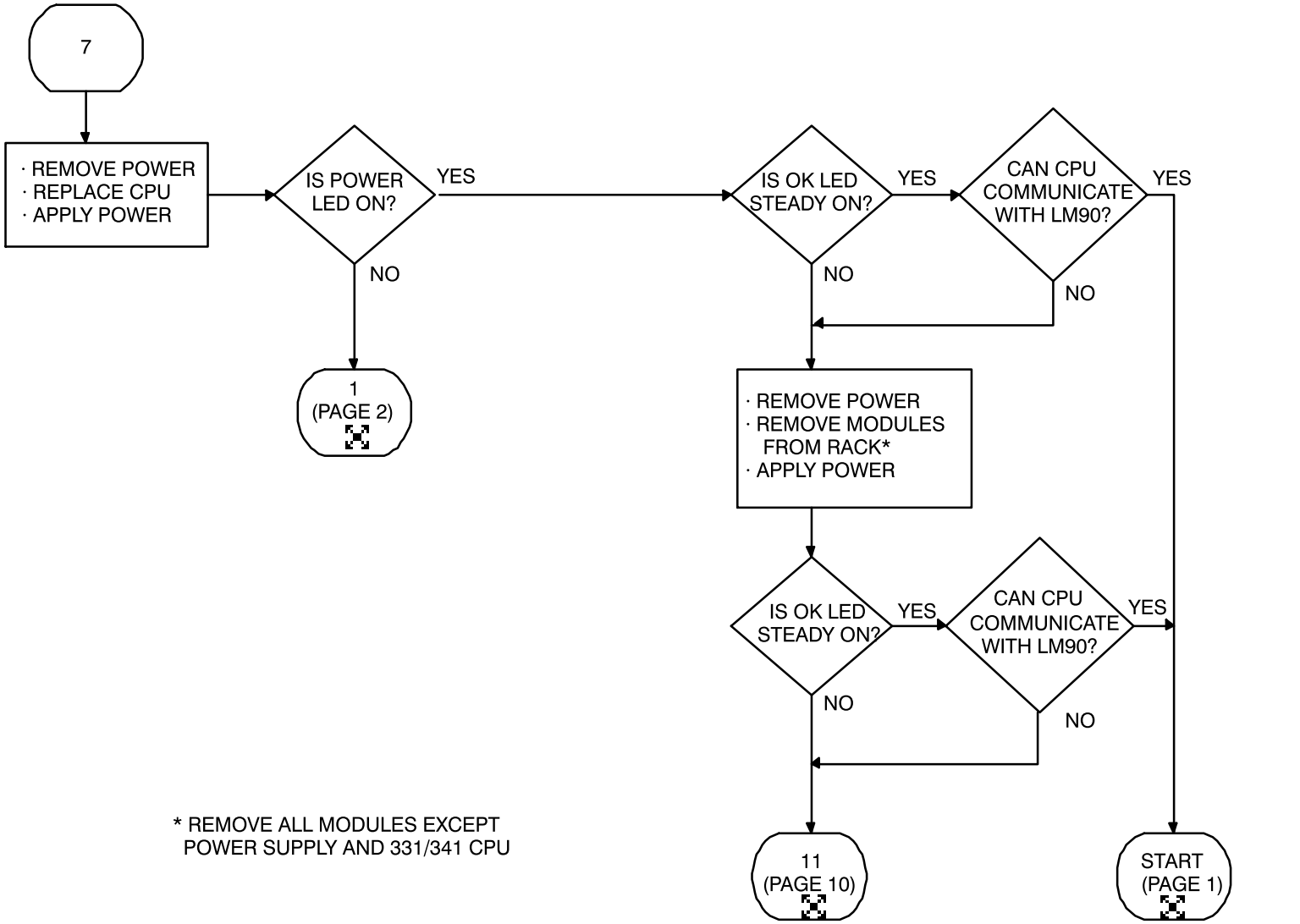


PAGE 6

DIA30FL

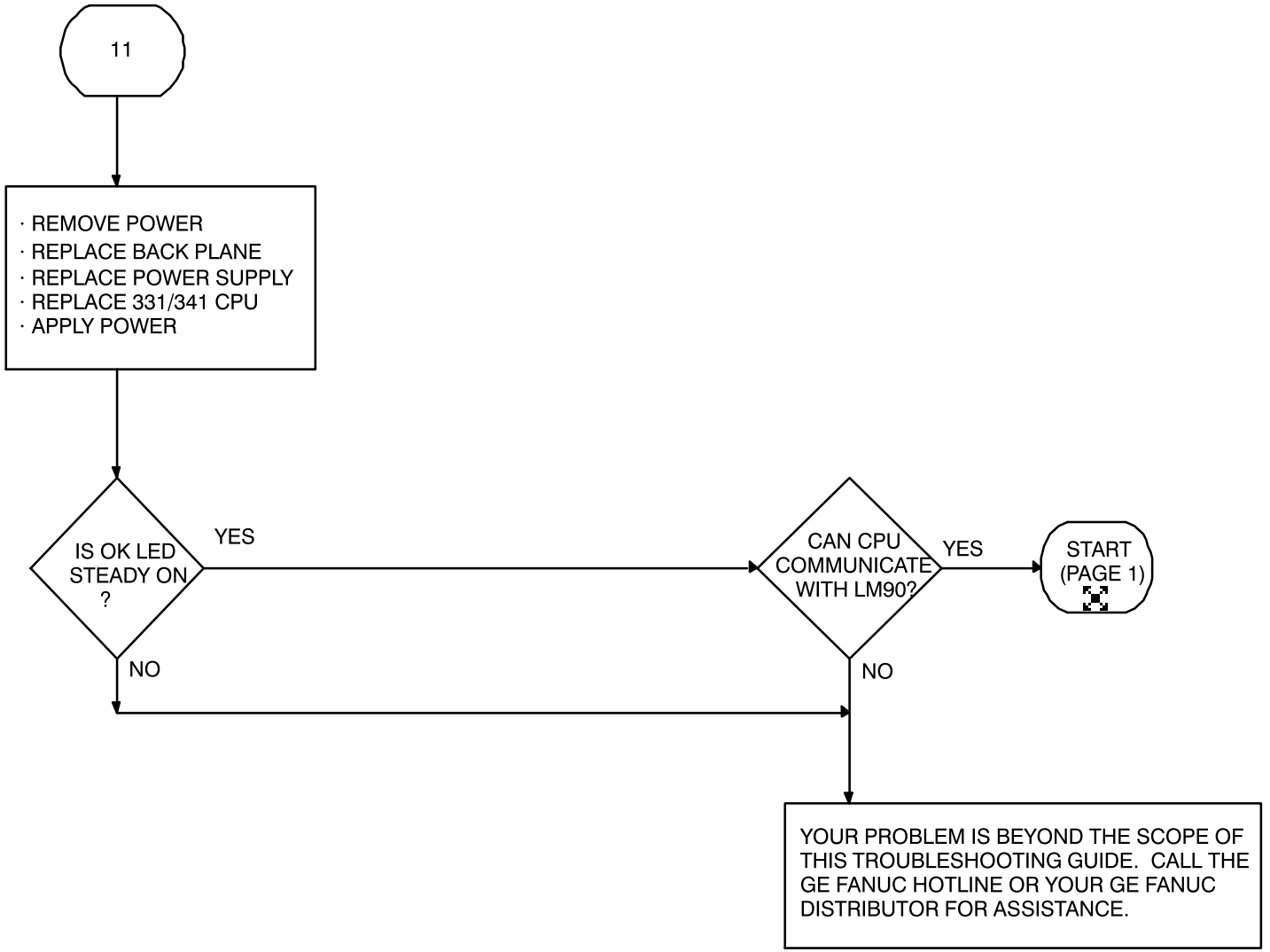

5
THE RACK AND SLOT OF THE MISMATCHED MODULE ARE GIVEN IN THE FAULT TABLE AS A DECIMAL NUMBER (EG, 0.1, 1.3, ETC.) AT THE FAR LEFT SIDE OF THE TABLE.
SELECT LM90 CONFIG
SELECT I/O CONFIG
IS CONFIGURED TYPE SAME AS HARDWARE?
YES
NO
· EXIT I/O CONFIG
· SELECT & CLEAR PLC FAULT TABLE
· SELECT & CLEAR I/O FAULT TABLE.
· SELECT UTILITIES
· STORE CONFIGURATION TO PLC
CHANGE LM90 CONFIG OR HARDWARE SO BOTH ARE THE SAME.
STILL CONFIG MISMATCH?
YES
REPLACE MISMATCHING BOARD
NO
START (PAGE 1)
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
PAGE 7
DIA30GL


2
CAN CPU COMMUNICATE WITH LM90?
YES
ARE LM90 LOGIC & CONFIG EQUAL TO PLC?
NO
· SELECT UTILITIES IN LM90
· STOP PLC
· STORE CONFIGURATION TO PLC
· START PLC
NO
YES
8 (PAGE 6)
VERIFY:
· ALL RACKS ARE PROPERLY GROUNDED
· ALL LOADS ARE PROPERLY SURPRESSED
· LAST RACK IS PROPERLY TERMINATED
· CABLES DO NOT EXCEED MAX LENGTH (SEE NOTE 6)
USE LM90 OR HHP TO PLACE PLC IN RUN MODE.
PROBLEM SOLVED!
YES
IS SYSTEM OPERATING OK?
YES
IS RUN LED ON?
NO
NO
VERIFY:
INPUTS APPEAR IN REF TABLES.
FORCED OUTPUTS ENERGIZE FIELD DEVICES
PROGRAM LOGIC
START (PAGE 1)
PAGE 8
DIA30HL



PAGE 9

DIA30JL



PAGE 10

DIA30KL

SP292

Section 5 - Functional Description

DIESEL STANDBY GENERATOR

LOCAL CONTROL PANEL FUNCTIONAL DESCRIPTION

FOR

BRISBANE WATER

Project No: 15016

May 2005

ABBREVIATIONS

G1 Generator 1 Diesel

1. GENERAL

1.1. The PLC for the above operation is a GE Fanuc IC693CPU350. This program has been designed for the use on G1. The operation below controls G1.

1.2. A mode selector switch selects how G1 shall operate :

1.2.1. Off

1.2.2. Manual Mode

1.2.3. Test Mode.

1.2.4. Automatic Mode.

2. MANUAL MODE

2.1. To operate G1 in MANUAL Mode.

2.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

2.3. Press the MANUAL START push button to start the generator.

2.4. The generator will begin to crank.

2.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

2.4.2. The generator set is allowed 3 attempts to start.

2.4.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

2.4.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

2.4.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

2.4.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

2.4.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

2.5. To Manual Transfer to Generator in the MANUAL Mode.

2.5.1. Start the generator and wait for the generator to run up to speed and voltage and ready to accept load.

2.5.2. Press the MANUAL TRANSFER TO GEN push button.

2.5.3. The MAINS ATS shall Open.

2.5.4. After a 30 second delay the GEN ATS shall Close.

2.5.5. If the MAINS ATS fails to Open.

2.5.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

2.5.5.2. The system shall return back to MAINS ATS operation.

2.5.6. If the GEN ATS fails to Close.

2.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

2.5.6.2. The system shall return back to MAINS ATS operation.

2.6. To Manual Transfer to Mains in the MANUAL Mode.

2.6.1. The GENERATOR ATS is Closed.

2.6.2. Press the MAN TRANSFER TO MAINS push button.

2.6.3. The GEN ATS shall Open.

2.6.4. After a 30 second delay the MAINS ATS shall Close.

2.6.5. If the GEN ATS fails to Open.

2.6.5.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

2.6.5.2. The system shall return back to GEN ATS operation.

2.6.6. If the MAINS ATS fails to Close.

2.6.6.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

2.6.6.2. The system shall return back to GEN ATS operation.

2.7. To stop the generator in the MANUAL Mode.

2.7.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

2.7.2. If the generator is still GEN ATS operation. The MANUAL TRANSFER TO MAINS is initiated.

2.7.3. When the GEN ATS is Open, the generator will enter the cool down time of 1 second.

2.7.4. After the cool down time, the generator will shut down.

2.7.5. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

3. NON-PERMANENT SITE, MANUAL MODE

3.1. To operate G1 in a Non-Permanent Site Location in MANUAL Mode.

3.2. Connect the generator cables to the site generator CB ensuring the site generator CB is OFF. See BCC procedures.

3.3. A plug with shorting links is required to be installed. It is required to be plugged into the 27 Pin Station Plug.

3.3.1. Pins 11 and 12 are required to be connected. This is to indicate that the Mains ATS is Closed. If they are not connected a MAINS ATS Alarm shall be indicated.

