TECHNICAL MANUAL

OPERATOR AND UNIT MAINTENANCE MANUAL

GENERATOR SET, DIESEL ENGINE DRIVEN, AIR TRANSPORTABLE SKID MTD., 750 KW, 3 PHASE, 4 WIRE, 2400/4160 AND 2200/3800 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
MEP 208A	PRIME UTILITY	50/60	6115-00-450-5881

***This manual supersedes TM 5-6115-604-12/NAFAC P-8-633-12/T.O. 35C2-3-467-1/TM-6115-12/9, 15 June 1985, including all changes.**

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y
3 1 A U G U S T 1 9 9 5

WARNING

MAINTENANCE LOCKOUT switch must be set to the MAINTENANCE position prior to performing any maintenance and reset to OPERATION when maintenance is completed.

WARNING

Batteries generate explosive gases during operation which can cause injury to personnel. Use extreme caution when working on or around batteries. Do not smoke or use open flames in the vicinity when servicing the batteries.

WARNING

Electrolyte contains sulfuric acid which can cause severe burns and injury to personnel. It is highly toxic to the skin, eyes, and respiratory tract. Skin, eyes, and respiratory protection is required to avoid injury to personnel.

WARNING

When necessary to remove batteries use two people as batteries have dry weight of 108 pounds (49 kg) and wet weight of 150 pounds (68 kg) each.

WARNING

DANGER HIGH VOLTAGE

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

WARNING

The radiator gets very hot during operation. Do not remove cap until radiator has reached a point at which there is no built-up steam pressure.

WARNING

The engine exhaust system becomes extremely hot during generator set operation. Do not touch muffler or exhaust pipe when they are hot.

WARNING

The engine exhaust system becomes extremely hot during and immediately after generator set operation. Avoid all physical contact with exhaust system when performing checks and inspection under such conditions.

WARNING

Do not touch exposed electrical connection when circuits are energized. Load cables must be In park position. DC CONTROL and UTILITY POWER CIRCUIT BREAKERS must be deenergized, MAINTENANCE LOCKOUT switch set to MAINTENANCE, and main disconnect switch S120 is set to OPEN be- fore starting any procedure.

WARNING

Avoid contact with any exposed terminals or cables on transformers even when generator set is shut down. Dangerous residual voltages can cause death or injury to personnel.

WARNING

Do not operate the equipment after removing a red tag if it is still tagged with another red tag. Death or injury to personnel could result.

WARNING

Only properly trained and qualified personnel should operate this equipment. Do not operate the generator set unless the chassis ground terminal is connected to a suitable ground. The generator neutral line is ground through a transformer for ground fault protection. The generator neutral line must be grounded. Failure to comply with this warning could cause loss of life and/or severe damage to equipment.

WARNING

Make certain all sets are shut down and that there are no voltages at switch gear terminals being connected to incoming set. Take extreme care not to cross Lo (Neutral) with any of the other phases (L1, L2, or L3). Death by electrocution or severe equipment damage may result from failure to heed this warning.

WARNING

To avoid accidental engine cranking or startup, which could cause Injury to maintenance personnel, place MAINTENANCE LOCKOUT switch S100 in the MAINTENANCE position prior to servicing the generator set. Return switch to the OPERATION position only after completion of service procedures.

WARNING

Dry cleaning solvent P-D-680, Type II, is flammable and toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to prevent injury to personnel.

WARNING

Do not operate the generator set unless it has been properly grounded. Electrical faults (such as leakage paths) in the generator set, feeder lines, or load equipment can cause injury or death by electrocution.

WARNING

Fueling operations generate flammable, toxic fumes. Do not smoke during fueling operations and avoid breathing fumes. Failure to comply with this warning could result in loss of life.

WARNING

Always connect grounding cable from fuel truck to skid ground. This will prevent the possibility of sparking caused by static electricity. Failure to comply with this warning could result in death or injury of personnel.

WARNING

Never remove power cables by hand unless generator set is off and power cables are not connected to a live voltage source. Never touch a high-voltage lead or terminal until it has been discharged to ground. Failure to observe this warning may result in death by electrocution.

WARNING

Hot refueling of generators while they are operating poses a safety hazard and should not be at- tempted. Hot engine surfaces and sparks produced from the engine and generator circuitry are possible sources of ignition. Severe personal injury, death and/or damage to the equipment may result.

WARNING

Do not use a crane with a lifting capacity of less than 45, 000 pounds (20, 400 kg). Do not allow generator set to swing while it is suspended. Personnel must not stand beneath the generator set as it is being lifted. Failure to observe this warning may result in serious injury or death to personnel.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag, and airborne particles. Wear welding goggles with properly tinted lenses, apron or jacket, and gloves to prevent injury to personnel.

WARNING

Paint is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to prevent Injury to personnel.

WARNING

To avoid injury to personnel, do not breathe fumes generated by soldering. Eye protection is required. Remove rings and watches while soldering.

WARNING

Exercise extreme care when heating oil or handling heated oil. Avoid spilling. Heated oil may cause severe burns.

WARNING

Failure to observe and comply with all safety requirements may result in death by electrocution. Maintenance procedures for high voltage equipment are contained in this section. Read and be thoroughly familiar with the safety procedures contained in Chapter 1, Section III, of this manual.

WARNING

Dangerous voltage levels may be present within upper cabinet B. Follow all applicable safety precautions outlined in Chapter 1, Section III, of this manual.

WARNING

Dangerous voltage levels may be present at components located within Cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

WARNING

The fuel tank, even when empty, may contain explosive fumes or vapors. Do not expose tank in vicinity of any source of intense heat. Smoking is prohibited within 50 feet (15 meters) of the work area. Failure to heed this warning may result in death or serious injury.

WARNING

Burns may result If proper care is not used when handling hot lube oil.

WARNING

Compressed air used for cleaning or drying can create airborne particles that enter the eyes. Wearing of goggles is required to avoid injury to personnel.

WARNING

Red core yarns in lifting attachment kit webbing indicate unsafe webbing. Webbing is not safe for lifting generator set if red yarn is visible at any point. Under no circumstances should generator set be lifted using webbing with visible safety indicator strand. Failure to observe this warning may result in loss of life, lifting attachment kit failure, and destruction of generator set.

WARNING

Do not touch exposed electrical connections when circuits are energized. DC CONTROL and UTILITY POWER CIRCUIT BREAKERS must be deenergized and MAINTENANCE LOCKOUT switch S100 set to MAINTENANCE before starting any procedure.

WARNING

Do not attempt to make connections to the control cubicle while generator set is in operation. Death or injury may result from failure to observe this warning.

WARNING

To avoid injury or death to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equip- ment is NOT energized. Residual voltage is present at the generator leads with the generator set shut down, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

WARNING

Disconnect all power and remove outgoing power cables and place in park position before performing inspection.

WARNING

Diesel fuel, while not as volatile as gasoline, will burn when it contacts a sufficiently hot surface or an open flame. Ensure that all hot surfaces under fuel lines to be replaced are covered. Ensure that buckets or pans are provided to catch any spilled fuel. Failure to observe this warning could cause injury to personnel or damage to equipment.

WARNING

Ether is highly flammable and toxic to the skin, eyes, and respiratory tract. Use only in an adequately ventilated area. Skin, eye, and respiratory protection is required to avoid injury to personnel. Do not perform this test on hot engine.

TECHNICAL MANUAL
NO. 9-6115-604-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 AUGUST 1995

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GENERATOR SET, DIESEL ENGINE DRIVEN, AIR TRANSPORTABLE SKID MTD., 750 KW, 3 PHASE, 4 WIRE, 2400/4160 AND 2200/3800 VOLTS

DOD MODEL	CLASS	HERTZ	NSN
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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help Improve this manual. If you find any mistakes or if you know of a way to Improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to Commander, US Army Aviation and Troop Command, ATTN- AMSAT-I-MP, 4300 Goodfellow Blvd., St Louis, MO 63120-1798. A reply will be furnished directly to you.

Distribution Statement A. Approved for public release; distribution is unlimited.

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***This manual supersedes TM 5-6115-604-12/NAVFAC P-8-633-12/T 0. 35C2-3-467-1/TM-6115-12/9, 15 June 1985, including all changes.**

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CHAPTER 1
INTRODUCTION

SECTION I. GENERAL

1-1. SCOPE. This manual is for your use in operating and maintaining the Model MEP208A 750 kilowatt (kW) diesel engine-driven generator set. This manual also contains operation and maintenance instructions for the remote control module (RCM).

1-2. LIMITED APPLICABILITY. Some portions of this publication are not applicable to all services. These portions are prefixed to. Indicate the services to which they pertain (A) for Army and (N) for Navy. Portions not prefixed are applicable to all services.

1-3. MAINTENANCE FORMS AND RECORDS. The forms and records used for maintenance purposes by the various services are specified as follows:

a. (A) Maintenance forms and records used by Army personnel are prescribed by DA PAM 738-750, supplemented by FESA PAM 700-2.

b. (N) Navy users should refer to their service peculiar directives to determine applicable maintenance forms and records to be used.

1-4. REPORTING OF ERRORS. Reporting of errors, omissions, and recommendations for improvement of this publication by the individual user Is encouraged. Reports should be submitted as follows:

a. (A) Army-DA Form 2028 or DA Form 2028-2 located in the back of this manual direct to Commander, U. S. Army Aviation and Troop Command, ATTN AMSAT-I-MP, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798.

b. (N) Navy-by letter directly to. Commanding Officer, U S Navy, Ships Parts Control Center, ATTN: Code 783, Mechanicsburg, PA 17066.

1-5. LEVELS OF MAINTENANCE ACCOMPLISHMENT. The authorized maintenance and repair functions will be accomplished as follows:

a. (A) Army users shall refer to the Maintenance Allocation Chart (MAC) for tasks and levels of maintenance to be performed.

b. (N) Navy users shall determine their maintenance levels in accordance with their services directives.

1-6. (A) DESTRUCTION OF ARMY MATERIEL. Destruction of materiel to prevent enemy use will be in accordance with the requirements of TM 750-244-3 (Procedures For Destruction of Equipment to Prevent Enemy Use).

1-7. (A) ADMINISTRATIVE STORAGE. Detailed information pertaining to administrative storage for the various service is contained In the following documents: Administrative Storage, TM 740-90-1, is applicable to Army personnel; Processing and Inspection of Aerospace Ground Equipment for Storage and Shipment.

1-8. PREPARATION FOR SHIPMENT AND STORAGE. The requirements pertaining to the preparation for shipment and storage for the following documents.

a. (A) Army-Refer to TB 740-97-2, TM 740-90-1, and TM 43-0156.

b. (N) Navy refer to individual service directives for requirements.

SECTION II. DESCRIPTION AND DATA

1-9. DESCRIPTION.

a. General. The generator set (see Figure 1-1 through Figure 1-8) Is an enclosed, diesel engine-driven, prime utility (Type II) unit, producing 750 kW, at 60 Hertz (Hz), 625 kW at 50 Hz, 0 8 power factor (pf), lagging, with the following output voltages:

(1) For 60 Hz operation. 2400/4160 volts, 3 phase, 4 wire, wye (2400 volts line-to-neutral, 4160 volts line-to-line).
(2) For 50 Hz operation. 2200/3800 volts, 3 phase, 4 wire, wye (2200 volts line-to-neutral, 3800 volts line-to-line).

b. Engine. The engine Is liquid-cooled, 12 cylinder, 2300 cubic inch (37 7 liters) displacement, four-stroke cycle diesel, turbocharged, and aftercooled.

c. Generator. The generator is a brushless, rotating exciter, single bearing, air-cooled, open-drip-proof unit. The generator is directly connected to the engine and delivers 50 Hz, 781 3 kVa at 0 8 power factor at 1500 revolutions per minute (rpm) or 60 Hz, 937.5 kVa at 0 8 power factor at 1800 rpm. The generator is wye connected.

d. Housing. The housing is a weathertight, removable enclosure, bolted to a skid-base. Doors enable access to major components for service or maintenance Air intake an exhaust opening allow set operation with all doors closed. A permanently installed ladder allows access to the roof of the generator set. The roof will support a 200 pound (91 kg) person. Fixed partitions within the housing divide the generator set Into an engine compartment, switchgear compartments (cabinets), and weathertight control compartments (control room).

e. Control Room. The control room has 24 square feet (2.2 square meters) of floor space and Is equipped with lights, exhaust fan, space heaters, and a small desk. Generator controls, on two panels, and engine controls, on a third panel, enable operation of the generator set from the control room.

f. Remote Control. Module (RCM) See Figure 1-9. The remote control module (RCM) is available as an auxiliary unit used In conjunction with the generator set. It allows remote start, stop, monitor, and control of a generator set in single operation or in parallel operation with the like sets from a remote location of up to 100 feet (30 m) away. Details on the operation and maintenance of the RCM are contained in Chapter 5 of this manual.

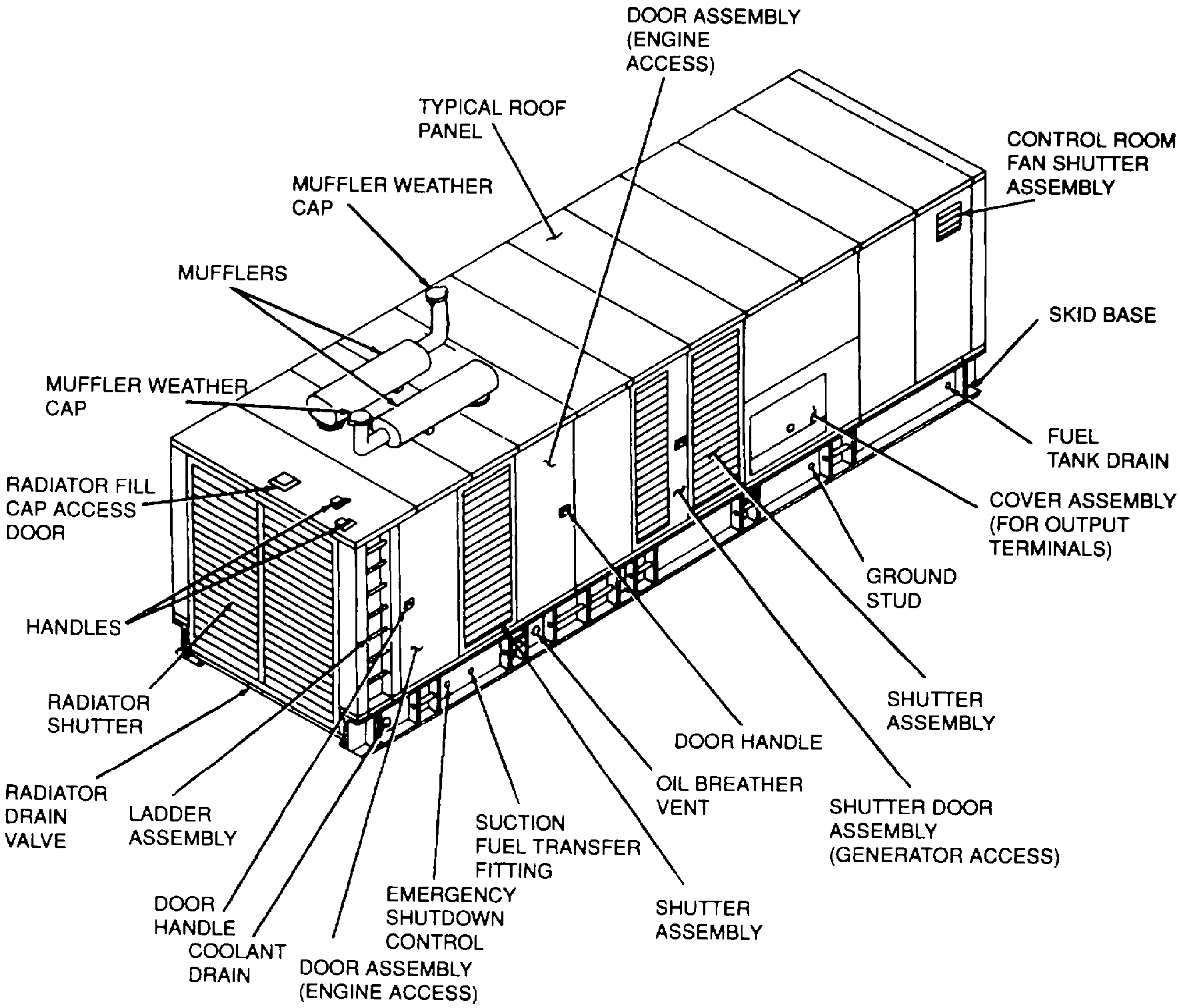


Figure 1-1. Generator Set - Front Three-Quarter View

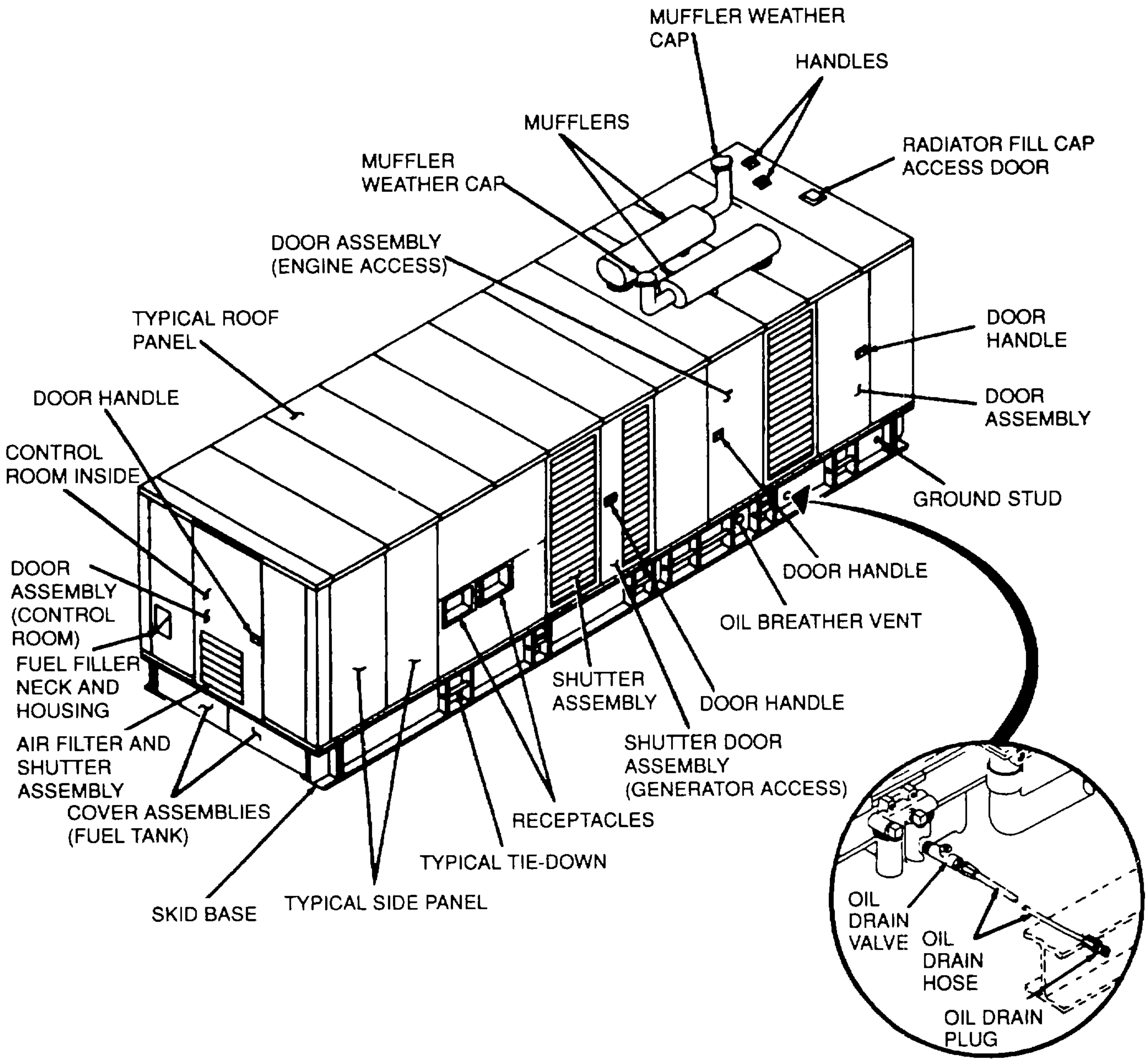


Figure 1-2. Generator Set - Rear Three-Quarter View

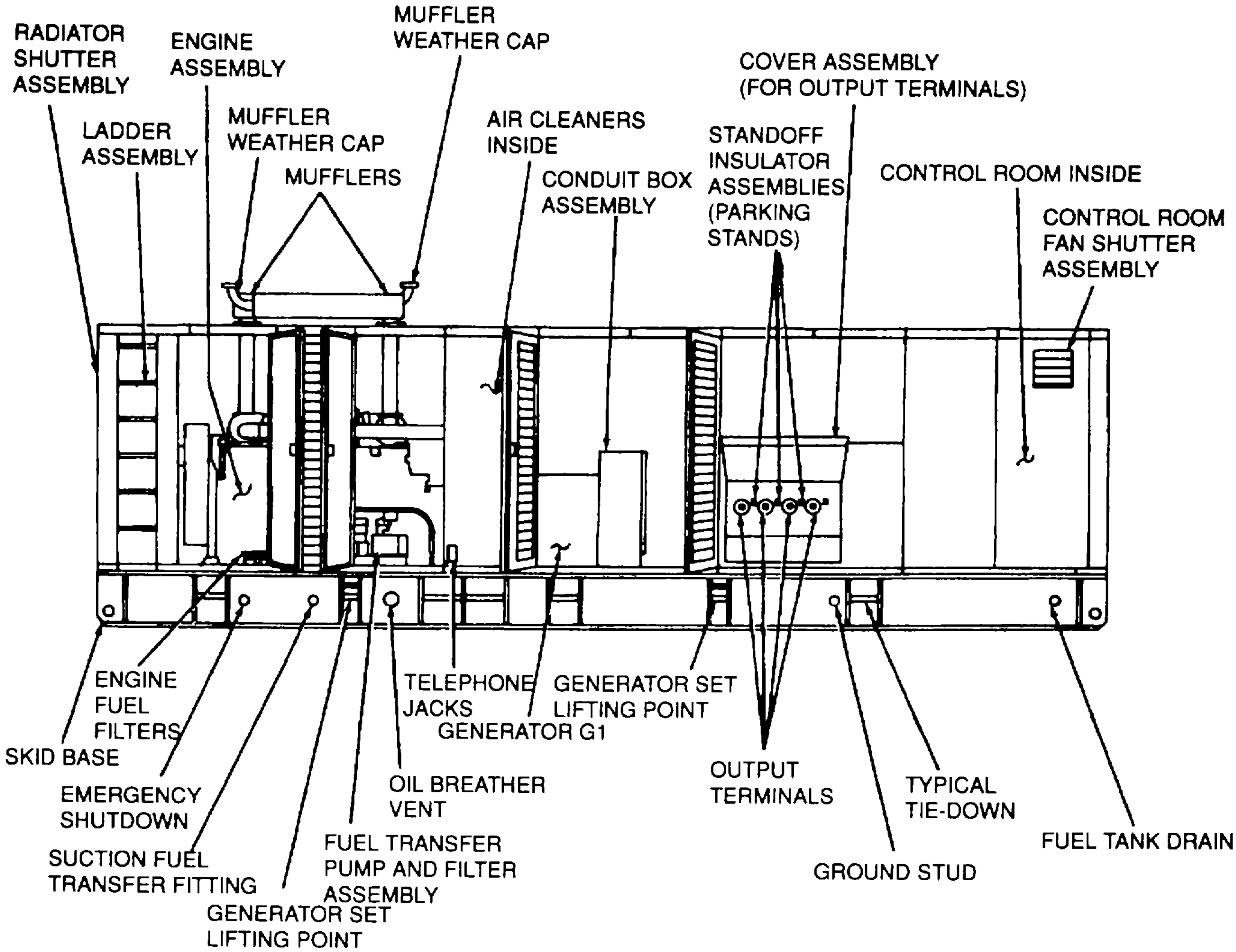


Figure 1-3. Generator Set - Left Side View

1-10. TABULATED DATA. Table 1-1 through Table 1-4, FO-1 through FO-3, and Figure 1-10 through Figure 1-13 provide a concise summary of technical data which is essential for operator and unit maintenance personnel.

a. Location and Informational Content of Identification and Instruction Plates. Refer to Figure 1-10.

b. Schematics. FO-1 is the DC schematic and FO-2 is the AC schematic for the generator set FO-3 IS the RCM schematic.

c. Wiring Diagrams. Foldouts FO-4 through FO-12 are the wiring diagrams for the generator set and remote control module.

d. System Diagrams. Figure 1-11 diagrams the fuel system of the generator set Note that the fuel transfer pump is used to draw fuel from an external source into the generator set fuel tank. Figure 1-12 is a diagram of the cooling system, and Figure 1-13 is a diagram of the lubrication system.

e. System Capacities and Detailed Data and Components. Table 1-1 gives system capacities for the fuel, cooling, and lubrication systems. This table also provides specifications of components in the generator set and the remote control module.

f. Torque and Engineering Data. Table 1-2 gives torque and engineering data essential for the performance of maintenance procedures in this manual.

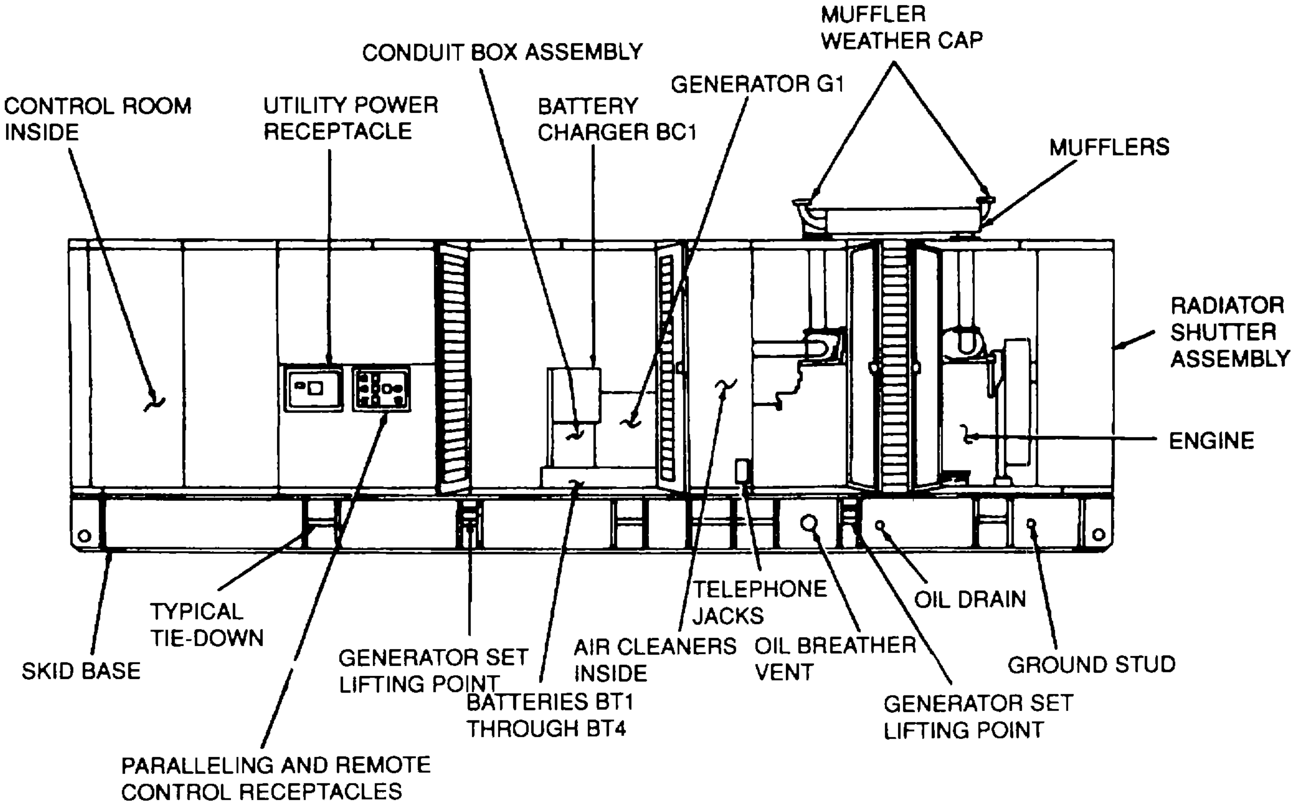


Figure 1-4. Generator Set-Right Side View

g. Clearances. Table 1-3 lists clearances and (where necessary) references illustrations, in the text, that show where the clearances are found. This table is a summary of clearances applicable to the maintenance procedures in this manual.

h. Differences Between Models. There are no differences in models of this unit.

i. (A) Reporting Equipment Improvement Recommendations (EIRs). Equipment Improvement Recommendations (EIRs) will be prepared using DA Form 2407, Maintenance Request. Instructions for preparing EIRs are provided in DA PAM 738-750, supplemented by FESA PAM 700-2, The Army Maintenance Management System. EIRs should be mailed directly to Commander, U. S. Army Aviation and Troop Command, ATTN AMSAT-QX, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

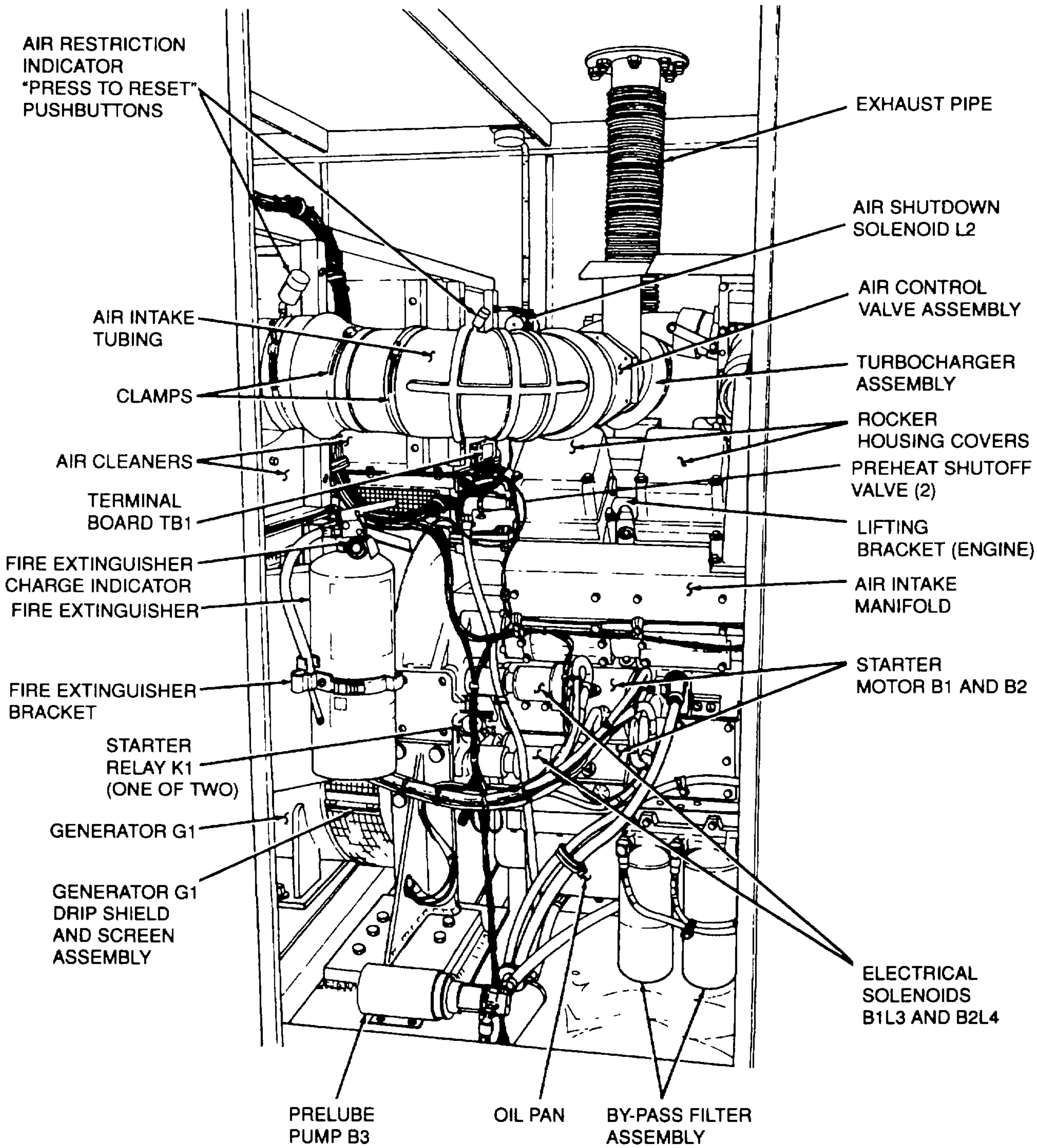


Figure 1-5. Generator Set - View Into Right Rear Side of Engine Compartment

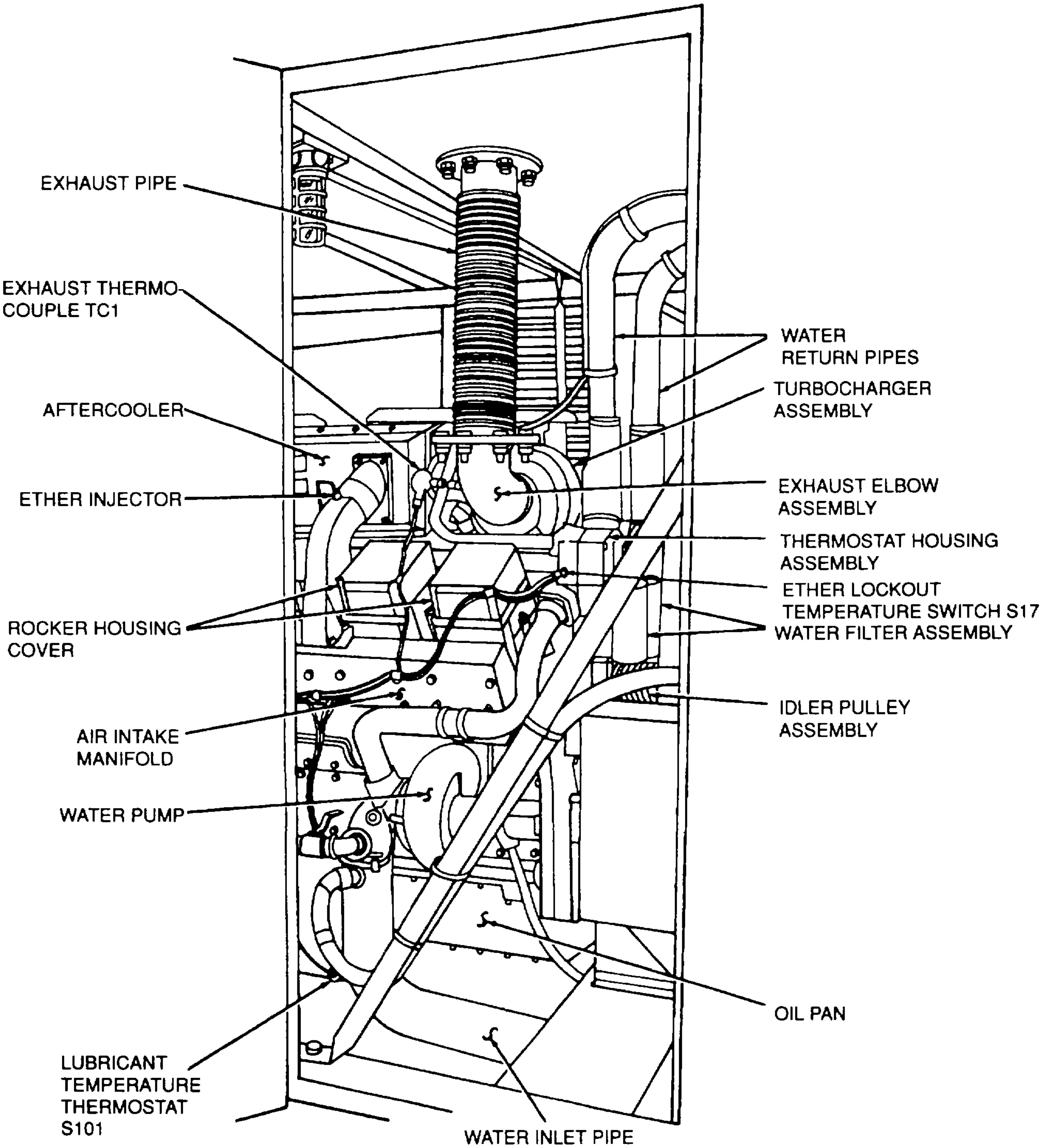


Figure 1-6. Generator Set - View Into Right Front Side of Engine Compartment

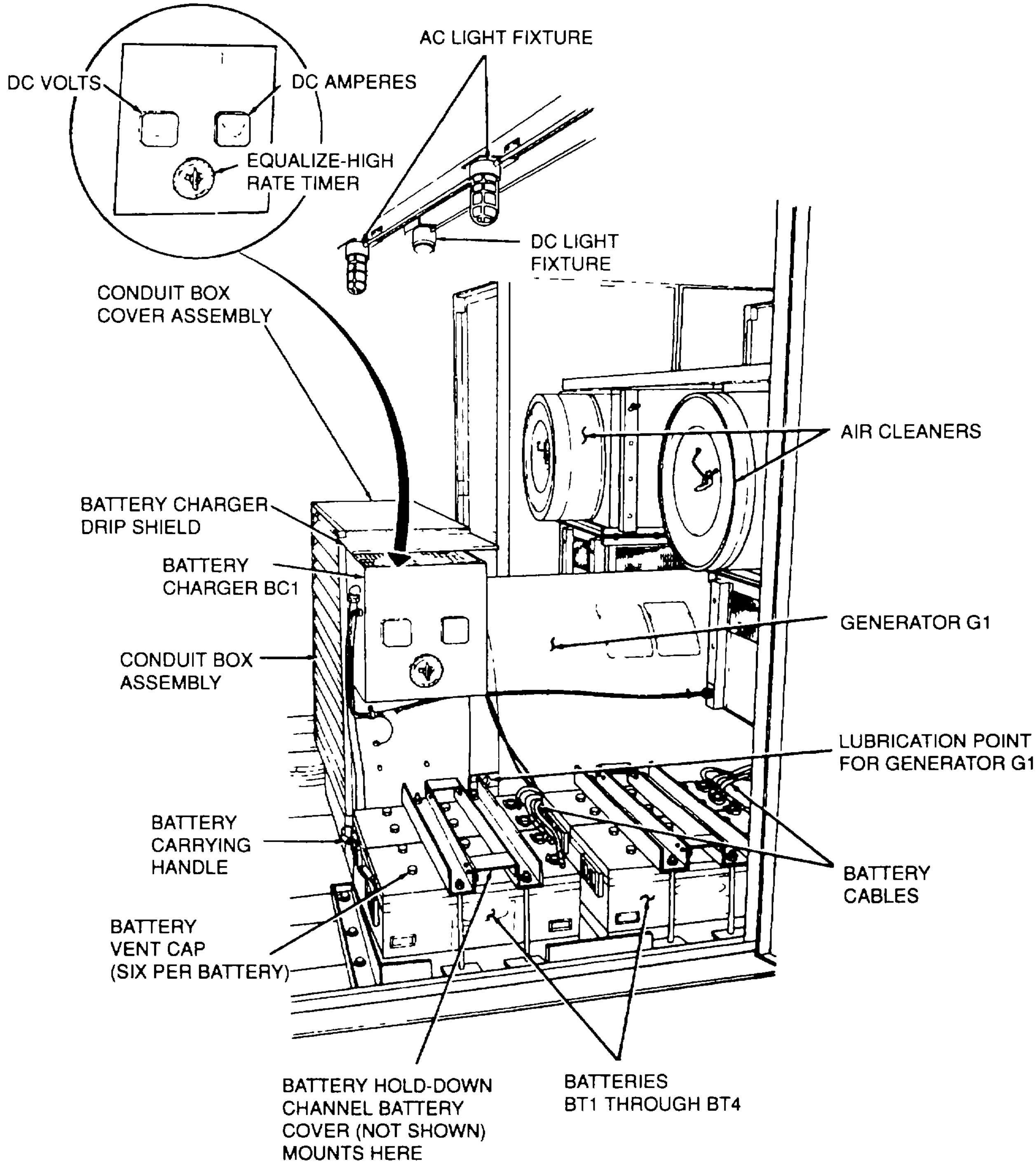


Figure 1-7. Generator Set - View Into Right Side of Generator Compartment

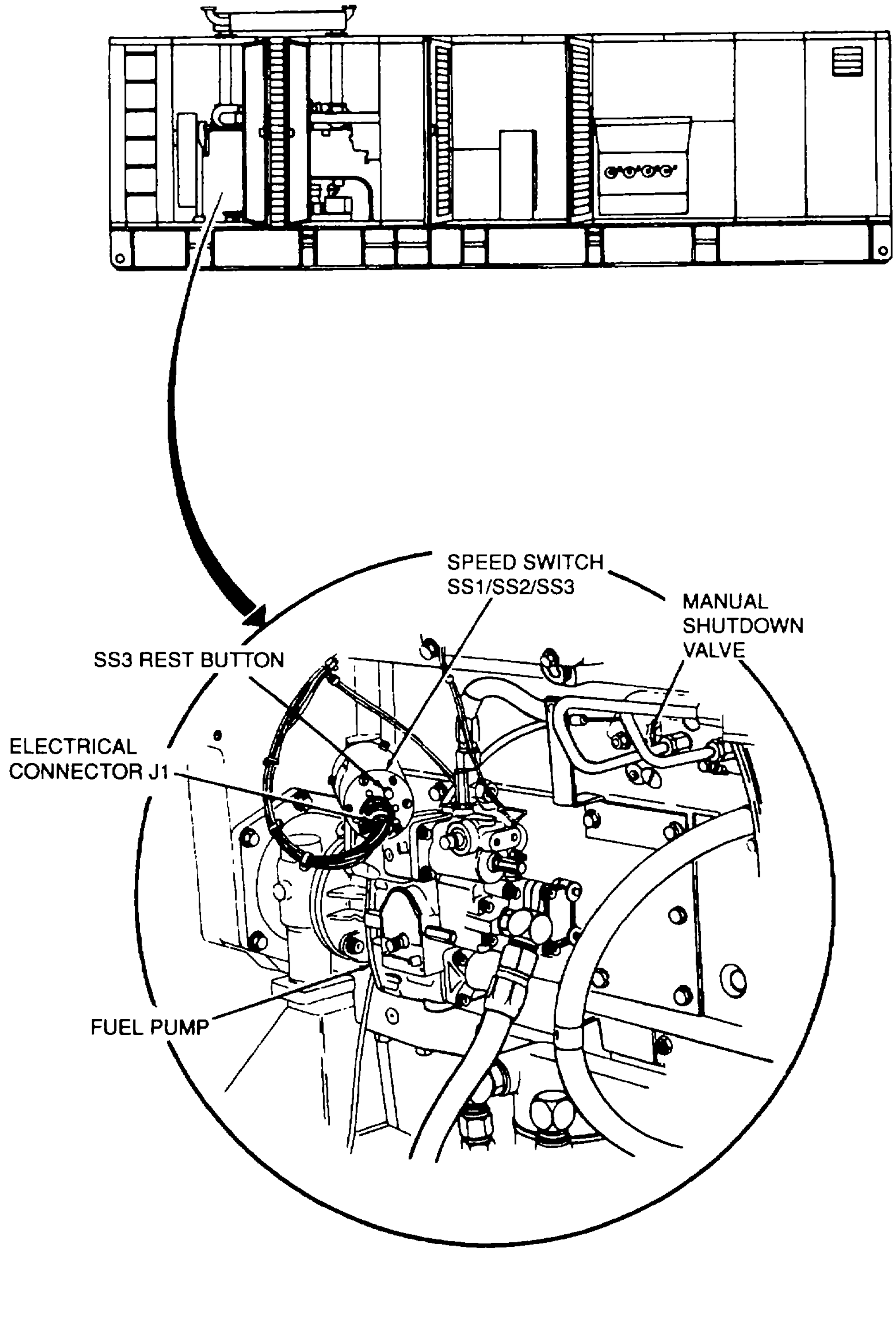


Figure 1-8. Generator Set - View Into Left Side of Engine Compartment (Sheet 1 of 2)

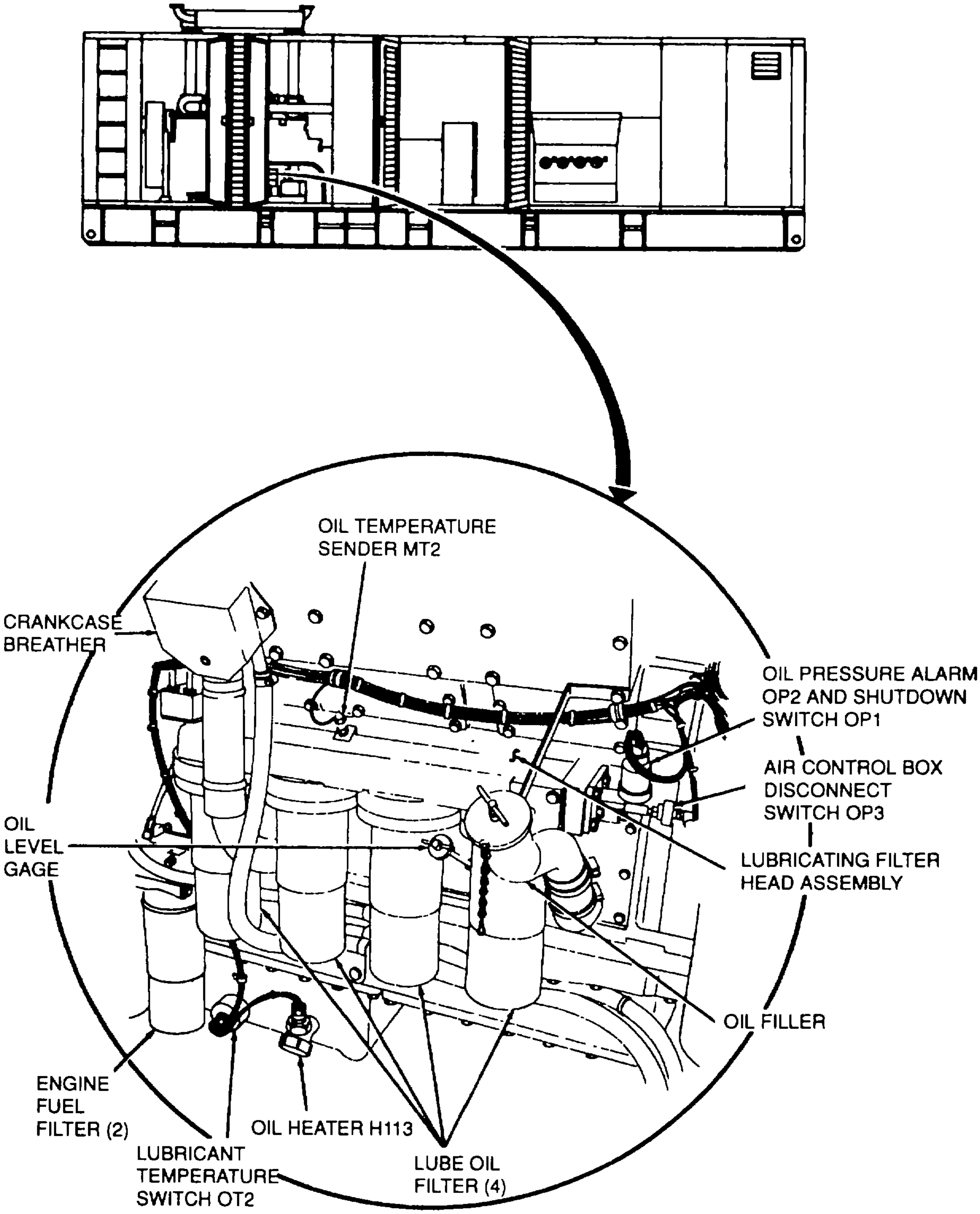


Figure 1-8. Generator Set - View Into Left Side of Engine Compartment (Sheet 2 of 2)

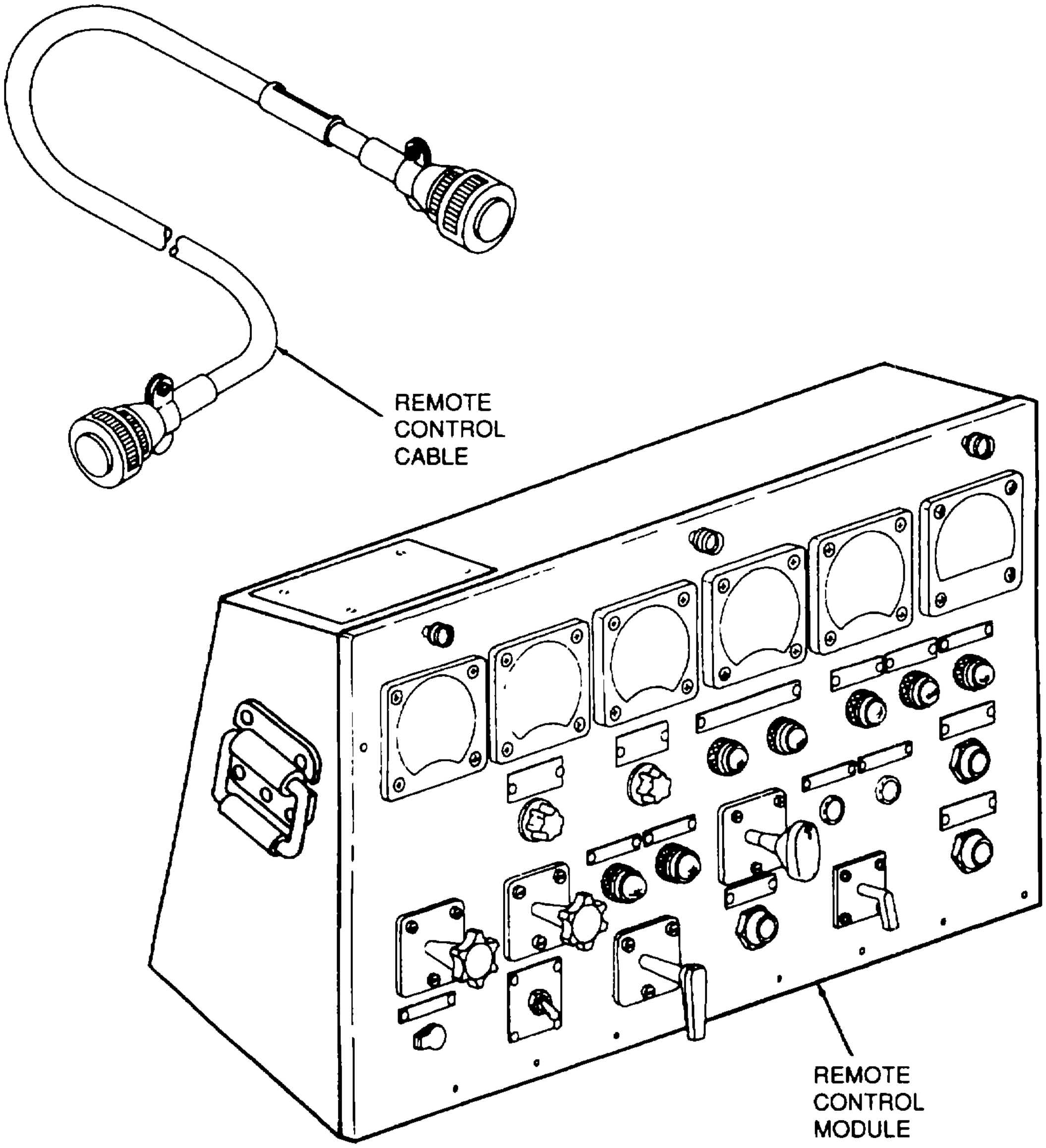


Figure 1-9. Remote Control Module Cable

1 COOLANT DRAIN IDENTIFICATION PLATE
2 EMERGENCY SHUTDOWN IDENTIFICATION PLATE
3 FUEL TRANSFER SUCTION IDENTIFICATION PLATE
4 GROUND STUD IDENTIFICATION PLATE
5 FUEL TANK DRAIN IDENTIFICATION PLATE
6 LIFTING DIAGRAM PLATE
7 GENERATOR SET IDENTIFICATION PLATE
8 OIL DRAIN IDENTIFICATION PLATE
9 GOVERNOR CONTROL
10 REMOTE CONTROL
11 SITE REQUIREMENTMODULE
12 REACTIVE LOAD
13 UTILITY POWER
14 OIL BREATHER VENT

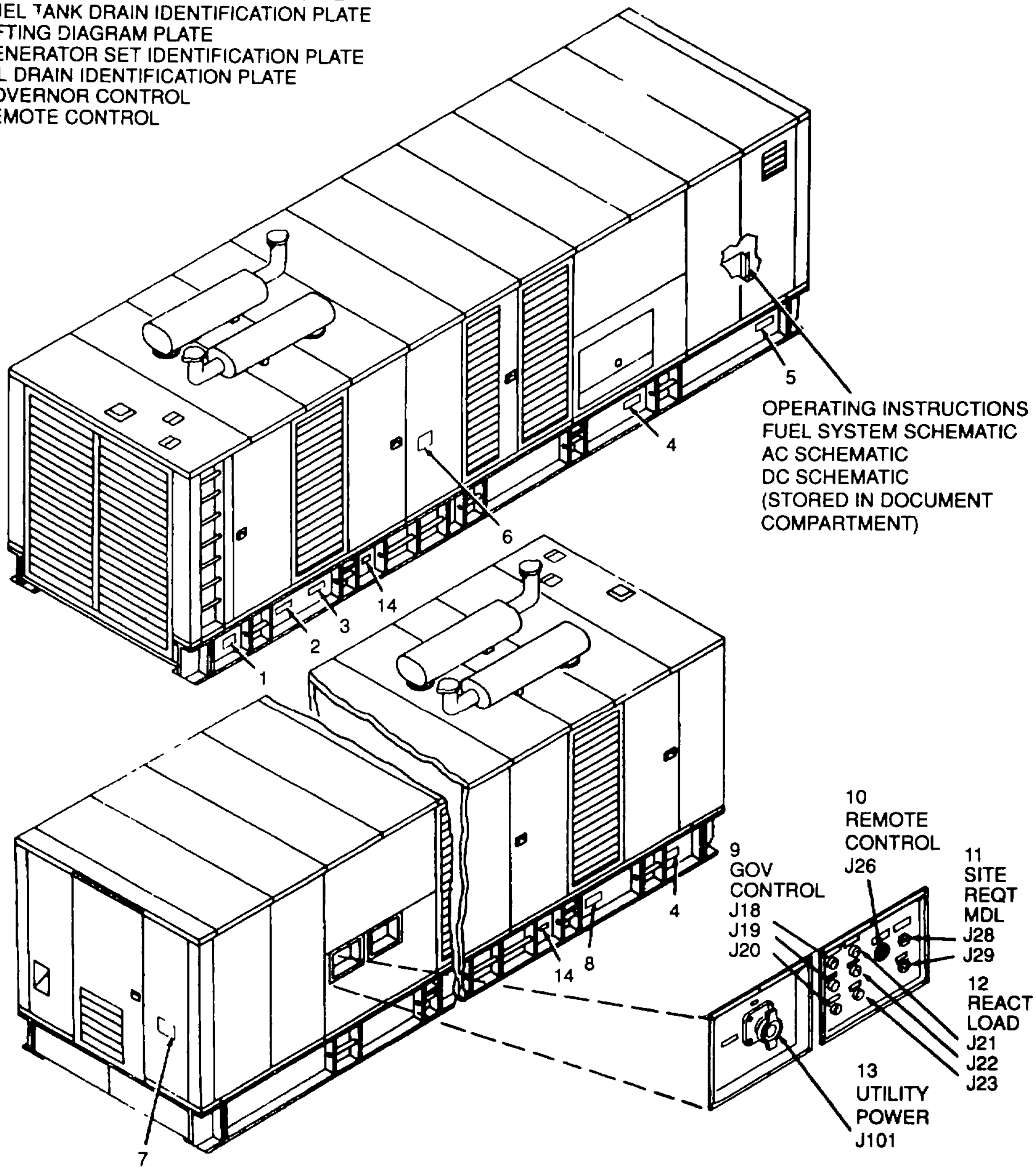


Figure 1-10. Identification and Instruction Plates

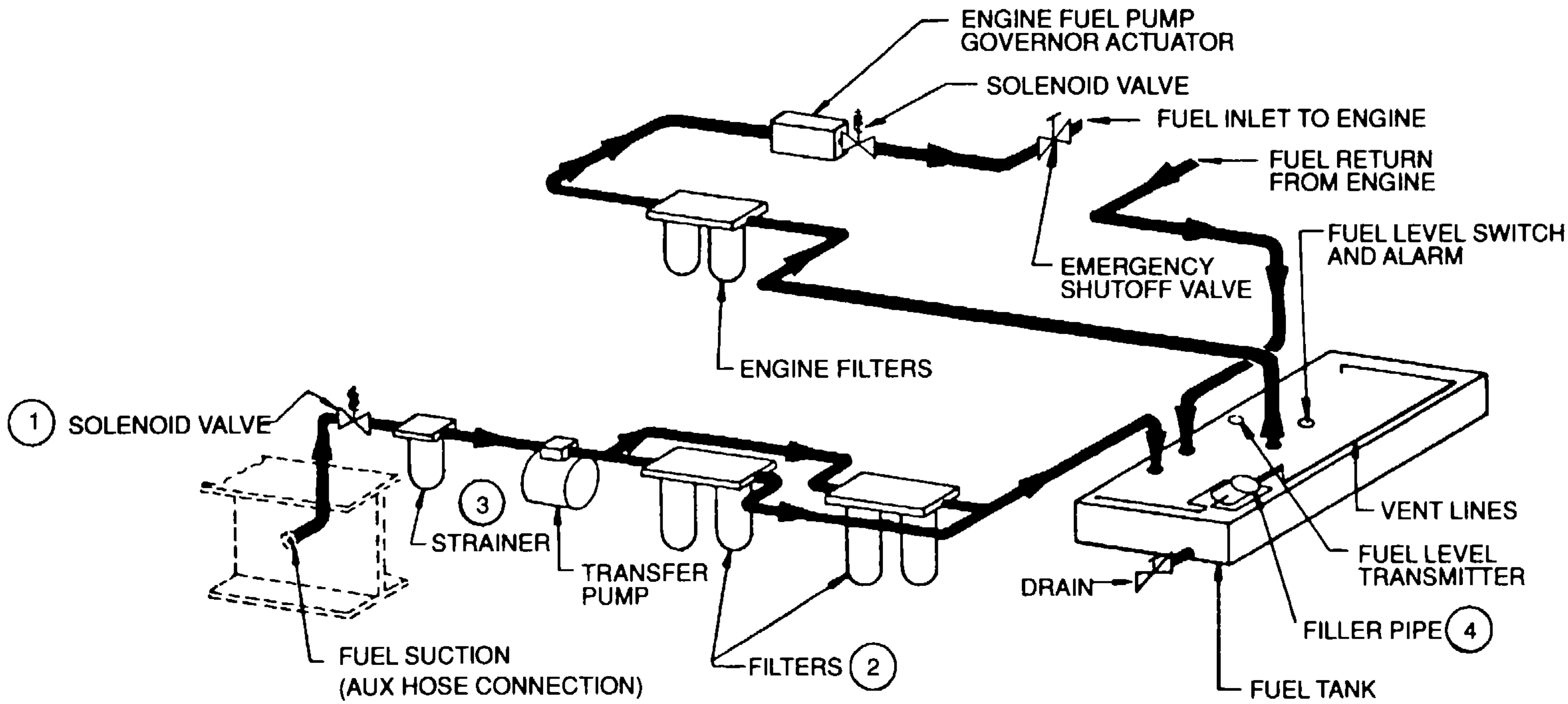


Figure 1-11. Fuel System Diagram

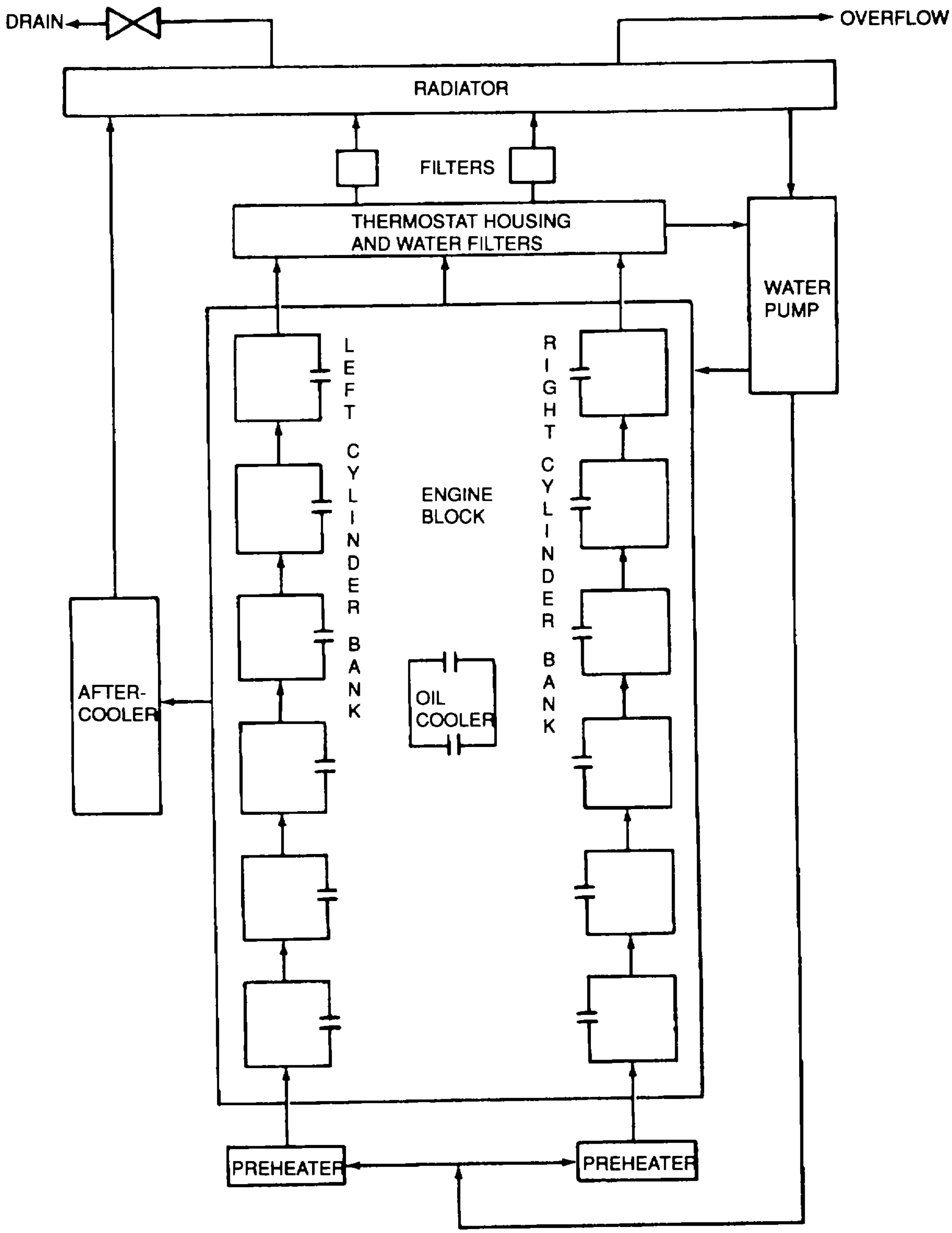


Figure 1-12. Cooling System Block Diagram

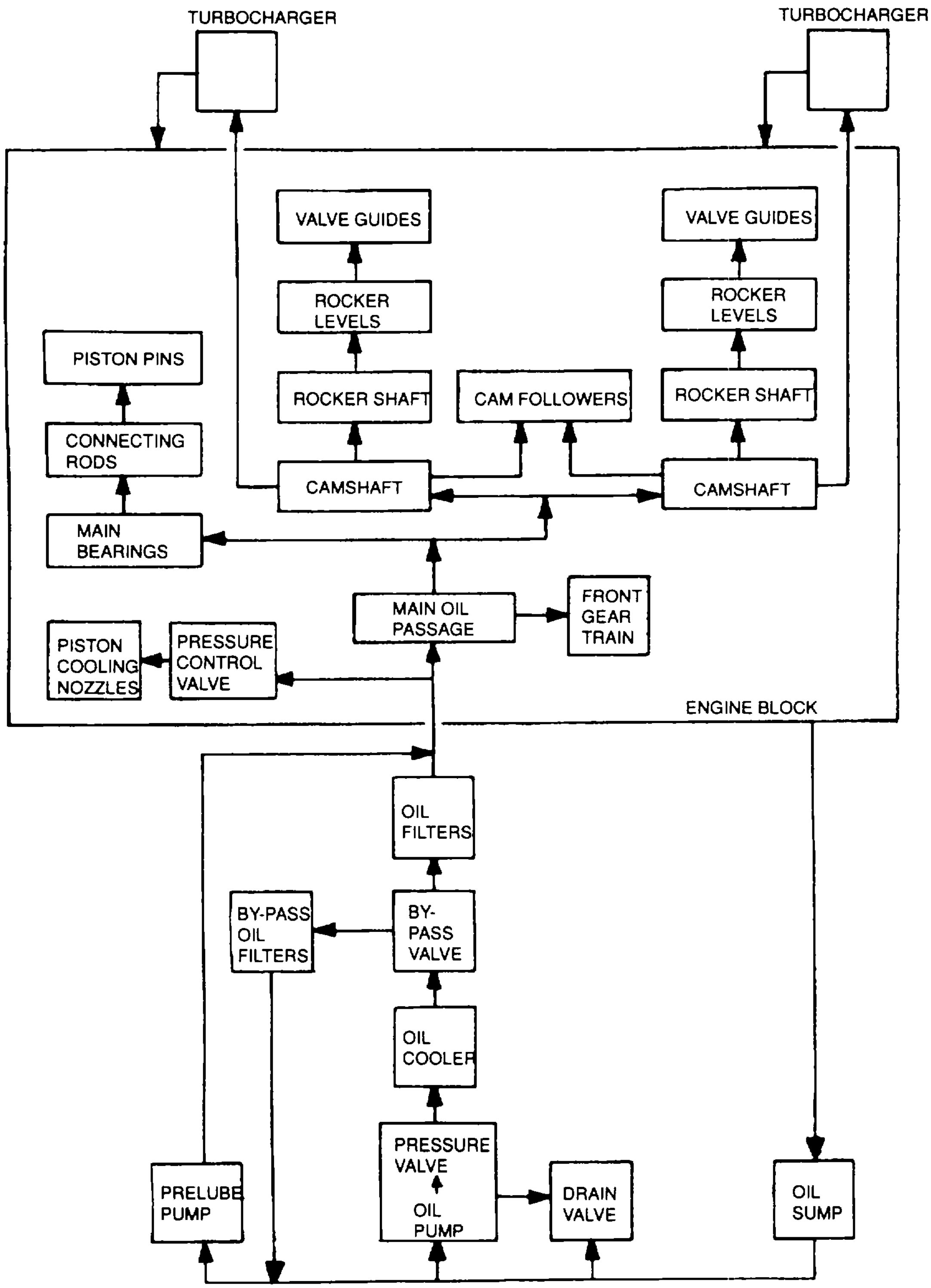


Figure 1-13. Lubrication System Block Diagram

Table 1-1. System Capacities and Detailed Data on Components

Generator Set Manufacturer		Dynamics Corporation of America, Fermont Division
Model	Model	Class
MEP208A	50/60 Hertz	Prime Utility
Operating Temperature Range		-25 to +125°F (-31 to +51°C)
Voltage Output:		
50 Hz:		2200/3800 volts, 3 phase, 4 wire
60 Hz:		2400/4160 volts, 3 phase, 4 wire
Power Factor:		0.8
Capacities:		
Fuel System:		133 6 gallons (505.7 liters)
Tank:		130 gallons (492 liters)
Lines:		3 6 gallons (13.6 liters)
Cooling System:		91.3 gallons (345.6 liters)
Radiator:		51.8 gallons (196.1 liters)
Engine Block:		31.25 gallons (118 3 liters)
Hose:		8 25 gallons (31.2 liters)
Lubricating Oil		36 gallons (136.3 liters)
Crankcase:		
Full:		30 gallons (113.6 liters)
Low:		23 gallons (87.1 liters)
Filter:		6 gallons (22.7 liters)
Dimensions:		
Overall Length:		330 inches (8382 mm)
Overall Width:		96 00 inches (2438.4 mm)
Overall Height: (without mufflers):		100 00 inches (2540 mm)
Net weight (dry):		37, 500 pounds (17,045.5 kg)
Net weight (wet):		39, 600 pounds (18,000 kg)
Engine		
Manufacturer:		Cummins Engine Company, Inc.
Model:		KTA-2300G
Type:		Four stroke cycle, 60° Vee, turbocharged and aftercooled
Number of Cylinders:		12
Displacement:		2300 cubic inches
Engine Power Output (BHP):		1235 at 1800 rpm 1030 at 1500 rpm
1. HOUSING AND BASE ASSEMBLY		
Fire Extinguisher		
Drawing Number:		80-7853
Specifications:		0-E-915, Type I, Class 2, Size 10
Manufacturer:		The Ansul Company
Part Number:		SY1024
FSCM:		03670

Table 1-1. System Capacities and Detailed Data on Components (Continued)

1. HOUSING AND BASE ASSEMBLY-Continued	
Fire Extinguisher	
Drawing Number:	80-7854
Specifications:	Carbon Dioxide Type, 15 pounds (7 kg), charged per MIL-E-24269
Manufacturer	The Ansul Company
Part Number:	17224
FSCM:	03670
Fan and Motor Assembly B103	
Drawing Number:	80-7625
Motor Rating:	115 Vac, single phase, 50/60 Hz, 1/10 horsepower, 1550 rpm
Fan Data :	10.00 diameter die formed steel or aluminum, dynamically balanced
Capacity:	Static Pressure of Water:
(Cubic feet per minute):	0 inch: 830; 0.10 inch: 680; 0.125 inch: 610; 0.250 inch: 375
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Penn Ventilator Company
Part Number:	BG-18F
FSCM:	02013
2. DC ELECTRICAL AND CONTROL SYSTEM	
Storage Batteries BT1 through BT4	
Drawing Number:	76-11252
Specifications:	12 volt, 200 amp hours, 20 hour rate. Conforms to Federal Specification W-B-131-8D, SAE 20T 8A
Manufacturer:	General Battery Corporation
Part Number:	G268D1
FSCM:	08163
Manufacturer:	Prestolite Battery Corporation
Part Number:	8908X
FSCM:	48873
Shielded Cable	
Drawing Number:	80-7963
Material:	Stranded tinned copper, vinyl insulation, clear nylon jacket, tinned copper braid shield, white vinyl jacket.
Capacitance between conductors:	70 pF per foot
Capacitance between one conductor and other conductor connected to shield:	120 pF per foot
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Belden Wire and Cable Company
Part Number:	9952
FSCM:	16428

Table 1-1. System Capacities and Detailed Data on Components (Continued)

2. DC ELECTRIC AND CONTROL SYSTEM-Continued	
Battery Charger BC1	
Drawing Number:	80-7935
Input:	120 V ac, 50/60 Hz, single phase
Output:	24 V dc, 20 amperes (two ranges float at 2.17 V dc per cell and equalize
Automatic AC Line Compensation:	at 2.33 V dc per cell
Mechanical Characteristics:	Automatic overload protection (current limiting), fused ac input and dc
Operating Temperature:	output, automatic surge suppressors -25 to +125°F (-31 to 51 °C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manual Float/Equalizer Time:	0 to 24 hours
Manufacturer:	La Marche Manufacturing Company
Part Number:	A-46-20-24V-A1-040-080
FSCM:	92731
Coolant Temperature Switch WT2	
Drawing Number:	80-7519
Rating:	10 amperes, 28 V dc
Connector:	MS3102R-14S-2P
Cover:	Aluminum, non-sealing
Cartridge:	Brass submersion type-1, vacuum filled assembly and sealed
Circuit:	Two independent double break circuits, normally open, to close on temperature rise.
Mechanical Life:	50, 000 cycles
Operation:	Circuit A and D (normally open) contacts close at 217 ± 2°F (102 ± 2°C) Circuit B and C (normally open) contacts close at 208 ± 2°F (97 ± 2°C).
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	The Nason Company
Part Number:	TC-152-208M/217M-4AN
FSCM:	85814
Coolant Level Switches S13 and S14	
Drawing Number:	80-7650
Voltage Rating:	9 to 32 V dc
Current Rating:	1 ampere, maximum
Response Time:	1 second, typical
Probe Pressure Rating:	100 psi (690 kPa)
Mechanical Characteristics:	Negative ground, low alarm (actuates on loss of liquid), fully encapsulated
Time Delay:	None
Humidity Conditions:	To 100%
Operating Temperature:	-40 to +250°F (-40 to 121°C)
Storage Temperature:	-5 to +155°F (-54 to 68°C)
Manufacturer:	Robert Shaw Control Company
Part Number:	613-NLG
FSCM:	00543

Table 1-1. System Capacities and Detailed Data on Components (Continued)

2. DC ELECTRIC AND CONTROL SYSTEM (CONTINUED)	
Lubricant Temperature Switch OT2	
Drawing Number:	80-7520
Rating:	10 amperes, 28 V dc
Connector:	MS3102R-14S-2P
Cover:	Aluminum, non-sealing
Cartridge:	Brass submersion type-1, vacuum filled at assembly and sealed
Circuit:	Double break circuit, normally open contact to close on increasing temperature
Operation:	Circuit A and D not used, circuits B and C (normally open) close at 245 ± 3°F (117 ± 3°C)
Manufacturer:	The Nason Company
Part Number:	TC-150-245M-4AN
FSCM:	85814
Oil Pressure Alarm and Shut Down Switch OP1 and OP2	
Drawing Number:	80-7518
Contact Rating:	10 amperes, 28 V dc resistive
Switch Configuration:	Two circuits, normally closed
Pressure Range:	500 psi (3448 kPa), maximum
Material:	A Housing molded glass filled nylon or steel B. Base. steel, with 0.125 NPT fitting copper brazed and cadmium plated
Pressure Setting:	
A-D Circuit:	Close at 39 ± 2 psi (269 ± 2 kPa)
B-C Circuit:	Close at 30 ± 2 psi (207 ± 2 kPa)
Life:	50, 000 cycles
Temperature Range:	A-25 to +125°F (-31 to 51°C) operating B.-65 to +155°F (-53 to 68°C) storage
Humidity Conditions:	To 100%
Manufacturer:	The Nason Company
Part Number:	SP-2BB-39-30-FA
FSCM:	85814
Speed Switch SS1/SS2/SS3	
Drawing Number:	70-1105-5
Material:	Container cadmium plated per QQ-P-416, Type II, Class 2
Elements No 1 and 2:	Automatic reset at 100 rpm maximum below trip speed
Elements No. 3:	Manual reset
Contact Rating:	
Element No 1:	4 amperes inductive at 24 V dc, 2 amperes inductive at 32 V dc
Elements No 2 and 3:	10 amperes inductive at 28 V dc
Temperature Range:	-5 to +1600F (-53 to 700C)
Interchangeability:	-1 and-3, -2 and 4; are Inter-changeable On-3 and-4 switches only: in order to check trip speed, apply 24 V dc to the switch, terminal E shall be positive and the case negative.