3.4. Select from the AUTO – TEST – MAN- OFF selector switch to the MANUAL position.

3.5. Press the MANUAL START push button to start the generator.

3.6. The generator will begin to crank.

3.6.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

3.6.2. The generator set is allowed 3 attempts to start.

3.6.3. If it fails to start on the third attempt, the generator is locked out on FAIL TO START Alarm.

3.6.4. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

3.6.5. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

3.6.6. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

3.6.7. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

3.7. To connect the generator to the site load.

3.7.1. Manually switch over to the generator supply via the site CB's. See BCC procedures.

3.7.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.8. To disconnect the generator from the site load.

3.8.1. Manually switch over to the mains supply via the site CB's. See BCC procedures.

3.8.2. Do not use the MANUAL TRANSFER TO GEN or the MAN TRANSFER TO MAINS push buttons.

3.9. To stop the generator in the MANUAL Mode.

3.9.1. When the generator is running, it may be stopped by pressing the MANUAL STOP push button.

3.9.2. The generator will enter the cool down time of 1 second.

3.9.3. After the cool down time, the generator will shut down.

3.9.4. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

4. TEST OPERATION

4.1. To operate the generator in the TEST Mode.

4.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the TEST position.

4.3. If the selector is changed to MAN while the generator is operating on TEST, the system shall change to MANUAL TRANSFER TO GEN.

4.4. The generator shall begin to crank.

4.4.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

4.4.2. The generator is allowed 3 attempts to start.

4.4.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

4.5. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

4.6. The MAINS ATS shall Open.

4.7. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

4.8. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

4.9. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

4.10. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

4.11. If the MAINS ATS fails to Open.

4.11.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.11.2. The system shall shut down and return back to MAINS ATS operation.

4.12. If the GEN ATS fails to Close.

4.12.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.12.2. The system shall shut down and return back to MAINS ATS operation.

4.13. To stop the generator in the TEST Mode.

4.13.1. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO or OFF position.

4.13.2. The GEN ATS shall Open.

4.13.3. After a 30 second delay the MAINS ATS shall Close.

4.13.4. If the GEN ATS fails to Open.

4.13.4.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

4.13.4.2. The system shall return back to GEN ATS operation.

4.13.5. If the MAINS ATS fails to Close.

4.13.5.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

4.13.5.2. The system shall return back to GEN ATS operation.

4.13.6. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

4.13.7. After the cool down time, the generator will shut down.

4.13.8. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

4.13.9. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

5. AUTOMATIC OPERATION

5.1. To operate the generator in the AUTO Mode.

5.2. Select this operation by turning the AUTO – TEST – MAN- OFF selector switch to the AUTO position.

5.3. The Phase Failure Relay from the clients switch board shall give a Start Signal for the generators to run.

5.4. The Remote Start Command.

5.4.1. The generator shall begin to crank.

5.4.1.1. If it fails to start within the 10 seconds, the starter motor is stopped and a delay of 10 seconds before it will attempt to restart.

5.4.1.2. The generator is allowed 3 attempts to start.

5.4.1.3. If it fails to start on the third attempt, the generator is faulted on FAIL TO START Alarm.

5.4.2. When the generator starts, the starter motor is stopped by a stop cranking input which measures the speed of the generator.

5.4.3. The MAINS ATS shall Open.

5.4.4. Once the generator has started, there is a 10 second time delay for the oil pressure to stabilise.

5.4.5. If the oil pressure is not up to pressure after the 10 second time delay, the generator shall shut down on LOW OIL PRESS Alarm.

5.4.6. Once the generator is running there is a 5 second warm up time before it is ready to accept load.

5.4.7. After the warm up time has expired and the MAINS ATS has been open for 30 seconds the GEN ATS shall Close.

5.4.8. If the MAINS ATS fails to Open.

5.4.8.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.4.8.2. The system shall shut down and return back to MAINS ATS operation.

5.4.9. If the GEN ATS fails to Close.

5.4.9.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.4.9.2. The system shall shut down and return back to MAINS ATS operation.

5.5. To stop the generator in the AUTO Mode.

5.5.1. The Phase Failure Relay from the clients switch board shall give a Stop Signal for the generators to run.

5.5.2. The Remote Stop Command.

5.5.3. There is a 2 minute proving time for the Phase Failure Relay.

5.5.4. After the 2 minute proving time the GEN ATS shall Open.

5.5.5. After a 30 second delay the MAINS ATS shall Close.

5.5.6. If the GEN ATS fails to Open.

5.5.6.1. After a 5 second delay an Alarm shall be generated and the GENERATOR CONNECTED indicator shall flash to indicate the Alarm.

5.5.6.2. The system shall return back to GEN ATS operation.

5.5.7. If the MAINS ATS fails to Close.

5.5.7.1. After a 5 second delay an Alarm shall be generated and the MAINS CONNECTED indicator shall flash to indicate the Alarm.

5.5.7.2. The system shall return back to GEN ATS operation.

5.5.8. When the GEN ATS is Open, the generator will enter the cool down time of 5 minutes.

5.5.9. After the cool down time, the generator will shut down.

5.5.10. If a Mains Failure occurs during the cool down period the generator shall transfer back to the GENERATOR ATS without shutting down.

5.5.11. Once the generator has shut down there is a 15 second delay before it may be restarted. This is to ensure the engine has mechanically stopped.

6. FAULT OPERATION

6.1. Emergency Stop Operation.

6.1.1. Operation of the Emergency Stop push button immediately shuts down the generator and Opens the Generator CB. The Emergency Stop is latched, and requires manual resetting to release the Emergency Stop push button.

6.1.2. After the Emergency Stop push button is released, a fault reset will need to be initiated to reset the PLC.

6.2. HIGH HIGH Alarm Operation.

6.2.1. The Generator CB is Opened immediately.

6.2.2. The generator is shut down immediately.

6.2.3. The following alarms will initiate a HIGH HIGH Alarm condition :-

6.2.3.1. Emergency Stop Fault

6.2.3.2. MEN Fault

6.2.3.3. Low Oil Pressure Shutdown Fault, 10 Seconds Startup Delay

6.2.3.4. High Engine Temperature Shutdown Fault, 30 Second Startup Delay

6.2.3.5. Low Radiator Level Fault, 5 Second Delay

6.2.3.6. Over Speed Fault

6.3. HIGH Alarm Operation

6.3.1. The Generator CB is Opened immediately.

6.3.2. Once the generator circuit breaker is opened, the generator will run through its normal cool down time and shut down.

6.3.3. The following alarms will initiate a HIGH Alarm condition:-

6.3.3.1. Generator Under Speed Fault, 5 Second Delay

6.3.3.2. Alternator Under Voltage Fault, 5 Second Delay

6.3.3.3. Alternator Over Voltage Fault, 5 Second Delay

6.3.3.4. Generator CB Tripped Fault

6.3.3.5. Alternator High Temperature Fault, 30 Second Startup Delay

6.4. MEDIUM Alarm Operation.

6.4.1. A Normal Shutdown shall be Initiated.

6.4.2. If the GEN ATS does not Open then the Generator CB is Opened.

6.4.3. The following alarms will initiate a MEDIUM Alarm condition :-

6.4.3.1. Fuel Empty Level Fault, 5 Second Delay

6.4.3.2. Fail To Start Fault, 3 Attempts

6.5. LOW Alarm Operation.

6.5.1. A Warning has occurred on the generator. The generator will not shut down.

6.5.2. The following alarms will initiate a LOW Alarm condition :-

6.5.2.1. Low Oil Pressure Warning Alarm, 10 Seconds Startup Delay

6.5.2.2. High Engine Temperature Warning Alarm, 30 Second Startup Delay

6.5.2.3. Fuel Low Level Alarm, 5 Second Delay

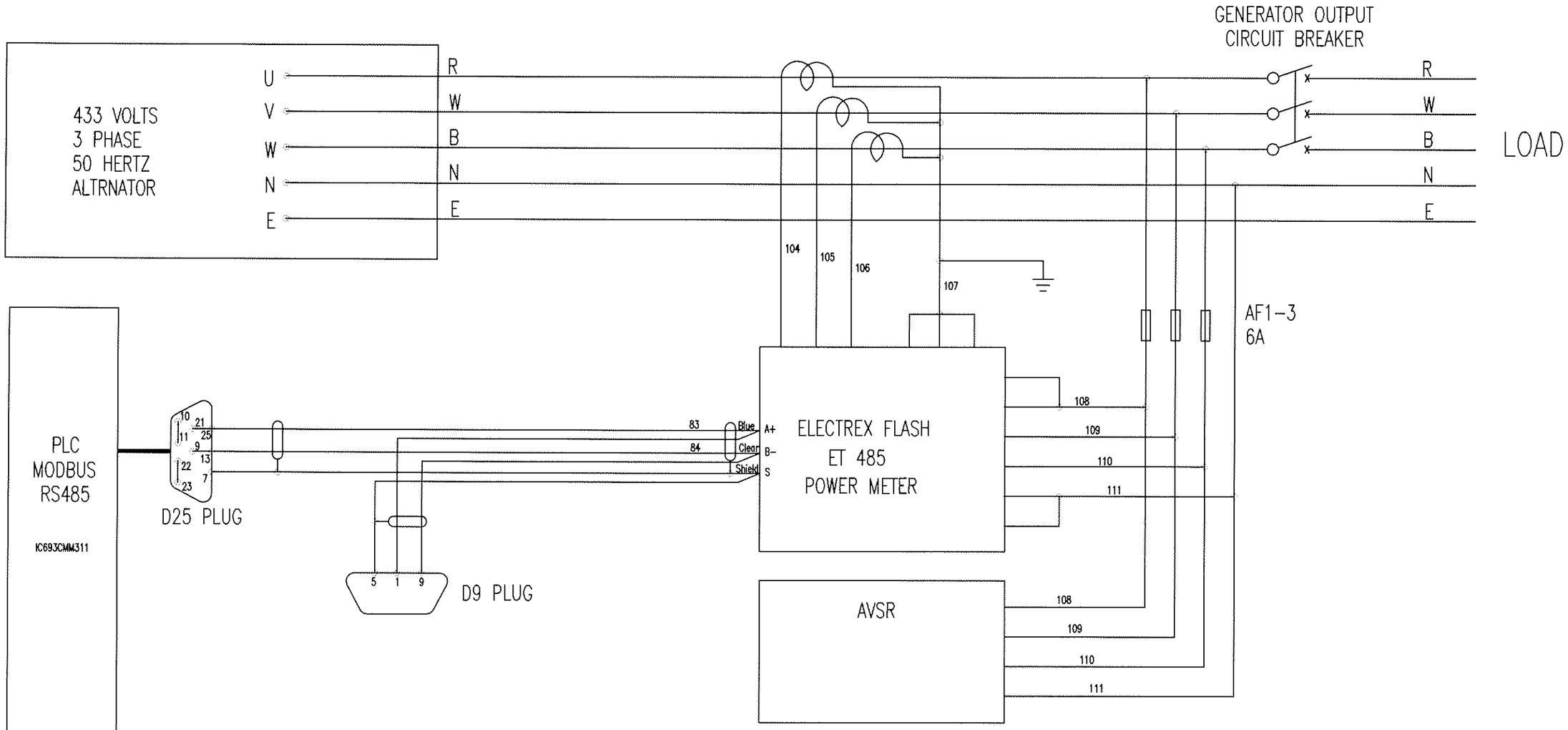
6.5.2.4. Battery Charger AC Supply Failed Alarm, 60 Second Delay