Table 1-1. System Capacities and Detailed Data on Components (Continued)

2. DC ELECTRIC AND CONTROL SYSTEM (CONTINUED)	
Manufacturer:	Synchro Start Products
Part Number:	
60 Hz, Dash No-5:	SA-2485-3D08
FSCM:	78388
MAINTENANCE LOCKOUT Switch S100	
Drawing Number:	80-7859
Electrical Characteristics:	240 V ac, 225 amperes, non-automatic trip 10, 000 amperes interrupting capacity UL listed conforming to Federal Specification WC-375B
Number of Poles:	3
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-5 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	General Electric Company
Part Number:	TQD32Y225LL
FSCM:	28432
24 VDC CONTROL POWER Circuit Breaker CB1	
Drawing Number:	80-7637
Voltage:	: 120 V ac
Drawing Number:	80-7637-01 80-7637-02
Trip Current:	15 20
Part Number:	EB1015L EB1020L
Poles:	One
Specifications:	Per Federal Specification WC-375
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Westinghouse Electric Company
Part Number:	
Model-01:	EB1015L
Model-02:	EB1020L
FSCM:	89946
Fuel Level Switches FL1 and FL2	
Drawing Number:	80-7533
Electrical Rating:	0.5 ampere resistive or Inductive (UP-0.026) at 6 to 32 V dc or 10 watts at 100 to 220 V ac
Operating Pressure:	0 to 150 psi (0 to 1034 kPa)
Operating Medium:	Diesel fuel -0.849 specific gravity JP-4 -0 775 specific gravity Gasoline -0 742 specific gravity
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	The Air Flow Instrument Company
Part Number:	8048-100-2
FSCM:	06102

Table 1-1. System Capacities and Detailed Data on Components (Continued)

2. DC ELECTRIC AND CONTROL SYSTEM (CONTINUED)	
Liquid Quantity Transmitter MT4	
Drawing Number:	80-7531
Procurement Specification:	Shall conform to MS500040, Unit 2, Type I, Class I with dimension as follows: A. 8.75 B. 0. 50 C. 4.58/4 38 D. 5.00 (maximum) Float diameter 1.31 (maximum); Float length 2.53
Resistance Calibration:	
Empty Position:	0.0 to 0.5 ohm
Full Position:	29.5 to 31.5 ohms
Mechanical Characteristics:	Portions of the assembly below mounting plane shall pass through an opening of 1 9/16 inch in diameter. A fuel reserve of 10% shall remain when the float first reaches the empty position (fuel level declining) Float lever fulcrum shall be in line with the 50% fuel capacity level For associated indicator, liquid quantity 24 V dc, engine fuel (see MS24544)
Manufacturer:	Thomas G Faria Corporation
Part Number:	LS4027
FSCM:	09527
Manufacturer:	Stewart Warner Corporation
Part Number:	507AS
FSCM:	57733
3. AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM	
Switchgear Circuit Breaker CB123	
Drawing Number:	80-7365
Voltage Rating:	120/240 V ac
Number of Poles:	2
Current Rating:	15 amperes
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-5 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Specifications:	Per Federal Specification WC-375/6
Interrupting Capacity:	10, 000 amperes
Wire Size:	No 1 to 300 mcm
Manufacturer:	General Electric Company
Part Number:	THQEZ115WL
FSCM:	28432

Table 1-1. System Capacities and Detailed Data on Components (Continued)

3. AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM (CONTINUED)

100 Amperes Distribution Panel DP1	
Drawing Number:	80-7401
Rating:	120/240 V ac, 100 amperes, single phase, three wire, 50/60 Hz
Specification:	WP115A, Type I, Class 2
Copper Lugs:	No 12 to 1/0 AWG
Circuit Breakers:	Per W-C-375 common trip
Enclosure:	NEMA 1
Material:	Box no 16 GA (0.060) steel, front panel no 14 GA (0.075) steel, recessed hinges, flush lock, milled key
Finish:	ANSI No. 61 light gray
Breaker Interrupting Capacity:	1000 amperes minimum symmetrical
Bus Bar Supports:	Glass filled polyester insulators
Frame Circuit Directory:	Located on rear of front panel and protected by clear plastic
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-5 to +1 55°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	ITE Electrical Products
Part Number:	7205-61581-M1
FSCM:	88220
200 Amperes Distribution Panel DP2	
Drawing Number:	80-7402
Rating:	120/240 V ac, 200 amperes, single phase, three wire, 50/60 Hz
Specification:	WP115A, Type I, Class 2
Lugs:	Copper, to accommodate one #6 to 350 mcm wire
Circuit Breakers:	Per W-C-375 common trip
Enclosure:	NEMA 1
Material:	Box No. 16 GA (0.060) steel, front panel no 14 GA (0.075) steel, recessed hinges, flush lock, milled key
Finish:	ANSI no. 61 light gray
Breaker Interrupting Capacity:	1000 amperes symmetrical
Bus Bar Supports:	Glass filled polyester insulators
Frame Circuit Directory:	Located on rear of front panel and protected by clear plastic
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +1 55°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	ITE Electrical Products
Part Number:	7205-61581-M1
FSCM:	88220

Table 1-1. System Capacities and Detailed Data on Components (Continued)

3. AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM (CONTINUED)	
Lightning Arresters E101 through E103	
Drawing Number:	80-7412
Rating:	4.5 kV
Altitude:	0 to 10, 000 feet
Material:	High-strength wet process porcelain
Insulation Tests:	Per ANSI C62 1
Pressure Relief Tests:	ANSI C62 1
High Currents Tests: (RMS Symmetrical Amperes)	65, 000 per ANSI C62 1 Class 1
Mechanical Characteristics:	Exhaust ports to provide directional venting
Maximum Leakage:	5 x 1013 atmosphere-cc/second
Operation:	50/60 Hz
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Westinghouse Electric Company
Part Number:	5556A60A04
FSCM:	08449
1/C 2 AWG Power Cable	
Drawing Number:	80-7900
5 kV Rome Portable Power Cable, Type SH:	
Components:	1/C 2 AWG 259/016 inch (37 x 7) rope stranded soft tinned copper; conforms to NEMA WC7 or WC8 5 kV insulated shielded cable 0.125 Inch (3.175 mm) two layer, reinforced hypalon black jacket
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Rome Cable Company
Part Number:	Type SH
FSCM:	74240
Main Disconnect Switch S120	
Drawing Number:	80-7394
Voltage and Current Ratings:	
Voltage (Nominal):	4 16 kV
Voltage (Maximum):	4 76 kV
Withstand:	
60 Hertz:	19 kV
Impulse:	60 kV
Continuous Current: (at 4.76 kV)	600 A/1200 A
10 Cycle Momentary RMS Asym:	61 kA
3 Second Short-time RMS Asym:	38 kA
Manufacturer:	Gould Brown Boveri
Part Number:	422464302 less ARC chutes
FSCM:	88220

Table 1-1. System Capacities and Detailed Data on Components (Continued)

3. AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM (CONTINUED)	
Duplex Receptacles J102 through J109	
Drawing Number:	80-7919
Rating:	125 V ac, 20 amperes
Material:	Molded phenolic body, brass mounting tabs
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Harvey Hubbell Inc.
Part Number:	5352
FSCM:	74545
Site Requirement Module Cable	
Drawing Number:	80-7903
Mechanical Characteristics:	Cable, 9 conductor, AWG #14, PVC jacket, 194°F (89°C), ICEA S-61-402 THHN/THWN per NEC Article 318 and 340, 600 volt rating, suitable for direct burial Color coding per NEMA and ICEA Specification, Method 1, Table K-2
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	ITT Royal Electric Division
Part Number:	V1209
FSCM:	82879
Site Requirement Module Cable	
Drawing Number:	80-7906
Mechanical Characteristics:	Cable, 24 conductor, AWG #16, PVC jacket, 194°F (89°C), ICEA S-61-402 THHN/THWN per NEC Article 318 and 340, 600 volt rating, suitable for direct burial Color coding per NEMA and ICEA Specification, Method 1, Table K-2
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	ITT Royal Electric Division
Part Number:	V1124
FSCM:	82879
Shielded Cable	
Drawing Number:	76-11253
Material:	2 conductor shielded cable; 2 No 16 AWG (19 strands of #29 wire); one black lead, one white lead nominal OD 0.266 ± 0.010; 450 WV; tinned copper, wrapped spiral shield
Manufacturer:	Belden Wire and Cable Company
Part Number:	8780
FSCM:	16428

Table 1-1. System Capacities and Detailed Data on Components (Continued)

3. AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM (CONTINUED)

Power Cable	
Drawing Number:	80-7901
Material:	Type W/3 conductor, round/600/2000 V
Conductor Size:	No 4
Strand	259
Nominal Insulation Thickness:	0.060 Inch (1.524 mm)
Nominal Jacket Thickness:	0 141 Inch (3.581 mm)
Nominal Outer Diameter:	1 17 inch (29 72 mm)
Ampacity:	104
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	E. J. Stephens Inc.
Part Number:	PC13030, Type W/3
FSCM:	None
4. FUEL SYSTEM	
Transfer Pump Assembly B102	
Drawing Number:	80-7527
Design Rating:	9.5 gpm (4.28 Umin) at 1140 rpm
Materials:	Gray iron housing and steel gears
Bearings:	Replaceable sleeve type
Seal:	Mechanical shaft type
Lubrication:	Self-lubricating (using fluid being pumped)
Rotation:	Clockwise facing pump shaft
Suction Lift:	15 Inch Hg minimum
Drive:	Direct connected
Key:	0.187 square by 0.75 long steel furnished loose
Operating Temperature:	-25 to +125°F (-31 to 51 C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Brown & Sharpe Company
Part Number:	713-30-7
FSCM:	09058
Electric Motor	
Drawing Number:	80-7684
Rating:	NEMA frame 56, fully enclosed cap. start; fan-cooled - counterclockwise rotation (facing shaft) 115/208 V ac, single phase, 50/60 Hz; 8/4-4 amperes full load, 0.5 horsepower, 1140 rpm
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Baldor Electric Company
Part Number:	L3505
FSCM:	05472

Table 1-1. System Capacities and Detailed Data on Components (Continued)

4. FUEL SYSTEM (CONTINUED)	
Solenoid Valve L102	
Drawing Number:	80-7529
Operation:	Normally closed
Body:	Forged brass
Size:	3/4 Inch NPT
Seals and Discs:	Buna "N" teflon, core tube 305 S.S
Solenoid Enclosure:	General Purpose (NEMA 1)
Voltage:	120, 60 Hz, 110 V ac, 50 Hz
Ambient Temperature:	-40 to +125°F (-40 to 51°C)
Humidity Conditions:	To 100%
Manufacturer:	Automatic Switch Company
Part Number:	JKF8210D95V
FSCM:	04845
Fuel Strainer	
Drawing Number.	80-7528
Maximum Operating Pressure:	125 psi (862 kPa)
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Case Capacity:	2 quarts (2 liters)
Particle Retention:	50 microns
Fuel Flow:	1 gpm (0.45 L/min)
Material:	Cast iron head, steel shell
Manufacturer:	Dynamics Corporation of America, Fermont Division
Part Number:	403930-001
FSCM:	93742
Fuel Filter Assembly	
Drawing Number:	80-7530
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Cummins Engine Company, Inc
Part Number:	FF6003
FSCM:	15434
Shutoff Valve	
Drawing Number:	80-7605
Working Pressure:	400 psi (2758 kPa) at -20 to +100°F (-29 to 37°C)
Test Pressure:	600 psi (4137 kPa)
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Temperature Service Range:	To 100°F (37°C)
Manufacturer:	Jamesbury Corporation
Part Number:	3/4-11-1100TT
FSCM:	01029

Table 1-1. System Capacities and Detailed Data on Components (Continued)

5. COOLING SYSTEM	
Radiator	
Drawing Number:	80-7553
Heat Rejection:	35,801 BTU/min at rated load
Air Temperature into Radiator Core:	139°F (59°C) maximum
Top Tank Temperature:	200°F (92°C)
Coolant Flow:	411 gpm (1562 L/min)
Pressure Drop:	7 psi (48 kPa)
Operating Ambient Temperature:	-25 to +125°F (-31 to 51°C) at sea level, 95°F (35°C) maximum at 8000 feet (2438 m) altitude
Storage Temperature:	-65 to +1 55°F (-53 to 68°C)
Capacities:	
Total System Coolant Capacity:	91.4 gallons (296 liters)
Expansion Space:	4.8 gallons (18 1 liters)
Drawn Down:	16 gallons (60.6 liters)
Total Radiator Capacity:	51.8 gallons (196.1 liters)
Manufacturer:	Stuart Radiator Company
Part Number	9153700
FSCM:	56661
Thermostat S105	
Drawing Number:	80-7535
Volts:	115/240
Amperes:	25
Temperature:	100°F (37°C) - ON, 120°F (48°C) - OFF
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity:	To 100%
Manufacturer:	Kim Hotstart Mfg. Company
Part Number	KS1012
FSCM:	95408
Coolant Temperature Sender MT3	
Drawing Number:	76-11249-20
Maximum Operating Temperature:	325°F (161°C)
Test Values:	
Temperature:	230°F (109°C)
Resistance Ohms Bridge.	341.3 ±31 ohms
Manufacturer'	Stewart Warner Corporation
Part Number	334J
FSCM:	57733
Coolant Heaters H101 and H102	
Drawing Number:	80-7534
Volts:	240 ± 1 0% Vac
Watts:	5,000
Current:	20.8 amperes
Phase:	One
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Kim Hotstart Mfg. Company

Table 1-1. System Capacities and Detailed Data on Components (Continued)

5. COOLING SYSTEM (CONTINUED)			
Part Number	E220		
FSCM	95408		
6 LUBRICATION SYSTEM			
Oil Temperature Sender MT2			
Drawing Number	76-11249-1		
Maximum Operating Temperature	300°F (147°C)		
Test Values			
Temperature	190°F (87°C)		
Resistance Ohms Bridge	143 ±14.5 ohms		
Manufacturer-	Stewart Warner Corporation		
Part Number	334H		
FSCM	57733		
Oil Pressure Sender MT1			
Drawing Number.	76-11255		
Pressure In psi (kPa)	0 (0)	25 (172)	75 (517)
Resistance in Ohms	227 to 257	142 to 162.5	58.2 to 74.4
Direction:	Descending	Descending	Descending
Manufacturer:	Stewart Warner Corporation		
Part Number:	279B		
FSCM	57733		
Liquid Level Gage			
Drawing Number.	80-7532		
Seals	Viton A		
Pressure Rating	125 psi at 72°F (862 kPa at 22°C) 0 psi at 205°F (0 kPa at 95°C)		
Operating Temperature:	-25 to +125°F (-31 to 51°C)		
Storage Temperature:	-5 to +155°F (-53 to 68°C)		
Humidity Conditions:	To 100%		
Manufacturer	Oil-Rite Corporation		
Part Number.	YB1900-1-S		
FSCM	80085		
Oil Heater H113			
Drawing Number.	80-7381		
Watts:	300		
Volts	230		
Amperes:	1.3		
Heating Capacity	5 to 15 gallons (19 to 57 liters)		
Operating Temperature.	-25 to +125°F (-31 to 51°C)		
Storage Temperature:	-65 to +155°F (-53 to 68°C)		
Humidity Conditions.	To 100%		
Manufacturer:	Kim Hotstart Mfg. Company		
Part Number	0L6323		
FSCM	95408		

Table 1-1. System Capacities and Detailed Data on Components (Continued)

7. ENGINE

Engine		
Drawing Number.	80-7514	
Model.	KTA-2300G	
Type:	Four-stroke cycle, 60° Vee, twelve-cylinder diesel, turbocharged and after cooled	
Compression Ratio:	14 5:1	
	60 Hz	50 Hz
Engine Speed (RPM):	1800	1500
Gross Engine Power Output (BHP)	1235	1030
Brake Mean Effective Pressure.	208	204
Piston Speed (ft/mn)	1875	1562
Engine Water Flow (GPM)	411	343
Maximum Exhaust System Back Pressure:	3 in Hg	
Oil Pressure at Idle Speed.	20 psi (min) (138 kPa)	
Oil Pressure at Rated Speed.	60 to 90 psi (414 to 621 kPa)	
Maximum Oil Consumption:	0.66 qt/hr (0.625 L/hr)	
Type Injection System:	Cummins PT Direct Injection	
Maximum Restriction to PT Fuel Injection Pump:	4 in Hg (clean fuel filter) 8 in Hg (dirty fuel filter)	
Maximum Injector Return Line Restriction.	4 In Hg	
Maximum Fuel Flow to Pump	183 gph (693 L/hr)	
Manufacturer:	Cummins Engine Company, Inc.	
Part Number	D233019 6X02	
FSCM.	15434	
Air Cleaner		
Drawing Number	80-7539	
Specifications:	MIL-A-52363, Class III	
Mechanical Characteristics	Capable of removing not less than 97% of all dust particles 5 microns and larger; overall efficiency not less than 99% when tested with ac fine test dust In accordance with SAE J726	
Restriction	25 ± 2.3 inches (635 ± 58.4 mm) of water	
Operating Temperature.	-25 to +125°F (-31 to 51°C)	
Storage Temperature.	-65 to +155°F (-53 to 68°C)	
Humidity Conditions:	To 100%	
Manufacturer:	Donaldson Company, Inc.	
Part Number:	SRG 20 0053	
FSCM:	18265	

Table 1-1. System Capacities and Detailed Data on Components (Continued)

8 EXHAUST SYSTEM	
Muffler	
Drawing Number:	80-7540
Material Aluminized steel except mounting	flange, HR steel, P&O
Manufacturer	Donaldson Company, Inc
Part Number:	DIU06-0530
FSCM	18265
9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR	
LUBE OIL PRESSURE Gage Ml	
Drawing Number	76-11227
Voltage 12 V dc negative ground	
Mounting Hardware:	Supplied by Vendor
Dial Position:	0 psi (0 Kpa) 100 psi (690 Kpa)
Resistance	240 ohms 60.3 ohms
Tolerance (on dial face):	±0.39 ± 0.039
Direction	Descending Ascending
Manufacturer	Stewart Warner Corporation
Part Number	460-BD (used with 76-11230)
FSCM:	57733
LUBE OIL TEMP Gage M2	
Drawing Number.	76-11228
Voltage 12 V dc negative ground	
Mounting Hardware-	Supplied by Vendor
Dial Position:	200°F (92°C) 300°F (147°C)
Resistance:	548 ohms 108 ohms
Tolerance (on dial face):	0.039 0.039
Direction.	Ascending Ascending
Manufacturer	Stewart Warner Corporation
Part Number:	465DY (used with 76-11230)
FSCM:	57733
COOLANT TEMP Gage M3	
Drawing Number	76-11229
Voltage.	12 V dc negative ground
Mounting Hardware:	Supplied by Vendor
Dial Position:	160°F (70°C) 280°F (136°C)
Resistance.	161.0 ohms 48.8 ohms
Tolerance (on dial face).	0.039 0.039
Direction'	Ascending Ascending
Manufacturer.	Stewart Warner Corporation
Part Number:	465DZ (used with 76-11230)
FSCM:	57733
FUEL LEVEL Gage M4	
Drawing Number.	69-575
Rating	24 V dc
Range:	Empty to full
Specifications.	MIL-1-18386, Type I, Unit 1, except: A. Terminal hardware to be brass B. Dial printing and pointer white with black background

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9 CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
Manufacturer	Stewart Warner Corporation
Part Number.	505BC
FSCM	57733
Time Totalizing Meter M5	
Drawing Number	73-0507
Specification:	MIL-M-3971/1, Type I, Part No M3971/1-5, except as shown on drawing
Terminal Size:	4, 5, or 6
Mounting Hardware Size:	6-32
Manufacturer	Stewart Warner Corporation
Part Number	M-5600
FSCM	74400
EXHAUST TEMP Gage M6	
Drawing Number	80-7612
Case. Steel finish, black backed enamel	
Window Shatterproof glass	
Scale Black figures on white background	
Scale Length	0 to 1600°F (0 to 862°C) Division 20°F (-70C)
Accuracy:	Within 1% of full scale
Reference Junction Compensation:	Automatic bi-metallic, steel case, shatter-proof glass window
Switch:	Single-pole, three-position, (OFF) 0 to 1 and 2)
Thermocouple Alloy	J-iron constant an
External Resistance.	5 ohms
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature.	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer	Alnor Instrument Company
Part Number:	603-102-094
FSCM.	01518
AC AMPERES Meter M102	
Drawing Number.	80-7430
Specifications	MIL-M-16034 except as noted
Scale 2500 ARC, 0 to 175 amperes	
Movement.	0 to 1 milliampere dc
Accuracy:	1.5%
Operating Temperature	-25 to +125°F (-31 to 51° C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Mechanical Characteristics	Meter to be used in conjunction with Transducer (80-7383)
Manufacturer.	General Electric Company
Part Number:	1014-2
FSCM:	24493

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

AC KILOVOLTS Meter M101	
Drawing Number	80-7429
Specifications.	MIL-M-16034/3, Type MR49WSPECMKVH except as noted
Rating.	262.5 V ac, 50/60 Hz
Scale.	250° ARC, 0 to 5.25 kV
Accuracy	1.5%
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Transformer Ratio	20:1 (208 V = 4160 V)
Manufacturer	Westinghouse Electric Company
Part Number	1-68244, Type KA-241 Style 3-81901, Type KP-241 (meter must match phase shifting transformer MV832, Style 292B048620)
FSCM	88416
FREQUENCY Meter M103	
Drawing Number:	80-7428
Specifications:	MIL-M-16125, Type Designation MR49W50/60SPECH except as noted
Rating:	120 V ac, 3 phase, 4 wire
Scale:	250° ARC, white background, 48 to 62 Hz
Scale Markings:	Blue at 50 Hz, red at 60 Hz; region between 53 and 57 Hz shall contrast with the rest of the scale or be unmarked
Accuracy	2%
Operating Temperature.	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Mechanical Characteristics:	Meter to be used In conjunction with frequency transducer 80-7360
Manufacturer	Westinghouse Electric Company
Part Number:	1-66967, Type KX-241 (includes 80-7360)
FSCM	88416
AC KILOWATTS Meter M107	
Drawing Number:	80-7427
Scale:	2500 ARC, 0 to 1000 kW
Movement:	0 to 1 milliampere dc
Accuracy:	1.5% (nominal)
Specifications:	MIL-M-16034 except as noted
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +1 55°F (-53 to 68°C)
Humidity Conditions:	To 100%
Mechanical Characteristics:	Meter to be used In conjunction with transducer 80-7384
Manufacturer:	General Electric Company
Part Number:	1014-1, Type DB-14
FSCM:	24493

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

AC KILOVARS Meter M108	
Drawing Number:	80-7426
Specifications:	MIL-W-19088 except as noted
Rating:	120 V ac, 5 amperes, 3 phases, 4 wire, 50/60 Hz
Scale:	250° ARC, white background with black markings
Accuracy:	1.5%
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Westinghouse Electric Company
Part Number:	Style 3-81901 Type KP-241 with MV-832 phase shifter (meter must match phase shifter)
FSCM:	88416
POWER FACTOR Meter M104	
Drawing Number:	80-7425
Specifications:	MIL-M-16034 except as noted
Scale:	250° ARC, calibrated to read 0.5 pf lag to 0.5 pf lead (cosine curve)
Movement:	+0.5 mA dc zero center
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Mechanical Characteristics:	Meter to be used in conjunction with transducer 80-7382
Manufacturer:	General Electric Company
Part Number:	1014-3, Type DB-14
FSCM:	24493
SYNCHROSCOPE M106	
Drawing Number:	80-7424
Specification:	MIL-I-16104, Type II, except as noted
Rating:	120 V ac, 5 amperes, single phase, 50/60 Hz calibrated at 55 Hz
Scale:	250 degrees ARC, white background with black markings
Accuracy	+1.5%
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer:	Westinghouse Electric Company
Part Number:	1-68248, Type KI-241
FSCM:	88416

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

GEN TEMP Gage M105	
Drawing Number:	80-7682
Rating:	120 V ac, 50/60 Hz
Insulation	Rating 800 V
Shielding.	
DC:	1% influence at 200 gauss
AC.	1% influence at 15 gauss
Mechanism:	Permanent magnet, moving coil
Dial:	White with black markings
Scale Reading:	0 to 270°F (0 to 131°C)
Accuracy	1.5%
Specifications.	MIL-T-2867 except as indicated
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer	Westinghouse Electric Company
Part Number	1-66842, Type KX-241
FSCM:	88416
BREAKER CONTROL Switch S4	
Drawing Number	80-7415
Voltage Rating	500 V ac continuous
Current Rating'	20 amperes
Operating Voltage.	125 V ac
Momentary Current (Thermal)	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations)	95 amperes -- 120 V ac
Making Ability for Circuit Breaker Coils:	95 amperes -- 125 V dc
Dielectric Strength:	2200 V rms
Insulation Resistance:	100 megohms
Contact Resistance:	10 milliohms
Continuous Rating:	30 amperes 600 V
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature.	-65 to +155°F (-53 to 68°C)
Mechanical Characteristics:	Silver contact surfaces; double sided, double wiping knife type, rotary contacts, handle pistol grip spring return to normal position (vertical); contacts material phosphor bronze alloy, terminals copper with silver overlay at contact area with overall silver plate
Manufacturer:	Electro Switch Corporation
Part Number:	2450J
FSCM:	82121

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9 CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
AMMETER Switch S114	
Drawing Number:	80-7414
Voltage Rating:	500 V ac continuous
Current Rating:	20 amperes
Operating Voltage:	125 V ac
Momentary Current (Thermal) :	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations) :	95 amperes -- 125 V dc
Making Ability for Circuit Breaker Coils:	95 amperes -- 125 V dc
Dielectric Strength:	2200 V rms
Insulation Resistance:	100 megohms
Contact Resistance:	10 milliohms
Continuous Rating:	30 amperes 600 V
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Mechanical Characteristics:	Silver contact surfaces; double sided, double wiping knife type rotary contacts, round knurled handle indexing 45°, contact material phosphor bronze alloy, terminals copper with silver overlay at contact area with overall silver plate
Manufacturer:	Electro Switch Corporation
Part Number:	2412H
FSCM:	82121
GEN/BUS VOLTMETER Switch S112	
Drawing Number:	80-7416
Voltage Rating:	500 V ac continuous
Current Rating:	20 amperes
Operating Voltage:	125 V ac
Momentary Current (Thermal):	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations):	95 amperes -- 120 V ac
Making Ability for Circuit Breaker Coils:	95 amperes -- 125 V dc
Dielectric Strength:	2200 V rms
Insulation Resistance:	100 megohms
Contact Resistance:	10 milliohms
Continuous Rating:	30 amperes 600 V
Operating Temperature:	-25 to +125°F (-31 to 51 C)
Storage Temperature:	-65 to +1550F (-53 to 68°C)
Humidity Conditions:	To 100%
Mechanical Characteristics:	Silver contact surfaces; double sided, double wiping knife type rotary contacts; round knurled handle indexing 45°; contact material phosphor bronze alloy, terminals copper with silver overlay at contact area with overall silver plate

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9 CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Manufacturer:	Electro Switch Corporation
Part Number:	2406H
FSCM:	82121
CROSS CURRENT ADJUST Rheostat R105	
Drawing Number:	80-7375
Resistance:	1 ohm ±10%
Power:	50 watts
Current:	7.07 amperes
Approximate Steps:	44
Torque:	0 25 to 2.0 inch pounds (0.11 to 0 9 kg)
Rotation:	300 ±5% degrees
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Contact Brush:	Metal graphite
Base, Core, Hub.	High-strength Ceramic
Retaining Ring.	Phosphor Bronze
Steel Shaft	Brass bushing
Manufacturer	Ohmite Manufacturing Company
Part Number	0309, Model J,
FSCM:	44655
PARALLEL Switch S6	
Drawing Number:	80-7422
Voltage Rating:	600 V ac continuous
Current Rating:	15 amperes
Operating Voltage	125 V ac
Momentary Current (Thermal).	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations):	95 amperes -- 120 V ac
Making Ability for Circuit Breaker Coils:	95 amperes -- 125 V dc
Dielectric Strength:	2200 V rms
Insulation Resistance:	100 megohms
Contact Resistance:	10 milliohms
Continuous Rating:	30 amperes 600 V
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Mechanical Characteristics:	Silver contact surfaces; double sided, double wiping knife type rotary contacts; handle pistol grip, spring return to normal position (vertical), contact material phosphor bronze alloy; terminals copper with silver overlay at contact area with overall silver plate
Manufacturer:	Electro Switch Corporation
Part Number:	75202LT
FSCM:	82121

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Rotary Switch S118	
Drawing Number:	80-7418
Voltage Rating:	600 V ac continuous
Current Rating:	15 amperes
Operating Voltage:	125 V ac
Momentary Current (Thermal):	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations)	95 amperes -- 120 V ac
Making Ability for Circuit Breaker Coils	95 amperes -- 125 V dc
Dielectric Strength.	2200 V rms
Insulation Resistance	100 megohms
Contact Resistance.	10 milliohms
Continuous Rating:	30 amperes 600 V
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Mechanical Characteristics	Silver contact surfaces; double sided, double wiping knife type rotary contacts; oval handle; contact material phosphor bronze alloy, terminals copper with silver overlay at contact area with over-all silver plate
Manufacturer	Electro Switch Corporation
Part Number:	31203B with 2F24A
FSCM	82121
LOCAL/REMOTE Switch S2	
Drawing Number	80-7431
Voltage Rating	600 V ac continuous
Current Rating.	30 amperes
Operating Voltage	125 V ac
Momentary Current (Thermal)	200 amperes -- 3 seconds 75 amperes -- 30 seconds 60 amperes -- 60 seconds
Overload (50 operations)-	95 amperes -- 120 V ac
Making Ability for Circuit Breaker Coils.	95 amperes -- 125 V dc
Dielectric Strength	2200 V rms
Insulation Resistance	100 megohms
Contact Resistance	10 milliohms
Continuous Rating.	30 amperes 600 V
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Mechanical Characteristics	Silver contact surfaces; double sided, double wiping knife type rotary contacts; oval handle; contact material phosphor bronze alloy, terminals copper with silver overlay at contact area with overall silver plate

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
Manufacturer	Electro Switch Corporation
Part Number	21211B with 2L24A
FSCM:	82121
OPERATION SELECTOR SWITCH S3	
Drawing Number:	80-7852
Voltage Rating.	110 V ac
Current Rating	30 amperes, inrush 60 amperes, 50/60 Hz
Contacts:	Silicon bronze, silver plated
Stages.	3
Rotor Material:	Glass polyester, positive snap action maintained contacts
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature.	-65 to +155°F (-53 to 68°C)
Manufacturer	Westinghouse Electric Company
Part Number.	505A622H01
FSCM	88416
SYNCHROSCOPE Switch S115	
Drawing Number	80-7417
Voltage Rating.	500 V ac continuous
Current Rating	20 amperes
Operation Voltage	125 V ac
Momentary Current (Thermal)	200 amperes - 3 seconds 75 amperes - 30 seconds 60 amperes - 60 seconds
Overload (50 Operations):	95 amperes - 120 V ac
Making Ability for Circuit Breaker Coils	95 amperes - 125 V dc
Dielectric Strength	2200 V rms
Insulation Resistance	100 megohms
Contact Resistance:	10 milliohms
Continuous Rating	30 amperes 600 V
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Mechanical Characteristics:	Silver contact surfaces, double sided, double wiping knife type rotary contacts, oval handle, contact material phosphor bronze alloy; terminal copper with silver overlay at contact area with overall silver plate
Manufacturer	Electro Switch Corporation
Part Number.	24203-K-1
FSCM:	82121

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9 CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Pushbutton Switches S12, S15, S16, and 5116		
Drawing Number:	80-7840	
Contact Block Rating.		
Voltage.	120 V ac	125 V dc
Current Break:	6.0	1.1
Amperes Continuous:	10	-
Operating Temperature:	-25 to +125°F (-31 to 51°C)	
Storage Temperature	-5 to +155°F (-53 to 68°C)	
Humidity Conditions.	To 100%	
Manufacturer.	Westinghouse Electric Company	
Part Numbers:	80-7840-01 = PB1MAAHAB and PB1A and PB1B 80-7840-02 = PB1AARA and PB1A 80-7840-03 = PB1AAHB 80-7840-04 = PB1 AAHA 80-7840-05 = PB1AARB	
FSCM:	89946	
TEMPERATURE INDICATOR Switch S113		
Drawing Number:	80-7683	
Voltage Rating.	110 V ac	
Current Rating'	30 amperes, inrush 60 amperes, 50/60 Hz	
Contacts: Gold plated		
Stages: 4		
Rotor Material.	Glass polyester positive snap action maintained	
Contact Frame.	6	
Operating Temperature	-25 to +125°F (-31 to 51°C)	
Storage Temperature	-65 to +155°F (-53 to 68°C)	
Humidity Conditions:	To 100%	
Mounting Screws	2 furnished	
Manufacturer.	Westinghouse Electric Company	
Part Number:	663A488G02	
FSCM	65054	
PHASE SEQ SEL SW S119		
Drawing Number	80-7432	
Voltage Rating:	600 V ac continuous	
Current Rating.	15 amperes	
Operation Voltage	125 V ac	
Momentary Current (Thermal).	200 amperes - 3 seconds 75 amperes - 30 seconds 60 amperes - 60 seconds	
Overload (50 Operations).	95 amperes - 120 V ac	
Making Ability for Circuit Breaker Coils	95 amperes - 125 V dc	
Dielectric Strength	2200 V rms	
Insulation Resistance:	100 megohms	
Contact Resistance:	10 milliohms	
Continuous Rating	30 amperes, 600 V	
Operating Temperature	-25 to +125°F (-31 to 51°C)	
Storage Temperature	-65 to +155°F (-53 to 68°C)	
Humidity Conditions.	To 100%	

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Mechanical Characteristics:	Silver contact surfaces; double sided; double wiping knife type rotary contacts; oval handle; contact material phosphor bronze alloy, terminals copper with silver overlay at contact area with overall silver plate
Manufacturer:	Electro Switch Corporation
Part Number:	31203B with 3P25B (plate)
FSCM:	82121
Annunciator Alarm Component Board Assembly A10 and A11	
Drawing Number:	80-7644
Printed Circuit Construction	
Relays K1 through K9	10 amperes, DPDT per MIL-R-5757
Terminal Boards TB1, TB2, and TB3.	Per MIL-T-55164, 38TB
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer.	Dynamics Corporation of America, Femont Division
Part Number.	690640-001
FSCM:	93742
ANNUNCIATOR HORN LS1	
Drawing Number	80-7369
Rating	24 V dc, 0.16 amperes, 3 5 V a, 24 ohms
Noise Level:	101 dB at 10 feet (3 m)
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer	Edwards Company, A Unit of General Signal Corporation
Part Number:	875-G1
FSCM	19557
CLOCK 60 Hz M110 and CLOCK 50 Hz Mill	
Drawing Number	80-7707
Voltage Rating	120 V ac 1.0%
Current Rating.	0.05 ampere
Dial	White with black arabic numerals, 1 through 12 and second marks
Hands:	Black tapered hour and minute, black sweep second hand
Case:	Conforms to Specification GG-C-466E UL listed molded plastic
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-5 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Manufacturer	P & I Industries Inc.
Part Numbers	
80-7707-01 (50 Hertz).	A OL-ESF-50 Hz
80-7707-02 (60 Hertz)	A10OL-ESF-60 Hz

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
Set Station Power Transformer T101	
Drawing Number:	80-7398
Rating:	15 kVa, single phase, 50/60 Hz
PRI Volts:	2400 V ac
Sec Volts:	120/240 V ac continuous; open construction
Insulation:	392°F (198°C)
Temperature Rise	239°F (114°C)
Operating Temperature.	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Rated Force	15 G honzontal, 13 G vertical
Manufacturer.	Power Mag
Part Number.	A40-4809
FSCM.	98994
Current Boost System A101	
Drawing Number	80-7359
Input Power (Ampere Turns)	
Terminals 1 to 2:	1200 to 3000
Terminals 1 to 3:	3000 to 7000
Output Power:	180 V dc, 5 ampere
Input Sensing	240 V, 15 V a
Operating Temperature	-40 to +140°F (-40 to 59°C)
Operating Temperature.	-65 to +155°F (-53 to 68°C)
Shock:	Withstands up to 15 G's In each of 3 mutually perpendicular planes
Vibration:	Withstands 5 to 26 Hz at 1.2 G's 27 to 52 Hz at 0.36 double amplitude; 53 to 260 Hz at 5.0 G's
Manufacturer:	Basler Electric Company
Part Number:	9-1096-00-100
FSCM:	97520
Head Set H5030	
Drawing Number.	80-7969
Noise Level Range	To 100 dB
MSHA Approval Number	9B-67
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Manufacturer David Clark Company	
Part Number:	12511G, Model F5030
FSCM:	71483

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Incandescent Lamp	
Drawing Number:	76-11220
Rating. 250 V, 10 watts	
Mechanical Characteristics	Double contact, bayonet base, clear finish per MIL-L-6363, Type III; base style S6DC
Manufacturer	General Electric Company
Part Number:	10S6DC-250V
FSCM:	08805
Incandescent Lamps DS26 through DS29	
Drawing Number:	69-594
Specification.	MS15579
Rating	6 watts at 30 volts
Life.	1500 hours approximately
Manufacturer.	General Electric Company
Part Number	6S6-30V
FSCM.	08805
Lampholders DS110 and DS111	
Drawing Number'	69-549
Mechanical Characteristics:	Uses MS15567-1 lamp, mounting hardware furnished with light assembly
Lens:	Convex, clear, unfrosted
Manufacturer:	Dialight Corporation
Part Number:	51-3502-0137-203
FSCM:	72619
Panel Light	
Drawing Number	69-593
Mechanical Characteristics:	Uses 30 V, 60 W lamp, mounting hardware furnished with light assembly
Manufacturer	Dialight Corporation
Part Number	47-0901-2900-201
FSCM 72619	
	Lamp Assembly Emergency DS20 through DS23
Drawing Number	80-7945
Lamp	Sealed beam flood light, 1000 CP 28 V dc
Housing:	Diecast aluminum, light blue finish
Lampholder	Black rubber compound
Operating Temperature:	-25 to +125°F (-31 to 51 °C)
Storage Temperature:	45 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer:	Betts Machine Company
Part Number	B47JF
FSCM	13226

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
Humidistat S107	
Drawing Number:	80-7893
Rating:	120 V ac, 4.4 amperes
Locked Rotor.	26 4 amperes
Non-Inductive.	12 amperes
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Manufacturer:	Auto-Flo Company
Part Number.	2E453
FSCM.	None
Circuit Breakers CB124 and CB125	
Drawing Number:	80-7983
Voltage Rating	240 V ac, 100 amperes
Number of Poles.	2
Specifications	Per Federal Specification WC-375B, UL listed
Wire Size	No 1 to 300 mcm
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Manufacturer.	General Electric Company
Part Number	TQD22100LL
FSCM	03497
Contactor K106	
Drawing Number:	80-7846
Current:	9 amperes continuous
Rating.	120 V ac, 600 volts maximum, 50/60 Hz
Number of Poles	2
Horsepower	1/3 at 115 V ac
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Terminals:	Pressure wire lug type, for wire sizes #16 - #12
Required Operating Ranges at 50 and 60 Hz	A 50 Hz nominal from 110 to 123 V ac and from 47.5 to 52 5 Hz B. 60 Hz nominal from 114 to 144 V ac from 57 5 to 62.5 Hz
Manufacturer.	Square "D" Company
Part Number	8536-A0-1 with thermal overload element A2 81
FSCM	51918
Heater Strips H105 through H107	
Drawing Number	80-7657
Rating	240 volts, 200 watts, 10 watts per square Inch
Mechanical Characteristics	Heater to be supplied with ceramic post insulators 1-41059 PCN 259805
Manufacturer	Chromalox Division Emerson Electric Company
Part Number:	Cat. No S-920 PCN 131140
FSCM:	13426

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)	
Radiant Heaters HR103 and HR104	
Drawing Number.	80-7619
Rating	240 V ac, 1250 watts, UL listed
Operating Temperature.	-25 to +125°F (-31 to 51°C)
Storage Temperature.	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer:	Electromagnet Industries
Part Number:	NBRA 2412
FSCM:	12670
Paralleling Current Transformer CT114	
Drawing Number	80-7403
Specification	ANSI C57.13
Accuracy Class.	0 6-B0-2
Current Ratio:	130/5 amperes
Burden.	5 V a minimum
Operating Temperature:	-25 to +125°F (-31 to 51 °C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Manufacturer	Instrument Transformer Company
Part Number	100-131
FSCM.	59138
Instrument Current Transformers CT10 through CT12	
Drawing Number	80-7409
Specification	ANSI C57.13
Accuracy Class	0.6 B0.9
Burden	22.5 V a minimum
Operating Temperature.	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Current Ratio	175/5 amperes
Manufacturer	Instrument Transformer Company
Part Number	112-1750
FSCM.	59138
Ground Fault Transformer T100	
Drawing Number	80-7437
Rating Single phase, 50/60 Hz, 1 kVa,	
	4160/230 volts
Low Voltage Cables:	No 14 AWG to terminal block
High Voltage Cables:	No. 14 AWG (5 kV insulation), 20 00 long
Operating Temperature	-25 to +125°F (-31 to 51 °C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer	General Electric Company
Part Number	9T28B9710G10
FSCM:	03512

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Current Boost Transformers CT2 and CT3	
Drawing Number:	80-7547
Input Power:	
Terminals 1 to 2:	1200 to 3000 A
Terminals 1 to 3:	3000 to 7000 A
Output Power:	180 V dc, 5 A
Burden:	10 V a
Terminals	0.164-32 screw type
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to + 155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer.	Basler Electric Company
Part Number.	BE15486-001
FSCM	97520
Voltage Regulator Transformer T102	
Drawing Number	80-7552
Pnmary Voltage:	2400/4160 V ac
Secondary Voltage	120/240 V ac
Dielectric Test Voltage:	
Primary	12,000 V ac
Secondary	2500 V ac
Operating Frequency Range	50/60 hz
Fuses3 in primary	
Primary Rating:	1000 V a
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions	To 100%
Manufacturer:	:Basler Electric Company
Part Number:	BE13616-001
FSCM	97520
	Generator and Bus Instrument Transformers T104 and T106 through T11 0
Drawing Number	80-7407
Specification'	ANSI C57.13
Voltage Class	5000 v
Voltage Ratio.	2400/120 V ac
Accuracy	90 to 110%, volts 0.6%, 50/60 Hz
Continuous Rating (Thermal)	450 V amperes
Primary and Secondary Terminals	190-32 into 375 deep brass inserts primary slave terminals provided for primary fuses core and windings encased in thermoplastic and filled under vacuum with resin
Operating Temperature.	-25 to +125°F (-31 to 51°C)
Storage Temperature:	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Manufacturer.	Instrument Transformer Company
Part Number:	PT3-45242FB20
FSCM:	59138

Table 1-1. System Capacities and Detailed Data on Components (Continued)

9. CONTROLS, INSTRUMENTS, AND SWITCHGEAR (CONTINUED)

Fuses F109, F111, F113, F117, F119, and F121, through F127			
Drawing Number	80-7397		
Voltage Rating:	250 volts		
Operating Temperature.	-25 to +125°F (-31 to 51°C)		
Storage Temperature	-65 to +155°F (-53 to 68°C)		
Humidity Condition:	To 100%		
	80-7397-01	80-7397-02	80-7397-03
	OT10	OT30	OT5
Current Rating	10 Amperes	30 Amperes	5 Amperes
Manufacturer'	Gould, Inc		
Part Numbers	OT10	OT30	OT5
FSCM.	99569		
Fuse F101			
Drawing Number:	80-7396		
Specifications'	NEMA S62-20-13		
Rating	5500 V ac, 10 amperes, 50/60 Hz		
Interrupting Rating	80,000 amperes (sym), 130,000 amperes (asym)		
Operating Temperature.	-25 to +125°F (-31 to 51°C)		
Storage Temperature:	-5 to +155°F (-53 to 68°C)		
Humidity	To 100%		
Manufacturer	Westinghouse Electric Company		
Part Number	TYPE CLE-PT		
FSCM	65054		
Disconnecting Fuse Holder			
Drawing Number	80-7367		
Voltage Rating.	4800 V ac nominal		
Insulator Voltage Rating	4800 V ac nominal		
Operating Temperature:	-25 to +125°F (-31 to 51°C)		
Storage Temperature:	-65 to +155°F (-53 to 68°C)		
Manufacturer	Westinghouse Electric Company		
Part Number:	676C233A01		
FSCM	65054		
Fuse Block			
Drawing Number	80-7977		
Voltage Rating	250 V ac		
Current Rating	30 amperes		
Operating Temperature	-25 to +125°F (-31 to 51°C)		
Storage Temperature	-65 to +155°F (-53 to 68°C)		
Material Phenolic			
Manufacturer	Marathon Special Products		
Part Number	F30A1S		
FSCM	26405		

Table 1-1. System Capacities and Detailed Data on Components (Continued)

10. REMOTE CONTROL MODULE

AC AMPERES Meter M102R	
Drawing Number:	80-7430 (see group 09)
AC KILOVOLTS Meter M1 01 R	
Drawing Number:	80-7429
Specifications:	MIL-M-16034/3, Type MR49WSPECAMKVH except as noted
Rating	262 5 V ac, 50/60 Hz
Scale:	250° ARC, 0 to 5 25 kV
Accuracy	1.5% (nominal)
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature.	-65 to +155°F (-53 to 68°C)
Humidity Conditions.	To 100%
Transformer Ratio.	20.1 (208 V = 4160 V)
Manufacturer:	Westinghouse Electric Company
Part Number:	1-68244, Type KA-241
FSCM:	88416
FREQUENCY Meter M103R	
Drawing Number:	80-7428 (see group 09)
AC KILOWATTS Meter M107R	
Drawing Number	80-7427 (see group 09)
POWER FACTOR Meter M104R	
Drawing Number.	80-7425 (see group 09)
SYNCHROSCOPE Meter M106R	
Drawing Number	80-7424 (see group 09)
BREAKER CONTROL Switch S4R	
Drawing Number:	80-7415 (see group 09)
AMMETER Switch S114R	
Drawing Number	80-7414 (see group 09)
GEN/BUS VOLTMETER Switch S112R	
Drawing Number	80-7416 (see group 09)
VOLT ADJ Rheostat R101 R	
Drawing Number:	80-7375 (see group 09)
PARALLEL Switch S6R	
Drawing Number	80-7422 (see group 09)
Station Power Receptacle	
Drawing Number	80-7371
Rating	600 V ac, 250 V dc, 100 amperes
Contacts:	3 pole for cable dia 0.98 to 1.71
weatherproof	
Material.	Copper-free aluminum
Finish:	Natural
Contacts	Brass solder type compliance with UL standard 498
Operating Temperature	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Manufacturer.	Crouse-Hinds Company
Part Number	AR1032S22, Style 2
FSCM.	15235

Table 1-1. System Capacities and Detailed Data on Components (Continued)

10. REMOTE CONTROL MODULE (CONTINUED)	
Remote Control Cable Assembly	
Drawing Number:	80-7918
Mechanical Characteristics:	Cable, 50 conductor, AWG #16, PVC Jacket, 194°F (89°C), ICEA S-61-402 THHN/THWN per NEC Article 318 and 340, 600 volt rating, suitable for direct burial; color coding per NEMA and ICEA specification, Method 1, Table K-2
Operating Temperature:	-25 to +125°F (-31 to 51°C)
Storage Temperature	-65 to +155°F (-53 to 68°C)
Humidity Conditions:	To 100%
Manufacturer.	Manhattan Electric Cable Corporation
Part Number	3844P-T-N
FSCM	62132

Table 1-2. Torque and Engineering Data

ITEM	FIGURE/ INDEX NO	TORQUE POUND-FEET	POUND-FEET	NEWTON-METERS
Fan hub locking nut	Figure 4-45, 11	190-200		258-271
Pivot arm to fan Idler arm capscrew	Figure 4-45, 19	20-25		27-34
Idler pivot arm shaft capscrew	Figure 4-45, 40	145-155		197-210
Idler pulley cover plate capscrew	Figure 4-45, 24	20		27
Torque locknut	Figure 4-45, 27	145-155		197-210
Fan idler shaft to fan Idler arm nut	Figure 4-45, 31	145-155		197-210
Thermostat housing to thermostat housing support capscrews	Figure 4-43, 13 and 15	30-35		41-47
Water filter head to thermostat housing capscrews	Figure 4-43, 1	30-35		41-47
Water pump adapter to block capscrews	Figure 4-41, 14	30-35		41-47
Water pump to drive adapter capscrews	Figure 4-41, 18	60-70		81-95
Water pump Inlet connection to body capscrews	Figure 4-41, 8	30-35		41-47
Water pump support bracket to inlet connection capscrews	Figure 4-41, 16	30-35		41-47
Water pump support bracket capscrews	Figure 4-41, 14	30-35		41-47
Rocker housing capscrews	Figure 3-22, 3 and 4	30-35		41-47
Hand hole cover capscrews	Figure 3-3	30-35		41-47
Air cleaner safety filter nut	Figure 4-49, 29	10		13-6
Injector plunger rocker lever adjusting locknut				
If adapter ST-669 is used	Figure 4-59	30-35		41-47
If adapter ST-669 is not used	Figure 4-59	40-45		54-61
Valve crosshead rocker lever adjusting locknut				
If adapter ST-669 Is used	Figure 4-52, 3	22-26		30-35
If adapter ST-669 is not used	Figure 4-52, 3	25-35		34-47
Turbocharger				

Table 1-2. Torque and Engineering Data (Continued)

ITEM	FIGURE/ INDEX NO	TORQUE		
		POUND-FEET	POUND-FEET	NEWTON-METERS
V band clamp nut	Figure 4-60, 8	40-60		54-81
Hose clamp bolts	Figure 4-60, 6	100-110		11 5 to 12 5
Capscrews	Figure 4-60,	30-35		41-47
Turbocharger air outlet retaining brace capscrews	Figure 4-60, 10	4-45		54-61
Turbocharger exhaust flange capscrews and locknuts	Figure 4-60, 15 and 14	30-35		41-47
Turbocharger oil drain tube fitting	Figure 4-60, 4	50		68
Turbocharger oil inlet hose fitting	Figure 4-60, 1	20		27
Front support to front support	Figure 4-61, capscrews	200-220 9		271-298
Engine support hexagon head	Figure 4-61, capscrews	200 1		271
Oil filter head to block capscrews	Figure 3-3 and Figure 4-47 1	35-40 ,		47-54
Starter motor assembly to flywheel housing capscrews	Figure 4-32, 3	180-200		244-271
FUEL LEVEL gage M4 hexagonal mounting nut	Figure 4-75, 3		8-12	0 9 to 1.4

Table 1-3. Clearances

FIGURE AND ITEM NUMBER	ITEM	CLEARANCE	
		INCHES	MILLIMETERS
Figure 3-8	Main disconnect switch S120, to operating mechanism assembly (maximum misalignment)	1	25.4
Figure 4-56	Injector plunger rocker	0.308 o0 001	7.82 i0.03
Figure 4-52	Valve spring to crosshead	0.025 (min)	0.64 (min)
Figure 4-58	Valve rocker lever contact surface to crosshead		
	Intake		
	Exhaust	0 014 -0/+0.002	0.36 -0/+0.05
		027 -0/+0.002	0.69 -0/+0.05

Table 1-4. Minimum Body Clearances

OPERATING VOLTAGE	MINIMUM DISTANCE
5000 to 8700	1 foot (0.305 m)
8700 to 15,000	2 feet (0 609 m)
15000 to 50,000	3 feet (0 914 m)
50,000 to 70,000	5 feet (1.524 m)

SECTION III. SAFETY

1-11. SCOPE. This section outlines and describes the use of forms and tags as well as work procedures related to deenergized and energized lines and equipment, which must be in accordance with AR 385-10 and ER385-1-1.

1-12. GENERAL. Electric lines or equipment must be deenergized and covered by the Safe Clearance procedure prescribed in paragraph 1-13 before work is performed.

1-13. SAFE CLEARANCE PROCEDURE. The procedure prescribed herein must be followed for all work performed on deenergized lines and equipment operating above 600 volts Use of DA forms 5-132, 4324, and 5-134 is involved

a Forms.

(1) Safe Clearance. DA Form 5-132, Safe Clearance (Electrical Facilities) must be used for all work on deenergized electric lines and equipment operating above 600 volts Red tags (DA Form 4324) must be used in connection with this form Yellow tags (DA Form 5-134) are used at the discretion of the supervisor.

(2) Red Tags Red tags (DA Form 4324) are used in connection with a Safe Clearance. Red tags must never be used for other than the protection of personnel working under a Safe Clearance Information entered on red tags includes the name of the installation, related Safe Clearance number, and identity of the affected line or equipment. Spaces are provided for signatures of personnel who are involved in placing or removing the tags as well as the times and dates of these actions.

(3) Yellow Tags. Yellow tags (DA Form 5-134) are used to indicate abnormal operating conditions of lines or equipment and are never used for the protection of personnel working under a Safe Clearance. Information entered on yellow tags includes the name of the installation and identity of the affected line or equipment. Abnormal and/or special conditions are noted in appropriate areas. Spaces are provided for signatures of personnel who are involved In placing or removing the tags as well as the times and dates of these actions.

b. Safe Clearance Procedures Detailed Instructions, Section By Section, Of The Safe Clearance Form (Da Form 5-132) Are As Follows:

(1) Number. A consecutive number must be assigned from records maintained in the supervisor's office. Place the applicable number in the right hand box.

(2) Other Numbers. If more than one Safe Clearance is to be issued on the same line or equipment, show in this box the numbers of the other clearances.

(3) Line or Equipment Involved. Give a brief description of the lines or equipment on which work is to be performed. This information may be filled in as much in advance of actual time of issuance as required.

(4) Time Applied Progressing downward in proper sequence on the form, fill in opposite each detail (blocking, switching, and/or tagging) the actual time each detail is performed.

(5) Details of Blocking and Tagging.

(a) The supervisor is responsible for designating a qualified person to perform the switching, blocking, and tagging. The technician who is to receive a Safe Clearance may be authorized to perform these operations. The supervisor is also responsible for making any necessary arrangements for interruptions of service, such as notifying electric power consumers (as required) and notifying the public utility supplying power to the installation prior to the performance of switching which may affect the public company's system. This information must be given to the person designated by the public utility to receive such information. In the event this individual cannot be reached, the nearest system operating or load dispatching office of the utility is to be Informed.

(b) The technician designated by the supervisor to receive the Safe Clearance is responsible for filling in all details of blocking, switching, and tagging operations In the space provided on the Safe Clearance form and for having these details checked and approved by the supervisor. This is done in advance of the beginning of switching. These details must be entered in their proper sequence, reading down the form. Included will be any switch moves necessary to transfer load or put other equipment Into operation before deenergizing the lines or equipment covered by the Safe Clearance

(c) Blocking is defined as the placing of a prime mover valve, switch, or other line opening In the open or closed position, as the case may be, and ensuring by mechanical means, or otherwise, that the position of the device will not be changed accidentally.

(d) Red tags are applied to devices to ensure that their position will not be changed by unauthorized persons as long as lines or equipment are blocked out and red tagged under an active Safe Clearance. A red tag must be applied for each Safe Clearance number and the name of the person to whom the Safe Clearance is to be Issued must be shown. Refer to the examples in sub steps 1 through 4, below Yellow tags are used in connection with Safe Clearances to show an abnormal position of a switch or other device (which does not require a red tag) and ensure that its position will not be changed. Refer to the example in sub step 5, below .

(e) Examples.

1 Gang-operated switches must be locked open and a single red tag applied to the lock.

2 On overhead lines, a visible line break must be provided at all points of possible feed. An open oil circuit breaker is not acceptable in lieu of visible line break on an overhead system and must not be used except when it is not reasonable to provide a visible line break by removing the line side leads from the oil circuit breaker bushing or otherwise. If used, the oil circuit breaker will be mechanically blocked or locked open and red tagged and more than ordinary caution exercised in determining that the line is deenergized. Grounds will be installed on the line as close as possible to the oil circuit breaker.

3 On underground systems, when it is not reasonable to provide a visible line break, an oil circuit breaker or subway oil disconnect switch locked or blocked mechanically in the open position and red tagged is acceptable, but the cautions cited in substep 2, above, for oil circuit breakers on overhead systems must be observed.

4 Oil fuse cutouts must be blocked or locked in the open position, the fuse block removed, and the clamp red tagged.

5 A normally open switch which has been closed to tie two lines together, preparatory to taking a section of one of the lines out of service on a Safe Clearance, is yellow tagged. Switches on the distribution system which are normally open should be yellow tagged. However, if the position of a yellow tagged switch is changed, the yellow tag must be removed and the proper spaces filled In by the person removing it. The completed tag must be turned in to the supervisor.

(6) Issued To. Fill In the name of the person receiving the Safe Clearance and time of issuance. Safe Clearances must be issued only to technicians authorized to receive them by the supervisor, who will maintain a list of all such technicians. Generally, only one Safe Clearance may be issued and if more than one crew is assigned to the work, the holder of the Safe Clearance must be responsible for all the crews. When it is necessary, because of the distance separating the various crews or the extent of the work, as many Safe Clearances as required may be issued. In such a case, the supervisor, or other designated technician, will issue and receive releases of all the Safe Clearances. The technician receiving a Safe Clearance is responsible for checking all blocking and tagging and being assured that all points of possible feed are open on all phases and properly blocked and tagged.

(7) Issued By. Fill in the name of the person issuing the Safe Clearance and time and date of issuance. The supervisor must either issue Safe Clearances, authorize another technician to issue them, or authorize the person receiving the Safe Clearance for self-issuance. In the latter case, the technician receiving the Safe Clearance will fill in both the "issued to" and "issued by" blocks.

(8) Released By. The person accepting release of the Safe Clearance must fill In the name of the person releasing the Safe Clearance, if it is someone else (see instructions for "issued by"). The person releasing a Safe Clearance is responsible for making sure that all personnel and temporary grounds are clear and that the line or equipment is ready for service.

(9) Accepted By. The name of the person accepting release of the Safe Clearance must be filled in as well as time and date of release (see instructions for "issued by") If issued more than one Safe Clearance, the person is responsible for seeing that all Safe Clearances are released before any change is made in the blocking or tagging which would affect Safe Clearances which have not been released.

(10) Time Removed. If blocking and tagging have been applied for more than one Safe Clearance, perform no switching until the Safe Clearances with numbers corresponding to the numbers on all red tags on the switch, valve, visible line break, or other device of blocking have been released When releases have been received for all Safe Clearances, perform switching in reverse order than that in which it was applied. Beginning with the last detail of switching, blocking, and tagging applied, perform the opposite operation, progressing upward on the form and enter the time each operation is performed. For instance, if a detail of switching, blocking, and tagging reads "Switch A open and red tagged", the opposite operation is "Red tags removed and switch A closed"

WARNING

Do not operate the equipment after removing a red tag if it is still tagged with another red tag. Death or Injury to personnel could result.

1-14. DEENERGIZED LINES AND EQUIPMENT.

a <u>Low Voltage (Below 600 Volts</u>) Lines and equipment must be positively proven to be deenergized before work is begun. An approved voltage detector must be used for this test The detector must be checked on a conductor known to be energized both before and after the test on the supposedly deenergized lines or equipment. A voltmeter known to be in good condition may be used in lieu of the voltage detector if an energized conductor IS not available. All energized conductors or equipment within reach of technicians must be covered with insulating material or approved rubber protective equipment. Lines and equipment to be worked on should be grounded unless it is considered undesirable by the supervisor. When putting in new conductors adjacent to or near energized conductors, the new conductors must be effectively grounded, and treated as if energized.

b <u>Intermediate Voltage (600 to 5.000 Volts</u>). (1) Lines and equipment, even though covered by a Safe Clearance, must be considered energized until positively proven to be deenergized. An approved voltage detector must be used for this purpose. The voltage detector must be checked on a conductor known to be energized both before and after the test on the supposedly deenerglzed lines and equipment. If an energized conductor is not available for the check, the detector may be checked on a spark plug of a running gasoline motor.

(2) After the lines or equipment have been proven to be deenergized, temporary grounds must be installed on first pole on each side of the location of the work. When installing temporary grounds, make ground connection first. Before making connection to line, test for static discharge with a switch stick as an added precaution. When removing temporary grounds, disconnect ground connection last.

(3) All lines or equipment (energized at 600 to 5,000 volts between conductors) within reach of technicians or which must be climbed through must be covered with rubber line hose, insulator hoods, blankets, or isolated with suitable barriers. A technician that changes position, before starting the new work, must cover or barricade any energized or grounded conductor or equipment coming within reach.

(4) Before working near energized equipment at the substation, shut it off properly and install suitable barriers and warning signs.

(5) Before cable is cut or an opening is made in the lead sheath or sleeve, be sure cable is identified by supervisor by checking duct location with that shown on working print. The working print must be checked against the facility engineer's map records. In addition, check identity by listening on cable with exploring coil for pulsating beat of interrupter signal.

(6) After cable has been identified and grounded, remove a 3 inch (76 mm) strip of lead around cable and test with two voltage detectors, one at a time, at two or more points around cable at center of exposed insulation.

(7) When cutting cable, place hacksaw on the exposed cable insulation adjacent to and touching the grounded lead sheath or temporary ground on sheath before cutting.

(a) High Voltage (Over 5,000 Volts).

1 Observe precautions of step b(1), above.

2 Apply temporary grounds as outlined in step b(2), above.

3 Observe precautions of step b(3), above.

4 Maintain minimum body clearance from energized lines and equipment in accordance with Table 1-4.

5 Observe precautions of step b(4), above.

6 Do not touch or approach reactors and connected equipment unless proved to be deenergized and grounded.

7 Discharge electrolytic and oxide film lightning arresters by grounding and shorting the horn gaps.

CHAPTER 2

OPERATING INSTRUCTIONS

WARNING

Only properly trained and qualified personnel should operate this equipment. Do not operate the generator set unless the chassis ground terminal Is connected to a suitable ground. The generator neutral line is grounded through a transformer for ground fault protection. The generator neutral line must be grounded. Failure to comply with this warning could cause loss of life and/or severe damage to equipment.

SECTION I. OPERATING PROCEDURES

2-1. GENERAL. This section provides Information on how to operate the generator set under normal conditions. Conditions other than those covered in Section III of this chapter and where the generator set is functioning properly are considered normal The location and function of the controls and Instruments necessary for operating the generator set are presented in Figure 2-1 through Figure 2-12 and Table 2-1 through Table 2-12. The purpose of these figures and tables is to enable the operator to become familiar with these controls and indicators prior to actually operating the equipment. Take the time to study these figures and tables while inspecting the actual equipment. The knowledge gained will greatly improve your ability to operate the generator set. The step-by-step operating Instructions for starting the generator set are presented beginning with Figure 2-13. The operating procedures are followed by detailed Instructions on how to apply an electrical load to the generator, then by procedures for stopping the set. If equipment malfunctions, refer to the troubleshooting and maintenance procedures In Chapter 3.

2-2. QUALIFICATION AND LICENSING OF PERSONNEL . Qualification and licensing of operator personnel shall be In accordance with:

a. (A) U S Army qualification and licensing shall be In accordance with AR 350-224, TB600-1, and USAFESA Supplement 1 to TB600-1

b. (N) U.S. Navy qualification and licensing shall be accomplished by the local commands licensing agency where the generator unit is deployed

2-3. CONTROLS AND INSTRUMENTS . The purpose, location, and normal operating readings or setting of generator set controls and instruments are illustrated in Figure 2-1 through Figure 2-12 and described in Table 2-1 through Table 2-12.

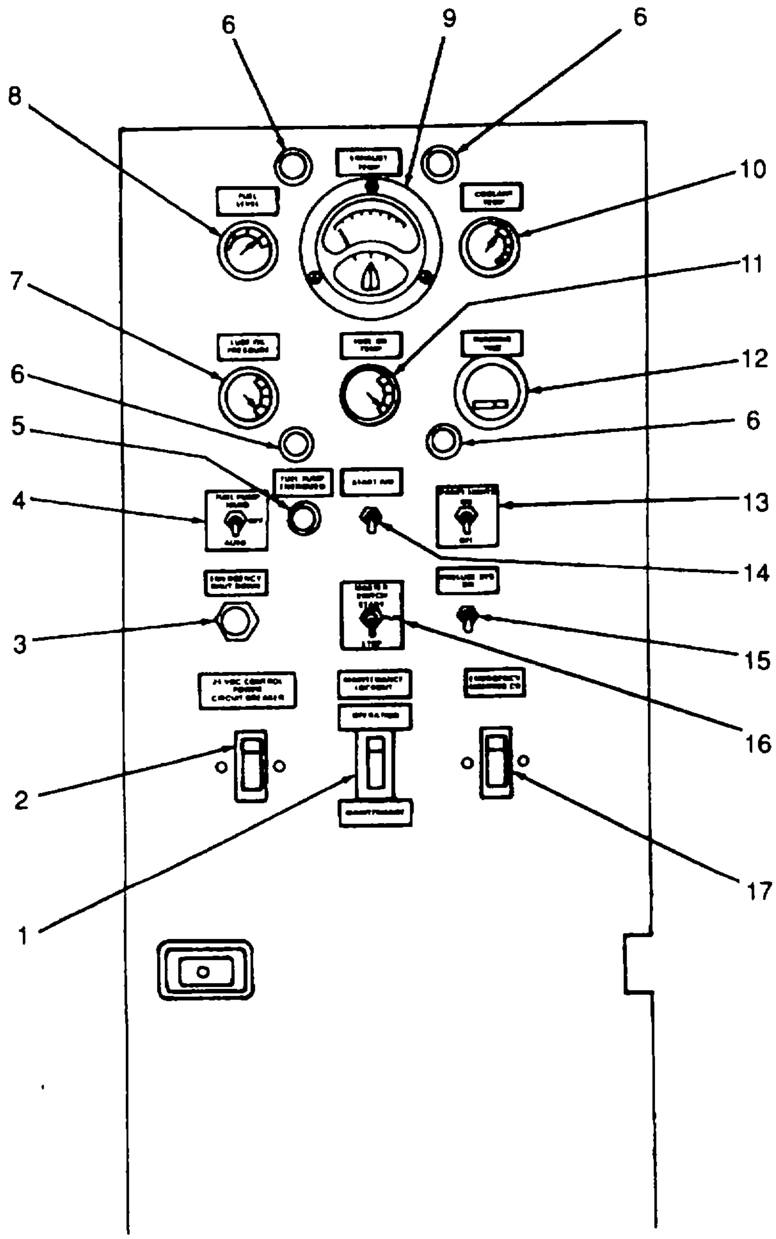


Figure 2-1. Engine Control Panel C, Controls and Instruments

Table 2-1. Engine Control Panel C, Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-1, 1	MAINTENANCE LOCKOUT switch S100	When set to LOCKOUT, disconnects battery power from DC control circuits	OPERATE
Figure 2-1, 2	24 V DC CONTROL POWER CIRCUIT BREAKER CB1	When set to ON, DC control circuits are operable CB1 will automatically open If control circuit current exceeds 20 amperes	ON
Figure 2-1, 3	EMERGENCY SHUTDOWN push-button S7	If pressed while operating, EMER-GENCY SHUTDOWN pushbutton S7 will stop the engine by cutting off air to the turbochargers and de- energize fuel solenoid valve.	--
Figure 2-1, 4	FUEL PUMP switch S8	When set to AUTO, the fuel transfer system will fill the fuel tank (from an external source) when the fuel level becomes low When set to HAND, the fuel transfer system will short cycle on and off When set to OFF, the fuel transfer system will not operate	AUTO
Figure 2-1, 5	FUEL PUMP ENERGIZED Indicator DS107	Lights to indicate fuel transfer Indicator pump motor 8103 Is operating.	Dark
Figure 2-1, 6	Panel Lights DS26, DS27, DS28, and DS29	Illuminate engine control panel C.	Dark
Figure 2-1, 7	LUBE OIL PRESSURE gage M1	Indicates engine oil pressure. (413.7 to 620.6 kPa)	60 to 90 psi
Figure 2-1, 8	FUEL LEVEL gage M4	Indicates fuel tank level. empty	Greater than
Figure 2-1, 9	EXHAUST TEMP gage M6	Indicates exhaust temperature at turbocharger outlets	800 to 1000°F (427 to 5380C)
Figure 2-1, 10	COOLANT TEMP gage M3	Indicates engine water temperature at the thermostats	180 to 200°F (82 to 930C)
Figure 2-1, 11	LUBE OIL TEMP gage M2	Indicates engine oil temperature	180 to 230°F (82 to 110°C)
Figure 2-1, 12	TIME TOTALIZING meter M5	Indicates how many hours the genera-tor set has run.	--
Figure 2-1, 13	PANEL LIGHTS switch S1	When set to ON, panel lights DS26 to DS29 illuminate.	OFF
Figure 2-1, 14	START AID switch S10	When set to ON and released, a me-tered amount of ether is Injected into the engine intake No ether is injected until switch is released	OFF

Table 2-1. Engine Control Panel C, Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-1, 15	PRELUBE SYS switch S5	When set to ON, prelube pump B3 and LUBE OIL PRESSURE gage Ml are energized When set to off, LUBE OIL PRESSURE gage Is connected to the generator set run circuit.	OFF (down)
Figure 2-1, 16	MASTER SWITCH S9	When set to START, the starter motors will crank and the engine will start When set to STOP, engine fuel supply is cut off and the engine stops. When released, this spring-loaded switch moves to the RUN position	RUN
Figure 2-1, 17	EMERGENCY LIGHTING CB, CB2	When set to ON, generator set emergency lights will illuminate if set is not operating and utility power Is not available.	ON

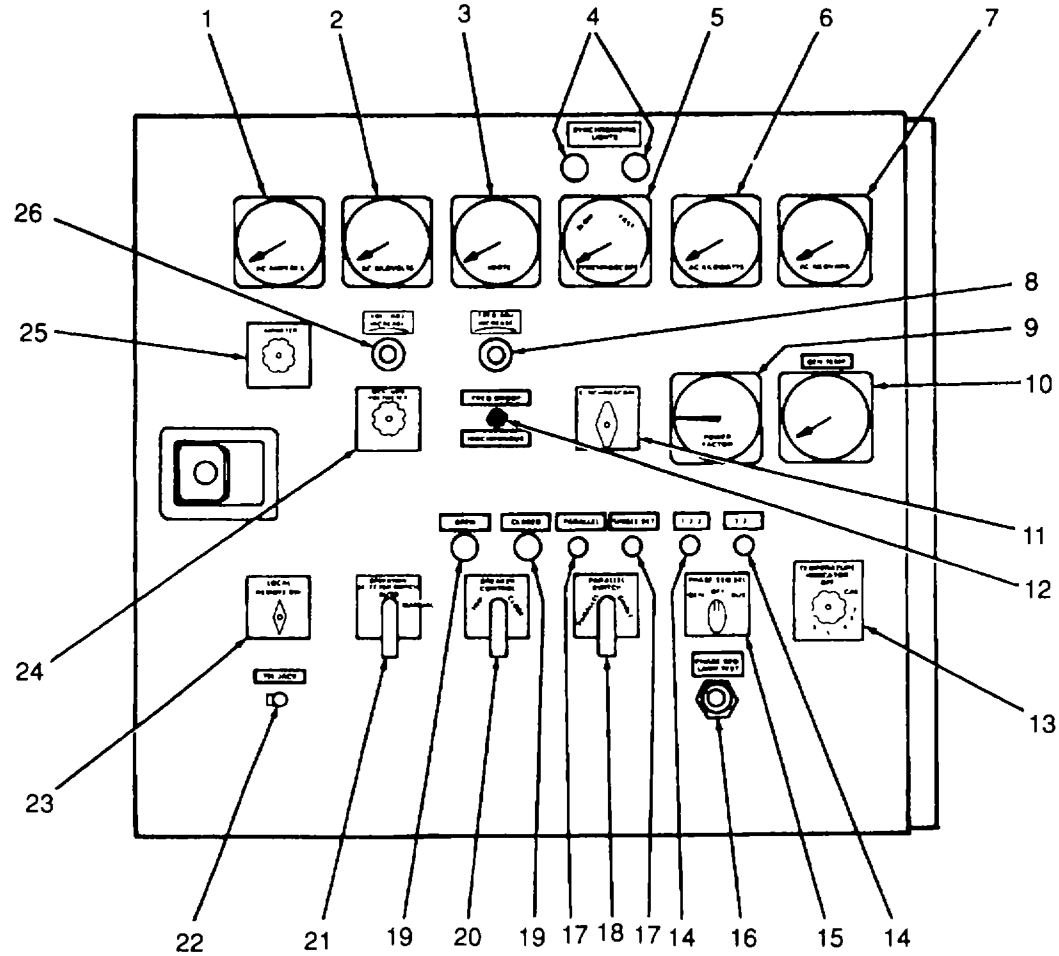


Figure 2-2. Generator Control Panel B, Controls and Instruments

Table 2-2. Generator Control Panel B, Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-2, 1	AC AMPERES meter M102	Indicates load current on a selected phase	50 Hz - 119 60 Hz - 130 Varies with load.
Figure 2-2, 2	AC KILOVOLTS meter M101	Indicates voltage between selected lines	50 Hz - 3800 60 Hz - 4160
Figure 2-2, 3	FREQUENCY meter M103	Indicates frequency of generator set output.	50 or 60
Figure 2-2, 4	SYNCHRONIZING LIGHTS DS110 and DS111	Used when paralleling to bring an incoming set on-line in phase	Both lights dark

Table 2-2. Generator Control Panel B, Controls and Instruments (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-2, 5	SYNCHROSCOPE M106	Used with SYNCHRONIZING LIGHTS DS110 and DS111 when paralleling. When the SYNCHROSCOPE pointer is at the 12 o'clock position, DS110 and DS111 will be dark. Shows phase relationship between on-line and incoming units.	--
Figure 2-2, 6	AC KILOWATTS meter M107	Indicates kilowatt output of generator set.	50 Hz - 625 60 Hz - 750
Figure 2-2, 7	AC KILOVARS meter M108	Indicates kilovar output of generator set.	50 Hz - 469 60 Hz - 562
Figure 2-2, 8	FREQ ADJ rheostat R102	Provides adjustments of generator set frequency In single set operation or load in parallel operation	--
Figure 2-2, 9	POWER FACTOR meter M104	Indicates power factor of generator set output. LAG Indicates an Inductive load. LEAD indicates a capacitive load.	50 Hz - 0.8 60 Hz - 0.8
Figure 2-2, 10	GEN TEMP meter M105	Indicates temperature of generator G1 windings at selected points	Normal ambient to 150°F (66°C)
Figure 2-2, 11	SYNCHROSCOPE switch S115.	Used to turn SYNCHROSCOPE M106 ON or OFF.	OFF.
Figure 2-2, 12	FREQUENCY DROOP/ ISOCHRONOUS switch S117	Used to select ISOCHRONOUS or FREQUENCY DROOP paralleling	
Figure 2-2, 13	TEMPERATURE INDICATOR switch S113	Used with GEN TEMP meter M105 to read generator G1 temperature at one of the six equally spaced points around the stator.	--
Figure 2-2, 14	Phase sequence lights (1-2-3, 3-2-1) DS112 and DS113	Used with PHASE SEQ SEL. SW S119 to compare generator and bus phase sequence.	Dark
Figure 2-2, 15	PHASE SEQ. SEL. SW S119	When set to GEN or BUS, indicates whether phase is 1-2-3 or 3-2-1.	Both GEN and BUS should indicate same phase sequence.
Figure 2-2, 16	PHASE SEQ LAMP TEST pushbutton S116	Used to test phase sequence lights DS112 and DS113.	When button is pressed, DS112 and DS113 should light.
Figure 2-2, 17	PARALLEL Indicator DS35 and SINGLE SET indicator DS36	Indicates setting of PARALLEL Switch S6.	
Figure 2-2, 18	PARALLEL switch S6	Used to select PARALLEL or SINGLE set operation.	
Figure 2-2, 19	OPEN indicator DS33 and CLOSED indicator DS34	Indicates whether load circuit breaker CB101 Is OPEN or CLOSED.	CLOSED indicator DS34 lit, OPEN indicator DS33 dark.

Table 2-2. Generator Control Panel B, Controls and Instruments (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-2, 20	BREAKER CONTROL switch S4	Used to open and close load circuit breaker CB101.	--
Figure 2-2, 21	OPERATION SELECTOR SWITCH S3	When set to MANUAL, the generator set must be manually operated from the control room or remote control module. When set to AUTO, the generator set is controlled by the site requirement module	--
Figure 2-2, 22	TEL JACK J15	Allows for voice communication, via headsets, between the control room and the engine compartment or RCM	--
Figure 2-2, 23	LOCAL REMOTE switch S2	When set to LOCAL, the generator set is operable from the control room When set to REMOTE, the remote control module Is used to operate the set.	--
Figure 2-2, 24	GEN/BUS VOLTMETER switch S112	Used with AC KILOVOLTS meter M101 to read generator set or bus line voltage.	--
Figure 2-2, 25	AMMETER SWITCH S114	Used with AC AMPERES meter M102 to read current output of a selected phase	--
Figure 2-2, 26	VOLT ADJUST rheostat R101	Allows adjustment of generator set voltage output	--

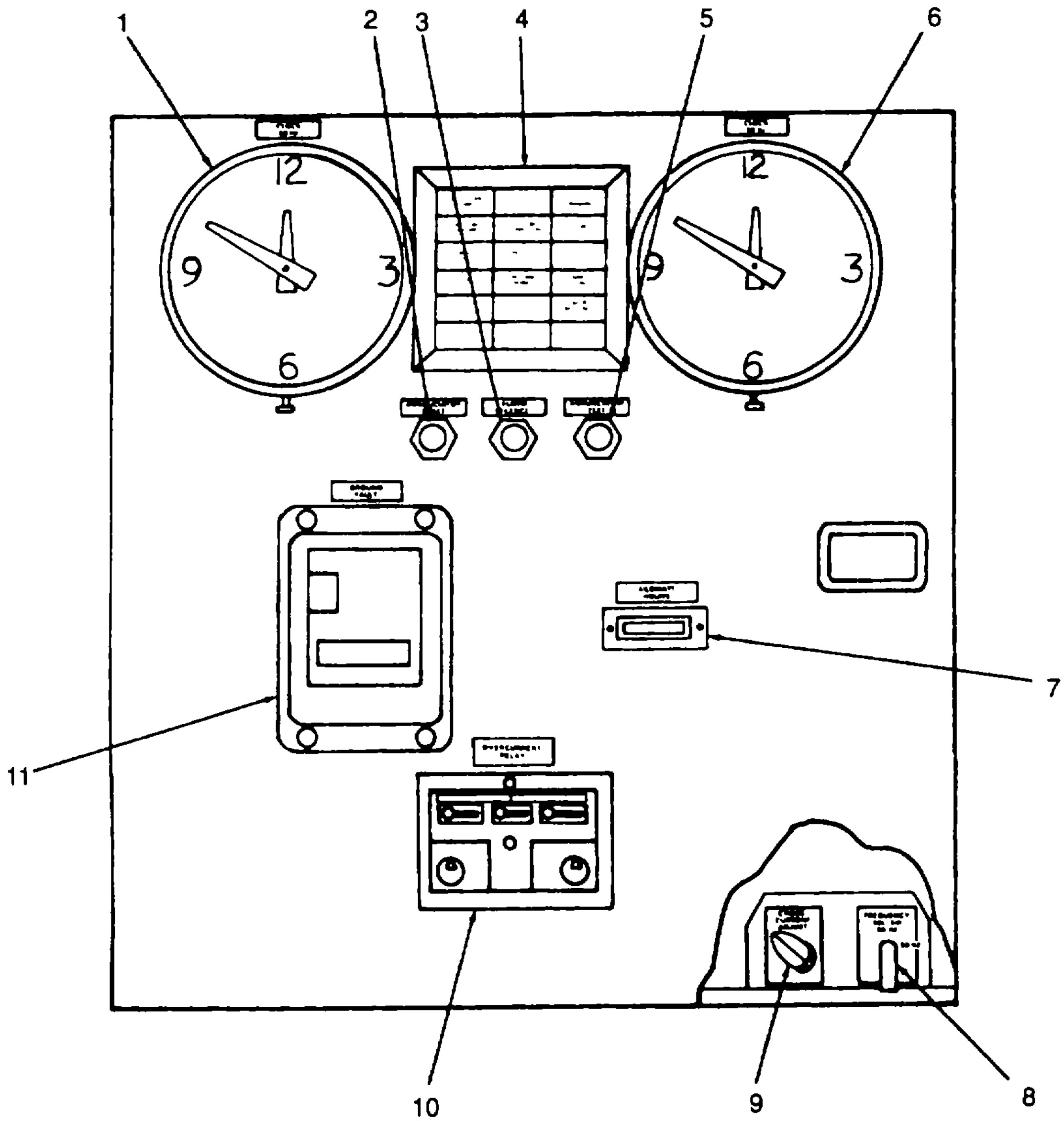


Figure 2-3. Annunciator Control Panel A, Controls and Instruments

Table 2-3. Annunciator Control Panel A, Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-3, 1	CLOCK 60 HZ Ml 110	To indicate time	--
Figure 2-3, 2	ANNUNCIATOR RESET push-button S12	Used to clear annunciator panel A9 after an alarm condition has been corrected.	--
Figure 2-3, 3	ALARM SILENCE pushbutton S16	Used to shut down horn LS1 and stop flasher DS19 after an alarm circuit trips.	--
Figure 2-3, 4	Annunciator Panel A9	In the event of an alarm condition, this back-lit panel will light to show which one of 14 possible alarm conditions caused the alarm. See figure 2-4	Dark
Figure 2-3, 5	ANNUNCIATOR TEST pushbut-ton S15	Used to test annunciator panel A9 and horn LS1 Horn will sound and all lights in annunciator panel will light when but-ton is pressed.	--
Figure 2-3, 6	CLOCK 50 HZ M111	To indicate time.	--
Figure 2-3, 7	KILOWATT HOURS counter CNTR	Indicates total accumulated kilowatt-hour output of the generator set	--
Figure 2-3, 8	FREQUENCY SEL SW S118 operation.	To set the generator set for 50 or 60 Hz	--
Figure 2-3, 9	CROSS CURRENT ADJUST Rheostat R105	Used when paralleling to prevent recir-culating currents between generator sets	--
Figure 2-3, 10	Over current Relay K114	Used to trip open load circuit breaker in event of overload current or short circuit. See figure 2-5.	--
Figure 2-3, 11	GROUND FAULT Relay K 115	Used to trip open load circuit breaker CB101 in event of current flow in neu-tral.	--

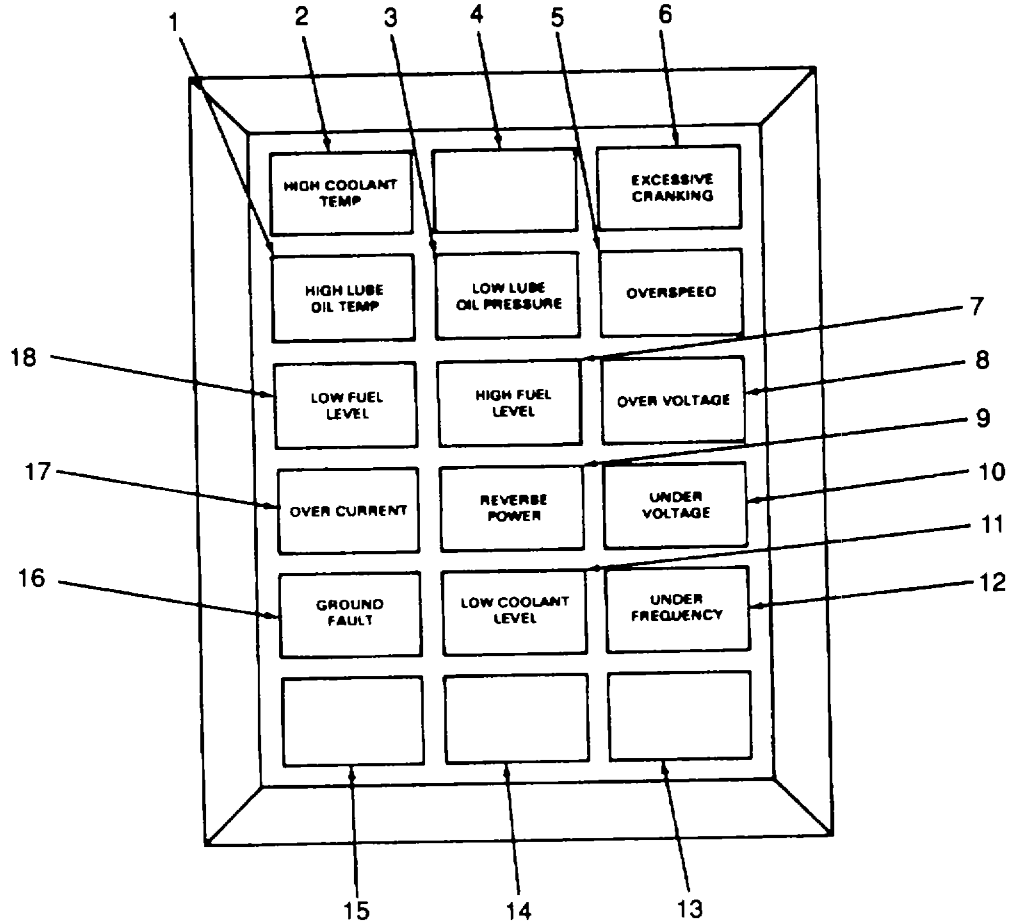


Figure 2-4. Annunciator Panel A9 Indicators

Table 2-4. Annunciator Panel A9 Indicators

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-4, 1	HIGH LUBE OIL TEMP Indicator A9DS4	Indicates that oil temperature switch OT2 has sensed an engine oil temperature of 242 to 248°F (118 to 120°C) or higher.	Dark
Figure 2-4, 2	HIGH COOLANT TEMP Indicator A9DS3	Indicates that coolant temperature warning switch WT2 has sensed an engine water temperature of 206 to 216°F (97 to 99°C) or higher.	Dark

Table 2-4. Annunciator Panel A9 Indicators (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-4, 3	LOW LUBE OIL PRESSURE indicator A9DS2	Indicates that oil pressure shutdown switch OP2 has sensed an engine oil pressure of 37 to 41 psi (267 to 271 KPa) or lower	Dark
Figure 2-4, 4	Spare Indicator A9DS12	To allow for the future addition of a new alarm circuit or to be used as a spare if an alarm circuit fails.	Dark
Figure 2-4, 5	OVERSPEED indicator A9DS1	Indicates that overspeed switch SS3 has sensed an engine speed greater than 2200 rpm.	Dark
Figure 2-4, 6	EXCESSIVE CRANKING Indicator A9DS13	Indicates that crank cycle timer M7 has put the generator set through fourconsecutive start cycles but the engine failed to start.	Dark
Figure 2-4, 7	HIGH FUEL LEVEL indicator A9DS6	Indicates that high fuel level switch FL4 has sensed a high fuel condition in the generator set fuel tank	Dark
Figure 2-4, 8	OVERVOLTAGE indicator A9DS7	Indicates that overvoltage relay K110 has sensed that line-to-line voltage of generator G1 line T1, T2, and/or T3 has risen to 4730 f 100 V ac, or higher, for 3 ± 1 seconds.	Dark
Figure 2-4, 9	REVERSE POWER Indicator A9DS10	Indicates that reverse power relay K109 has sensed that generator G1 has been motonng (receiving current instead of delivering current)	Dark
Figure 24, 10	UNDERVOLTAGE indicator A9DS8	Indicates that undervoltage relay Kill has sensed that line-to-line voltage of generator G1 line T1, T2, and/or T3 has fallen below 3540 V ac for more than 1.5 ± 1 seconds	Dark
Figure 2-4, i1	LOW COOLANT LEVEL indicator A9DS1 5	Indicates that coolant level warning switch S13 has sensed an unacceptably low level of coolant in the radiator.	Dark
Figure 24, 12	UNDER FREQUENCY indicator A9DS14	Indicates that under frequency relay K107 (60 hertz operation) or K108 (50 hertz operation) has sensed abnormally low frequency output from generator G1.	Dark
Figure 2-4, 13	Spare indicator A9DS16	To allow for the future addition of a new alarm circuit or to be used as a spare if an alarm circuit fails	Dark
Figure 2-4, 14	Spare indicator A9DS17	To allow for the future addition of a new alarm circuit or to be used as a spare If an alarm circuit fails	Dark

Table 2-4. Annunciator Panel A9 Indicators (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-4, 15	Spare indicator A9DS18	To allow for the future addition of a new alarm circuit or to be used as a spare If an alarm circuit fails.	Dark
Figure 2-4, 16	GROUND FAULT indicator A9DS11	Indicates that ground fault relay Kl15 has sensed a ground fault potential of 506 V ac or more for 1 second	Dark
Figure 2-4, 17	OVERCURRENT indicator A9DS9	Indicates that overcurrent relay K114 has sensed excessive current In generator G1 line T1, T2, and/or T3	Dark
Figure 2-4, 18	LOW FUEL LEVEL indicator A9DS5	Indicates that low fuel level switch FL3 has sensed low fuel In the generator set fuel tank.	Dark

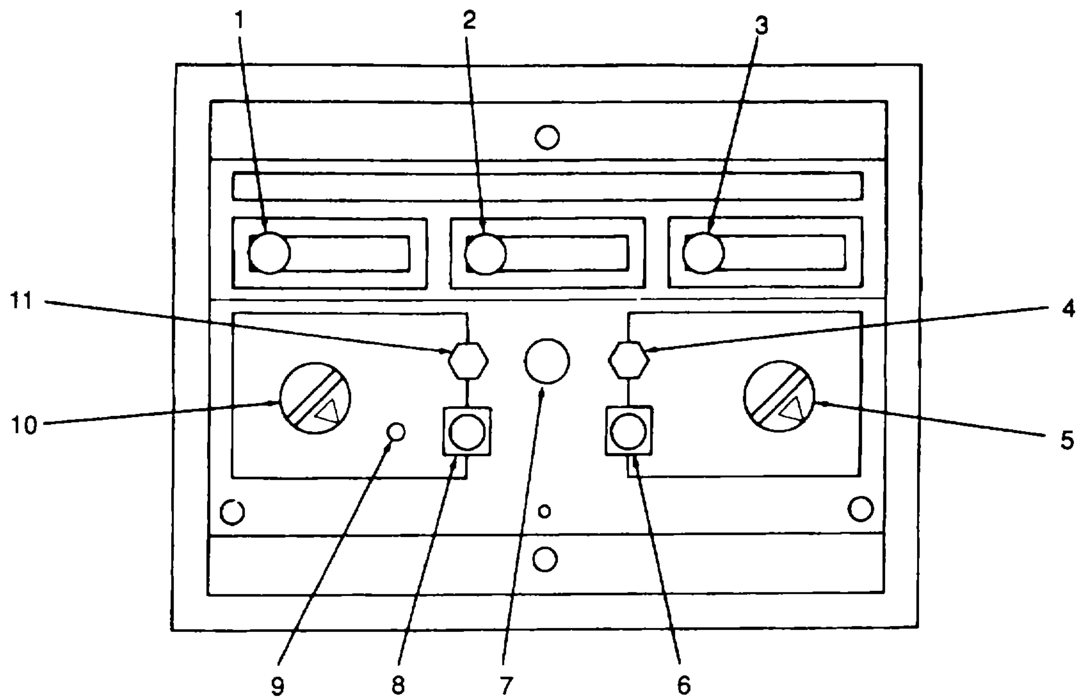


Figure 2-5. Overcurrent Relay K114 Controls and Instruments

Table 2-5. Overcurrent Relay K114 Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-5, 1	Current Pickup Tap for phase A	Provides for seven pickup settings which are marked In CT secondary amperes When a pin is pulled out, that phase switches to the maximum tap setting. The pin may be moved with the relay In service	4
Figure 2-5, 2	Current Pickup Tap for phase B	Provides for seven pickup settings which are marked in CT secondary amperes. When a pin Is pulled out, that phase switches to the maximum tap setting The pin may be moved with the relay In service	4

Table 2-5. Overcurrent Relay K114 Controls and Instruments (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-5, 3	Current Pickup Tap for phase C	Provides for seven pickup settings which are marked In CT secondary amperes. When a pin is pulled out, that phase switches to the maximum tap setting The pin may be moved with the relay. In service.	4
Figure 2-5, 4	TRIP test pushbutton for INST function	This pushbutton, recessed to prevent accidental operations, will produce a trip signal and operate the INST target (6, below).	
Figure 2-5, 5	INST dial	Used to select instantaneous pickup settings. The markings around the dial Indicate multiples of pickup tap setting For example, if the phase A tap is set to 6 amperes and the INST dial is set at 8, the INST setting is 6 amperes x 8 = 48 amperes and an instantaneous trip will occur at 48 amperes in phase A of the relay.	3
Figure 2-5, 6	INST target	Operates if INST circuit causes a trip	Dark
Figure 2-5, 7	TARGET RESET pushbutton	Used to reset targets after a trip.	--
Figure 2-5, 8	TIME target	Operates If TIME circuit causes a trip.	Dark
Figure 2-5, 9	TIME vernier adjust	Allows for TIME settings between values marked around TIME dial.	Fully counter-clockwise
Figure 2-5, 10	TIME dial	Used to select one of 10 time-current curves.	10
Figure 2-5, 11	TRIP test pushbutton for TIME function	This pushbutton, recessed to prevent accidental operations, will produce a trip signal and operate the TIME target (8, above)	--

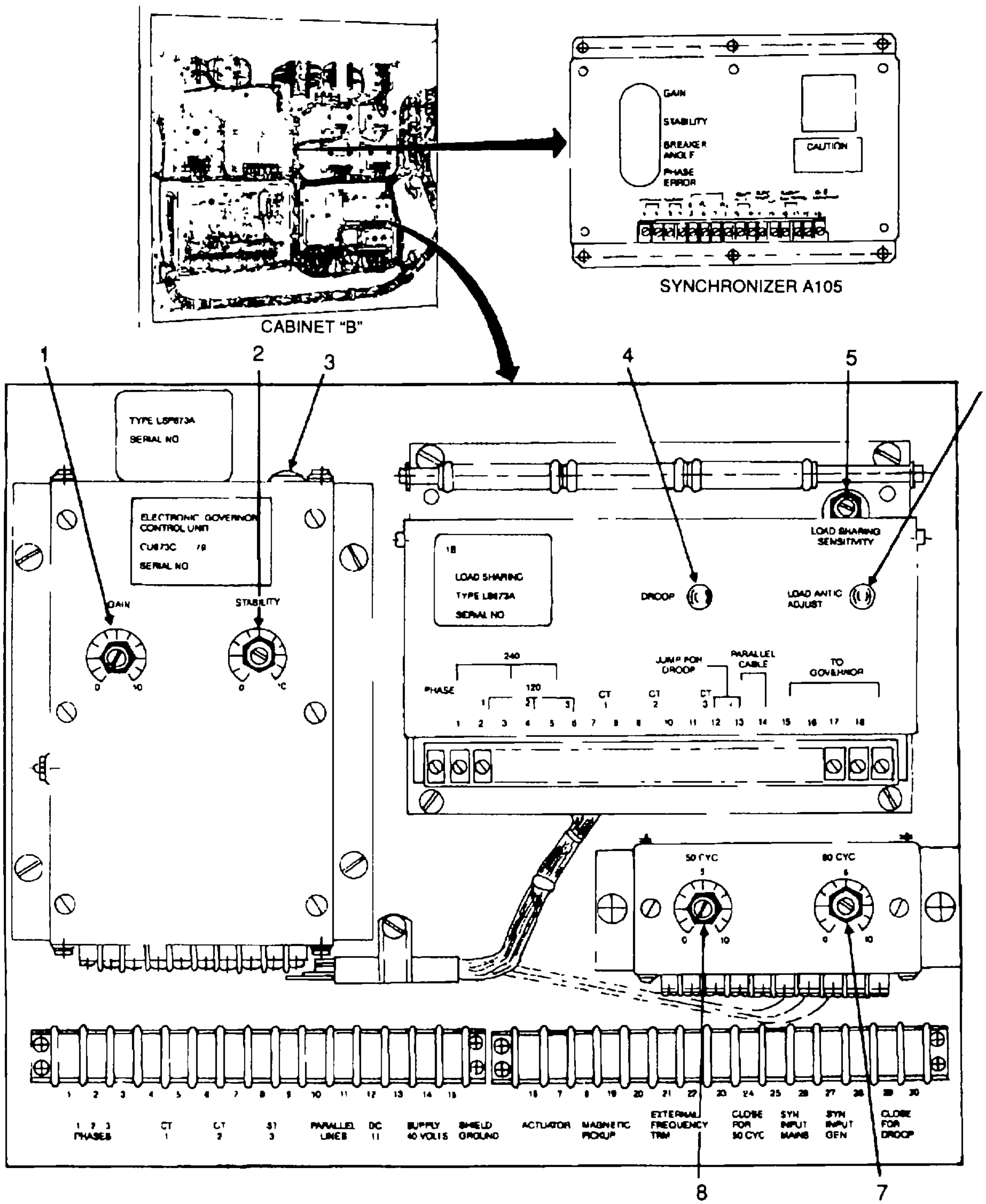
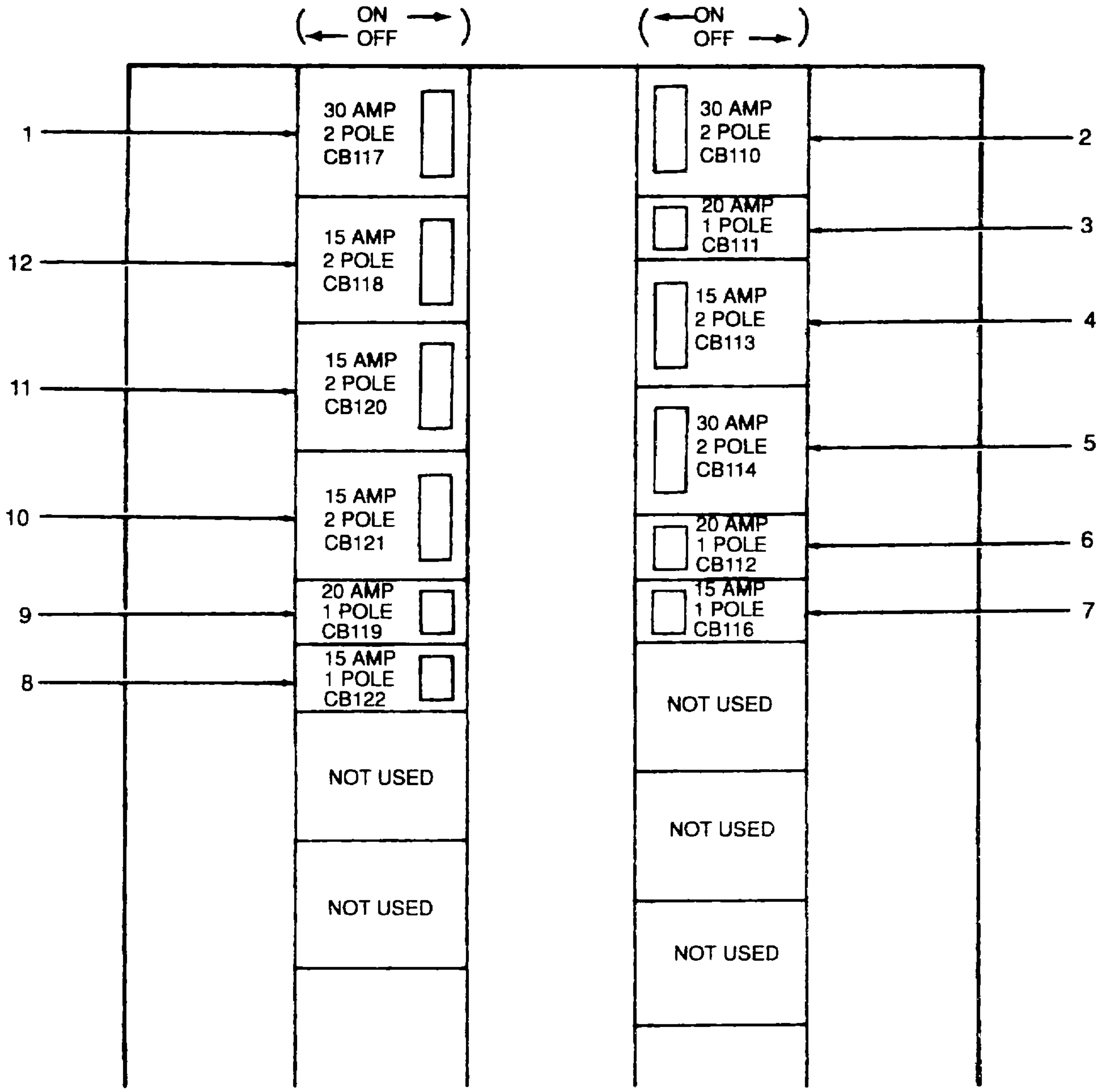


Figure 2-6. Synchronizer and Load Sharing Panel Controls

Table 2-6. Load Sharing Panel A104, Controls

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-6, 1	GAIN	To adjust sensitivity of governor to a change In load. Clockwise adjustment increases gain. Instability will result with full clockwise adjustment. Full counter-clockwise adjustment will result in sluggish control.	--
Figure 2-6, 2	STABILITY	To adjust the governor time constant Time constant is length of time required for engine to return to set speed after change In load Clockwise adjustment shortens the time constant	--
Figure 2-6, 3	FREQUENCY ADJUST	To adjust engine speed on initial factory setup Clockwise adjustment increases the speed setting. Normal frequency adjust rheostat on cabinet B control panel.	--
Figure 2-6, 4	DROOP	To adjust frequency droop for parallel or single unit operation.	--
Figure 2-6, 5	LOAD SHARING SENSITIVITY	To adjust paralleling cable signal when paralleling with other, identical generator sets.	--
Figure 2-6, 6	LOAD ANTIC ADJUST	To adjust governor response under load application	--
Figure 2-6, 7	60 CYC	To provide coarse adjustment of frequency for 60 Hz operation	--
Figure 2-6, 8	50 CYC	To provide coarse adjustment of frequency for 50 Hz operation	--

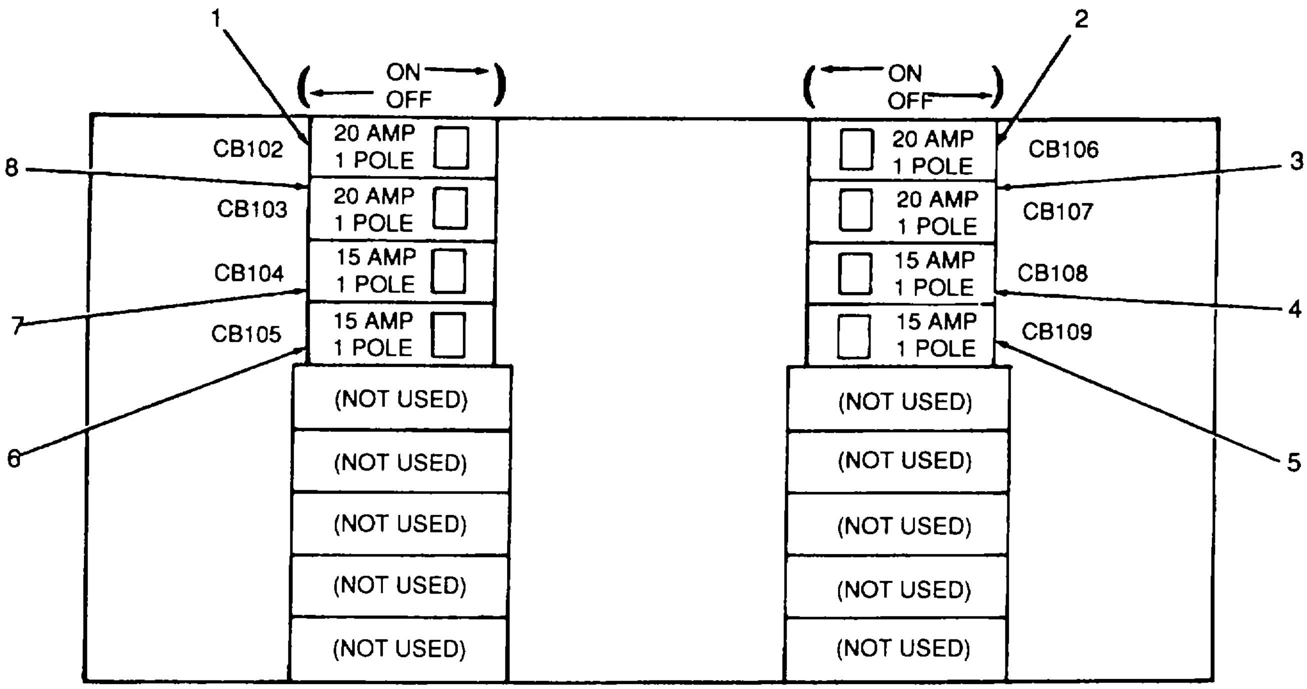


NOTE
CIRCUIT BREAKERS ARE SHOWN SET TO THEIR NORMAL OPERATING POSITIONS.

Figure 2-7. Distribution Panel DP2 Controls

Table 2-7. Distribution Panel DP2, Controls

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-7, 1	Coolant and oil heater (LB) circuit breaker CB117	To provide power and circuit protection to coolant heater H101 and lube oil heater H113	ON
Figure 2-7, 2	Coolant heater (RB) circuit breaker CB110	To provide power and circuit protection to coolant heater H102.	ON
Figure 2-7, 3	Spare circuit breaker CB111	To be used as a spare, If required	OFF
Figure 2-7, 4	Switchgear heater circuit breaker CB113	To provide power and circuit protection to heaters H105, H106, and H107 switchgear.	ON
Figure 2-7, 5	Spare circuit breaker CB114	To be used as a spare, if required	OFF
Figure 2-7, 6	Switchgear heater circuit breaker CB112	To provide power and circuit protection to humidistat S107 and contactor Kl17	ON
Figure 2-7, 7	Battery charger circuit breaker CB116	To provide power and circuit protection to battery charger BC1	ON
Figure 2-7, 8	Fuel transfer system and coolant heater circuit breaker CB122	To provide power and circuit protection to fuel transfer solenoid L102, fuel transfer pump contactor K106, and coolant heater contactor K104	ON
Figure 2-7, 9	Spare circuit breaker CB119	To be used as a spare, if required	OFF
Figure 2-7, 10	Fuel transfer pump circuit breaker CB121	To provide power and circuit protection to fuel transfer pump motor B102	--
Figure 2-7, 11	Generator heater to circuit breaker CB120	To provide power and circuit protection generator heaters H109 and H 1 0.	--
Figure 2-7, 12	Control room heaters circuit breaker CB118	To provide power and circuit protection to control room heaters H103 and H 104	OFF(ON in cold weather)



NOTE
CIRCUIT BREAKERS ARE SHOWN SET TO THEIR NORMAL OPERATING POSITIONS.

Figure 2-8. Distribution Panel DP1 Controls

Table 2-8. Distribution Panel DP1, Controls and Indicators

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-8, 1	Control room receptacles circuit breaker CB102	To provide power and circuit protection to control room receptacles J102 and J103	ON
Figure 2-8, 2	Engine room receptacles circuit breaker CB106	To provide power and circuit protection to engine room receptacles J106 and J107	ON
Figure 2-8, 3	Engine room receptacles circuit breaker CB107	To provide power and circuit protection to engine room receptacles J108 and J109.	ON
Figure 2-8, 4	Engine room lighting circuit breaker CB108	To provide power and circuit protection to engine room lights DS103 and DS104.	ON
Figure 2-8, 5	Control room circuit breaker CB109	To provide power and circuit protection to control room fan motor B103.	ON or OFF, as comfort dictates

Table 2-8. Distribution Panel DP1, Controls and Indicators (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-8, 6	Station power available relay circuit breaker CB105	To provide power and circuit protection to relay K100. f utility power fails, K100 win deenergize and turn on emergency lights DS20 through DS23 if EMERGENCY LIGHTING circuit breaker CB2 (17, Figure 2-1) is set to ON.	ON (OFF if generator set is not connected to utility power)
Figure 2-8, 7	Control room lighting circuit breaker CB104	To provide power and circuit protection ON to control room light DS101.	
Figure 2-8, 8	Control room receptacle circuit breaker CB103	To provide power and circuit protection ON to J104 and J105.	

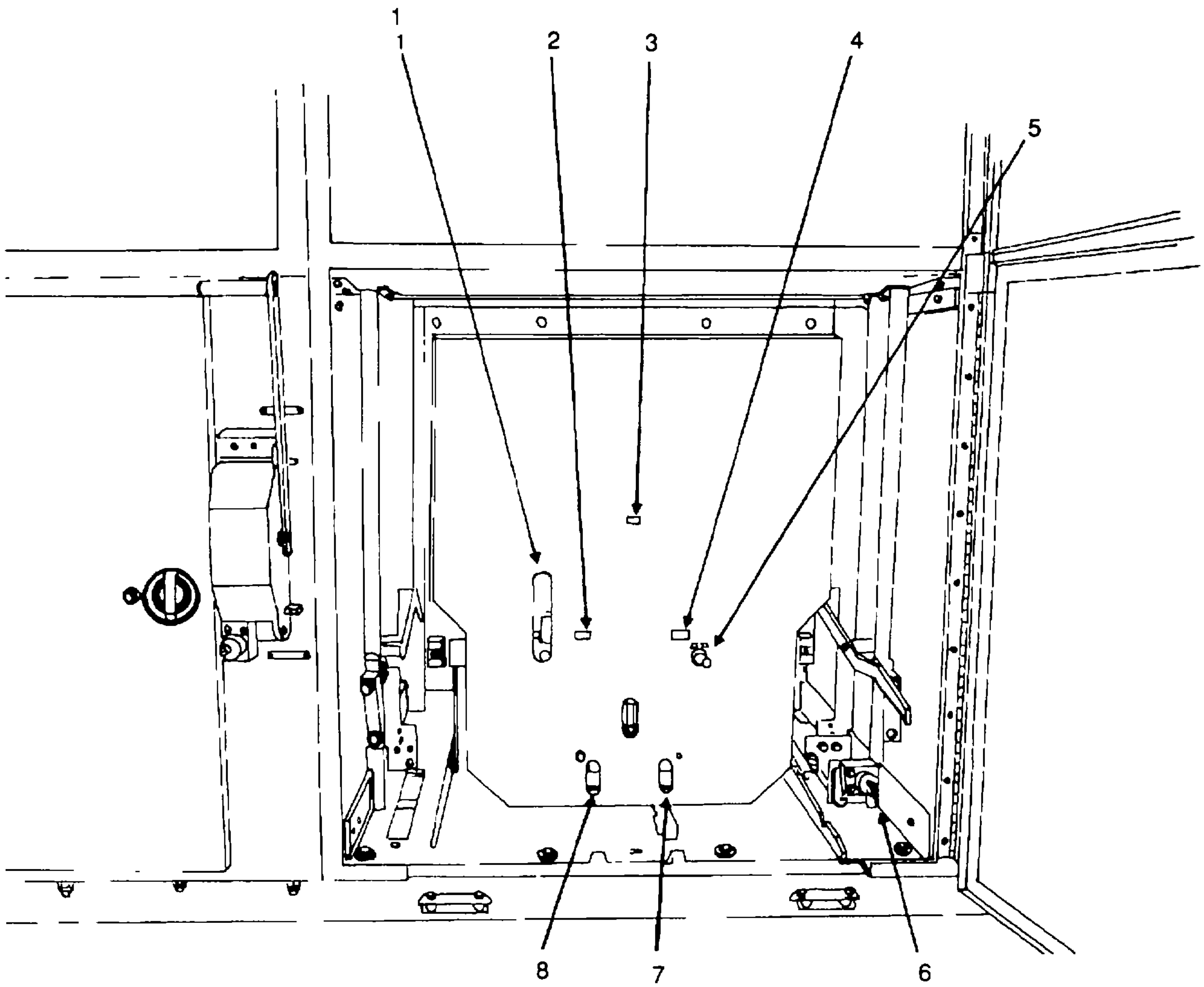


Figure 2-9. Load Circuit Breaker CB101, Controls and Indicators

Table 2-9. Load Circuit Breaker CB101, Controls and Indicators

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-9, 1	MANUAL CHARGING arm	To manually charge the load circuit breaker CB101 drive springs	--
Figure 2-9, 2	MAIN CHARGE indicator	To indicate whether or not the load circuit breaker CB101 drive springs are charged	CHARGE
Figure 2-9, 3	OPERATIONS counter	To indicate how many times the load circuit breaker CB101 has operated	--
Figure 2-9, 4	CONTACTS OPEN/ CLOSED indicator	To indicate whether the load circuit breaker CB101 is open or closed.	CLOSED
Figure 2-9, 5	RACKING handle	To crank the load circuit breaker CB 101 IN to or OUT of the bottom of cabinet B	--
Figure 2-9, 6	Kirk key interlock	To prevent racking in of load circuit breaker CB101 while main disconnect switch S120 (Figure 3-8) is OPEN	Locked with key in lock
Figure 2-9, 7	OPEN tab	To manually open (trip) the load circuit breaker CB101 **CAUTION** **Never manually close load circuit breaker CB101 when utility power or a like generator set power is present at load terminals as this power could be backfed into the generator, causing severe damage to the generator set.**	--
Figure 2-9, 8	CLOSE tab	To manually close the load circuit breaker CB101	

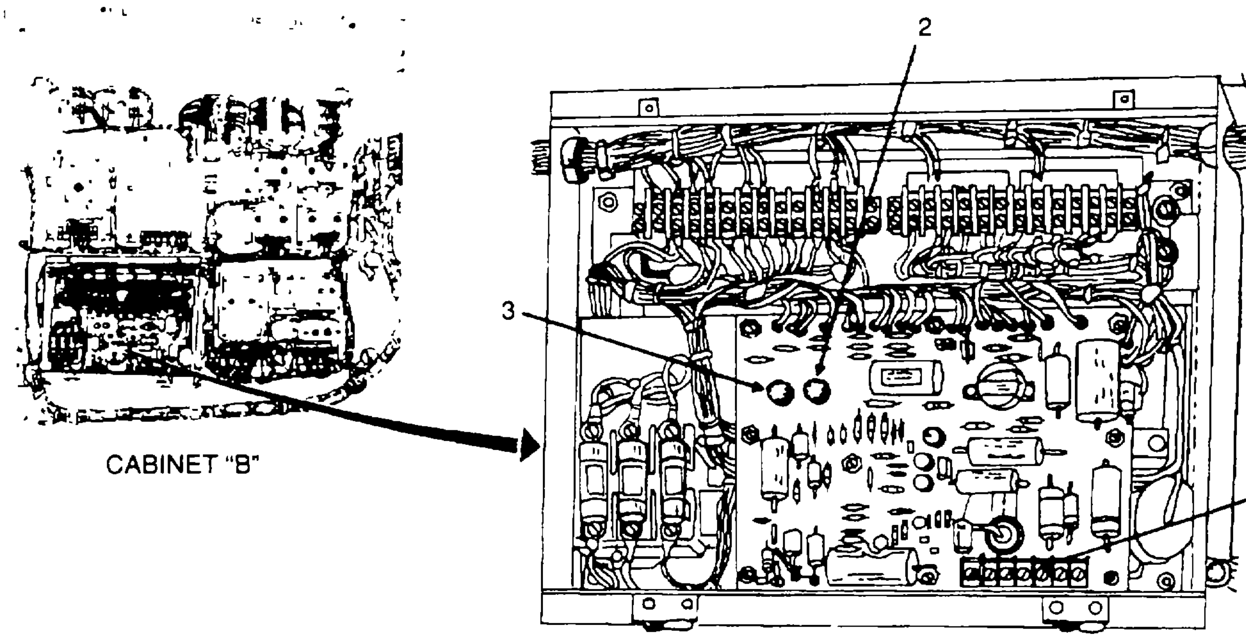


Figure 2-10. Voltage Regulator VR101, Controls

Table 2-10. Voltage Regulator VR101, Controls

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-10, 1	Stability selection links	To adjust exciter and generator time constants	Both links set to SLOW
Figure 2-10, 2	RANGE ADJ VR101R14	To vary the limits of VOLT ADJ rheostat R101 (26, Figure 2-2)	
Figure 2-10, 3	STABILITY ADJ VR101R11	To adjust for stable voltage operation.	

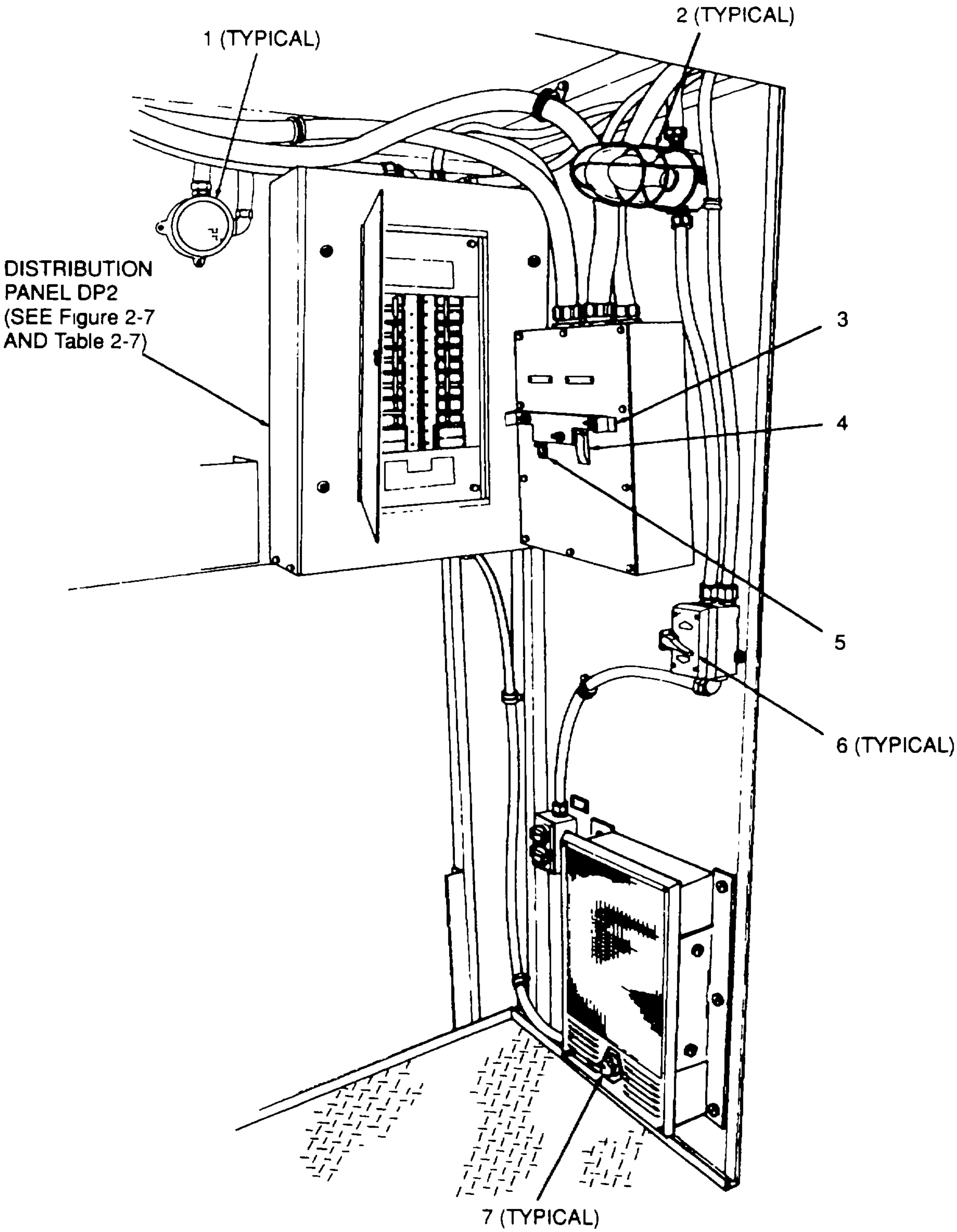


Figure 2-11. Miscellaneous Controls and Instruments

Table 2-11. Miscellaneous Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-11, 1	DC Emergency lights DS20 through DS23	To provide control room and engine room lighting upon failure of set or utility 120 V ac power.	Dark
Figure 2-11, 2	Control room and engine room lights DS101, DS103, and DS104	To provide 120 V ac lighting.	Lit
Figure 2-11, 3	Circuit breaker locking beam	To make It Impossible for SET POWER CB124 and UTILITY POWER CB125 to be ON simultaneously.	--
Figure 2-11, 4	SET POWER circuit breaker CB124	When set to ON, generator set 120 V ac lights are connected to generator set power through set station power transformer T101.	OFF
Figure 2-11, 5	UTILITY POWER circuit breaker CB125	When set to ON, generator set 120 V ac lights and receptacles are connected to utility power through utility station power transformer T103.	ON
Figure 2-11, 6	ON/OFF switches S102, S103, and S104	To switch control room and engine room lights DS101, DS103, and DS104 ON or OFF.	ON
Figure 2-11, 7	Control room heater switches S108 and S109	To operate control room heaters H103 and H104.	

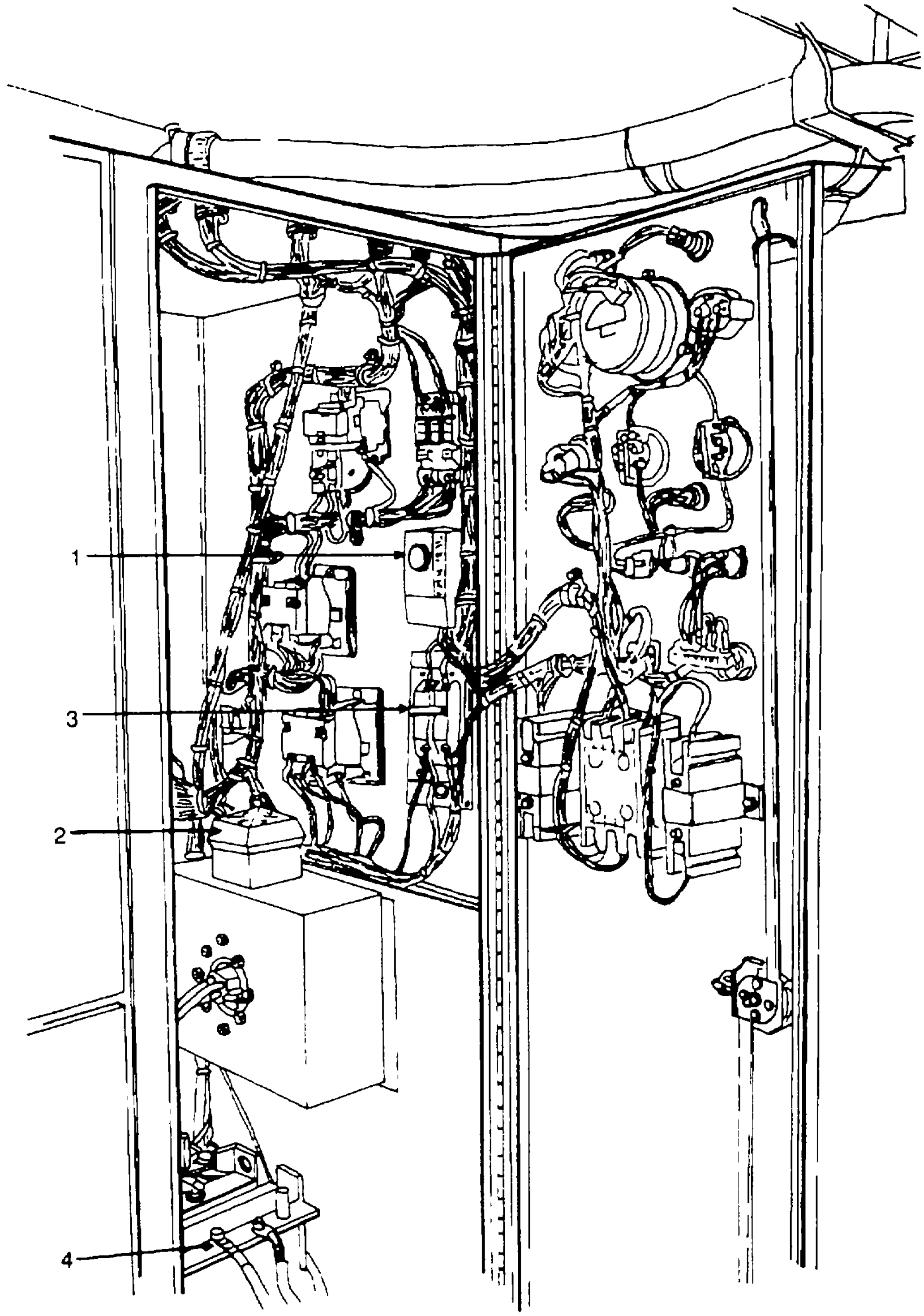


Figure 2-12. Cabinet C, Front Interior Section, As Seen From Control Room

Table 2-12. Cabinet C, Front Interior Section, As Seen From Control Room

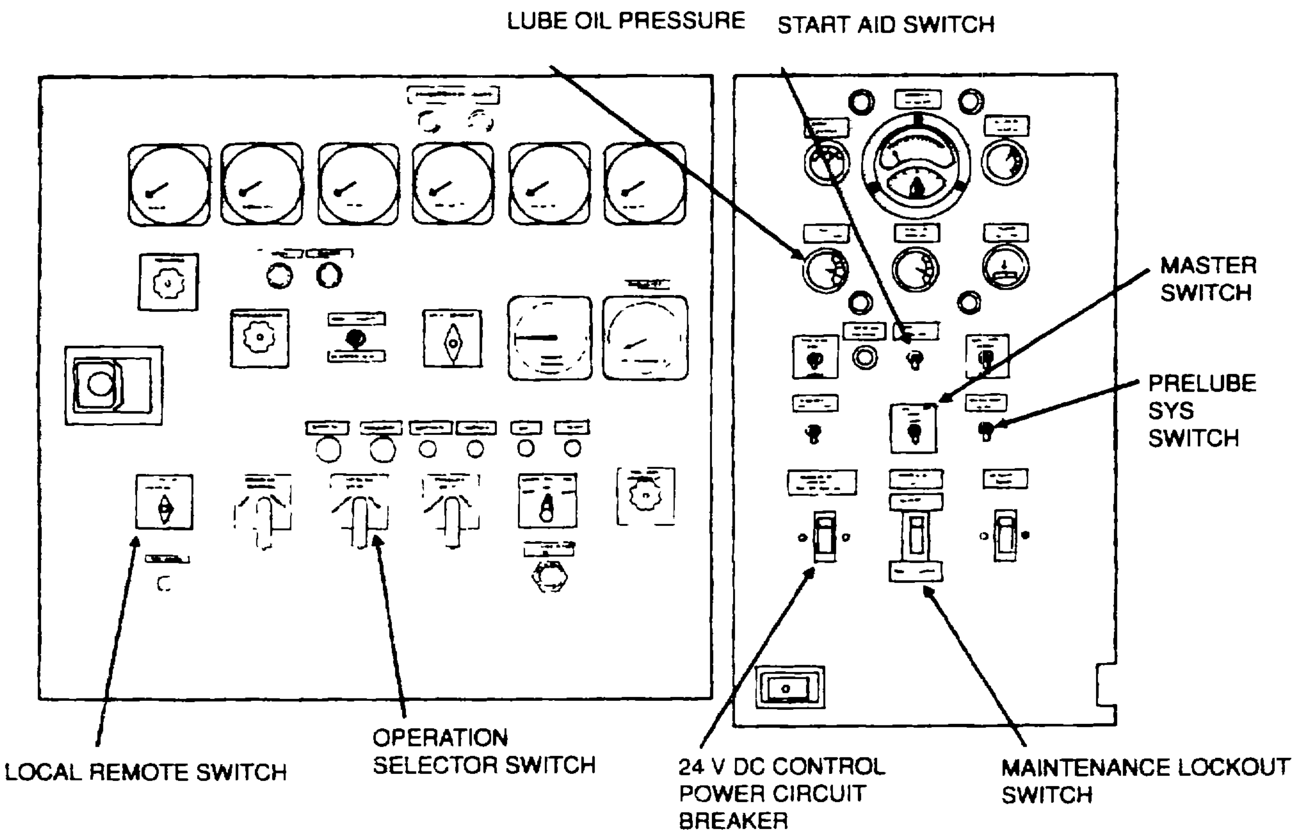
FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-12, 1	Humidistat S107	To control actuation temperature for the switchgear heaters H 105, H 106, and H107	Fully clockwise
Figure 2-12, 2	Annunciator Horn LS1	To provide audio indication of a generator set fault condition	Silent
Figure 2-12, 3	Switchgear Circuit Breaker CB123	To provide power and circuit protection to SET POWER circuit breaker.	ON
Figure 2-12, 4	Set Station Power Transformer T101	Converts 2400 V ac generator set power to 240 V ac and 120 V ac for the generator set circuits	--

2-4. STARTING THE GENERATOR SET. To start the generator set under usual (normal) conditions, proceed as follows:

a. Ensure that organizational maintenance personnel have performed the procedures described In Chapter 4, Section I, "Service Upon Receipt of Equipment".
b. Perform before operation preventive maintenance checks and services (see Table 3-2).
c. Open all shutters on the generator set. Use handle at the base of each shutter assembly to open that shutter and secure in open position with the pin provided (see Figure 3-4). Shut all doors on the generator set.
d. Start the generator set in accordance with Figure 2-13.

2-5. OPERATING THE GENERATOR SET (SINGLE UNIT). To operate the generator set as a single unit, proceed as follows:

a. Start the generator set In accordance with Figure 2-13.
b. Operate the generator set in accordance with Figure 2-14.
c. When in operation, the generator set shall be monitored periodically (at least once an hour) for signs of possible malfunctions.
d. After warmup, lubricating oil pressure and oil level shall remain fairly constant. Check and record level of lubricating oil while engine is running normally If any significant changes occur, maintenance personnel shall be notified
e. Check and record coolant temperature and level with engine running normally. Notify maintenance personnel if coolant temperature or level changes significantly
f. Learn the sounds of a normally running generator set so that any unusual sounds Indicating the possible start of a malfunction may be detected early enough to avoid major damage.
g. To stop generator set, refer to Figure 2-15.



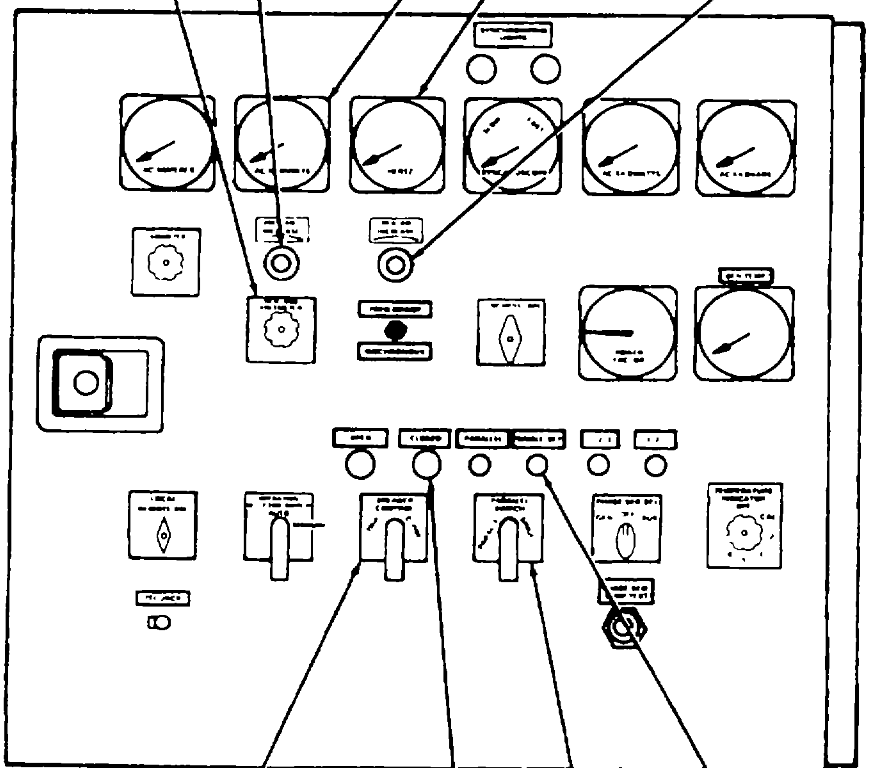
STEP 1. PERFORM PMCS PRESTART CHECKS.
STEP 2. SET <u>24 V DC CONTROL POWER CIRCUIT BREAKER</u> TO <u>ON.</u>
STEP 3. SET <u>MAINTENANCE LOCKOUT</u> SWITCH TO <u>MANUAL.</u>
STEP 4. SET <u>OPERATION SELECTOR</u> SWITCH TO <u>MANUAL..</u>
STEP 5. SET <u>LOCAL REMOTE</u> SWITCH TO <u>LOCAL</u>..

NOTE

WHEN ENGINE TEMPERATURE IS BELOW 40°F (4°C) AND THE PREHEATER HAS NOT BEEN USED, ENGINE ETHER PRIMER MAY BE REQUIRED. TO USE ETHER PRIMER, MOMENTARILY SET START AID SWITCH TO THE ON POSITION AT THE BEGINNING OF THE SECOND, THIRD, OR FOURTH CRANK CYCLE. EACH TIME START AID SWITCH IS SET TO ON AND RELEASED, ETHER IS INJECTED INTO THE ENGINE AIR INTAKE MANIFOLD.

STEP 6. HOLD <u>PRELUBE SYS</u> SWITCH TO WAND WATCH <u>LUBEOIL PRESSURE</u> GAGE FOR RISING OIL PRESSURE. WHEN PRESSURE STABILIZES (WITHIN 2 MINUTES) PROCEED TO NEXT STEP.
STEP 7. SET <u>MASTER SWITCH</u> TO <u>START</u> AND RELEASE TO RUN. (THE ENGINE WILL AUTOMATICALLY CRANK FOR 15 SECONDS AND REST FOR 15 SECONDS, UNTILTHE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES.)
STEP 8. RELEASE <u>PRELUBE SYS</u> SWITCH.

Figure 2-13. Starting Generator Set - Single Unit Operation



STEP 1. START GENERATOR SET (REFER TO Figure 2-13).

STEP 2. ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

STEP 3. SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.

STEP 4. ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4.16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3.8 KILOVOLTS (FOR 50 HERTZ OPERATION).

STEP 5. SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS

STEP 6. SET PARALLEL SWITCH TO, SINGLE SET. SINGLE SET INDICATOR WILL LIGHT.

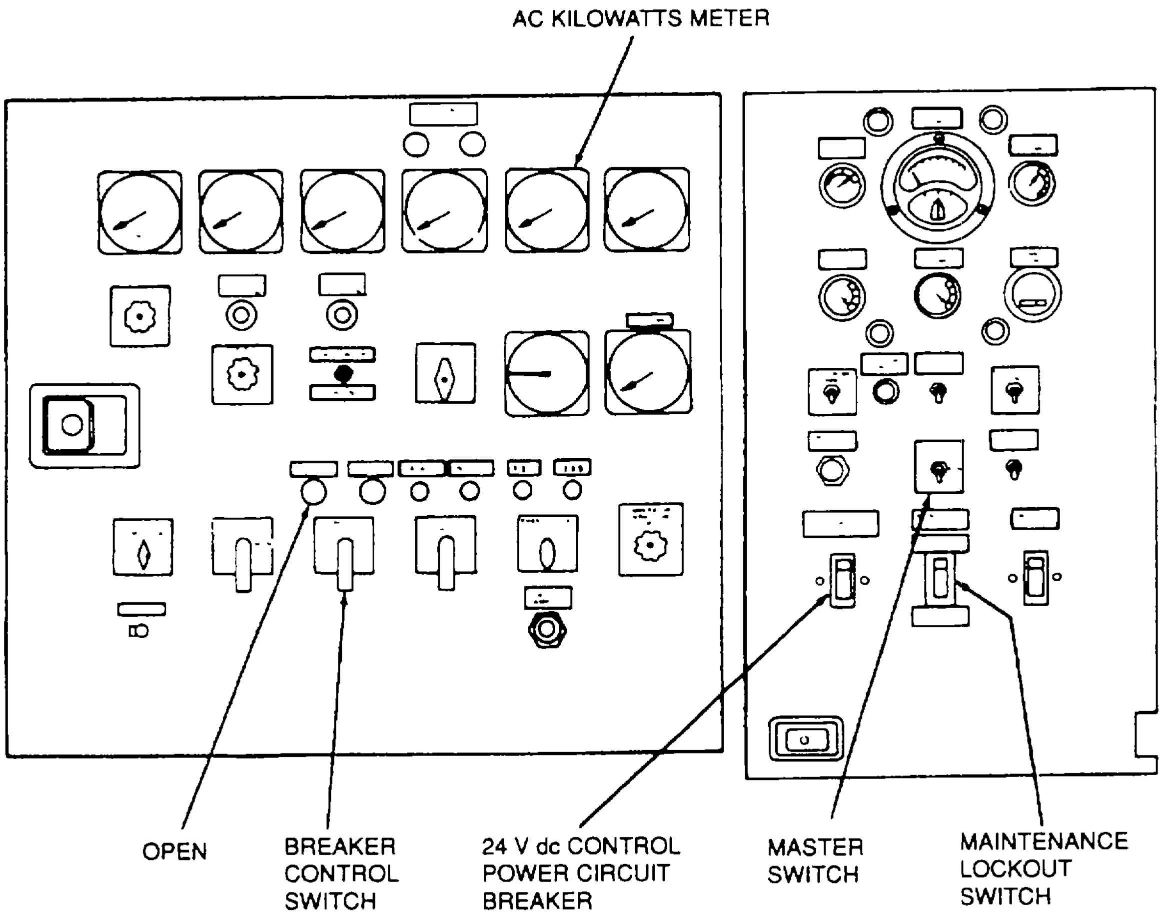
STEP 7. SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.

STEP 8. PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.

STEP 9. PERFORM "DURING OPERATION. PREVENTIVE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.

STEP 10. TO STOP UNIT REFER TO Figure 2-15.

Figure 2-14. Single Unit Operation



STEP 1. SET BREAKER CONTROL SWITCH TO TRIP. OPEN INDICATOR WILL LIGHT.
STEP 2. ALLOW ENGINE TO OPERATE 5 MINUTES AT NO LOAD.
STEP 3. SET MASTER SWITCH TO STOP.
STEP 4. SET MAINTENANCE LOCKOUT SWITCH TO MAINTENANCE.
STEP 5. SET 24v, DC CONTROL POWER CIRCUIT BREAKER TO OFF.

Figure 2-15. Stopping Generator Set - Unit Operation

2-6. PARALLELING THE GENERATOR SET (UNITS IN PARALLEL).

NOTE

These procedures assume that one generator set Is on-line (connected to the distribution feeder lines through switchgear). The set that Is to be paralleled shall be designated the "incoming set"

Refer to Figure 2-16 through Figure 2-19 for parallel operation, and to Figure 2-20 for removing a generator set from parallel operation

When operated In parallel, generator sets must have the same output voltage, frequency, phase relation, and phase sequence before they can be connected to a common distribution bus. Severe damage may occur to the generator sets if these requirements are not met Adjusting engine speed of the Incoming set while observing output frequency, the SYNCHRONIZING LIGHTS, and the SYNCHROSCOPE will bring the phase and frequency into exact agreement. As the phase and frequency approach the same value, the SYNCHRONIZING LIGHTS will gradually turn on and off. When the blinking slows to a rate of once or less per second, close the main circuit breaker of the incoming set while the SYNCHRONIZING LIGHTS are at a point of being dark and the SYNCHROSCOPE is in the 12 o'clock position. Phase sequence has to do with the order in which the generator windings are connected If phase sequence Is not correct, the SYNCHRONIZING LIGHTS will not blink on and off together.

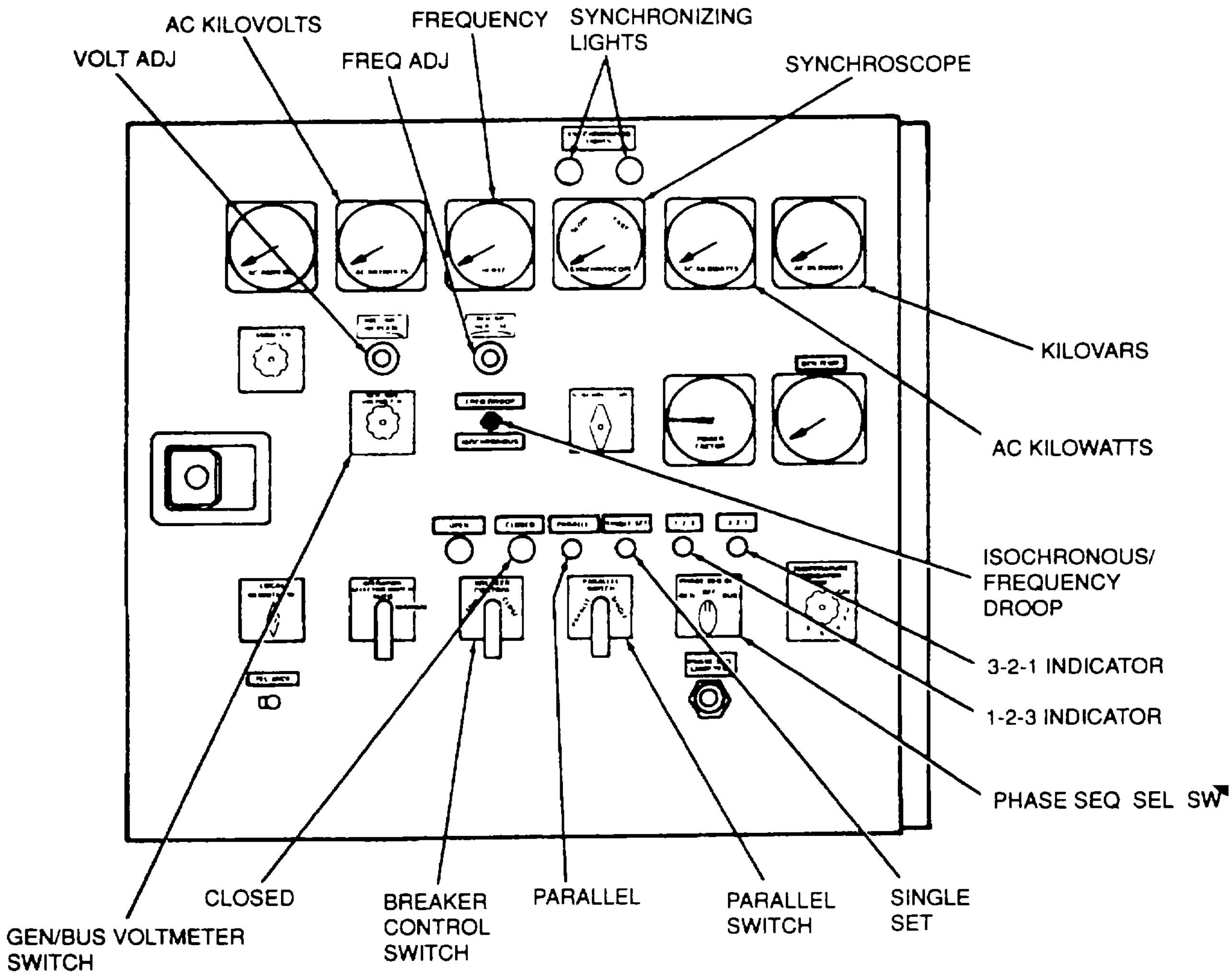
CAUTION

Should either generator set lose speed, "buck", or "shudder" when the incoming set is connected to the distribution feeder lines, immediately set BREAKER CONTROL switch of incoming set to TRIP and recheck paralleling set-up procedures.

When the Incoming set is first connected to the load (through appropriate switchgear) the following may occur if the phase. sequence, voltage, frequency, phase and engine performance are the same, the changeover will be smooth with only the slightest hesitation In engine speed, if each output is slightly out of phase, one of the engines will "shudder" at the point of changeover; if the phase sequence or voltage levels are Incorrect, the reverse power relay will trip on one of the generator sets and open its main circuit breaker contactors, if the Incoming generator set loses speed significantly or almost stalls, the Incoming engine governing system may be defective.

2-7. EMERGENCY STOPPING.

a. To stop the generator set from the control room In an emergency, press the EMERGENCY SHUTDOWN pushbutton S7 on engine control cabinet C (3, Figure 2-1).
b. To stop the generator set from outside the housing In an emergency, pull out the EMERGENCY SHUTDOWN control In the skid base (Figure 1-1)
c. To stop the generator set from the remote control module In an emergency, press the EMERGENCY SHUTDOWN pushbutton S7R (17, Figure 2-21)
d. After stopping generator set In accordance with step a or step c, above reset the two air control valves In accordance with Figure 3-21.
e. After stopping generator set In accordance with step b, above, reset EMERGENCY SHUTDOWN control In skid base (Figure 1-1).



WARNING

MAKE CERTAIN ALL SETS ARE SHUT DOWN AND THAT THERE ARE NO VOLTAGES AT SWITCH GEAR TERMINALS BEING CONNECTED TO INCOMING SET. TAKE EXTREME CARE NOT TO CROSS LO (NEUTRAL) WITH ANY OF THE OTHER PHASES (L1, L2, OR L3). DEATH BY ELECTROCUTION OR SEVERE EQUIPMENT DAMAGE MAY RESULT FROM FAILURE TO HEED THIS WARNING.

STEP 1. CONNECT INCOMING SET AS SHOWN IN FIGURE 2-17.

STEP 2. INSTALL SHORTING PLUG ON ONE REACTIVE LOAD RECEPTACLE OF ON-LINE GENERATOR SET AND EACH INCOMING GENERATOR SET REFER TO FIGURE 2-18.

STEP 3. SET FREQUENCY/ISOCHROUNOUS DROOP SWITCH TO ISOCHRONOUS ON ON-LINE GENERATOR SET AND TO FREQUENCY DROOP ON EACH INCOMING GENERATOR SET.

STEP 4. ENSURE OPERATION OF ON-LINE GENERATOR SET.

STEP 5. ON-LINE SET ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

Figure 2-16. Droop Parallel Operation (Sheet 1 of 2)

STEP 6. ON-LINE SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.
STEP 7. ON-LINE SET: ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 8. ON-LINE SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 9. ON-LINE SET: SET PARALLEL SWITCH TO SINGLE SET. SINGLE SET INDICATOR WILL LIGHT.
STEP 10. ON-LINE SET: SET BREAKER CONTROL SWITCH TO CLOSE. CLOSE INDICATOR WILL LIGHT.
STEP 11. ON-LINE SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 12. START ONE INCOMING GENERATOR SET (REFER TO Figure 2-13).
STEP 13. INCOMING SET ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.
STEP 14. INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.
STEP 15. INCOMING SET ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 16. INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 17. INCOMING SET: CHECK PHASE SEQUENCE USING PHASE SEQ. SEL. SW. AND 1-2-3 AND 3-2-1 INDICATOR LIGHTS. ENSURE THAT SETS ARE IN PHASE BEFORE PROCEEDING
STEP 18. INCOMING SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 19. INCOMING SET: SET SYNCHROSCOPE SWITCH TO ON. SYNCHROSCOPE WILL BEGIN ROTATING AND SYNCHRONIZING LIGHTS WILL BEGIN BLINKING.
STEP 20. INCOMING SET: ADJUST FREQ ADJ RHEOSTAT UNTIL SYNCHRONIZING LIGHTS ARE BLINKING VERY SLOWLY AND SYNCHROSCOPE NEEDLE IS ROTATING SLOWLY IN THE CLOCKWISE (FAST DIRECTION.
STEP 21. INCOMING SET: ADJUST VOLT ADJ RHEOSTAT USING GEN/BUS VOLTMETER SWITCH AND AC KILOVOLTS METER UNTIL GEN AND BUS VOLTAGES ARE IDENTICAL.
STEP 22. INCOMING SET: WHEN SYNCHRONIZING LIGHTS ARE DARK AND SYNCHROSCOPE NEEDLE IS IN 12 O'CLOCK POSITION, SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.
STEP 23. INCOMING SET: SET SYNCHROSCOPE SWITCH TO OFF.
STEP 24. ALL SETS: ADJUST VOLT ADJ AND FREQ ADJ RHEOSTATS TO BALANCE THE LOAD ON ALL SETS AS INDICATED BY THE KILOVARS AND AC KILOWATTS METERS. ADJUST VOLT ADJ TO EFFECT KILOVARS. ADJUST FREO ADJ TO EFFECT KILOWATTS.
STEP 25. IF ADDITIONAL GENERATOR SETS ARE TO BE PARALLELED, REPEAT STEP 12 THROUGH STEP 24, ABOVE, FOR EACH SET.
STEP 26. ALL SETS: ISOCHRONOUS WILL PICK UP LOAD CHANGES BEFORE BASE UNIT LOAD CHANGES WILL AFFECT VOLTAGE AND FREQUENCY OF DROOP-PARALLELED SETS EQUALLY. TO VARY FREQUENCY OR VOLTAGE OUT- PUT OF DROOP-PARALLELED SETS, ADJUST FREQ ADJ OR VOLT ADJ RHEOSTAT THE SAME WAY (INCREASE OR DECREASE) ON BOTH SETS.
STEP 27. ALL SETS: PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.
STEP 28. ALL SETS: PERFORM DURING OPERATION" PREVENTIVE MAINTENANCE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.
STEP 29. TO STOP UNIT REFER TO Figure 2-20.

Figure 2-16. Droop Parallel Operation (Sheet 2 of 2)

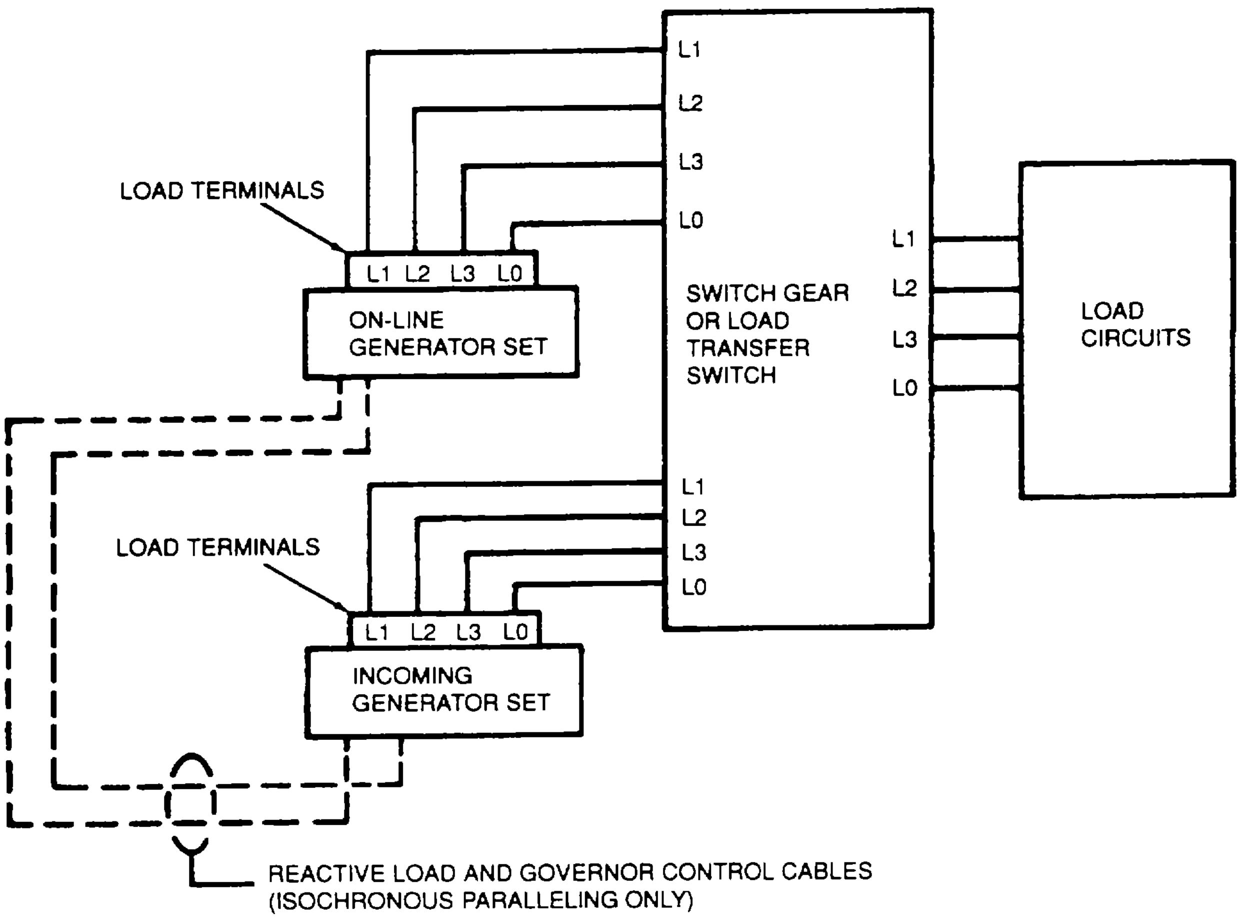
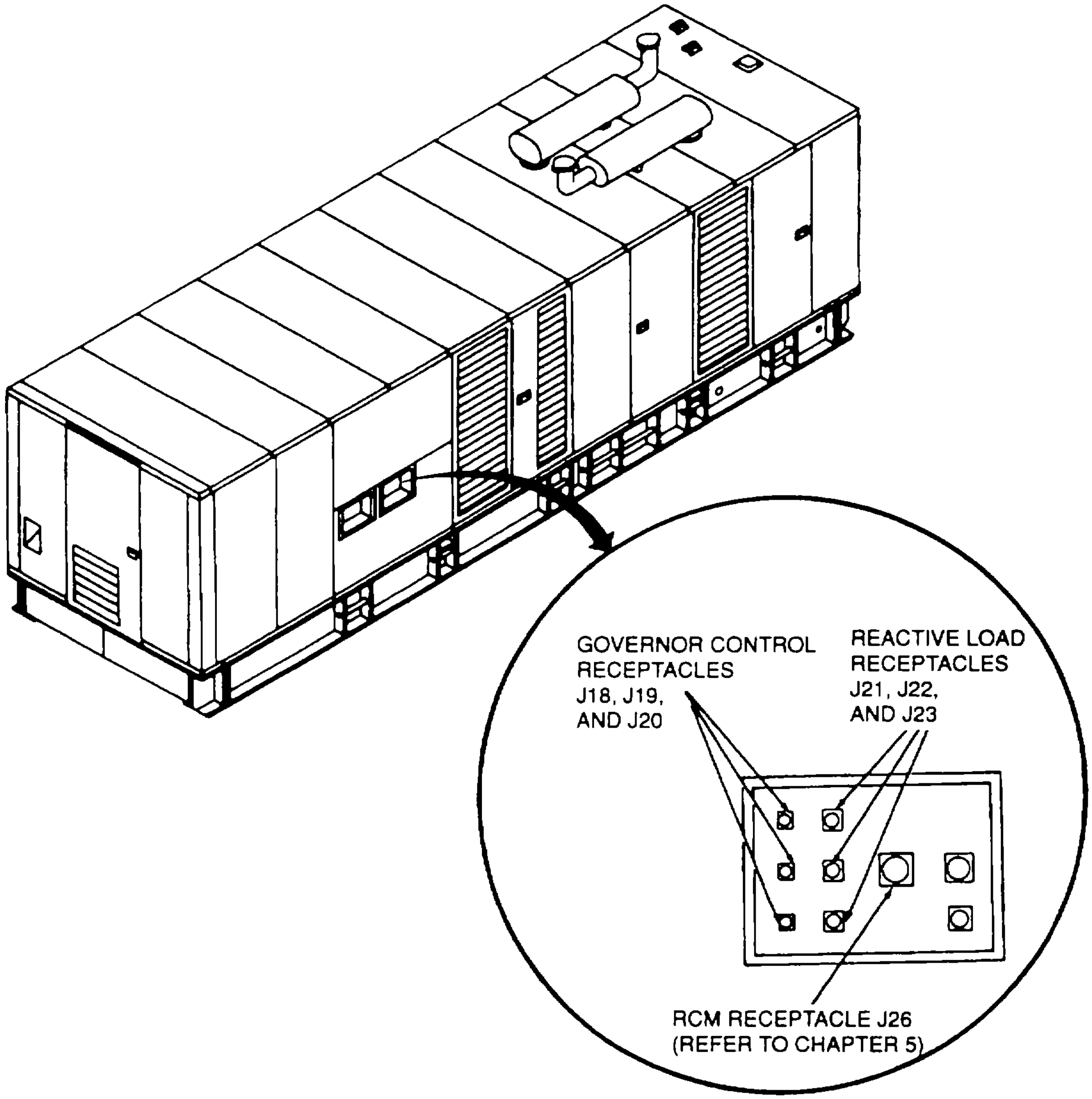


Figure 2-17. Parallel Operation Connection Diagram.

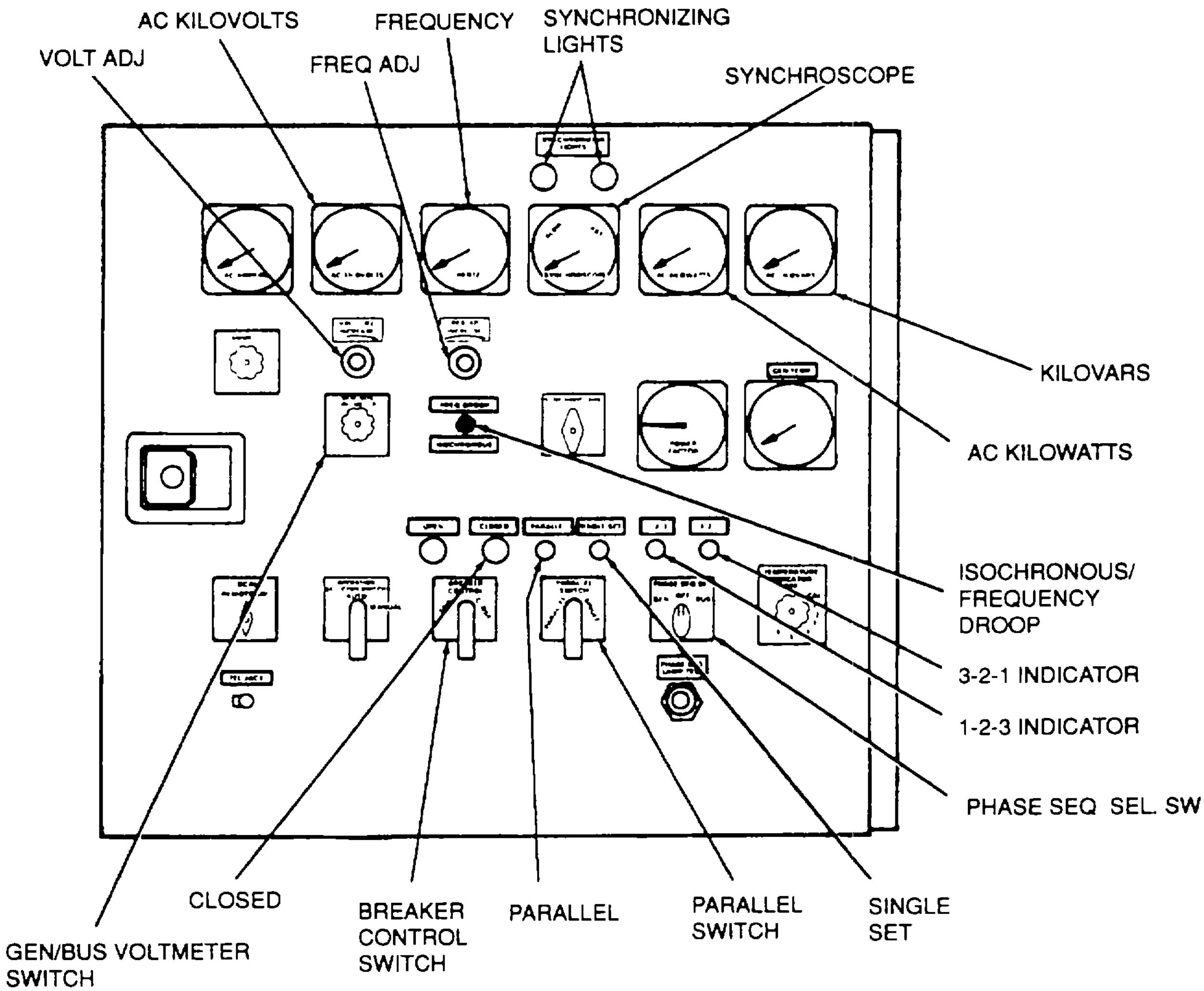


NOTE

1. FOR DROOP PARALLELING, USE NO PARALLELING CABLES AND INSTALL SHORTING PLUG IN ONE OF THE REACTIVE LOAD RECEPTACLES FOR EACH GENERATOR SET TO BE PARALLELED.

2. FOR ISOCHRONOUS PARALLEING, DO NOT USE ANY SHORTING PLUGS AND INSTALL ONE GOVERNOR CONTROL CABLE AND ONE REACTIVE LOAD CABLE BETWEEN THE ON-LINE GENERATOR SET AND EACH INCOMING GENERATOR SET (UP TO 3 INCOMING GENERATOR SETS POSSIBLE).

Figure 2-18. Paralleling Receptacles



WARNING

MAKE CERTAIN ALL SETS ARE SHUT DOWN AND THAT THERE ARE NO VOLTAGES AT SWITCH GEAR TERMINALS BEING CONNECTED TO INCOMING SET. TAKE EXTREME CARE NOT TO CROSS LO (NEUTRAL) WITH ANY OF THE OTHER PHASES (L1, L2, OR L3). DEATH BY ELECTROCUTION OR SEVERE EQUIPMENT DAMAGE MAY RESULT FROM FAILURE TO HEED THIS WARNING

STEP 1. ALL SETS: REMOVE SHORTING PLUGS (REFER TO figure 2-18) INTERCONNECT REACTIVE LOAD COMPENSATION AND GOVERNOR CONTROL PARALLELING CIRCUIT CABLES (REFER TO Figure 2-17) FOR ALL SETS TO BE PARALLELED.

STEP 2. ALL SETS: SET FREQUENCY DROOP/ISOCHRONOUS SWITCH TO ISOCHRONOUS.

STEP 3. ENSURE OPERATION OF ON-LINE GENERATOR SET.

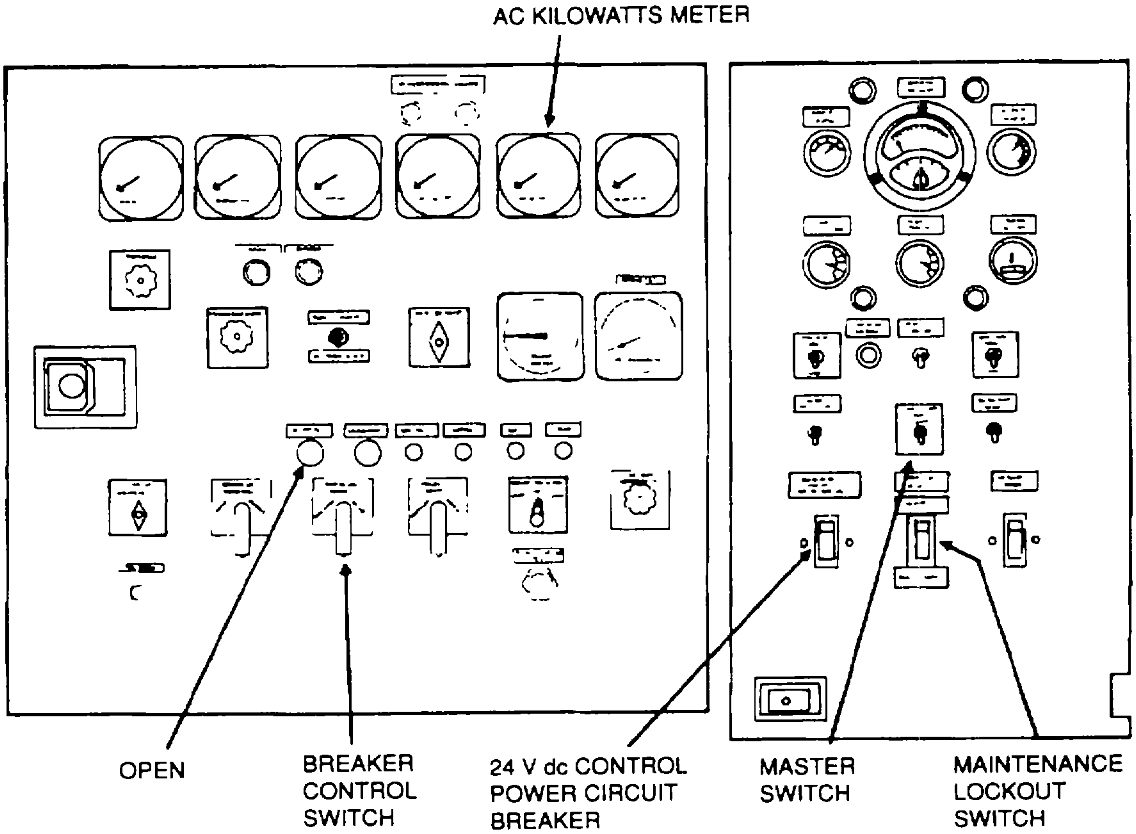
STEP 4. ON-LINE SET: ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

STEP 5. ON-LINE SET: SET GEN/8US VOLTMETER SWITCH TO GEN 3-1.

Figure 2-19. Isochronous Parallel Operation (Sheet 1 of 2)

STEP 6. ON-LINE SET ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 7. ON-LINE SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2 VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 8. ON-LINE SET: SET PARALLEL SWITCH TO SINGLE SET. SINGLE SET INDICATOR WILL LIGHT.
STEP 9. ON-LINE SET: SET BREAKER CONTROL SWITCH TO CLOSE CLOSED INDICATOR WILL LIGHT.
STEP 10. ON-LINE SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 11. START ONE INCOMING GENERATOR SET (REFER TO Figure 2-13).
STEP 12. INCOMING SET: ADJUST FREQ ADJ RHEOSTAT FOR A FRFOUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.
STEP 13. INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.
STEP 14. INCOMING SET ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4.16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 15. INCOMING SET. SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2 VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 16. INCOMING SET CHECK PHASE SEQUENCE USING PHASE SEQ. SEL. SW AND 1-2-3 AND 3-2-1 INDICATOR LIGHTS ENSURE THAT SETS ARE IN PHASE BEFORE PROCEEDING.
STEP 17. INCOMING SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 18. INCOMING SET: SET SYNCHROSCOPE SWITCH TO ON. SYNCHROSCOPE WILL BEGIN ROTATING AND SYNCHRONIZING LIGHTS WILL BEGIN BLINKING.
STEP 19. INCOMING SET: ADJUST FREQ ADJ RHEOSTAT UNTIL SYNCHRONIZING LIGHTS ARE BLINKING VERY SLOWLY AND SYNCHROSCOPE NEEDLE IS ROTATING SLOWLY IN THE CLOCKWISE (FAST) DIRCTION.
STEP 20. INCOMING SET: ADJUST VOLT ADJ RHEOSTAT USING GEN/BUS VOLTMETER SWITCH AND AC KILOVOLTS METER UNTIL GEN AND BUS VOLTAGES ARE IDENTICAL..
STEP 21. INCOMING SET: WHEN SYNCHRONIZING LIGHTS ARE DARK AND SYNCHROSCOPE NEEDLE IS IN 12 O'CLOCK POSITION, SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.
STEP 22. INCOMING SET: SET SYNCHROSCOPE SWITCH TO OFF.
STEP 23. ALL SETS ADJUST VOLT ADJ AND FREQ ADJ RHEOSTATS TO BALANCE THE LOAD ON ALL SETS AS INDICATED BY THE KILOVARS AND AC KILOWATTS. METERS ADJUST VOLT ADJ TO EFFECT KILOVARS. ADJUST FREQ ADJ TO EFFECT KILOWATTS.
STEP 24. IF ADDITIONAL GENERATOR SETS ARE TO BE PARALLELED, REPEAT STEP 11 THROUGH STEP 23, ABOVE. FOR EACH SET.
STEP 25. ALL SETS: PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.
STEP 26. ALL SETS: PERFORM *DURING OPERATION" PREVENTIVE MAINTENANCE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.
STEP 27. TO STOP UNIT REFER TO Figure 2-20.

Figure 2-19. Isochronous Parallel Operation (Sheet 2 of 2)



CAUTION

PRIOR TO REMOVAL OF GENERATOR SET(S) FROM PARALLEL OPERATION, MAKE SURE LOAD DOES NOT EXCEED FULL LOAD RATING OF GENERATOR SET(S) REMAINING ONLINE. SEVERE DAMAGE TO EQUIPMENT MAY RESULT FROM FAILURE TO MEET THIS CAUTION.

STEP 1. REDUCE LOAD UNTIL AC KILOWATTS METER INDICATES 60 KW OR LESS.
STEP 2. OUTGOING SET: SET BREAKER CONTROL SWITCH TO TRIP. OPEN INDICATOR WILL LIGHT.
STEP 3. OUTGOING SET: ALLOW ENGINE TO OPERATE 5 MINUTES AT NO LOAD.
STEP 4. OUTGOING SET: SET MASTER SWITCH TO STOP.
STEP 5. OUTGOING SET: SET MAINTENANCE LOCKOUT SWITCH TO MAINTENANCE.
STEP 6. 24v, DC CONTROL POWER CIRCUIT BREAKER TO OFF.
STEP 7. TO STOP ON-LINE SET REFER TO FIGURE 2-15.

Figure 2-21. Remote Control Panel, Controls and Instruments

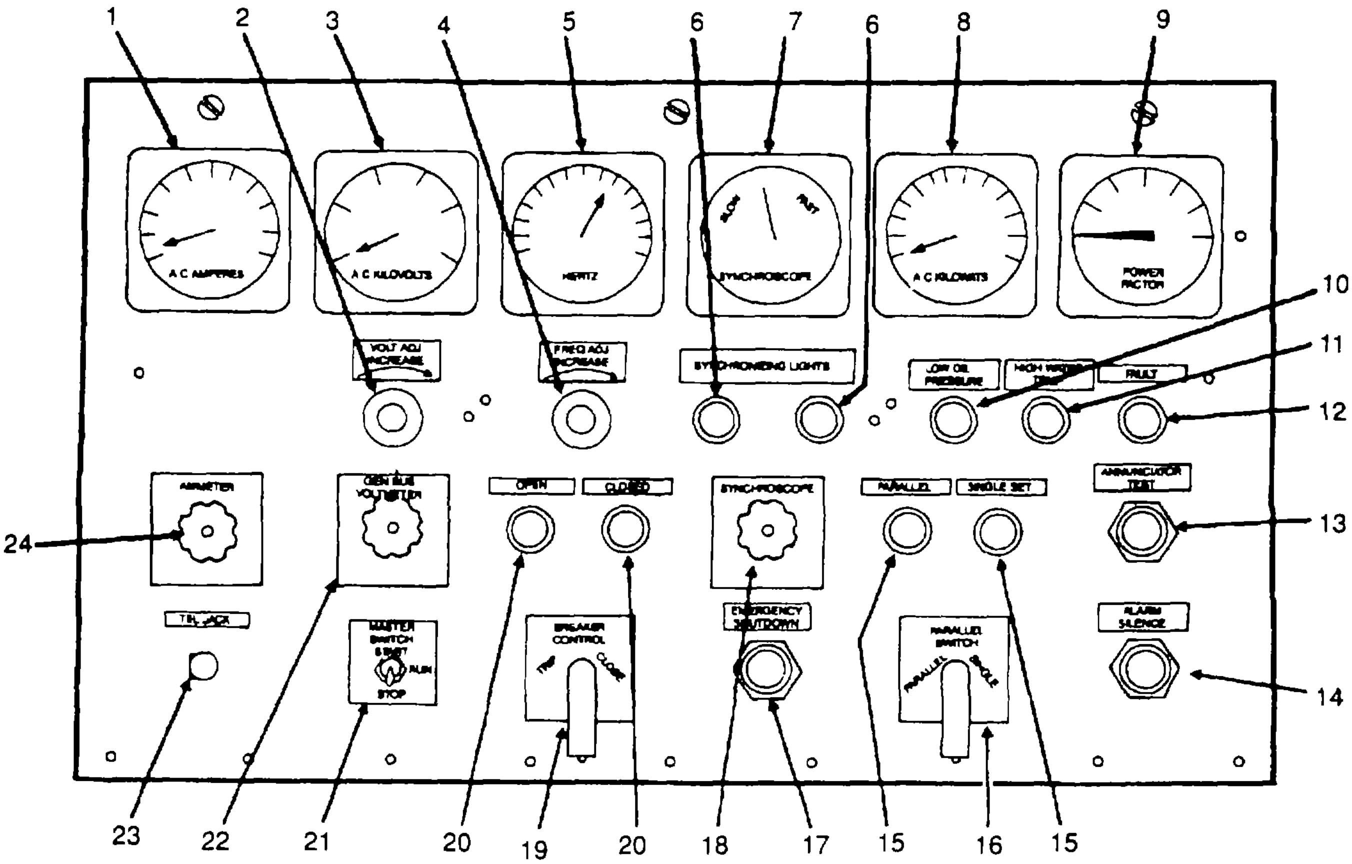


Table 2-13. Remote Control Panels, Controls and Instruments

Table 2-13. Remote Control Panels, Controls and Instruments

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-21, 1	AC AMPERES meter M102R	Indicates load current on a selected phase.	50 Hz - 119 60 Hz - 130 Vanes with load.
Figure 2-21, 2	VOLT ADJ rheostat R101R	Allows adjustment of generator set voltage output	--
Figure 2-21, 3	AC KILOVOLTS meter M101R	Indicates load voltage between selected lines.	60 Hz - 4160 volts; 50 Hz - 3800 volts
Figure 2-21, 4	FREQ ADJ rheostat R 102R	Provides adjustments of generator set frequency in single set operation or load in parallel operation.	

Table 2-13. Remote Control Panels, Controls and Instruments (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-21, 5	FREQUENCY meter M103R	Indicates frequency of generator set out put.	50 or 60 Hz
Figure 2-21, 6	SYNCHRONIZING LIGHTS DS110R and DS111 R	Used when paralleling to bring an in-coming unit on-line In phase.	Both lights dark.
Figure 2-21, 7	SYNCHROSCOPE M106R	Used with SYNCHRONIZING LIGHTS DS11 OR and DS111 R when paralleling. When the SYNCHROSCOPE pointer is at the 12 o'clock position, DS110OR and DS111R will be dark. Shows phase relationship between on-line and Incoming units.	--
Figure 2-21, 8	AC KILOWATTS meter M107R	Indicates kilowatt output of generator set.	50 Hz - 625 60 Hz - 750
Figure 2-21, 9	POWER FACTOR meter M104R	Indicates power factor of generator set output LAG indicates an Inductive load LEAD indicates a capacitive load.	50 Hz - 0.8 60 Hz - 0.8
Figure 2-21, 10	LOW OIL PRESSURE indicator light DS2R	When lit, indicates engine has insufficient oil pressure.	Dark
Figure 2-21, 11	HIGH WATER TEMP Indicator light DS3R	When lit, indicates engine has excessively high coolant temperature.	Dark
Figure 2-21, 12	FAULT indicator light DS103R	When lit, Indicates generator set has a fault condition.	Dark
Figure 2-21, 13	ANNUNCIATOR TEST pushbutton S15R	Used to test annunciator lights DS2R, DS3R, and DS103R and horn LS1R Horn will sound and all annunciator lights will light when button is pressed	--
Figure 2-21, 14	ALARM SILENCE pushbutton S16R	Used to shut down horn LS1R and stop flasher DS19 after an alarm circuit trips	--
Figure 2-21, 15	PARALLEL indicator DS35R and SINGLE SET indicator DS36R	Indicates setting of PARALLEL SWITCH S6R.	--
Figure 2-21, 16	PARALLEL SWITCH S6R SET operation	Used to select PARALLEL or SINGLE	--
Figure 2-21, 17	EMERGENCY SHUTDOWN pushbutton S7R	If pressed while operating, EMERGENCY SHUTDOWN S7R will stop the engine by cutting off air to the turbochargers and deenergizing fuel solenoid valve.	--
Figure 2-21, 18	SYNCHROSCOPE switch S115R	Used to turn SYNCHROSCOPE M106 ON or OFF	OFF
Figure 2-21, 19	BREAKER CONTROL switch S4R	Used to open and close load circuit breaker CB101	--
Figure 2-21, 20	OPEN indicator DS33R and CLOSED indicator DS34R	Indicates whether load circuit breaker CB101 Is OPEN or CLOSED.	--

Table 2-13. Remote Control Panels, Controls and Instruments (Continued)

FIGURE AND INDEX NO.	CONTROL OR INSTRUMENT	FUNCTION	NORMAL READING/ SETTING AT RATED LOAD
Figure 2-21, 21	MASTER SWITCH S9R	When set to START the starter motors will crank and the engine will start. When set to STOP, engine fuel supply is cut off and the engine stops. When re-leased, this spring loaded switch moves to the RUN position.	RUN
Figure 2-21, 22	GEN/BUS VOLTMETER switch S112R	Used with AC KILOVOLTS meter M101 R to read generator set or bus voltage lines.	--
Figure 2-21, 23	TEL JACK J15R	Allows for voice communication, via headsets, between RCM and the gener-ator set engine compartment.	--
Figure 2-21, 24	AMMETER switch S114R	Used with AC AMPERES meter M102R to read current output of a selected phase.	--

SECTION II . OPERATION OF AUXILIARY EQUIPMENT

2-8. GENERAL This section provides step-by-step procedures for operating the generator set in conjunction with the remote control module (rcm).

2-9. OPERATION WITH THE REMOTE CONTROL MODULE. The remote control module allows operation of the generator set from distances up to 100 feet (30 meters) The function and normal readings/settings of controls and instruments on the remote control module panel are described in Table 2-13 and Illustrated In Figure 2-21.

a. Connection Procedure for Using Remote Control Module Refer to paragraph 5-3.

b. Use of Remote Control Module.

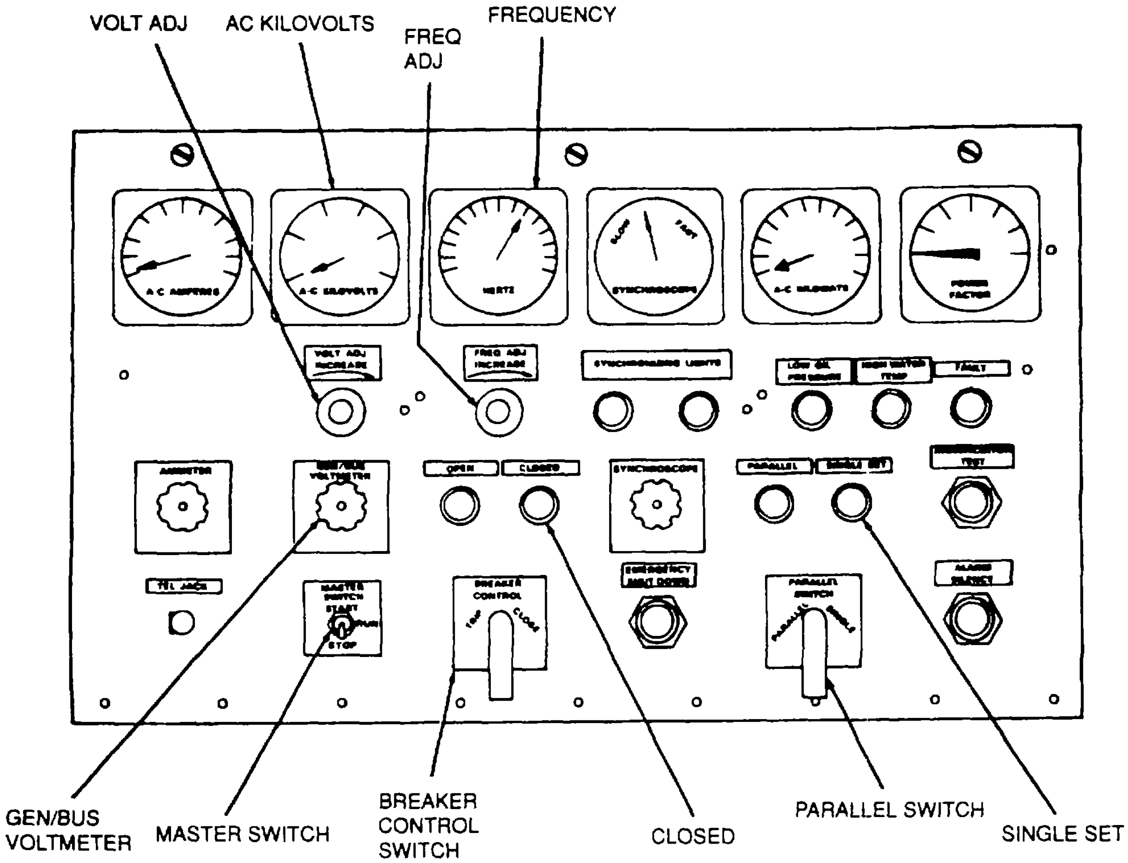
(1) Refer to Figure 2-22 for single unit remote operation.

(2) Refer to Figure 2-23 for stopping the generator set using the RCM.

(3) Refer to Figure 2-24 and Figure 2-25 for parallel remote operation In manual mode.

(4) Refer to Figure 2-26 for removing a generator set from parallel operation when using the RCM.

c. Emergency Stopping To stop the generator set from the remote control module In an emergency, press the EMERGENCY SHUTDOWN pushbutton S7R (17, Figure 2-21 , Table 2-13) Prior to starting a generator set shut down In this manner, manually reset the air control valve In accordance with Figure 3-21.



NOTE

WHEN ENGINE TEMPERATURE IS BELOW 40 ° F (4° C) AND THE PREHEATER HAS NOT BEEN USED, ENGINE ETHER PRIMER MAY BE REQUIRED. TO USE ETHER PRIMER, THE GENERATOR SET MUST BE STARTED FROM THE GENERATOR SET CONTROL ROOM WITH THE LOCAL REMOTE SW. SET TO LOCAL. REFER TO Figure 2-13.

STEP 1. PERFORM PMCS PRESTART CHECKS AND PRELUBE STEP FROM UNIT CONTROL ROOM.

STEP 2 SET OPERATION SELECTOR SWITCH IN GENERATOR SET CONTROL ROOM TO REMOTE POSITION.

STEP 3 SET MASTER SWITCH TO START AND RELEASE TO RUN. (THE ENGINE WILL AUTOMATICALLY CRANK FOR 15 SECONDS AND REST FOR 15 SECONDS UNTIL THE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES).

STEP 4 ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

STEP 5 SET GEN / BUS VOLTMETER SWITCH TO GEN 3-1.

STEP 6 ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4.16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3.8 KILOVOLTS (FOR 50 HERTZ OPERATION).

Figure 2-22. Single Unit Remote Operation (Sheet 1 of 2)

STEP 7. SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2, VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.

STEP 8. SET PARALLEL SWITCH TO SINGLE SET. SINGLE SET INDICATOR WILL LIGHT.

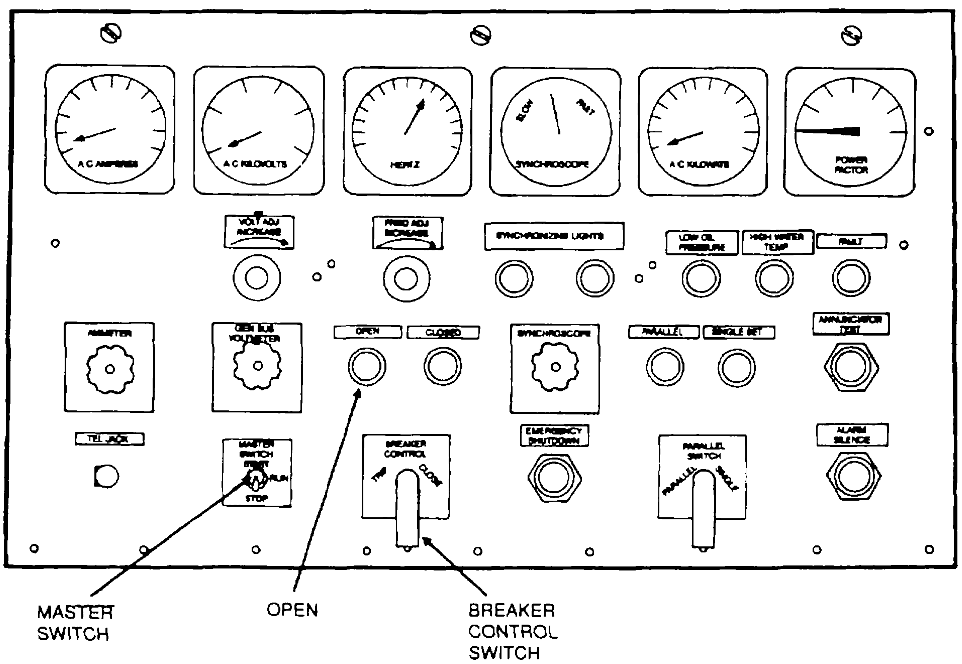
STEP 9. SET BREAKER CONTROL SWITCH TO CLOSE CLOSED INDICATOR WILL LIGHT.

STEP 10. PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.

STEP 11. PERFORM 'DURING OPERATION" PREVENTIVE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.

STEP 12. TO STOP UNIT REFER TO Figure 2-23.

Figure 2-22. Single Unit Remote Operation (Sheet 2 of 2)



STEP 1 SET BREAKER CONTROL SWITCH TO TRIP. OPEN INDICATOR WILL LIGHT

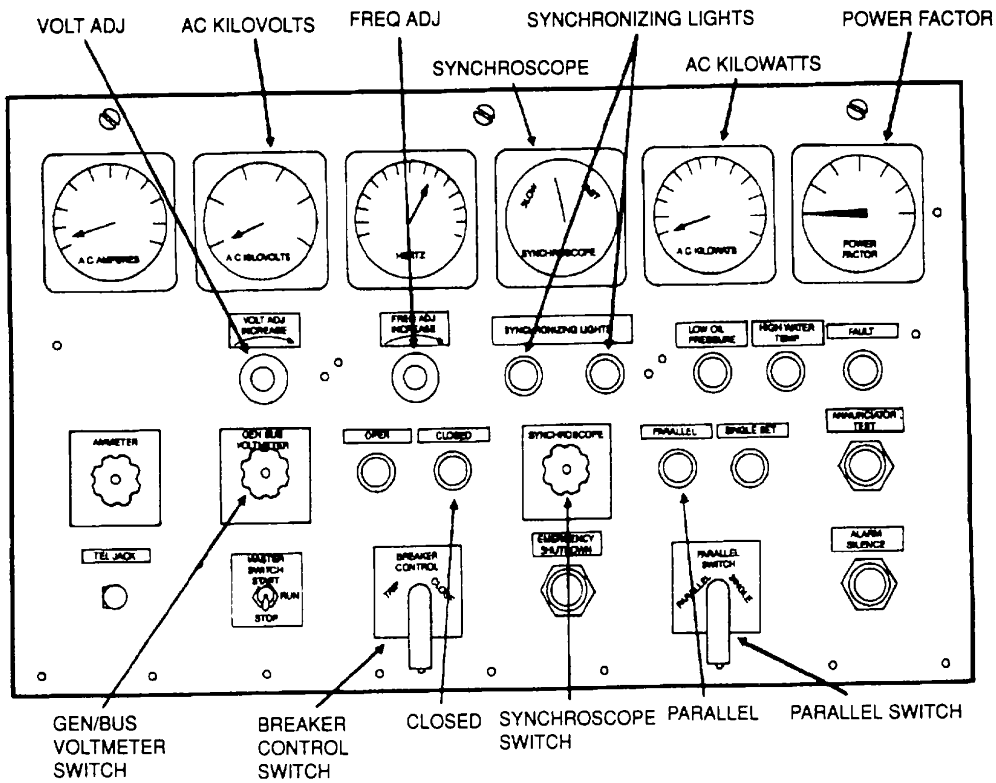
STEP 2 ALLOW ENGINE TO OPERATE 5 MINUTES AT NO LOAD

STEP 3 SET MASTER SWITCH TO STOP.