6.5.2.5. Control Battery Low Volts Alarm, 30 Second Delay

6.5.2.6. Start Battery Low Volts Alarm, 60 Second Delay

SP292

Section 6 - Drawings



AS BUILT

DESIGN CHECK

DATE 5-7-05

No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	AMENDMENT
C					
B					
A	07-03-05				NEW DRAWING

47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

CLIENT	BRISBANE WATER		
PROJECT	BRISB. WATER PUMP STATION GENERATOR		
DRAFTER HJR	DRAFTING CHECK	EPAC JOB NUMBER 4284	SE POWER JOB NUMBER 15016
DESIGNED HJR	DESIGN REVIEW		

TITLE: ELECTRICAL SCHEMATIC

SCALE	DRAWING No	No IN SET	AMDT
NTS	15016–02	4 of 5	A

67

2A 2A 2A

80 79 81

1,6,11,16 Q07 IC693MDL940

2	Q07-A01	CONTROLS IN AUTO
3	Q07-A02	CONTROLS IN TEST
4	Q07-A03	CONTROLS IN MANUAL
5	Q07-A04	REMOTE START
7	Q07-A05	MAINS AVAILABLE
8	Q07-A06	MAINS CONNECTED
9	Q07-A07	GENERATOR RUNNING
10	Q07-A08	GENERATOR CONNECTED
12	Q07-B01	MAINS FAILED
13	Q07-B02	EMERGENCY STOP
14	Q07-B03	MEN FAULT
15	Q07-B04	LOW OIL PRESS. S'DOWN
17	Q07-B05	LOW OIL PRESS. WARNING
18	Q07-B06	HIGH ENGINE TEMP. S'DOWN
19	Q07-B07	HIGH ENGINE TEMP. WARNING
20	Q07-B08	LOW RADIATOR LEVEL

1,6,11,16 Q08 IC693MDL940

2	Q08-A01	FUEL EMPTY
3	Q08-A02	FUEL LOW
4	Q08-A03	OVERSPEED
5	Q08-A04	UNDERSPEED
7	Q08-A05	FAILED TO START
8	Q08-A06	ALTERNATOR UNDER VOLTAGE
9	Q08-A07	ALTERNATOR OVER VOLTAGE
10		
12	Q08-B01	GENERATOR OVERLOAD
13	Q08-B02	CHARGER AC SUPPLY FAILED
14	Q08-B03	CONTROL BATTERY LOW VOLTS
15	Q08-B04	START BATTERY LOW VOLTS
17	Q08-B05	CANOPY DOORS OPEN
18		
19		
20		

1,6,11,16 Q09 IC693MDL940

2	Q09-A01		
3	Q09-A02		
4	Q09-A03		
5	Q09-A04		
7	Q09-A05		
8	Q09-A06		
9	Q09-A07		
10	Q09-A08	STARTER MOTOR RELAY	SMR
12	Q09-B01	GOVERNOR CONTROL RELAY	GCR
13	Q09-B02	AUDIBLE ALARM RELAY	AAR
14	Q09-B03	SHUTDOWN ALARM RELAY	SDAR
15	Q09-B04		
17	Q09-B05		
18	Q09-B06		
19			
20			

CB AUX SWITCH — CLOSES WHEN CB IS OFF OR TRIPPED — 43

27 PIN STATION PLUG

Q09-A01	0.5A	18	2	CLOSE MAINS ATS
Q09-A02	0.5A	19	3	CLOSE GEN ATS
Q09-A03	0.5A	20	4	GEN SHUTDOWN ALARM
Q09-A04	0.5A	21	5	GEN WARNING ALARM
Q09-A05	0.5A	22	6	LOW FUEL
Q09-A06	0.5A	23	7	GENERATOR RUNNING
Q09-A07	0.5A	24	8	GENERATOR CONNECTED
Q09-B04	0.5A	41	20	GEN CANOPY DOORS OPEN
Q09-B05	0.5A	42	22	GENERATOR IN AUTO
	0.5A	43	21	GENERATOR CB OFF/TRIPPED
			23	GENERATOR CONTROLS CONNECTED
			24	GENERATOR CONTROLS CONNECTED
Q09-B06	0.5A	44	25	REFUEL NEEDED

AS BUILT

DESIGN CHECK Hooper

DATE 5-7-05

PLC INPUTS SHEET 2

12 / 17	9 / 10	PFR1-1	PHASE FAILURE
13 / 17	11 / 12	MCB-AUX	MAINS ON LINE
14 / 17	13 / 14	GCB-AUX	GEN ON LINE
15 / 17	15 / 16	GRST-1	REMOTE START
16 / 17	17 / 18	GRSP-1	REMOTE STOP
17	1		24V NEGATIVE SUPPLY

2-8

2-8

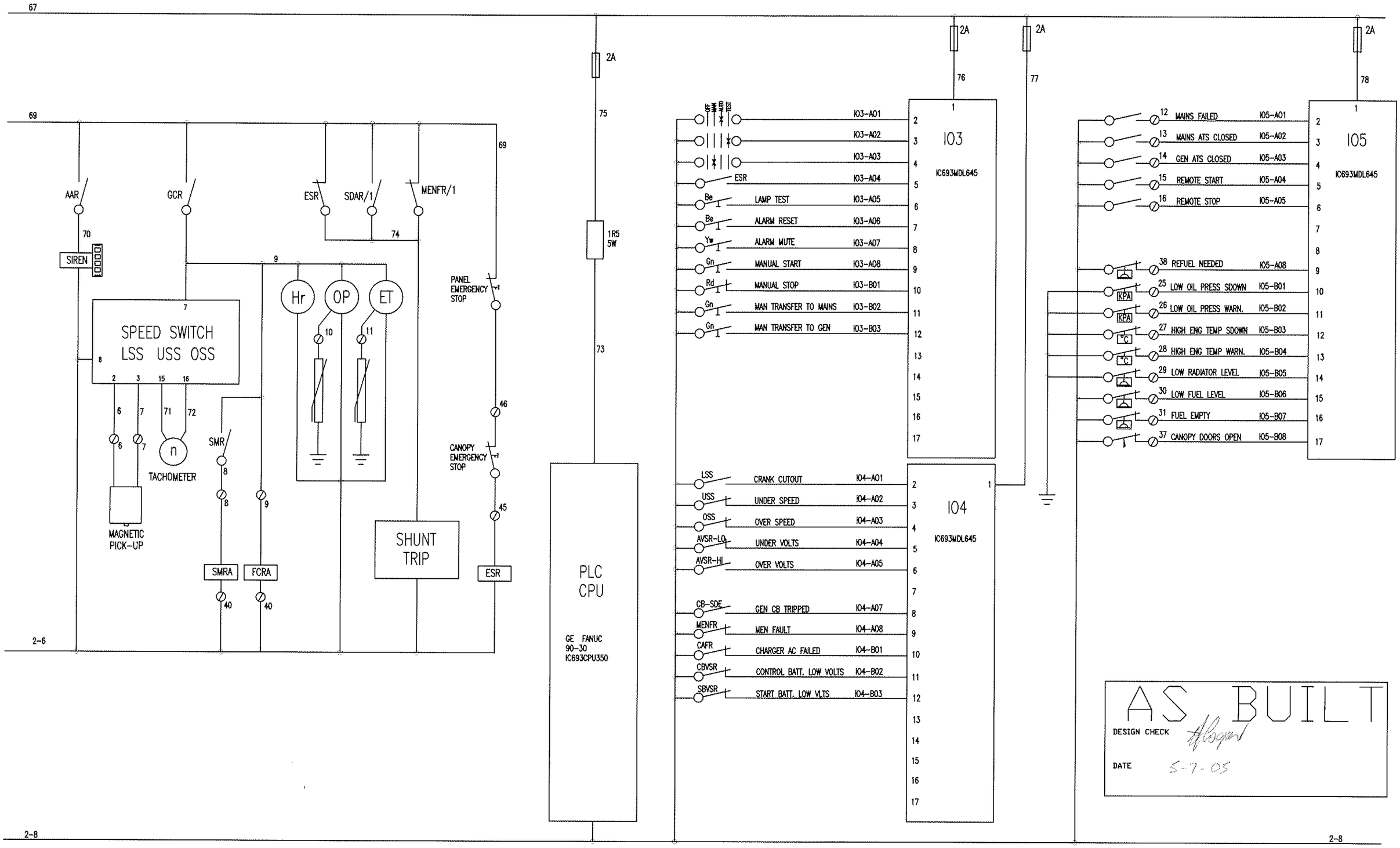
No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	NEW DRAWING
A	07-03-05				AMENDMENT

47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

Active 13/12/2013

CLIENT: BRISBANE WATER
PROJECT: BRISB. WATER PUMP STATION GENERATOR
DRAFTER: HJR | DRAFTING CHECK | EPAC JOB NUMBER: 4284 | SE POWER JOB NUMBER: 15016
DESIGNED: HJR | DESIGN REVIEW

TITLE: GENERATOR ELECTRICAL SCHEMATIC
SCALE: NTS | DRAWING No: 15016-02 | No IN SET | AMDT



AS BUILT

DESIGN CHECK

DATE 5-7-05

No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	AMENDMENT
C					
B	15-06-05				PLC VOLT REG. REMOVED AND CONTACT ESR WAS ADDED TO SHUNT TRIP
A	07-03-05				NEW DRAWING