STEP 4 SET MAINTENANCE LOCKOUT SWITCH TO MAINTENANCE THIS SWITCH IS ON CABINET C IN THE CONTROL ROOM OF GENERATOR SET

STEP 5 SET 24v, DC CONTROL POWER CIRCUIT BREAKER TO OFF THIS BREAKER IS ON CABINET C IN THE CONTROL ROOM OF THE GENERATOR SET.

Figure 2-23. Stopping Generator Set - Single Unit Operation with Remote Control Module



WARNING

MAKE CERTAIN ALL SETS ARE SHUT DOWN AND THAT THERE ARE NO VOLTAGES AT SWITCH GEAR TERMINALS BEING CONNECTED TO INCOMING SET. TAKE EXTREME CARE NOT TO CROSS LO (NEUTRAL) WITH ANY OF THE OVER PHASES (L1, L2, OR L3). DEATH BY ELECTROCUTION OR SEVERE EQUIPMENT DAMAGE MAY RESULT FROM FAILURE TO HEED THIS WARNING.

NOTE

WHEN ENGINE TEMPERATURE IS BELOW 40°F (4°C) AND THE PREHEATER HAS NOT BEEN USED, ENGINE ETHER PRIMER MAY BE REQUIRED TO USE EITHER PRIMER, THE GENERATOR SET MUST BE STARTED FROM THE GENERATOR SET CONTROL ROOM WITH THE LOCAL REMOTE SW SET TO LOCAL. REFER TO FIGURE 2-13.

STEP 1. CONNECT INCOMING SET AS SHOWN IN FIGURE 2-17.
STEP 2. INSTALL SHORTING PLUG ON ONE REACTIVE LOAD RECEPTACLE OF ON-LINE GENERATOR SET AND EACH INCOMING GENERATOR SET REFER TO FIGURE 2-18.

Figure 2-24. Remote Droop Parallel Operation (Sheet 1 of 2)

STEP 3 SET ISOCHRONOUS/FREQUENCY DROOP SWITCH TO FREQUENCY DROOP ON ON-LINE GENERATOR SET AND EACH INCOMING GENERATOR SET THIS SWITCH IS ON CABINET B IN THE CONTROL ROOM OF EACH GENERATOR SET.

STEP 4 ON-LINE SET: SET MASTER SWITCH TO START AND RELEASE TO RUN. (THE ENGINE WILL AUTOMATICALLY CRANK FOR 15 SECONDS AND REST FOR 15 SECONDS UNTIL THE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES)

STEP 5 ON-LINE SET: ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

STEP 6 ON-LINE SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.

STEP 7 ON-LINE SET: ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).

STEP 8 ON-LINE SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2 VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.

STEP 9 ON-LINE SET: SET PARALLEL SWITCH TO SINGLE SET, SINGLE SET INDICATOR WILL LIGHT.

STEP 10 ON-LINE SET: SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.

STEP 11 ON-LINE SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.

STEP 12 INCOMING SET: SET MASTER SWITCH TO START AND RELEASE TO RUN (THE ENGINE WILL AUTOMATICALLY CRANK FOR 15 SECONDS AND REST FOR 15 SECONDS UNTIL THE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES).

STEP 13 INCOMING SET: ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.

STEP 14 INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.

STEP 15 INCOMING SET: ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).

STEP 16 INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.

STEP 17 INCOMING SET: CHECK PHASE SEQUENCE USING PHASE SEQ. SEL. SW AND 1-2-3-AND 3-2-1 INDICATOR LIGHTS. ENSURE THAT SETS ARE IN PHASE BEFORE PROCEEDING.

STEP 18 INCOMING SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.

STEP 19 INCOMING SET: SET SYNCHROSCOPE SWITCH TO ON SYNCHROSCOPE WILL BEGIN ROTATING AND LIGHTS WILL BEGIN BLINKING.

STEP 20 INCOMING SET: ADJUST FREQ ADJ RHEOSTAT UNTIL SYNCHRONIZING LIGHTS ARE BLINKING VERY SLOWLY. AND SYNCHROSCOPE NEEDLE IS ROTATING SLOWLY IN THE CLOCKWISE (FAST) DIRECTION.

STEP 21 INCOMING SET: ADJUST VOLT ADJ RHEOSTAT USING GEN/BUS VOLTMETER SWITCH AND AC KILOVOLTS METER UNTIL GEN AND BUS VOLTAGES ARE IDENTICAL.

STEP 22 INCOMING SET: WHEN SYNCHRONIZING LIGHTS ARE DARK AND SYNCHROSCOPE NEEDLE IS IN 12 O'CLOCK POSITION, SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.

STEP 23 INCOMING SET: SET SYNCHROSCOPE SWITCH TO OFF.

STEP 24 ALL SETS: ADJUST VOLT ADJ AND FREQ ADJ RHEOSTATS TO BALANCE THE LOAD ON ALL SETS AS INDICATED BY THE KILOVAR AND AC KILOWATTS METERS ADJUST VOLT ADJ TO EFFECT KILOVARS ADJUST FREQ ADJ TO EFFECT KILOWATTS.

STEP 25 IF ADDITIONAL GENERATOR SETS ARE TO BE PARALLELED, REPEAT STEP 12 THROUGH STEP 24, ABOVE, FOR EACH SET.

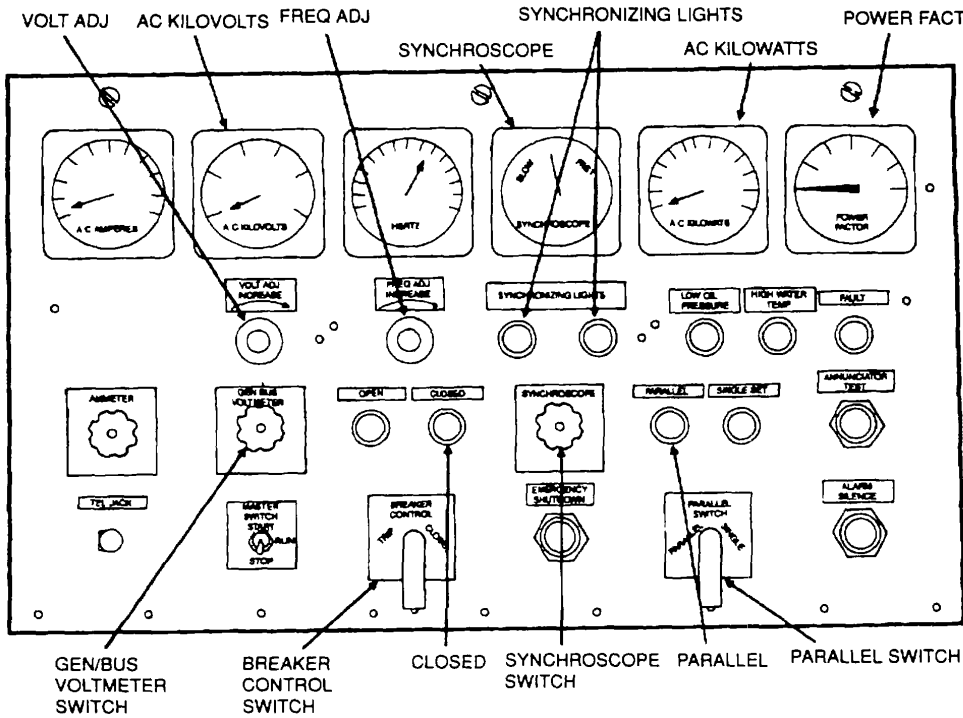
STEP 26 ALL SETS: LOAD CHANGES WILL AFFECT VOLTAGE AND FREQUENCY OF DROOP-PARALLELED SETS EQUALLY. TO VARY FREQUENCY OR VOLTAGE OUTPUT OF DROOP-PARALLELED SETS, ADJUST FREQ ADJ OR VOLT ADJ RHEOSTATS THE SAME WAY (INCREASE OR DECREASE) ON BOTH SETS.

STEP 27 ALL SETS: PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.

STEP 28 ALL SETS: PERFORM 'DURING OPERATION" PREVENTIVE MAINTENANCE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.

STEP 29 TO STOP ENGINE REFER TO Figure 2-26.

Figure 2-24. Remote Droop Parallel Operation (Sheet 2 of 2)



WARNING

MAKE CERTAIN ALL SETS ARE SHUT DOWN AND THAT THERE ARE NO VOLTAGES AT SWITCH GEAR TERMINALS BEING CONNECTED TO INCOMING SET. TAKE EXTREME CARE NOT TO CROSS LO (NEUTRAL) WITH ANY OF THE OTHER PHASES (L1, L2, OR L3). DEATH BY ELECTROCUTION OR SEVERE EQUIPMENT DAMAGE MAT RESULT FROM FAILURE TO HEED THIS WARNING.

WHEN ENGINE TEMPERATURE IS BELOW 40 ° F (4° C) AND THE PREHEATER HAS NOT BEEN USED, ENGINE ETHER PRIMER MAY BE REQUIRED. TO USE ETHER PRIMER, THE GENERATOR SET MUST BE STARTED FROM THE GENERATOR SET CONTROL ROOM WITH THE LOCAL REMOTE SW. SET TO LOCAL. REFER TO FIGURE 2-13.

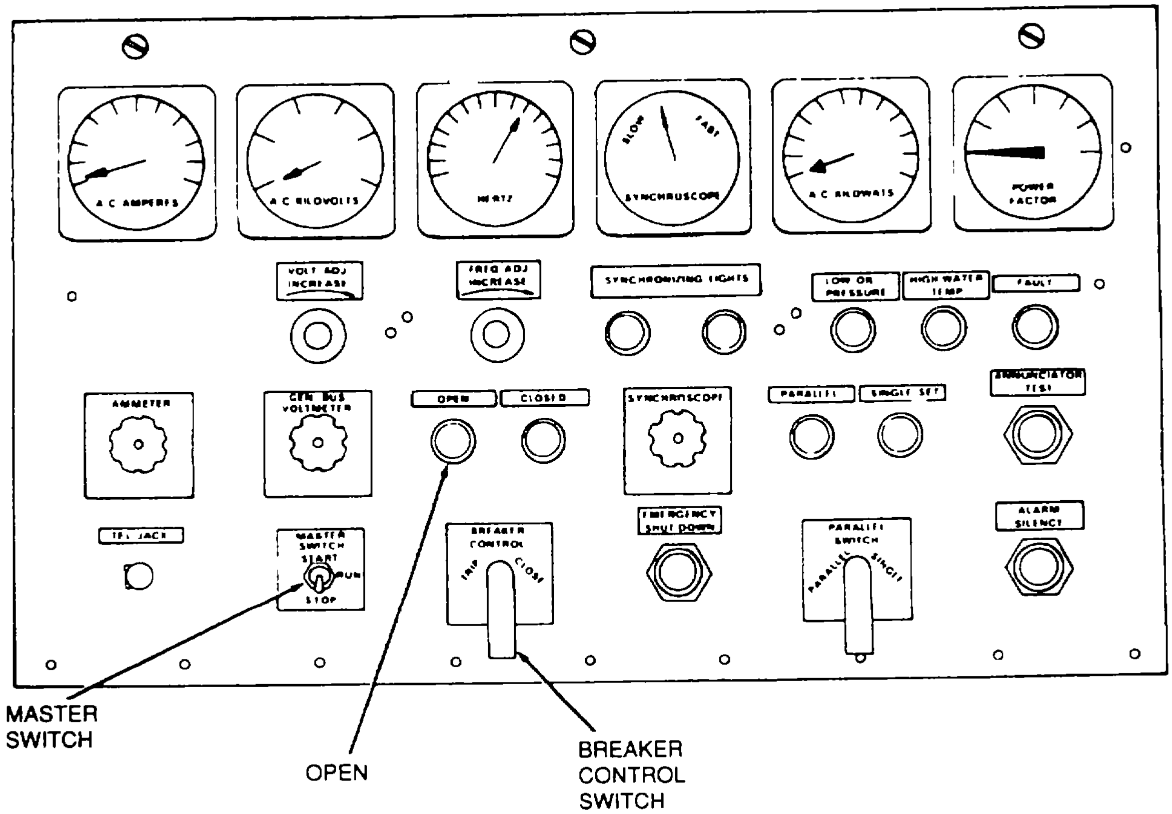
STEP 1. ALL SETS: REMOVE SHORTING PLUGS (REFER TO FIGURE 2-18). INTERCONNECT REACTIVE LOAD COMPENSATION AND GOVERNOR CONTROL PARALLELING CABLES (REFER TO FIGURE 2-17) FOR ALL SETS TO BE PARALLELED.

STEP 2 SET FREQUENCY DROOP / ISOCHRONOUS SWITCH TO ISOCHRONOUS ON ON-LINE GENERATOR SET AND EACH INCOMING GENERATOR SET. THIS SWITCH IS ON CABINET B IN THE CONTROL ROOM OF EACH GENERATOR SET.

Figure 2-25. Remote Isochronous Parallel Operation (Sheet 1 of 2)

STEP 3. ON-LINE SET SET MASTER SWITCH TO START AND RELEASE TO RUN. (THE ENGINE WILL AUTOMATICALLYCRANK FOR 15 SECONDS AND REST FOR 15 SECONDS UNTIL THE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES).
STEP 4. ON-LINE SET ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.
STEP 5. ON-LINE SET SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.
STEP 6. ON-LINE SET ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 7. ON-LINE SET- SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 8. ON-LINE SET SET PARALLEL SWITCH TO SINGLE SET. SINGLE SET INDICATOR WILL LIGHT.
STEP 9. ON-LINE SET SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.
STEP 10. ON-LINE SET SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 11. INCOMING SET SET MASTER SWITCH TO START AND RELEASE TO RUN (THE ENGINE WILL AUTOMATICALLY CRANK FOR 15 SECONDS AND REST FOR 15 SECONDS UNTIL THE ENGINE HAS STARTED, FOR A TOTAL OF FOUR CRANK CYCLES)
STEP 12. INCOMING SET ADJUST FREQ ADJ RHEOSTAT FOR A FREQUENCY METER READING OF 50 HERTZ OR 60 HERTZ, AS APPLICABLE.
STEP 13. INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 3-1.
STEP 14. INCOMING SET: ADJUST VOLT ADJ RHEOSTAT FOR AN AC KILOVOLTS READING OF 4 16 KILOVOLTS (FOR 60 HERTZ OPERATION) OR 3 8 KILOVOLTS (FOR 50 HERTZ OPERATION).
STEP 15 INCOMING SET: SET GEN/BUS VOLTMETER SWITCH TO GEN 2-3, THEN GEN 1-2. VERIFY THAT AC KILOVOLTS READING IS THE SAME AT ALL THREE SETTINGS.
STEP 16. INCOMING SET: CHECK PHASE SEQUENCE USING PHASE SEQ. SEL. SW AND 1-2 3 AND 3-2-1 INDICATOR LIGHTS. ENSURE THAT SETS ARE IN PHASE BEFORE PROCEEDING.
STEP 17 INCOMING SET: SET PARALLEL SWITCH TO PARALLEL. PARALLEL INDICATOR WILL LIGHT.
STEP 18 INCOMING SET: SET SYNCHROSCOPE SWITCH TO ON SYNCHROSCOPE WILL BEGIN ROTATING AND SYNCHRONIZING LIGHTS WILL BEGIN BLINKING.
STEP 19. INCOMING SET ADJUST FREQ ADJ RHEOSTAT UNTIL SYNCHRONIZING LIGHTS ARE BLINKING VERY SLOWLY AND SYNCHROSCOPE NEEDLE IS ROTATING SLOWLY IN THE CLOCKWISE (EST) DIRECTION.
STEP 20 INCOMING SET: ADJUST VOLT ADJ RHEOSTAT USING GEN/BUS VOLTMETER SWITCH AND AC KILOVOLTS METER UNTIL GEN AND BUS VOLTAGES ARE IDENTICAL.
STEP 21 INCOMING SET: WHEN SYNCHRONIZING LIGHTS ARE DARK AND SYNCHROSCOPE NEEDLE IS IN 12 O'CLOCK POSITION, SET BREAKER CONTROL SWITCH TO CLOSE. CLOSED INDICATOR WILL LIGHT.
STEP 22 INCOMING SET SET SYNCHROSCOPE SWITCH TO OFF;
STEP 23 ALL SETS ADJUST VOLT ADJ AND FREQ ADJ RHEOSTATS TO BALANCE THE LOAD ON ALL SETS AS INDICATED BY THE KILOVAR AND AC KILOWATTS METERS ADJUST VOLT ADJ TO EFFECT KILOVARS ADJUST FREQ ADJ TO EFFECT KILOWATTS.
STEP 24 IF ADDITIONAL GENERATOR SETS ARE TO BE PARALLELED, REPEAT STEP 11 THROUGH STEP 24, ABOVE, FOR EACH SET.
STEP 25 ALL SETS PERIODICALLY (NOT LESS THAN ONCE PER HOUR) MONITOR ENGINE AND GENERATOR INDICATORS TO ENSURE CONTINUED OPERATION.
STEP 26 ALL SETS PERFORM DURING OPERATION" PREVENTIVE MAINTENANCE CHECKS AND SERVICES AS SPECIFIED IN Table 3-2.
STEP 27 TO STOP ENGINE REFER TO Figure 2-26.

Figure 2-25. Remote Isochronous Parallel Operation (Sheet 2 of 2)



CAUTION

PRIOR TO REMOVAL OF GENERATOR SET(S) FROM PARALLEL OPERATION, MAKE SURE LOAD DOES NOT EXCEED FULL LOAD RATING OF GENERATOR SET(S) REMAINING ON -LINE. SEVERE DAMAGE TO EQUIPMENT MAY RESULT FROM FAILURE TO HEED THIS CAUTION .

STEP 1. REDUCE LOAD UNTIL AC KILOWATTS METER INDICATES 60 KW OR LESS.
STEP 2. OUTGOING SET SET BREAKER CONTROL SWITCH TO TRIP. OPEN INDICATOR WILL LIGHT.
STEP 3. OUTGOING SET ALLOW ENGINE TO OPERATE 5 MINUTES AT NO LOAD.
STEP 4. OUTGOING SET: SET MASTER SWITCH TO STOP.
STEP 5. OUTGOING SET SET MAINTENANCE LOCKOUT SWITCH TO MAINTENANCE THIS SWITCH IS ON CABINET C IN THE CONTROL ROOM OF THE GENERATOR SET.
STEP 6. SET 24v. DC CONTROL POWER CIRCUIT BREAKER TO OFF THIS BREAKER IS ON CABINET C IN THE CONTROL ROOM OF THE GENERATOR SET.
STEP 7. TO STOP ON-LINE UNIT REFER TO FIGURE 2-23.

Figure 2-26. Removing generator Set From Remote Parallel Operation

SECTION III. OPERATION UNDER UNUSUAL CONDITIONS

2-10. OPERATION IN COLD (40°F to -25°F) (40C to -320C).

WARNING

Avoid contacting metal items with bare skin In extreme cold weather. Failure to observe this warning can result in personal injury.

a. General. The generator set operates in temperatures down to -25°F (-320C) To operate successfully down to this temperature, the engine Is heated by an integrally mounted preheat system which receives auxiliary power from an external source. The generator and switchgear are heated by integrally mounted strip heaters which also require auxiliary power from an external source.

b. Fuel System. Be sure to use proper grade of fuel for existing temperatures. Refer to Table 3-1 Service fuel filters and strainers more frequently than normal (every 200 hours instead of every 300 hours). Remove ice, snow, and moisture from the filler cap and filler neck.

c. Engine Electrical. System Clean storage batteries BT1 through BT4 and cables and Inspect for cracked or damaged cases Be sure the battery terminals are tight, clean, and lightly greased. See that the battery cap vent holes are open The electrolyte level must be 3/8 inch (9 5 mm) above the plates To prevent the batteries from freezing, see that they are kept fully charged. Inspect all electrical wiring for cracks, breaks, and fraying Tighten loose connections.

NOTE

After adding water to the batteries In freezing temperatures, charge the batteries for at least 1 hour.

d. Lubrication Inspect level of oil in crankcase by checking sight glass. Lubricate in accordance with Instructions In Chapter 3, Section II.

e. Cooling System Inspect level of coolant In radiator by checking sight glass. Inspect cooling system for leaks, paying particular attention to gaskets and hose connections. Use a hydrometer to verify that antifreeze mixture is in accordance with Table 3-1 and Table 4-1. When starting the generator set, keep shutters closed until engine reaches operating temperature Ensure that drifting snow does not obstruct normal cooling or combustion air flow.

2-11. OPERATION IN EXTREME HEAT (UP TO 125°F) (52°C).

a. Cooling System. Keep the cooling system free from rust and scale by changing water filters every 300 hours. Keep cooling system filled with clean coolant. Avoid use of alkaline water or salt water, which causes the accumulation of rust and scale Inspect belt for proper tension. Be sure generator set is free of dust and dirt. Check obstruction in radiator cooling fins and make sure shutters are kept open.

b. Lubrication. Lubricate In accordance with the Instructions In Chapter 3, Section II.

c. Inspect battery electrolyte level daily. The plates should be covered with 3/8 Inch (9 5 mm) of water. Add water If necessary.

d. Be sure generator set is free of airflow restrictions. When operating Indoors, make provisions for adequate ventilation and the venting of exhaust fumes to the outside

e. Keep external surface of engine clean.

f. Allow sufficient space for fuel expansion when filling fuel tank.

g. Change engine oil and oil filter frequently.

h. Store oil and fuel In dust-free containers.

i. Ensure that generator set ground connections are free of dust and sand and connections are tight before starting the unit.

j. Prior to shutdown, run generator set at no load for 5 minutes to allow engine temperature to stabilize and cool.

2-12. OPERATION IN BLOWING DUST OR SAND STORM CONDITIONS.

a. If possible, provide a shelter for generator set. Use available natural barriers to shield generator set from blowing dust or sand.
b. Wet down dusty and sandy surface areas around generator set frequently If water is available.
c. Keep all access doors closed, as much as possible, to prevent entry of dust and sand into housing assembly.
d. Wipe dust and sand frequently from the generator set external surface and components. Wash exterior surfaces frequently with clean water when generator set Is not operating
e. Service engine air cleaner frequently to compensate for intake of additional dust or sand.
f. Drain sediment frequently from fuel filter/water separator. When servicing fuel tank be careful to prevent dust or sand from entering fuel tank.

2-13. OPERATION UNDER RAINY OR HUMID CONDITIONS . Keep fuel tank full to prevent condensation of moisture. During dry periods when the set is not operating, open the doors and allow the set to dry out. Remove rust or other corrosion and paint all damaged prepainted surfaces In accordance with service requirements.

2-14. OPERATION IN SALT WATER AREAS.

a. Salt water causes corrosive action on metal. Care must be taken to avoid equipment contact with salt water. If contact Is made, or if the unit Is exposed to salt spray, wash the generator set frequently with clean, fresh water.
b. Remove rust or other corrosion and paint all damaged prepainted surfaces In accordance with service requirements.

2-15. OPERATION AT HIGH ALTITUDES . The generator set will operate at elevations up to 1500 feet (457 meters) above sea level without special adjustment or reduction In load. A reduction in the load at higher altitudes may be necessary, since engines are more likely to overheat. The following derating factors are applicable:

60 Hz
750 kW to 1500 feet (457 meters at 125°F (520C) (sea level) to 90°F (320C) (1500 feet (457 meters))
600 kW to 5000 feet (1410 meters) at 107°F (420C)
563 kW to 8000 feet (2435 meters) at 950F (350C)
50 Hz
625 kW to 1500 feet (457 meters) at 1250F (52°C) (sea level) to 90°F (320C) (1500 feet (457 meters))
500 kW to 5000 feet (1410 meters) at 107°F (420C)
469 kW to 8000 feet (2435 meters) at 950F (35°C)

2-16. EMERGENCY OPERATION ON JP5 FUEL. Generator sets require no adjustments to engine timing or fuel injectors for operation on JP5 fuel. When JP5 fuel is used, power output must be reduced by a factor of 20 percent.

CHAPTER 3
OPERATOR MAINTENANCE INSTRUCTIONS

SECTION I. CONSUMABLE OPERATING AND MAINTENANCE SUPPLIES

3-1. GENERAL. This section contains a tubular listing of the consumable materials needed to operate and maintain the generator set. This listing includes only those items peculiar to, and required for, maintenance and operation of this generator set. Information is provided to enable the operator to properly identify these Items by military specification or National Stock Number. Table 3-1 lists these consumable supplies. Table 3-1. Consumable Operating and Maintenance Supplies.

COMPONENT APPLICATION	NATIONAL STOCK NUMBER	DESCRIPTION	QTY REQUIRED FOR INITIAL OPERATION	QTY REQUIRED FOR 8 HOURS OPERATION	NOTES
Tank, Fuel	9130-00-273-2379(1)	Fuel JP-5 MIL-T-5624	130 gal (491.4 L)	440 gal (1,663.2 L)	(3), (4)
	9140-00-286-5294(1)	Regular Grade, DF2 VV-F-800	130 gal (491.4 L)	440 gal (1,663.2 L)	(3), (4)
	9140-00-286-5283(1)	Artic Grade, DFA VV-F-800	130 gal (491 4 L)	440 gal (1,663.2 L)	(3), (4)
Pump, Fuel Transfer		Strainer Tube, Fuel Strainer	(0)	(0)	(11)
	2910-01-043-8112	Element, Fuel Fil-ter	(0)	(0)	(12)
Ether Starting System	2910-00-209-4997	Tank, Prime Starting (Ether)	(1)	(1)	(5)
Parts Assembly	8030-00-252-3391	Sealing Compound Permatex 2C	(0)	(0)	
		Adhesive	(0)	(0)	(21)
	8030-00-252-3391	Sealing Compound	(0)	(0)	(20)
	7520-00-904-1265	Marker, Nylon, Tube Type	(0)	(0)	(22)
Crankcase and Lubncat-ing System		Oil Lubricating Grade, OEA MIL-L-46167	36 gal (136 L)	(0)	(6), (8), (9)
	9150-00-402-4478	1 QT			
	9150-00-402-2372	5 GAL			
	9150-00-491-7197	55 GAL			
		Grade, OE/HDO 10 MIL-L-2104D	36 gal (136 L)	(0)	(6), (8), (9)
	9150-00-189-6727	1 QT			
	9150-00-186-6668	5 GAL			
	9150-00-191-2772	55 GAL			

Table 3-1. Consumable Operating and Maintenance Supplies (Continued)

COMPONENT APPLICATION	NATIONAL STOCK NUMBER	DESCRIPTION	QTY REQUIRED FOR INITIAL OPERATION	QTY REQUIRED FOR 8 HOURS OPERATION	NOTES
		Grade, OE/HDO 30 MIL-L-2104D	36 gal (136 L)	(0)	(6), (8), (9)
	9150-00-186-6681	1 QT			
	9150-00-188-9858	5 GAL			
	9150-00-189-6729	55 GAL			
		Grade, OE/HDO	36 gal	(0)	(6),
(8),					
			15/40	(136 L)	(9)
		MIL-L-2104D			
	9150-01-152-4117	1 OT			
	9150-01-152-4118	5 GAL			
	9150-01-152-4119	55 GAL			
Lube Oil Filters	2940-01-019-4513	Filter, Oil Spin-on Element Full-Flow	(0)	(0)	(13)
	2940-01-145-9455	Element, Oil By-Pass Filter	(0)	(0)	(13)
Air Cleaner		Element, Safety	(0)	(0)	(14)
		Element, Primary	(0)	(0)	(14)
Radiator and Cooling System	6850-00-181-7929	Coolant Antifreeze, Inhibited Glycol (1 gal bottle)	45 6 gal (172 4 L)	(0)	(7)
	6850-00-174-1806	Antifreeze Compound Arctic	91 3 gal (345 6 L)	(0)	(7)
(		55 gal drum)			
		Precharger, Element, DCA Water Filter	(0)	(0)	(15)
	2930-01-046-4642	Service Element DCA Water Filters	(0)	(0)	(15)
		DCA-4L, Precharge Direct Chemical	(0)	(0)	(16)
			Additive		
	2815-01-163-7940	Test Kit, DCA Coolant Fleet-Guard	(1)	(0)	(17)
Batteries	6810-00-249-9354	Sulfuric Acid, Electrolyte, 1 gal 3 8L)	16 4 gal (62 L)	(0)	(10)

Table 3-1. Consumable Operating and Maintenance Supplies (Continued)

COMPONENT APPLICATION	NATIONAL STOCK NUMBER	DESCRIPTION	QTY REQUIRED FOR INITIAL OPERATION	QTY REQUIRED FOR 8 HOURS OPERATION	NOTES
Parts, Cleaning	6850-00-281-1985	P-D-680, Dry Cleaning Solvent, 1.0 gal (3.8 L)	(0)	(0)	(18)
	6850-00-285-8011	P-D-680, Dry Cleaning Solvent, 55 gal (208 L)	(0)	(0)	(18)
Parts, Assembly	9150-01-023-3934	VV-P-236, Petrolatum	(0)	(0)	(19)

NOTES

(1) See Federal Supply Catalog C9100-1L for additional requisitioning data.
(2) See Federal Supply Catalog C6800-1 L for additional requisitioning data
(3) Fuel tank capacity is 130 gallons (492 L)
(4) Average fuel consumption Is 55 gallons (208 L) per hour 8 hours continuous duty will require approximately 440 gallons (1665 L).
(5) One tank, if required, for cold weather starting.
(6) Crankcase capacity Is 30 gallons (113 L) plus 6 gallons (23 L) for the filters.
(7) Total cooling system capacity Is 91 3 gallons (345 6 L), 31 25 gallons (118 3 L) for the engine block and 51.8 gallons (196 1 L) for the radiator.
(8) See Figure 3-2 for lube points
(9) See Figure 3-2 for grade, application, and replenishment intervals
(10) Each battery requires 4.1 gallons (15.5 L) of electrolyte.
(11) One fuel strainer element is required at any given time. Replace strainer tube every 300 hours, continuous duty cycle or every 6 months at standby duty
(12) Four transfer pump fuel filter and two engine mounted fuel filter elements are required at any given time. Replace transfer pump strainer every 300 hours for continuous duty or every 6 months with generator set at standby duty
(13) Two oil by-pass filters and four full-flow oil filters are used at any given time. Replace all oil filter elements every 300 hours for continuous generator set duty or every 6 months for standby duty.
(14) Two primary and two safety air cleaner elements are used at any given time Service the primary elements whenever the air restriction indicators turn amber or red The primary elements may be cleaned and reused six times (or after two years, whichever comes first), after which they should be replaced Do not attempt to clean the safety elements. Replace the safety elements after the primary elements have been changed three times.
(15) New generator set engines are equipped with four DCA precharge water filter canisters which should be replaced with the DCA service filters (WF 2010) at the first oil change after initial operation. Thereafter, replace the DCA service elements after 250 hours continuous duty or 6 months standby duty, whichever comes first.
(16) Precharge new engine coolant whenever the cooling system is drained and cleaned. The DCA-4L precharge direct chemical additive Is used for this purpose and is compatible with either plain or antifreeze-treated water (except Dowtherm 209) Use 16 pints of DCA-4L additive to precharge the entire generator set cooling system (74 gallons (280L), approximate). Use the precharge additive, also when storing make-up coolant in bulk.
(17) The DCA coolant test kit is used to check DCA concentration In the engine coolant. Draw coolant sample every 6 months and use the test kit to check effectivity of coolant filtering and DCA treatment.

NOTES (Continued)	
(18)	Solvent quantities required are, in general, dependent on environmental and operational conditions for a specific generator set.
(19)	Petrolatum provides for lubrication of preformed packings and seals to facilitate assembly of mechanical parts.
(20)	Sealant Is required to waterproof housing panel joints
(21)	Required for Installation of acoustical absorber for housing
(22)	Required for lettering nylon identification tags on wiring harness.

SECTION II. LUBRICATION INSTRUCTIONS

3-2. GENERAL. This section contains a reproduction of the lubrication order and lubrication Instructions which are supplemental to, and not covered in, the lubrication order. The lubrication order shown in Figure 3-2 is an exact reproduction of the approved lubrication order. Army personnel should refer to DA PAM 310-3 to ensure the latest edition of the lubrication order (LO) is being used.

WARNING

To avoid accidental cranking or startup, which could cause injury to maintenance personnel, place MAINTENANCE LOCKOUT switch in the MAINTENANCE position prior to servicing the generator set. Return switch to the OPERATION position only after completion of service procedures.

3-3. LUBRICATION INFORMATION.

a. General. Keep all lubricants In closed containers and store In a clean, dry place away from external heat Allow no dust, dirt, or other foreign material to mix with the lubricants Keep all lubrication equipment clean and ready to use.

b. Cleaning. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

c. Points of Lubrication. Service the lubrication points at proper Intervals as illustrated In Figure 3-2 and as described in subparagraphs below.

d. Checking and Servicing Crankcase Oil Level. The engine oil level gage (see Figure 3-3) is used for reading crankcase oil level only when the engine Is not running. The oil level sight gage on the right side of the oil pan (see Figure 3-3) is used to read crankcase oil level whether the engine Is running or not.

CAUTION

Crankcase air pressure is greater than the atmosphere. When adding lube oil with the engine running, wrap the oil spout with a rag so that the engine oil filler neck will be plugged when the spout Is inserted. This will prevent oil from being blown out of the crankcase.

NOTE

OIL SIGHT GAGE READINGS

The oil sight gage is marked to indicate a static (non-operating) HI and LOW oil level. However, with the oil level at the HI mark statically, the oil level reading will be at the LOW mark when the engine is running. If, while the engine Is running, the oil level reading should drop to the lowest visible level on the oil sight gage, add an additional 4 gallons (15.2 L) of oil until the level Is brought back to the LOW level mark.

(1) Inspect See Figure 3-3. Perform the following procedures with the engine shut down.

(a) Loosen the oil filler cap by turning counterclockwise to allow crankcase air pressure to escape.

(b) Remove the oil level gage by pulling out from engine. Wipe oil from the oil level gage.

(c) Check oil level by reinserting oil level gage and pulling out. Oil level reading should be at the HI mark on the oil level gage If oil level is below the HI mark, add oil in accordance with step (d), below

CAUTION

Do not fill crankcase above the HI mark on the oil level gage.

(d) Remove crankcase oil fill cap (see Figure 3-3). Add oil as required to obtain a HI level reading on oil level gage. Refer to Table 3-1 for proper lubricating oil Reinstall and tighten oil fill cap and oil level gage after oil fill procedure.

WARNING

Dry cleaning solvent P-D-80, Type II, is flammable and toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to prevent injury to personnel.

(e) After each operating interval of 300 hours, remove crankcase breather (see Figure 3-19) and clean with cleaning solvent. P-D-680, Type II, or equivalent Dry with compressed air and reinstall on engine.

LUBRICATION ORDER

LO 9-6115-604-12
LI-6115-12/9

GENERATOR SET, DIESEL ENGINE DRIVEN, AIR TRANSPORTABLE SKID MOUNTING, 750 KW 3 PHASE, 4 WIRE, 2400/4160 AND 2200/3800 VOLTS DOD MODEL MEP208A; CLASS PRIME UTILITY; HERTZ 50/60 NSN 6115-00-450-5881

Reference TM 5-6115-604-12, Federal Supply Catalog C9100-IL

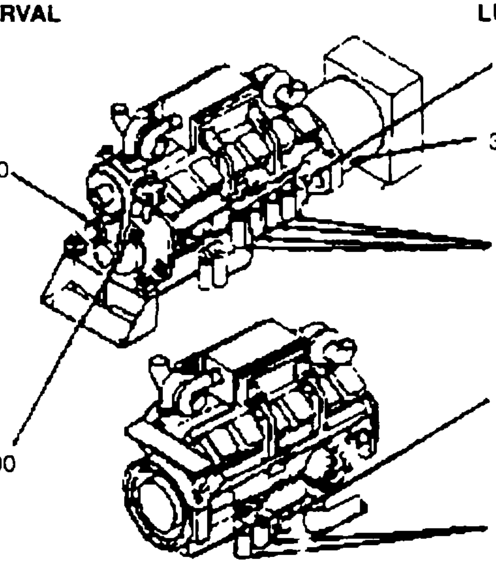
Intervals and the related task-hour times are based on normal operation. The task-hour time specified is the time you need to do all the services prescribed for a particular interval Change the interval if your lubricants are contaminated or if you are operating the equipment under adverse operating conditions, including longer than usual operating hours. You may extend the interval during periods of low activity, but you must take adequate preservation precautions.

Clean all fitting before lubricating. Clean parts with SOLVENT DRY CLEANING or OIL FUEL DIESEL *Dry before lubricating*

Relubricate after washing

The lowest level of maintenance authorized to lubricate a point is indicated by one of the following symbols as appropriate Operator Crew (C), Organizational Maintenance (O), and Field Maintenance (F)

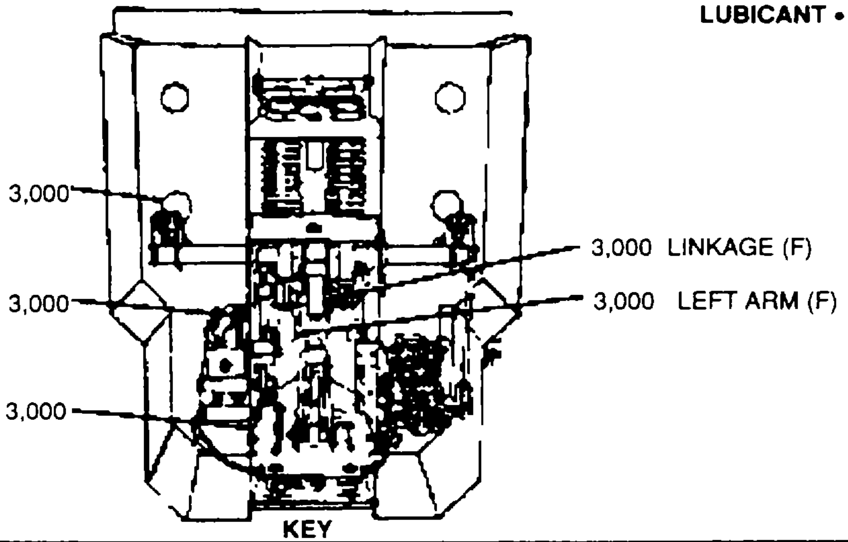
Drain crankcase when hot Fill and check oil



TOTAL TASK-HR		TOTAL TASK-HR	
INTERVAL	**TASK-HR**	**INTERVAL**	**TASK-HR**
300	0.3	3,000	4.0

Figure 3-1. Engine and related Parts (Sheet 1 of 2)

LUBICANT • INTERVAL



LUBICANT • INTERVAL

KEY

LUBRICANTS		CAPACITY	EXPECTED TEMPERATURES 20° TO 125°F (-6.6° to 51° C)	0° to 20°F (-18° to 6.6° C)	-25° to 0°F (-32° to -18° C)	INTERVALS
OE/HDO-30 (MIL-L-9000) *or* OE/HDO-10 (MIL-L-21040) *or* (MIL-L-46167) (MIL-L-2104D)	Lubricating oil diesel engine	36 gallons (137 liters)	OE/HDO-30 OE/HDO-15/40	OE/HDO-10	OEA	Check level daily Change oil every two weeks if operating continuously, monthly otherwise
MIL-G-18709 (Shell Alvanue #2)	Grease generator G1 main bearing	24 ounces (0.57 L)	MIL-G-18709	MIL-G-18709	MIL-G-18709	Every six months
GAA (MIL-G-10924)	Grease automotive and artillery		MIL-G-10924	MIL-G-10924	MIL-G-10924	Every six months

NOTES

1 Check crankcase sight indicator on right hand side of pan Add oil as required.

2 Generator set must be shut down to grease generator G1 main bearing. Refer to TM 9-6115-604-12, Chapter 3, for procedures

3 Change lubricating oil when replacing filters Prime lube system Refer to TM9-6115-604-12, Chapter 3, for procedures Oil gasket of new filters before installing Observe filter for 15 minutes after installation to verify good seal Remove filter and oil gasket again if leaks are observed.

4 Clean fittings before lubricating Lubricate with grease gun.

Reporting of errors. You can improve this publication by calling attention to errors and by recommending improvements and by stating your reason for the recommended Changes to Publications and Blank Forms, should be mailed directly to Commander, US Army Aviation and Troop Command, ATTN AMSAT-I-MP, 4300 Goodfellow Blvd , St Louis, MO 63120-1798 A reply will be furnished directly to you A copy of this lubrication order will remain with the vehicle at all times Instructions contained herein are madatory

Copy of this Lubrication Order will remain with the equipment at all times Instructions contained herein are mandatory

By Order of the Secretaries of the Army, and the Maine Corps

JOHN A. WICKHAM, JR
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Official

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DISTRIBUTION

To be distributed in accordance with DA Form 12-25A, Operator and Organizational Maintenance requirements for Generator Set, Skid Mounted, 2400/416V, 2200/3800V, 50/60HZ, 3PH, 4 Wire (MEP209A) (TM 5-6115-604 Series)

Figure 3-1. Engine and Related Parts (Sheet 2 of 2).

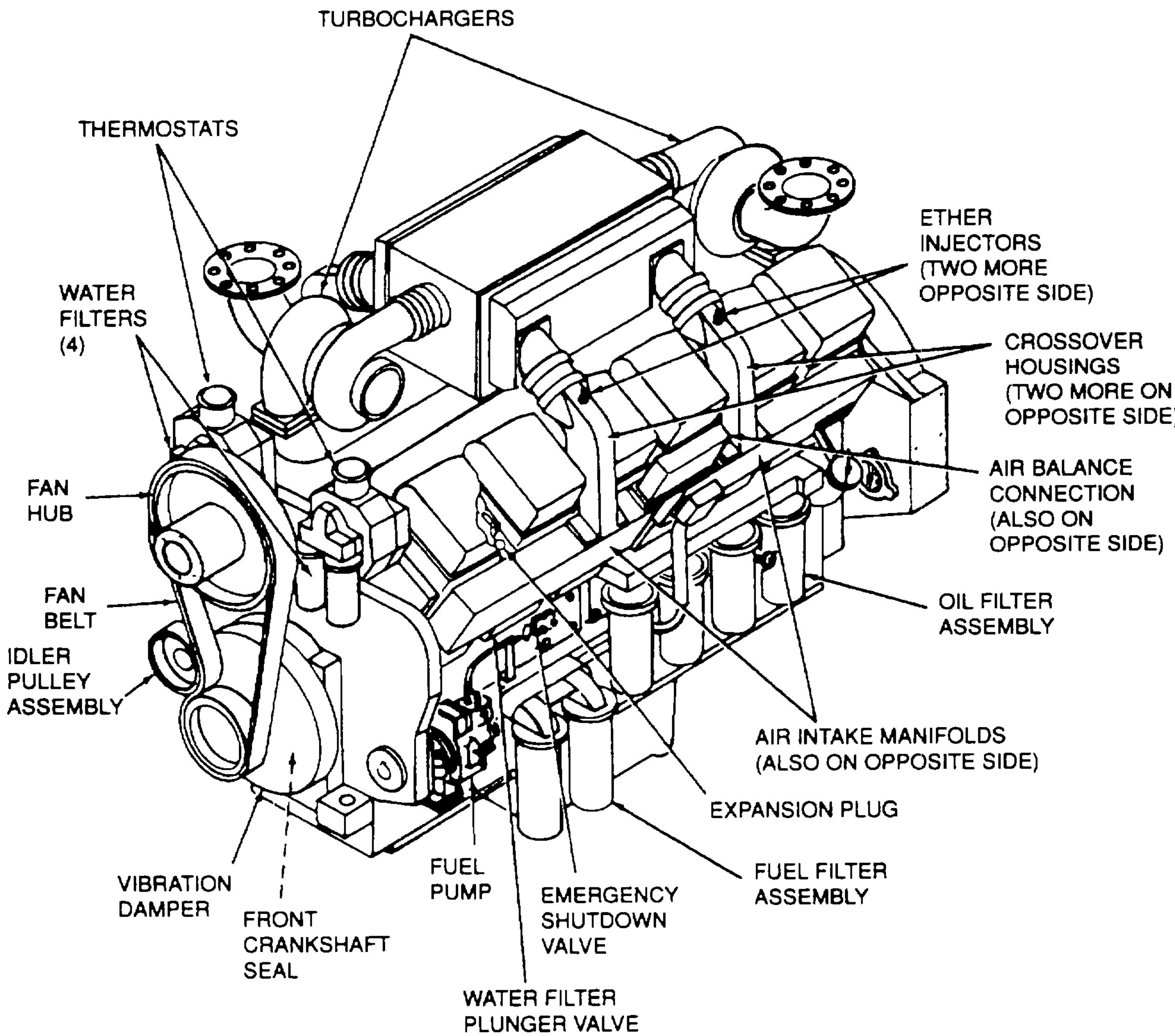


Figure 3-2. Engine and Related Parts (Sheet 1 of 5).

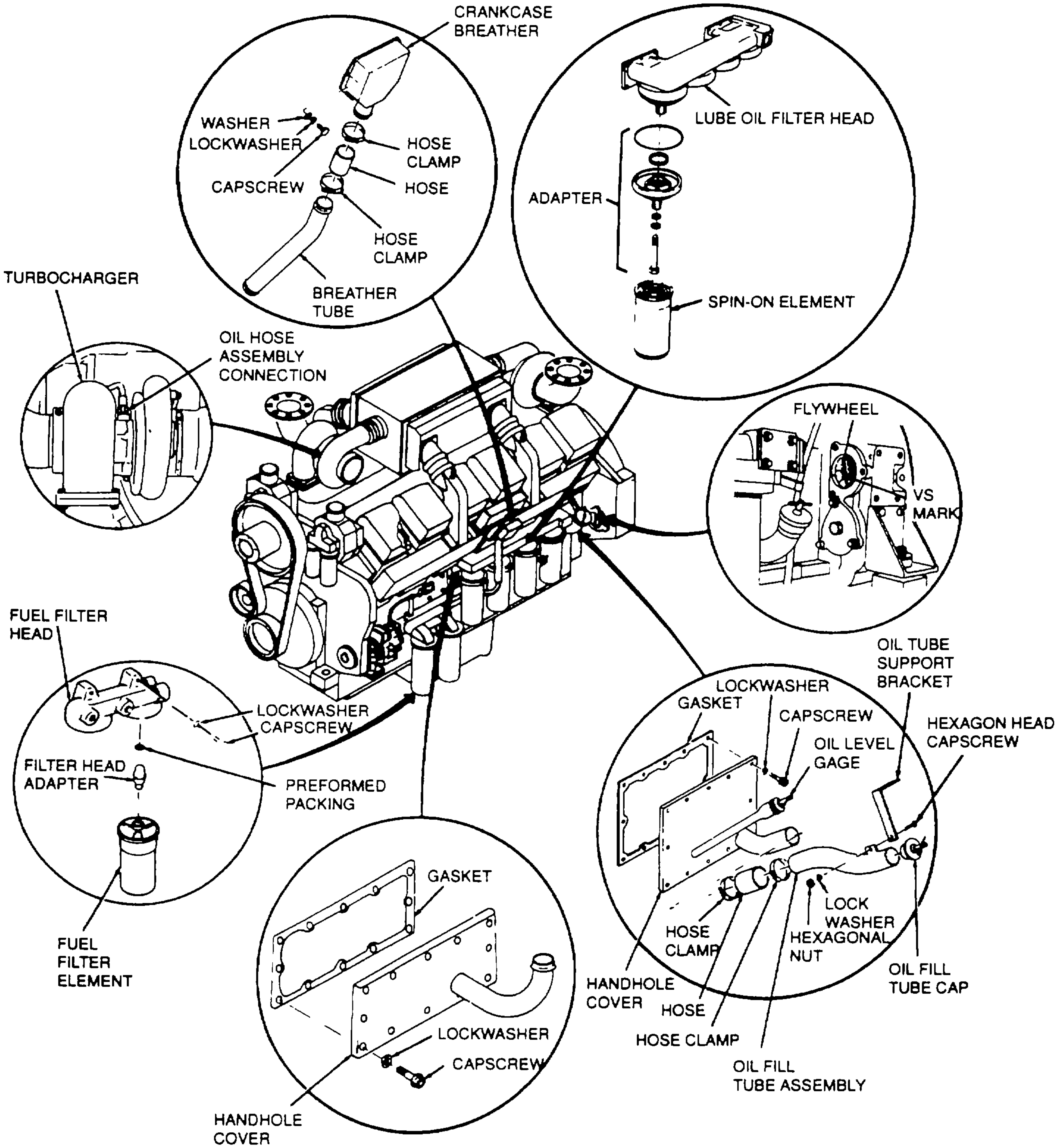


Figure 3-2. Engine and Related Parts (Sheet 2 of 5)

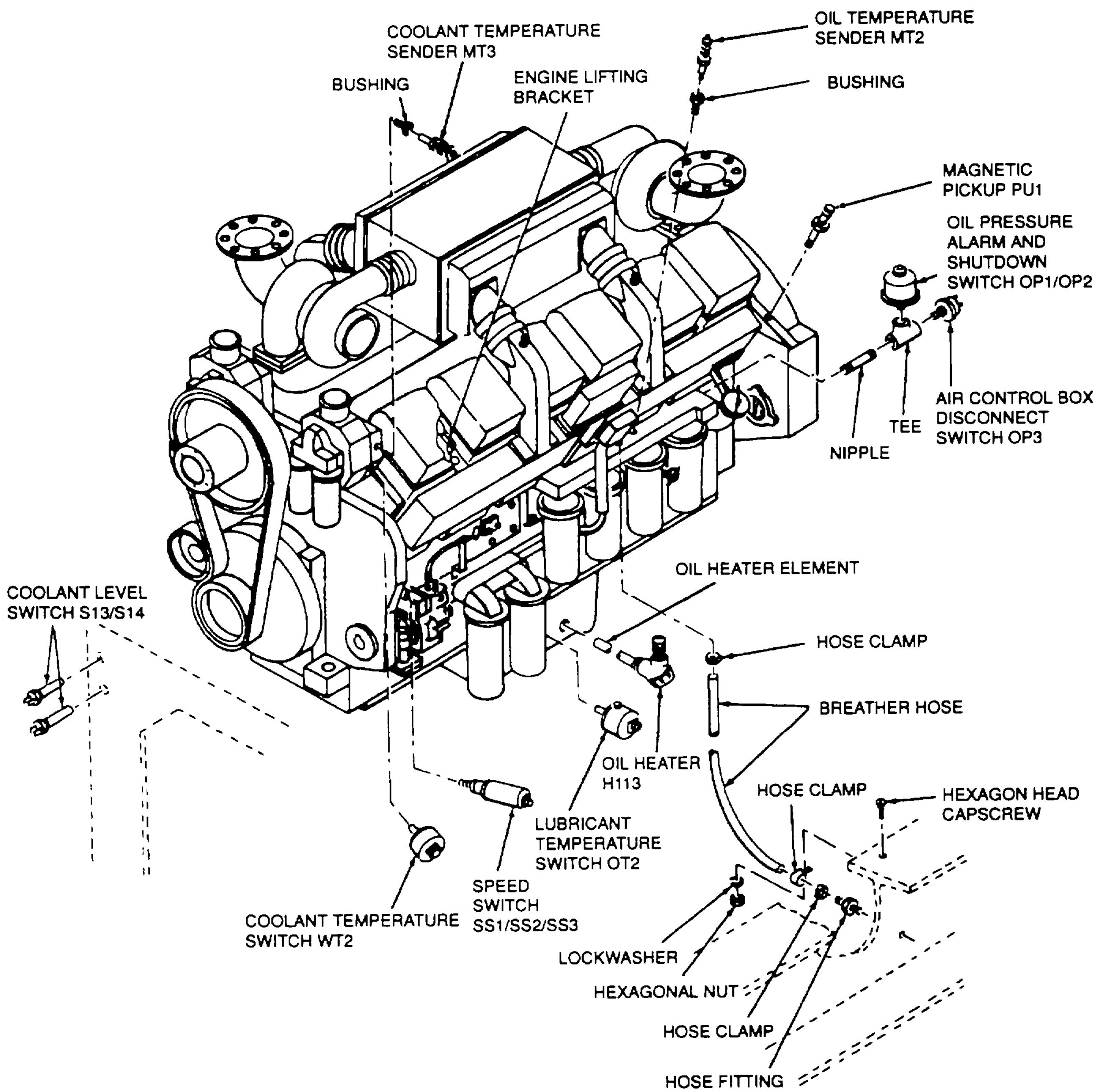


Figure 3-2. Engine and Related Parts (Sheet 3 of 5)

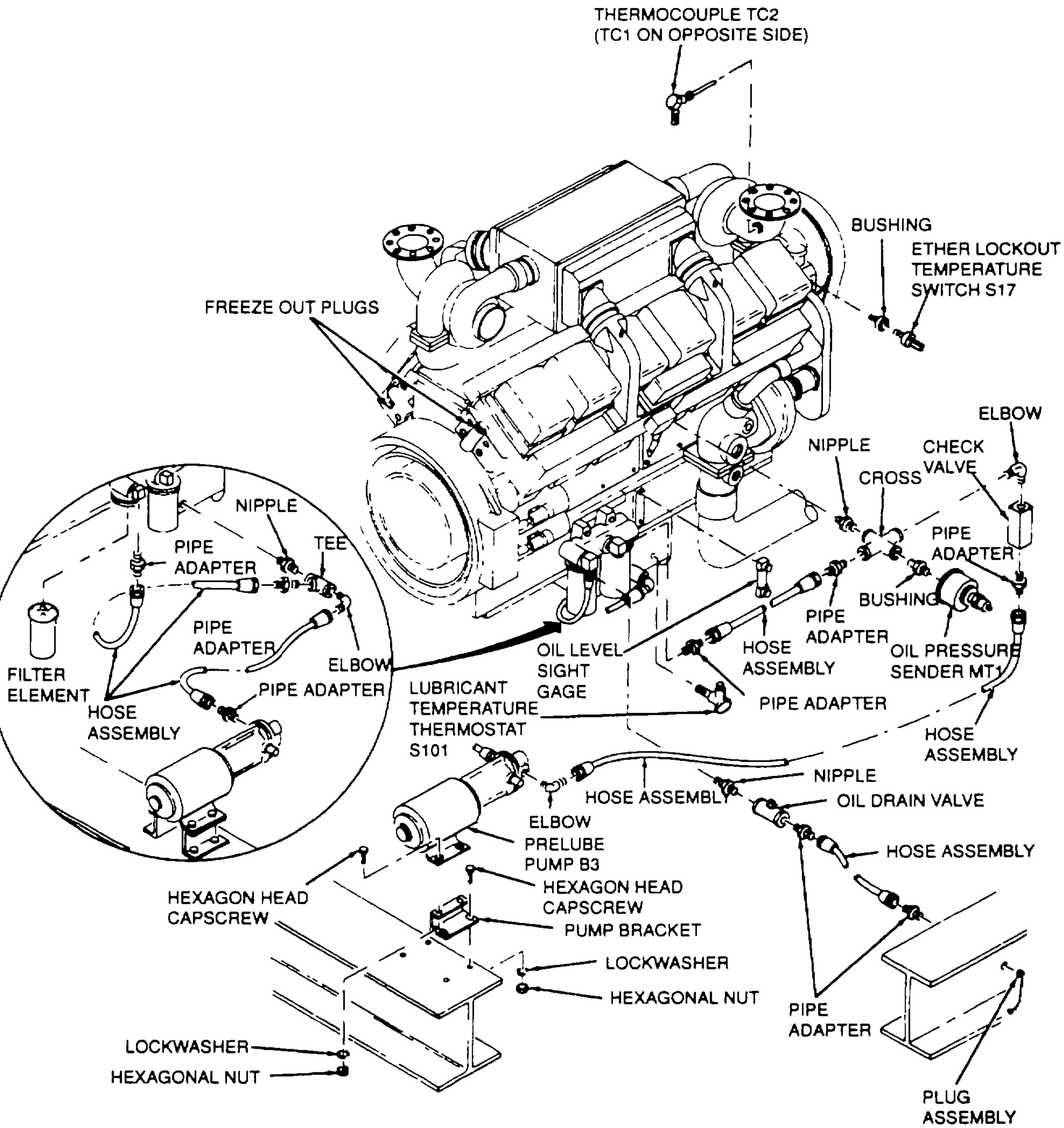


Figure 3-2. Engine and Related Parts (Sheet 4 of 5)

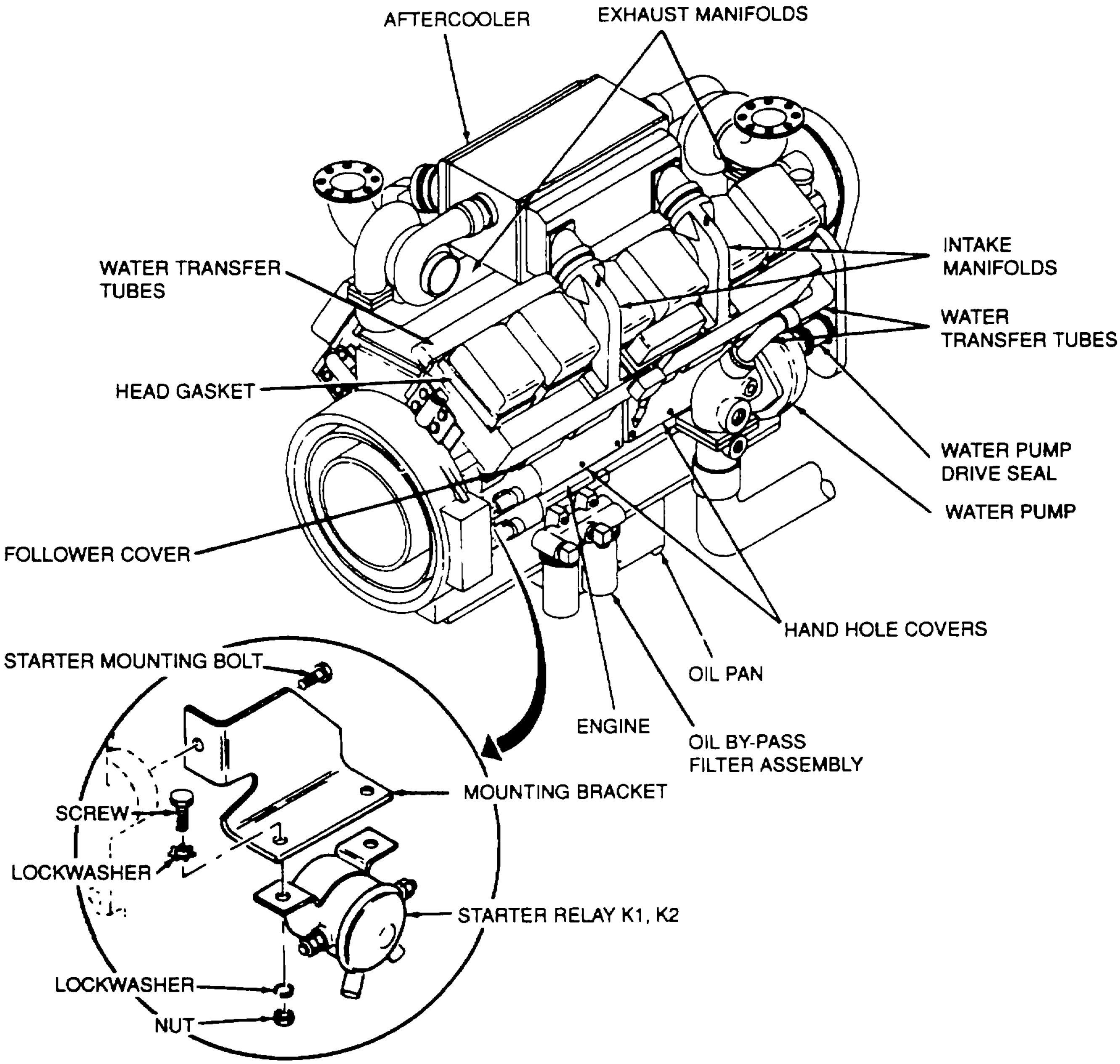


Figure 3-2. Engine and Related Parts (Sheet 5 of 5)

e. Oil Change Instructions. Change oil every 300 hours of operation or 3 months, whichever comes first. During cold weather operating conditions, change oil more frequently than usual due to increased contamination by dilution and sludge formation.

(1) Before draining the oil system, operate the engine until minimum coolant temperature of 160°F (710C) is obtained. Then shut engine off and set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1) to MAINTENANCE.

(2) Remove oil drain cap from skid base fitting, then open engine oil drain valve and allow oil to drain into a container. Refer to Table 3-1 for oil capacity. Refer to Figure 1-2 for oil drain point.

(3) Close oil drain valve and install drain plug. Add oil to HI mark on oil level gage or LOW mark on oil sight glass.

(4) Set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1), to OPERATION Start and operate engine for approximately 5 minutes.

(5) Stop engine and allow oil to drain back into crankcase before rechecking oil level.

f. Oil Filter Service. See Table 3-2 and paragraph 3-2 Service the oil filters by replacing the main and by-pass oil filter elements at intervals noted in Table 3-1. Perform oil filter servicing with the engine not running. Refer to Table 3-1 for quantity, and type of oil filter elements.

(1) Replace the spin-on elements (Figure 3-3) of the main oil filters. Fill the filter with lubricating oil and apply a small amount of lubricating oil to the gasket sealing surfaces prior to installation. Tighten by hand until the seal touches the filter head and then tighten an additional one-half to three-fourths turn.

(2) Replace the spin-on elements (Figure 3-3) and preformed packing of the by-pass filter assembly. Fill the filter with lubricating oil and apply a small amount of lubricating oil to the gasket sealing surfaces prior to installation. Tighten by hand until the seal touches the filter head and then tighten an additional one-half to three-fourths turn.

(3) Run the engine and check for leaks Stop engine and wait 3 minutes. Recheck the engine oil level, add oil as necessary to bring the oil level to HI mark on the oil level gage.

g Lubrication of Generator G1 Main Bearing.

WARNING

To avoid accidental engine cranking or startup, which could cause injury to maintenance personnel, place MAINTENANCE LOCKOUT switch S100 in the MAINTENANCE position prior to servicing the generator set. Return switch to the OPERATION position only after completion of service procedures.

(1) With the generator set shut down, and the MAINTENANCE LOCKOUT switch S100 In the MAINTENANCE position, wipe clean the filler and drain plugs (refer to Figure 3-4).

(2) Remove the filler and drain plugs.

(3) Free the drain hole of any hard grease using a piece of wire as necessary.

(4) Insert a 1/8 inch NPT grease fitting in the filler plug hole.

(5) Using a low pressure grease gun, add approximately 2 1 ounces (59.5 grams) of grease. Refer to Figure 3-2 for proper grease at expected temperature range.

(6) Remove the 1/8 Inch NPT grease fittings and Install the filler plug.

(7) With the drain plug removed, start the generator set and allow the unit to run for 15 minutes to allow excess grease to drain

(8) Stop the generator set, wipe off any drained grease, then install the drain plug.

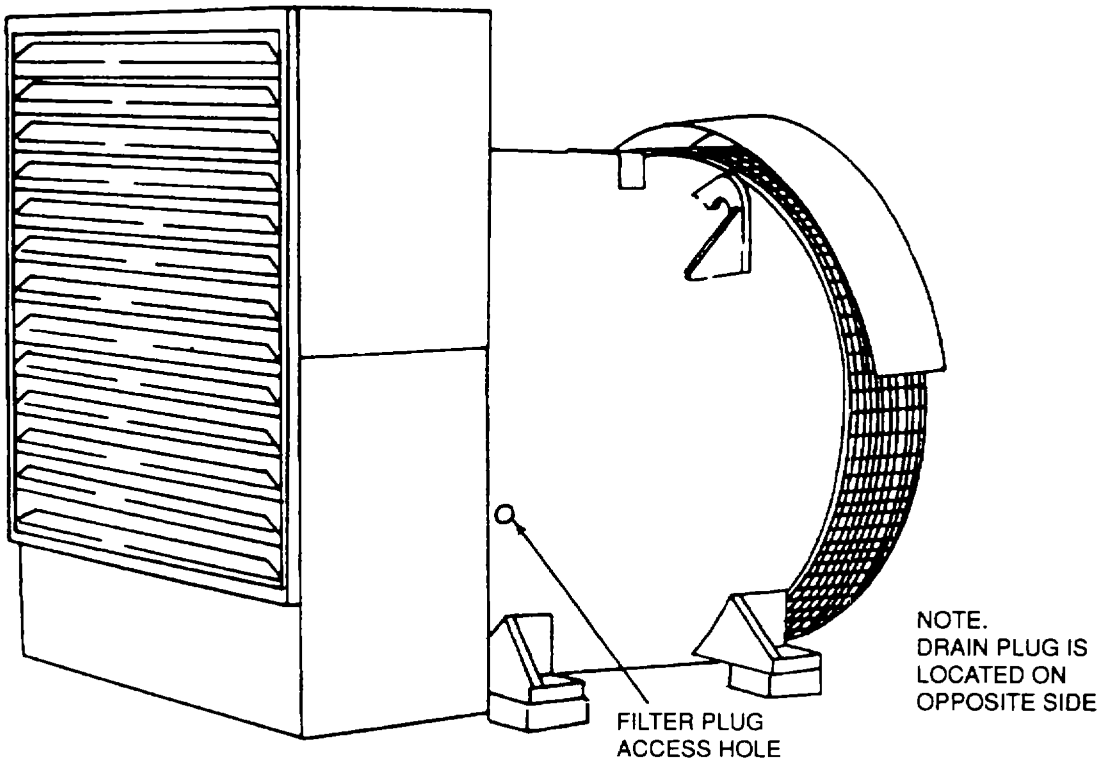


Figure 3-3. Lubrication of Generator G1 Main Bearing

SECTION III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

3-4. GENERAL. To insure that the generator set is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result In serious damage or failure. The necessary PMCS to be performed are listed and described in paragraph 3-5. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation Immediately if a deficiency Is noticed which would damage the equipment if operation were continued.

a. Before You Operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your BEFORE PMCS.
b. While You Operate. Always keep In mind the CAUTIONS and WARNINGS. Perform your DURING PMCS.
c. After You Operate. Be sure to perform your AFTER PMCS

NOTE

When a check and service procedure is required for both weekly and before Intervals, it is not necessary to perform the weekly procedure during the same week In which the before procedure was done.

d. Perform weekly PMCS once weekly.

NOTE

When a check and service procedure is required for both monthly and before intervals, it is not necessary to perform the monthly procedure during the same week in which the before procedure was done.

e. Perform monthly PMCS once monthly.
f. Use DA Form 2404 (Equipment Inspection and Maintenance Worksheet) to record any faults that you discover before, during, or after operation, unless you can fix them, you DO NOT need to record faults that you fix.

3-5. PMCS PROCEDURES.

a. Your Preventive Maintenance Checks and Services. Table 3-2 lists inspections and care required to keep your equipment in good operating condition. The check and service procedures are grouped according to their intervals, which are before, during, after, weekly, monthly.
b. The Item No column of Table 3-2 contains the number assigned to each check or service procedure of the PMCS.
c. The INTERVAL column of Table 3-2 tells you when to do a certain check or service.
d. LOCATION, ITEM TO CHECK/SERVICE column of Table 3-2 provides the location of the item within the equipment and name of the item to be checked or serviced.
e. The PROCEDURE column of Table 3-2 tells you how to do required checks and services Carefully follow these instructions.

NOTE

Terms ready/available and mission capable refer to same status Equipment is on hand and ready to perform its combat missions (See DA Pam 738-750).

f. The NOT FULLY MISSION CAPABLE IF column In Table 3-2 tells you when your equipment Is nonmission capable and why it cannot be used.
g If the equipment does not perform as required, refer to Chapter 3, Section IV, Troubleshooting.

3-6. LEAKAGE DEFINITIONS FOR OPERATOR PMCS.

It is necessary for you to know how fluid leakage affects the status of the equipment. Following are types/classes of leakage an operator needs to know to be able to determine the status of the equipment. Learn these leakage definitions and remember - when In doubt, notify your supervisor.

CAUTION

- **Equipment operation is allowable with minor leakages (Class I or II). Of course, consideration must be given to fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.**
- **When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.**
- **Class III leaks should be reported immediately to your supervisor.**

a. CLASS I - Seepage of fluid (as Indicated by wetness or discoloration) not great enough to form drops.
b. CLASS II - Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
c. CLASS III - Leakage of fluid great enough to form drops that fall from item being checked/inspected.

Table 3-2. Operator Preventive Maintenance Checks and Services.

Item No.	Interval	Location Item to Check/ Service	Procedure	Not Fully Mission Capable If:
1.	Before	Ground Terminals	Check for proper ground connection at both terminals. Refer to para 4-2	
2	Before During	Muffler and Exhaust	Check mufflers on roof and stacks between engine and roof for condition, leakage, and security During operation, be alert for development of excessively black, white, or blue exhaust smoke. (If coloration develops, refer to TROUBLESHOOTING for interpretation.	
3	Before During After	Radiator Water Filters, Lines and Coolant	Check sight glass for proper coolant level During operation, be alert for possibility of gradually falling level Check for leaks and security. Replace filters at intervals specified in Table 3-1, note (15).	
4	Before During	Crankcase	Check sight glass for proper oil level Refer to paragraph 3-3 to add oil during operation.	
5	Before	Batteries and Cables	Remove battery covers. Service batteries and check cable for security Change batteries if necessary Refer to Paragraph 3-9.	
6	Before During	Air Restriction Indicators	Check condition of air filter elements by checking air restriction indicators (Figure 1-5). If window shows amber or red refer to the next higher level of maintenance for element servicing.	
7	Before After	Fire Extinguishers	Check charge indicators on fire extinguishers in engine compartment and control room.	
8	Before	Air control	Make sure that air control valves are reset to the open Valves position. Refer to Figure 3-21.	
9	Before	Coolant Pre-heat Manual Valves	If coolant preheat system is to be used, make sure that all manual valves in the system are open to allow coolant to circulate.	
10	Before	Oil Breather Vents	Make sure that oil breather vents on skid base are not capped	

Table 3-2. Operator Preventive Maintenance Checks and Services. (Continued)

Item No.	Interval	Location Item to Check/ Service	Procedure	Not Fully Mission Capable If:
11	Before During	External Fuel Supply	Check that the external fuel supply Is adequate for the mission and is properly connected to the generator set fuel suction port. Be alert for possibility of increasing fuel consumption.	
12	Before During After	Fuel Filter Lines, and Strainer	Check for security. Look for leaks Drain water from strainer. Replace filters and strainer element at intervals specified in Table 3-1. Change fuel filters every 300 hours of operation.	
13	Before During After	Lube Oil Filters, By-pass Filters, and Oil Lines	Check for security Look for leaks. Replace filters at Intervals specified In Table 3-1	
14	Before	Housing	Check that sound insulation panels are Installed between generator compartment and switchgear cabinets and are properly secured.	
15	Before	Cabling	Verify that cabling from generator set to load, utility power, RCM, SRM, and other generator sets, as applicable, is properly connected, in serviceable condition, protected from local traffic, and doors are locked on output terminals.	
16	Before	Generator Set	Make sure set Is free of tools, equipment and spilled fuel, coolant, and lubricating oil.	
17	Before During	Shutter Assemblies	Set shutter assemblies as required. Close and service all doors to engine and generator compartments. Adjust shutter as required during operation.	
18	Before During	Annunciator Panel A9	Make sure that no fault indicators are lit If any are lit, verify that fault condition has been corrected. Then reset annunciator alarm system via ANNUNCIATOR RESET pushbutton S12. During operation, be alert for possible HIGH LUBE OIL TEMP, HIGH COOLANT TEMP, HIGH FUEL LEVEL, LOW COOLANT LEVEL, or LOW FUEL LEVEL alarms. These will not cause a shutdown, but shutdown may occur If conditions are not corrected.	
19	Before After	Coolant Pre-heat System	If required for operation, make sure coolant preheat system is on long enough to warm engine coolant prior to starting. External AC voltage Is required to operate the preheat system. Refer to paragraph 2-10.	
20	Before After	Fuel Transfer System	If external AC voltage is available, check that FUEL PUMP switch S8 has been set to AUTO prior to operation. This will fill generator set fuel tank and will automatically refill the tank (from external fuel source) during operation. If external AC voltage is not available, fill fuel tank manually using filter neck and set FUEL PUMP switch S8 to AUTO during operation (when generator set AC voltage will be available).	

Table 3-2. Operator Preventive Maintenance Checks and Services. (Continued)

Item No.	Interval	Location Item to Check/ Service	Procedure	Not Fully Mission Capable If:
21	Before During	Battery Charger BCI	After generator set is started and operating normally, set TIMER on battery charger panel (generator compartment above batteries) to a full 24 hours.	
22	During	Control Room Instruments	Monitor control room instruments not less that once per hour. (Record readings, if required.) Refer to Table 2-1, Table 2-2, and Table 2-3 for normal instrument readings under rated load. (If using RCM, refer to Table 2-13) Be alert for trends or changes in readings that could Indicate developing problems. Be especially alert for unequal voltage or current between lines, uneven generator temperature readings, uneven exhaust temperature readings; rising, falling, or fluctuating frequency output.	
23	Before After	Inertial Air Filter	Empty accumulated debris from cup assemblies at bottom of each air cleaner.	

SECTION IV. TROUBLESHOOTING

3-7. GENERAL

a. Table 3-3 contains troubleshooting information for locating and correcting operating troubles which may develop in the generator set. Each malfunction for an individual component, unit, or system is followed by a list of inspections or tests which will help you to determine probable causes and corrective actions to take You should perform the Inspections/tests and corrective actions In the order listed.

b. This manual does not list all malfunctions that may occur, nor all Inspections or tests and corrective actions. If a malfunction is not listed or cannot be corrected by listed corrective actions, notify your supervisor.

NOTE

Before you use Table 3-3, be sure you have performed all applicable PMCS operating checks.

Table 3-3. Operator Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. ENGINE FAILS TO CRANK.

Step 1 Check annunciator panel for any alarms

Reset alarms.

Step 2. With utility power available, check BATTERY CHRG AMPS and BATTERY CHRG VOLTS meters on battery charger. Current and voltage reading should be within 0 and 5 amperes and 26 to 28 V dc, respectively.

If readings are not within limits indicated, proceed to Step 3, Step 4, and Step 5, as required

Step 3 Check for defective, corroded, or loose battery cables and battery terminals

If cables or terminals are defective, refer to paragraph 3-9 for service or replacement procedures.

Step 4 Check electrolyte level of batteries Level should be 3/8 Inch above the plates.

If necessary, add distilled or clean water to required level.

Step 5 Test the batteries In accordance with paragraph 3-10.

Service or replace batteries, as required, in accordance with paragraph 3-10.

Step 6 Test speed switch in accordance with paragraph 4-28

Replace switch If defective.

2. ENGINE CRANKS BUT WILL NOT START.

Step 1 Check air control valve to ensure lever Is set to open.

If lever Is in closed position, reset to open position and try to start engine.

Step 2 Check air restriction Indicator.

If indicator shows amber or red, service filters In accordance with paragraph 3-15.

Step 3. Test batteries In accordance with paragraph 3-10.

Replace

Table 3-3. Operator Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. ENGINE CRANKS BUT WILL NOT START (CONTINUED).

Step 4. Inspect all fuel lines for leaks, loose connections, and any signs of damage
If fuel lines or fittings are loose, tighten If damaged, refer to the next higher level of maintenance for replacement

Step 5. Check LOW FUEL LEVEL Indicator lamp on control panel
a. Set FUEL PUMP switch to AUTO if connected to external fuel source
b. If fuel tank Is full and LOW FUEL LEVEL indicator lamp will not reset, refer to direct support maintenance level.

Step 6. Check OVER CRANK Indicator lamp. If lit, reset fault Indicator panel and try cranking again If light Is lit and will not go out, refer malfunction to direct support maintenance level.

Step 7 Check emergency shutdown controls see Figure 1-1.
Reset emergency shutdown control If it was pulled

3. ENGINE SHUTS DOWN SOON AFTER STARTING.

Step 1. Check annunciator panel for fault.
Reset alarm

Step 2. Check for low fuel level In fuel tank.
Add fuel as required

Step 3. Check for restricted fuel filters
Replace fuel filter elements.

4. ENGINE SHUTS DOWN AND WILL NOT RESTART.

Step 1. Check ENG FAULT Indicator lamps on control panel.
If any one of them is lit, refer to appropriate step, below

Step 2. If HI COOLANT TEMP indicator lamp Is lit, check the following

a. Coolant level at radiator site glass.
b. Radiator core dirty
c. Louvers not fully opened and cleaned.
d. Fan belt broken.
e. Idler pulley for proper fan belt tension

Table 3-3. Operator Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. ENGINE SHUTS DOWN AND WILL NOT RESTART.

WARNING

The radiator gets very hot during operation. Allow engine to cool before removing radiator cap.
If low, add coolant as required by temperature conditions, in accordance with paragraph 3-13.
If coolant level is normal, check for loose or broken fan belt. Check idler pulley and fan belt for looseness. Check for proper ventilation of engine and radiator. Open all louvers, as necessary. If no deficiencies are uncovered, refer to the next higher level of maintenance.

Step 3. If HI LUBE OIL TEMP Indicator lamp is lit, check lube oil level using oil level gage.
Add lube oil as required.

Step 4. If LOW LUBE OIL PRESS indicator lamp is lit, check lube oil level using oil level gage
Add lube oil as required.

Step 5 If LOW FUEL LEVEL Indicator lamp Is lit, check level of fuel In tank.
Refill as required

Step 6. Inspect fuel system components for leaks in accordance with paragraph 3-12
If fuel leakage is observed, refer to the next higher level of maintenance for repair

Step 7 Check OVERSPEED Indicator lamp
Reset speed switch and attempt to restart If OVERSPEED indicator lights again, refer to the next higher level of maintenance

5. ENGINE RUNS ERRATICALLY OR MISFIRES.

Step 1 Drain sample from fuel tank, see Figure 1-1, and visually Inspect for cloudy fuel or air bubbles.
If contamination exists, drain fuel tank, fuel lines, replace fuel filters, and clean fuel strainer. Ensure the auxiliary fuel source Is Inspected and replaced as necessary Bubbles in the fuel Indicate air in the fuel system Check fuel lines from fuel manifold to fuel tank and tighten fittings as necessary.

Step 2. Disconnect fuel line between EFC fuel injection pump and fuel manifold, see Figure 1-8, and draw sample.
Visually Inspect for cloudy fuel or air bubbles.
If contamination exists, follow procedure In Step 1, above Refer EFC fuel injection pump to direct support maintenance level for purging or replacement.

Step 3 Check air restriction Indicators for amber or red signal.
If either or both air restriction Indicators show amber or red, service air cleaner filters in accordance with paragraph 3-15.

Step 4. With engine running, check the engine exhaust fumes If fumes are excessively black proceed to malfunction 6 below. If fumes are blue or white proceed to malfunction 7, below

Table 3-3. Operator Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. ENGINE EXHAUST EXCESSIVELY BLACK.

Step 1 Check air restriction indicators.

If ether or both air restriction Indicators shows red, service air cleaner In accordance with paragraph 3-15.

Step 2. Check AC KILOWATTS meter on control panel for overload condition.

Reduce load to rated level.

Step 3. Inspect crankcase breather and hose for obstruction

Refer to the next higher level of maintenance for repair.

Step 4. Restricted exhaust system.

Repair exhaust system.

Step 5. Light loads.

Increase load.

7. ENGINE EXHAUST WHITE OR BLUE.

Step 1 Verify that proper grade fuel and lubricant Is used.

Refer to Table 3-1 for proper grade fuel and lubricant.

Step 2. Check for excessive lube oil using sight gage with engine running or oil level gage If not running.

Drain crankcase until proper level is indicated.

Step 3 Excessive oil consumption Refer to the next higher level of maintenance.

8. GENERATOR OUTPUT FREQUENCY AND VOLTAGE CANNOT BE MAINTAINED.

Finely adjust the FREQ ADJ rheostat on the front panel until the exact desired frequency reading is obtained on the FREQUENCY meter.

If frequency still cannot be maintained, see malfunction 5, above.

9. ANNUNCIATOR PANEL INDICATOR LAMPS FAIL TO LIGHT.

Check FAULT indicator lamps by pressing ANNUNCIATOR TEST switch.

If any lamps fall to light or light dimly, replace lamp If replacing lamp falls to correct problem, refer to direct support maintenance level.

10. LOAD CIRCUIT BREAKER CB101 FAILS TO CLOSE.

Step 1. Check phase connection of generator set to bus. Load circuit breaker CB101 will not close If generator set and bus are out of phase

Shut down generator set. Correct phase connections.

Step 2. Check status of bus. Load circuit breaker CB101 will not close onto live bus If In single unit operation.

Perform parallel operating procedures to close onto a live bus.

Table 3-3. Operator Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

10. LOAD CIRCUIT BREAKER CB101 FAILS TO CLOSE. (CONTINUED)
Step 3. Check position of C8123
Close If set to open.

11. AC/DC LIGHTS NOT WORKING.
Check for defective light bulbs
Replace light bulbs

SECTION V. OPERATOR MAINTENANCE INSTRUCTIONS

3-8. GENERAL. The instructions In this section are provided to assist the operator In maintaining the generator set. If defective components are noted during Inspection, perform the repair or replacement procedures listed in this section. If no repair or replacement procedure is shown in this section, then you are not authorized to perform that procedure and you must report the defective component to the next higher level of maintenance.

WARNING

MAINTENANCE LOCKOUT switch must be set to the MAINTENANCE position prior to performing any maintenance and reset to OPERATION when maintenance is completed.

3-9. MAINTENANCE OF HOUSING AND BASE ASSEMBLY . The generator set Is enclosed In an all weather housing (see Figure 1-1 and Figure 1-2). Refer to step a, below, for general maintenance Instructions Detailed Instructions for specialized maintenance of the housing and base assembly are provided in steps b through h, below.

WARNING

Dry cleaning solvent P-D-680, Type II, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory tract protection is required to avoid injury to personnel.

a General Maintenance General maintenance consists of Inspections and servicing Inspection of weatherproof equipment and components Is required at periodic intervals Inspect for discolorations, leaks, or paint cracks. Service the equipment by keeping it clean, free of grease, corrosion, rust, and deterioration. Use clean cloth, stiff brushes, and dry cleaning solvent P-D-680, Type II, or equivalent, as required Repaint in accordance with MIL-T-704

b Access Doors and Covers The generator set uses several access doors and covers Check that doors do not bind In their frames, that they swing easily on their hinges, and that they remain closed when latched

c Housing Panels Check the housing panels for corrosion, holes, scrapes, and/or dents Check sound insulation material in control room and between switchgear and generator compartment for any evident damage.

d. Shutter Assemblies. See Figure 3-5. Inspect and service all shutter assemblies on a regular basis. Check that the shutter assemblies can be adjusted for optimum ventilation Ensure that the openings are not clogged with debris of any type. Verify that the formed metal portions (louvers) of the fixed position shutters are fully open.

e. Skid Base. Inspect and service the skid base by checking It for corrosion, dents, and paint scrapes. Repaint as required In accordance with MIL-T-704. Refer to the next higher level of maintenance for major repairs.
f. Tool Box. Inspect tool box to verify that the hinges are straight and secure. Check for dents and scratches. Repaint as required in accordance with MIL-T-704.
g. Fire Extinguishers. The set contains three fire extinguishers, two in the engine compartment and one In the control room. Verify validity dates on tags. Check charge indicators on cylinders.
h. Exhaust Fan. The exhaust fan ventilates the control room. Ensure that the exhaust fan is free of debris on both interior and exterior sides. Lubricate the shutters as required. Repaint as necessary in accordance with MIL-T-704.

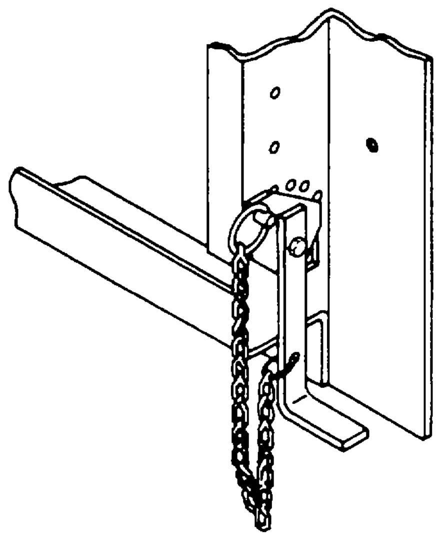


Figure 3-4. Shutter Control Lever Assembly

3-10. MAINTENANCE OF DC ELECTRICAL AND CONTROL SYSTEM.

a. Maintenance of Batteries. The generator set contains four 12-volt, lead-acid storage batteries located In the generator compartment on the right hand skid.

WARNING

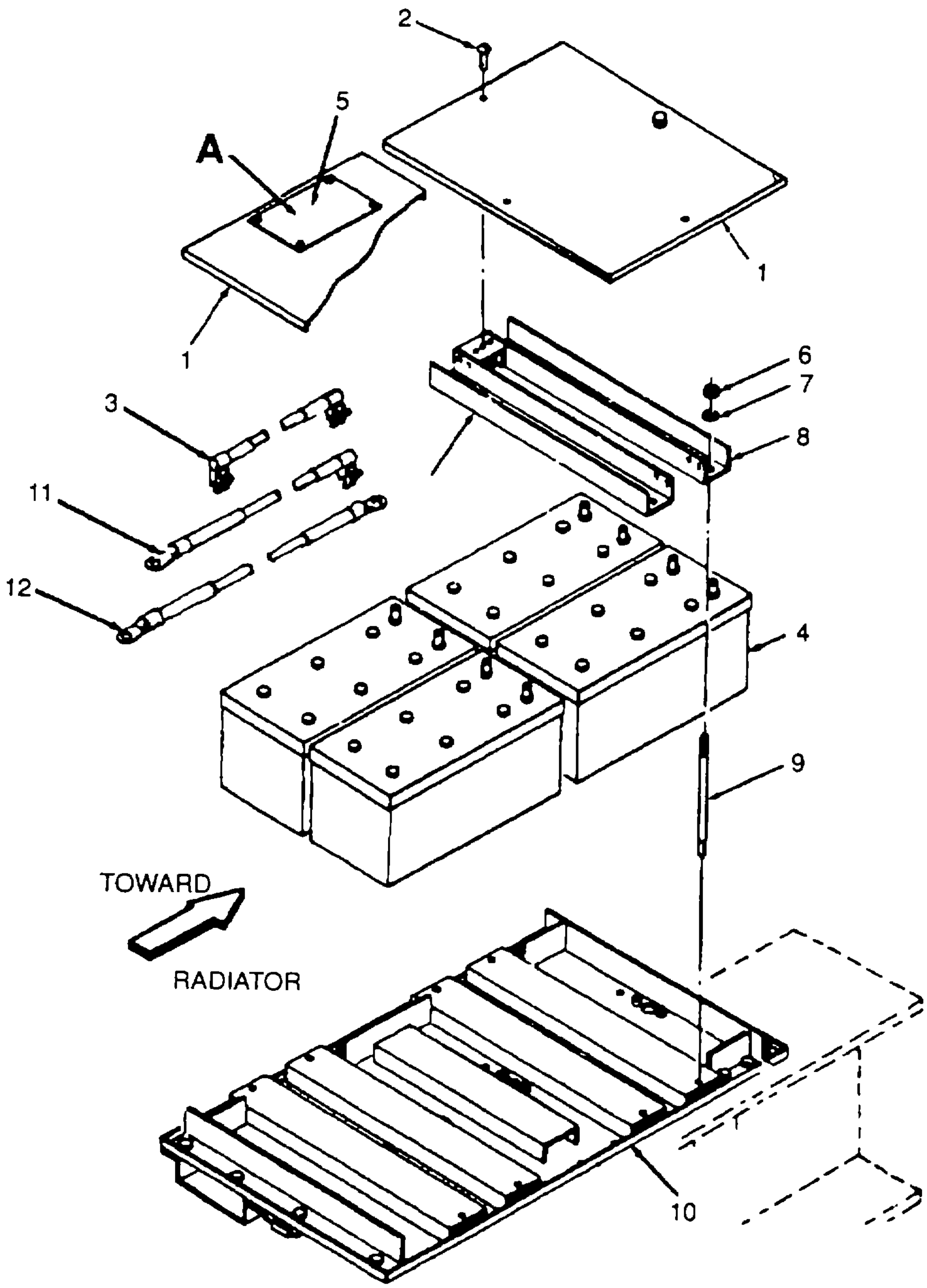
Batteries generate explosive gases during operation which can cause injury to personnel. Use extreme caution when working on or around batteries. Do not smoke or use open flames in the vicinity when servicing the batteries.

WARNING

Electrolyte contains sulfuric acid which can cause severe burns and Injury to personnel. It is highly toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to avoid injury to personnel.

WARNING

When necessary to remove batteries, use two people. Batteries have dry weight of 108 pounds (49 kg) and wet weight of 150 pounds (68 kg) each. Lifting may cause Injury to personnel.



1 BATTERY COVER
2. QUARTER-TURN STUD
3. BATTERY CABLE
4. STORAGE BATTERIES BT1 THROUGH BT4
5 BATTERY CONNECTION NAMEPLATE
6. HEXAGONAL NUT
7 LOCKWASHER
8. BATTERY HOLD-DOWN CHANNEL
9 BATTERY STUD
10. BATTERY TRAY
11 BATTERY CABLE
12 BATTERY CABLE

Figure 3-5. Batteries and Related Parts (Sheet 1 of 2)

(1) Inspect. Remove battery cover by turning quarter turn studs (2, Figure 3-6) and visually inspect batteries for obvious damage, such as cracked or broken case or covert, or leakage of battery acid.

(2) Test.

(a) Remove the vent caps on top of the battery, one at a time, and check the electrolyte level. If the metallic plates are visible above the fluid level, service in accordance with step (3), below.

(b) Test the specific gravity of the electrolyte with a hydrometer. The specific gravity shall be 1.265 :0.010. A hydrometer reading of 1.150 or less will allow the battery to freeze at -550 (-48°). With a specific gravity of 1.280 the battery will withstand temperatures as low as -65°F (-54°C) without freezing. A battery with a specific gravity of less than 1.150 at -25°F (-31°C) should be charged or replaced.

(c) If the battery has passed the tests, Install the cover in accordance with step (5)(e) through (h), below.

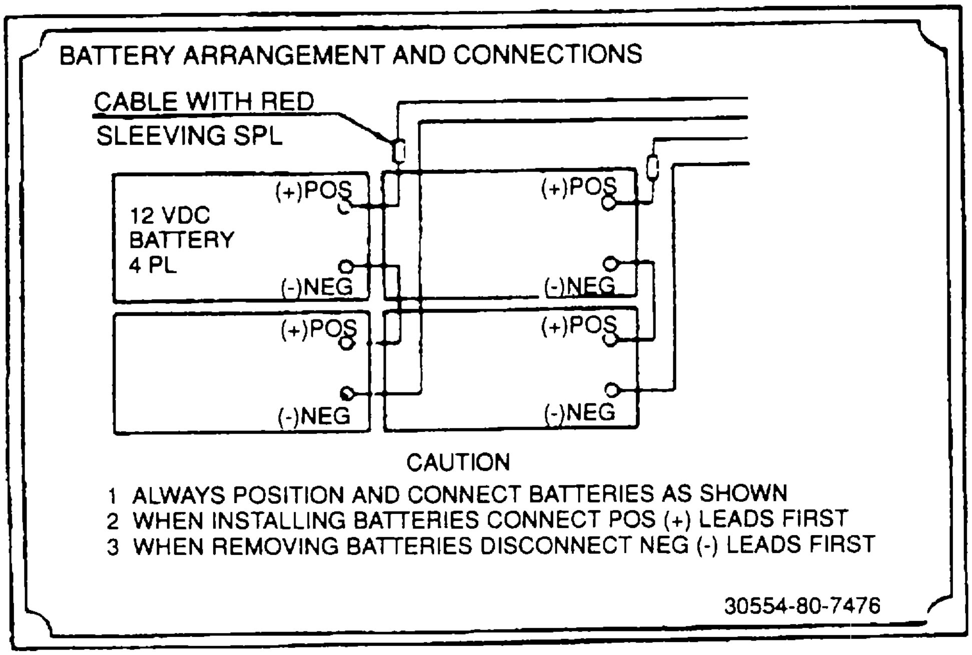


Figure 3-5. Batteries and Related Parts (Sheet 2 of 2)

(3) Service. Service the batteries at the intervals shown In the Operator Preventive Maintenance Checks and Services, Table 3-2.

(a) If the electrolyte level In the batteries was seen to be low In step (2)(a), above, fill with distilled water to 3/8 inch (9 5 mm) above the plates.

(b) Replace vent caps as soon as servicing is completed.

(4) Install and Charge If the batteries are shipped dry, add electrolyte prior to installation.

WARNING

Electrolyte contains sulfuric acid which can cause severe burns and injury to personnel. It is highly toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to avoid injury to personnel.

(a) The electrolyte Is diluted sulfuric acid. Ensure vent holes In cell caps are open. Prepare 4.1 gallons (15.5 L) of electrolyte, MIL-STD-605, Class II, for each battery.
(b) Using an acid-proof funnel, carefully pour the electrolyte into the battery cells. Cover the plates in each cell with 3/8 inch (9.5 m) of solution.
(c) Install the battery in accordance with step (5) (e) through (h), below.
(d) The electrolyte level must be rechecked and adjusted approximately 30 minutes after initial fill.
(e) Bring battery electrolyte to proper specific gravity (1.250 or higher at 800F (270C)).

NOTE

Battery charger BC1 applies an equalizing charge to batteries BT1 through BT4 for up to 24 hours The TIMER is set from 1 to 24 hours when the battery charger is used. Actual length and intensity of charge is determined by internal battery charger circuitry. The TIMER rotates toward zero hours as time elapses. The DC VOLTS meter and DC AM- PERES meter on the door of BC1 indicate battery charger output voltage and current at any given moment.

(5) Replace See Figure 3-6
(a) Remove the battery covers (1) by pivoting quarter-turn studs (2).
(b) Disconnect the negative-cables, the positive cables, and the jumper cables from the storage batteries BT1 through BT4 (4) See battery connection nameplate (5) on battery cover for cable identification.
(c) Remove the hexagonal nuts (6) and lockwashers (7) and remove the four battery hold-down channels (8). It is not necessary to remove the retaining battery studs (9).
(d) Lift out the storage batteries BT1 through BT4 (4).
(e) Install new batteries on the battery tray (10), orienting the terminals as shown on battery connection nameplate (5).
(f) Install the battery hold-down channels (8) and secure with hexagonal nuts (6) and lockwashers (7).
(g) Connect the cables as shown on battery connection nameplate (5).
(h) Install the battery covers (1) with quarter-turn studs (2)

b Maintenance of Battery Cables. There are six battery cables two positive leads, two negative leads, and two jumper cables Connectors may be lugs (1, Figure 3-7) or clamps (2) The jumper cables have two clamp battery terminals. A red sleeve (3) identifies positive terminal ends Negative terminal ends are identified with a black sleeve (4).

(1) Inspect Remove battery covers by turning quarter-turn studs (2, Figure 3-6) and visually Inspect cables and connectors for corrosion and looseness.
(2) Test.
(a) Unfasten attachments and separate all of the negative terminal ends.
(b) Separate all positive terminal ends and lift out the battery cables
(c) Using a multimeter (ohms), test continuity of each cable Meter (RX1) should read zero.

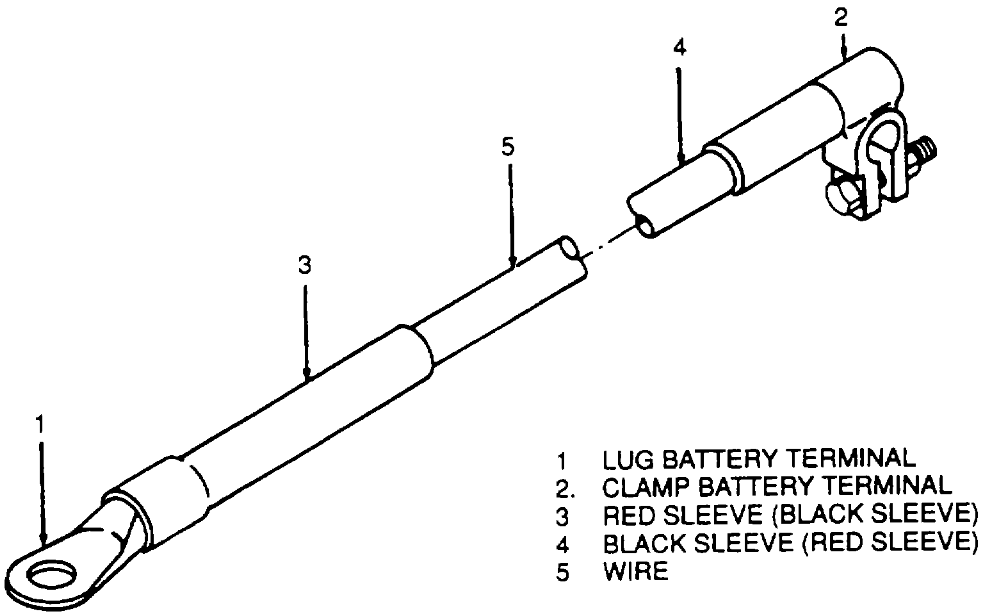


Figure 3-6. Battery Cable Assemblies

NOTE

Use a battery brush to clean terminal ends. If corrosion Is present, brush well with a solution of baking soda and water. Flush with water.

(3) Service. Apply grease (see Table 3-1) to the cable connectors to prevent corrosion. If connectors are corroded, clean with a stiff bristle brush prior to applying grease.

(4) Replace.

(a) Loosen or remove hexagonal nuts, fastening terminal lugs, or terminal clamps and lift off battery cable being replaced.

(b) Install new or repaired battery cable, ensuring that the mating battery terminal post or mating connection is clean.

(c) Secure attaching hexagonal nuts.

NOTE

When replacing cables, ensure that the red sleeving ends are correctly oriented with the positive terminals of mating connections.

(5) Repair.

(a) To replace a damaged terminal lug or clamp, remove the insulation sleeving and terminal lug or clamp and thoroughly clean the end of the wire cable with wire brush. Battery jumpers are repaired by replacement only.

(b) Slide new insulation sleeving onto the cable, employing the proper color coding, red for positive, black for negative.

(c) Assemble the cable end attachment and crimp securely In place.

(d) Slide the insulation sleeving into position and shrink by applying heated air at 400°F (204.4°C) for 3 to 5 seconds

c. Inspect Battery Charger. Battery charger BC 1 converts 120 V ac input into 24 Vdc output to charge storage batteries BT1 through BT4 The battery charger (see Figure 1-7) is located at the rear of the generator, above the batteries. Check battery charger input and output cable connections for looseness or corrosion. Check all components for loose mounting, poor solder connections, broken wires, overheated resistors, or any other signs of damage.
d. Inspect Starter Relays K1 and K2. Starter relays K1 and K2 are located near the starter motors (see Figure 3-3). Inspect the relays for secure mounting. Inspect for signs of overheating or corrosion
e. Inspect HIGH Coolant Temperature Switch WT2. Ensure that the coolant temperature switch (Figure 3-3) is clean, does not leak, and that the connector is undamaged and secure.
f. Inspect LOW Coolant Level Switches S13 and S14 Ensure that the coolant level switches S13 and S14 (figure 3-3) are clean, do not leak, and that the connectors are undamaged and secure.
g. Inspect Lubricant Temperature Switch OT2. Ensure that the lubricant temperature switch OT2 (Figure 3-3) Is clean, does not leak, and that the connector is undamaged and secure.
h. Inspect LOW Oil Pressure Alarm OP2 and LOW Lubricating Oil Shutdown Switch OP1 Ensure that the oil pressure alarm switch OP2 and LOW lubricating oil shutdown switch OP1 (Figure 3-3), are clean, do not leak, and that the connectors are undamaged and secure
i. Inspect Speed Switch SS1/SS2/SS3. Speed switch SS1/SS2/SS3 (Figure 3-3) is mounted on the engine next to the mechanical governor Ensure that the switch is clean and that the connectors are undamaged and secure.
j. Inspect Air Box Disconnect Oil Pressure Switch OP3. Ensure that the air box disconnect oil pressure switch OP3 (figure 3-3) is clean and that the connector Is undamaged and secure.
k. Inspect DC Circuit Breakers CB1 and CB2 (24 V DC CONTROL POWER CIRCUIT BREAKER CB1 and EMERGENCY LIGHTING CB CB2) The generator set contains two DC circuit breakers. Both are located on engine control panel C (2 and 17, Figure 2-1). Ensure that the 24 VDC CONTROL POWER CIRCUIT BREAKER CB1 and EMERGENCY LIGHTING CB CB2 are undamaged and that no discoloration is evident.
l. Inspect Starter Motors B1 and B2. Cables and Solenoid. The two starter motors B1 and B2 are mounted on the right side of the engine (see Figure 1-5)
   (1) Inspect terminals on starter motor solenoids for corrosion.
   (2) If corrosion exists, disconnect battery ground cables Tag and disconnect battery cables to solenoids one at a time. Remove cushion clamps and clean terminals as required to produce bare metal surfaces
   (3) Check starter motors and solenoids for damage and secure mounting.
   (4) Check surfaces of starter motors for signs of overheating, discolored or blistered paint.
   (5) Connect battery cables to starter motor solenoids, remove tags and replace tiewraps. Reconnect battery ground cables.
m. Emergency Lights DS20 through DS23 The generator set contains four emergency lights one located in the control room and three mounted in the engine compartment.
   (1) Inspect Inspect emergency lights DS20 through DS23 for secure mounting Check for broken light bulb and secure wiring connections Check light bulb operation by setting the EMERGENCY LIGHTS circuit breaker CB2(17, Figure 2-1) on engine control cabinet C to ON AC power must be shut off in order for dc lights to function.
   (2) Service Service as follows.
   (a) Remove lamp by pulling it out of rubber gasket.
   (b) Label and disconnect wires.
   (c) Connect wires to new lamp.
   (d) Install new lamp In rubber gasket.

3-11. MAINTENANCE OF AC POWER GENERATION AND CONTROL SYSTEM.

a. Visually Inspect Main Disconnect Switch S120. (See Figure 3-8.) Main disconnect switch S120 is located in the control room behind the lower door to cabinet A.

WARNING

DANGER HIGH VOLTAGE

Do not touch exposed electrical connections when a source of power or another generator set is connected to the load terminals. Death or Injury may result from failure to observe this warning.

WARNING

To avoid injury to personnel, no electrical component will be worked on while energized. Ensure equipment Is "tagged out" In accordance with Chapter Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage Is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

(1) Open lower cabinet A door.
(2) Visually inspect the main disconnect switch S120 for severe discoloration or deterioration of the conductors or insulators.
(3) Close the compartment door.

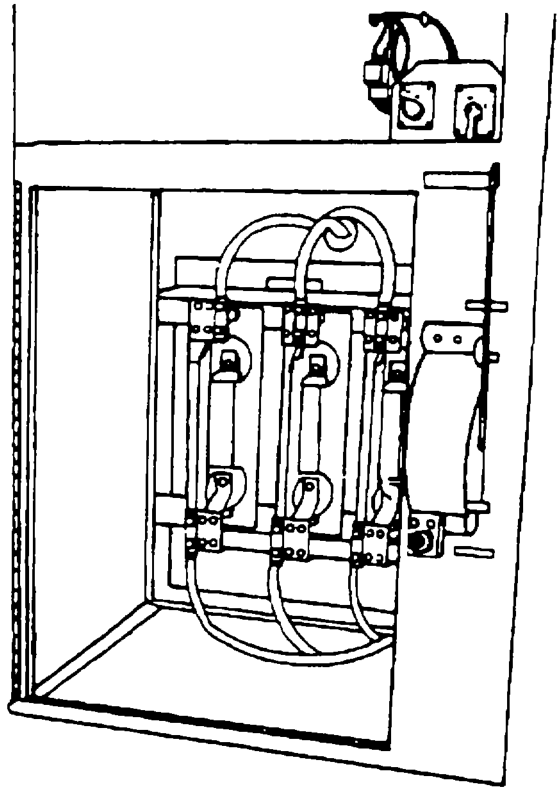


Figure 3-7. Main Disconnect Switch S120

b. Maintenance of Station Power Cable Assembly
   (1) Inspect. See Figure 3-9 Perform visual inspection on station power cable assembly as follows:
      (a) Inspect plug connector for deformities, cracks, and other damage. Check that the female terminals inside the connector are clean, free from any obstruction, and not damaged.
      (b) Check securing nut on plug connector against mounting hardware on J1 01 on the generator set for possible cross-threading or damage.
      (c) Check that the cable grip is securely fastened to the cable insulation sleeve. Check that the tie-down loop on the cable grip Is functional.
      (d) Lay out cable and inspect station power cable insulation throughout Its entire length Check for cuts, cracks, ruptures, or deformities indicative of internal cable breakage.
      (e) Check that the station power cable marker band is clearly legible and securely attached to the power cable.
   (2) Replace. Replace defective station power cable. Refer to the next higher level of maintenance for repair.

WARNING

Disconnect all power and remove outgoing power cables before performing inspectIon. Put cables in park position.

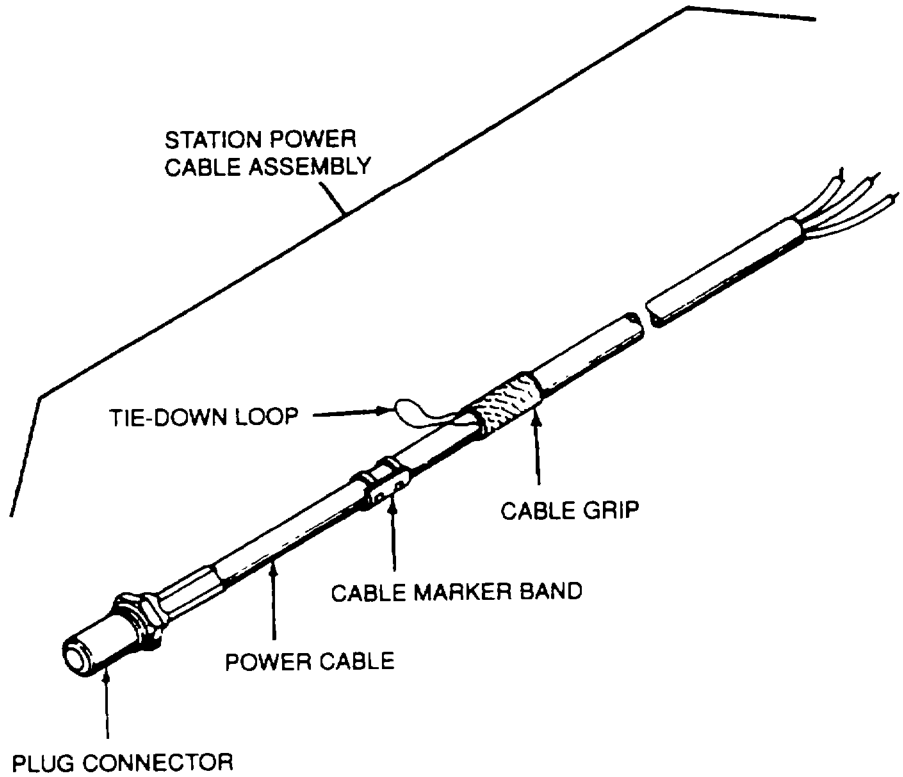


Figure 3-8. Cable Assemblies (Sheet 1 of 2)

c. Maintenance of Outgoing Power Cable Assemblies. (Load Cables L0, L1, L2, and L3.)

(1) Inspect. See Figure 3-9. Perform visual inspection on each outgoing power cable assembly as follows:

(a) Check elbow connectors for cracks, deformities, and other damage Check that the conductor sleeve inside each elbow connector is clean and free from obstructions and damage.

(b) Lay out cables and inspect insulation for cuts, cracks, ruptures, and other possible damage.

(c) Check that the shielding braid (wire) on each power cable is secured at the base of the elbow connector. Also check that the shield grounding wire is secured at the other side of the shield wire mounting screw.

(d) Inspect output terminal lugs on each cable Check that the lugs are securely attached to the cables and free from corrosion and damage. Also check that the other end of the cable shielding wire is firmly attached to the cable.

(e) Check that the outgoing power marker bands on each cable (L0, L1, L2, and L3) are clearly legible and securely attached.

(f) Check that the cable grips are securely fastened to the cable insulation sleeves Check that the tie-down loop on each cable grip is functional.

(2) Replace. Replace defective outgoing power cable assembly. Refer to the next higher level of maintenance for repair.

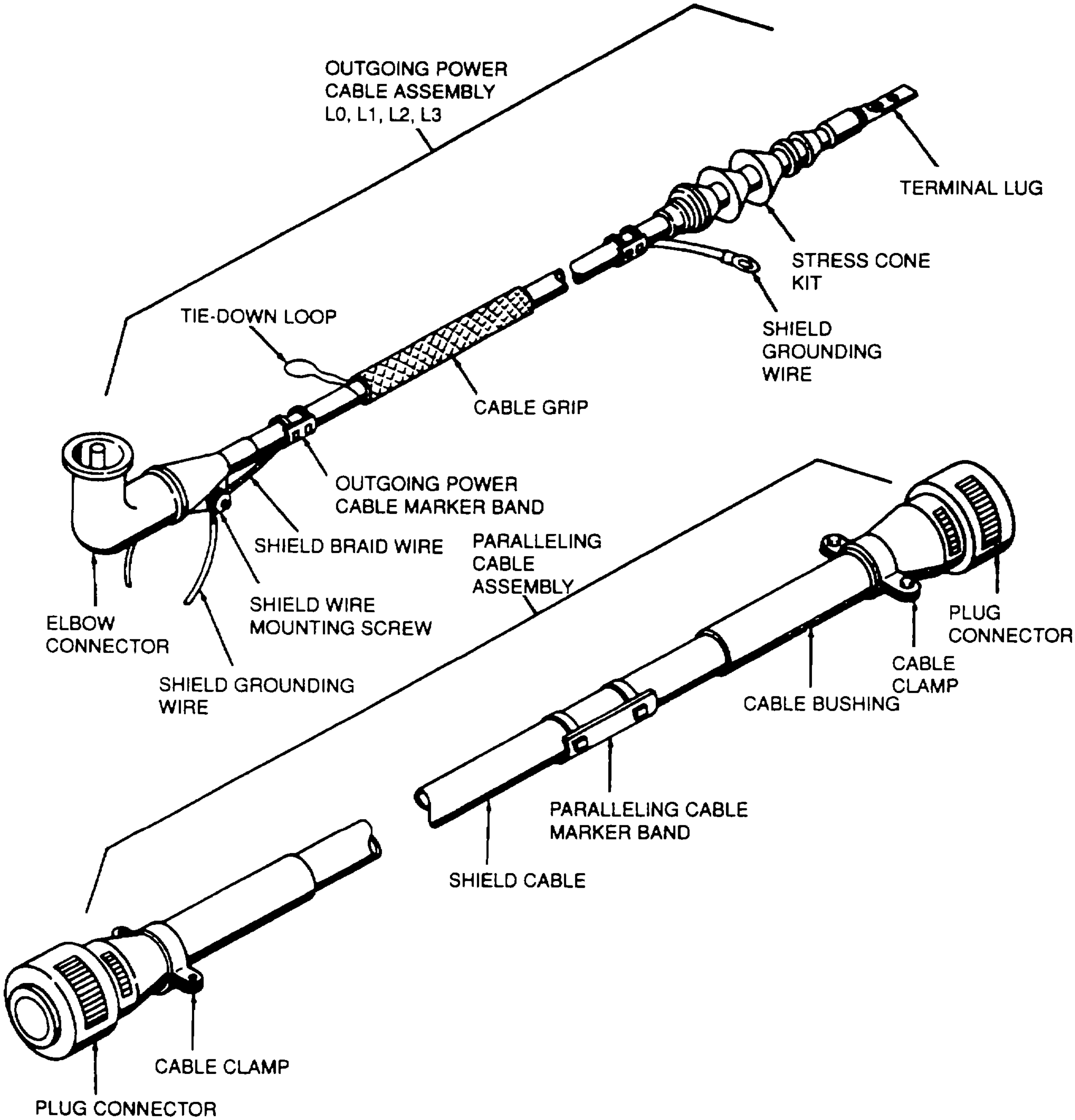


Figure 3-8. Cable Assemblies (Sheet 2 of 2)

d. Maintenance of Parallel Cable Assemblies. These procedures apply for both the reactive load and governor control cables.
   (1) Inspect. See Figure 3-9. Perform visual inspection on parallel cable assemblies as follows:
      (a) Inspect plug connectors on both ends of the parallel cables. Check for cracks, deformities, and other damage. Check that the conductor terminals Inside each connector are free from dirt, other obstructions, and damage. Check mounting hardware on cable connectors for possible cross-threading.
      (b) Lay out the parallel cable assemblies. Inspect cable bushings and cable insulation sleeves for cracks, cuts, ruptures, and other damage. Check that the cable clamps are securely mounted.
      (c) Check that the cable marker bands are clearly legible and securely attached to the corresponding cable.
   (2) Replace. Replace defective reactive current parallel cable assembly or governor parallel cable assembly. Refer to the next higher level of maintenance for repair.

e. Maintenance of 120 V AC Receptacles, Lights, and Switches.
   (1) Inspect. See Figure 3-10.
      (a) Visually Inspect all light fixtures. Check for broken light bulbs and loose mountings.
      (b) Open all junction boxes Check that all electrical connections inside boxes are secure. Check for shorted, frayed, or broken wires, and for signs of overheating. Replace covers on boxes after inspection.
      (c) Check receptacles, lights, and switches for loose mountings, damage, and signs of overheating. Check that receptacle boxes and covers are undamaged.
   (2) Test. Turn on 120 V ac auxiliary power Turn switches ON to verify light bulb operation. With voltmeter, check for presence of 120 V ac line In receptacles.
   (3) Repair See Figure 3-11
      (a) Replace light bulbs that do not function.
      (b) Refer any obvious deficiency (e g loose connections, shorted wires, loose hardware) uncovered during visual inspection to the next higher level of maintenance.

f. Inspect Magnetic Pickup PU1. The magnetic pickup PU1 (Figure 3-3) is located on the left side of the engine flywheel housing. Inspect the magnetic pickup for broken or damaged wires and ensure that it is mounted securely to the flywheel housing. If any damage is noted as described above, refer the magnetic pickup PU1 to the next higher level of maintenance.

3-12. MAINTENANCE OF FUEL SYSTEM.

a. Inspect Fuel Transfer Pump. See Figure 1-3 and Figure 3-12 If the fuel transfer pump falls any of the following inspections, refer to the next higher level of maintenance.
   (1). Lines and Fittings. Check the hoses from the fuel transfer pump (1, Figure 3-12) to the fuel strainer (2) and the hoses from the duplex filters (3) to the fuel transfer pump (1) for leaks and secure mounting.
   (2). Fuel Transfer Pump. Check the fuel transfer pump (1) for excessive noise or sluggish operation. Check for secure mounting.
   (3). Overall Appearance. Visually Inspect overall appearance to ensure that pump Is free of dirt, sand, and other foreign matter.
   (4). Motor. Check for overheating and broken or frayed wires (10).

b. Inspect Solenoid Valve. See Figure 3-12. If the solenoid valve (4) fails any inspection, refer to the next higher level of maintenance.
   (1) Check for fuel leakage.
   (2) Check for excessive heating by checking for smoke or the odor of burning insulation during operation.
   (3) Visually inspect for cleanliness to ensure that valve is free of dirt, oil, and other foreign matter.
   (4) Inspect condition of wiring for wear and damage.

c. Maintenance of Fuel Strainer Assembly. The fuel strainer is a replaceable element type, with a cast head. The strainer element is constructed so that dirt or foreign matter will not pass through the element. The fuel strainer is associated with the fuel transfer pump (see Figure 3-2, Figure 3-12, and Figure 3-13).
   (1) Inspect.
      (a) Inspect fuel strainer (2, Figure 3-12) for leaks.
      (b) Check for secure mounting.
   (2) Service
      (a) When servicing fuel strainer, be sure FUEL PUMP switch S8 (4, Figure 2-1) Is OFF
      (b) Remove drain plug (2, Figure 3-13) and drain plug gasket (3) Drain into 1 quart (1 liter) container.
      (c) IInstall drain plug (2) and gasket (3), using care not to damage gasket.
      (d) Turn FUEL PUMP switch S8 to HAND position to fill fuel strainer
   (3) Clean.
      (a) Perform steps (2)(a) and (b), above.
      (b) Remove cover nut (4) and preformed packing (5), discard preformed packing (5), separate fuel strainer shell assembly from cover (6) Remove gasket (10).

WARNING

Dry cleaning solvent, P-D-680, Type II, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye and respiratory tract protection is required to avoid injury to personnel.

      (c) Remove strainer (7) and clean thoroughly with cleaning solvent P-D-680, Type II, or equivalent. Rinse thoroughly.
      (d) Check strainer (7) for imbedded particles and damage. Do not reuse damaged or deformed strainer.
      (e) Position preformed packing (5) and secure between cover nut (4) and cover (6).
      (f) Install gasket (10) on shell assembly (1) and install strainer (7) and reattach shell assembly (1) to cover (6) by tightening cover nut (4) around center bolt (8).
      (g) Turn FUEL PUMP switch S8 to HAND position to fill fuel strainer.

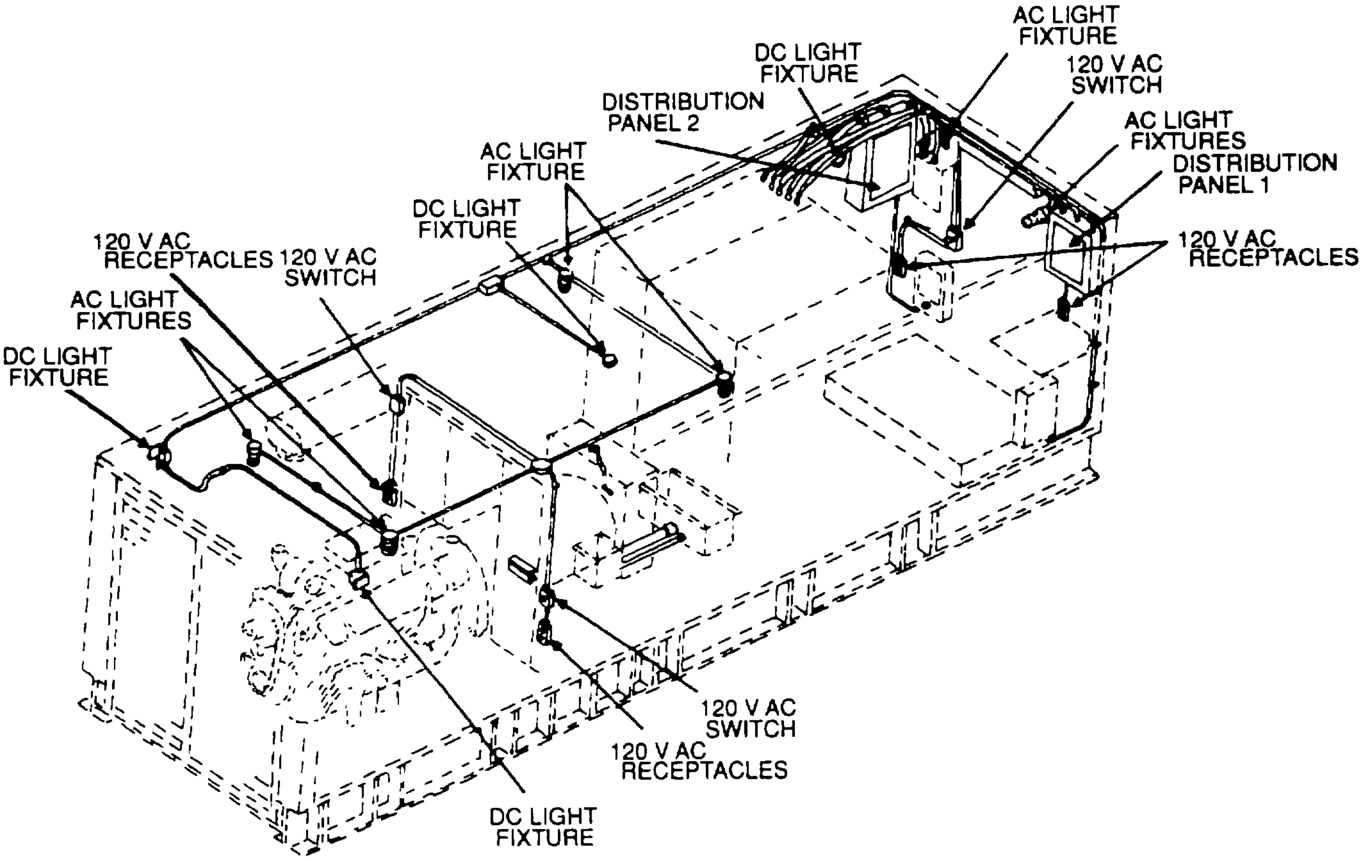
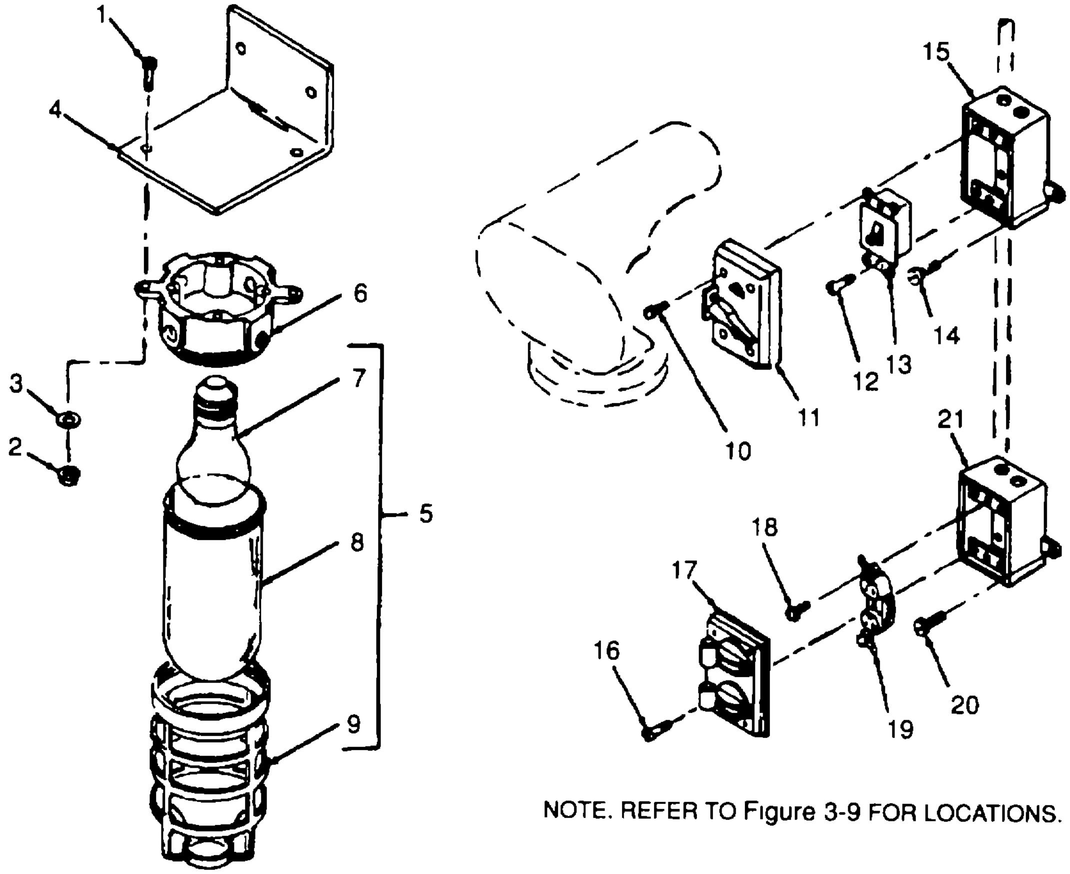


Figure 3-9. Location of AC and DC Service Lights, Switches, and Receptacle



1 SCREW AND CAPTIVE WASHER ASSEMBLY
2 NUT AND CAPTIVE WASHER ASSEMBLY
3. FLAT WASHER
4 FIXTURE MOUNTING BRACKET
5. AC LIGHT FIXTURE ASSEMBLY
6. BASE
7. BULB
8. GLOBE
9 GUARD
10. SCREW AND CAPTIVE WASHER ASSEMBLY
11. SWITCH PLATE
12. SCREW AND CAPTIVE WASHER ASSEMBLY
13. 120 V AC SWITCH
14 SCREW AND CAPTIVE WASHER ASSEMBLY
15 RECEPTACLE BOX
16 SCREW AND CAPTIVE WASHER ASSEMBLY
17 DUPLEX RECEPTACLE COVER
18. SCREW AND CAPTIVE WASHER ASSEMBLY
19 120 V AC RECEPTACLE
20. SCREW AND CAPTIVE WASHER ASSEMBLY
21 RECEPTACLE BOX

Figure 3-10. Maintenance of AC Lights, Switches, and Receptacle

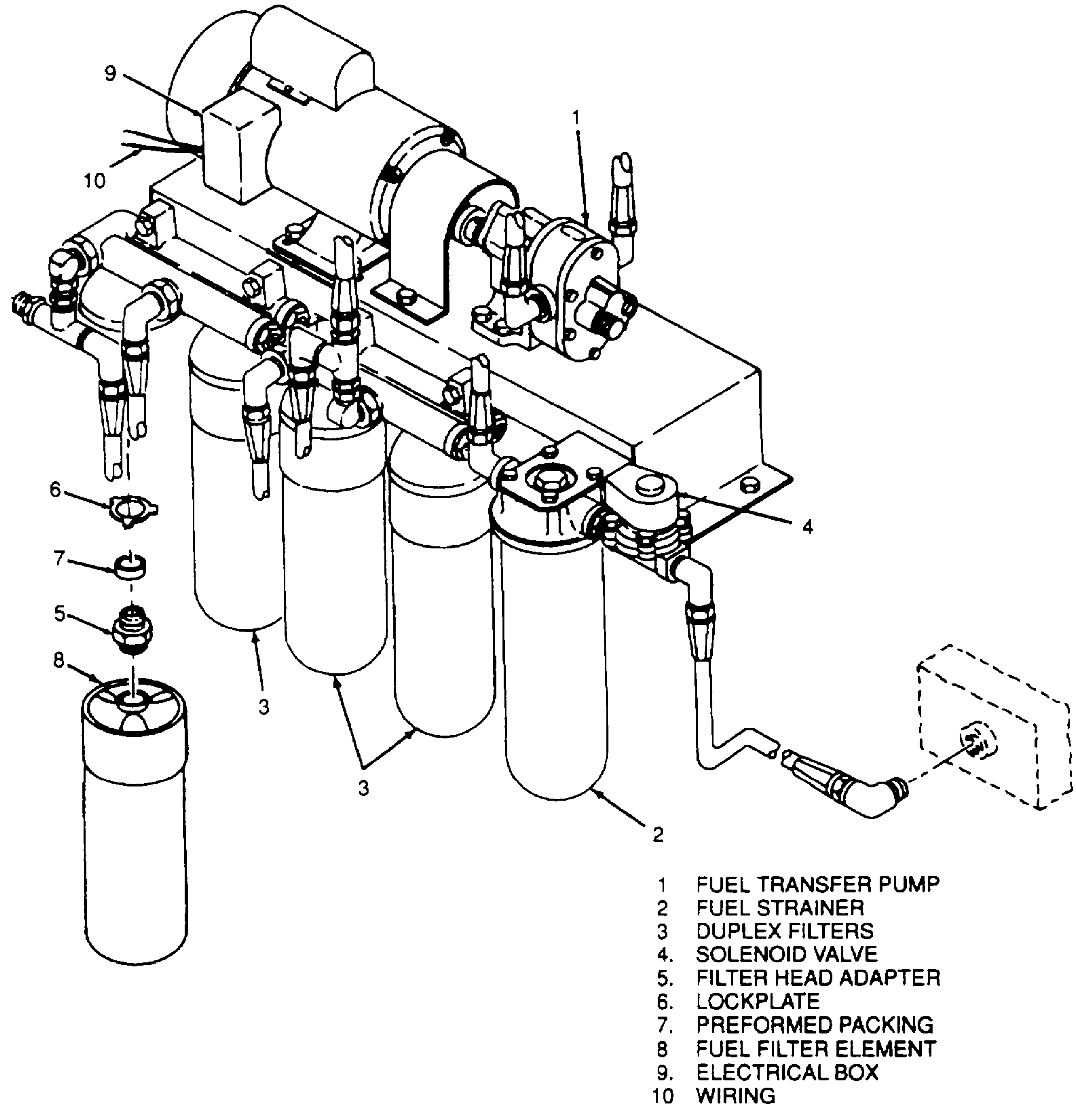


Figure 3-11. Fuel Transfer Pump and Related Parts

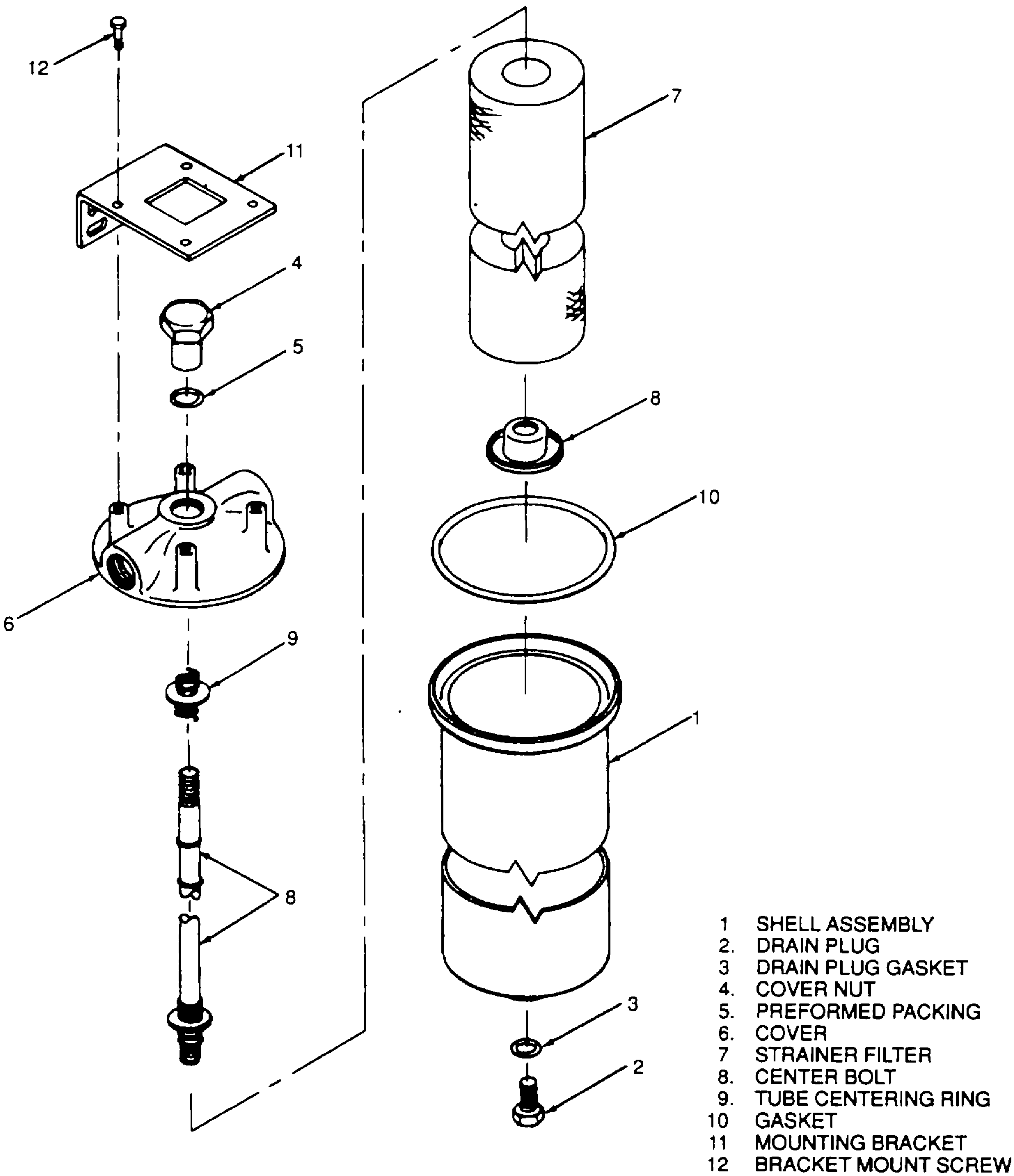


Figure 3-12. Maintenace of Fuel Strainer Assembly

(4) Replace fuel strainer.
   (a) Perform steps (2)(a) and (b), above.
   (b) Perform step (3)(b), above.
   (c) Remove and discard used strainer (7).
   (d) Install new strainer (7) and perform steps (3)(f) and (g), above.

NOTE

The new strainer (7) may compress approximately 1/4 inch (6 mm) when shell assembly (1) is reattached to cover (6).

d. Maintenance of Fuel Filter Assemblies. The fuel filters are duplex assemblies with a cast head. There are two duplex filters associated with the transfer pump and another associated with the engine supply line from the tank. Inspect and service each fuel filter assembly at intervals noted in Table 3-1 and Table 3-2.

(1) Inspect See Figure 3-3 and Figure 3-12. Inspect each fuel filter head assembly for signs of leakage at the plugs or hose connections and check for secure mounting.

WARNING

Diesel fuel, while not as volatile as gasoline, will burn when it contacts a sufficiently hot surface or an open flame. Ensure that all hot surfaces under fuel lines to be re- placed are covered. Ensure that buckets or pans are provided to catch any spilled fuel. Failure to observe this warning could cause injury to personnel or damage to equipment.

(2) Service. Refer to Figure 3-12 and service each fuel filter assembly by replacing the elements as follows:
   (a) Unscrew the fuel filter elements (8) from filter head adapter (5) and discard.
   (b) Lightly coat new filter gasket with fuel and fill all filters with fuel prior to installing them.

NOTE

Always replace both elements of the duplex filter in sets to prevent excessive deterioration of replacement parts.

e. Maintenance of Fuel Tank. The fuel tank is located Immediately below the control room floor. Inspect for signs of fuel leakage under skid base and surrounding area If leakage Is evident, refer to the next higher level of maintenance.

f Inspect Fuel Lines and EFC Fuel Injection Pump.
   (1) The fuel lines must not be unnecessarily close to any heat-producing part of the engine or its exhaust system, nor should any line be rubbing any part of the engine or generator set (see Figure 3-14).
   (2) Inspect for sections of fuel lines that appear worn or damaged.
   (3) Inspect for kinks or excessively sharp bends In the fuel lines.
   (4) Inspect fuel lines for secure mounting There should be no evidence of missing or damaged clamps.
   (5) Inspect for evidence of leakage.
   (6) Inspect for evidence of corrosion or deterioration.
   (7) Inspect EFC fuel Injection pump for secure mounting and leakage.

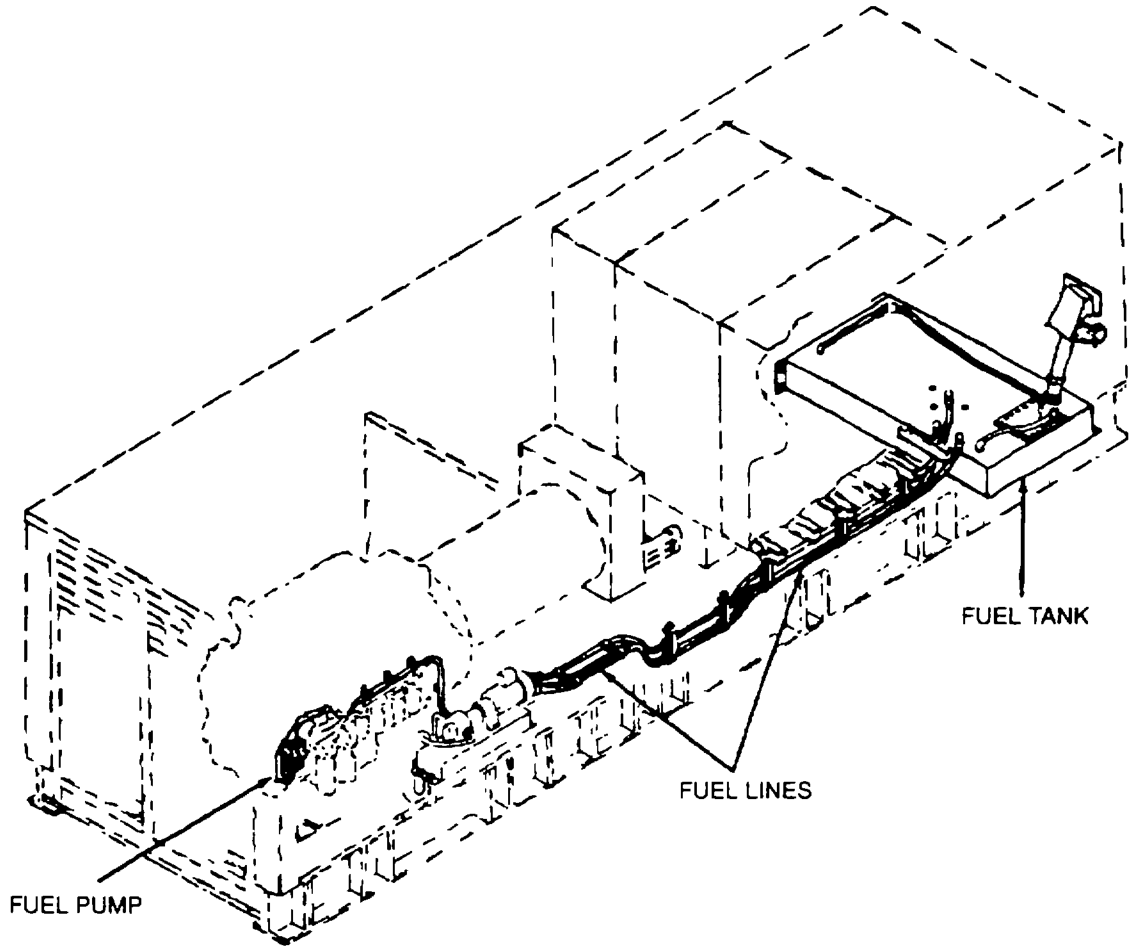


Figure 3-13. Fuel Lines

g. Maintenance of the Ether Injection Assembly. Refer to Figure 3-15.

WARNING

Ether is highly flammable and toxic to the skin, eyes, and respiratory tract. Use only In an adequately ventilated area. Skin, eye, and respiratory protection is required to avoid injury to personnel.

(1) Inspect.
   (a) Check tightness of ether start tank (1) in threaded mount of solenoid valve (2) It should be fully seated prior to operation of the generator set.
   (b) Check that the cylinder wing nut (15) is securely fastened.
   (c) Inspect ether line tubes (4 and 5) for kinks, breakage, ruptures, or damage.
   (d) Check entire routing of ether line tubes to both intake manifolds. Loop clamps shall be properly spaced and fastened securely.

CAUTION

When ether system is not required, the ether start tank (1) should be removed and stored in a safe, designated area. Cap should be threaded into solenoid valve (2) to ensure cleanliness.

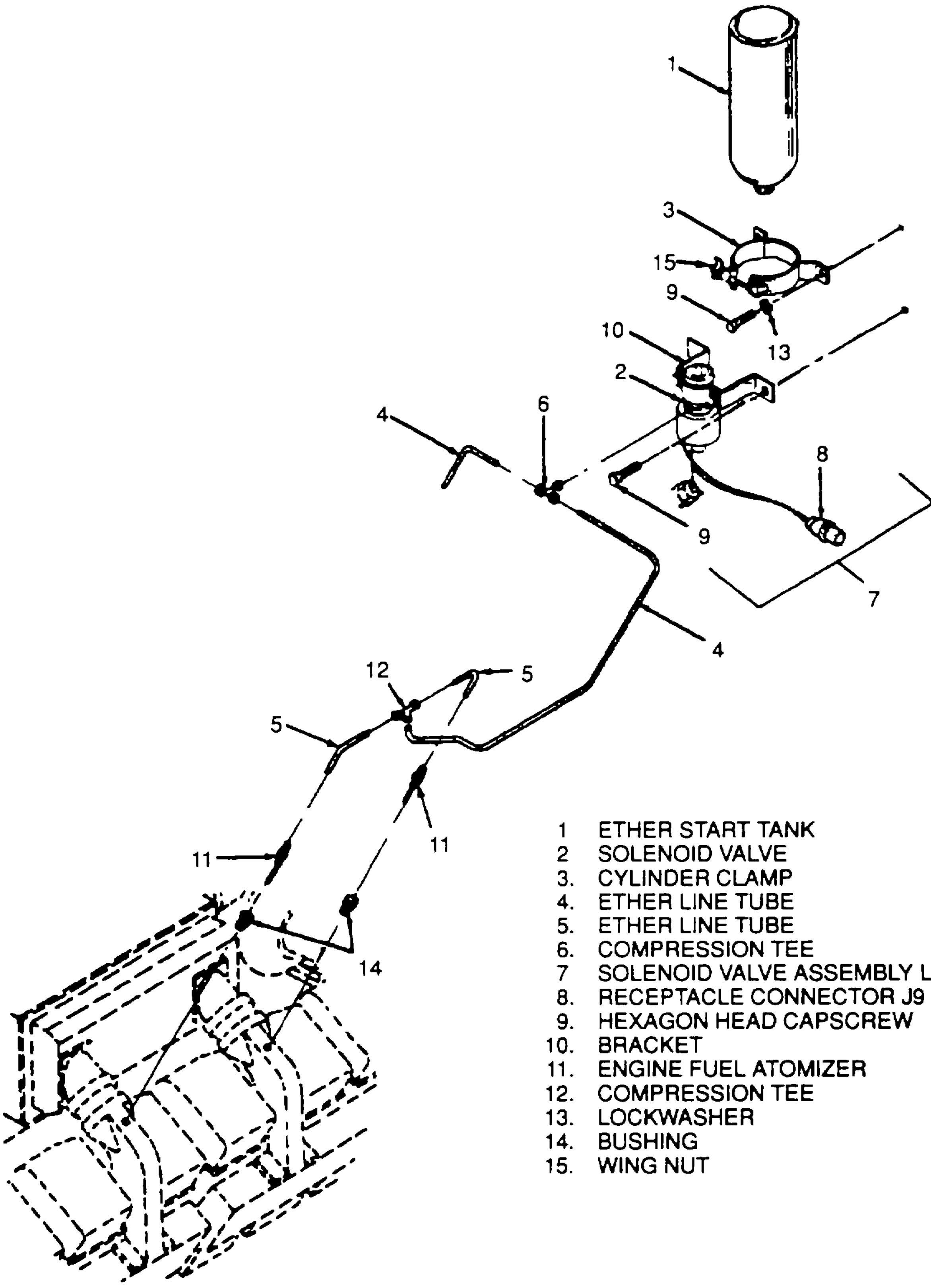
(2) Service.
  (a) Remove ether start tank (1) from solenoid valve (2) and cylinder clamp (3) Shake the tank to determine existing supply of ether.
  (b) If supply is adequate, reinstall ether tank If tank is empty, Install new tank in solenoid valve (2) and tighten cylinder clamp (3).

h. Maintenance of Filler Cap and Strainer. See Figure 3-16.
  (1) Inspect.
    (a) Remove fuel tank cap (4).
    (b) With a flashlight, Inspect Inside of element strainer (5). Strainer protection plate, located mid-way down the tube, should be free of debris and securely attached.
    (c) Check wire strainer located In base of element strainer (5) for accumulation of dirt or other foreign matter
    (d) Check that the fuel tank cap chain is securely attached to fuel tank cap (4) and element strainer (5) Fuel tank cap vent should be In OPEN position.
  (2) Service.
    (a) Replace fuel tank cap gasket if worn or fitting is loose.
    (b) Remove fuel tank cap (4), along with its attaching chain, from element strainer (5).
    (c) Slide element strainer (5) out of filler neck and housing (6).

WARNING

Dry cleaning solvent, P-D-680, Type II, Is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eyes, and respiratory tract protection Is required to avoid injury to personnel.

    (d) Cleaning solvent P-D-680, Type II, or equivalent, and a stiff bristle brush (nonmetallic) may be used In cleaning filler neck element strainer.
    (e) Inspect wire cone strainer for punctures, cuts, and tears If damaged, a new element strainer (5) is required.
    (f) Check strainer protector plate Inside element strainer (5). It should be firmly attached.
    (g) Slide element strainer (5) into filler neck and housing (6).
    (h) Reattach fuel tank cap (4), fastening the chain to the clip provided inside element strainer (5).
  (3) Replace Remove and replace defective parts in accordance with step (2), above.



1 ETHER START TANK
2 SOLENOID VALVE
3. CYLINDER CLAMP
4. ETHER LINE TUBE
5. ETHER LINE TUBE
6. COMPRESSION TEE
7 SOLENOID VALVE ASSEMBLY L5
8. RECEPTACLE CONNECTOR J9
9. HEXAGON HEAD CAPSCREW
10. BRACKET
11. ENGINE FUEL ATOMIZER
12. COMPRESSION TEE
13. LOCKWASHER
14. BUSHING
15. WING NUT

Figure 3-14. Ether Tank Installation.

3-13. MAINTENANCE OF COOLING SYSTEM.

a. Inspect Water Pump. The water pump is located on the right side of the engine (see Figure 3-3). Inspect the water pump for secure installation, damage, and evidence of leakage.

b. Maintenance of Radiator. See Figure 3-17. Radiator maintenance includes inspection, cleaning, and testing, addition or replacement of coolant.

(1) Inspect. Visually Inspect core assembly for leaks or damage. Using strong light, examine core by looking through radiator shutter assembly from outside the set and by looking through fan guard assembly from inside the set. Refer to the next higher level of maintenance for repair.

(2) Service. Service the radiator and cooling system annually by cleaning and flushing the radiator assembly and the engine cooling manifold.

WARNING

The radiator gets very hot during operation. Do not remove cap until radiator has reached a point at which there is no built-up steam pressure.

(a) See Figure 1-1. Remove plug from coolant drain pipe, on the exterior skid base, lower left front of the generator housing.

(b) Open the radiator fill cap access door on top of the roof and remove the radiator cap.

(c) Open the radiator drain valve located on the skid base Immediately below the exterior radiator shutter assembly (see Figure 1-1). Allow all used coolant to drain from the radiator into a suitable container and reclose the drain valve (see Figure 1-1) and reinstall drain plug.

(d) Flush the radiator and engine block before replacing the coolant supply.

(3) Coolant Replacement.

(a) Open the radiator access door on top of the housing and remove the radiator cap.

(b) Fill the radiator with coolant prescribed in Table 3-1, treated with DCA additive, until coolant level is stabilized at 2 inches (50 mm) below the filler neck or at center of the coolant sight glass assembly (45, Figure 3-17). This level may decrease due to air displacement once the engine Is operated. Add more coolant as required until level Is fully stabilized. Refer to Table 3-1 for coolant antifreeze (If needed) and DCA (corrosion inhibitor) requirements. Refer to Table 3-4 for freezing points, composition, and specific quantities of antifreeze.

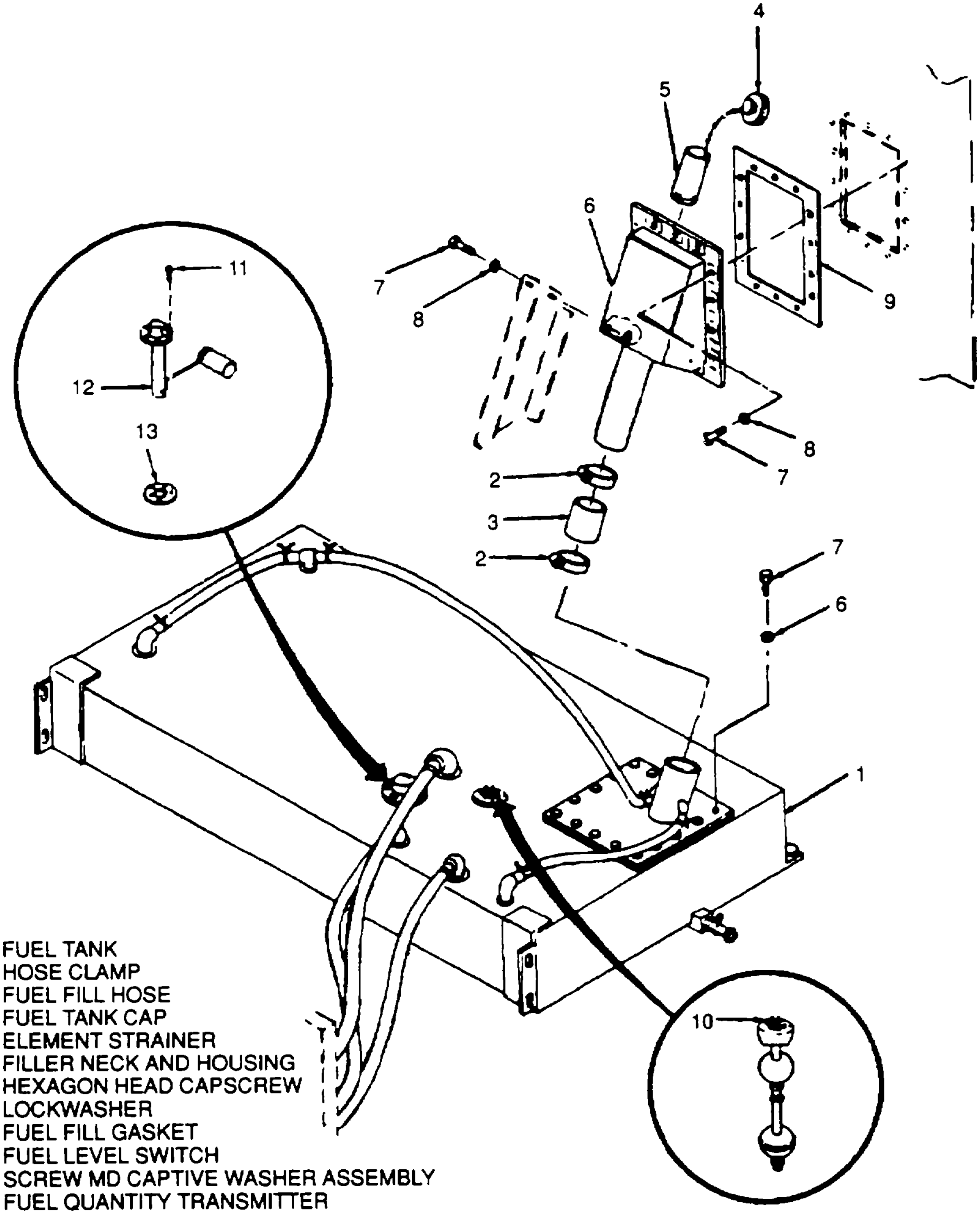
(c) Fasten tag near radiator cap Indicating date of coolant replacement, type of coolant, and level of protection. Replace radiator cap and close radiator fill cap access door.

(4) Coolant Addition. Check coolant level on coolant sight glass assembly (45, Figure 3-17) daily to determine whether additional coolant is required. Level should be at center of the sight Also, depending on results of the DCA coolant test Immediately following, drain part of existing coolant and add make-up coolant as required. If additional coolant Is required, follow replacement procedures outlined In step (3), above.

(5) DCA Coolant Test.

Engine coolant should be tested every 6 months to ensure that the frequency of water filter servicing or concentration of corrosion Inhibitor (DCA) is adequate to control corrosion for any operational condition.

The concentration of effective corrosion Inhibitor dissolved In the coolant may be tested, using the Fleet guard DCA coolant Test Kit or Cummins Coolant Test Kit.



1. FUEL TANK
2. HOSE CLAMP
3. FUEL FILL HOSE
4. FUEL TANK CAP
5. ELEMENT STRAINER
6. FILLER NECK AND HOUSING
7. HEXAGON HEAD CAPSCREW
8. LOCKWASHER
9. FUEL FILL GASKET
10. FUEL LEVEL SWITCH
11. SCREW MD CAPTIVE WASHER ASSEMBLY
12. FUEL QUANTITY TRANSMITTER
13. GASKET

Figure 3-15. Tank and Related Parts

Table 3-4. Freezing Points, Composition, and Specific Gravities of Military Antifreeze

LOWEST EXPECTED AMBIENT TEMPERATURE °F	(°C)	PINTS (LITERS) OF INHIBITED GLYCOL PER GALLONS (LITERS) OF COOLANT [1] PINTS	LITERS	COMPOUND ANTIFREEZE ARCTIC [2], [3]	ETHYLENE GLYCOL COOLANT SOLUTION SPECIFIC GRAVITY AT 68°F (20°C)
+20	(-6 7)	1 1/2	(0.7098)	Issued full strength and ready mixed for 0 to 65°F	1.022
+10	(-12 2)	2	(0 9464)	(-17 8 to 18 3°C) temperatures for both Initial Installa-	1.036
0	(-17 8)	2 3/4	(1 3013)	tions and replenishment of losses	1.047
-10	(-23 3)	3 1/4	(1 5379)		1 055
-20	(-28 9)	3 1/2	(1 6562)		1.062
-30	(-34 4)	4	(1 6562)		1 067
-40	(-40 0)	4 1/4	(1 8927)		1.073
-50	(-45 6)	ARCTIC ANTI-FREEZE PREFERRED		DO NOT DILUTE WITH WATER OR ANY OTHER SUBSTANCE	
-60	(-51.1)				
-75	(-59.4)				

1. Maximum protection is obtained at 60 percent volume (4 8 pints (2 27 liters)) of ethylene glycol per gallon (3.785 liters) of solution.
2. Military Specification MIL-A-11755 Arctic type, nonvolative antifreeze compound Is Intended for use In the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic regions where the ambient temperature is close to -40°F (-40°C) for extended periods or drops below, to as low as -75°F (-59.40C).
3. Fasten a tag near the radiator filler cap indicating the type antifreeze.

The test kit indicates DCA concentration by measuring nitrite content of a coolant sample, which provides cylinder liner cavitation protection. Use of an antifreeze may contribute to nitrite content. However, most nitrite protection is obtained from the DCA Inhibitor present In the disposable water filter elements (Figure 3-3) or in a pretreated coolant supply. In general, a good nitrite reading indicates that the combined inhibitor packages contained in the antifreeze (If used) and in the DCA are sufficient to ensure complete cooling system protection. Use coolant -rest Kit as follows:

(a) Drain sample of engine coolant and dilute one part with nine parts tap water Mix solution thoroughly.
(b) Fill the mixing vial supplied with kit to the 10 mil scribe mark. Add two or three drops of nitrite Indicator solution B and swirl to attain a uniform red color.
(c) Add one drop of nitrite test solution A to the vial, being careful to hold the dispenser provided in a vertical position Swirl to mix.
(d) Continue adding drops of nitrite test solution A. Keep count of the number of drops added and swirl vial between each drop until the liquid color changes from red to a pale grey, green, or blue.
(e) Record the number of drops required for color change and consult Table 3-5 for coolant condition and recommended maintenance.

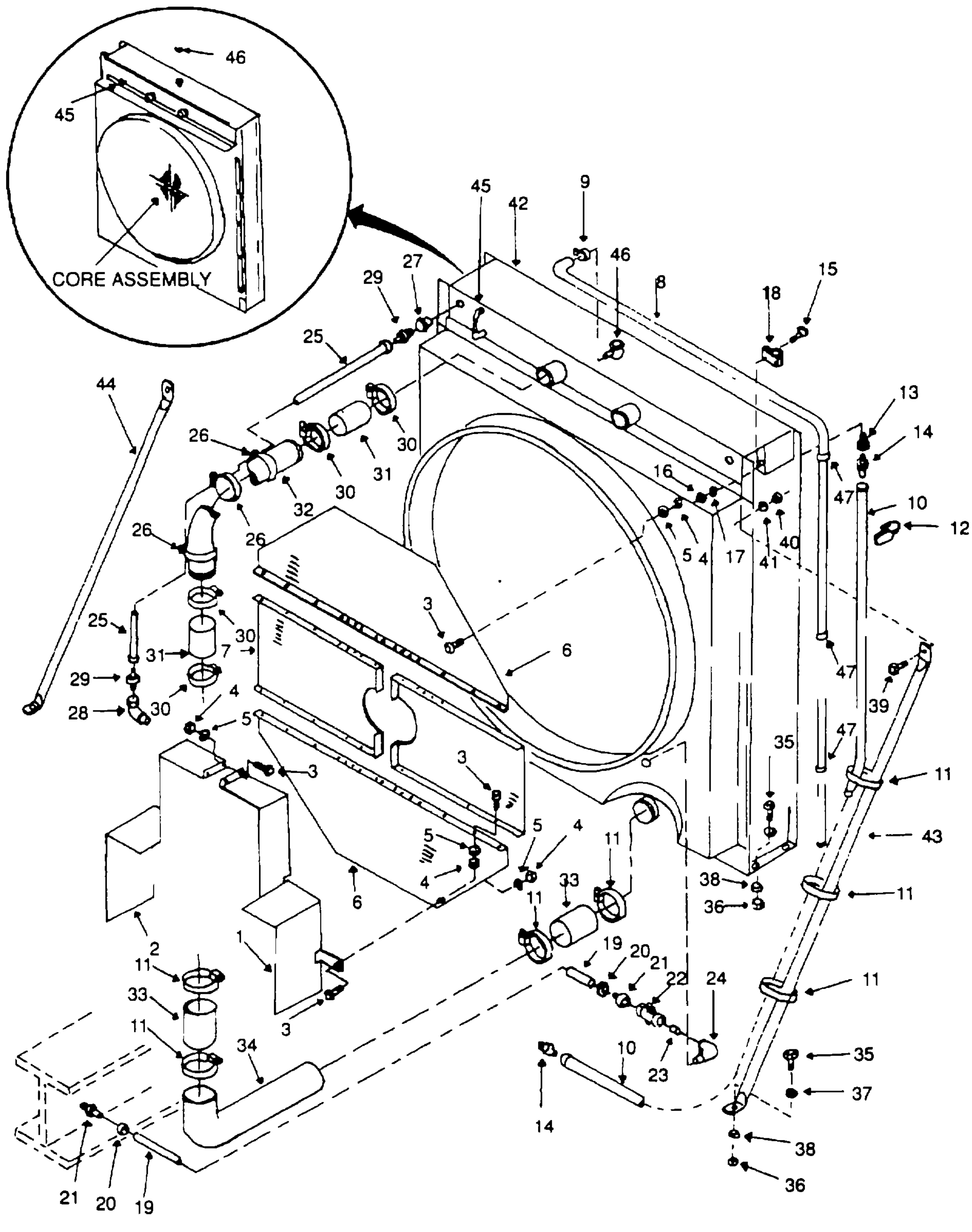


Figure 3-16. Radiator Assembly and Related Parts (Sheet 1 of 2)

1. RIGHT HAND FAN SHROUD
2. LEFT HAND FAN SHROUD
3. HEXAGON HEAD CAPSCREW
4. HEXAGONAL NUT
5. LOCKWASHER
6. TOP AND BOTTOM GRILL
7. CENTER GRILL
8 OVERFLOW HOSE
9. HOSE CLAMP
10. HOSE ASSEMBLY
11. HOSE CLAMP
12. MARKER BAND
14. PIPE ADAPTER
15. HEXAGON HEAD CAPSCREW
16. HEXAGONAL NUT
17 LOCKWASHER
18. HOSE CLAMP
19. RADIATOR DRAIN HOSE
20. HOSE CLAMP
21 STRAIGHT ADAPTER
22 SHUT OFF COCK
23. PIPE NIPPLE
24 ELBOW
25 HOSE ASSEMBLY
26 HOSE CLAMP
27 PIPE BUSHING
28 ELBOW
29. STRAIGHT ADAPTER
30. HOSE CLAMP
31 RADIATOR OUTLET HOSE
32. WATER OUTLET TUBE
33 RADIATOR INLET HOSE
34. WATER INLET TUBE
35. HEXAGON HEAD CAPSCREW
36 HEXAGON NUT
37. FLAT WASHER
38. LOCKWASHER
39 HEXAGON HEAD CAPSCREW
40 HEXAGONAL NUT
41 LOCKWASHER
42. RADIATOR
43 RIGHT HAND RADIATOR SUPPORT
44 LEFT HAND RADIATOR SUPPORT
45 SIGHT GLASS ASSEMBLY
46 RADIATOR CAP
47 CLAMP

Figure 3-17. Radiator Assembly and Related Parts (Sheet 2 of 2)

c. Maintenance of Radiator Cap

WARNING

The radiator gets very hot during operation. Do not remove cap until radiator has reached a point at which there is no built-up steam pressure.

(1) Inspect. Inspect the radiator cap (46, Figure 3-17) for rust or signs of leakage. Remove cap and check for worn tabs.
(2) Replace. Replace defective radiator cap.

d. Maintenance of Water Filter Assemblies. See Figure 3-3.
(1) Inspect. Inspect the water filters for secure mounting or signs of leakage.
(2) Service. Service by replacing the elements. See Table 3-1 and Figure 3-3.
(a) Close the valves on the water filter heads.
(b) Unscrew the water filter elements and discard.
(c) Apply a light coat of lubricating oil, MIL-L-9000, to the gasket sealing surfaces prior to installing the water filter element.

Table 3-5. Coolant Test Results and Recommendations

NUMBER OF DROPS, NITRITE TEST SOLUTION A FOR COLOR CHANGE IN RED COOLANT SOLUTION		COOLANT CONDITION	RECOMMENDED MAINTENANCE
WITH ANTIFREEZE	WITHOUT ANTIFREEZE		
0-12	0-6	Dangerous (0 to 0.6 oz per gallon DCA)	Precharge system or add make-up DCA
12-17	7-12	Borderline (0.7 to 1.2 oz per gallon DCA)	Replace service filter and/or add make-up DCA
18-25	13-20	Acceptable (1 3 to 2.0 oz per gallon DCA)	None
25-30	20-30	Tolerable (2.0 to 3.0 oz per gallon DCA)	None
over 30	over 30	Overrated (over 3 0 oz per gallon DCA)	Drain part of coolant and make-up with plain antifreeze and/or water

(d) Install new water filter elements, and tighten until the seals touch the water filter head. Tighten an additional one-half to three-fourths turn.

(e) Open the valves

e. Maintenance of Radiator Pipes. Hoses. and Clamps. See Figure 3-17.

(1) Inspect. Inspect the radiator pipes, hoses, and clamps for security. Check for rust or other signs of leakage. Check hoses for deterioration.

(2) Replace.

(a) Drain the radiator in accordance with paragraph 3-13 b, above.

(b) Remove overflow hose (8) by removing hose clamp (9) and clamps (47).

NOTE

To remove hose assembly (10) unit level maintenance must remove radiator shutter assembly.

(c) To remove hose assembly (10), loosen hose clamps (11) and disconnect pipe adapter (14) from reducer (13) and clamps (47).

(d) To remove radiator drain hose (19), remove hose clamps (20), unscrew straight adapter (21), shut off cock (22), pipe nipple (23), and elbow (24).

(e) To remove hose assembly (25), remove hose clamps (26), unscrew pipe bushing (27), elbow (28), and straight adapter (29).

(f) To remove radiator outlet hoses (31) and water outlet tubes (32), remove hose clamps (30).

(g) To remove radiator inlet hoses (33) and water inlet tubes (34), remove hose clamps (11).

(3) Install.
   (a) Lubricate threads of fittings with sealing compound MIL-S-45180, Type II, before installation.
   (b) Attach radiator inlet hoses (33) and water inlet tube (34) using hose clamps (11).
   (c) Attach radiator outlet hoses (31) and water outlet tubes (32) using hose clamps (26 and 30).
   (d) Install hose assembly (25) using straight adapters (29), pipe bushing (27), and elbow (28). Secure with hose clamps (26).
   (e) Install radiator drain hose (19) using elbow (24), pipe nipple (23), shut off cock (22), straight adapter (21), and hose clamps (20) and clamps (47).
   (f) Install hose assembly (10) using reducer (13) and pipe adapters (14) and secure with clamps (11) and tiewraps.
   (g) Install overflow hose (8) and secure with hose clamp (9) and clamps (47).
   (h) Refill the radiator in accordance with step b, above.

f. Inspect Sight Gage. Inspect the sight glass assembly (45, Figure 3-17) for damage, leaks, and secure mounting. Refer to the next higher level of maintenance for repair or replacement If necessary, service the radiator in accordance with step b(2), above.

g Maintenance of Fan Belt. See Figure 3-3.

(1) Inspect. Inspect the fan belt for cracking, glazing, fraying, or other signs of excessive wear. Make sure belt tracks are riding in pulley grooves. Since the fan belt Is only visible from the top of the engine, it will be necessary to bar the engine over. Refer to Figure 3-3.

NOTE

The barring mechanism is spnng loaded to disengage. Whenever the retaining pin is positioned in the barring mechanism groove, the barring mechanism is disengaged.

   (a) Remove the retaining pin and ensure the barring mechanism engages.
   (b) Using a wrench on the barring mechanism, bar the engine over as necessary to Inspect the fan belt.

(2) Replace.

NOTE

This task requires two people.

   (a) Remove right and left hand fan shrouds (1 and 2, Figure 3-17) and top, bottom, and center grills (6 and 7) as necessary to gain access to fan belt by removing hexagonal nuts (4), lockwashers (5), and hexagon head capscrews (3).
   (b) Using a wrench, relieve tension on idler assembly from fan belt.
   (c) Remove belt from bottom pulley. Cut unserviceable belt or remove by working belt over fan.
   (d) Install replacement belt by working over fan. Pry idler assembly away from crankshaft to slip on belt. Be sure that tracks on belt mate with grooves of all two pulleys.
   (e) Install right and left hand fan shrouds and grills as per step (a), above.

h. Inspect Idler Pulley Assembly. See Figure 1-6. Inspect pulley for cracks, pits, or damage.

i. Maintenance of Fan Shrouds and Grills.

(1) Inspect. See Figure 3-17. Inspect the right and left hand fan shrouds (1 and 2), center grills (7), and top and bottom grills (6) for obvious signs of damage. Ensure that there are no tears in the grills. Check security of installation.

(2) Replace.
   (a) Remove right and left hand fan shrouds (1 and 2) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
   (b) Remove center grill (7) and top and bottom grills (6) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(3) Install.
   (a) Install new top and bottom grills (6) and center grills (7) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
   (b) Install left and right hand fan shrouds (1 and 2) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).

j. <u>Inspect Thermostat Sensing Unit S105 and S106.</u> The engine preheat assembly Is mounted to the skid base under the engine Inspect the thermostats S105 and S106 (see figure 3-18) for loose mountings, loose electrical connections, and signs of overheating or leakage.

k. <u>Inspect Electrical Coolant Heaters H 101 and H102.</u> Inspect electrical coolant heaters H101 and H102 (Figure 3-17) for loose mountings, loose electrical connections, signs of overheating, and leakage.

l. <u>Maintenance of Preheat Shutoff Valves.</u>
(1) Inspect See Figure 1-5 and Figure 3-18. Inspect the preheat shutoff valves for secure mounting, signs of leakage, and damage Turn valve handles to check for looseness and proper valve operation.
(2) Replace. Replace damaged preheat shutoff valve (Figure 1-5 and Figure 3-18) as follows:
   (a) Drain the coolant supply (In accordance with paragraph 3-13 b, above), into a suitable container for reuse.
   (b) With wrench, remove damaged preheat shutoff valve (Figure 1-5 and Figure 3-18) from fittings, pipe adapters, nipples, and elbows. Note position of valve prior to removing and return to its original position.
   (c) Apply a uniform coat of sealing compound, MIL-S-15204C, on threads of replacement preheat shutoff valve. With wrench, install replacement valve on the appropriate fittings. Position preheat shutoff valve with the handle side upwards. When tightening valve to pipe, apply wrench to valve end nearest the pipe being worked. Make certain that the body cap end of the valve does not turn out of the valve body. Return valve to original position.
   (d) With new preheat shutoff valve installed, replace the coolant supply through the radiator as outlined in step b, above.

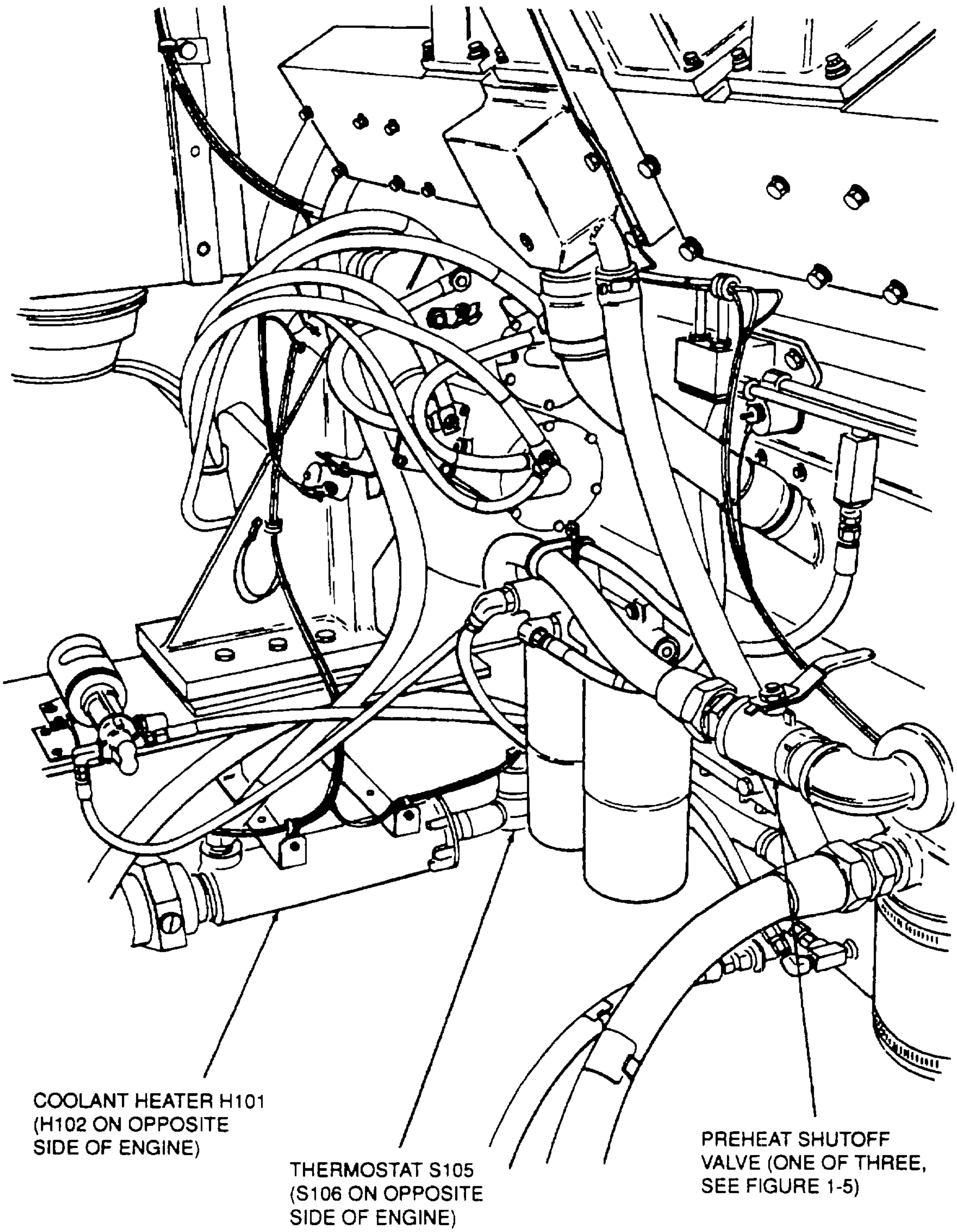


Figure 3-17. Engine Preheater and Thermostat

3-14. MAINTENANCE OF LUBRICATION SYSTEM.

a. Inspect Main Oil Filter Assemblies and By-pass Filter Assembly. See Figure 3-3. Check filter assemblies for secure mounting and signs of leakage Check spin-on filter elements for leaks, rupture, or other damage. Service by replacing filter elements at intervals Indicated In Table 3-1.

b. Inspect Drain Valve and Hose. See Figure 3-3. Inspect oil drain valve coupling, located on the right side of the oil pan, for leaks. Inspect hose couplings and adapters for damage or leaks. Inspect hoses for deterioration.

c. Inspect Oil Level Sight Gage. Visually Inspect the oil level sight gage (Figure 3-3) for damage and security.

d. Maintenance of Oil Filler Cap.

(1) Inspect. Inspect the oil filler cap (Figure 3-3) for deterioration or damage.

(2) Replace. Remove defective oil filler cap and replace with a serviceable oil filler cap.

e. Inspect Lube Oil Lines. See Figure 3-3. Inspect hoses for wear, deterioration, or cracks. Inspect straight adapters, pipe bushings, pipe adapters, pipe nipples, and pipe tees for leakage.

f. Maintenance of the Crankcase Breathers.

(1) Inspect. Visually Inspect the crankcase breathers (Figure 3-19) for security of installation. Check for clogged hoses. Check for loose fittings.

WARNING

Dry cleaning solvent, P-D-680, Type II, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection Is required to avoid injury to personnel.

(2) Service If necessary, remove and clean with cleaning solvent P-D-680, Type II, or equivalent.

(3) Remove.

(a) See Figure 3-19. Detach mounting clamps (3) by removing hexagon head capscrews (4), hexagonal nuts (5), and lockwashers (6).

(b) Remove hose clamps (7) and detach hose (2) from hose fittings (8) and crankcase breathers (1).

(c) Remove capscrew (9), lockwasher (10), and flat washer (11) to remove crankcase breathers (1).