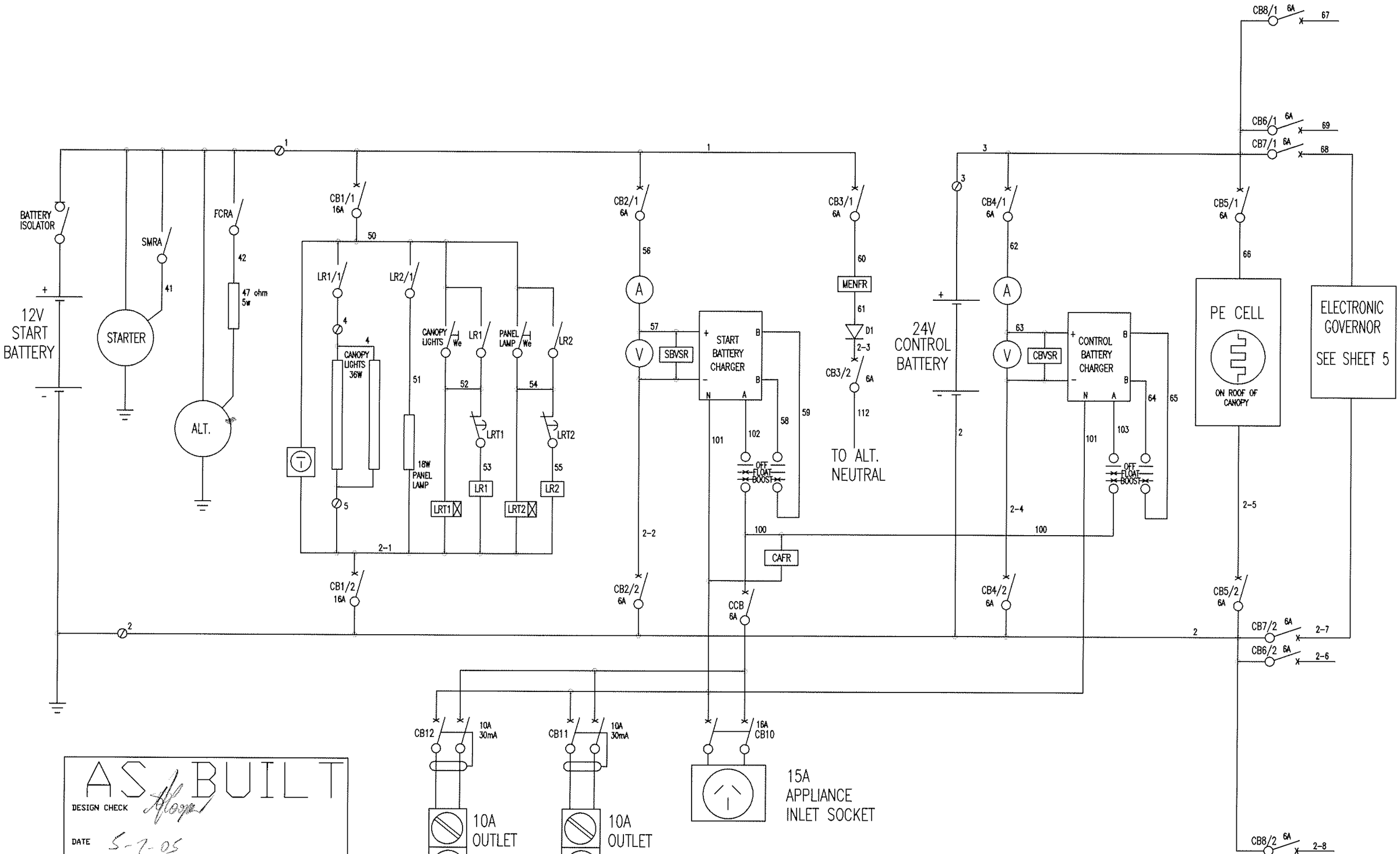
47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

Active 13/12/2013

CLIENT	BRISBANE WATER		
PROJECT	BRISB. WATER PUMP STATION GENERATOR		
DRAFTER HJR	DRAFTING CHECK	EPAC JOB NUMBER 4284	SE POWER JOB NUMBER 15016
DESIGNED HJR	DESIGN REVIEW		

TITLE: GENERATOR ELECTRICAL SCHEMATIC

SCALE	DRAWING No	No IN SET	AMDT
NTS	15016-02	2 of 5	B



AS BUILT

DESIGN CHECK

DATE 5-7-05

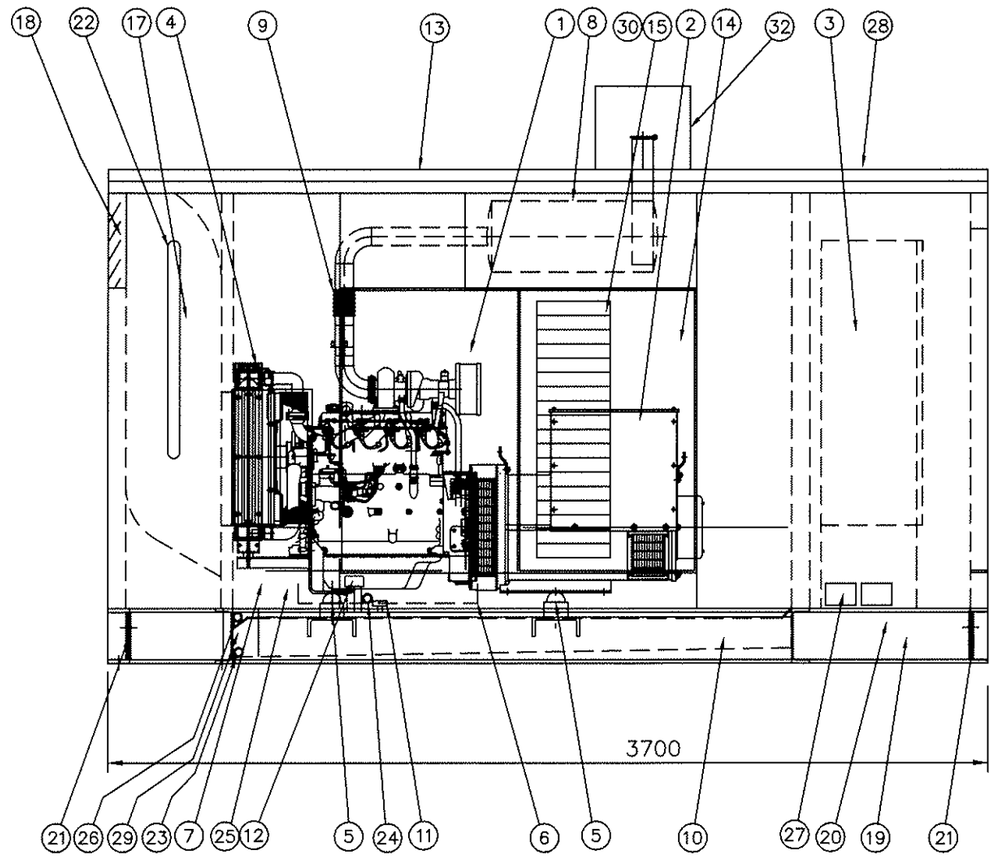
No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	
C					
B					
A	07-03-05				NEW DRAWING
					AMENDMENT

47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

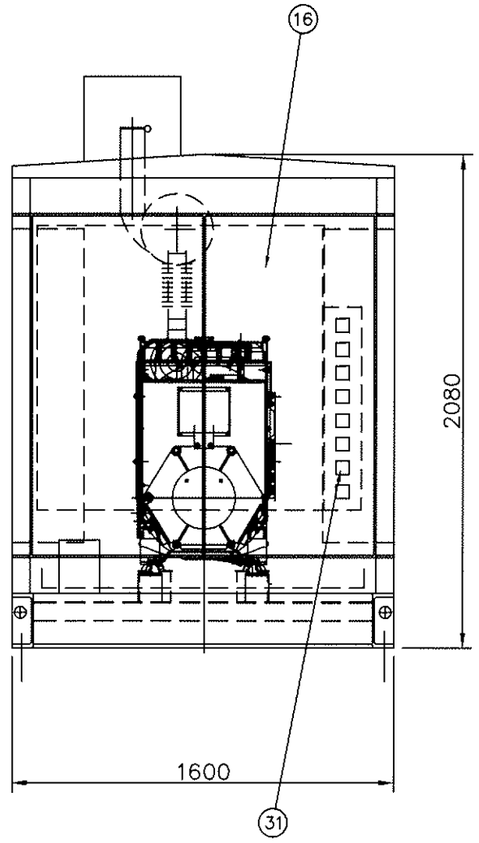
Active 13/12/2013

CLIENT	BRISBANE WATER		
PROJECT	BRISB. WATER PUMP STATION GENERATOR		
DRAFTER HJR	DRAFTING CHECK	EPAC JOB NUMBER 4248	SE POWER JOB NUMBER 15016
DESIGNED HJR	DESIGN REVIEW		

TITLE	GENERATOR ELECTRICAL SCHEMATIC			
SCALE NTS	DRAWING No 15016-02	No IN SET 1 of 5	AMDT A	



SIDE ELEVATION



ALTERNATOR END ELEVATION

LEGEND	
ITEM	DESCRIPTION
1	ENGINE JOHN DEERE 4039T
2	ALTERNATOR STAMFORD UC274E
3	CONTROL SWITCHBOARD
4	RADIATOR
5	A/V MOUNTS (4 OFF)
6	ENGINE DRIP TRAY
7	STARTING BATTERY (382)
8	EXHAUST SILENCER
9	EXHAUST PIPE FLEXIBLE ø75
10	FUEL TANK BASE FRAME 400 L
11	FUEL GAUGE (MECHANICAL)
12	FUEL FILL POINT (INSIDE ENCLOSURE)
13	ACOUSTIC ENCLOSURE (60dbA @ 5m)
14	SIDE ACCESS DOORS (2 OFF)
15	AIR INLET GRILL
16	SWITCHBOARD ACCESS DOOR
17	PLENUM CHAMBER
18	AIR OUTLET GRILL
19	CABLE ENTRY ZONE
20	ANCHOR POINT
21	LIFTING POINTS
22	OUTLET AIR BAFFLE
23	FUEL TANK DRAIN (LOCKABLE)
24	OIL DRAIN (LOCKABLE)
25	RADIATOR DRAIN HOSE
26	CATCHMENT TRAY DRAIN
27	CONTROL BATTERIES 2x12 VOLT
28	BATTERY CHARGING SOLAR PANEL
29	DRAIN POINT LOCKABLE COVER
30	INSECT SCREEN
31	OUTPUT & CONTROL SOCKETS T.B.A.
32	EXHAUST OUTLET PROTECTION CAGE