(4) Install

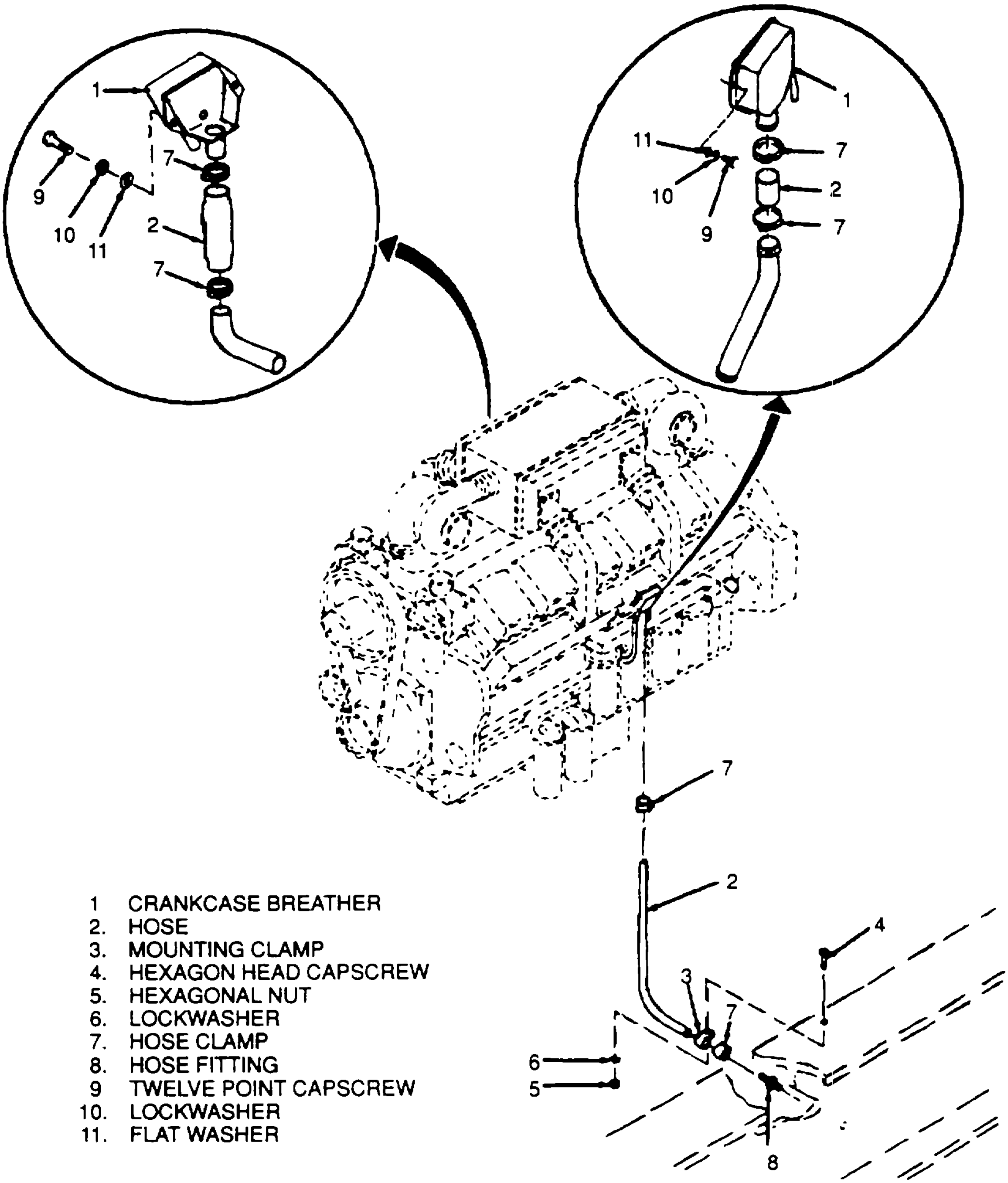
(a) Install crankcase breather (1) and secure with capscrew (9), lockwasher (10), and flat washer (11)

(b) Attach hose (2) to hose fittings (8) and crankcase breather (1) using hose clamps (7)

(c) Attach clamps (3) using hexagon head capscrews (4), hexagonal nuts (5), and lockwashers (6).

g. Inspect Lube Oil Heater. See Figure 3-3. Visually Inspect the oil heater H113 and lubricant temperature thermostat S101 on the engine oil pan for secure mounting and electrical connections and for signs of overheating or damage.

h. Inspect Prelube Pump. See Figure 1-5 and Figure 3-3. Check pump for secure mounting, loose electrical connections, signs of damage, or leakage. Check that all hose connections to and from the pump are securely attached.



1 CRANKCASE BREATHER
2. HOSE
3. MOUNTING CLAMP
4. HEXAGON HEAD CAPSCREW
5. HEXAGONAL NUT
6. LOCKWASHER
7. HOSE CLAMP
8. HOSE FITTING
9 TWELVE POINT CAPSCREW
10. LOCKWASHER
11. FLAT WASHER

Figure 3-18. Crankcase Breathers

3-15. MAINTENANCE OF THE ENGINE.

a. Maintenance of Engine Assembly (see Figure 3-3).

(1) Inspect.

(a) Inspect engine fuel components for leaks or damage in accordance with paragraph 3-12.

(b) Inspect engine cooling system components for leaks or damage in accordance with paragraph 3-13.

(c) Inspect head gasket areas, water transfer tubes, aftercooler, and expansion plugs for evidence of coolant leakage. See Figure 3-3.

(d) Inspect engine lubricating system components for leaks or damage in accordance with paragraph 3-14.

(e) Inspect follower covers, handhole covers, rocker covers, timing gear covers, and oil pan for evidence of oil leaks.

(f) Inspect auxiliary engine equipment for wear or defects that would Interfere with proper engine operation.

(g) Refer defects to the next proper level of maintenance for repair or replacement.

(2) Service. Service the engine assembly in accordance with Table 3-2 and the Lubrication Order contained in paragraph 3-2.

b. Air Cleaner Assembly Hoses and Clamps. In addition to the hoses and clamps connecting the air cleaner assembly to the turbochargers, the air cleaner assembly has a cup assembly, primary element assemblies, safety element assemblies, and indicator assemblies. Before reaching the primary element assembly, the air must pass through a tube network consisting of inner and outer tubes. Air enters through the outer tubes In a downward direction, makes a 180 degree change in direction, and flows up through the inner tubes to the cleaner element chamber. The centrifugal force created by this abrupt change in air flow direction throws most of the dust out of the Incoming air, and into the dust collector cup. This centrifugal cleaning action greatly increases the service life of the primary element assemblies. Indicator assemblies, located on the engine side of the air cleaner assembly, provide a visual signal when the primary element assemblies require cleaning or replacement.

(1) Inspect.

(a) Visually inspect the overall appearance and condition of the air cleaner assemblies, hoses, and clamps. All clamps, elbows, and adapters must be securely attached to their respective connections.

(b) Check condition of rubber elbows and adapters. Any defects will be cause for replacement.

(c) Check security of attachments on air cleaner support frame members (1 and 2, Figure 3-20) and security of air cleaners (3).

(d) Check the Indicator assemblies (4) for an amber or red signal If the amber or red signal is visible, refer to the next higher level of maintenance for element cleaning or replacement.

(e) Check cup gasket (9) for damage or deterioration.

(2) Service. Service by disposing of collected dust on daily basis or depending on operational environment.

(a) Locate dust cup assembly (6, Figure 3-20) attached at the bottom of each air cleaner body assembly

(b) Unsnap the hinged latch (7) at the base of each dust cup assembly (6) Hinged trap-door cup (8) will swing downwards to dump contents.

(c) Clean the hinged trapdoor cup (8) with a damp cloth and close. Check cup gasket, if defective, refer to the next higher level of maintenance for repair. Secure to the bottom of dust cup assembly (6) by snapping the hinged latch (7) shut.

1. BRACE
2. RIGHT HAND BRACKET
3. AIR CLEANER
4. INDICATOR ASSEMBLY
5. COUPLING CLAMP
6. CUP ASSEMBLY
7. HINGED LATCH
8. HINGED TRAPDOOR CUP
9. GASKET

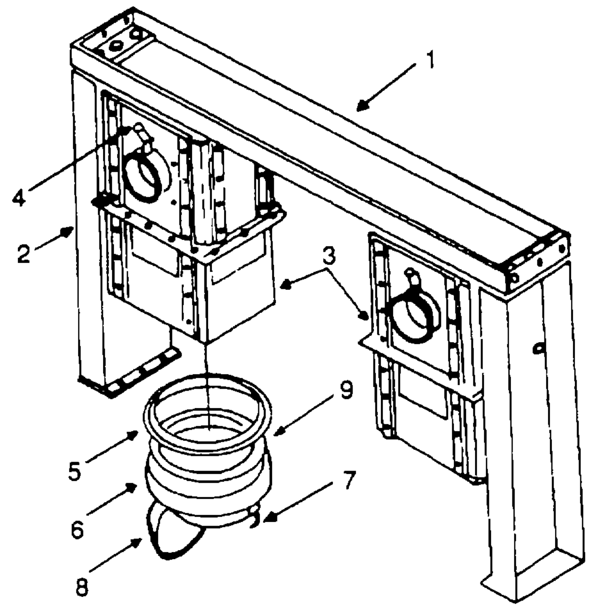


Figure 3-19. Air Cleaner Assembly

c. Air Restriction Indicators. Indicator assemblies (4, Figure 3-20) are resettable Items and need not be replaced except for obvious physical damage or the Inability to reset to green. The green, amber, and red color coding of the air restriction Indicators Is Intended to Indicate the degree to which the air cleaners have become contaminated during the filtration process. Green indicates an acceptable level of contamination. Amber or red Indicates an unacceptable level of contamination. Refer to the next higher level of maintenance for maintenance of the air cleaners when the amber portion of the indicator sleeve is visible through the sight window of the air restriction indicator.

d. Air Control Valve.

(1) Inspect. Visually Inspect each air control valve (Figure 3-21) for secure mounting, damage, or rust.

CAUTION

Do not perform this test on a hot engine. if engine has been running at operational temperature, allow generator set to run at no load for at least 5 minutes before performing the test. This will allow the engine time to cool and will prolong engine life.

(2) Test. While engine is operating, depress EMERGENCY SHUTDOWN pushbutton S7 to trip shut down valves. Air valves must shut down engine. Manually reset valves to open position after test.

e. Maintenance of Rocker Housing Covers.

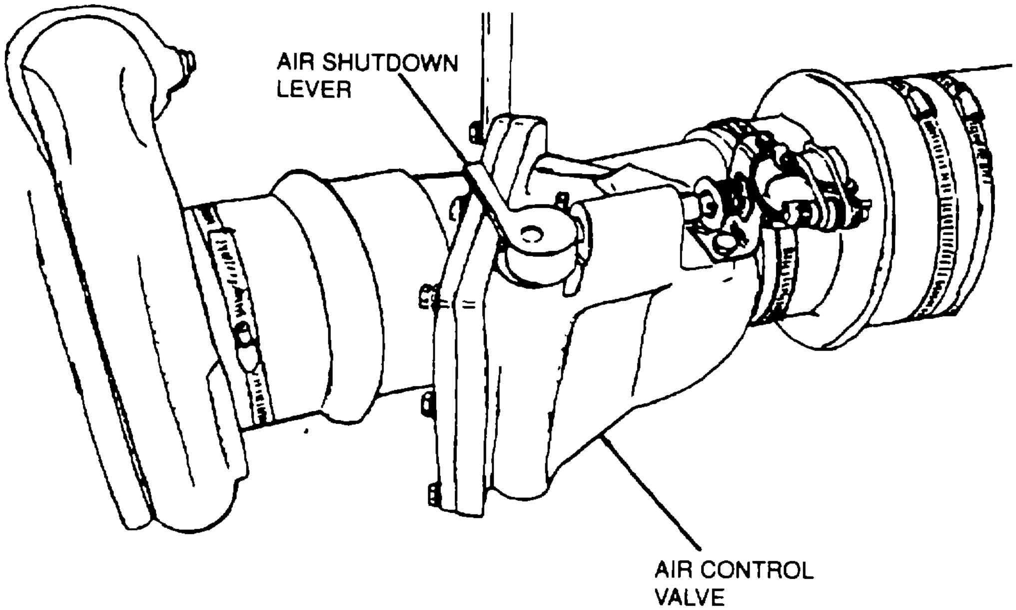
(1) Inspect.

(a) Visually inspect rocker housing covers (1, Figure 3-22) for evidence of cracks.

(b) Inspect area of rocker housing cover gasket (2) for leaks. Replace leaking gasket In accordance with step.

(2) below.

(c) Check capscrews (3 and 4) for damage and proper torque, 30 to 35 pound-feet (41 to 47 newton-meters). Replace damaged capscrews.



NOTES.
1 THERE ARE TWO AIR CONTROL VALVES ONE FOR EACH TURBOCHARGER
2 AIR SHUTDOWN LEVER IS SHOWN IN THE SET (OPEN) POSITION

Figure 3-20. Air Control Valve

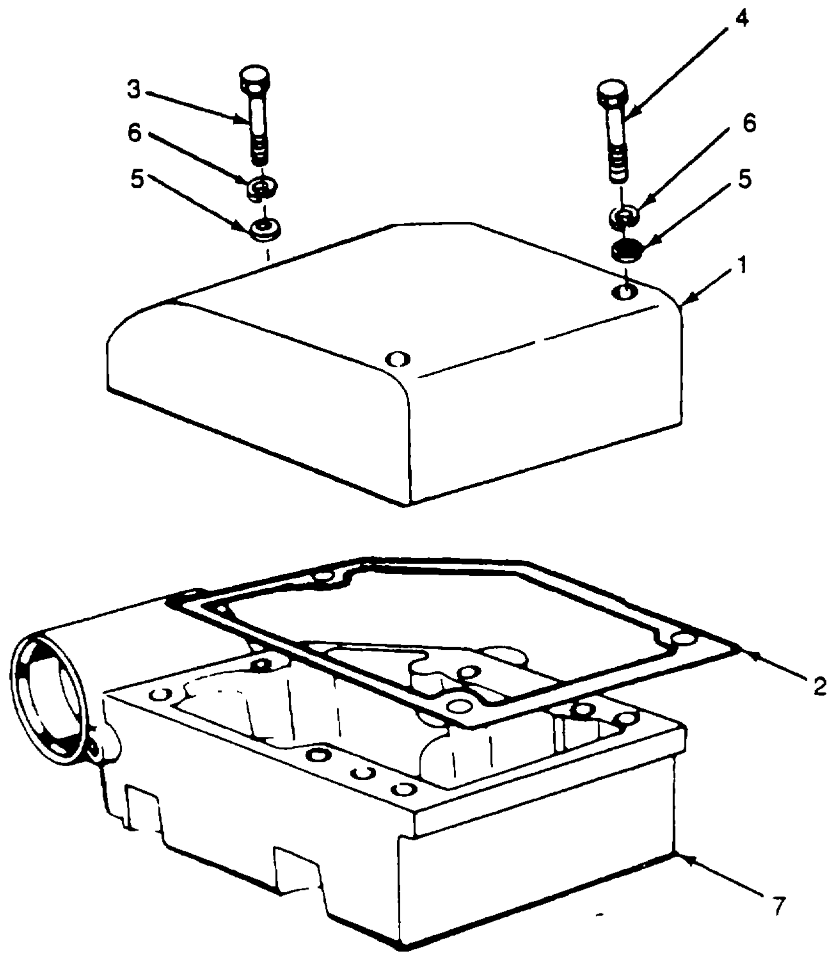
(2) Replace.
- (a) Remove capscrews (3 and 4), plain washers (5), and lockwashers (6).
- (b) Remove rocker housing cover (1) from rocker housing (7), and remove and discard rocker housing cover gasket (2).

WARNING

Dry cleaning solvent P-D-80, Type II, is flammable and moderately toxic to the skin eyes, and respiratory tract. Skin, eye, and respiratory protection is required to avoid injury to personnel.

(3) Install.
- (a) Scrape all traces of old rocker housing cover gasket (2) from rocker housing cover (1) and rocker housing (7). Ensure that gasket material removed from rocker housing does not fall inside rocker housing. Clean rocker cover housing with solvent P-D-680, Type II, or equivalent.
- (b) Inspect rocker housing (1) and rocker housing (7) for damaged gasket surfaces.
- (c) Position a new rocker housing cover gasket (2) on rocker housing (7), and install rocker housing cover (1), using plain washers (5), lockwashers (6), and capscrews (3 and 4).
- (d) Tighten capscrews (3 and 4) to a torque of 30 to 35 pound-feet (41 to 47 newton-meters).

f. Inspection of Front and Rear Crank-Shaft and Accessory Drive Seals.
   (1) Carefully examine the area around the front crankshaft seals and accessory drive seals for evidence of leakage (see Figure 3-3).
   (2) Remove the VS marks access cover and examine flywheel face for evidence of leakage.
   (3) Slight seepage around a seal area, as evidenced by a slight accumulation of oil dampened spots, should be considered normal. Refer any evidence of free flowing oil to the next higher level of maintenance.



1. ROCKER HOUSING COVER
2. ROCKER HOUSING COVER GASKET
3. CAPSCREW
4. CAPSCREW
5 PLAIN WASHER
6. LOCKWASHER
7 ROCKER HOUSING

Figure 3-21. Rocker Housing Covers

g. Inspect Oil Pan Assembly. Visually check the oil pan (Figure 3-3) for cracks or leaks. Check around the threaded plugs and sensors for oil leaks. Refer any leaks or damage to the next higher level of maintenance.

h. Maintenance of Handhole Covers and Gaskets. Inspect the covers (Figure 3-3) for physical damage and evidence of leakage.

I. Inspect Expansion Plugs. Inspect expansion plugs (Figure 3-3) located on all cylinder heads, and engine block.

3-16. MAINTENANCE OF ENGINE EXHAUST SYSTEM.

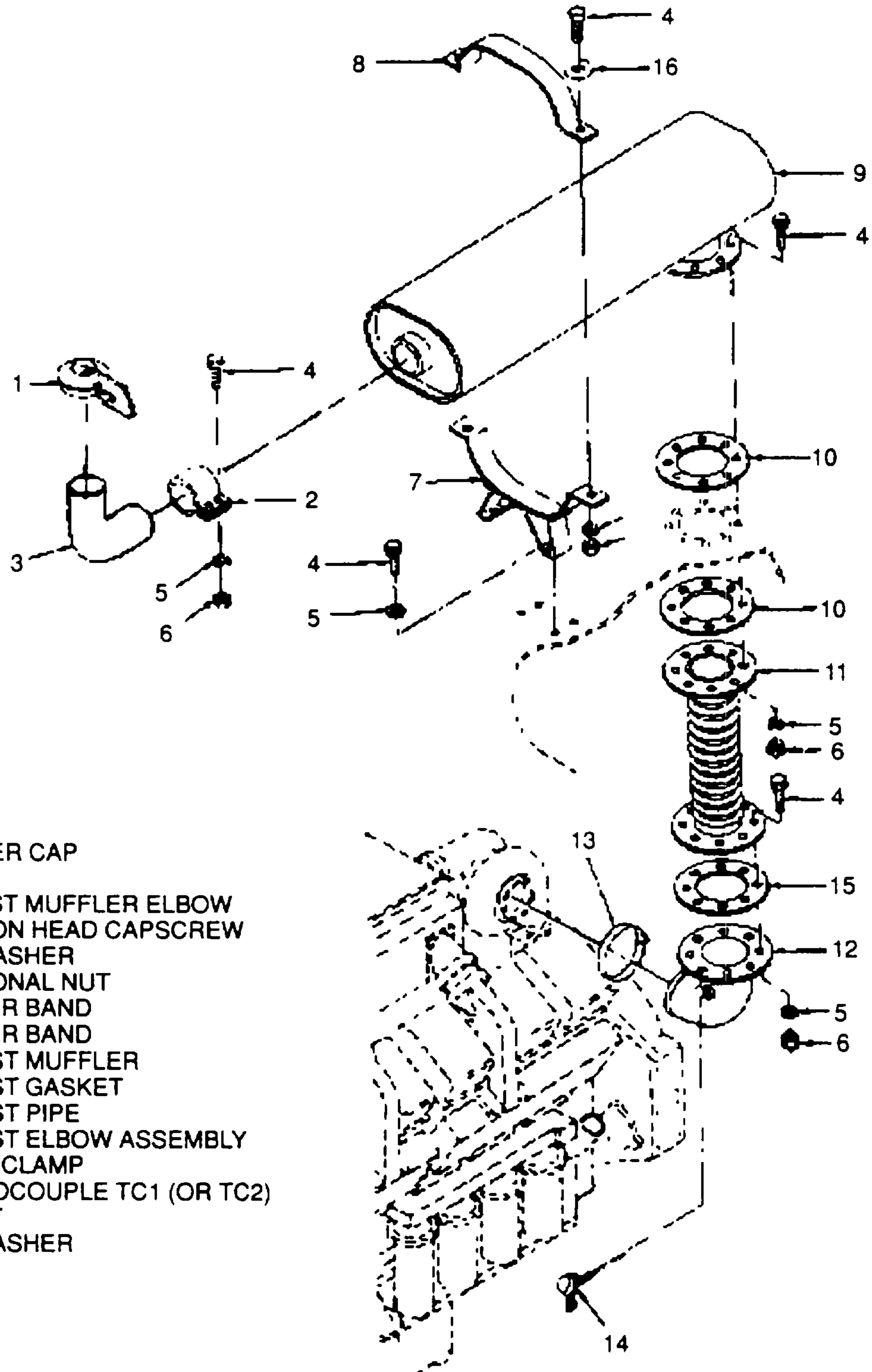
WARNING

The engine exhaust system becomes extremely hot during generator set operation. Do not touch muffler or exhaust pipe when they are hot.

a. Maintenance of Weather Caps.
   (1) Inspect Visually Inspect weather caps (1, Figure 3-23) for secure mounting, free lid movement, deformity, and corrosion. Replace defective caps In accordance with step (2), below.
   (2) Replace Loosen tightening bolt in weather cap (1) and remove cap from exhaust muffler elbow (3).
   (3) Install. Install new weather cap (1) by clamping cap securely around exhaust muffler elbow (3) with tightening bolt.

b. Maintenance of Mufflers.
   (1) Inspect Visually Inspect exhaust mufflers (9, Figure 3-23) for secure mounting, deformities, rupture, or excessive corrosion Check muffler mounting hardware for excessive rust or damage.
   (2) Install.
      (a) Position replacement gasket (10) on roof of unit. Mount muffler (9) and secure with hexagon head capscrews (4), hexagonal nuts (6), and lockwashers (5).
      (b) Attach top section of muffler band (8).
      (c) Install exhaust muffler elbows (3) and secure with muffler clamp (2).
      (d) Attach weather cap (1).
   (3) Replace.
      (a) Loosen clamp and remove weather cap (1).
      (b) Remove exhaust muffler elbow (3) by removing muffler clamp (2).
      (c) Remove upper section of muffler band (8) by removing screws.
      (d) Detach exhaust muffler (9) from root of unit by removing hexagon head capscrews (4), hexagonal nuts (6), and lockwashers (5).

c. Maintenance of Muffler Bands.
   (1) Inspect. Check muffler bands (7 and 8, Figure 3-23) for secure mounting. Check for damage and excessive corrosion Replace damaged bands In accordance with step (2), below.
   (2) Replace A damaged muffler band (7 and 8) may be replaced without removing the exhaust muffler (9). Obtain a support block with sufficient clearance to slip under the exhaust muffler near the band. This will prevent excessive free play that may otherwise damage the muffler when the band Is removed.
      (a) Remove the upper half of the muffler band (8) by removing the capscrews (4), lockwashers (5), flat washers (16), and hexagonal nuts (6). Slip the support block under the exhaust muffler (9) immediately adjacent to the lower half of the band.
      (b) Remove the lower half of the muffler band (7) by removing the hexagon head capscrews (4) and lockwashers (5).
   (3) Install.
      (a) Position lower half of new muffler band (7) under exhaust muffler (9) and over the band mounting holes. Attach lower half of the muffler band (7) to the roof using hexagon head capscrews (4) and lockwashers (5).
      (b) Remove the support block Position upper half of muffler band (8) over the exhaust muffler (9) and secure to the lower half of the muffler band (7) with hexagon head capscrews (4), lockwashers (5), hexagonal nuts (6), and flat washers (16).



1. WEATHER CAP
2. CLAMP
3. EXHAUST MUFFLER ELBOW
4 HEXAGON HEAD CAPSCREW
5 LOCKWASHER
6. HEXAGONAL NUT
7. MUFFLER BAND
8. MUFFLER BAND
9. EXHAUST MUFFLER
10. EXHAUST GASKET
11. EXHAUST PIPE
12. EXHAUST ELBOW ASSEMBLY
13 V BAND CLAMP
14. THERMOCOUPLE TC1 (OR TC2)
15. GASKET
16. FLAT WASHER

Figure 3-22. Muffler and Related Parts

d. Maintenance of Exhaust Pipes Elbows Gaskets and Thermocouples.

(1) Inspect.

(a) Visually inspect exhaust pipe (11, Figure 3-23) for damage Check for cracks, ruptures, excessive corrosion, damage, and secure mounting to the roof Visually inspect exhaust elbow assembly (12) for damage, excessive corrosion, ruptures and secure connection to the turbocharger exhausts. Also check the exhaust thermocouples TC1 and TC2 (14) for damage and secure mounting.

WARNING

The engine exhaust system becomes extremely hot during and immediately after generator set operation. Avoid all physical contact with exhaust system when performing checks and inspection under such conditions.

(b) With the generator engine operating, check the exhaust pipe (11) and exhaust elbow assembly (12) for leakage Pay particular attention to pipe connections with exhaust gasket seals (10) at the roof and at the exhaust elbow assembly (12). Exhaust leakage inside the generator housing may be detected visually (soot marks), audibly, through the sense of smell, or any combination thereof Replace damaged pipes, elbows, and leaking gaskets as described below.

(2) Remove exhaust elbow assemblies (12, Figure 3-23) (Replacement procedures apply for both exhaust elbow assemblies)

(a) Tag and disconnect wiring to exhaust thermocouple TC1 or TC2 (14, Figure 3-23) mounted on exhaust elbow assembly (12). Remove exhaust thermocouple TC1 or TC2 by unscrewing.

(b) Loosen V band clamp (13) holding exhaust elbow assembly (12) to the turbocharger exhaust rim

(c) Remove damaged exhaust elbow assembly (12) by removing hexagon head capscrews (4), lockwashers (5), and hexagonal nuts (6) holding the exhaust elbow assembly to the exhaust pipe (11). Remove and discard exhaust gasket (15) from exhaust elbow assembly (12) flange.

(3) Install exhaust elbow assemblies (12).

(a) Pass the V band clamp (13) across the exhaust elbow assembly Position unflanged elbow end over turbocharger exhaust rim and the flanged elbow end directly under the exhaust pipe (11) flange. Tighten the V band clamp (13) only when capscrew mounting holes on the flanged ends of both the exhaust elbow assembly (12) and exhaust pipe (11) are precisely aligned.

(b) Install exhaust gasket (15) between exhaust elbow assembly (12) and exhaust pipe (11) flanges. Bolt the exhaust elbow assembly (12) and exhaust pipe (11) flanges together tightly using hexagon head capscrews (4), lockwashers (5), and hexagonal nuts (6).

(c) Reinstall exhaust thermocouple TC1 or TC2 (14, Figure 3-23), removed in step (a), above, on the exhaust elbow assembly (12). Connect wiring and discard tags.

(4) Remove exhaust pipes (11).

NOTE

Two people may be required to perform the following procedure.

(a) Remove hexagon head capscrews (4), hexagonal nuts (6), and lockwashers (5) holding the bottom flange of exhaust pipe (11) to the exhaust elbow assembly (12).

(b) Remove exhaust pipe (11) by removing the hexagon head capscrews (4), hexagonal nuts (6), and lock washers (5) securing exhaust pipe to roof. Discard gasket (10).

(5) Install exhaust pipes (11).

(a) Position exhaust gasket (10) on exhaust pipe (11) roof flange and another exhaust gasket (15) on the exhaust elbow assembly (12) flange. Secure exhaust pipe (11) and exhaust gasket (10) to the roof using hexagon head capscrews (4), hexagonal nuts (6), and lockwashers (5).

(b) With exhaust gasket (15) positioned in between, bolt the exhaust elbow assembly (12), to the exhaust pipe (11) using hexagon head capscrews (4), hexagonal nuts (6), and lockwashers (5).

3-17. MAINTENANCE OF CONTROLS, INSTRUMENTS, AND SWITCHGEAR.

a. General. The equipment covered in this paragraph is located In the control room compartment situated at the rear of the generator set housing. The majority of the controls, instruments, and switchgear are contained in three separate cabinets: A, B, and C. Cabinets A and B contain generator controls and equipment, while cabinet C is used primarily for engine-related controls and instruments. Access to the equipment and wiring is provided through hinged, key-latched, front cabinet door panels and removable rear access panels. The front panels of all three cabinets can be opened from the control room itself, while access to the rear of the cabinets is through the generator section of the housing enclosure. interior roof and wall panels of the control room are lined with sound insulation material to reduce inherent noise levels caused by engine vibration during generator set operation. The noise damping provision also functions to minimize possible adverse effects of vibration on controls and instrumentation.

b. Removal and Installation of Switchgear Access Panels. Access panels (see Figure 3-24) consisting of sheet metal and sound insulation material separate the switchgear from the generator compartment. To remove and install these panels, proceed as follows:

NOTE

Access panels must be removed in order. First, right and left outer panels then inner panels.

(1) Remove. To remove any switchgear access panels (4 through 8), remove hexagon head capscrews (1), flat washers (3), and grommets (30).

(2) Install. Install switchgear access panel (4 through 8), replace grommet (30), flatwasher (3), and secure with hexagon head capscrew (1).

WARNING

Do not touch exposed electrical connections when circuits are energized. DC CONTROL and UTILITY POWER CIRCUIT BREAKERS must be deenergized, MAINTENANCE LOCKOUT switch set to MAINTENANCE, main disconnect switch S120 is set to OPEN, and load cables placed in park position before starting any procedure.

CAUTION

Do not allow dry cleaning solvent P-D-680, Type II, to come into contact with exposed electrical components. Damage to the equipment could result from failure to observe this precaution.

c. Control Room Heaters. H103 and H104. Control room area heaters H103 and H104 (see Figure 3-25) are controlled by circuit breaker CB118 (located in distribution panel DP2), integral switches, and temperature adjustment knobs. Adjust to attain desired temperature Inspect heaters for visible damage or evidence of scorching. Check security of mounting and wiring connections.

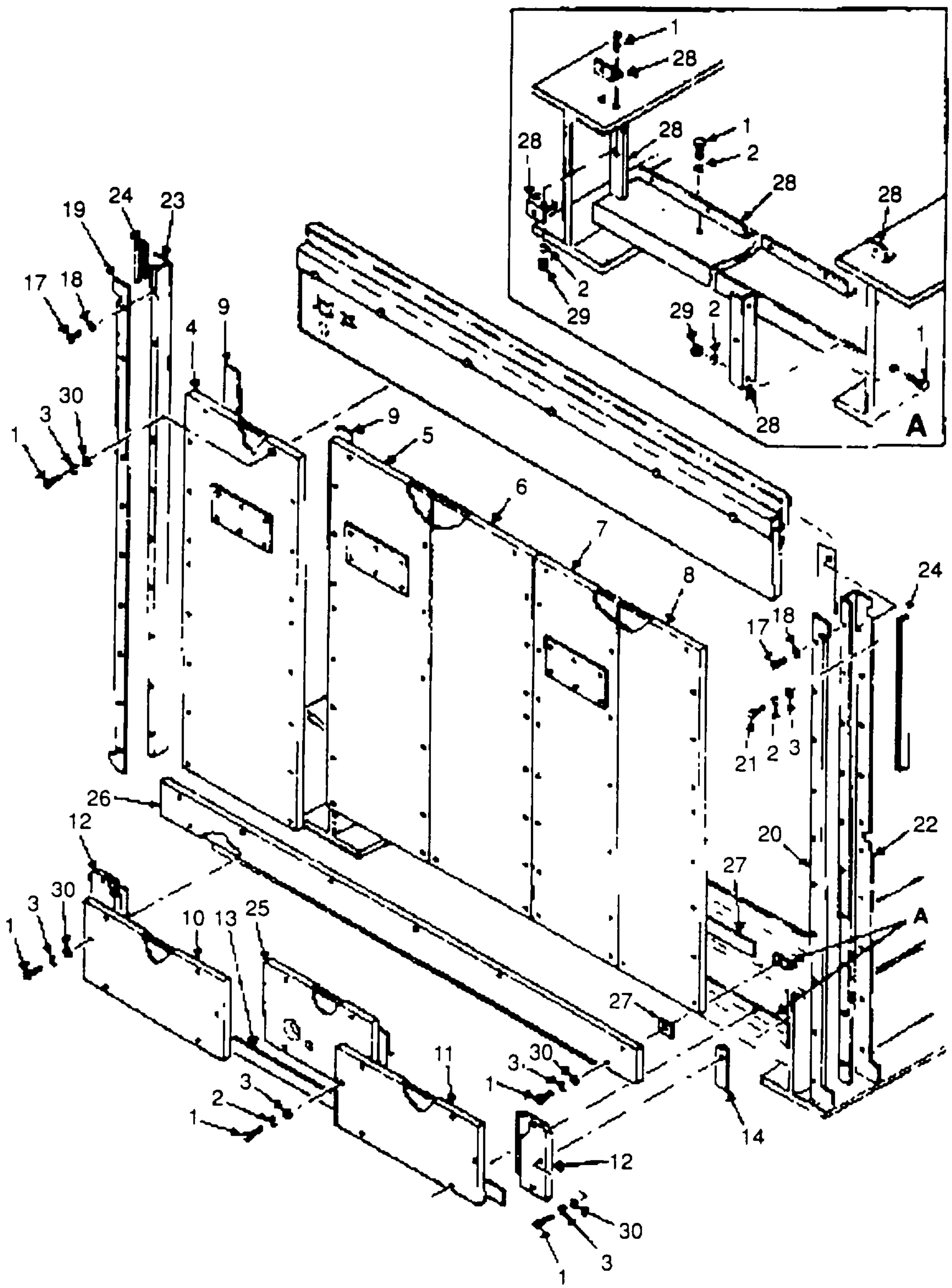


Figure 3-23. Switchgear Access Panel (Sheet 1 of 2)

1. HEXAGON HEAD CAPSCREW
2. LOCKWASHER
3. WASHER
4. CABINET C SWITCHGEAR ACCESS PANEL
5. CABINET B SWITCHGEAR ACCESS PANEL
6. CABINET B SWITCHGEAR ACCESS PANEL
7. CABINET A SWITCHGEAR ACCESS PANEL
8. CABINET A SWITCHGEAR ACCESS PANEL
9. GASKET
10. ACOUSTICAL PANEL
11. ACOUSTICAL PANEL
12. ACOUSTICAL PANEL
13. GASKET
14. GASKET
15. GASKET
16. GASKET
17. SCREW AND CAPTIVE WASHER ASSEMBLY
18. WASHER
19. ACOUSTICAL PANEL COVER
20. ACOUSTICAL PANEL COVER
21. HEXAGON HEAD CAPSCREW
22. ACOUSTICAL PANEL
23. ACOUSTICAL PANEL
24. GASKET
25. ACOUSTICAL PANEL
26. ACOUSTICAL PANEL
27. GASKET
28.. ANGLE
29. HEXAGONAL NUT
30. GROMMET

Figure 3-23. Switchgear Access Panel (Sheet 2 of 2)

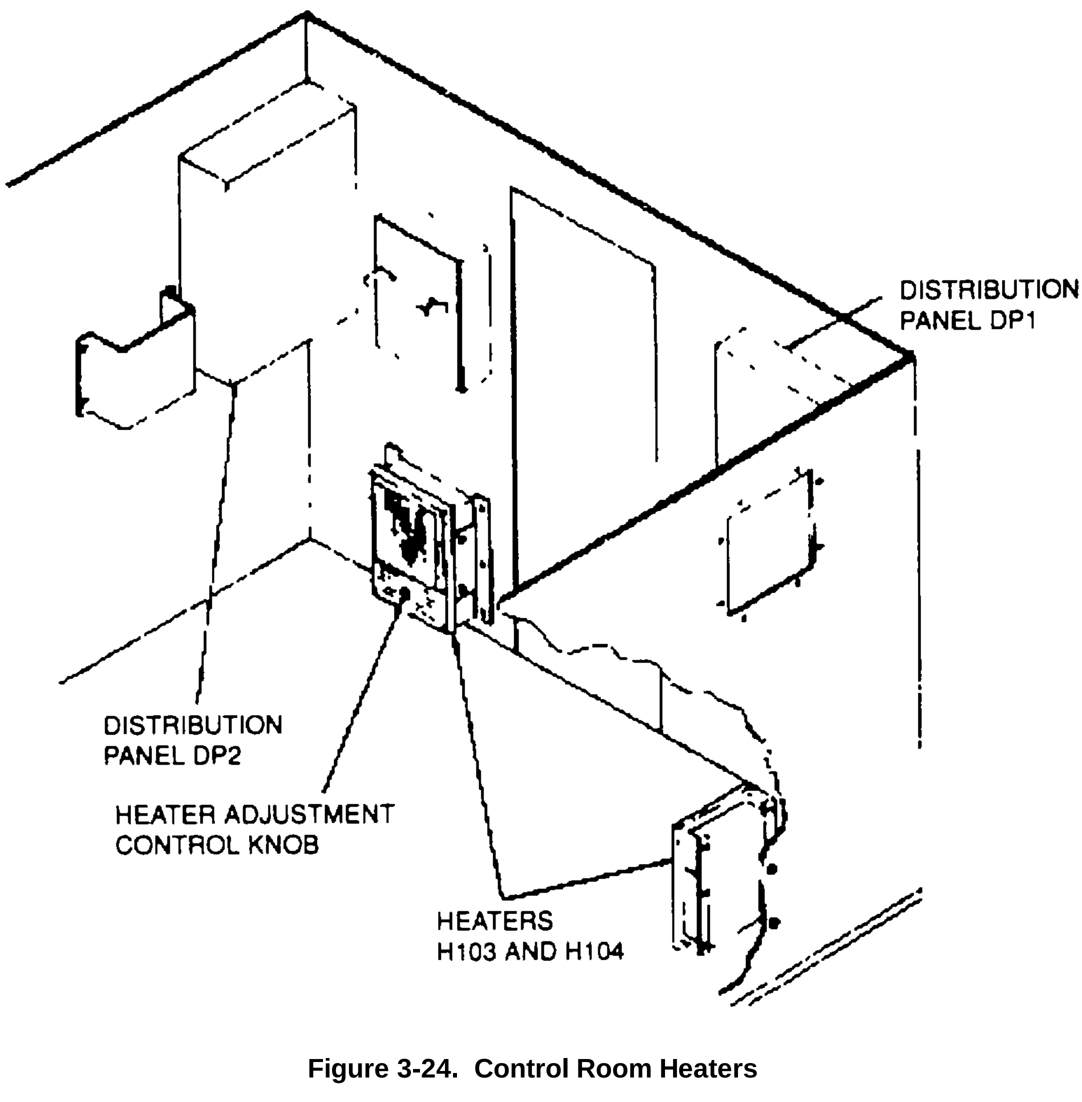


Figure 3-24. Control Room Heaters

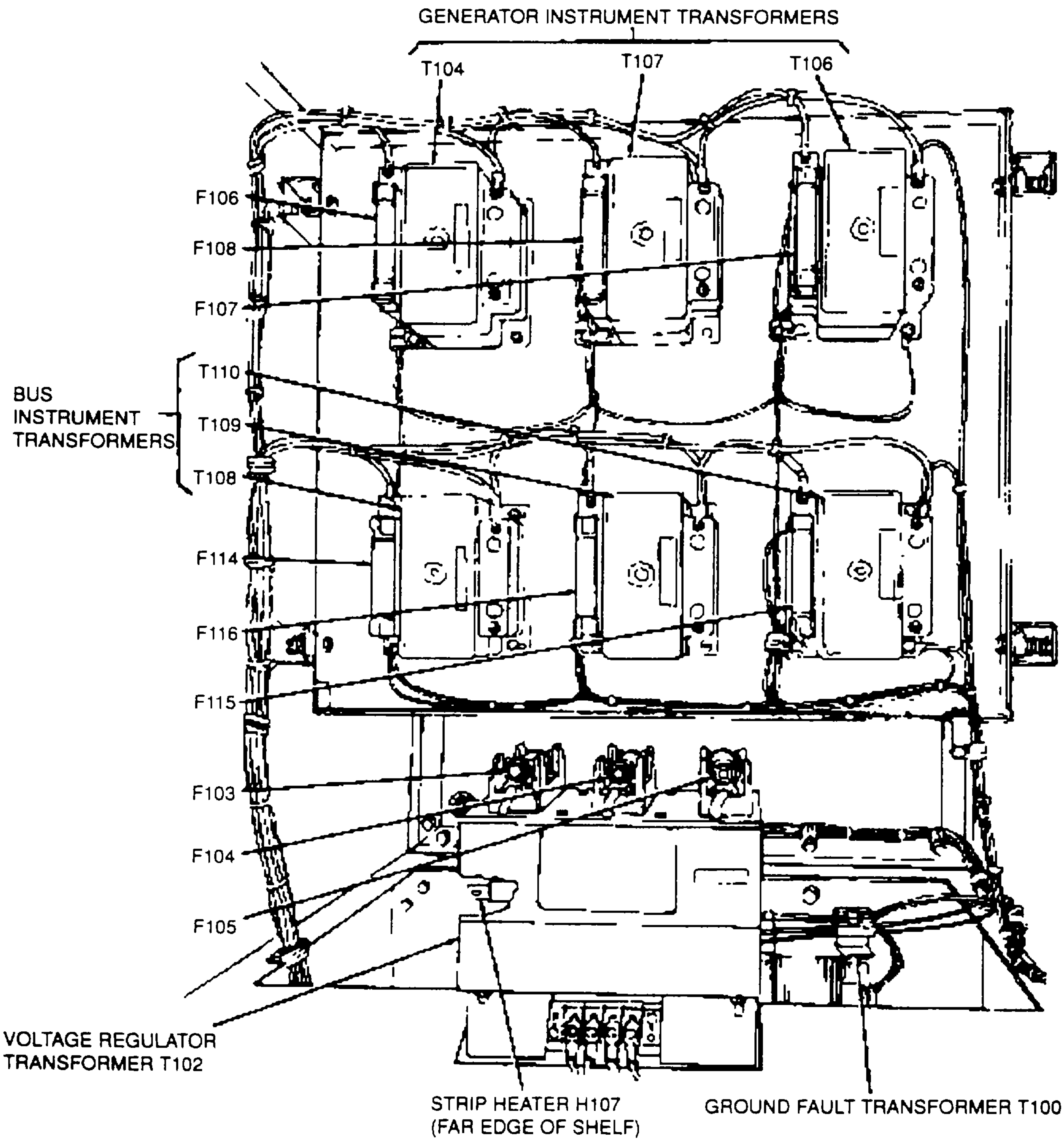


Figure 3-25. Cabinet A, As Seen From Generator Compartment (Sheet 1 of 2)

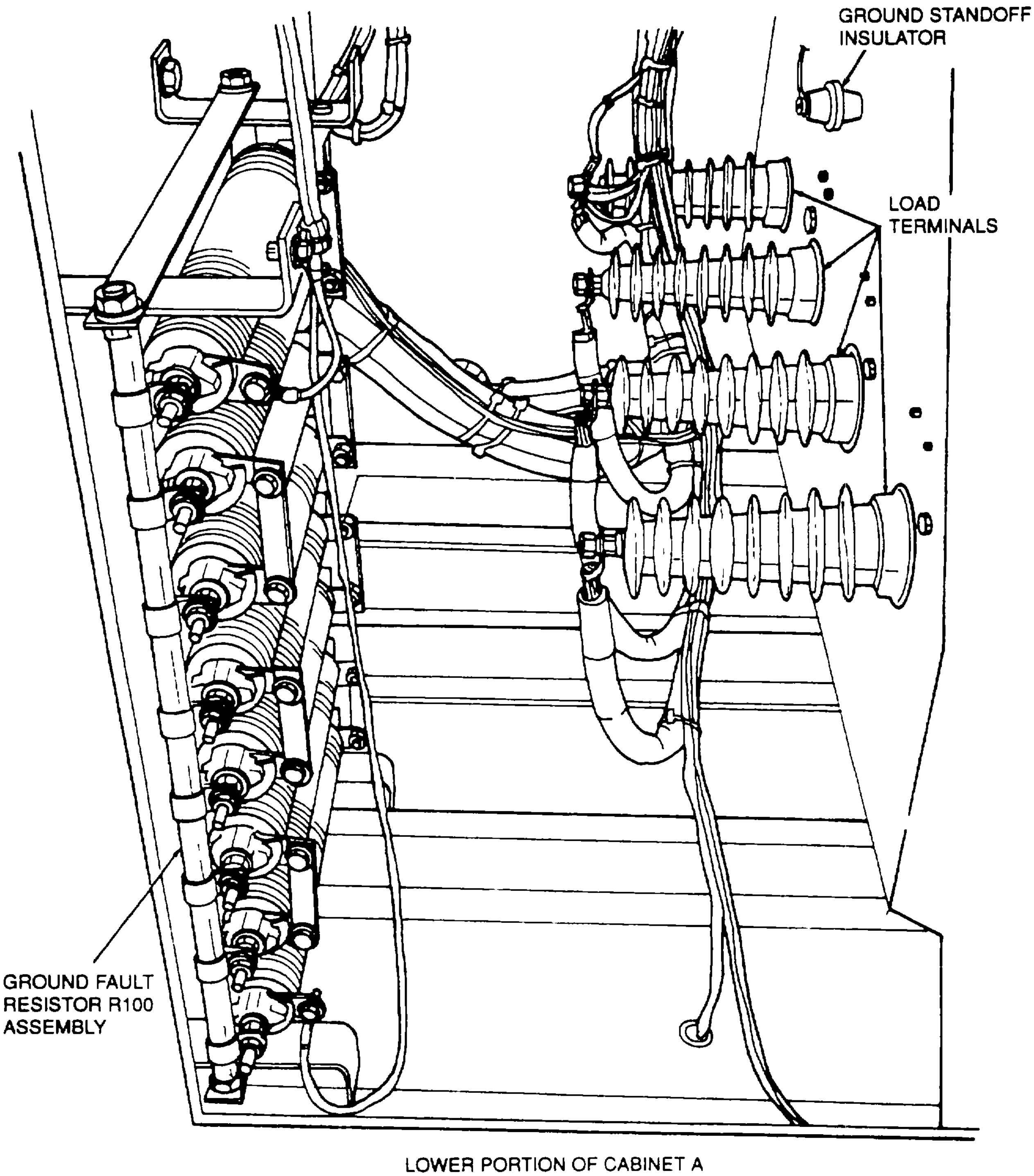


Figure 3-26. Cabinet A, As Seen From Generator Compartment (Sheet 2 of 2)

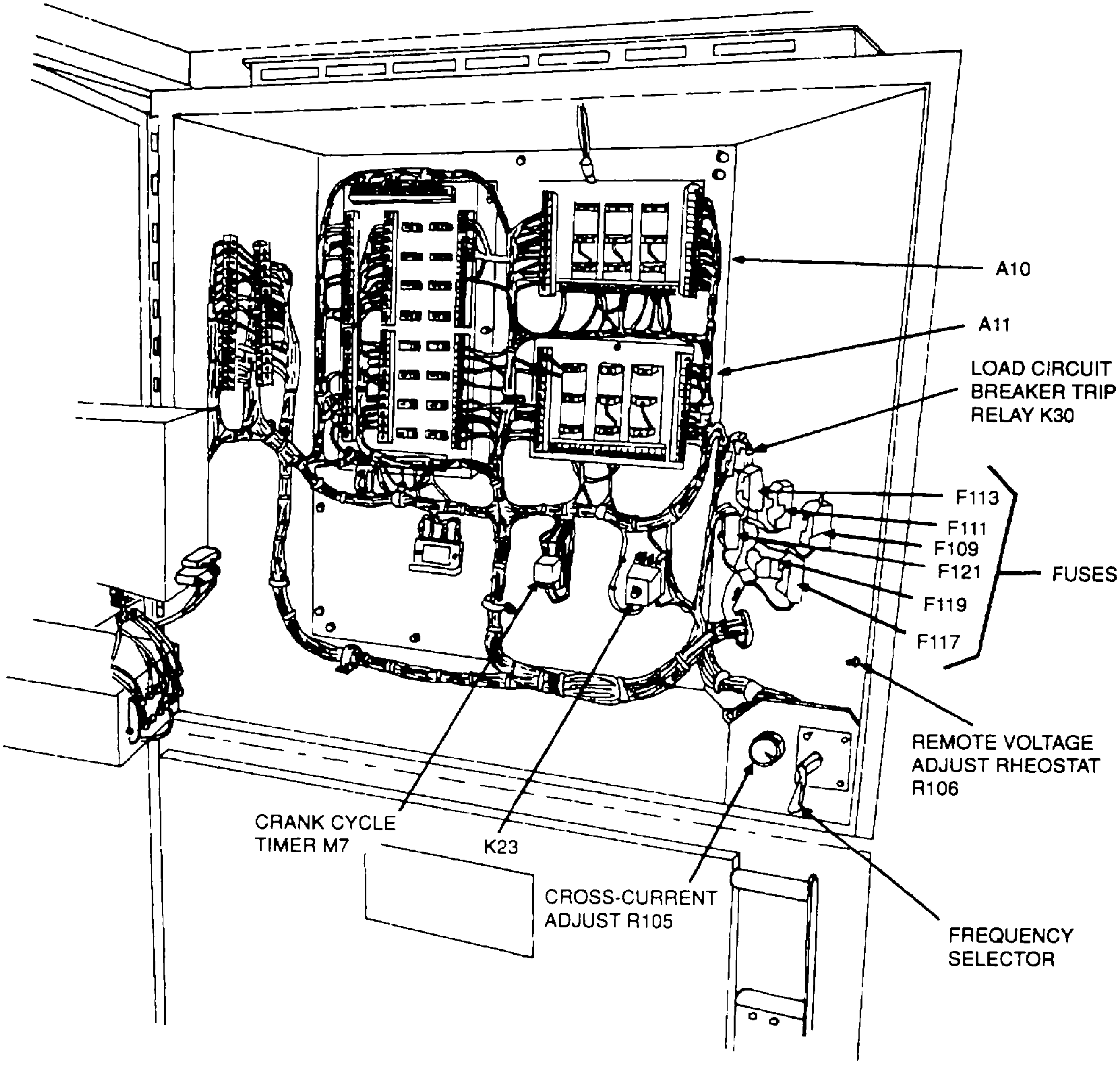


Figure 3-26. Inside Upper Cabinet A, Right Interior Wall, As Seen From The Control Room

d. Generator Controls Cabinet A. See Figure 3-26 and Figure 3-27.

WARNING

To avoid Injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" In accordance with Chapter 1, Section III, of this manual and equipment Is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

(1) Inspect. See Figure 3-24. Remove any switchgear access panels (4 through 8), by removing hexagon head capscrews (1), lockwashers (2), and flat washers (3).
  (a) Inspect for overall cleanliness and damage Check operation of keyed latches on front access doors. Remove rear cabinet panels for inspection of internal components. Refer to paragraph 3-16, step b, for panel removal.
  (b) Inspect that all interior sections of cabinet A are free of debris and accumulations of dirt, sand, and moisture.
  (c) Check that harness and wiring runs are secure and that there Is no evidence of burned or otherwise damaged insulation.
  (d) Visually inspect for damage to any component on control panel A..
(2) Service.
  (a) Secure loose wiring connections.
  (b) Clean instrument cover glass using lintless material dampened with cleaning compound P-C-438A, or equivalent.
  (c) Remove all accumulated debris.

e. Annunciator Control Panel A. See Figure 2-3

WARNING

To avoid injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

(1) Inspect.
  (a) Open upper front door assembly and lower front door.
  (b) Check overall appearance for cleanliness, proper operation of door latch rods, and for damage to components.
  (c) Check security of Installed instruments and wiring connections
  (d) Check for cracked or loose cover glasses on Installed instruments.

(2) Service.
   (a) Secure loose wiring connections.
   (b) Clean Instrument cover glass using lintless material dampened with cleaning compound P-C-438A, or equivalent.
   (c) Remove all accumulated debris.

f. 60 Hz CLOCK M110 and 50 Hz CLOCK M111 (1 and 6, Figure 2-3) Inspect faces for cleanliness, damage, or cracks. Adjusting stems should be secure, not bent, and operational Check wires for security.

g. KILOWATT HOURS Counter CNTR (7. Figure 2-3). Inspect for cleanliness and signs of damage. Check security of panel mounting and wiring connections.

h. GROUND FAULT Relay K115 (11. Figure 2-3). Inspect for cleanliness and signs of damage Check security of panel mounting and wiring connections at rear of control panel.

i. Overcurrent Relay K114 (10. Figure 2-3). Inspect for cleanliness and signs of damage Check security of panel mounting and wiring connections at rear of control panel.

j. Annunciator Panel A9 (4. Figure 2-3). Inspect front of annunciator panel A9 for cleanliness and damage. Check security of mounting clamps at rear of panel. Check that the hinged panel containing the fault lamps Is secured. Check that the three pushbutton switches below the annunciator panel are secure and undamaged Check for loose, frayed, or broken wiring.

k. CROSS CURRENT ADJUST Rheostat R105 (9. Figure 2-3). Rheostat R105 Is mounted on a bracket inside the upper section of cabinet A. Inspect for cleanliness and signs of damage Check security of mounting, wiring connections, and ensure that switch handle turns freely.

l. FREQUENCY SFL SW S118 (8, Figure 2-3). The relay switch S118 is mounted on a bracket inside the upper section of cabinet A. Inspect for cleanliness and signs of damage. Check security of mounting, wiring connections, and that switch handle turns freely. Check for satisfactory operation of click stops in both 50 and 60 Hz positions.

WARNING

Avoid contact with any exposed terminals or cables on transformers even when generator set is shut down. Dangerous residual voltages can cause death or injury to personnel.

m. Ground Fault Transformer T100. Inspect fault transformer T100 (Figure 3-26) for signs of damage or burned insulation. Overheating will be evident by telltale odor. Wiring should be secure and not damaged.

n. Voltage Regulator Transformer T102. Inspect for cleanliness and debris In area of voltage regulator transformer T102 (Figure 3-26) Inspect for signs of damage, burned Insulation, and telltale odors of overheating. Wiring should be secure.

o. Ground Fault Resistor R100. Inspect ground fault resistor R100 (Figure 3-26) located on the lower left inside wall of cabinet A (as seen from the generator compartment) Check for secure mounting, wiring connections, and signs of overheating. Check resistors on the bank for cracks.

p. Generator Instrument Transformers T104. T106. T107. and Bus Instrument Transformers T108. T109. and T110. See Figure 3-26. Inspect transformers for cleanliness. Check security of wiring and attachments. Inspect for damage, burned Insulation, and telltale odors of overheating.

q. Strip Heater H107. Strip heater H107 (Figure 3-26) Is mounted on the rear of the shelf supporting voltage regulator transformer T102. Inspect for security of mounting and wiring connections and for scorching.

r. Fuses F103 through F108, F114 through F116, and F109, F111, F113, F117, F119 and F121. (See Figure 3-26 and Figure 3-27.)
   (1) Inspect. Inspect fuses for evidence of burning or damage.
   (2) Test. Test fuses for continuity using an ohmmeter set to RX1 scale.
   (3) Replace. Discard and replace any fuse which does not show a zero reading on ohmmeter.
s. Maintenance of Generator Cabinet B.

WARNING

To avoid injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III , of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

   (1) Inspect.
      (a) Inspect for overall cleanliness and signs of damage.
      (b) Check operation of keyed latches on front access doors (see Figure 2-2). Remove rear cabinet panel for inspection of interior Refer to paragraph 3-17 step b.
      (c) Inspect that all Interior sections of cabinet B are free of debris.
      (d) Check that harness and wiring runs are properly mounted Check for evidence of burned or damaged insulation.
      (e) Inspect appearance and condition of equipment Installed on cabinet B door assembly.
   (2) Service.
      (a) Secure loose wiring connections and harness attachments.
      (b) Clean instrument cover glass using lintless material dampened with cleaning compound P-C-438A, or equivalent.
      (c) Remove all accumulated debris.
t. Generator Control Panel B. See figures Figure 2-2, Figure 3-28, and Figure 3-29.
   (1) Inspect.
      (a) Open both upper front door assembly and lower front door.
      (b) Check overall appearance for cleanliness, proper operation of door latch rods, and for obvious damage to components.
      (c) Check security of installed instruments and wiring connections.
      (d) Check for cracked or loose cover glasses and broken indicators on instruments.
   (2) Service.
      (a) Secure loose attaching screw and captive washer assemblies or nut and captive washer assemblies.
      (b) Secure loose wiring connections.
u. AC AMPERES Meter M102 (1. Figure 2-2). Inspect for cleanliness and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.
v. AC KILOVOLTS Meter M101 (2. Figure 2-2). Inspect for cleanliness and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.

w. FREQENCY Meter M103 (3. Figure 2-2).. Inspect for cleanliness and damage Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators
x. SYNCHRONIZING LIGHTS DS110 and DS111 (4. Figure 2-2). Inspect that lenses are secure and undamaged and lamp sockets are secure In panel Check wiring security at rear of panel.
y SYNCHROSCOPE Meter M106 (5. Figure 2-2). Inspect for cleanliness and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.
z. AC KILOWATTS Meter M107 (6. Figure 2-2). Inspect for cleanliness and damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.
aa. AC KILOVARS Meter/Transformer M108 (7, Figure 2-2). Inspect for cleanliness and damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken indicators.
ab. FRFO ADJ Rheostat R102 (8. Figure 2-2). Inspect for cleanliness and damage to knob. Check security of knob on shaft. Rotate full range In both directions while observing that travel Is smooth and uninterrupted and no evidence of bent shaft Is noted Check rear of panel for security of mounting and wiring connections.
ac. POWFR FACTOR Meter M104 (9. Figure 2-2). Inspect for cleanliness and damage Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.
ad. GFN TEMP Meter M 105 (10. Figure 2-2). Inspect for cleanliness and damage Check for secure attachment to panel and for chipped, cracked, or loose cover glass and broken Indicators.
ae. SYNCHROSCOPE Switch S115 (11. Figure 2-2). Inspect for cleanliness and signs of damage Check security of panel mounting, wiring connections, and switch knob Check for satisfactory operation of click stops In both positions.
af. FRFOUENCY DROOP/ISOCHRONOUS Switch S117 (12. Figure 2-2). Inspect for cleanliness and signs of damage Check security of mounting, wiring connections. Check that the switch turns freely In both positions and seats properly In both positions.
ag. Phase Sequencing Indicator Lights DS112 and DS113 (14, Figure 2-2). inspect that lenses are secure and undamaged and lamp sockets are secure In panel Check wiring security at rear of panel.
ah. PHASE SEO. SEL, SW 119 (15, Figure 2-2). Inspect for cleanliness and signs of damage. Check security of panel mounting, wiring connections, and switch handle Check for satisfactory operation of click stops In all three positions.
ai. PARALLEL /SINGLF Set Lights DS35 and DS36 (17, Figure 2-2). Inspect that lenses are secure and not cracked and that lamp sockets are secure in panel. Check wiring security at rear of panel
aj. PARALLFL Switch S6 (18. Figure 2-2). Inspect for cleanliness and signs of damage Check security of panel mounting, wiring connections, and switch handle Check for satisfactory operation of click stops in both PARALLEL and SINGLE positions. Spring action should return switch handle to normal-vertical position.
ak. OPEN/CLOSFD Circuit Breaker Position Indicator Lights DS33 and DS34 (19, Figure 2-2). Inspect that lenses are secure and undamaged and lamp sockets are secure In panel Check wiring security at rear of panel.
al. BREAKFR CONTROL Switch S4 (20. Figure 2-2). Inspect for cleanliness and signs of damage Check security In panel mounting and wiring connections. Check handle operation in CLOSE position and In the TRIP position. Spring-loaded handle must return to normal vertical attitude after each command operation with handle Index on the target window. Target window should show red when last command operation was CLOSE and green when last command operation was TRIP Check for proper PULL TO LOCK operation for handle In TRIP position. Handle should remain locked until pushed for release and then must spring back to normal vertical position.
am. LOCAL RFMOTE Switch S2 (23. Figure 2-2). Inspect for cleanliness and signs of damage. Check security of panel mounting, wiring connections, and switch handle Check for satisfactory operation of click stops in both local and remote positions.
an. GFN/BUS VOLTMETER Switch S2 (24. Figure 2-2). Inspect for cleanliness and signs of obvious damage. Check for security of panel mounting, wiring connections, and switch knob. Check for operation of click stops In all eight positions.

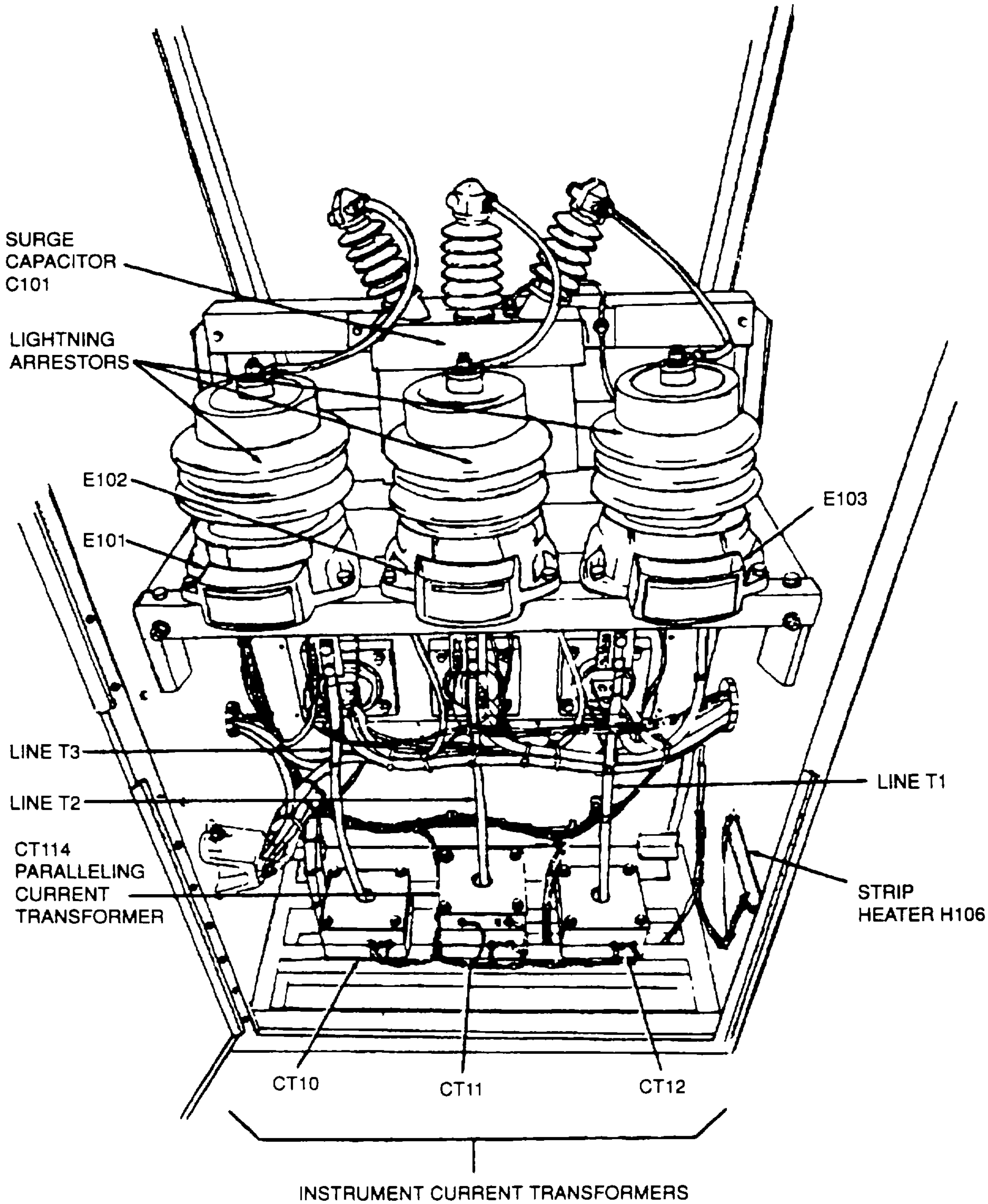


Figure 3-27. Lower cabinet, B. As Seen Generator Compartment

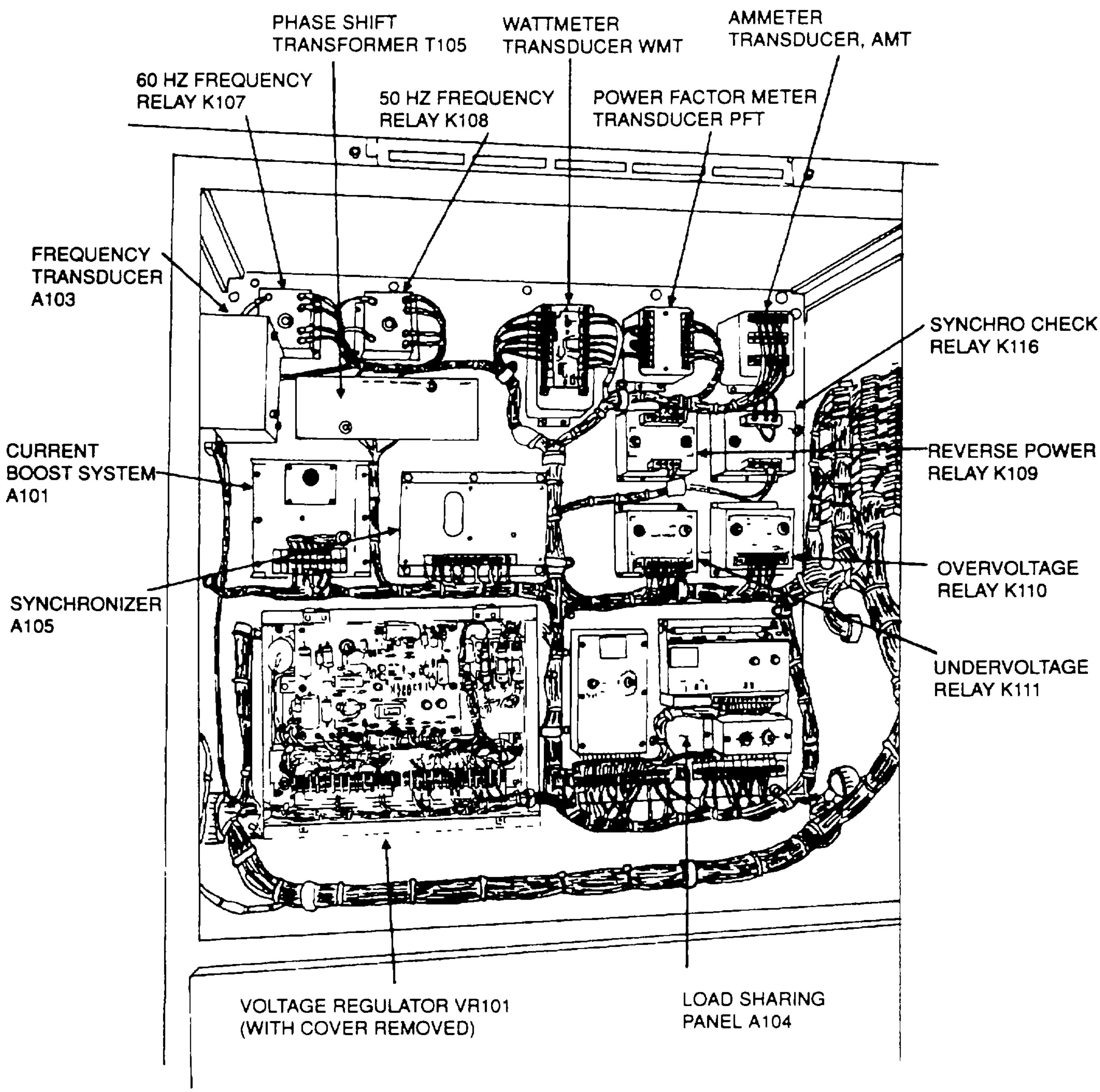


Figure 3-28. Upper Cabinet B, As Seen From The Control Room

ao. AMMFTFR Switch S114 (25. Figure 2-2). Inspect for cleanliness and signs of damage. Check security of panel mounting, wiring connections, and switch knob. Check for operation of click stops In all four positions.

ap. VOLT ADJUST Rheostat R101 (26. Figure 2-2) Inspect for cleanliness and damage to knob. Check security of knob on shaft. Rotate knob full range In both directions while observing that travel is smooth and uninterrupted and no evidence of bent shaft Is noted. Check rear of panel for security of mounting and wiring connections.

aq. Remote Voltage Adjust Rheostat R106 (Figure 3-7). Inspect for cleanliness and damage. Check that shaft is not bent. Check security of mounting and wiring connections.

ar. Instrument Current Transformers CT10. through CT12 and Paralleling Instrument Transformer CT114. (Figure 3-28). Inspect cleanliness of transformers. Check security of wiring and mounting attachments. Inspect for signs of damage, burned insulation, and telltale odors of overheating_

as. Wattmeter Transducer (WMTI. Power Factor Meter (PFT). and Ammeter (AMT) Transducers. (Figure 3-29). The three meter transducers are mounted on the rear interior panel, upper front section of generator control cabinet B. Inspect transducers for secure mounting, wiring connections, or damage.

at. Frequency Transducer A103. (Figure 3-29) The frequency transducer A103 is mounted on the left interior panel, upper front section of generator control cabinet B. Inspect transducer for secure mounting, wiring connection, and signs of damage.

au. Maintenance of Engine Control Cabinet C

(1) Inspect

(a) Inspect cabinet exterior for cleanliness and damage. Open cabinet door and check operation of handle. Remove rear cabinet panel (refer to paragraph 3-17 step b, for inspection of internal components. Check front cabinet door for secure mounting.

(b) Inspect front and rear cabinet interiors for debris.

(c) Check that harnesses and wiring runs are secured Check for damaged Insulation.

av. Engine Control Panel C. (Figure 2-1).

(1) Inspect.

(a) Check overall front panel appearance for cleanliness and obvious damage to components. Check for cracked or loose cover glasses on panel Instruments and broken Indicators.

(b) Open cabinet door Check that all instruments are securely mounted behind the door. Check for damage to components Check that all wiring harnesses are properly secured. Check for loose, frayed, or damaged wires.

aw. MAINTENANCF LOCKOUT Switch S100 (1. Figure 2-1). Inspect for cleanliness and signs of damage. Check for security of mounting and for operation In both OPERATE and LOCKOUT positions.

ax. FUEL PUMP Switch S8 (4. Figure 2-1). Inspect for cleanliness and signs of damage. Check security of panel mounting and for operation in all positions. HAND, AUTO, and OFF.

ay. FUEL PUMP FNFRGI7FD Indicator DS107 (5. Figure 2-1) Inspect that lenses are secure and not cracked and that lamp socket is secure in panel. Check security of wiring.

az. Panel Illumination Lights DS26 through DS29 (6. Figure 2-1). Inspect for cleanliness and signs of damage. Check security of installation and wiring connections. Lamp shields should rotate freely.

ba. LUBE OIL PRESSURF Gage M1 (7. Figure 2-1). Inspect for cleanliness and signs of damage. Check for secure panel mounting and for chipped, cracked, or loose cover glass and broken indicator.

bb. FUEL LEVEL Gage M4 (8. Figure 2-1). Inspect for cleanliness and signs of damage. Check for secure panel mounting and for chipped, cracked, or loose cover glass.

bc. EXHAUST TEMP Gage M6 (9. Figure 2-1). Inspect for cleanliness and signs of damage Check for secure panel mounting to panel and for chipped, cracked, or loose cover glass and broken indicator.

bd. COOLANT TFMP Gage M3 (10. Figure 2-1). Inspect for cleanliness and signs of damage. Check for secure panel mounting and for chipped, cracked, or loose cover glass and broken Indicator.

be. LUBE OIL TFMP Gage M2 (11. Figure 2-1) Inspect for cleanliness and signs of damage Check for secure panel mounting and for chipped, cracked, or loose cover glass and broken indicator.

bf. TIME TOTALIZ1NG Meter M5 (12. Figure 2-1) Inspect for cleanliness and signs of damage Check for secure panel mounting and for chipped, cracked, or loose cover glass and broken Indicator.

bg. PANEL LIGHTS Switch S1 (13. Figure 2-1) Inspect for cleanliness and signs of damage. Check security of mounting and for operation In both positions.

bh. START AID Switch S 10 (14. Figure 2-1). Inspect switch for cleanliness and secure mounting. Toggle switch on and off to verify proper operation.

bi. MASTER (START/STOP/RUN) SWITCH S9 (16. Figure 2-11 Inspect for cleanliness and signs of damage. Check security of mounting and for operation In START, RUN, and STOP positions.

bl. Utility Station Power Transformer T103 (Figure 3-29). Utility station power transformer T103 Is located In the lower rear section of engine control cabinet C. Inspect transformer for cleanliness and damage Check mounting and wiring connections for security Check for burned Insulation and telltale odors of overheating. Refer any evidence of overheating or damage to the next higher level of maintenance.

WARNING

Do not touch fuse during inspection or attempt to remove and replace fuse by hand. Verify that the generator set is completely shut off prior to servicing the fuse. Use a grounding stick on both terminal ends of the fuse holder to discharge any residual voltages present on lines and components. Use properly insulated tools and equipment to remove and replace the fuse. Failure to heed this warning may result in death or serious injury.

bk. Set Station Power Transformer T101 (Figure 2-12). Set station power transformer T101 Is located In the lower front section of engine control cabinet C Inspect transformer for cleanliness and obvious damage Check mounting and wiring connections for security Check for burned insulation and telltale odors of overheating.

bl. Strip Heater H105. See (Figure 3-29) Strip heater H105 Is mounted on the right cabinet panel, rear Interior section of engine control cabinet C Inspect heater for secure mounting and wiring connections. Check for signs of scorching, burned insulation, and damage.

bm. Humidistat S107 (1. Figure 2-12) Humidistat S107 Is mounted on the Interior right side panel of engine control. cabinet C Check humidistat for secure mounting and wiring connections, and damage.

WARNING

To avoid injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

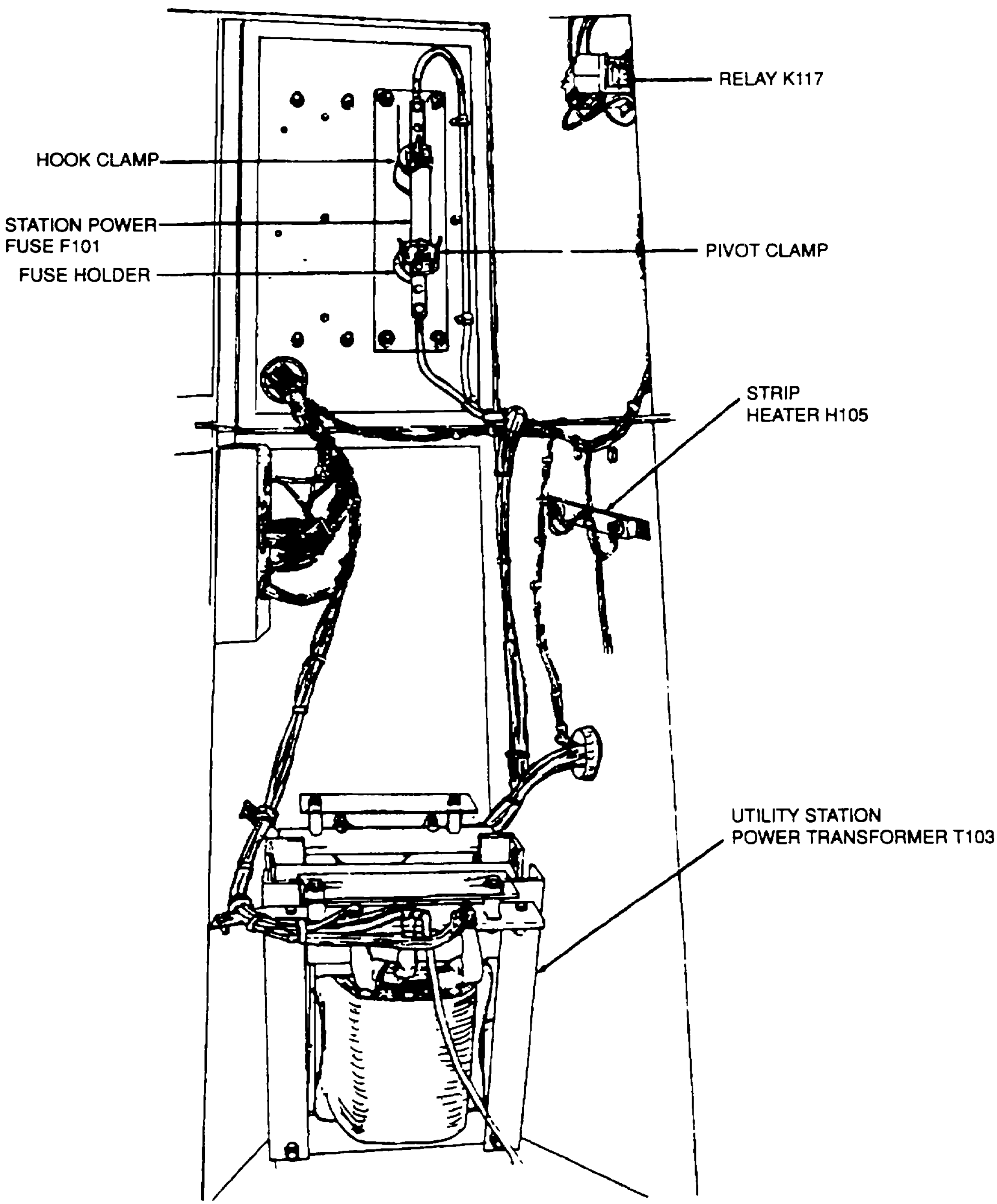


Figure 3-29. Cabinet C, Rear Interior Section, As Seen From Generator Compartment.

bn. SET POWFR Circuit Breaker CB124 and UTILITY POWFR Circuit Breaker CB125 (4 and 5. Figure 2-11). Inspect the two circuit breakers mounted immediately to the Right side of the control room door. Inspect circuit breakers and mounting panel for obvious damage Check functional operation of locking beam (3) that prevents simultaneous operation of circuit breaker. Remove circuit breaker panel cover and check Interiors for loose wiring and damage. Check for secure panel mounting Replace cover after Inspection.

bo Maintenance of Telephone Circuits (Figure 1-3. Figure 1-4. and Figure 2-2). The telephone circuit consists of a shielded two-wire coaxial hookup between TEL JACK J15 (22, Figure 2-2) on cabinet B control panel and four external jacks mounted in pairs on each side of the exterior housing (see Figure 1-3 and Figure 1-4). The telephone circuit may also be paralleled with the remote control module (RCM) through appropriate terminals in RCM connector J26. Voice actuated headsets are employed throughout.

(1) Inspect.

(a) Inspect control room TEL JACK J15 and external jacks (Figure 1-3 and Figure 1-4) for damage, secure mounting, and electrical connections. Check that the protective snap shields are Intact and properly seated. Open snap shields and Inspect jacks for accumulations of dirt or obstruction.

(b) Inspect voice actuated headset. Check for damage, loose, broken, or kinked headset wires and cables. Inspect connecting plugs for secure wiring connections and cleanliness.

(2) Remove and repair as follows:

(a) Secure any loose mounting or wiring connection on telephone jacks

(b) Remove any accumulation of dirt or grease Inside jacks.

(3) Replace any obviously defective headset.

bp. Switchgear Circuit Breaker CB123 (Figure 2-12). Main circuit breaker CB123 (3) is mounted inside upper cabinet C on the right hand side Inspect the circuit breaker for signs of scorching or burning, loose connections, and loose mountings

bq Motor Controllers and Contactors K104A. K104B. K106. and K117. These controllers and contactors are mounted Inside upper cabinet C on the right hand side. Inspect for signs of scorching or burning, loose connections, and loose mountings

br Incandescent Lamps (5 and 6. Figure 2-1. 4. 17. and 19. Figure 2-2. and 4. Figure 2-3). Incandescent lamps are used as status monitors on generator control cabinet B, for annunciator alarm indicators on control cabinet **A,** and as status monitors and for panel Illumination on engine control cabinet C.

(1) Inspect. Inspect all Incandescent lamp assemblies on cabinets A, B, C Open cabinet doors and check lampholders for secure mounting and electrical connections Inspect for front panel light lenses for damage and secure mounting.

(2) Test.

(a) Ensure that there Is no power provided to the Incandescent lamp socket being tested.

(b) Test socket for continuity with a multimeter set for resistive reading (RX1) Multimeter should indicate infinite resistance, replace bulb.

(3) Replace Typical incandescent lamp replacement procedure is as follows:

(a) Remove lens on front panel by unscrewing from Integral lampholder.
(b) Remove defective lamp by unscrewing.
(c) Install replacement lamp and replace lens.

bs. Neon Lamps (14. Figure 2-2). Neon lamps are used as phase sequence test lamps on control cabinet B.

(1) Inspect. Open control cabinet B door and inspect lampholder for secure mounting and electrical connections. Inspect front panel lamp lens for damage and secure mounting.

(2) Test.

NOTE

Neon lamps can only be tested by replacement of the lamp itself.

(3) Replace.
- (a) Remove lens on front of panel by unscrewing from the integral lampholder.
- (b) Remove defective lamp.
- (c) Install replacement lamp and replace lens.

CHAPTER 4
UNIT MAINTENANCE

SECTION I. SERVICE UPON RECEIPT OF EQUIPMENT

4-1. INSPECTION UPON RECEIPT. Inspect for damage which may have occurred during shipment. Check for loose or missing hardware, fuses, or bulbs. Refer to Figure 4-1 and-

a. Inspect Control Room Check for'
  (1) Remote control module (RCM), (if procured) on floor, bolted to right wall.
  (2) Two headsets, extension cord and shorting plug in wall mounted box above RCM location.
  (3) Fire extinguisher on floor to left of control room door.
  (4) Schematic Lamination located In document compartment.
  (5) Racking handle located in bottom of cabinet B.

b. Inspect Generator Compartment Check for
  (1) Lifting kit two slings, on floor, beneath generator

NOTE

Remove slings from engine compartment during operation to avoid contact with fuel and lube oil that could cause deterioration of nylon fabric sling

  (2) Two ground clamps, inside tool box.
  (3) Circuit breaker ramps, channel mounted to the rear generator support beam.
  (4) Two ground cables, on floor, between conduit box and tool box.
  (5) Mufflers, standing upright on floor and bolt mounted, by means of a stowage angle, to the conduit box.
  (6) Lifting kit (four spreader bars), on floor, beneath switchgear
  (7) Four load cables, on floor, between conduit box and switchgear.
  (8) Station power cable assembly, on floor, between conduit box and switchgear
  (9) Reactive load and governor control assemblies, on floor, between conduit box and switchgear
  (10) RCM cable assembly (if procured), on floor, between conduit box and switchgear.

c. Inspect Engine Compartment. Check for:
  (1) Two fire extinguishers hanging next to air cleaners.
  (2) Auxiliary fuel hose assembly coiled and hanging from bracket behind radiator.
  (3) Three grounding rods clamp-mounted to skid base.
  (4) Two ground clamps in tool box.
  (5) Two blocking pins in tool box.

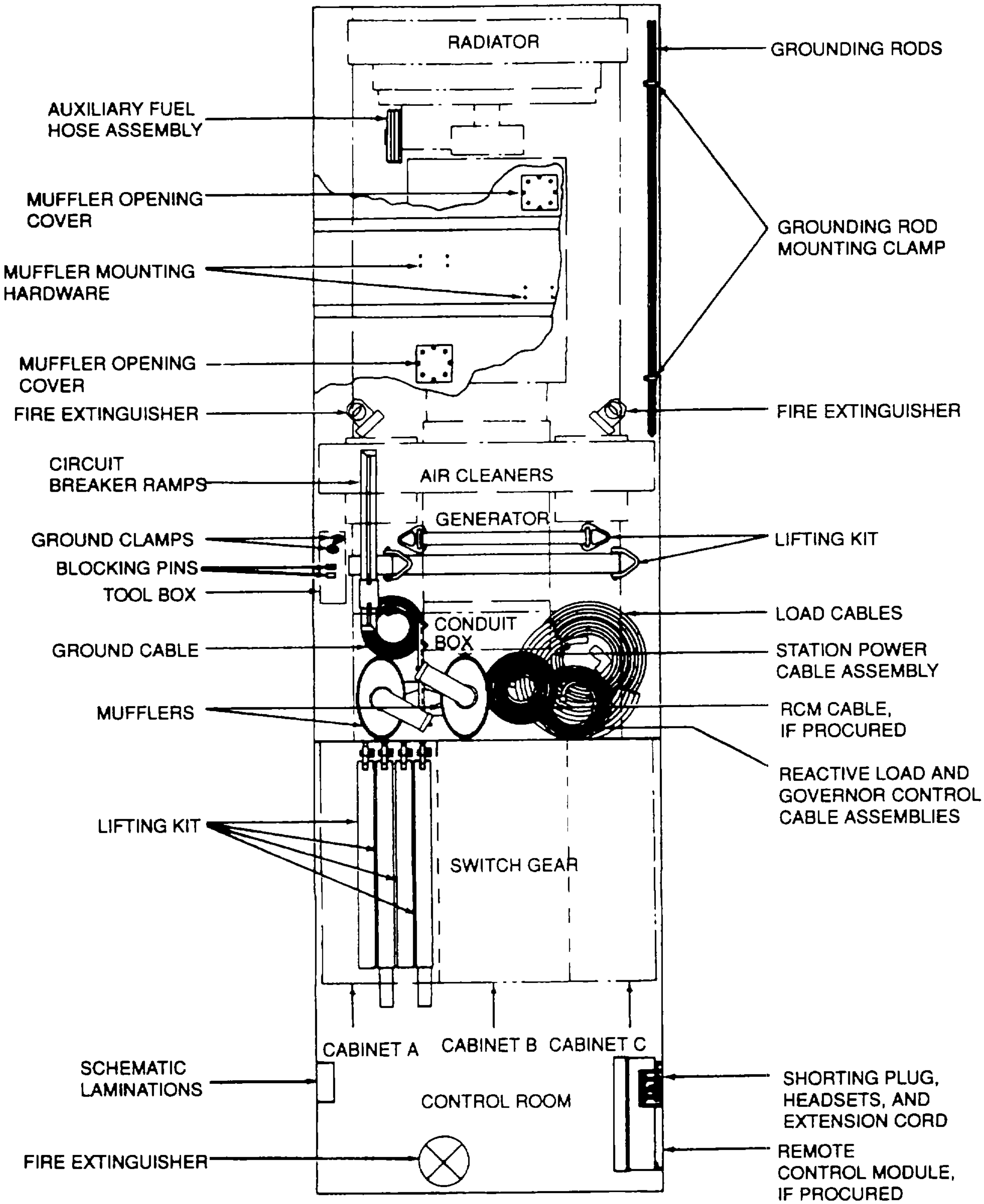


Figure 4-1. Generator Set Configured For Shipment.

4-2. INSTALLATION.

a. Site Selection. The generator set must be suitably located When choosing a site, consider the following:

(1) Interconnections If the generator set is to be used In parallel with another generator set, they must be close enough to each other to allow Interconnections with available cables Similarly, if the generator set is to be tied to a public utility, cable limitations must again be considered. The generator set comes equipped with the following cables:

(a) Load Cables Four 100-foot (30.5-meter) cables Used to connect generator output to the load

(b) Remote Control Cable Assembly (if procured) Used to connect generator set to remote control module(RCM). 100 feet (30 meters) long.

(c) Reactive Cable Assembly 100 feet (30.5 meters) long.

(d) Governor Paralleling Circuit Cable Assembly. 100 feet (30 5 meters) long.

(e) Ground Cables. Two 50-foot (15-meter) cables Used to ground the generator set and site requirement module (SRM) Refer to step b, below for grounding requirements.

(f) Station Power Cable Assembly. 100 feet (30 5 meters) long.

(2) Clearances To allow ease of access and ensure adequate air supply to the generator set, the set should be clear of obstruction on radiator end 50 ft and 10 ft on all other sides.

(3) Weight. The generator set weighs approximately 37,500 pounds (17,025 kg) dry, or 39,600 pounds (17,978 kg) wet. This weight is distributed, by skid base main girders, to an average of 750 pounds per square foot (3660 kg per square meter) The surface where the set is to be sited must be able to support this weight.

(a) Indoor Siting Be sure the floor surface is rated for the load It will have to bear.

(b) Outdoor Siting Be sure the ground Is not too soft. Logs or heavy planking under the skid base should be used where the firmness of the soil Is doubtful Be sure to consider effects of rain when judging soil firmness. Be sure the radiator end faces with (not against) the prevailing winds.

(4) Leveling. The generator set should be sited on a level surface (within 5 degrees) It must not be out of level by more than 5 degrees (6 gradients).

(5) Exhaust Fumes If siting the generator set indoors, measures must be taken to vent exhaust fumes to the outside atmosphere If necessary, loosen screw and nut which secure the weather cap to the exhaust outlet and remove weather cap Install a gas-tight metal exhaust pipe from the exhaust outlet to the outside atmosphere. Keep the pipe as short as possible and with as few bends as possible The pipe should include a low point with means for draining condensation. Provide metal shields, 12 inches (305 mm) diameter larger than the exhaust pipe where pipe passes flammable walls Insulate pipe wherever danger of contact with personnel exists.

(6) Air Supply If siting the generator set Indoors, measures must be taken to ensure the generator set receives a maximum supply of fresh air If necessary, provide duct work, with an opening at least as large as the radiator, to the outside atmosphere. If louvers are used at the air entrance, increase duct work cross-sectional area by 50 percent.

(7) Emplacement After selecting site for generator set emplace, in accordance with lifting procedures in paragraph 4-3.

b. Grounding (General). Consult your local facility engineer on the grounding method to be used. Use two grounding rods on each set If grounding rods are used Use separate grounds for paralleled units. Steps c, d, and e, below, provide acceptable grounding methods. The generator set comes equipped with the following grounding equipment.

WARNING

Do not operate the generator set unless It has been properly grounded. Electrical faults (such as leakage paths) in the generator set, feeder lines, or load equipment can cause injury or death by electrocution.

(1) Three grounding rods. These are inside the engine compartment, clamp mounted to the right skid of the skid base.

(2) Two ground clamps. These are inside the tool box. The tool box Is In the generator compartment on the left hand side

(3) Two grounding cables These are coiled on the floor of the generator compartment.

c. Grounding to a Driven Metal Rod. Proceed in accordance with Figure 4-2
d. Grounding to a Buried Metal Plate A plate used with this method must have a minimum area of 9 square feet (0.8 square meter) The minimum depth of plate burial is 4 feet (1 2 meters). Proceed In accordance with Figure 4-3.
e. Grounding to an Underground Metallic Water Piping System. Proceed In accordance with Figure 4-4

NOTE
Muffler installation will require the services of two or more persons.

f. Muffler Installation The two mufflers are stored In the generator compartment during shipment. To Install mufflers for generator set operation proceed as follows'

(1) Remove muffler opening covers (Figure 4-1). Retain mounting hardware and exhaust roof gaskets

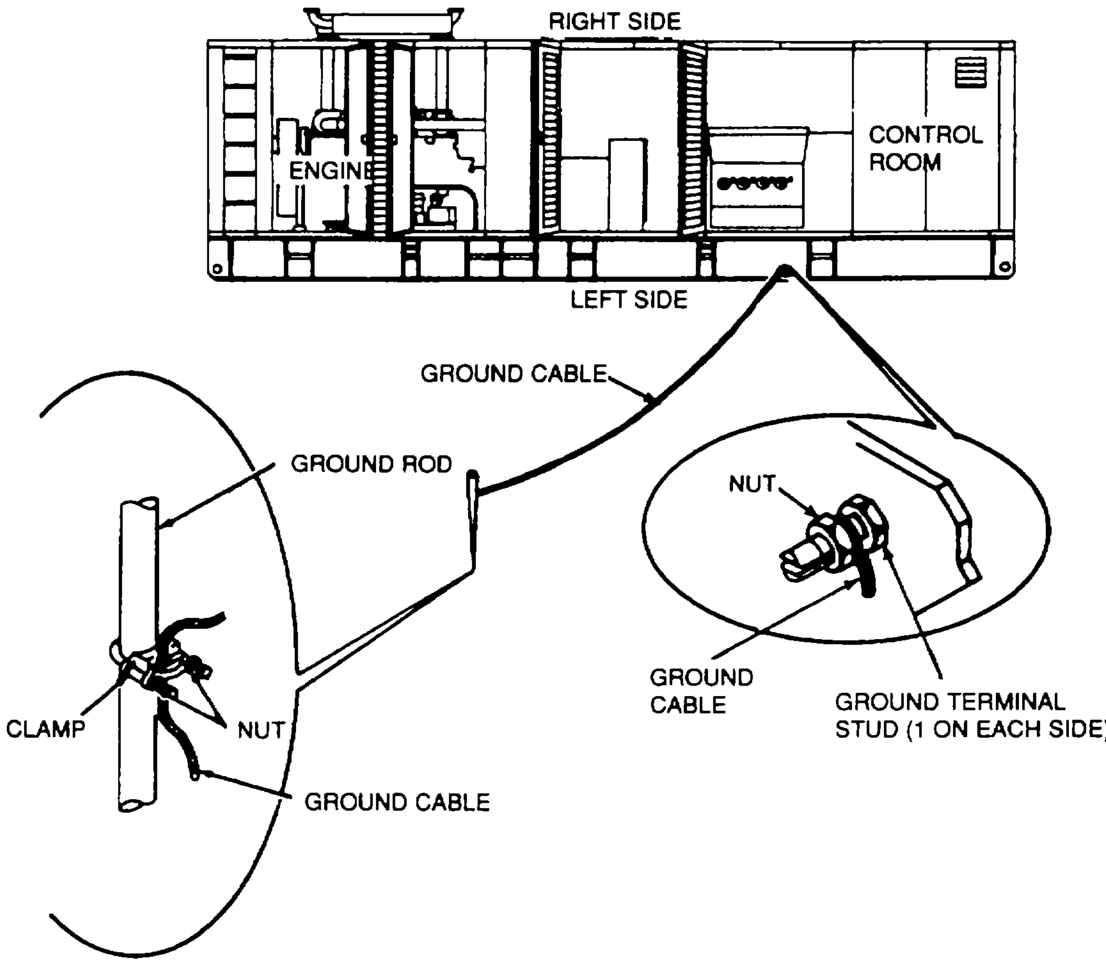
(2) Secure muffler opening covers to the air filters. See detail insert, Figure 4-5.

(3) Remove hexagon head cap screws (2), lock washers (3), and hexagonal nuts (4) to remove muffler assemblies from storage

(4) Remove screws (6) to remove angle (7). Store screws and angle in tool box

(5) See Figure 3-23. Remove muffler bands (7 and 8) from muffler (9) by removing hexagon head cap screws (4), lock washers (5), hexagonal nuts (6), and flat washers (16) Separate lower muffler band (7) from upper muffler band (8)

(6) Install lower muffler band (7) on roof Remove hexagon head cap screws (4) and lock washers (5) installed on roof band mounting holes for shipping and use same hardware to mount the lower muffler band (7) on roof.

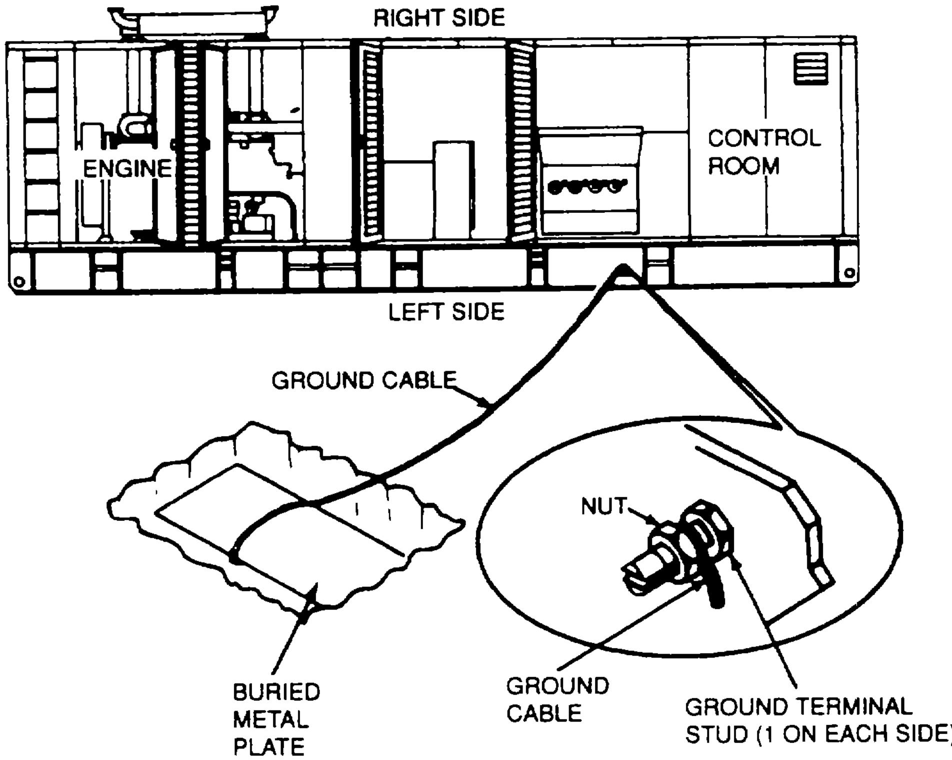


WARNING

DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. ELECTRICAL FAULTS (SUCH AS LEAKAGE PATHS) IN THE GENERA. TOR SET, FEEDER LINES OR LOAD EQUIPMENT CAN CAUSE INJURY OR DEATH BY ELECTROCUTION.

STEP 1 INSERT GROUND CABLES INTO SLOTS IN GROUND TERMINAL STUDS AND TIGHTEN NUT.
STEP 2 DRIVE GROUND RODS INTO GROUND UNTIL ROD PROTRUDES 6 INCHES (152mm) ABOVE SURFACE.
STEP 3 CONNECT CLAMP AND GROUND CABLE TO EXPOSED GROUND ROD AND SECURE BY TIGHTENING NUTS.

Figure 4-2. Grounding Generator set to a Driven Metal Rod

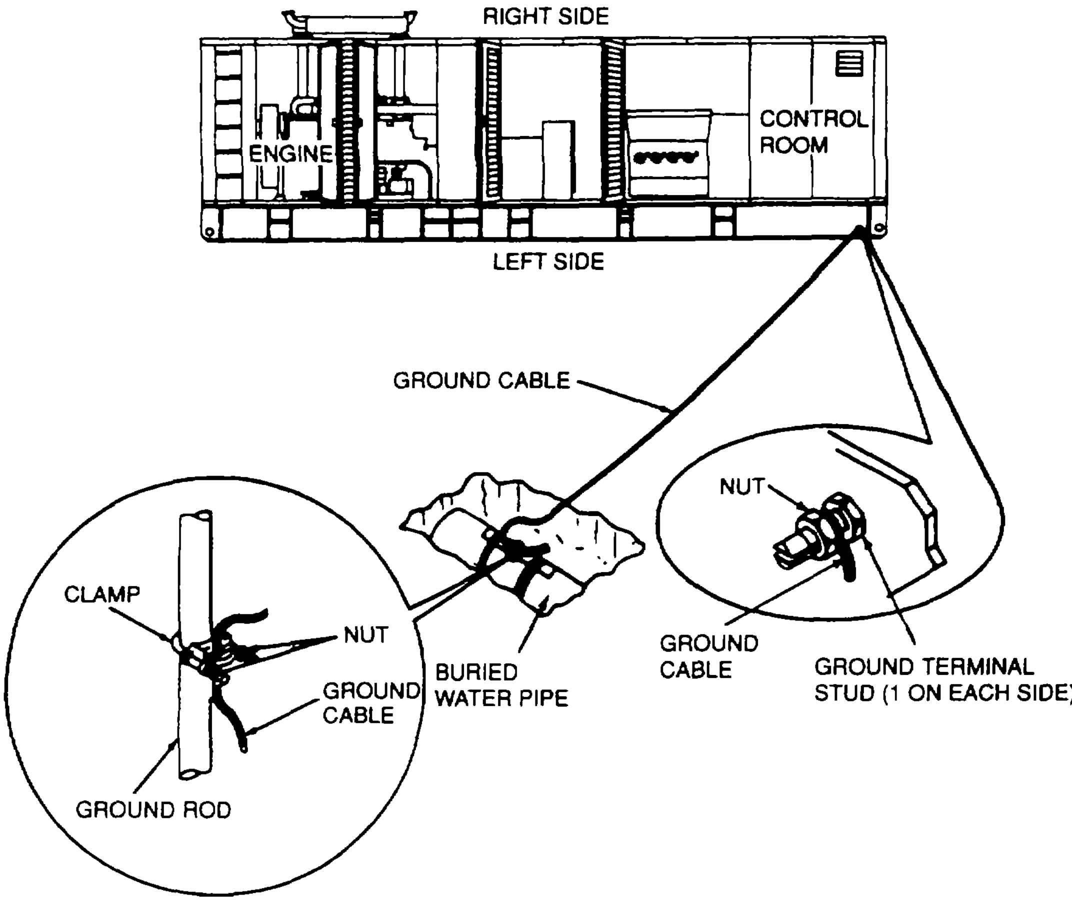


WARNING

DO NOT OPERATE THE GENERATOR SET UNLESS it HAS BEEN PROPERLY GROUNDED, ELECTRICAL FAULTS (SUCH AS LEAKAGE PATHS) IN THE GENERATOR SET, FEEDER LINES, OR LOAD EQUIPMENT CAN CAUSE INJURY OR DEATH BY E LECTROCUTION.

STEP 1. INSERT GROUND CABLES INTO SLOTS IN GROUND TERMINAL STUDS AND TIGHTEN NUTS.
STEP 2. PERFORM EXCAVATION AND BURY A METAL PLATE AS SHOWN.
STEP 3. ATTACH GROUND CABLE TO METAL PLATE AND CHECK THAT GOOD ELECTRICAL BOND IS ACHIEVED.

Figure 4-3. Grounding Generator Set to a Buried Metal Plate.



WARNING

DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED, ELECTRICAL FAULTS (SUCH AS LEAKAGE PATHS) IN THE GENERATOR SET, FEEDER LINES, OR LOAD EQUIPMENT CAN CAUSE INJURY OR DEATH BY E-LECTROCUTION .

STEP 1. INSERT GROUND CABLES INTO SLOTS IN GROUND TERMINAL STUDS AND TIGHTEN NUTS

STEP 2. PERFORM EXCAVATION TO EXPOSE WATER PIPE FOR AT LEAST 10 FEET (3 m) AS SHOWN AND CHECK THAT NC INSULATED SECTION APPEARS WITHIN THE 10 FEET (3 m) AREA IF INSULATED SECTIONS EXIST, PROCEDURE OF FIGURE 4-2 AND/OR 4-3 MUST BE PERFORMED.

STEP 3. ATTACH GROUND CABLE TO GROUND ROD USING GROUND ROD AND CLAMPS AS SHOWN, BY TIGHTENING THE NUTS ON CLAMP.

STEP 4. SECURE GROUND ROD) TO WATER PIPE AND CHECK THAT A GOOD ELECTRICAL BOND IS ACHIEVED.

Figure 4-4. Grounding Generator set to an Underground Metallic Water Piping System

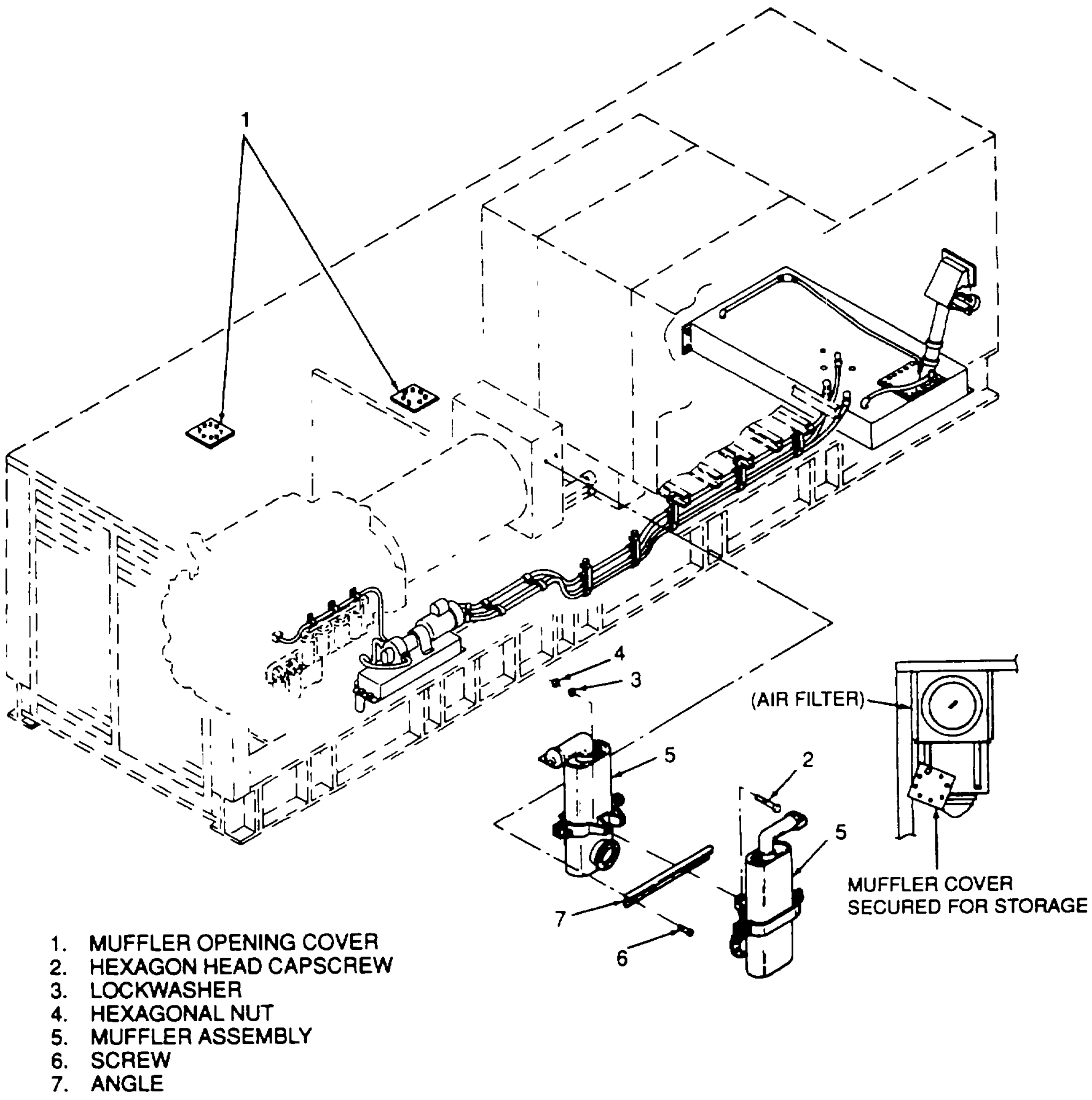


Figure 4-5. Muffler Storage Location

(7) Position exhaust gasket (10) removed In step (1), above, over muffler roof opening. Position exhaust muffler (9) flange over exhaust gasket (10) and muffler body over lower muffler band (7). Secure exhaust muffler (9) to roof at the gasket area using mounting hardware (4, 5, and 6) removed In step (1), above.

(8) Install upper muffler band (8) over exhaust muffler (9) and lower muffler band (7) Secure upper and lower muffler bands (7 and 8) using attaching hardware removed in step (5), above

(9) Loosen clamp (2) and rotate exhaust muffler elbow (3) to position the weather cap (1) facing upwards. Tighten the clamp (2) and check weather cap (1) for proper functioning

(10) Repeat steps (4) through (9), above, to Install the other muffler.

g. <u>Load Circuit Breaker CB101 and Main Disconnect Switch S120</u> Load circuit breaker CB101 and main disconnect switch S120 (Figure 4-6) are tied in series with the generator set output terminals and are equipped with a kirk-key interlock provision used to disable operation of both devices when maintenance is being performed. During set operation, the kirk-key Interlock prevents main disconnect switch S120 from being opened while load circuit breaker CB101 is closed, and also prevents load circuit breaker CB101 from being racked whenever main disconnect switch S120 Is opened.

The generator set Is shipped or transported with main disconnect switch S120 locked in CLOSED position and the kirk-key interlock key Installed on load circuit breaker CB101 For shipping purposes, load circuit breaker CB101 is secured in place with Integral shipping braces that must be removed and placed In storage position during set installation to allow breaker operation.

(1) Locate shipping braces (1), Figure 4-6 holding both sides of load circuit breaker CB101 (8) to the cabinet frame.

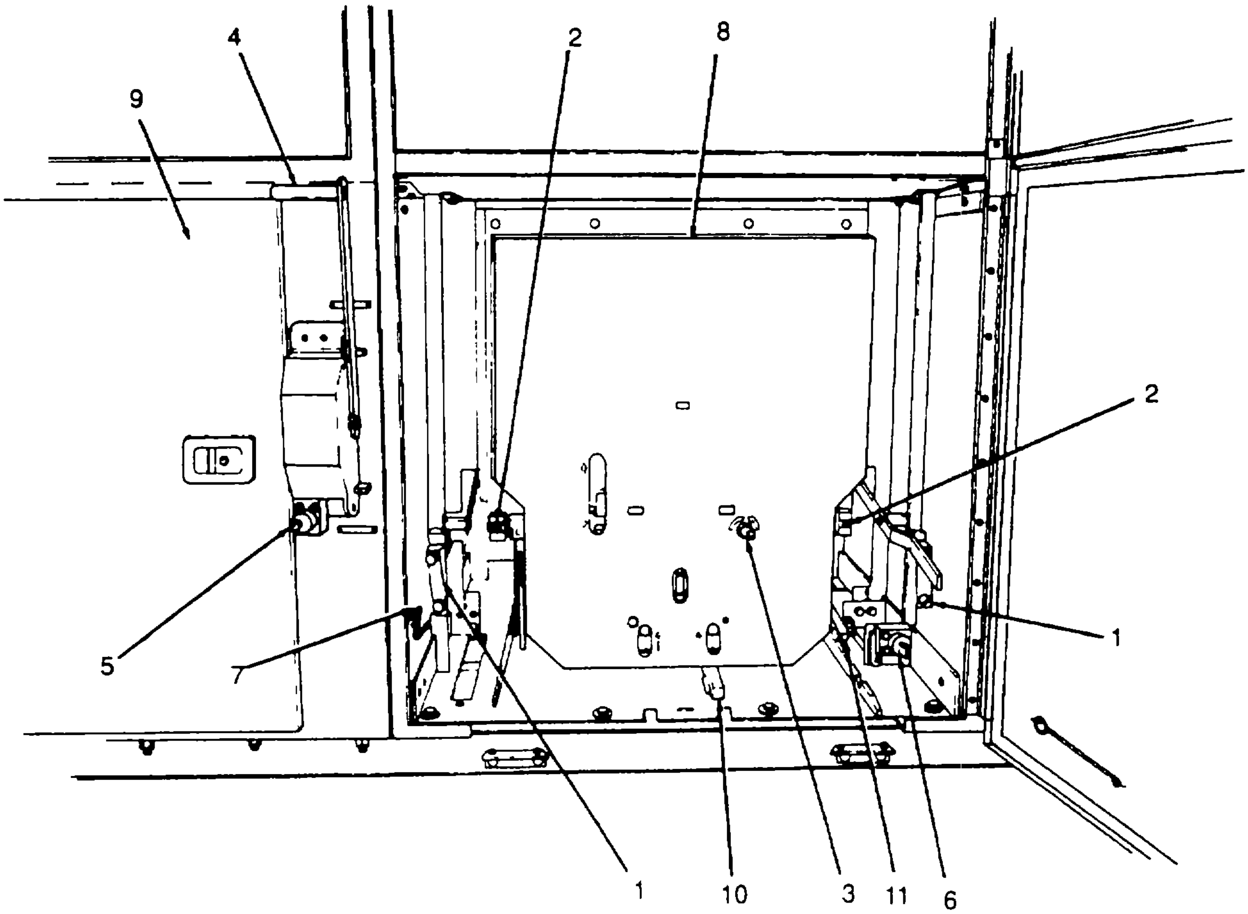
(2) Remove two long inner screws holding the shipping braces on both sides of the load circuit breaker CB101 (8) panel. Loosen the outer screws holding the shipping braces (1) to the cabinet frame enough so that the braces are freely swinging downwards vertical with the frame. With braces (1) aligned downwards with the cabinet frame, tighten screws on braces to prevent loss. Install and tighten the two long Inner screws on threaded mounts (2) at rear of circuit breaker frame to prevent loss.

(3) Locate racking handle (7) stowed at left side of load circuit breaker C8101 (8). With racking handle (7), turn the racking crank (3) counterclockwise until load circuit breaker CB101 (8) moves as far out as rt will go.

(4) Locate load circuit breaker CB101 kirk-key interlock (6). Turn the lock and remove the kirk-key interlock key.

(5) Open main disconnect switch S120 compartment door (9) With interlock key removed from load circuit breaker CB101, unlock the main disconnect switch kirk-key Interlock (5). Check main disconnect switch S120 operation by pulling switch handle (4) downwards to OPEN position Restore switch handle (4) upwards to CLOSED position Lock the main disconnect switch kirk-key Interlock (5) and remove key Close switch compartment door (9)

(6) Restore kirk-key Interlock key in load circuit breaker CB101 kirk-key interlock (6) and unlock. With racking handle (7), turn racking crank (3) clockwise until load circuit breaker CB101 (8) is all the way in. Remove racking handle (7) and restore In storage position at left of load circuit breaker CB101 (8)



1. SHIPPING BRACE (SHOWN IN STORAGE POSITION)
2 SCREW (SHOWN THREADED INTO LOAD CIRCUIT BREAKER)
3 RACKING CRANK
4 MAIN DISCONNECT SWITCH S120 HANDLE (SHOWN IN THE CLOSED POSITION)
5. MAIN DISCONNECT SWITCH S120 KIRK-KEY INTERLOCK
6. LOAD CIRCUIT BREAKER CB101 KIRK-KEY INTERLOCK
7. RACKING HANDLE
8. LOAD CIRCUIT BREAKER CB101
9. MAIN DISCONNECT SWITCH S120 COMPARTMENT
10. GUIDE RAIL
11. INTERLOCK

Figure 4-6. Main Disconnect Switch S120 and Load Circuit Breaker CB101 Lock-ups

h. 120/240/380 Connection Board TB103 (located in bottom of cabinet C as viewed from control room). TB103 is used when bringing In external utility power to operate the generator sets 120/240 V ac circuits. If available external power is 120/240 V ac, connection board TB103 Is used to directly connect utility power to generator set circuits. If, however, the available power Is 380 V ac, then connection board TB103 is used to connect utility power to utility station power transformer T103. Transformer T103 steps down and divides the voltage to provide 120/240 V ac to generator set circuits. Set connection board TB03 as follows:

CAUTION

Do not connect utility power cable to UTILITY POWER receptacle unless you are sure that connection board TB103 has been properly configured.

(1) Check setting of connection board TB103 (refer to Figure 4-7) If already set to match available power, go to step (6) below Otherwise, proceed as follows'

WARNING

Dangerous voltages may be present at connection board TB103. Death by electrocution may result if the following sequential steps are not strictly adhered to.

(2) Isolate connection board TB103 as follows:

(a) Remove utility power cable from UTILITY POWER receptacle J101 (see Figure 4-8) if installed.

(b) Set SET POWER circuit breaker CB124 (4, Figure 2-11) to OFF and UTILITY POWER circuit breaker CB125 (5) to OFF

(3) Refer to Figure 4-7 Remove hexagon head cap screws (1), lock washers (2), and flat washers (3) to remove TB103 shield (4).

(4) Set bus bars In accordance with Figure 4-7 for 120/240 V ac or 380 V ac, as required. To set a bus bar, proceed as follows:

(a) Remove hexagonal nuts (5) and lock washers (6) securing bus bars (7) to studs (8).

(b) Remove bus bars (7) from studs (8) and reinstall bus bars (7) as required for 120/240 or 380 V ac operation Refer to Figure 4-7, configuration "A" or configuration "B".

(c) Secure bus bars (7) to studs (8) with lock washers (6) and hexagonal nuts (5).

(5) Install TB103 shield (4) and secure with flat washers (3), lock washers (2), and hexagon head cap screws (1). Close cabinet C door.

(6) Interconnect generator set to utility power by connecting utility cable to utility power source and to UTILITY POWER receptacle J101 (see Figure 4-8).

(7) Operate circuit breaker locking beam (3, Figure 2-11) as necessary and set UTILITY POWER circuit breaker CB125 to ON

I. AC Lighting and Receptacle Circuits. If an external source of utility power is available and connected to the generator set In accordance with step h, above, then the AC lighting and receptacle circuits may be switched on. (If an external source of utility power is not available, the AC circuits can be activated only after generator set operation has started) Activate circuits as follows:

(1) Open door to distribution panel DP1

(2) See Figure 2-8. Set CB102 through CB108 to ON.

(3) Set CB109 to ON if control room fan operation is desired.

(4) Close door to distribution panel DP1.

NOTE

AC lights and receptacles are now operational. See Figure 2-11 for Illustration of typical ON/OFF light switch (6).

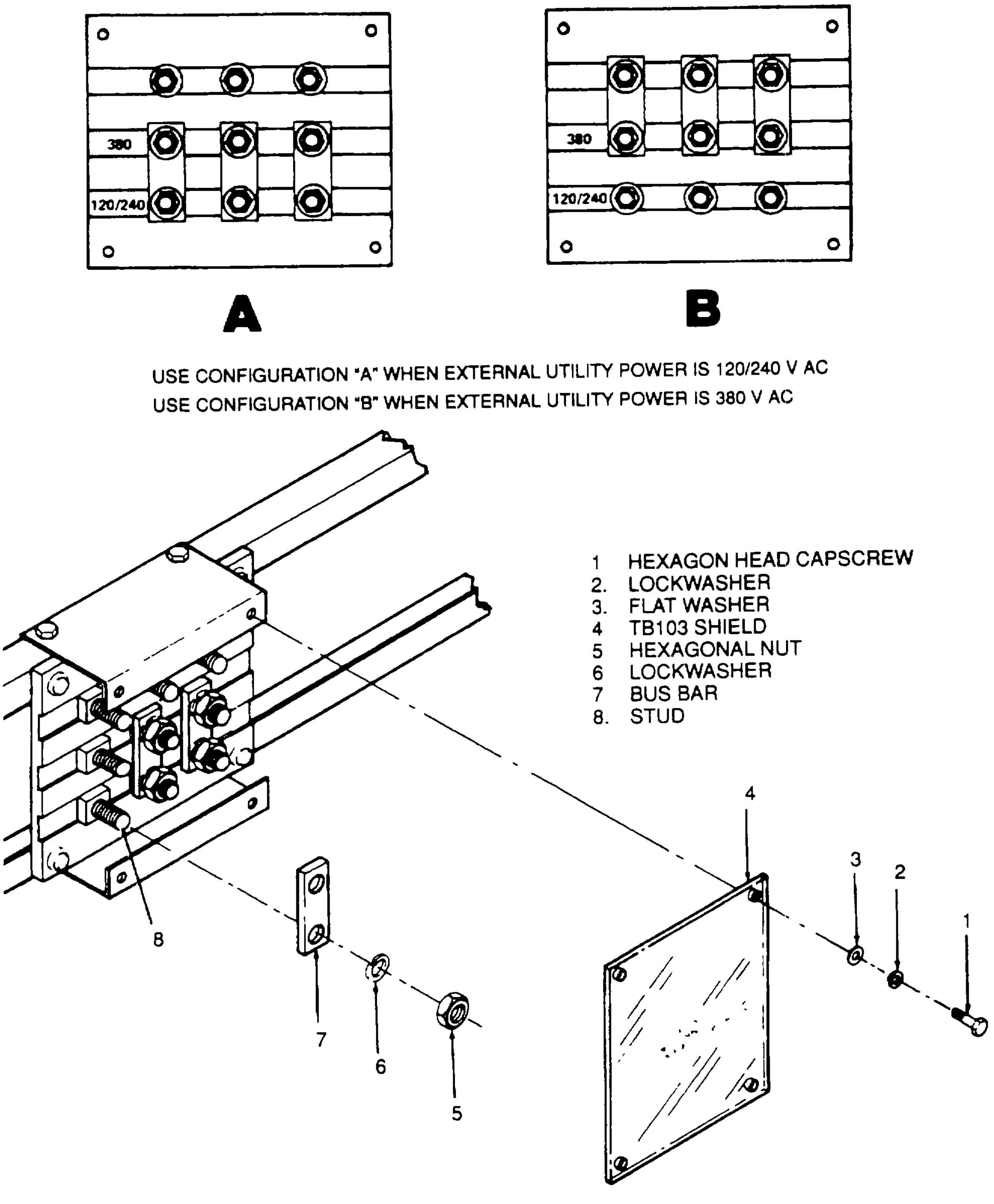


Figure 4-7. Connection Board TB103 Configurations.

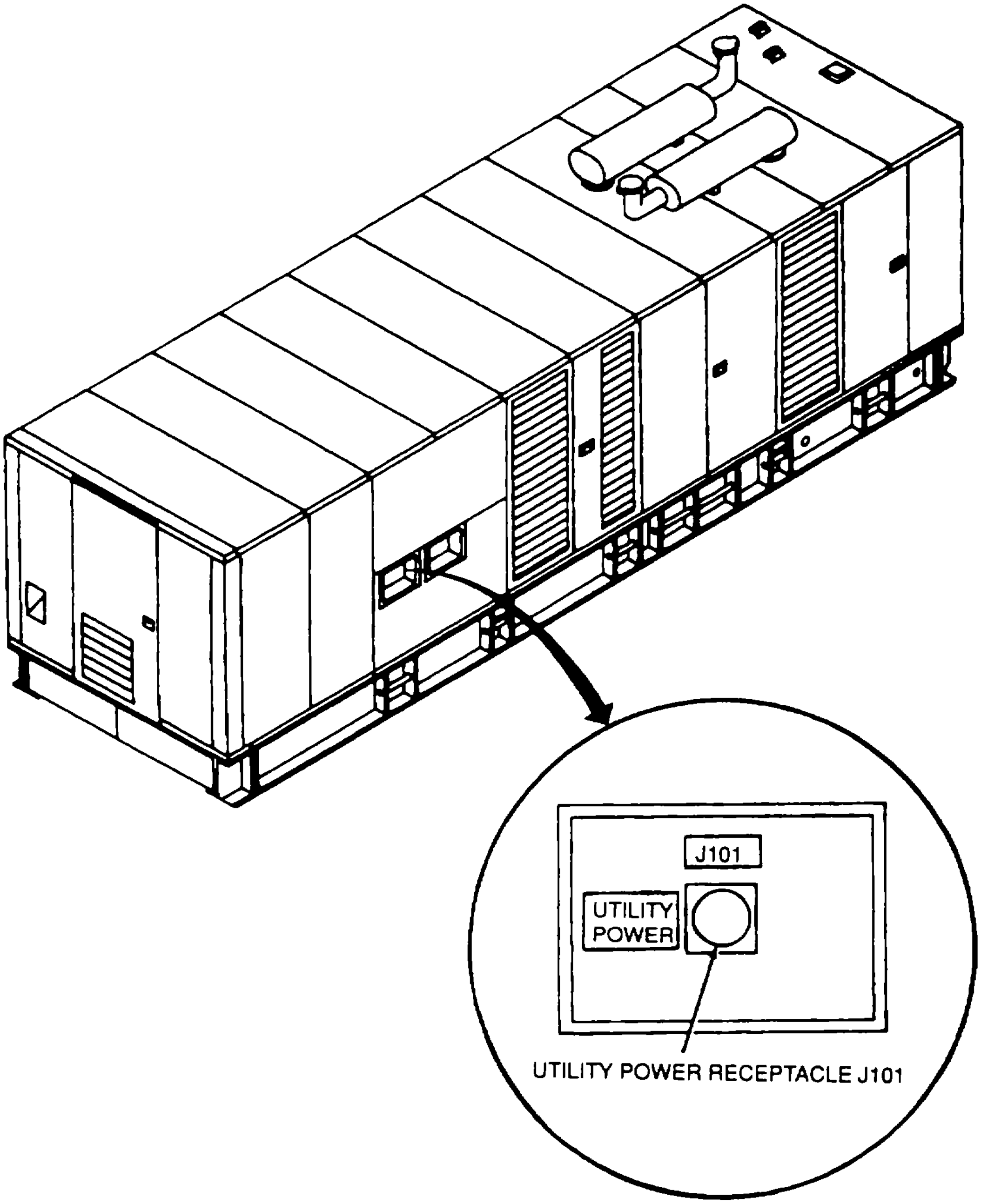


Figure 4-8.Utility Power Receptacle J101.

J. Depreservation and Initial Servicing.

(1) Remove polyethylene bag which covers entire unit. Do not discard serviceable bag.

NOTE

All keys for the unit will be collectively bagged and secured to the unit.

(2) The following openings are sealed for shipment. Remove the tape, plates, or plugs that seal these openings.

(a) Crankcase breathers
(b) Oil fill caps
(c) Ol level gage tube
(d) Exhaust outlets
(e) Air cleaner inlets

WARNING

To avoid accidental engine cranking or start up, set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE prior to servicing the generator set. Failure to comply with this warning could cause injury or death by electrocution.

(3) Batteries are normally shipped in a dry state Battery electrolyte must be requisitioned *separately.* See table 3-1 for quantity and electrolyte stock number To activate batteries, refer to paragraph 3-9, step a(4).

(4) Refer to the lubrication order (Figure 3-2 and paragraph 3-3) Add oil of correct type to engine crankcase. Fill crankcase to HI mark level on oil level gage.

(5) Prime the fuel system as follows:

WARNING

Fueling operations generate flammable, toxic fumes. Do not smoke during fueling operations and avoid breathing fumes. Failure to comply with this warning could result in loss of life.

(a) Refer to Figure 3-3 Spin-off fuel filters.
(b) Fill fuel filters with fuel. Refer to Table 3-1 for fuel type.
(c) Spin-on fuel filters until snug, then 1/2 turn more.

(6) Fill fuel tank (utility power available). If the generator set has been connected to a utility power source In accordance with step h, above, fill fuel tank as follows. Otherwise, fill fuel tank In accordance with step (7), below.

WARNING

Always connect grounding cable from fuel truck to skid ground. *This* will prevent the possibility of sparking caused by static electricity. Failure to comply with this warning could result in death or Injury of personnel.

Do not allow dirt to enter fuel pump or fuel suction line or equipment damage may occur.

(a) Using auxiliary fuel hose assembly, connect external fuel supply to the SUCTION FUEL TRANSFER fitting. (See Figure 1-1 for fitting and Figure 4-1 for stowage location of hose. Refer to Table 3-1 for quantity and type of fuel)

(b) Set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1) to OPERATION.
(c) Set 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 (2) to ON.

(d) Set FUEL PUMP switch S8 (4) to AUTO FUEL PUMP ENERGIZED Indicator DS107 (5) will light to indicate fuel transfer pump motor B102 Is operating and bringing fuel, via the auxiliary fuel hose, Into the fuel tank. The pump will continue to operate until FUEL LEVEL gage M4 (8) indicates F, at which time FUEL PUMP ENERGIZED Indicator DS107 (5) will go out.

NOTE

When using an external fuel supply, leave FUEL PUMP switch S8 (4) set to AUTO at all times. Fuel transfer pump motor B102 will then operate automatically to replenish fuel to the generator set fuel tank if generator set is connected to utility power, or If generator set is running

(7) Fill fuel tank (utility power unavailable). If utility power Is unavailable, the fuel tank must be filled initially via the fuel filler neck (see Figure 2-1) After the generator set is operating, SET POWER will be available and the automatic fuel transfer system can be actuated Proceed as follows

WARNING

Always connect grounding cable from fuel truck to skid ground. This will prevent the possibility of sparking caused by static electricity. Failure to comply with this warning could result in death or injury of personnel.

WARNING

Fueling operations generate flammable, toxic fumes. Do not smoke during fuel operations and avoid breathing fumes. Failure to comply with this warning could re- suit in loss of life.

(a) Set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1) to OPERATE
(b) Set 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 (2) to ON
(c) Remove fuel cap from filler neck (see Figure 1-2)
(d) Fill fuel tank until FUEL LEVEL gage M4 (8, Figure 2- 1) indicates F. Refer to Table 3-1 for quantity and type of fuel.
(e) Set MAINTENANCE LOCKOUT switch S100 (1) to MAINTENANCE.
(f) Set FUEL PUMP switch S8 (4) to AUTO.

CAUTION

Do not allow dirt to enter fuel pump or fuel suction line or equipment damage may occur.

(g) Using auxiliary fuel hose assembly, connect external fuel supply to the SUCTION FUEL TRANSFER fitting (see Figure 1-1 for fitting and Figure 4-1 for stowage location of hose. Refer to Table 3-1 for quantity and type of fuel).

(h) Operate circuit breaker locking beam (3, Figure 2-11) as necessary and set SET POWER circuit breaker CB124 to ON. The generator set is now configured so that the fuel transfer system will begin to operate as soon as the generator set begins operation When enough fuel has been consumed from the fuel tank, FUEL PUMP ENERGIZED indicator DS107 (5, Figure 2-1) will light to indicate fuel transfer pump B102 is operating and bringing fuel, via the auxiliary fuel hose, Into the fuel tank. The pump will continue to operate until FUEL LEVEL gage M4 (8) Indicates F, at which time FUEL PUMP ENERGIZED indicator DS107 (5) will go dark.

NOTE

When using an external fuel supply, leave FUEL PUMP switch S8 (4) set to AUTO at all times. Fuel transfer pump motor B102 will then operate automatically to replenish fuel to the generator set fuel tank If generator set Is connected to utility power, or if generator set is running.

(8) Install ether tank as follows

NOTE

Ether tank Is not shipped with the set and must be requisitioned separately, if required.

(a) See Figure 3-15. Open cylinder clamp (3).
(b) Install ether start tank (1) onto 24 V solenoid valve assembly L5 (7). Screw on ether tank until it seats.
(c) Close cylinder clamp (3).

(9) Fill radiator In accordance with paragraph 3-12

k. Operational Checkout.

(1) Set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1) to OPERATION.
(2) See Figure 2-7. Set CB117, CB120, CB121, CB122, CB112, CB113, CB116, and CB123 (See Figure 2-12) to ON Set all other DP2 circuit breakers to OFF

NOTE

If needed, set CB118 to ON to activate control room heaters. Adjust switches S108 and S109 (7, Figure 2-11) to comfort. If generator set is not connected to utility power, heaters will become activated after operation begins.

(3) Set humidistat (1, Figure 2-12) fully clockwise.
(4) If necessary, before starting engine In step (8), below, wait 6 hours (minimum) for oil and coolant heaters to heat engine oil and coolant

NOTE

Oil and coolant heaters will not operate if generator set is not connected to utility power In accordance with step h, above Engine may be started without oil and coolant heaters using starting aid.

(5) Use power cables to connect generator set to load.
(6) Perform before-operation preventive maintenance checks and services (PMCS) In accordance with Table 3-2.
(7) Open upper door of cabinet A Set FREQUENCY SEL SW S118 (8, Figure 2-3) for 50 or 60 Hz operation In accordance with Intended generator set application Close cabinet A door.
(8) Start and operate generator set in accordance with Figure 2-14.
(9) Be prepared to add coolant to radiator, as necessary, to obtain a steady level of coolant as Indicated by coolant level sight glass (see Figure 3-17) Add coolant as necessary

NOTE

LOW COOLANT LEVEL alarm will trip if coolant level falls too far Generator set will automatically shut down If coolant level falls too far.

(10) Proceed in accordance with the following as applicable.

(a) If FREQ ADJ rheostat (Figure 2-14) cannot be adjusted for FREQUENCY meter reading of 50 Hertz or 60 Hertz, as applicable, proceed as follows'

1 Set FREQ ADJ to mid-range.
2 Open upper cabinet B door.
3 See Figure 2-6 Adjust 50 CYC (8) or 60 CYC (7), as applicable on load sharing panel for FREQUENCY meter (Figure 2-14) reading of 58 to 62 Hz (for 60 Hz operation) or 48 to 52 Hz (for 50 Hz operation), as applicable
4 See Figure 2-6 If unable to obtain required FREQUENCY meter reading, adjust 50 CYC (8) or 60 CYC (7), as applicable, to mid-range, adjust FREQUENCY ADJUST (3) on load sharing panel, for FREQUENCY meter (Figure 2-14) reading anywhere on scale between pegs, then repeat step 3, above.
5 After meeting requirements of step 3, above, close upper cabinet B door and adjust FREQ ADJ rheostat (Figure 2-14) in accordance with Figure 2-14

(b) If VOLT ADJ rheostat (Figure 2-14) cannot be adjusted for AC KILOVOLTS reading of 4 16 kilovolts (for 60 Hz operation) or 3.8 kilovolts (for 50 Hz operation) proceed as follows:
1 Set VOLT ADJ rheostat (Figure 2-14) to mid-range
2 Open upper cabinet B door.
3 Open voltage regulator cover.
4 See Figure 2-10. Adjust RANGE ADJ (2) for an AC KILOVOLTS (Figure 2-14) reading of 4.16 kilovolts or 3 8 kilovolts, as applicable
5 If unable to obtain required AC KILOVOLTS (Figure 2-14) reading because of voltage fluctuation (hunting), check that stability selection links (1, Figure 2-10) are both set to SLOW and that STABILITY ADJ (3) Is set 1/8 turn back from full clockwise position Then repeat step 4, above
6 Close voltage regulator cover
7 Close upper cabinet B door.

(11) Perform the following sub-steps If generator set will be used In droop type parallel with other generator set(s). Otherwise, proceed to step (12), below.

NOTE

Power factor of load must be 0 8 power factor or this procedure Is Invalid. A dc voltmeter will be required

(a) Set PARALLEL SWITCH S6 (18, Figure 2-2) to PARALLEL
(b) Set FREQ DROOP/ISOCHRONOUS switch S117 (12) to FREQUENCY DROOP Install shorting plug in REACTIVE LOAD receptacle J21, J22, or J23 (see Figure 2-18).
(c) Set BREAKER CONTROL switch S4 (20, Figure 2-2) to CLOSE
(d) Check reading on POWER FACTOR meter M104 (9). Verify load has 0 8 power factor to 48 6 for 50 Hz operation If not, proceed as follows
1 Open upper cabinet B door
2 Refer to Figure 2-6 Adjust DROOP (4) on load sharing panel for a FREQUENCY meter (3, Figure 2-2) reading of 58 1 to 58 3 Hz for 60 Hz operation or 48.4 to 48.6 Hz for 50 Hz operation
3 Close upper cabinet B door.
(f) Set FREQ DROOP/ISOCHRONOUS switch S117 (12) to ISOCHRONOUS
(g) Remove shorting plug from REACTIVE LOAD receptacle J21, J22, or J23 (Figure 2-18).

(h) Measure dc voltage across pins A and B of GOVERNOR CONTROL receptacles J18, J19, or J20 (see Figure 2-18). Voltage should be 5.4 to 5 6 V dc If not, proceed as follows:

<u>1</u> Open upper cabinet B door.

<u>2</u> See Figure 2-6 Adjust LOAD SHARING SENSITIVITY (5) on the load sharing module to obtain a reading of 5.4 to 5.6 V dc across PARALLEL LINES terminals 10 and 11. These are on the terminal board across the bottom of the load sharing module

<u>3</u> Close upper cabinet B door.

(I) Set BREAKER CONTROL switch S4 (20, Figure 2-2) to TRIP

(12) Operate generator set until engine thermostats open and normal coolant temperatures can be obtained. Add additional coolant If necessary

(13) Allow generator set to operate at least 5 minutes at no load. Then shut down generator set in accordance with Figure 2-20

I. <u>Final Notes</u>.

(1) Leave generator set connected to utility power at all times, if possible. If not possible, set UTILITY POWER circuit breaker CB125 (5, Figure 2-11) to OFF, operate circuit breaker locking beam (3), and set SET POWER circuit breaker CB124 (4) to ON.

(2) Leave EMERGENCY LIGHTING switch CB CB2 (17, Figure 2-1) on at all times Emergency lights will automatically shut off in presence of set or utility power.

(3) Leave generator heaters and engine coolant and oil heaters on at all times The heaters will automatically shut off when the generator set is running.

SECTION II. MOVEMENT TO A NEW WORK SITE

4-3. DISMANTLING FOR MOVEMENT. Shut down generator set in accordance with Figure 2-15 (single set) or Figure 2-20 (parallel), then proceed as follows

a. <u>Load Circuit Breaker CB101 and Main Disconnect Switch S120</u>. The generator set Is shipped with main disconnect switch S120 locked in CLOSED position and the kirk-key interlock key Installed on load circuit breaker CB101. For shipment purposes, load circuit breaker C8101 Is held In place using integral shipping braces that are *installed as* follows ;

(1) Open lower cabinet B door (Figure 4-6) Remove shipping screws (2) Installed on threaded mounts on both sides of the circuit breaker frame

(2) Loosen mounting screws holding shipping braces (1) Rotate shipping braces 90 degrees upwards and towards center of compartment

(3) With racking handle (7), turn racking crank (3) counterclockwise until load circuit breaker CB101 (8) frame is flush against shipping braces (1). Position braces (1) so that mounting holes on load circuit breaker CB101 (8) frame and braces are exactly aligned. Then tighten screws holding braces against cabinet frame.

(4) Install shipping screws (2) removed from threaded mounts on braces (1) against load circuit breaker CB101 (8) frame and tighten.

b. <u>Disconnection of Cables Harnesses and Hoses</u>

WARNING

Never remove power cables by hand unless generator set Is off and power cables are not connected to a live voltage source. Never touch a high-voltage lead or terminal until it has been discharged to ground. Failure to observe this warning may result in death by electrocution.

(1) Be sure generator set power cables are not connected to a live source of voltage. Discharge cables to ground if connected to transformers, high-voltage windings, or capacitors Use an insulated rod with grounded metal tip

(2) Disconnect power cables Coil and stow cables on floor In generator compartment See Figure 4-1

(3) Be sure utility power cable is not connected to a live source of voltage. Furthermore, discharge cables to ground if connected to transformers, high voltage windings, or capacitors Use an insulated rod with grounded metal tip.

(4) Disconnect utility power cable. Coil and stow cable on floor in generator compartment. See Figure 4-1.

(5) Disconnect reactive load cable, governor control cable, remote control cable, and/or site requirement module cable, as applicable, if connected to generator set. Coil and stow cables on floor In generator compartment See Figure 4-1.

WARNING

Fuel operations generate flammable, toxic fumes. Do not smoke during fueling operations and avoid breathing fumes. Failure to comply with this warning could result in loss of life.

(6) Disconnect auxiliary fuel hose from fuel source and from generator set. Drain fuel from hose into auxiliary fuel source, then coil hose and stow In engine compartment See Figure 4-1.

(7) When required for commercial shipment, remove batteries from generator set in accordance with paragraph 3-9.

(8) Remove ground connection from generator set. Stow grounding rods and secure with ground rod mounting clamps (See Figure 4-1) Stow ground clamps In tool box. Coil ground cable and stow on floor In generator compartment.

c. Fuel. Coolant. and Oil Drainage. The generator set may be safely shipped "wet" with fuel, oils and coolant at maximum capacities or less Draining generator set liquids Is not required unless Federal, state, or local regulations prohibit "wet" shipment. Refer to paragraph 3-12 for draining procedures Refer to Figure 1-1 through Figure 1-4 for drain caps, fittings, and valves Refer to Table 1-1 for liquid capacities.

d. Removal of Lifting Attachment Kit (Figure 4-1)

(1) Remove leg assemblies from beneath generator assembly.

WARNING

Red core yams in lifting attachment kit webbing indicate unsafe webbing. Webbing is not safe for lifting generator set If red yam is visible at any point. Under no circumstances should generator set be lifted using webbing with visible safety indicator strand. Failure to observe this warning may result in loss of life, lifting attachment kit failure, and destruction of generator set.

(2) Carefully Inspect webbing In leg assemblies. Look for red core yarns at any point over entire length of webbings. Do not use leg assemblies if red core yarns show. In some cases webbing may be dirty, making inspection difficult. Inspect carefully

(3) Remove hexagon head bolts, hexagonal nuts, and lock washers securing spreader bars to spreader bar stowage angles.

(4) Remove spreader bars. Retain hexagon head bolts, hexagonal nuts, and lock washers by installing back onto stowage angles.

e. Muffler Stowage.
  (1) Remove mufflers from roof of generator set In accordance with paragraph 3-15.
  (2) See Figure 4-5. Remove muffler opening covers (1) from air filters. Install muffler opening covers over holes In roof and secure with muffler hardware.
  (3) Remove angle (7) from tool box and secure to conduit box with screws (6).
  (4) Install muffler assemblies (5) in generator compartment and secure to angle (7) with hexagon head cap screws (2), lock washers (3), and hexagonal nuts (4).

f. Assemble Lifting Attachment Kit.
  (1) Refer to Figure 4-9 Assemble lifting attachment kit as follows:
    (a) Connect together male and female (1 and 2) elements of spreader bars and secure with quick release pins 3.
    (b) Remove cotter pins (4) Remove anchor pins (5) from shackles (6).
    (c) Hook shackles (6) through eyes of leg assemblies (7). Using anchor pins (5), pin shackles (6) to spreader bar assemblies (8) Assure that leg assemblies (7) are not twisted Install cotter pins (4).
    (d) Connect leg assemblies with hooks (12) to spreader bar assemblies (8) in same manner as above.

g. Lift (Generator Set.

WARNING

Do not use a crane with a lifting capacity of less than 45,000 pounds (20,400 kg). Do not allow generator set to swing while it is suspended. Personnel shall not stand beneath the generator set as it is being lifted. Failure to observe this warning may result in serious injury or death to personnel.

  (1) Hoist the lifting attachment kit over the top of the generator set. Lower the lifting attachment kit enough to hook It onto the generator set skid base in four places In accordance with Figure 4-10.

  (2) Attach guide lines to the generator set, as required Attach at least two lines, on opposite sides, and at opposite ends

  (3) Position vehicle, as required, to receive the generator set

  (4) Lift generator set and position onto vehicle

  (5) After generator set is positioned on vehicle, disconnect hooks (4, Figure 4-10) Hoist lifting attachment kit clear of the generator set and lower kit to ground

h. Disassemble Lifting Kit, (Figure 4-9)
  (1) Remove cotter pins (4) and anchor pins (5) to remove shackles (6) from spreader bar assemblies (8)

  (2) Unhook shackles (6) from eyes of leg assemblies (7) Reinstall shackles (6) on spreader bar assemblies (8) and secure with anchor pins (5) and cotter pins (4).

  (3) Remove cotter pins (4) and anchor pins (5) to remove shackles (6) securing leg assemblies with hooks (12) to spreader bar assemblies (8) Leave shackles (6) hooked through eyes of leg assemblies with hooks (12) and reinstall cotter pins (9)
  (4) Remove quick release pins (3) and separate spreader bar assemblies into male and female elements (1 and 2)

  (5) Inspect webbing of leg assemblies for any evidence of damage If soiled, clean thoroughly using water and detergent.

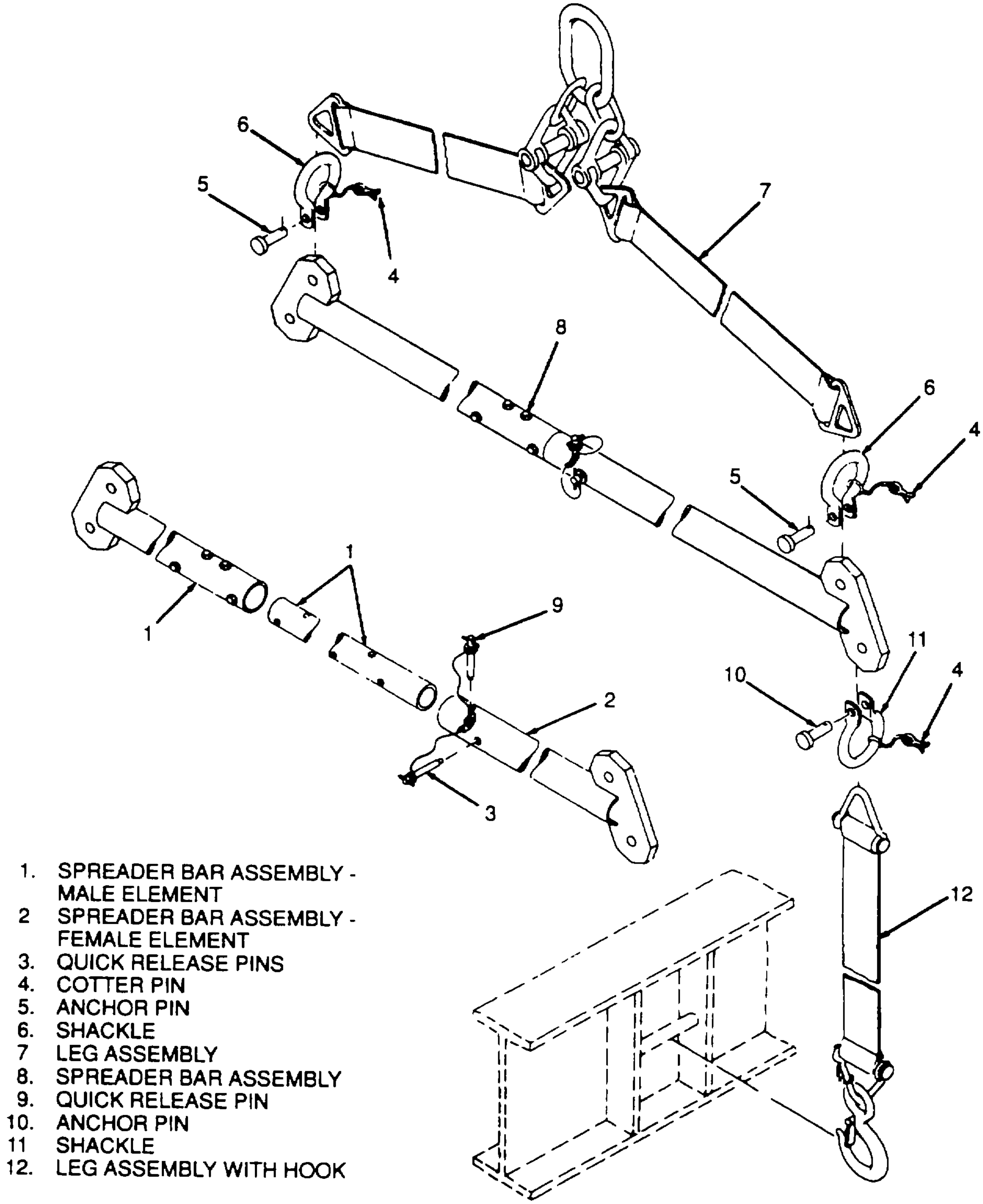


Figure 4-9. Lifting Attachment Kit

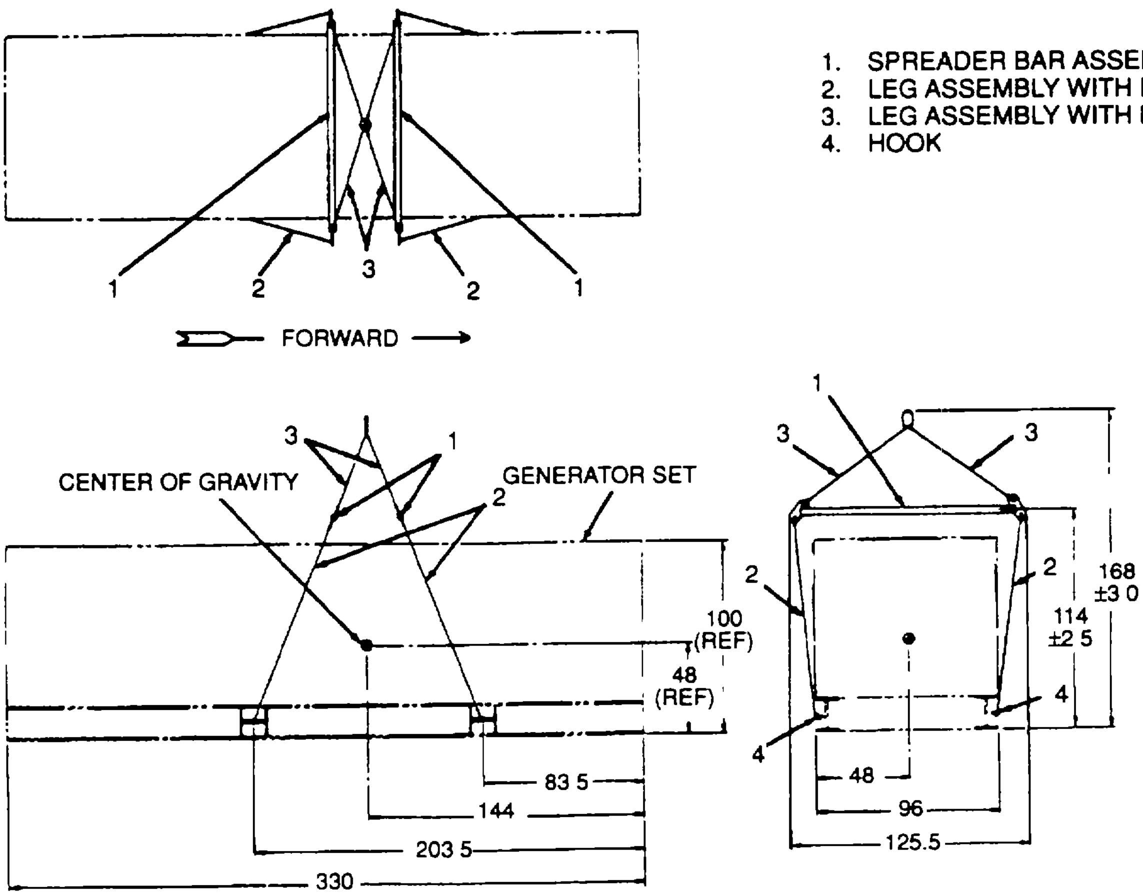


Figure 4-10. Rigging Lifting Attachment Kit to Lift Generator Set

CAUTION

Prolonged exposure of leg angles assemblies to ultraviolet rays will shorten service life of lifting attachment kit. Keep leg assemblies out of direct sunlight when not In use.

(6) Store leg assemblies In a sheltered area.
(7) Remove hexagon head bolts, hexagonal nuts, and lock washers from spreader bar stowage angles. Install spreader bar members under cabinet A and secure to spreader bar stowage angles. Refer to Figure 4-1.
(8) Close and secure generator set doors.

i. Transporting Generator Set. Assure that generator set Is securely tied to platform of vehicle. Use all skid base tie downs, if possible.

j. Unloading Generator Set. Select a site in accordance with paragraph 4-2, and proceed as follows:
(1) Assemble lifting kit in accordance with step f, above.
(2) Lift generator set in accordance with step g, above, and set generator set down onto selected site.
(3) Disassemble lifting kit in accordance with step h, above

4-4. REINSTALLATION AFTER MOVEMENT. Refer to Section I of this chapter.

SECTION III. REPAIR PARTS: SPECIAL TOOLS; MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE); AND SPECIAL SUPPORT EQUIPMENT

4-5. TOOLS AND EQUIPMENT. Special tools and equipment required by unit maintenance personnel for maintenance of the generator set are listed In Table 4-1 Refer also to the unit (Direct and General Support) and Depot Maintenance Repair Parts and Special Tools List; TM 9-6115-604-24P.

4-6. MAINTENANCE REPAIR PARTS. Repair parts and special tools are listed and Illustrated In the Organizational, Intermediate (Field) (Direct and General Support) and Depot Maintenance Repair Parts and Special Tools List; TM 5-6115-604-24P.

Table 4-1. Special Tools and Equipment

ITEM	NSN OR REFERENCE NUMBER	FIG. NO.	PARA NO.	USE
Multimeter	6622-00-495-3513	Figure 4-26	4-20	Used for continuity test
Circuit Breaker Tester	MSIA (0426)		4-28	Test circuit breaker
Ammeter	6625-00-892-1497	Figure 4-29	4-28	Checks schematic current draw
Voltmeter	M-45 (94075)		4-32	Checks schematic voltage
Radiator Tester 15 psi	SUT262 (90191)		4-55	Test radiator
Tester, Antifreeze	6630-00-105-1418		3-12	Test antifreeze
Thermometer	A378 (41258)		4-24	Test switch
Adapter, Torque Wrench	ST-669 (15434)	Figure 4-59	3-14	Holds adjusting screw in place
Megohmmeter	6625-00-643-1030		4-43	
Dial Indicator	CM200 (90191)	Figure 4-56	3-14	Used to set injector timing
Rocker Lever Actuator	3375010 (15434)	Figure 4-57	3-14	Used to check Injector plunger travel
Spanner, Adjustable, 3 Inch (76 2 mm)	383 (96645)		4-30	Repair of fuel tank

SECTION IV. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

4-7. GENERAL.

a. To ensure that the generator set Is ready for operation at all times, It must be Inspected systematically so defects may be discovered and corrected before they result in serious damage or failure. Defects discovered during operation of the unit, such as minor oil leaks or burnt out lights, should be noted for future correction Stop operation Immediately if a deficiency, such as abnormal noises, excessive vibration, fuel leaks, or smoke is noted which would indicate equipment damage All deficiencies and shortcomings will be recorded together with the corrective action taken on the applicable form Air Force users should refer to the applicable Inspection manuals and work card sets In TO 35C2-3 Series for periodic requirements and Table 4-2 for detailed procedures. Marine Corps users should refer to the current issue of TM 11275-15/1. Army users should refer to TM 48-750. Navy users should refer to their service peculiar directives to determine applicable maintenance forms and records to be used. When the generator set is being operated continuously In dusty or sandy areas, the lubricating oil filters must be serviced more frequently.

b. (A. N. MC) Preventive Maintenance Checks and Services. Table 4-2 contains a tabulated listing of preventive maintenance checks and services which will be performed by unit maintenance personnel at weekly, monthly, semi-annual, and operating hours intervals. Refer to Table 3-2 for Operator PMCS.

Table 4-2. Unit Preventive Maintenance Checks and Services

Item No	Location Interval	Item to Check/ Service	Procedure	Not Fully Mission Capable If:
1	Weekly	Coolant Heaters	Check for proper operation In accordance with paragraph 4-63	
2	Weekly	Oil Heaters	Check for proper operation in accordance with paragraph 4-72	
3	Weekly	Lighting Arresters	Inspect for signs of burns, cracked insulators, and loose connections In accordance with paragraph 4-38	
4	Weekly	Load Terminals	Inspect for damage and loose connection In accordance with paragraph 4-43	
5	Weekly	Fuel Manifolds	Inspect fuel manifolds for leaks In accordance with paragraph 4-54	
6	Weekly	Electronic Speed Control	Inspect for signs of damage in accordance with paragraph 4-51	
7	Weekly	Water Manifolds	Inspect for leaks In accordance with paragraph 4-85	

SECTION V. TROUBLESHOOTING

4-8. GENERAL

a. Table 4-3 contains troubleshooting information for locating and correcting operating troubles which may develop in the generator set Each malfunction for an individual component unit, or system, is followed by a list of tests or inspections which will help you to determine probable cause and corrective actions to take Perform the tests, inspections, and corrective actions In the order listed

b. Troubleshoot In accordance with Table 3-3 before using Table 4-3. Use Table 4-3 only if the operator inspections, test, and corrective actions fall to restore the generator set to an operational condition

c This manual cannot list all malfunctions that may occur, nor all tests or Inspections and corrective actions If a malfunction cannot be corrected by listed corrective actions, notify your supervisor

Table 4-3. Unit Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. ENGINE FAILS TO CRANK.

Step 1. Check annunciator panel for lit OVERSPEED indicator.
If OVERSPEED Indicator is lit, reset OVERSPEED indicator on annunciator panel, reset speed switch SS1/SS2/SS3, and relatch air control valves.

Step 2. Check for 24 V dc at starter solenoids.
If 24 V dc is not present, check wiring (refer to FO-1)
If 24 V dc is present, replace starter relays.

Step 3. Bar over engine and If It turns freely, check starter motor amperage draw Refer to paragraph 4-33.
Replace starter motors If amperage draw exceeds 120 amperes

Step 4. Check for proper operation of starter motors.
Replace starter motors If defective

2. ENGINE CRANKS BUT WILL NOT START.

Step 1. Check fuel solenoid valve and fuel filters.
Check power to fuel solenoid valve on Injection pump and check for plugged fuel filters.
Replace plugged fuel filters.

Step 2. Check emergency manual fuel shut off valve.
Make sure that the push/pull emergency control is pushed In.

Step 3. Check air supply to engine.
Remove obstructions Replace clogged filters. Check that air control valves are open.

Step 4. Step 4 Check starter motor current draw. Refer to paragraph 4-33.
Replace starter if defective.

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. ENGINE SHUTS DOWN SOON AFTER STARTING.

Step 1. Check OVERSPEED indicator.

Reset OVERSPEED indicator on annunciator panel reset speed switch SS1/SS2/SS3, and relatch air control valves.

Step 2. Adjust FREQ ADJ rheostat R102 to minimize and attempt to restart.

If engine overspeeds, test, adjust, or replace speed switch SS1/SS2/SS3 as necessary.

4. ENGINE SHUTS DOWN AND WILL NOT RESTART.

Check safety circuits associated with shutdowns only low oil pressure switch, high coolant temperature switch, coolant level switch, low fuel level, and speed switch.

Replace defective switches.

5. ENGINE RUNS ERRATICALLY OR MISFIRES.

Step 1. Check all fuel lines for bends, breaks, or loose fittings.

Repair or replace.

Step 2. Check air inlet filters and pipes.

Clear obstructions and/or replace filters as necessary. Check that air control valves are open

Step 3. Check turbochargers for dirt. Make sure turbocharger wheels turn freely

Replace If dirty

Step 4. Check fuel quality Drain a sample from the fuel tank into a clear container

Change fuel if cloudy. If fuel has water in it, change all filters

Step 5. Check valve lash and injector travel

Set valves and Injectors according to specifications. Refer to paragraph 4-81.

6. ENGINE EXHAUST EXCESSIVELY BLACK.

Step 1. Check engine fuel return line for obstruction

Correct as necessary.

Step 2. Check air intake system for obstructions or defective turbochargers.

Clear obstructions and replace defective components as necessary.

Step 3. Check for restricted fuel return lines or blocked fuel line vent.

Clear obstructions as required.

Step 4. Check air control valves.

Reset air control valves.

Step 5. Weather and altitude affect engine performance. If being operated In hot weather or at high altitude, engine may be overloaded

Reduce load as required.

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. ENGINE EXHAUST EXCESSIVELY BLACK (CONTINUED).

Step 6. Check turbochargers for proper operation.
Replace turbochargers.

Step 7. Check valve adjustment and Injector timing.
Adjust valves and/or Injector timing as necessary Refer to paragraph 4-81.

7. ENGINE EXHAUST WHITE OR BLUE.

Step 1. If problem occurs after an ether start, check ether Installation for defects resulting an applications of excessive ether to engine.
Repair as necessary.

Step 2..Low coolant temperature may be the problem.
Adjust radiator shutters.

Step 3. Check for faulty (stuck open) thermostat.
Replace.

Step 4. Check turbocharger seals.
Replace a defective turbocharger.

8. GENERATOR OUTPUT FREQUENCYNOLTAGE CANNOT BE MAINTAINED.

Perform an operational checkout in accordance with paragraph 4-2, step k
Adjust circuits as specified.

9. LOW POWER OR LOSS OF POWER.

Step 1. Perform all tests and Inspections listed for malfunctions 5 through 7, above.
Correct as specified.

Step 2. Oil level may be too high Check
Drain excess oil.

10. ENGINE CANNOT REACH GOVERNED RPM.

Step 1. Load sharing panel A104 may be set too low.
Perform operational checkout, paragraph 4-2, step k.

Step 2. Check fuel quality. Drain a sample from the fuel tank into a clear container.
Change fuel If cloudy If fuel has water in it, change fuel filters.

Step 3. Check for cracked or broken fuel lines.
Replace damaged fuel lines as necessary.

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

11. EXCESSIVE FUEL CONSUMPTION.

Step 1. Check air intake for blockage Check turbochargers for proper operation.
Clear obstructions, service air filters, or replace turbochargers as required.

Step 2. Check for plugged muffler or bends or obstruction In piping causing high exhaust back-pressure.
Repair or replace as necessary.

Step 3. Check for restricted fuel return lines, or fuel leaks.
Correct as necessary

Step 4. Check for high oil level.
Drain excess oil.

Step 5. Check Intake and exhaust valves, rocker arms, and crossheads for correct adjustment.
Adjust as necessary.

12. EXCESSIVE OIL CONSUMPTION.

Step 1. Check for external oil leaks.
Tighten all oil connections

Step 2. Check grade of oil being used against weather conditions that unit is being operated In.
Replace oil with proper grade.

Step 3. Check turbocharger crossover and exhaust casing for wetness
If wet, turbocharger is defective. Replace.

Step 4. Check engine crankcase breathers for obstructions
Clear any obstructions from breathers.

13. CRANKCASE SLUDGE.

Step 1. Check fuel quality.
Use only specified fuel.

Step 2. Check oil filter for dirt.
Replace filter. Check for leaks where dirt can enter engine and repair as necessary.

Step 3. Test thermostats for proper operation. Refer to paragraph 4-59.
Replace

Step 4**.** Change oil filters more often and observe oil temperature closely

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

14. OIL DILUTION (CRANKCASE).

Step 1. Check for proper coolant level and evidence of leaks.
Repair as necessary.

Step 2. Check for low coolant temperature during operation If low, check thermostats for proper operation.
Replace defective thermostats.

15. LOW **OIL PRESSURE.**

Step 1. Check crankcase oil level. If low or empty, Inspect for leaks.
Repair leaks. Add oil to crankcase.

Step 2. Check all lines, connections, and gaskets for external oil leaks
Repair as necessary.

Step 3. Check oil grade.
Use proper grade for weather conditions.

Step 4. Check for by-pass filter restriction. Check size of orifice
Replace filter.
Change orifice if incorrect.

Step 5. Check for defective gages and sender.
Replace if defective.

16. COOLANT TEMPERATURE TOO LOW.

Step 1. Check louvers for proper adjustment.
Close louvers to adjust for cool ambient air.

Step 2. Test engine coolant thermostat for proper operation. Refer to paragraph 4-59.
Replace if defective or of improper heat range.

Step 3 Check for defective gage and sender.
Replace If defective.

17. COOLANT TEMPERATURE TOO HIGH.

Step 1. Check coolant level. Check radiator
Fill to proper level. Clean radiator Flush coolant system Replace coolant

Step 2. Test engine coolant thermostat. Refer to paragraph 4-59.
Replace If defective.

Step 3. Check water pump operation.
Replace **If** defective

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

17. COOLANT TEMPERATURE TOO HIGH (CONTINUED).

Step 4. Check for external leaks or air in system. Check all hoses, connections, gaskets, and pressure cap.
Repair or replace as necessary.

Step 5. Check radiator louver position.
Open all radiator louvers to increase air flow.

Step 6. Check crankcase oil level and grade.
Add oil if low. Use proper grade for weather conditions.

Step 7. Check for defective gage and sender.
Replace If defective.

18. OIL TEMPERATURE TOO HIGH.

Step 1. Check oil level.
If low, check for leaks and add oil. If high, drain excess oil.

Step 2. Troubleshoot in accordance with MALFUNCTION 14, above.

Step 3. Excessive load on engine.
Reduce load.

Step 4, Check for defective gage and sender
Replace If defective.

19. FUEL KNOCKS (COMBUSTION NOISE).

Step 1. Check for possible improper use of starting aid.
Use starting aid properly.

Step 2. Check fuel quality.
Use only specified fuel.

Step 3. Check fuel lines for breaks and inspect all fuel connections for air leaks.
Repair as necessary.

Step 4. Check for low coolant temperature.
See MALFUNCTION **16,** above.

Step 5. Check for engine overload.
Reduce load.

Step 6. Check valve adjustment or Injector timing. Refer to paragraph 4-81.
Adjust valves and injector timing.

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

20. EXCESSIVE OIL PRESSURE.

Step 1. Check for defective oil pressure gage and sender
Replace if defective.

Step 2. Check for proper lubricant.
Use proper grade for weather conditions.

Step 3. Low oil temperature.
Check for proper operation of lube oil heater and thermostat. Replace as necessary. Refer to paragraph 4-72..

21. FUEL TRANSFER PUMP NOT WORKING.

Step 1. Check availability of AC power.
Set UTILITY power circuit breaker C8125 or SET STATION POWER circuit breaker CB124, as applicable, to ON. Check that CB121 is set to ON.

Step 2. Check power to terminals T1 and T2 of fuel transfer pump motor B102.
If unavailable, check and repair wiring between motor B102 and AC power source (See FO-1).

Step 3. Check motor pump and coupling.
Replace defective components.

22. AC AMPERES METER NOT WORKING.

Test meter in accordance with paragraph 4-97.
Replace.

23. AC KILOVOLTS METER NOT WORKING.

Test meter in accordance with paragraph 4-98.
Replace.

24. FREQUENCY METER NOT WORKING.

Test meter In accordance with paragraph 4-99.
Replace

25. AC KILOWATTS METER NOT WORKING.

Test meter in accordance with paragraph 4-100.
Replace.

26. AC KILOVARS METER NOT WORKING.

Test meter in accordance with paragraph 4-101
Replace.

Table 4-3. Unit Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

27. POWER FACTOR METER NOT WORKING.
Test meter In accordance with paragraph 4-102.
Replace.

28. SYNCHROSCOPE METER NOT WORKING.
Test meter in accordance with paragraph 4-103.
Replace.

29. GEN TEMP GAGE FAILS TO REGISTER ON ONE OR MORE CHANNELS.
Test gage in accordance with paragraph 4-104.
Replace.

30. AMMETER SWITCH NOT WORKING.
Test switch In accordance with paragraph 4-107.
Replace.

31. VOLT ADJ. RHEOSTAT SWITCH NOT WORKING.
Test switch In accordance with paragraph 4-108.
Replace.

32. AC/DC LIGHTS NOT WORKING.
Step 1. Check circuit breaker. Set to ON.
Step 2. Test circuit breaker
Replace.

33. EXHAUST TEMPERATURE GAGE NOT WORKING.
Step 1. Check wiring and thermocouples for correct resistance. Refer to paragraph 4-126.
Step 2. Test gage in accordance with paragraph 4-126.
Repair or replace defective components.

34. EXHAUST TEMPERATURE GAGE INDICATES TEMPERATURE CHANGE EXCESSIVELY SLOW.
Step 1. Check thermocouples for excessive buildup of carbon and dirt.
Clean thermocouples.

SECTION VI. RADIO INTERFERENCE SUPPRESSION

4-9. GENERAL METHODS USED TO ATTAIN PROPER SUPPRESSION. Essentially, suppression is attained by providing a low resistance path to ground for stray currents. The methods used include shielding the wires, grounding the frame with bonding straps, and using a filtering system.

4-10. INTERFERENCE SUPPRESSION COMPONENTS.

a. Primary Suppression Components. The primary suppression components are those whose primary function is to suppress radio interference. Voltage regulator VR101 contains an electromagnetic interference (EMI) suppression assembly to eliminate any possible effects of EMI on the functioning of its component parts. Surge suppression capacitor C101 grounds radio frequency emissions generated by generator G1 VR101 and C101 are maintained by higher level maintenance personnel.

b. Secondary Suppression Components. These components have radio interference suppression functions which are Identical or secondary to their primary function. Housing assembly components fully enclose the generator set and are all grounded. The housing is, effectively, an RFI shield for the entire generator set.

NOTE

Check with local facility engineer to be sure generator set will not produce RFI detrimental to the operation of electronic equipment. This is especially Important near air fields and missile sites.

SECTION VII. MAINTENANCE OF HOUSING ASSEMBLY

4-11. GENERAL. Unit maintenance of the housing assembly consists primarily of removal, repair or replacement of damaged components, and re-installation after repair/replacement

4-12. FAN AND MOTOR ASSEMBLY B103, FAN SHUTTER ASSEMBLY, FIRE EXTINGUISHER BRACKETS, DESK TOP, AND DOCUMENT COMPARTMENT. Maintenance of the fan and motor assembly B103, fan shutter assembly, desk top, and document compartment is accomplished by replacement of damaged components or strengthening and welding, if possible. The fire extinguisher is rechargeable.

a. Fan and Motor Assembly B103.

(1) Test.

(a) Set control room circuit breaker CB109 (5, Figure 2-8), located In distribution panel DP1 to ON, fan and motor assembly B103 (4, Figure 4-11) should operate

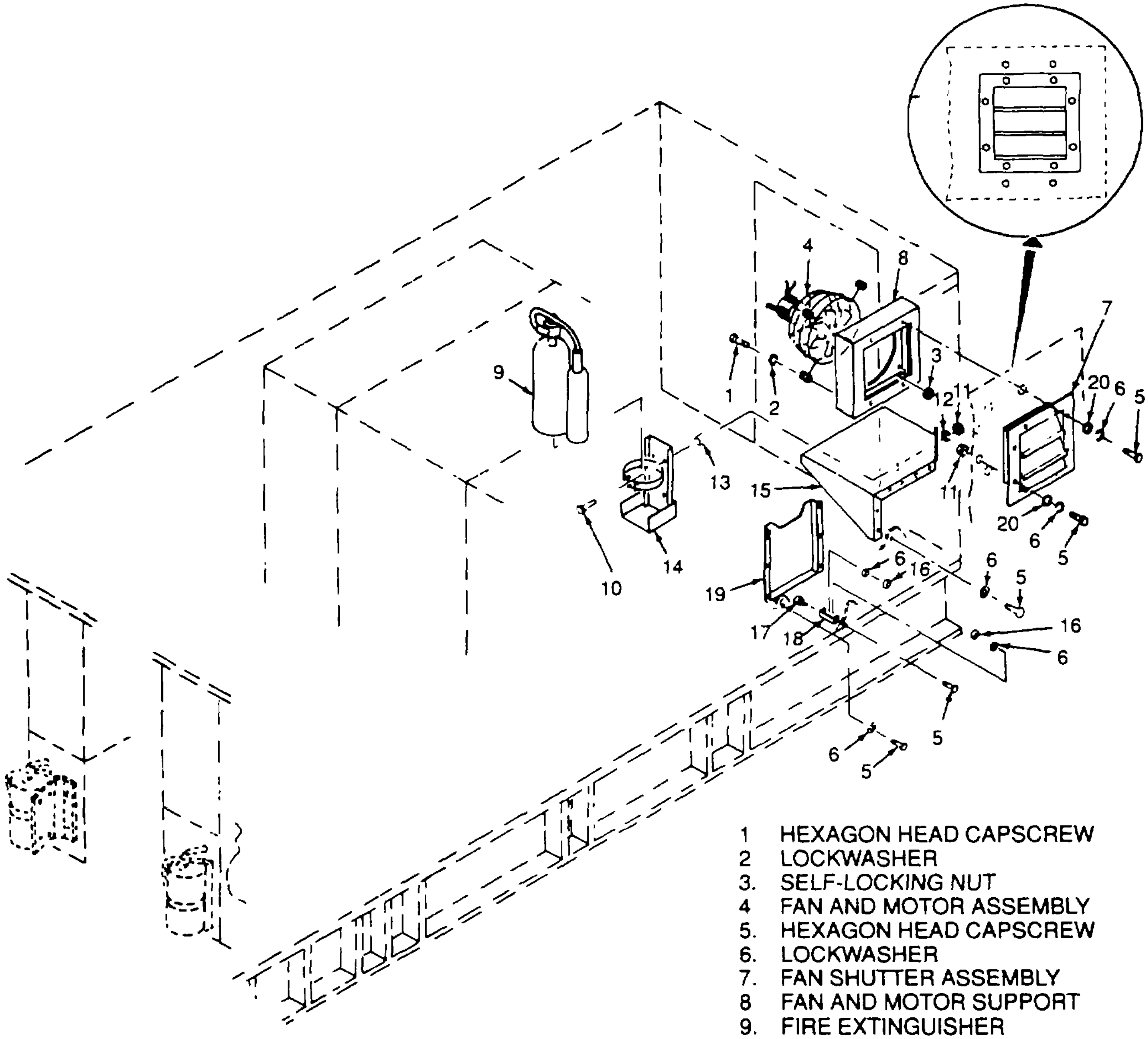
(b) If fan and motor assembly B103 (4) does not operate, ensure that fan rotates freely by inserting a screwdriver through the fan grill and manually rotating the fan.

(c) If fan and motor assembly B103 (4) does not rotate freely, check for mechanical obstructions, or bent or broken blades

(d) If fan and motor assembly B103 (4) rotates freely, check for presence of 120 V ac at fan motor electrical wires In the conduit box mounted to the fan motor housing.

(e) Test the motor start capacitor. Using a multimeter, set on RX1 scale, perform a continuity check on the capacitor. The multimeter should read Infinity. If the multimeter Indicates a closed circuit, the capacitor is shorted and must be replaced.

(f) Replace the fan and motor assembly B103 (4) if 120 V ac is present and fan does not operate.



1 HEXAGON HEAD CAPSCREW
2 LOCKWASHER
3. SELF-LOCKING NUT
4 FAN AND MOTOR ASSEMBLY
5. HEXAGON HEAD CAPSCREW
6. LOCKWASHER
7. FAN SHUTTER ASSEMBLY
8 FAN AND MOTOR SUPPORT
9. FIRE EXTINGUISHER
10 HEXAGON HEAD CAPSCREW
11. HEXAGONAL NUT
12. LOCKWASHER
13. SPACER
14 FIRE EXTINGUISHER BRACKET
15. DESK TOP
16. HEXAGONAL NUT
17. RUBBER BUMPER
18 DOOR STOP
19. DOCUMENT COMPARTMENT
20. FLAT WASHER

Figure 4-11. Fan and Motor Assembly and Related Parts

(2) Remove
  (a) Set control room circuit breaker CB109 (5, Figure 2-8), located In distribution panel DP1 to OFF.
  (b) Disconnect wiring to the fan and motor assembly B103 (4, Figure 4-11) at conduit box on the fan motor housing.
  (c) Remove hexagon head cap screws (5), lock washers (6), and flat washers (20), and remove the fan and motor support (8) with the fan and motor assembly B103 (4).
  (d) Separate the fan and motor assembly B103 (4) from the fan and motor support (8) by removing the hexagon head cap screws (1), lock washers (2), and self-locking nuts (3).