NOTE
ENCLOSURE COLOUR : MIST GREEN
BASE TANK COLOUR : MIST GREEN

AS BUILT

DESIGN CHECK

DATE 5-7-05

47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744
Fax: (07) 3390 9723

NO.	DATE	AMENDMENT	INITIALS
--	--	--	--
--	--	--	--
A	08.03.05	INITIAL ISSUE	VDR

	R.P.E.Q. NO.	DATE
PRINCIPAL ENGINEER		
MANAGER ENGINEERING		DATE
PRODUCTION / NETWORK DELEGATE		DATE

	NAME	DATE
DESIGN	--	--
DRAWN	VDR	07.03.05
CHECKED	--	--

Brisbane City

JOB FILE	--
ACAD FILE	--
SURVEY No.	
SURVEYED	
FIELD BOOK	
A.H. DATUM	

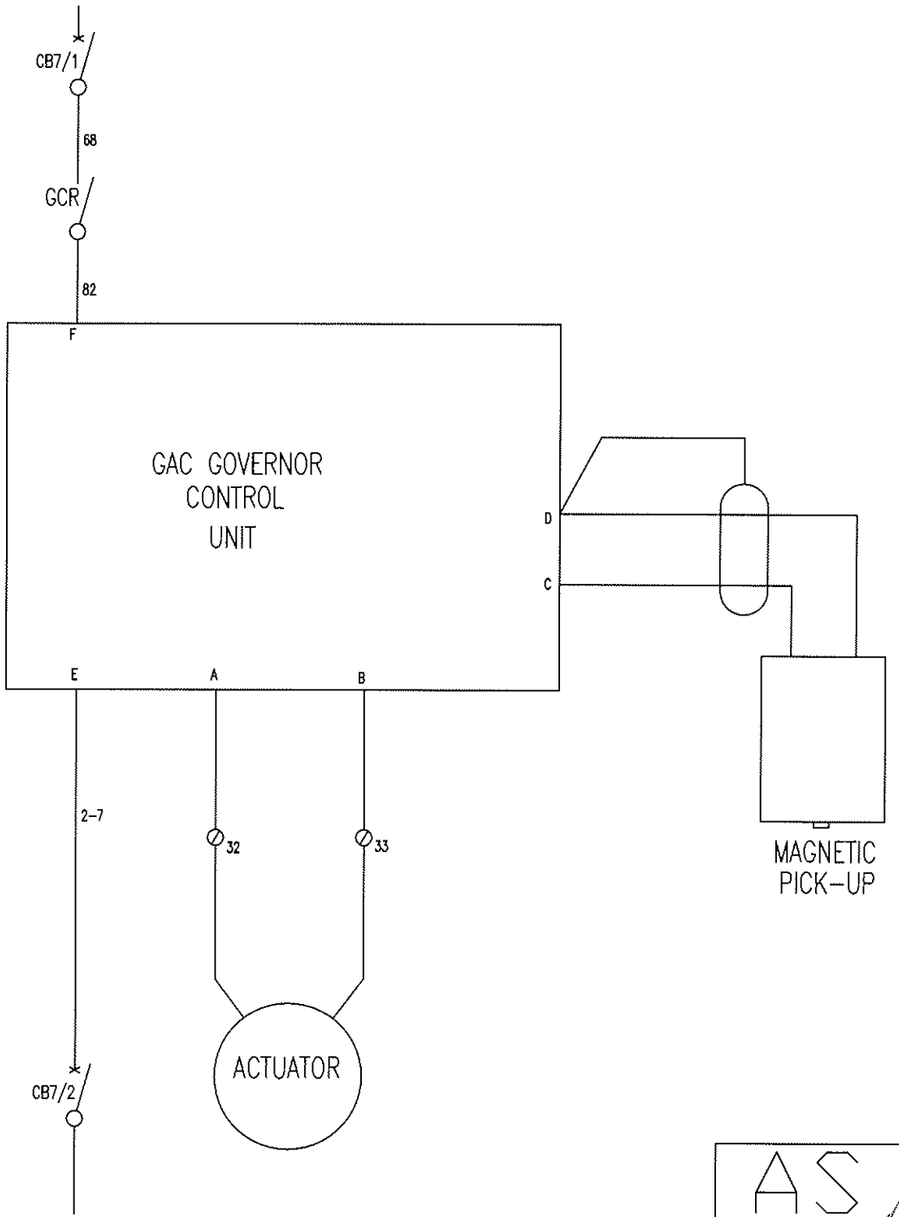
Brisbane Water — Projects + Engineering

PROJECT: BRISBANE WATER SEWAGE PUMP STATION BACKUP GEN SET

TITLE: SP087 ST ACHS RD. ARRANGEMENT

SCALE NTS | N° 1 OF 1 SHEETS

DRAWING N° 05.15016-010 | AMEND. A



AS BUILT

DESIGN CHECK

DATE 5-7-05

No	DATE	DESIGN REVIEW	REV'D P.MGR	APP'D P.MGR	AMENDMENT
C					
B					
A	07-03-05				NEW DRAWING

47 PROPRIETARY ST.
TINGALPA
BRISBANE, QLD. 4173
Phone: (07) 3890 1744

Active 13/12/2013

CLIENT	BRISBANE WATER		
PROJECT	BRISB WATER PUMP STATION GENERATOR		
DRAFTER HJR	DRAFTING CHECK	EPAC JOB NUMBER 4284	SE POWER JOB NUMBER 15016
DESIGNED HJR	DESIGN REVIEW		

TITLE			
GAC GOVERNOR CONTROLS			
SCALE NTS	DRAWING No 15016-02 5 of 5	No IN SET	AMDT A

SP292

Section 7 - Test Reports

INSPECTION & TEST PLAN

SP292 WIRRIBOOT COURT

Generator Sets
For
Brisbane Water
Contract BW. 50081-04/05

SEPE Document No. ITR 15016

Prepared by S E Power
47 Proprietary St., Tingalpa
Brisbane, Qld, 4173
Telephone: (07) 3890 1744

Document Control

REVISION		PREPARED BY	APPROVED BY
C	18.03.05	Paul Hlavka	Jim Pringle

Initials List

All personnel performing tests or signing ITP shall enter their name and sample signature and initials below.

Name **Company** **Signature** **Initials**

DOCUMENT REGISTER

Document No.	Testing	Manufacture / Workshop
010		Fuel Tank and Pipe Testing Schedule
011		Base / Tank Fabrication Procedure
012		Enclosure Fabrication Procedure
013		Engine / Alternator Assembly Procedure
014		Tank Base Assembly Procedure
015		Enclosure Assembly Procedure
	Factory Testing	
016	Electrical Functions Test Sheet	
017	Final Inspection Test Sheet	
018	Factory Load Test	
019	Transient Load Response Test Sheet	
020	Sound Pressure Level Factory Test	
	Site Acceptance Testing	
S016	Electrical Functions Test Sheet	
S017	Final Inspection Test Sheet	
S018	Site Load Test	
S019	Transient Load Response Test Sheet	
S020	Sound Pressure Level Test	

S.E. POWER	**ITP and Procedures**
Subject: Brisbane Water	Sheet 1

1. PURPOSE

1.1 Description of methods and processes involved in the Manufacture, Testing and delivery of the Brisbane Water pump station generators including factory testing of the generators resulting in the production of an ITP.

2. SCOPE

2.1 Detailed design mechanical G/A and electrical schematic.
2.2 Drawing of major components.
2.3 Manufacture skid tank base, switchboard and enclosure.
2.4 Assembly of skid tank base, switchboard and enclosure as approved in drawing package.
2.5 Workshop visual inspection and pre-testing of the works. Including factory testing up to pre commissioning stage.
2.6 Site delivery.
2.7 Site acceptance testing.

3. REFERENCES
3.1 All Design Drawings supplied by S.E. Power.
3.2 S.E. Power ITP and factory test sheets.
3.3 S.E. Power site acceptance testing document and test sheets.

4. DESCRIPTION

4.1 The generators will be tested separately in the workshop.
4.2 The installation of the generators will follow the process of, manufacture, painting, assembly and factory testing.

5. PROCEDURE

5.1 Drawings for comment - One set of completed drawings for Brisbane Water will be issued for comment.
5.2 A schematic showing the calculated design will be issued to Brisbane Water for approval. Following approval of these drawings and return of the “For Comment” drawings, design will proceed.

S.E. POWER	ITP and Procedures
Subject: Brisbane Water	Sheet 1

5.3 Fabrication – Following approval to proceed and any amendments notes marked on the drawings that may affect final approval the sheet metal drawings will be issued for construction to the relative supplier.
5.4 Purchasing of materials – Major components and associated items will be purchased.
5.5 Sheet metal inspection – During construction the generators will be inspected for compliance to the approved drawings and specifications.
5.6 Factory Testing – Factory tests to the requirements of S.E. Power's factory test sheets will be fulfilled..
5.7 Delivery to site – Delivery to site will be via a specialised contractors for all of the generators..
5.8 Installation of generators and cables - By others.
5.9 Site acceptance testing – All installed equipment will be tested to the requirements of the specification prior to the starting of commissioning tests.
5.10 Site Commissioning – All site commissioning will be carried out by BW staff. and S.E. Power will assist with the operation of generators and controls.

S.E. POWER
ITP and Procedures

Subject: Inspection and Test Plan | Sheet 1of 3

INSPECTION AND TEST PLAN – QUALITY STANDARD AS 9001/2002	
Design, Manufacture and Testing	
Client:	Approved By:
Project:	Contract:
Date:	Contract No:
Component:	Site:
Unit: Generators	Technical Spec.

QP No.	Section	Activity	Method or Reference	Acceptance	Inspect		
					SE		BW
1	Drawings	Mechanical Electrical	Specification Standard SE. Procedures	Design Intent			
2	Procurement	Engine Alternator Associated Items	Drawings and Acceptance Practise	Meets Specification and Drawing Components			
3	Manufacturing	Skid Base Enclosures Switchboard	Drawings and Acceptance Practise	Meets Specifications and Drawing Components			
4	Painting	Skid Base Enclosures Switchboard	Specification	Physical Check			
5	Assembly	Skid Base Enclosures Switchboard	SE Procedures	Specification SE Power drawings			
6	Testing	Generator Unit	ITR (Factory Test Sheets)	Specification SE Power drawings			
7	Delivery Site Testing	Place on slab Site acceptance testing	SE SAT Document	As Per Brisbane Water Requirement Specification SE SAT Document acceptance			

Symbols, Abbreviations, Definitions		
O Operational Activity	**V** Verification	**W** Work Instruction
BW Brisbane Water	**W** Witness Point	**QP** Quality Procedure
SE S.E. Power Equipment	H Hold Point	**RC** Release Certificate
	X Manufacture Inspection	**Hold Point** Client Must Inspect
		Witness Point Notify Client of option to inspect item.

47 Proprietary Street
Tingalpa Qld 4073
Ph. 3890 1744
Fax 3390 9723

TRANSIENT LOAD RESPONSE TEST SHEET

Transient Response for Load Changes: Load pf 0.8

% Change Electrical kW	0-25	0-50	0-75	0-100	100-0	75-0	50-0	25-0
Change in Electrical kW			37.5	49.5	49.5	37.5		
% Change Hz			1.9	2.5	2.4	1.3		
% Change Volts			1	3	1	1		
Recovery Secs			3	4	3	2		

52 69

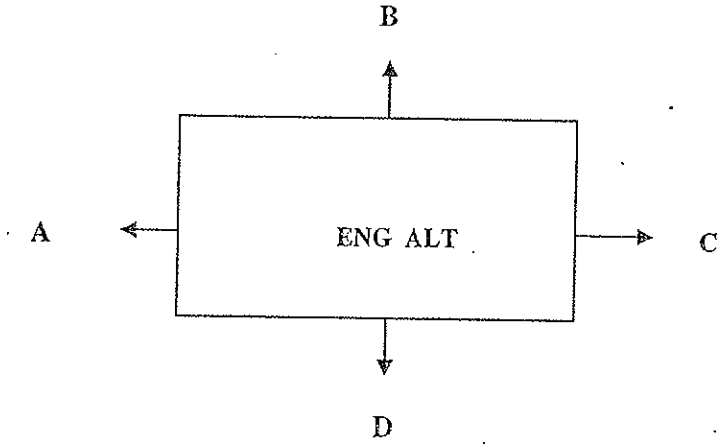
DIESEL GENERATOR SET SOUND PRESSURE LEV(FACTORY TEST REPORT

CLIENT: B/water 292 Wirriboot ct DATE: 16-6-05

JOB NO: 15016 JOB TYPE:

ENGINE TYPE: 4039 T ALTERNATOR TYPE: 274 E

SOUND PRESSURE LEVEL REQUIRED 55 dbA @ 5 m



NO LOAD					FULL LOAD	AMPS			
POSITION	1m	3m	5m	7m	POSITION	1m	3m	5m	7m
A					A			57	
B					B			53	
C					C			51.5	
D					D			53	

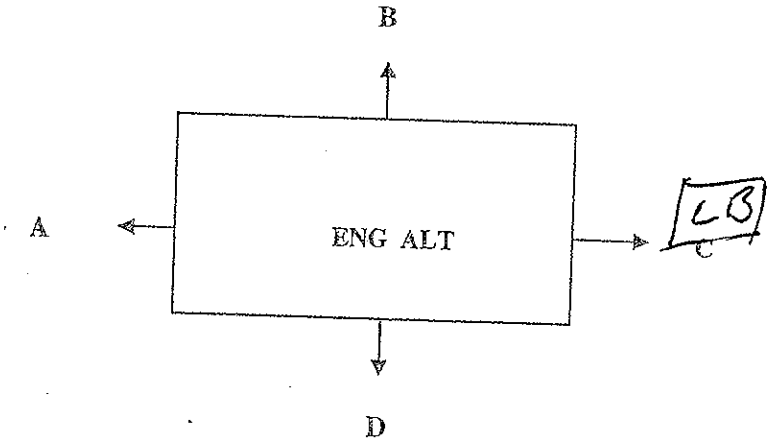
DIESEL GENERATOR SET SOUND PRESSURE LEVEL FACTORY TEST REPORT

CLIENT: B/water DATE: 31-5-05

JOB NO: 15016 JOB TYPE:

ENGINE TYPE: John Deere 4039T ALTERNATOR TYPE: Stamford 274E

SOUND PRESSURE LEVEL REQUIRED [redacted] 55 dbA @ 5 m



NO LOAD					FULL LOAD			AMPS	
POSITION	1m	3m	5m	7m	POSITION	1m	3m	5m	7m
A			55		A			61	
B			55		B			61	
C			56		C			60	
D			55		D			61	

FACTORY LOAD TEST REPORT
Form 018

CLIENT: B/water 292 Wirriboot Crt. DATE: 16-6-05

SERIAL NO: 0505004 JOB NO/CONTRACT NO: 15016

ENGINE TYPE: 4039 T ENG. SERIAL NO: 460721

ALTERNATOR TYPE: 274E ALT. SERIAL NO: X04I 360 364/1

GOVERNOR TYPE: GAC CONTROLLER TYPE:

OVERSPEED TYPE: PLC UNDERSPEED TYPE: PLC

SHUTDOWN SOLENOID: GAC ENGINE SHUTDOWN TEMP: 100 °C

LOW OIL PRESSURE SHUTDOWN: 15 psi

kVA: 154 kW: 61 A @ UNITY PF: 69

TIME	12:00	12:15							
OIL PRESSURE	480	350							
OIL TEMPERATURE	—	—							
JACKET WATER TEMPERATURE	0	70							
AMPS	0	Pump 1 - 58 Pump 2 - 92 total		P1 running run P 2 92 amps		258 V 216 5 V			
LINE VOLTS	240	240		Pump 2 running run P 1		217	✓		
PHASE	415.6	413.3				238.6	V		
AMBIENT TEMPERATURE	25	25							
Hz	50.1	50.1							
LOAD%	0	Pump Start							
BATTERY VOLTAGE CURRENT	—	—							

Code: 30 kw Auto trans. 14.5 % V.D.
(2 X 30) soft starter.

□= Data Recorded

N/A = Not Applicable

N/C = Not Compliant

Signed: E McGregor

Technician Name:

FACTORY LOAD TEST REPORT
Form 018

SP 292 Wimboot Crt.

CLIENT: B/Water
SERIAL NO: 0505004
ENGINE TYPE: John Deere 4039T
ALTERNATOR TYPE: Stamford 274 E
GOVERNOR TYPE: GAC
OVERSPEED TYPE: PLC
SHUTDOWN SOLENOID: GAC
LOW OIL PRESSURE SHUTDOWN: 15 PSI
kVA: 154 kW: 61

DATE: 26-5-05
JOB NO/CONTRACT NO: 15016
ENG. SERIAL NO: 460721
ALT. SERIAL NO: X041 360364/1
CONTROLLER TYPE:
UNDERSPEED TYPE: PLC
ENGINE SHUTDOWN TEMP: 100 °C
A @ UNITY PF: 69 A

TIME	15 min	30 min	30 min	30 min	15 min				
OIL PRESSURE	500	325	325	325	350				
OIL TEMPERATURE	—	—	—	—	—				
JACKET WATER TEMPERATURE	0	75	82	86	72				
AMPS	0	51	69	78	0				
LINE VOLTS	240	240	240	240	240				
PHASE	415.7	414.7	415.1	415	415.2				
AMBIENT TEMPERATURE	25	25	26	26	26				
Hz	50.1	50.1	50.1	50.1	50.3				
LOAD%	0	75%	100%	110	0				
BATTERY VOLTAGE CURRENT									

Code:

□= Data Recorded

N/A = Not Applicable

N/C = Not Compliant

Signed: G M "Gregor" 26-5-05

Technician Name:

SE POWER

ELECTRICAL FUNCTION TEST SHEET
AS 3000 WIRING RULES
FACTORY ITP Form 016

CLIENT: B/Water
SERIAL NO: 0505004
ENGINE TYPE: John Deere 4039T
ALTERNATOR TYPE: Stamford 274E
CONTROLLER TYPE:

DATE: 24-5-05
JOB NO: 15016
ENG. SERIAL NO: 460721
ALT. SERIAL NO: X041360364/1

SP 292

GENERATOR CONTROL FUNCTIONS	CODE	COMMENTS
CB Tripped / Alt. Overload		—
Genset Running	ok	
MEN Fault	ok	
Remote Start / Stop	ok	Start ok STOP ok
Engine High Temp. Alarm	ok	96 c°
Engine High Temp. Shutdown	ok	101 "
Low Water Level Alarm	ok	shutdown ok
Low Oil Pressure Alarm	ok	20 P.S.I.
Low Oil Pressure Shutdown	ok	15 "
Start Fail Alarm	ok	3 Attempts
Status Lamps / Controls	ok	
Emergency Stop	ok	Sftboard – Genset ok
Lamp Test	OK	
Fuel Low – Refill Needed	ok	Low ok Refill ok
Fuel Empty	ok	
Starter Motor Relay	ok	
Underspeed Shut Down	ok	1350 rpm
Overspeed Shut Down	ok	1800 rpm
Alarm Shut Down	OK	
Alt. Undervolts	ok	190 V
Alt. Overvolts	ok	270 V
Charger AC Failed	ok	
Control Batt. Low Volts	ok	
Start Batt. Low Volts	ok	
Engine Gauges	ok	
Enclosure Doors Open	ok	
Alternator High Temperature		—
Audible Alarm / Mute	ok	Mute ok
Remote ATS Controls		—

Code:
☐= Data Recorded
N/A = Not Applicable
N/C = Not Compliant

Signed: W McGregor
Technician Name:
24-5-05

SP292

Section 9 - General

ELECTREX

FLASH
FLASH ET

Instructions
English

CE ELECTREX hereby declares that its range of products complies with the EMC requirements of Directive 89/336/EEC and also the requirements regulating the energy measurement instruments CEI EN 61326.

1 SAFETY

This instrument was manufactured and tested in compliance with class 2 IEC 1010 and VDE 411 standards, in accordance with group B VDE 0110 standards for operating voltages lower or equal to 250 VACrms phase neutral.
In order to maintain this condition and to ensure safe operation, the user must comply with the indications and markings contained in the following instructions:
When the instrument is received, before beginning installation, check that it is still intact and no damage was incurred during transport.
Ensure that the operating voltage and mains voltage set are the same and then proceed with installation.
The power supply must not be earth connected.
The instrument is not fitted with a protection fuse on the power supply, thus the installer must care for the protection.
Maintenance and/or repairs must be carried out only by qualified, authorized personnel.
If there is ever the suspicion that safe use is no longer possible, the instrument must be taken out of service and precautions taken against any accidental use.
Operation is no longer safe when:
1) There is clearly visible damage.
2) The instrument no longer functions.
3) After lengthy storage in unfavorable conditions.
4) After severe damages incurred during transport.

1.1 OPERATOR SAFETY

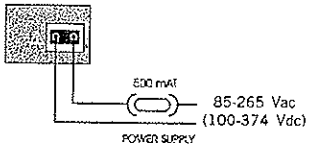
Read these instructions carefully before installing and using the instrument
The instrument described in this user manual is intended for use by properly trained staff only. Maintenance and/or repairs must be carried out only by authorized personnel.
For proper, safe use of the instrument and for maintenance and/or repair, it is essential that the persons instructed to carry out these procedures follow normal safety precautions.

1.2 SIMBOLS

READ THE INSTRUCTION

1.3 POWER SUPPLY

The instrument is fitted with a separated power supply with extended functioning range. The terminals for the power supply are numbered (13 and 14). Max 2,5 mm² cross-section cables must be used.

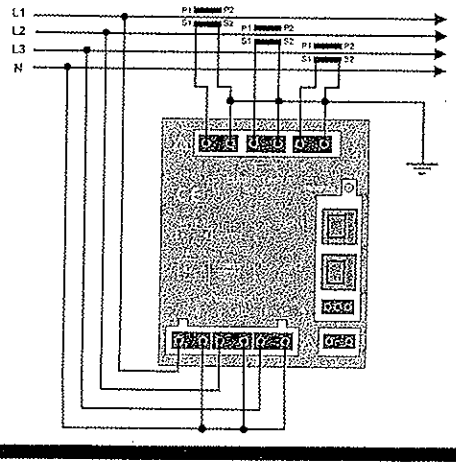


2 VOLTAGE AND CURRENT MEASUREMENT CONNECTIONS

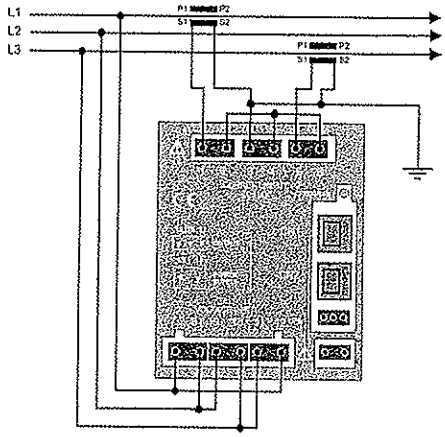
Use cables with max cross-section of 2,5 mm², attach them to the terminals marked with VOLTS INPUT according to the below diagrams. It is necessary to use 3 CT with 5A secondary.
Connect the CT amperometric signal to the terminals marked with CURRENT INPUT according to the below diagrams. Use cables with a cross-section adequate to the CT output and to the distance to be covered. The terminals max cross-section is 2,5 mm².
N.B. The CT secondary must always short circuit when it is not connected to the instrument to avoid damages and risks for the operator.

THE PHASE RELATIONSHIP AMONG VOLTAGE AND CURRENT SIGNALS MUST BE CAREFULLY RESPECTED. Disregard of this rule or of the wiring diagram will result in measurement error.

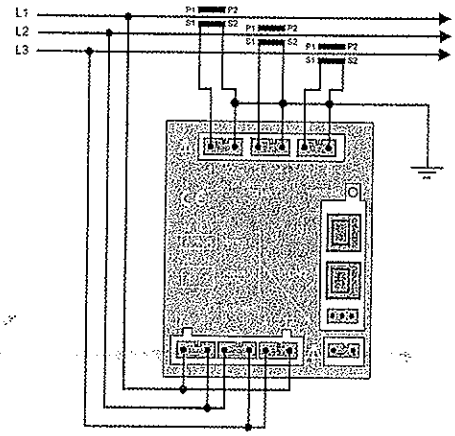
Star Connection



Delta Connection with 2 CTs

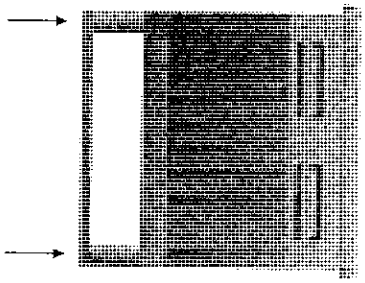


Delta Connection with 3 CTs



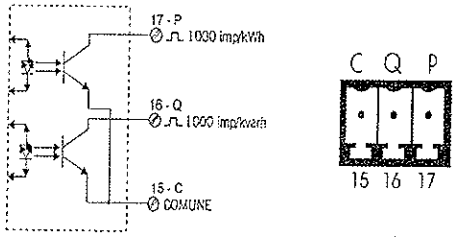
3 FIXING AND LOCKING

The connection terminals of the instrument are held in place by a plastic panel, which must be mounted using four screws (supplied). This set-up will prevent the disconnection of the current measurement terminals.



4 PULSE OUTPUT

The instrument is fitted with two impulse outputs proportional to the active and reactive power. The max cross- section of the cables to be used is 1,5 mm2. Max values 27 Vdc 27 mA. The output location is described in figure.

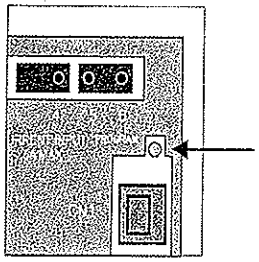


Rev. 04/04

ELECTREX

5 PROGRAMMING MODE

The procedure of instrument's programming allows to set-up the functions' parameters.
To access the programming pages a button 'Program' is available at the instrument rear.



With these 2 buttons ▼ , ▲ it is possible modify the blinking selected field.

On define field either a functioning parameter or a numerical field.

With this button E it is possible to move next page.

With this button U/↑ it is possible to go back previous page.

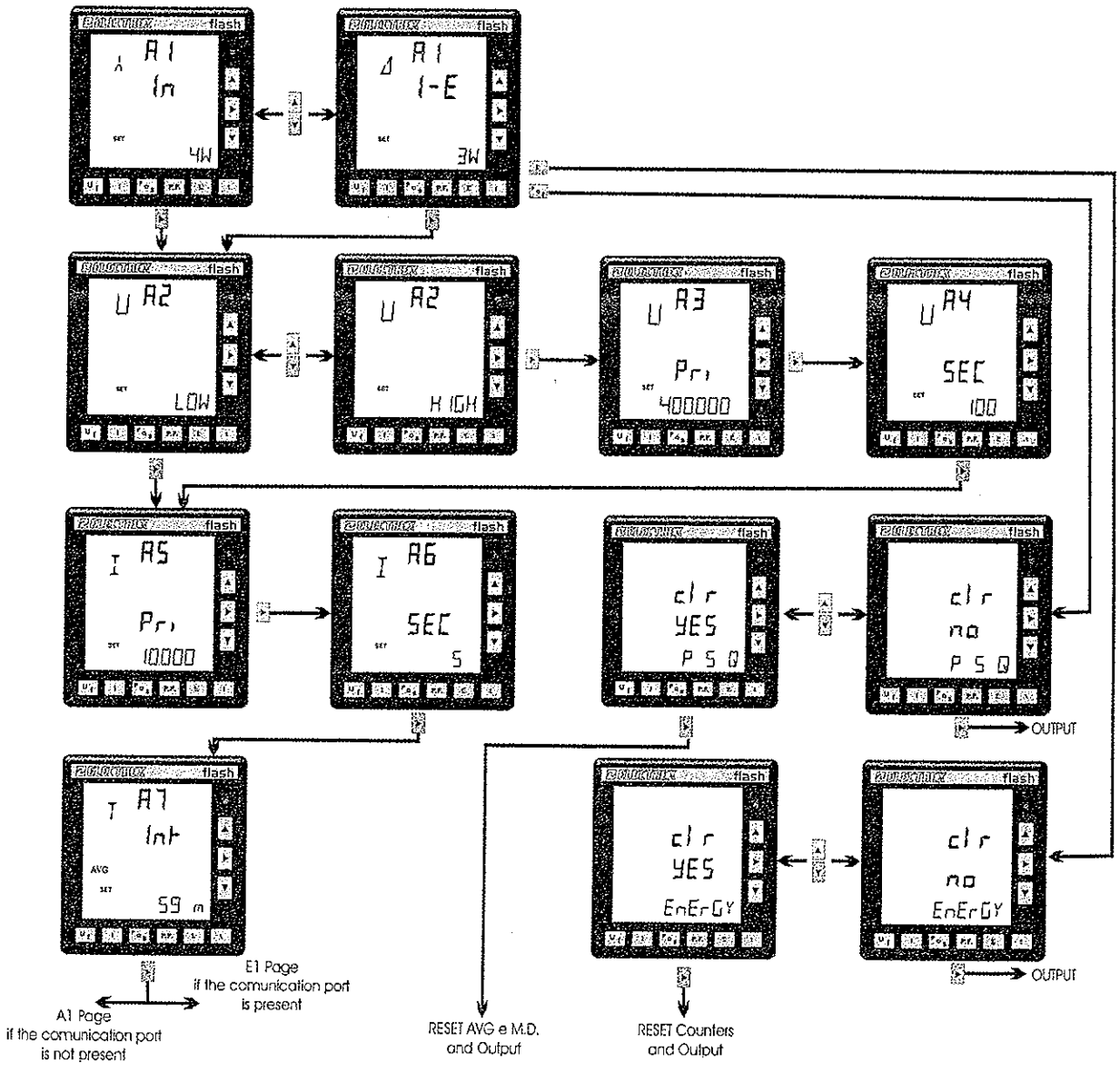
Pressing again the button 'Program' to exit the Set-up allows to memorise parameters.

If at the first programming page, after pressed the button 'Program', on press the button E on enter the counter reset page.

If at the first programming page, after pressed the button 'Program', on press the button P/S on enter the average power reset page and maximum demand reset page.

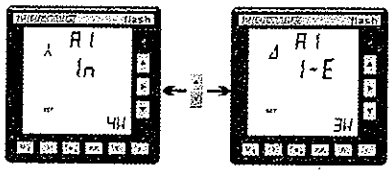
With this button ▶ it is possible to move from a field to another of a page and then move to next page.

6 INSTRUMENT SET-UP



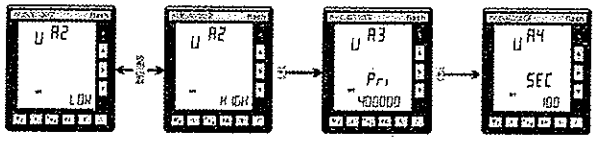
7 INSTRUMENT PROGRAMMING

First programming page allows to set-up network configuration.



At the beginning on choose between just import In or import-export system 1-E.
Then the connection: 4 wires with neutral 4W, star Y or 3 wires without neutral, delta 3W, triangle Δ. Default setting is 4W and just import In.

Next page allows set-up Low or High Voltage and parameters of Potential and Current Trasformer.



After selecting direct LOW on move to page A5, otherwise selecting on move to page A5, otherwise selecting HIGH for Medium or High Voltage, next 2 pages allow programming primary Pri and secondary SEC voltage transformer with reference to the values printed on VT plate.
Default setting is LOW.

Page A5 allows set-up primary Pri and secondary SEC current transformer as printed on CT plate. Default setting is Pri=1 and Sec=1.

Next page allows programming the integration time (from 1 up to 60 minutes) for measure of average power and maximum demand.

Programming in the range from 1 to 60 minutes.

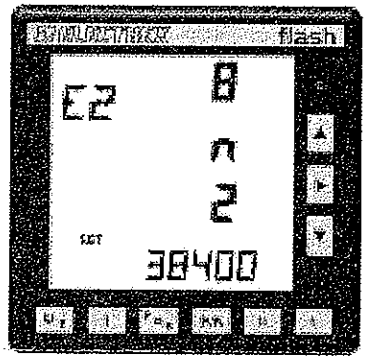
8 RS485 PROGRAMMING

WARNING: ALL MODIFICATIONS TO THE SETTINGS OF THE INSTRUMENT BECOME ACTIVE ONLY WHEN EXITING THE SETTING MENU WITH THE "PROGRAM" PUSH BUTTON ON THE BACK.
The COM port setting pages are following the measuring set uo pages. To join them use the [t] push button to go on from one page to the other and the [U r] push button to go back.

The first page is:

Where:
- E1 is the page identifier.
- 2 is the Modbus Address of the instrument (can be changed)
- 0.10 is a programmable delay in the instrument answere. It is the minimum time from request to answere.
- Modbus protocol comunication.

The second page is:

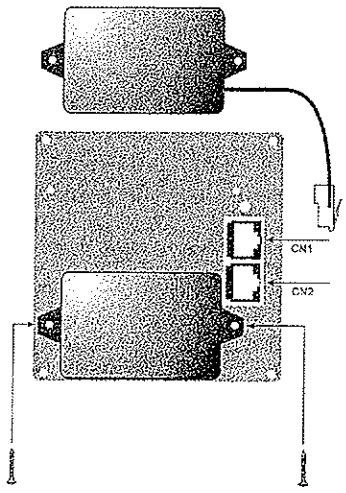


Where:
- E2 is the page identifier
- 8 is the number of bit (Fixed)
- n is the parity (n, O, E)
- 2 is the number of stop bit (1 or 2)
- 38400 is the comunication baud rate (from 2400 up to 38400)

9 CONNECTING OPTIONAL COMPONENTS

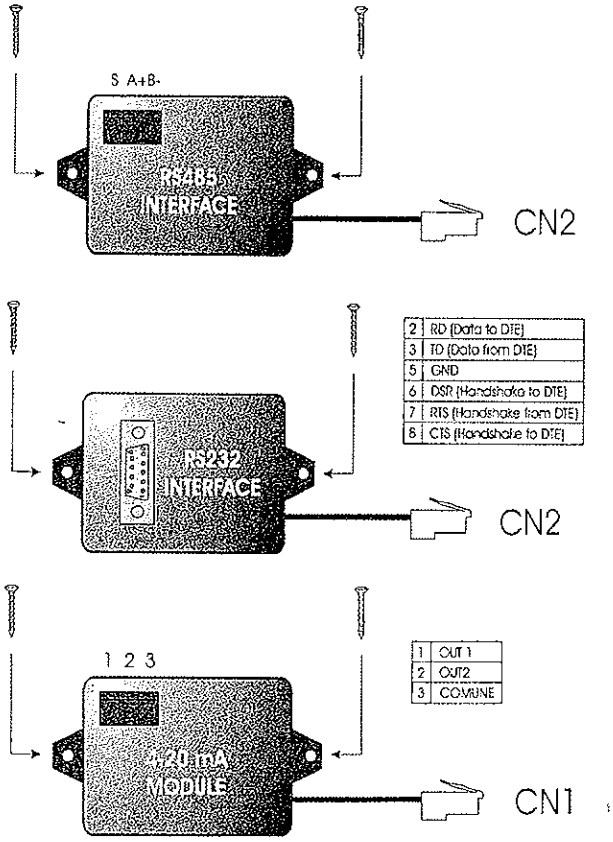
⚠ *All the options must be inserted with the instrument off*

The options of the Flash instrument are fixed mechanically to the back anchor plate of the instrument, where are accessible the RJ45 connectors for the electrical connection. The window concerning the setting of the option characteristics appears only when one of the options is inserted in the instrument.



CN1 = 4-20 mA Module or Hardware Key
CN2 = RS485 Interface or RS232 Interface

ELECTREX



2	RD (Data to DTE)
3	TD (Data from DTE)
5	GND
6	DSR (Handshake to DTE)
7	RTS (Handshake from DTE)
8	CTS (Handshake to DTE)

1	OUT 1
2	OUT2
3	COMUNE

10 HARDWARE KEY

CN1

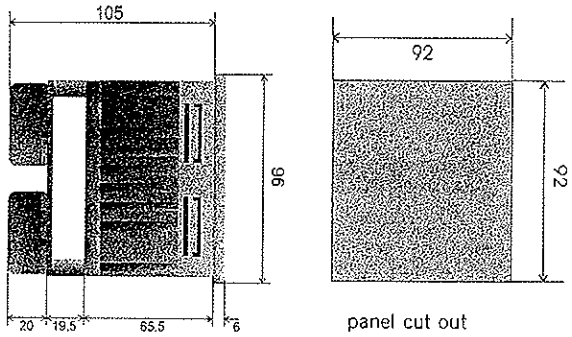
The use of the hardware key allows to the user to add functionalities to the instrument (for example, the key "ET UPGRADE" transforms a Flash in a Flash ET). In order to do so, once the key is inserted into the instrument off, follow the procedure:

1) Turn on the instrument and verify if on the display appears "UPG" (if the key is not valid, it is showed an error message "Error");
2) Wait for the key reading and check the residual credits number (if the number is zero on the display appears "dEniEd");
3) When the instrument is ready to execute the updating, on the display appears "ConFirm" blinking.

Pressing the button ▶, the instrument enables the supplementary functions and updates the key decreasing the credits number.

NOTES: During the updating it is showed "LoAdinG". Pressing any button during the updating, it is showed "AbortEd" and the instrument is not updated. If all the supplementary functions which can be enabled are already active, on the display appears "no nEEd" blinking.

11 DIMENSIONS (MM)



12 TECHNICAL CHARACTERISTICS

Display:	backlit 256 segments 63x65 mm LCD with white electroluminescent lamp.
Measurement sections:	Voltage input: 500 Vrms (max 1,7 crest factor); input overload: 800 Vrms; max 900 Vrms for 1 second; Current input: 5 Arms (1,7 crest factor); input overload: 20 Arms; max 100 Arms for 1 second;
Power supply:	85-265 Vac (100-374 Vdc)
Frequency:	45-65 Hz
Accuracy:	Class 1 on the active power in compliance with CEI EN 61036; 0,5% on the voltage and current measurements; RMS up to the 31st harmonic
Outputs:	2 digital outputs for impulse or alarms (DIN 43864 27 Vdc 27mA - 1000 Imp./kWh)
Protection level:	Front panel = IP51
Temperature Range:	from 0°C to +50°C
Humidity:	Max 90% without condensate
Counters:	power counters with resolution 0,0001 kWh up to 99.999.999,9999 kWh (serial)
Mounting:	96x96mm panel

DEEP SEA ELECTRONICS PLC

5103/5 BATTERY CHARGER

Issue 2
VH 5/7/01

DESCRIPTION

The model 5100 series 3 Amp and 5 Amp **battery chargers** are designed for permanent connection to automotive batteries, maintaining them in a fully charged condition without overcharging. The chargers are also capable of rapidly recharging the batteries at a current up to the full rated output. The charger may also be used to supply a standing load attached to the battery. The charger output may be factory set to account for the standing load.

The charger is designed for reliability, ease of installation and accessibility during routine servicing. It features radio frequency suppression and its smooth output **linear mode design** has a low ripple voltage making the charger suitable for use with electronic equipment.

The charger has both **Overload** and **Short Circuit protection** features, achieved by limiting the current to a safe value during these conditions. It will automatically recover after the condition is removed.

If a short circuit or a severe overload is applied such that the voltage falls below four volts for longer than 10 seconds, then the **Charge Fail Alarm** relay will energise and the charge fail contact will close.

If the charger is inadvertently reverse connected to the battery then the fuse-link on the circuit board will rupture. This should be replaced with a 10A quick blow type.

Note

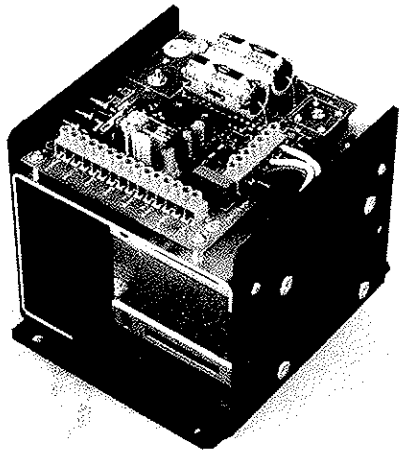
The 'Charger On' LED will illuminate even if the fuse has ruptured.

The **electronic control** circuit ensures that the charger can remain operating during engine cranking and running, operating in parallel with the charge alternator where necessary.

The charger features a **boost charge** facility to enable rapid recharging of discharged batteries or to allow periodic equalisation of battery cells. When the 'boost mode select' terminals are connected together the charger output will rise by 0.35V per cell.

CAUTION!

Boost mode must only be used in accordance with the battery manufacturers instructions otherwise cell damage or an increased maintenance requirement will occur.

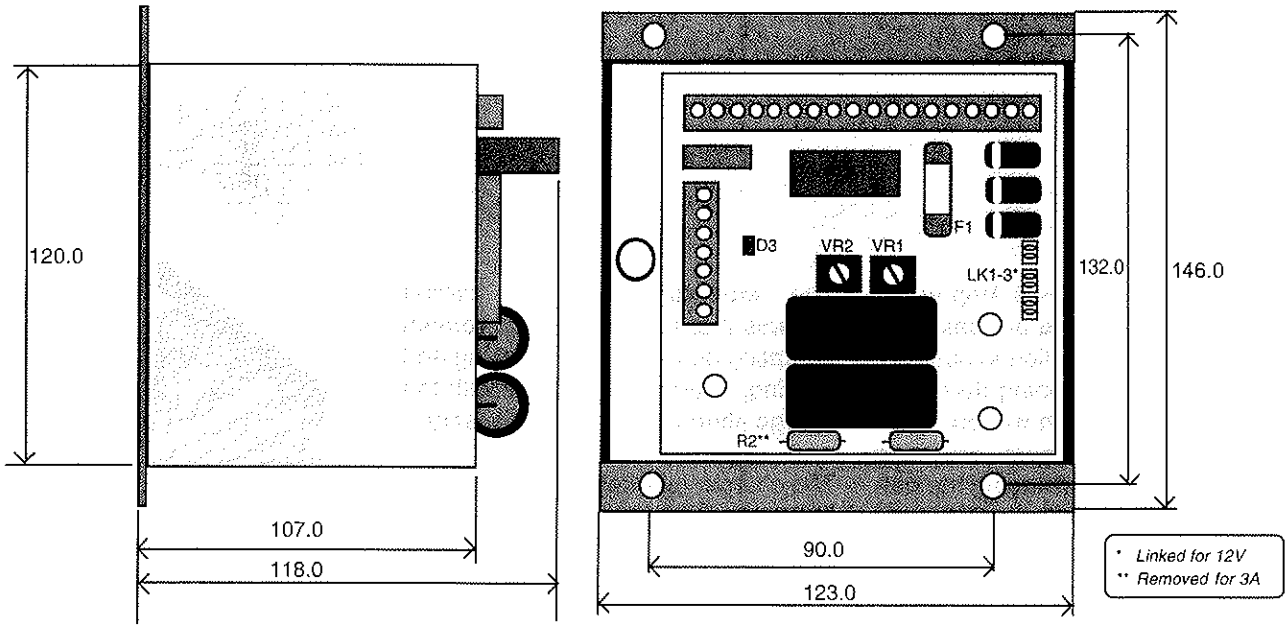


SPECIFICATION

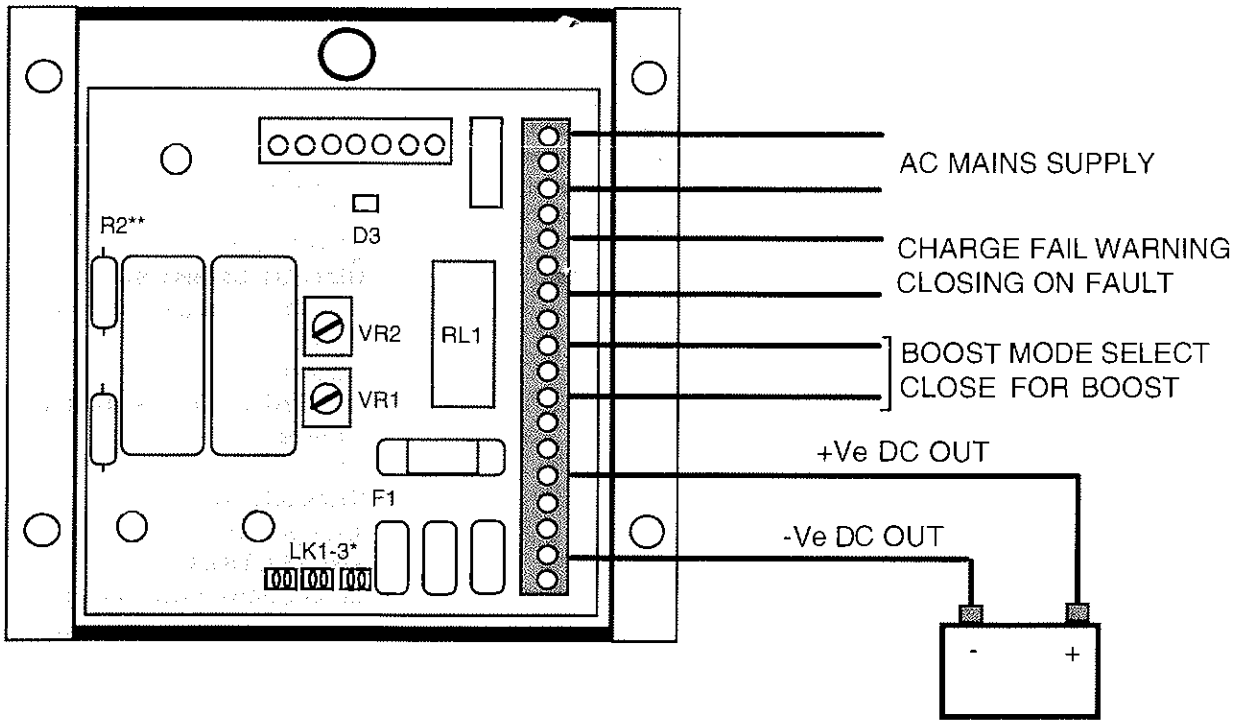
DC OUTPUT:
12 V DC or 24V DC Nominal (specified on ordering)
AC INPUT:
220 - 250 V AC 50/60Hz (Specified on ordering)
OUTPUT CURRENT:
3Amps or 5Amps electronically limited
(specified on ordering).
OPERATING TEMPERATURE RANGE:
-10 to +60°C
INDICATIONS:
'Charger On' LED.
PROTECTIONS:
Short Circuit, Over Voltage, Over-current, Reverse Polarity, Reverse Power
BOOST MODE:
+0.35V per Cell above Float voltage.

OPERATION:
The charger will supply current to the battery until the battery terminal voltage is equal to the set float voltage, at which point only a trickle charge current is present. When the battery voltage falls due to a load being applied and the battery being discharged, the charger will once again supply current to restore the voltage of the battery to the float voltage.

CASE DIMENSIONS



TYPICAL CONNECTIONS



Battery Type	12Volt	24Volt
Lead Acid	13.7V	27.4V
Planté	13.5V	27.0V
Sealed Lead Acid	13.6V	27.2V
Nicad (9 or 18 Cells)	13.0V	26.0V
Nicad (10 or 20 Cells)	14.5V	29.0V

(These are standard settings. Please ensure that the quoted values are suitable for the intended battery. Refer to battery manufacturer for details.)

Deep Sea Electronics plc
Highfield House, Hunmanby Industrial Estate, North Yorkshire, YO14 0PH, England
Tel: +44 (0) 1723 890099 Fax: +44 (0) 1723 893303 E-mail: sales@deepseaplc.com