(3) Install.
  (a) Secure the fan and motor assembly B103 (4, Figure 4-11) to the fan and motor support (8) with hexagon head cap screws (1), lock washers (2), and self-locking nuts (3).
  (b) Install the fan and motor support (8) with the fan and motor assembly B103 (4), using hexagon head cap screws (5), lock washers (6), and flat washers (20).
  (c) Reconnect wiring to the fan and motor assembly B103 (4) at the conduit box on the fan motor housing.
  (d) Set control room circuit breaker CB109 (5, Figure 2-8), located in distribution panel DP1, to ON.

b. <u>Fan Shutter Assembly</u>.

(1) Remove
  (a) Remove fan and motor assembly B103 (4, Figure 4-11) and fan and motor support (8) In accordance with step a(2), above.
  (b) Remove hexagon head cap screws (5), lock washers (6), flat washers (20), and hexagonal nuts (11), and remove the fan shutter assembly (7).

(2) Install.
  (a) Install the fan shutter assembly (7, Figure 4-11) with hexagon head cap screws (5), lock washers (6), flat washers (20), and hexagonal nuts (11).
  (b) Install the fan and motor assembly B103 (4) and fan and motor support (8) in accordance with step a(3), above.

c. <u>Fire Extinguisher Brackets (Figure 4-11</u>). The generator set contains three bracket mounted fire extinguishers, one of which is located to the left and lust Inside the door to the generator set control room. The remaining two fire extinguishers are located in the engine compartment of the generator set, one on each of the forward facing sides of the air cleaner assemblies

NOTE
This task requires two people.

(1) Remove. Remove the fire extinguisher bracket (14, Figure 4-11) in the generator set control room by removing the fire extinguisher (9) from the bracket, and then removing hexagon head cap screws (10), spacers (13), lock washers (12), and hexagonal nuts (11).

(2) Install. Install the fire extinguisher brackets in the generator set control room (14, Figure 4-11**)** by installing spacers (13), hexagon head cap screws (10), lock washers (12), and hexagonal nuts (11), and then installing the fire extinguisher (9).

d. <u>Desk Top.</u>

NOTE
This task requires two people.

(1) Remove. Remove the desk top (15, Figure 4-11) by removing hexagon head cap screws (5) and lock washers (6).

(2) Install. Install the desk top (15, Figure 4-11) by Installing hexagon head cap screws (5) and lock washers (6).

e. Document Compartment.

NOTE
This task requires two people

(1) Remove. Remove hexagon head cap screws (5, Figure 4-11), lock washers (6), and hexagonal nuts (16), to remove rubber bumper (17) and door stop (18) Remove hexagon head cap screws (5) and lock washers (6) and remove document compartment (19).
(2) Install. Install document compartment (19, Figure 4-11) by installing hexagon head cap screws (5), and lock washers (6). Install rubber bumper (17) and door stop (18) by Installing hexagon head cap screws (5), lock washers (6), and hexagonal nuts (16).

4-13. REMOVAL OF ROOF PANELS, ACCESS DOORS, AND SHUTTERS.

NOTE
Two people may be required to perform the following procedure.

a. Removal of Roof Panels.
(1) If necessary, remove mufflers in accordance with paragraph 3-15.
(2) Remove hexagon head cap screws (16, Figure 4-13), flat washers (18), lock washers (17), and hexagonal nuts (19), and remove conduit support assembly (13)
(3) Remove hexagon head cap screws (16), lock washers (17), flat washers (18), and hexagonal nuts (19), and remove support bracket (15), and conduit support hanger (14).
(4) Remove hexagon head cap screws (16), lock washers (17), and hexagonal nuts (18) securing roof angles (4 through 8).
(5) Remove hexagon head cap screws (1, Figure 4-12), hexagonal nuts (2), and lock washers (3) from roof angles (4 through 8, Figure 4-13) to separate #12 roof panel (4, Figure 4-12), #10 and #11 roof panels (7). Remove roof gaskets (8, Figure 4-12).
(6) See Figure 4-13. Remove screw and captive washer assemblies (1) from roof angles (6, 7, and 8) and upper plate (11), attached to the switchgear. Remove gasket (12).
(7) See Figure 4-12. Remove hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) to separate #7, #8 and #9 roof panels (7).
(8) See Figure 4-12. Remove #12 roof panel (4) and #9, #10, and #11 roof panels (7) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) from right hand upper rear stiffener (5) and left hand upper rear stiffener (6). Remove #7 and #8 roof panels (7) by removing hardware (1), (2), and (3) from right and left hand upper center stiffeners (22 and 23, Figure 4-14).
(9) See Figure 4-14. Remove hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) from inside the housing to loosen or separate #1 through #6 roof panels (8, 7, 6, 5 and 4). Remove roof gaskets (9), and the various wrong support hardware bolted into the panels.
(10) See Figure 4-14. Remove #5 and #6 roof panels (4), #4 roof panels (5), #3 roof panels (6), #2 roof panel (7), #1 roof panel (8), and wiring supports (10 and 11) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) from right and left hand upper center stiffeners (22 and 23) and right and left hand upper front stiffeners (24 and 25).
(11) See Figure 4-14. From #1 roof panel (8), remove screw and captive washer assembly (12) to remove handle (13). Remove cross pin (14), quarter-turn stud (15), screw and captive washer assembly (16), nut and captive washer assembly (17), and radiator fill access door (18). Remove door seal (19), rivet (20), and floating receptacle (21).
(12) Remove roof stiffeners (5 and 6, Figure 4-12 and 22, 23, 24, and 25, Figure 4-14) by removing hexagon head cap screws from the generator housing corner support posts and housing side panels.

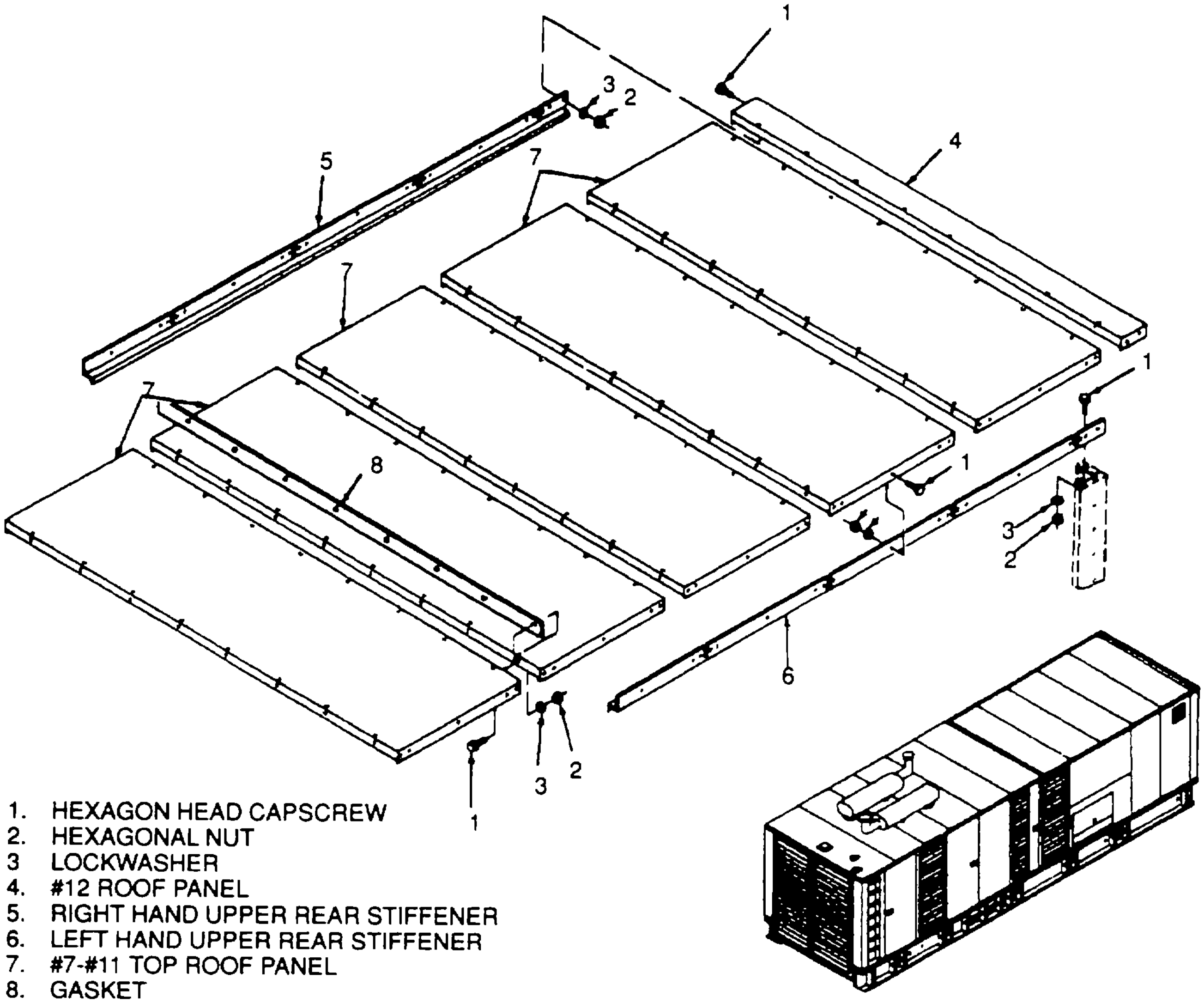
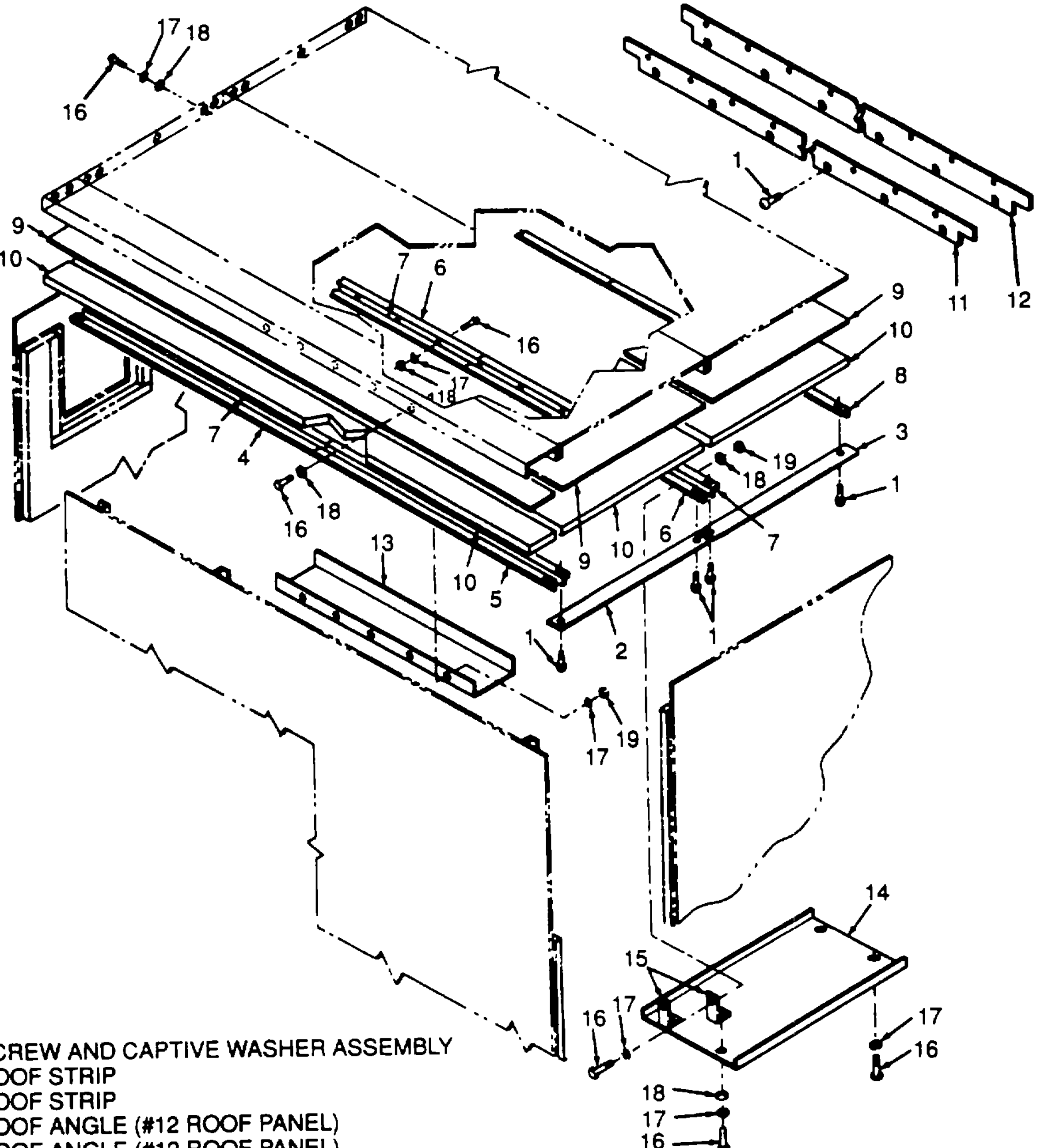


Figure 4-12. Roof Panels, Control Room

b. Removal of Housing Panels. Access Doors, and Shutter Assemblies. (See Figure 4-15)

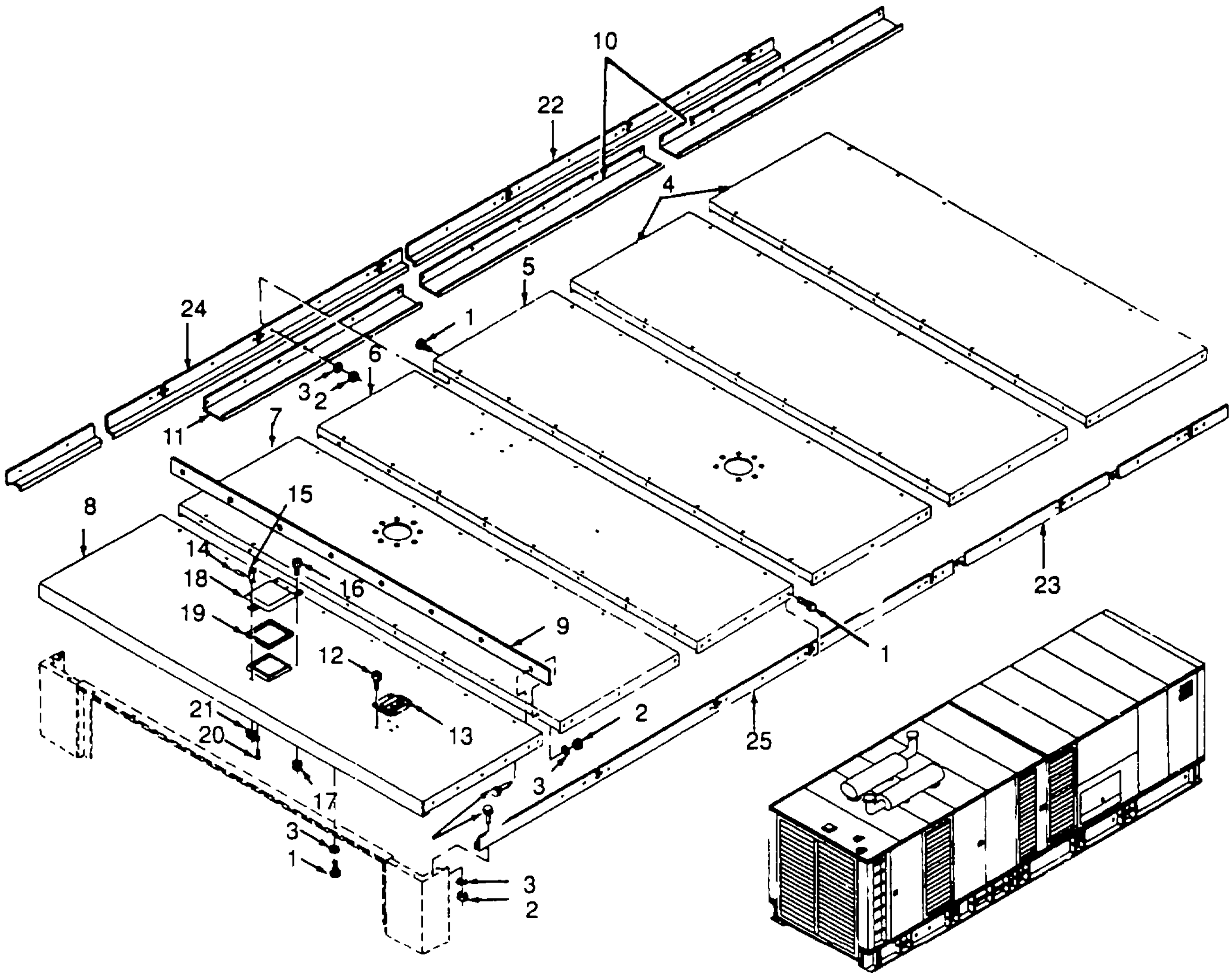
(1) Remove hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) to remove front corner post (4), and detach #1 left lower support (5) from the skid base. Remove ladder assembly (6) and #1 L2 side panel (7).

(2) Remove two left door assemblies (10) and left shutter door assembly (14) by removing screw and captive washer assemblies (8) and nut and captive washer assemblies (9) from door hinges and attached housing panels. Detach left hand shutter assembly (12), from #2 left side panel (11) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Detach #2 left side panel (11) from the #2 left lower support (15) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Detach #3 left side panel (13) from #3 left lower support (16) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Remove #2 left lower support (15) and #3 left lower support (16) by loosening hexagonal nuts (2), and lock washers (3) from interior housing and removing hexagon head cap screws (1), from exterior skid base.



1. SCREW AND CAPTIVE WASHER ASSEMBLY
2. ROOF STRIP
3. ROOF STRIP
4. ROOF ANGLE (#12 ROOF PANEL)
5. ROOF ANGLE (#12 ROOF PANEL)
6. ROOF ANGLE (#5 ROOF PANEL)
7. ROOF ANGLE (#5 ROOF PANEL)
8. ROOF ANGLE (#5 ROOF PANEL)
9. ACOUSTIC DAMPER LAYER
10. ACOUSTIC ABSORBER LAYER
11. UPPER PLATE
12. GASKET
13. CONDUIT SUPPORT ASSEMBLY
14. CONDUIT SUPPORT HANGER
15. SUPPORT BRACKET
16. HEXAGON HEAD CAPSCREW
17. LOCKWASHER
18. FLAT WASHER
19. HEXAGONAL NUT

Figure 4-13. Control Room Sound Insulation



1. HEXAGON HEAD CAPSCREW
2. HEXAGONAL NUT
3 LOCKWASHER
4. #5 AND #6 ROOF TOP PANELS
5 #4 ROOF TOP PANEL
6. #3 ROOF TOP PANEL
7 #2 ROOF TOP PANEL
8. #1 ROOF TOP PANEL
9 GASKET
10. WIRING SUPPORT
11. WIRING SUPPORT
12. SCREW AND CAPTIVE WASHER ASSEMBLY
13. HANDLE
14. CROSS PIN
15 QUARTER-TURN STUD
16 SCREW AND CAPTIVE WASHER ASSEMBLY
17 NUT AND CAPTIVE WASHER ASSEMBLY
18 RADIATOR FILL ACCESS DOOR
19. DOOR SEAL
20 RIVET
21 FLOATING RECEPTACLE
22. RIGHT HAND UPPER CENTER STIFFENER
23. LEFT HAND UPPER CENTER STIFFENER
24 RIGHT HAND UPPER FRONT STIFFENER
25 LEFT HAND UPPER FRONT STIFFENER

Figure 4-14. Engine Compartment Roof Panels

(3) Remove left hand shutter door assembly (14) by removing screw and captive washer assemblies (8), and nut and captive washer assemblies (9) from door hinges and attached housing panel (13). Remove shutter assembly (18) and door seal (19) from left hand door (17) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Remove door holder rod (20) from left hand door (17). Remove left hand door (17) from attached panels (21 and 28) by removing screw and captive washer assemblies (8) and nut and captive washer assemblies (9).

(4) Detach #4 upper left side panel (21), #4 bottom left side panel (28), #5 and #6 left side panels (22 and 23) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) holding panels together. Detach #6 left side panel (23) from #7 left rear corner post (31) by removing similar attaching hardware (1, 2, and 3). Remove #4 bottom left side panel (28), #5 and #6 side panels (22 and 23) from #4 and #5 left lower supports (29 and 30) by removing hexagon head screws (1), hexagonal nuts (2), and lock washers (3). Remove #4 and #5 left lower supports (29 and 30) from skid base by removing hexagon head cap screws (1) from exterior skid base; and hexagonal nuts (2), and lock washers (3) from interior housing.

(5) Remove cover assembly (26) and gasket (27) from #4 bottom left side panel (28) by removing screw and captive washer assemblies (24), and nut and captive washer assemblies (25).

(6) Remove rear door assembly (33) by removing screw and captive washer assemblies (8); and nut and captive washer assemblies (9) from door hinges, and left hand rear panel (34).

(7) Detach #7 left rear corner post (31), left hand rear panel (34) from #6 left lower support (32) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Remove #6 left lower support (32) from skid base by removing similar mounting hardware (1, 2, and 3).

(8) Remove rear door stop plate (38) and door holder clip (37). Remove control room floor plates (40, 41, and 42) by removing flat head machine screws (39) from skid base.

(9) Detach right hand rear panel (36), #7 right rear corner post (44) and #5 right side panel (45) from each other by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3). Remove #7 right rear corner post (44) and right hand rear panel (36) from #6 left lower support (47) by removing mounting hardware (1, 2, and 3) Remove #6 right lower support (47) by removing hexagonal nuts (2) and lock washers (3) from interior housing and hexagon head cap screws (1) from exterior skid base.

(10) Remove two right side door assemblies (10) and two right hand shutter door assemblies (53 and 54) by removing screw and captive washer assemblies (8), and nut and captive washer assemblies (9) from door hinges and attached housing panels.

(11) Detach #5 and #6 right side panels (44 and 45), #4 upper right side panel (49), and #4 lower right side panel (51) by removing hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) holding panels together Remove #5 and #6 right side panels (44 and 45), and #4 lower right side panel (51), #4 and #5 right lower supports (48 and 52) by removing similar mounting hardware. Remove #4 and #5 right lower supports (48 and 52) by removing hexagon head cap screws (1) from exterior base skid, and hexagonal nuts (2), and lock washers (3) from interior housing Remove two conduit box sealing frames (50) from #4 lower right side panel (51) by removing screw and captive washer assemblies (8), and nut and captive washer assemblies (9).

(12) Remove #2 and #3 right side panels (56 and 55), and front corner post (57) from #3, #2, and #1 right lower supports (58, 59, and 60) by removing hexagon head cap screws (1), nuts (2), and lock washers (3). Remove right lower supports (58, 59, and 60) by removing similar mounting hardware (1, 2, and 3).

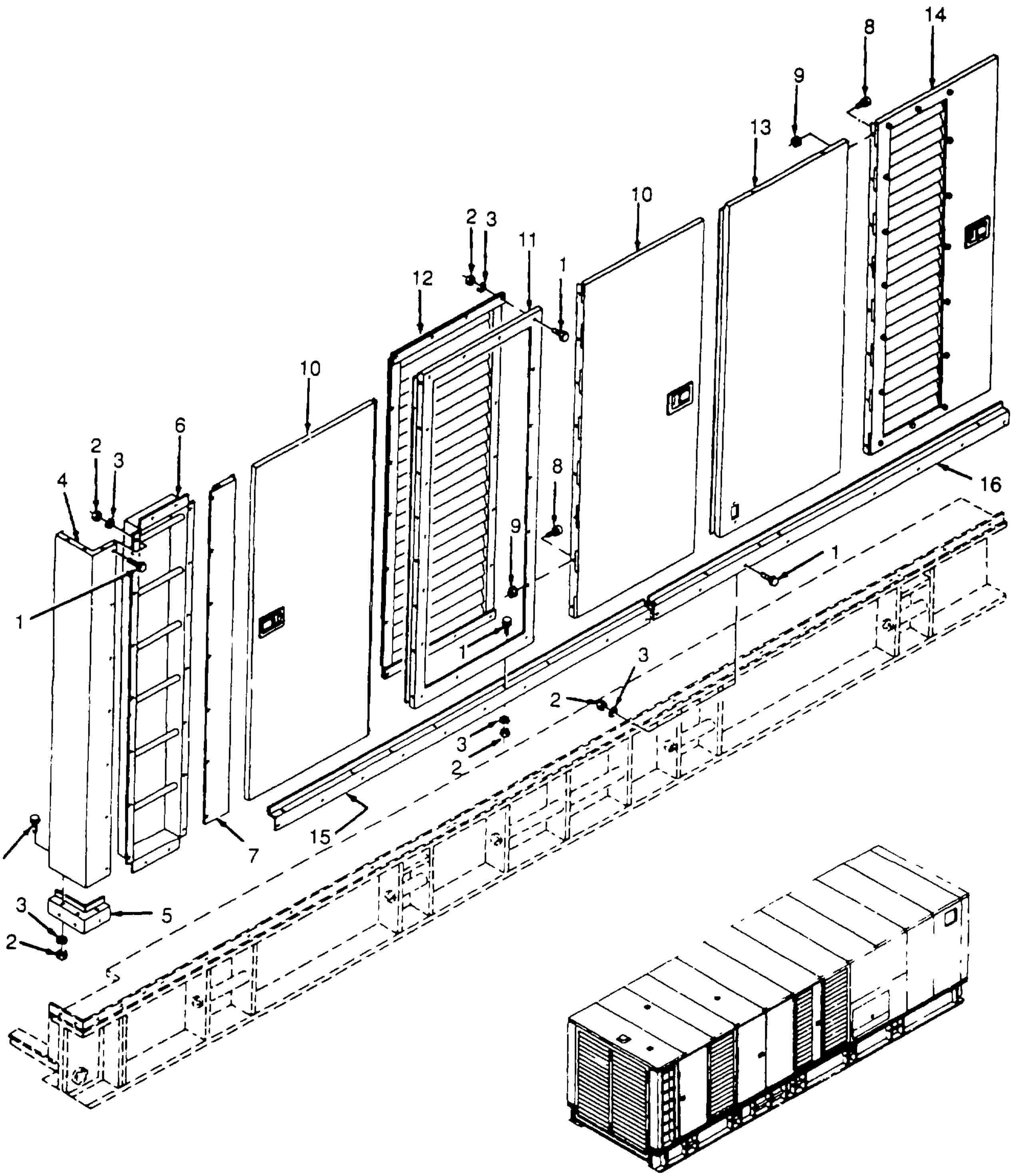


Figure 4-15. Access Doors and Shutters (Sheet 1 of 6)

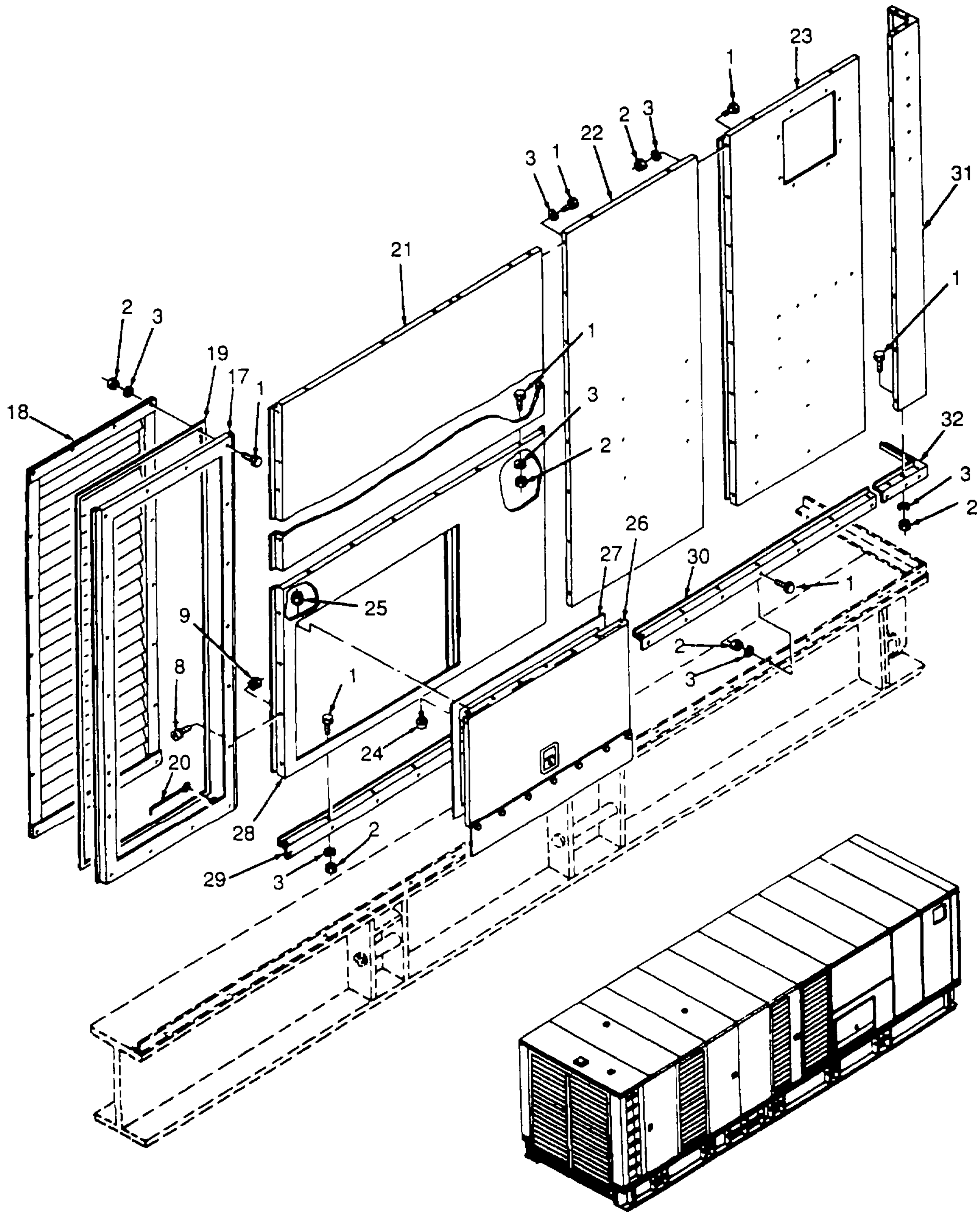


Figure 4-15. Access Doors and Shutters (Sheet 2 of 6)

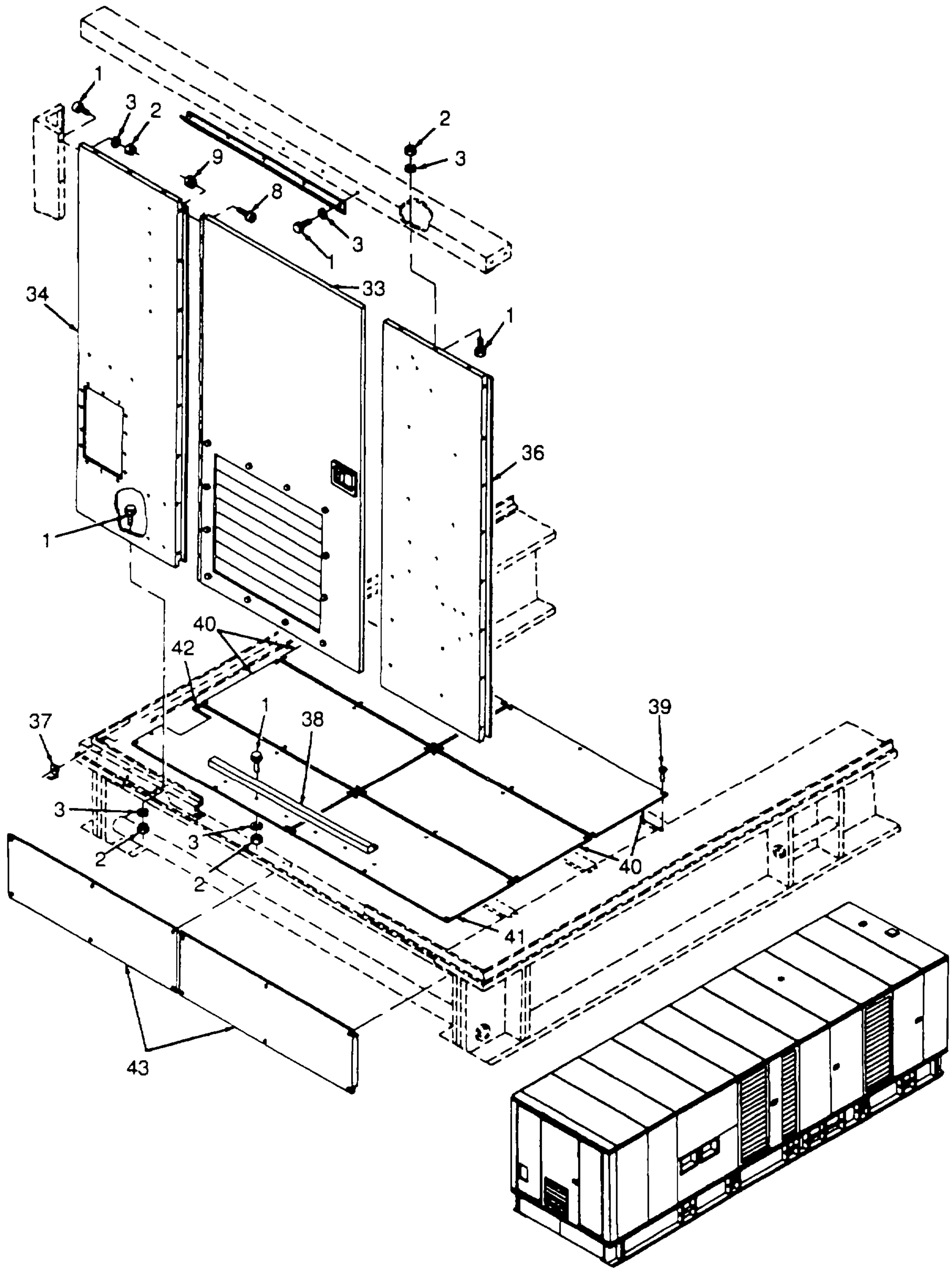


Figure 4-15. Access Doors and Shutters (Sheet 3 of 6)

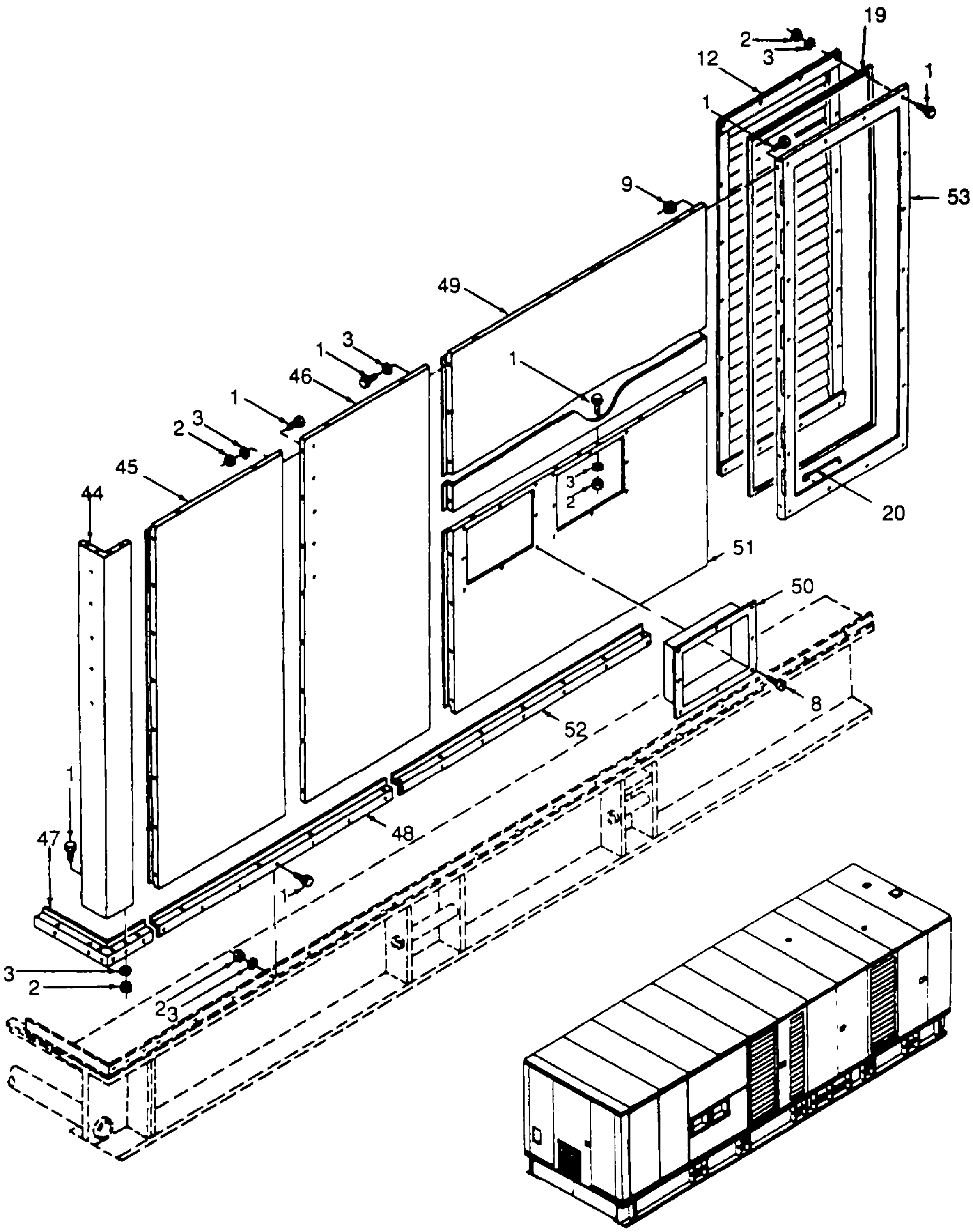


Figure 4-15. Access Doors and Shutters (Sheet 4 of 6)

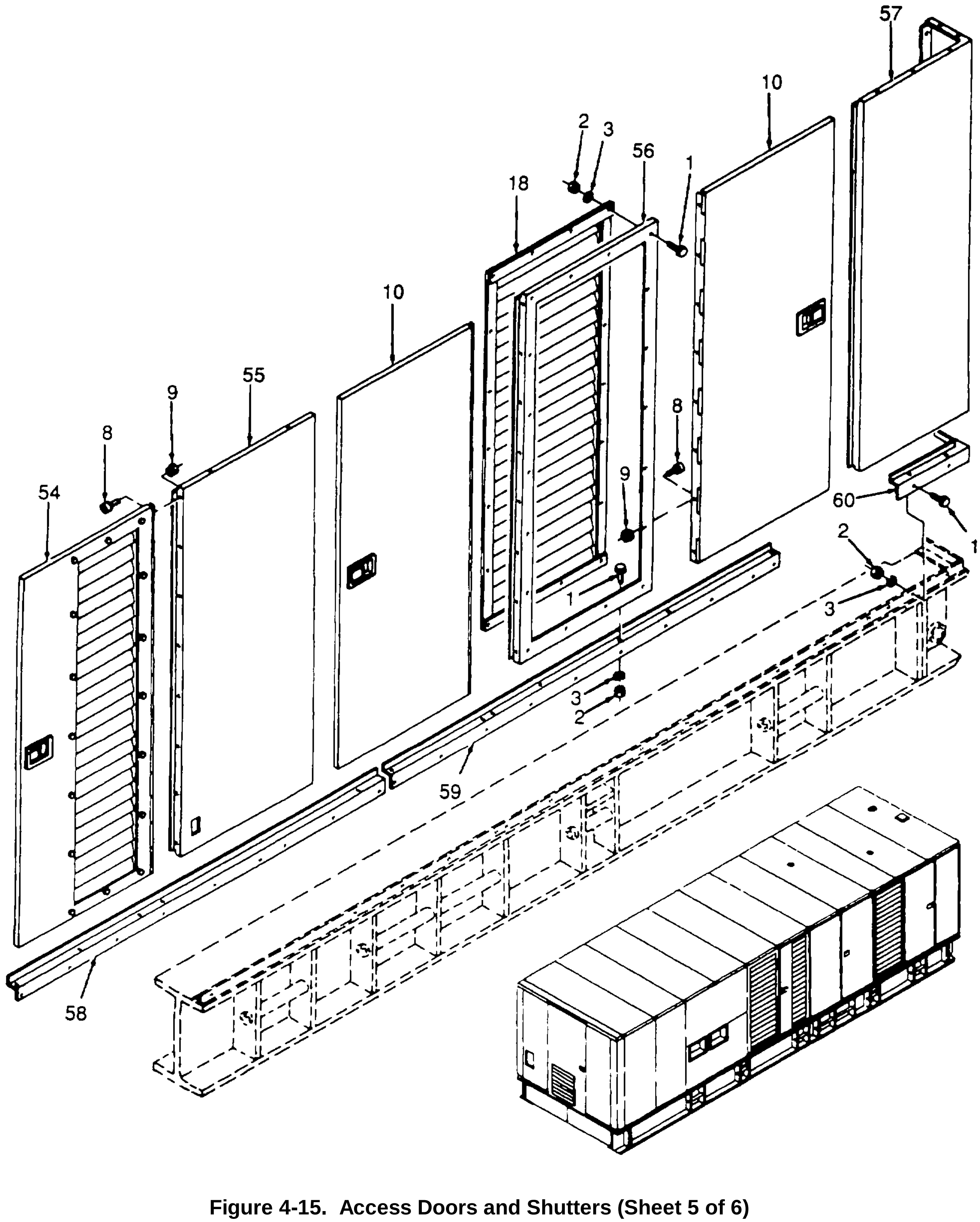


Figure 4-15. Access Doors and Shutters (Sheet 5 of 6)

1. HEXAGON HEAD CAPSCREW
2. HEXAGONAL NUT
3 LOCKWASHER
4 FRONT CORNER POST
5. #1 LEFT LOWER SUPPORT
6. LADDER ASSEMBLY
7. #1 L2 SIDE PANEL
8. SCREW AND CAPTIVE WASHER ASSEMBLY
9. NUT AND CAPTIVE WASHER ASSEMBLY
10. DOOR ASSEMBLY
11. #2 LEFT PANEL
12. LEFT HAND SHUTTER ASSEMBLY
13. #3 LEFT SIDE PANEL
14. LEFT HAND SHUTTER ASSEMBLY
15. #2 LEFT LOWER SUPPORT
16. #3 LEFT LOWER SUPPORT
17. LEFT HAND DOOR
18. RIGHT HAND SHUTTER ASSEMBLY
19. DOOR SEAL
20. DOOR HOLDEER ROD PNL
21. #4 UPPER LEFT SIDE PANEL
22. #5 LEFT SIDE PANEL
23. #6 LEFT SIDE PANEL
24. SCREW AND CAPTIVE WASHER ASSEMBLY
25. NUT AND CAPTIVE WASHER ASSEMBLY
26. COVER ASSEMBLY
27 DOOR GASKET
28. #4 BOTTOM LEFT SIDE PANEL
29. #4 LEFT LOWER SUPPORT
30. #5 LEFT LOWER SUPPORT
31. #7 LEFT REAR CORNER POST
32. #6 LEFT LOWER SUPPORT
33. REAR DOOR ASSEMBLY
34. LEFT HAND REAR PANEL
35. DRIP CHANNEL
36. RIGHT HAND REAR PANEL
37. DOOR HOLDER CLIP
38. REAR DOOR STOP PLATE
39. COUNTERSUNK FLAT HEAD MACHINE SCREW
40. FLOOR PLATE
41. FLOOR PLATE
42. FLOOR PLATE
43. COVER ASSEMBLY
44. #7 RIGHT REAR CORNER POST
45. #5 RIGHT SIDE PANEL
46. #6 RIGHT SIDE PANEL
47 #6 RIGHT LOWER SUPPORT
48. #5 RIGHT LOWER SUPPORT
49. #4 UPPER RIGHT SIDE PANEL
50. CONDUIT SEALING FRAME
51. #4 LOWER RIGHT SIDE PANEL
52. #4 LOWER RIGHT SUPPORT
53. RIGHT HAND DOOR
54. RIGHT HAND SHUTTER DOOR ASSEMBLY
55. #3 RIGHT SIDE PANEL
56. #2 RIGHT SIDE PANEL
57. FRONT CORNER POST
58. #3 RIGHT LOWER SUPPORT
59. #2 RIGHT LOWER SUPPORT
60. #1 RIGHT LOWER SUPPORT

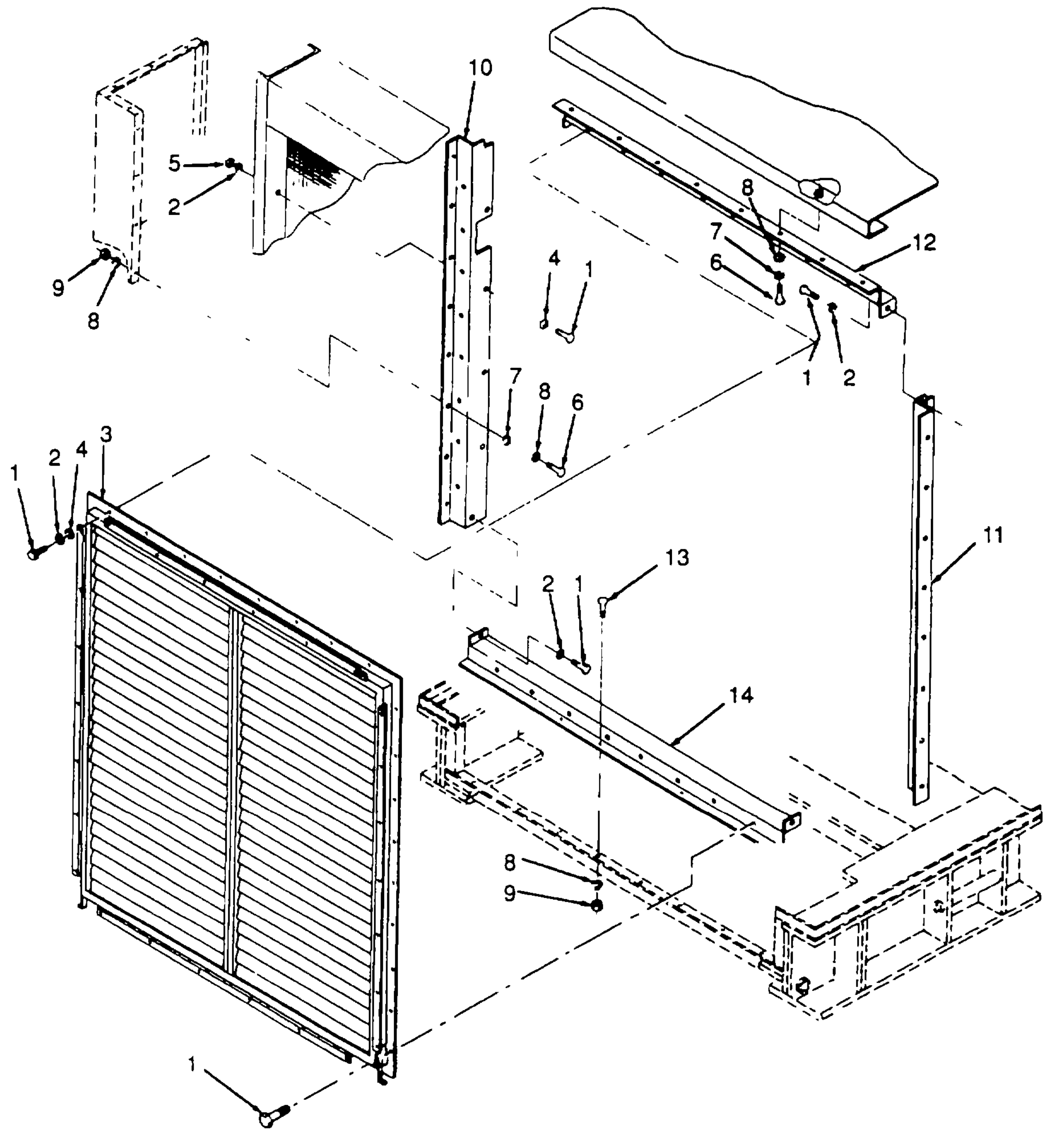
Figure 4-15. Access Doors and Shutters (Sheet 6 of 6)

4-14. REMOVAL OF RADIATOR SHUTTER ASSEMBLY.

NOTE

Two people may be required to perform the following procedure

a. Remove hexagon head cap screws (1, Figure 4-16), lock washers (2), and flat washers (4) to remove radiator shutter assembly (3).
b. Remove hexagon head cap screws (1 and 6), flat washers (4 and 7), lock washers (2 and 8), and hexagonal nuts (5 and 9) to remove shutter mounting supports (10 and 11) and support (12)
c. Remove hexagon head cap screws (13), lock washers (8), and hexagonal nuts (9) to remove support (14).



1	HEXAGON HEAD CAPSCREW	8.	LOCKWASHER
2.	LOCKWASHER	9.	HEXAGONAL NUT
3	RADIATOR SHUTTER ASSEMBLY	10.	SHUTTER MOUNTING SUPPORT
4	FLAT WASHER	11	SHUTTER MOUNTING SUPPORT
5	HEXAGONAL NUT	12.	SUPPORT
6.	HEXAGON HEAD CAPSCREW	13.	HEXAGON HEAD CAPSCREW
7.	FLAT WASHER	14.	SUPPORT

Figure 4-16. Radiator Shutter Assembly

4-15. REPAIR OF HOUSING COMPONENTS. The housing assembly can be disassembled to facilitate sheet metal repairs.

a. Disassembly of Door Assemblies (10. Figure 4-15)
   (1) Remove bar (1, Figure 4-17) and door holder assembly (2).
   (2) Remove screw and captive washer assemblies (3) and nut and captive washer assemblies (4) and separate door lock support (5) and striker (6).
   (3) Remove door seal (7) from door panel assembly (8).

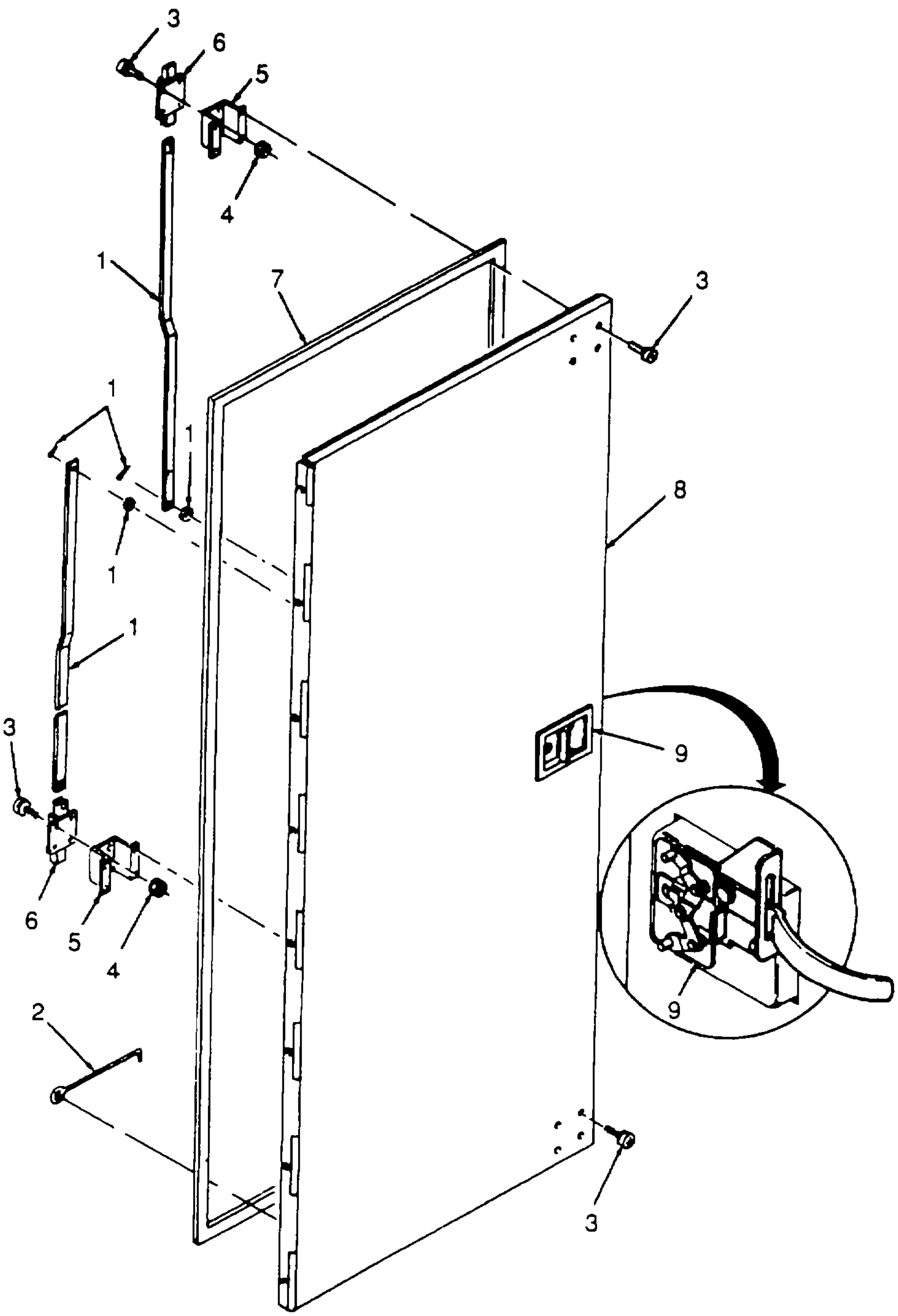
b. Disassembly of Fixed Frame Shutter Assemblies (18 and 12. Figure 4-15).
   (1) Remove hexagon head bolt (1, Figure 4-18), locknut (2), flat washer (3), connecting pin (4), locking ring (5), and pin assembly (6) to remove the lever mounting bar (7), and right hand control lever (8).
   (2) Disassemble each of the 23 vane assemblies (9) by removing the right and left hand cranks (10 and 11) and vinyl seals (12) from the vane stocks (13). Remove the right and left hand control bars (14 and 15).
   (3) Remove round head screws (16) to remove right and left hand angles (17 and 18) from the frame assembly (19).

c. Disassembly of Left Hand Shutter Door Assembly (14. Figure 4-15).
   (1) Remove hexagon head cap screws (1, Figure 4-19), lock washers (2), and hexagonal nuts (3) to separate left hand shutter assembly (4) from left hand door (12).
   (2) Remove door holder rod (5) and bar (6).
   (3) Remove screw and captive washer assemblies (7) and nut and captive washer assemblies (8) to separate door lock support (9) and striker (10) from left hand door (12).
   (4) Remove door seal (11) from left hand door (12).

d. Disassembly of Right Hand Shutter Door (54. Figure 4-15).
   (1) Remove hexagon head capscrew (1, Figure 4-20), lock washers (2), and hexagonal nut (3) to separate right hand shutter assembly (4) from right hand door (12).
   (2) Remove door holder rod (5) and bar (6).
   (3) Remove screw and captive washer assemblies (7) and nut and captive washer assemblies (8) to separate door lock support (9) and striker (10) from right hand door (12).
   (4) Remove door seal (11) from right hand door (12)

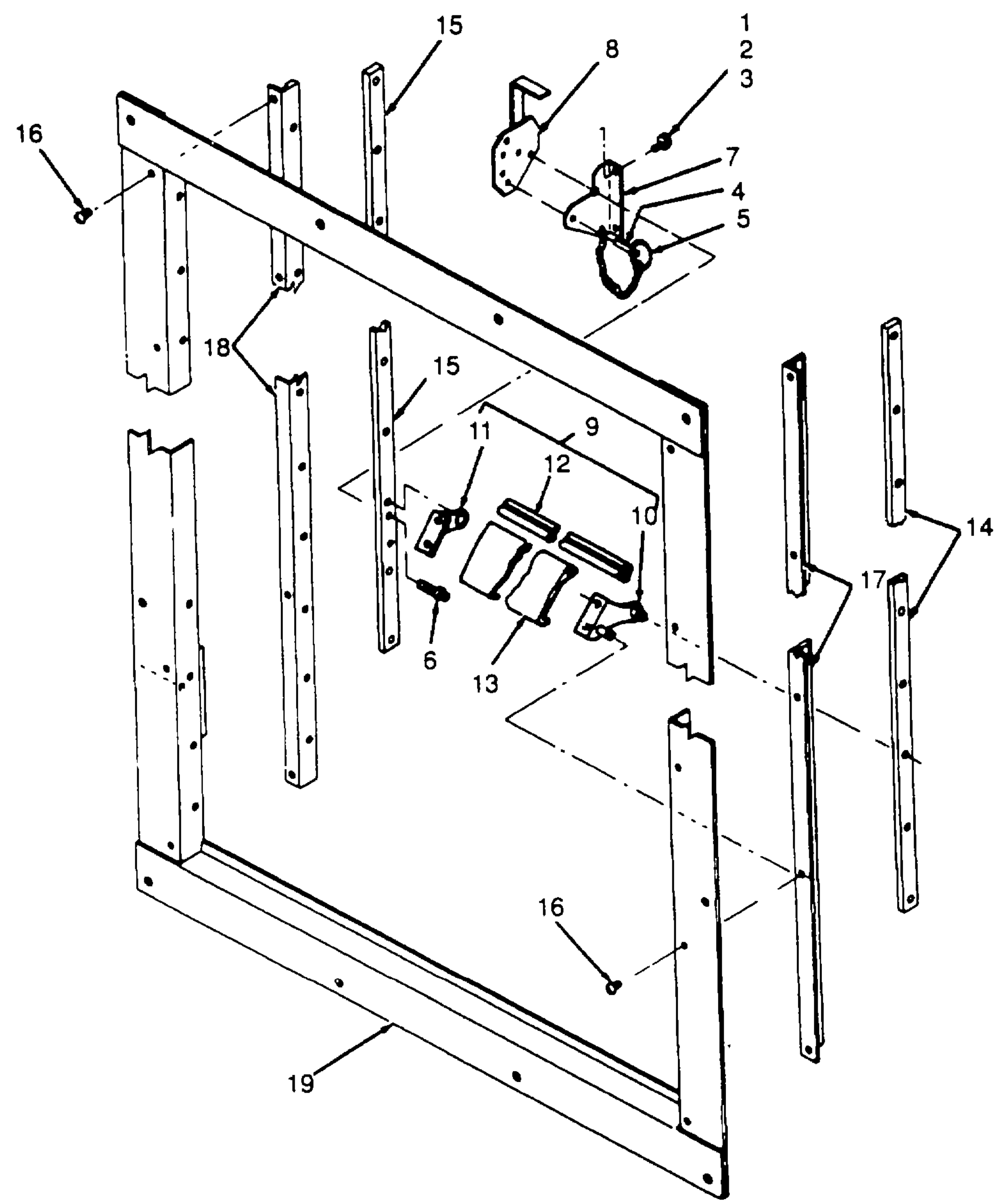
e. Disassembly of Right Hand Shutter (Figure 4-20) and Left Hand Shutter Door Control Lever Assemblies (Figure 4-19). Remove hexagon head bolt (1, Figure 4-21), locknut (2), flat washer (3), connecting pin (4), locking ring (5), and pin assembly (6) to remove the lever mounting bracket (7) and right hand/left hand control lever (8).

f. Disassembly of Rear Door (33. Figure 4-15).
   (1) Remove grab handle (36, Figure 4-22) by removing hexagon head cap screws (8) and lock washers (10) (2) Unhook and remove bar (1, Figure 4-22).
   (3) Remove screw and captive washer assemblies (2) and nut and captive washer assemblies (3) to remove door lock support (4) and striker (5). Remove door seal (6).
   (4) Remove air filter (7) from air filter mounting shroud (12). Remove hexagon head capscrew (8), hexagonal nut (9), and lockwasher (10) and separate chain assembly (11), air filter mounting shroud (12), and rear door shutter assembly (13) from the right hand door panel assembly (35).
   (5) Disassemble rear door shutter assembly by removing hexagon head bolt (14), locknut (15), flat washer (16), connecting pin (17), locking ring (18), pin assembly (19), lever mounting bracket (20), and control lever assembly (21).



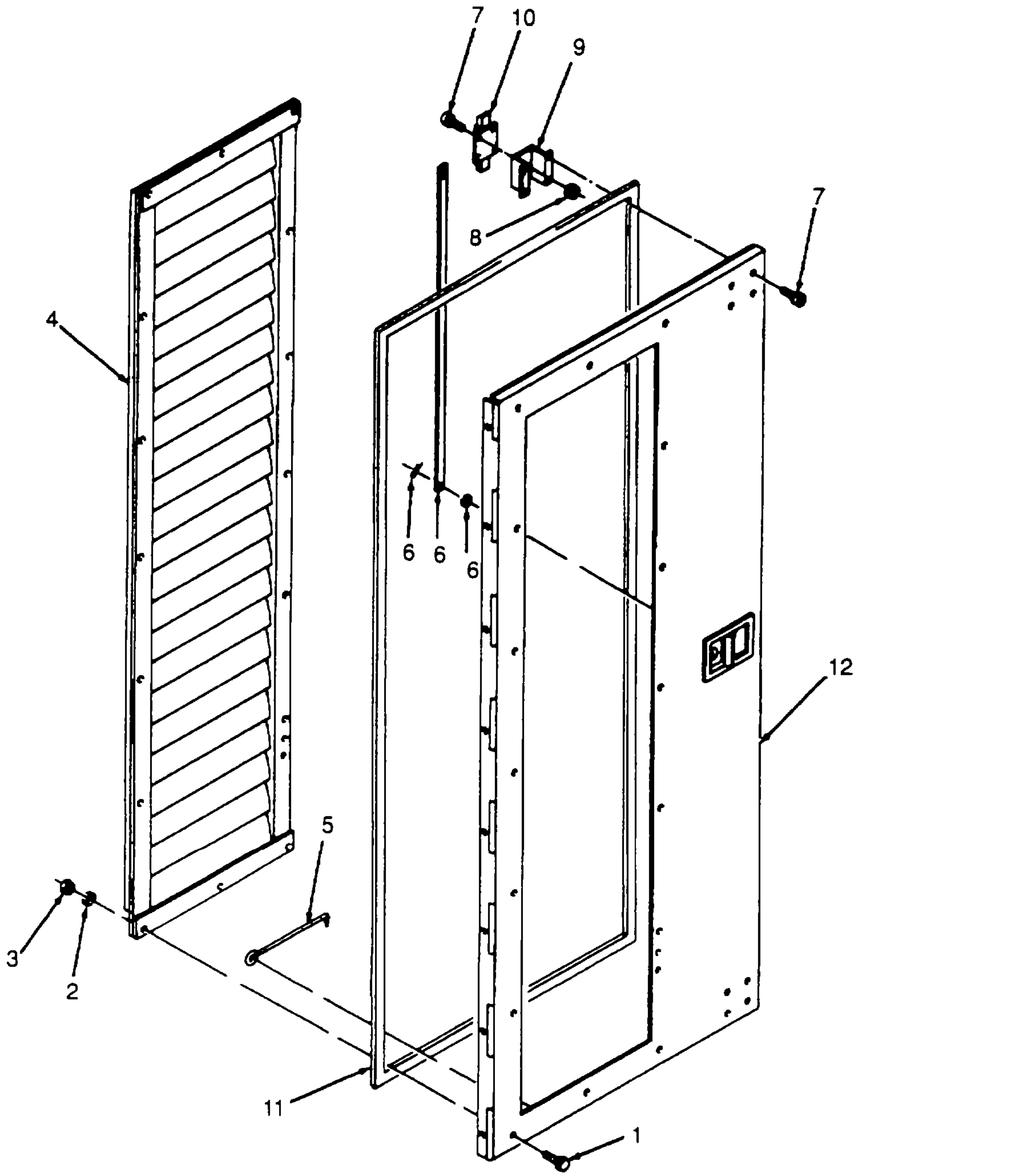
1. BAR
2. DOOR HOLDER ASSEMBLY
3. SCREW AND CAPTIVE WASHER ASSEMBLY
4. NUT AND CAPTIVE WASHER ASSEMBLY
5. DOOR LOCK SUPPORT
6. STRIKER
7 DOOR SEAL, 210 INCHES
8 DOOR PANEL ASSEMBLY
9 DOOR HANDLE

Figure 4-17. Door Assemblies



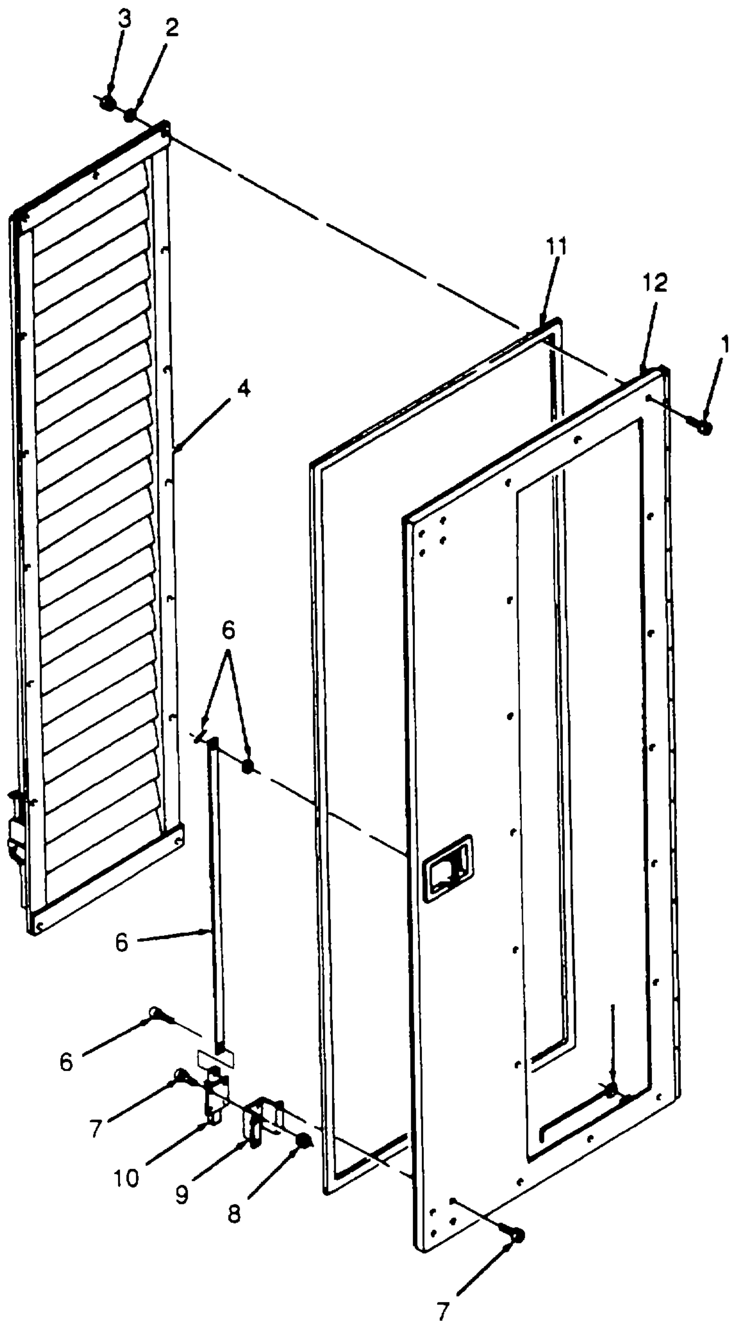
1. HEXAGON HEAD BOLT
2. LOCKNUT
3. FLAT WASHER
4. CONNECTING PIN
5. LOCKING PIN
6. PIN ASSEMBLY
7. LEVER MOUNTING BAR
8. RIGHT HAND CONTROL LEVER
9. VANE ASSEMBLY
10. RIGHT HAND CRANK
11. LEFT HAND CRANK
12. VINYL SEAL
13. VANE STOCK
14. RIGHT HAND CONTROL BAR
15. LEFT HAND CONTROL BAR
16. ROUND HEAD SCREW
17. RIGHT HAND ANGLE
18. LEFT HAND ANGLE
19. FRAME ASSEMBLY

Figure 4-18. Fixed Frame Shutter Assembly



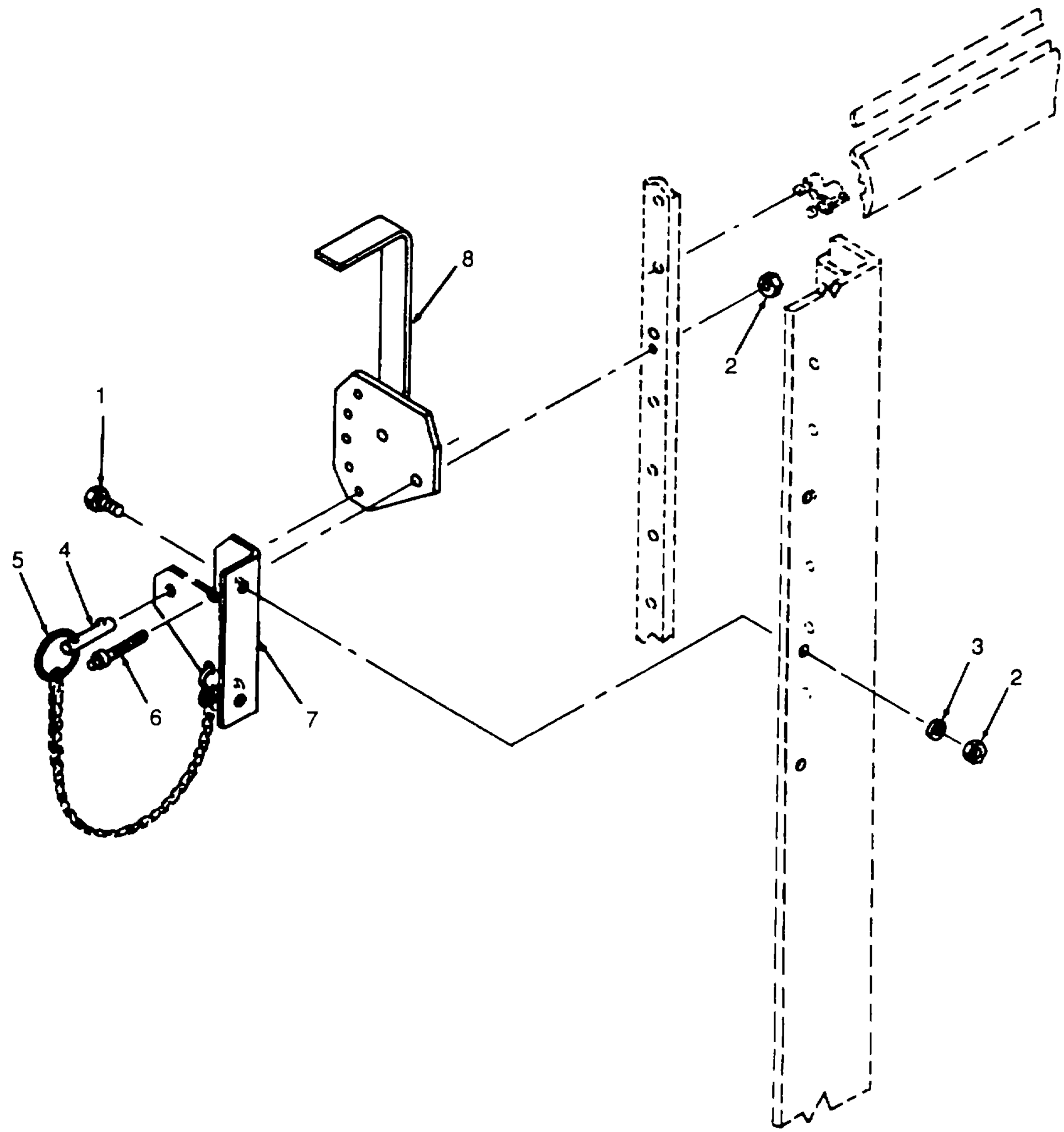
1. HEXAGON HEAD CAPSCREW
2. LOCKWASHER
3. HEXAGONAL NUT
4. LEFT HAND SHUTTER ASSEMBLY
5. DOOR HOLDER ROD
6. BAR
7. SCREW AND CAPTIVE WASHER ASSEMBLY
8. NUT AND CAPTIVE WASHER ASSEMBLY
9. DOOR LOCK SUPPORT
10. STRIKER
11. DOOR SEAL, 210 INCHES
12. LEFT HAND DOOR

Figure 4-19. Left Hand Shutter Door Assembly



1 HEXAGON HEAD CAPSCREW
2. LOCKWASHER
3. HEXAGONAL NUT
4. RIGHT HAND SHUTTER ASSEMBLY
5. DOOR HOLDER ROD
6 BAR
7. SCREW AND CAPTIVE WASHER ASSEMBLY
8. NUT AND CAPTIVE WASHER ASSEMBLY
9 DOOR LOCK SUPPORT
10 STRIKER
11 DOOR SEAL, 210 INCHES
12. RIGHT HAND DOOR

Figure 4-20. Right Hand Shutter Door Assembly



1. HEXAGON HEAD BOLT
2. LOCKNUT
3. FLAT WASHER
4. CONNECTING PIN
5. LOCKING RING
6. PIN ASSEMBLY
7. LEVER MOUNTING BRACKET
8. RIGHT HAND/LEFT HAND CONTROL LEVER

Figure 4-21. Right Hand/Left Hand Shutter Control Lever Assembly.

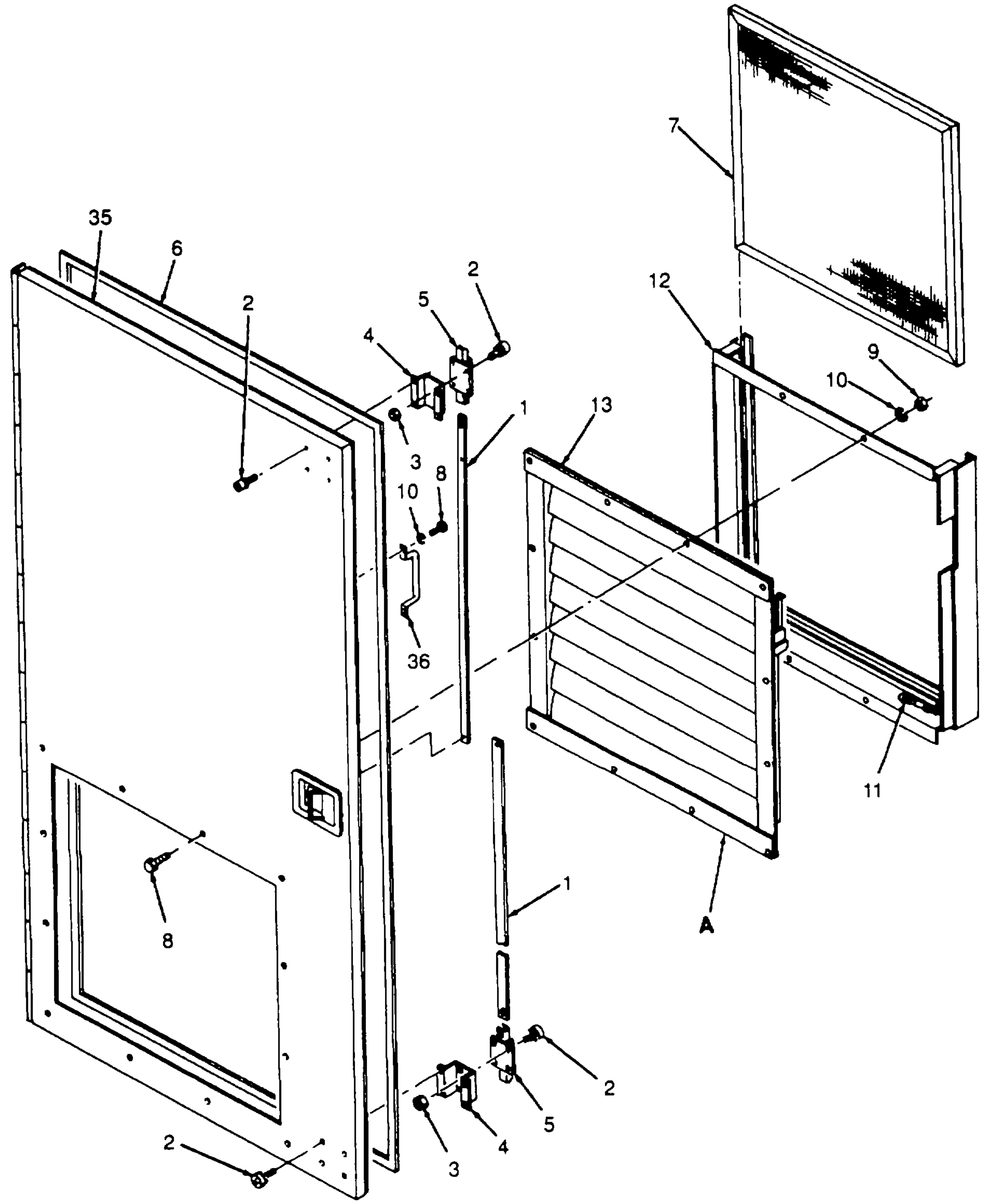


Figure 4-22. Control Room Door Assembly (Sheet 1 of 3)

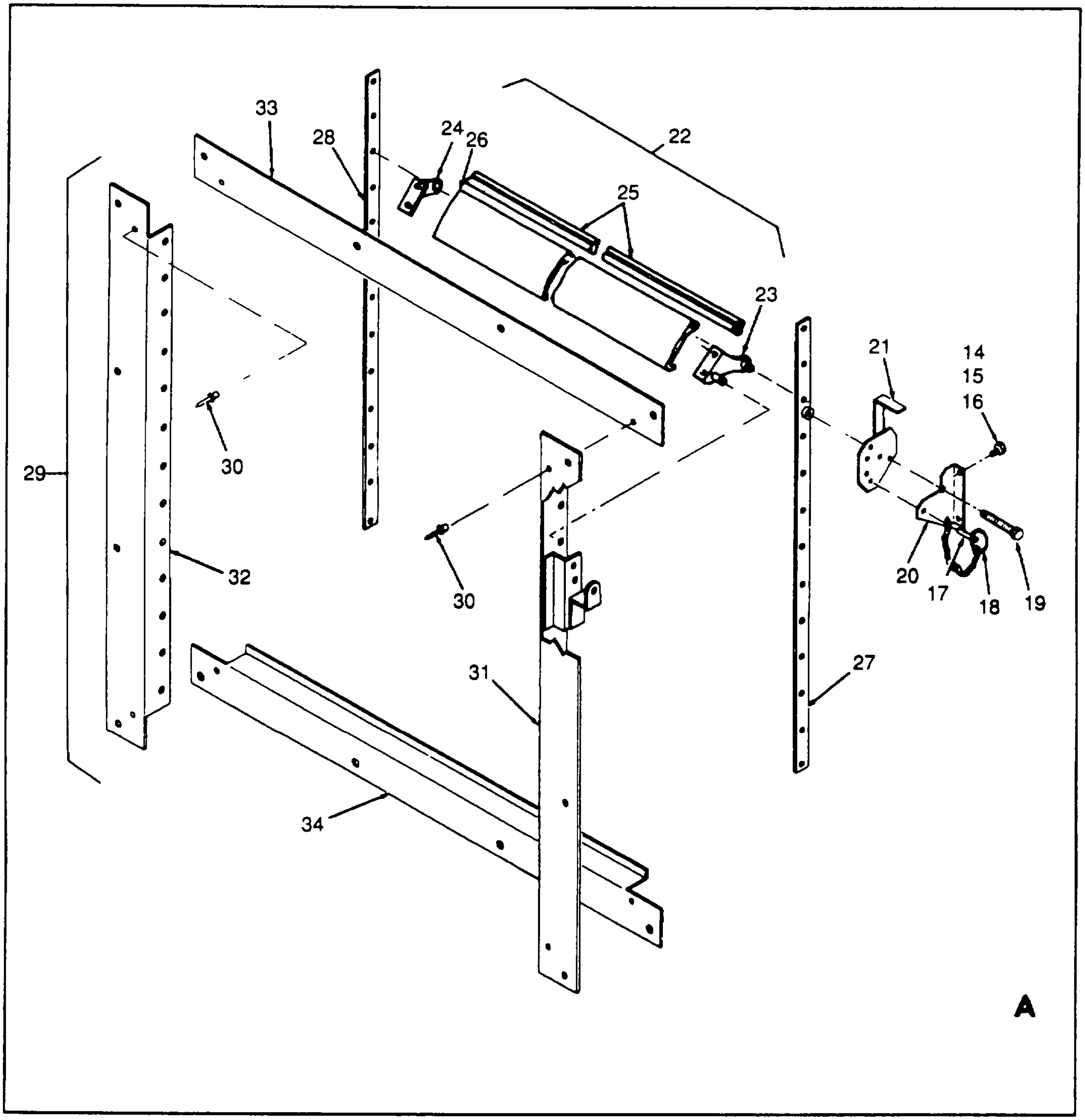


Figure 4-22. Control Room Door Assembly (Sheet 2 of 3)

1. BAR
2. SCREW AND CAPTIVE WASHER ASSEMBLY
3 NUT AND CAPTIVE WASHER ASSEMBLY
4. DOOR LOCK SUPPORT
5. STRIKER
6 DOOR SEAL, 210 INCHES
7 AIR FILTER
8. HEXAGON HEAD CAPSCREW
9. HEXAGONAL NUT
10. LOCKWASHER
11. CHAIN ASSEMBLY
12. AIR FILTER MOUNTING SHROUD
13. REAR DOOR SHUTTER ASSEMBLY
14. HEXAGON HEAD BOLT
15. LOCKNUT
16 FLAT WASHER
17 CONNECTING PIN
18 LOCKING RING
19. PIN ASSEMBLY
20. LEVER MOUNTING BRACKET
21 CONTROL LEVER ASSEMBLY
22. VANE ASSEMBLY
23 RIGHT HAND CRANK
24 LEFT HAND CRANK
25. VINYL SEAL
26. VANE STOCK
27 RIGHT HAND CONTROL BAR
28 LEFT HAND CONTROL BAR
29. FRAME ASSEMBLY
30. RIVET
31. RIGHT HAND FRAME SECTION
32. LEFT HAND FRAME SECTION
33 TOP FRAME SECTION
34. BOTTOM FRAME SECTION
35 RIGHT HAND DOOR PANEL ASSEMBLY
36 GRAB HANDLE

Figure 4-21. Control Room Door Assembly (Sheet 3 of 3)

(6) Disassemble each of the 13 vane assemblies (22) by removing the right and left hand cranks (23 and 24) and vinyl seals (25) from the vane stocks (26). Remove the right and left hand control bars (27 and 28).
(7) Break down the frame assembly (29) by removing rivets (30), separating the right and left hand frame sections (31 and 32) and the top and bottom frame sections (33 and 34).

g. <u>Disassembly of Cover (26. Figure 4-15).</u>
(1) Remove screw and captive washer assemblies (1, Figure 4-23) and nut and captive washer assemblies (2) to remove retainer (3) and rubber strip (4)
(2) Remove door latch rod (5) from cover (6)

h. <u>Disassembly of Radiator Shutter (3. Figure 4-16</u>). Remove hexagon head bolt (1, Figure 4-24), locknut (2), flat washer (3), locking ring (4), pin assembly (5), spacer (6), and right hand and left hand control lever assemblies (7 and 8).

i. <u>Repair.</u>
(1) Straighten bent bars and door holder rods
(2) Replace damaged door seals, roof weather strips, vinyl seals, and rubber strips.

WARNING

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag, and airborne particles. Wear welding goggles with properly tinted lenses, apron or jacket, and gloves to prevent injury to personnel.

(3) Caulk all housing panels that have evidence of leaking with caulking compound.
(4) Doors, roof panels, desk top, side panels, and the cover assembly are to be repaired by straightening if possible, and by welding in accordance with MIL-W-12332A If necessary Door handles are tack welded in place. Door handles may be replaced by cutting the welds loose with a grinder and tack welding a new handle in place.

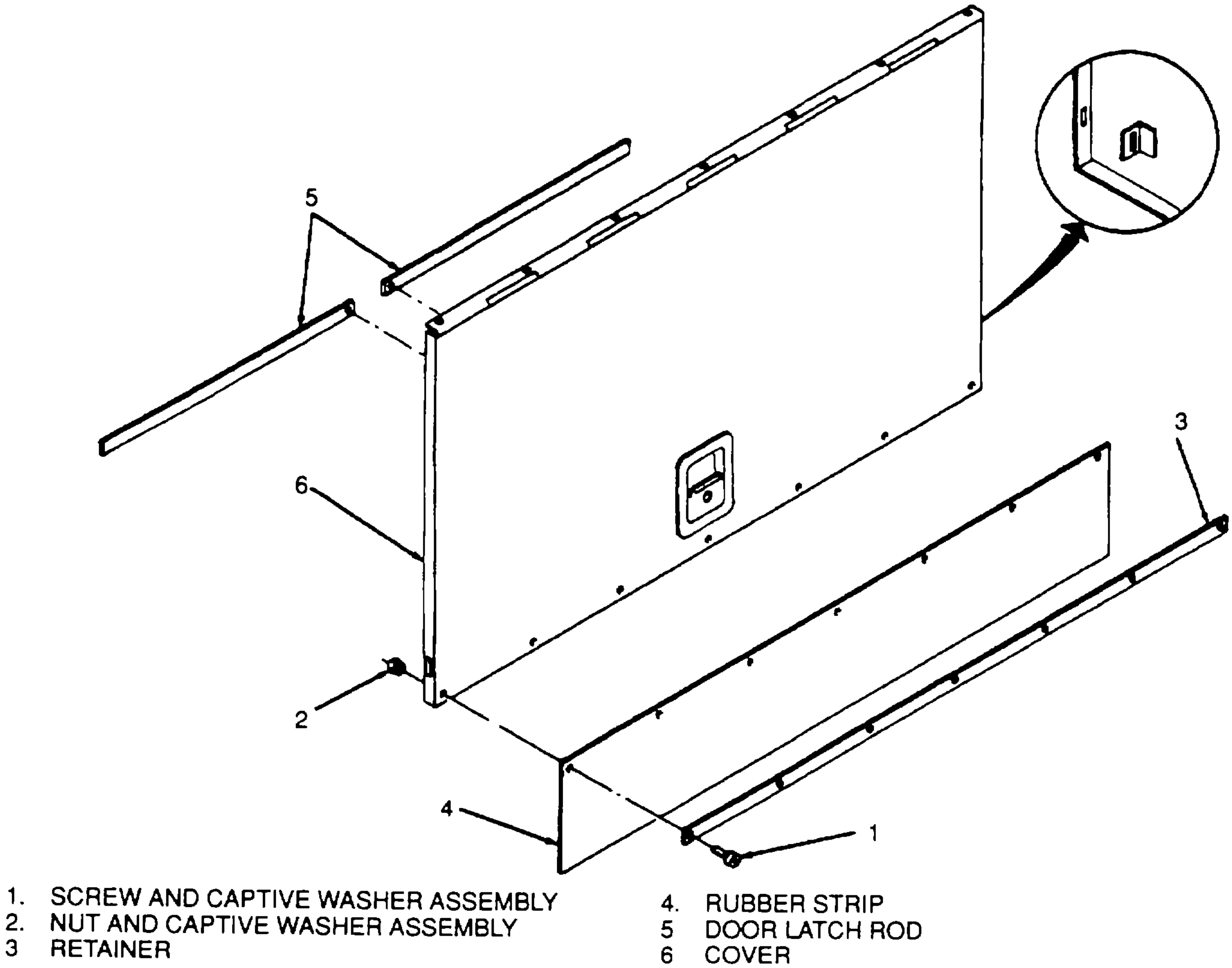


Figure 4-23. Cover Assembly

WARNING

Paint Is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection Is required to prevent injury to personnel.

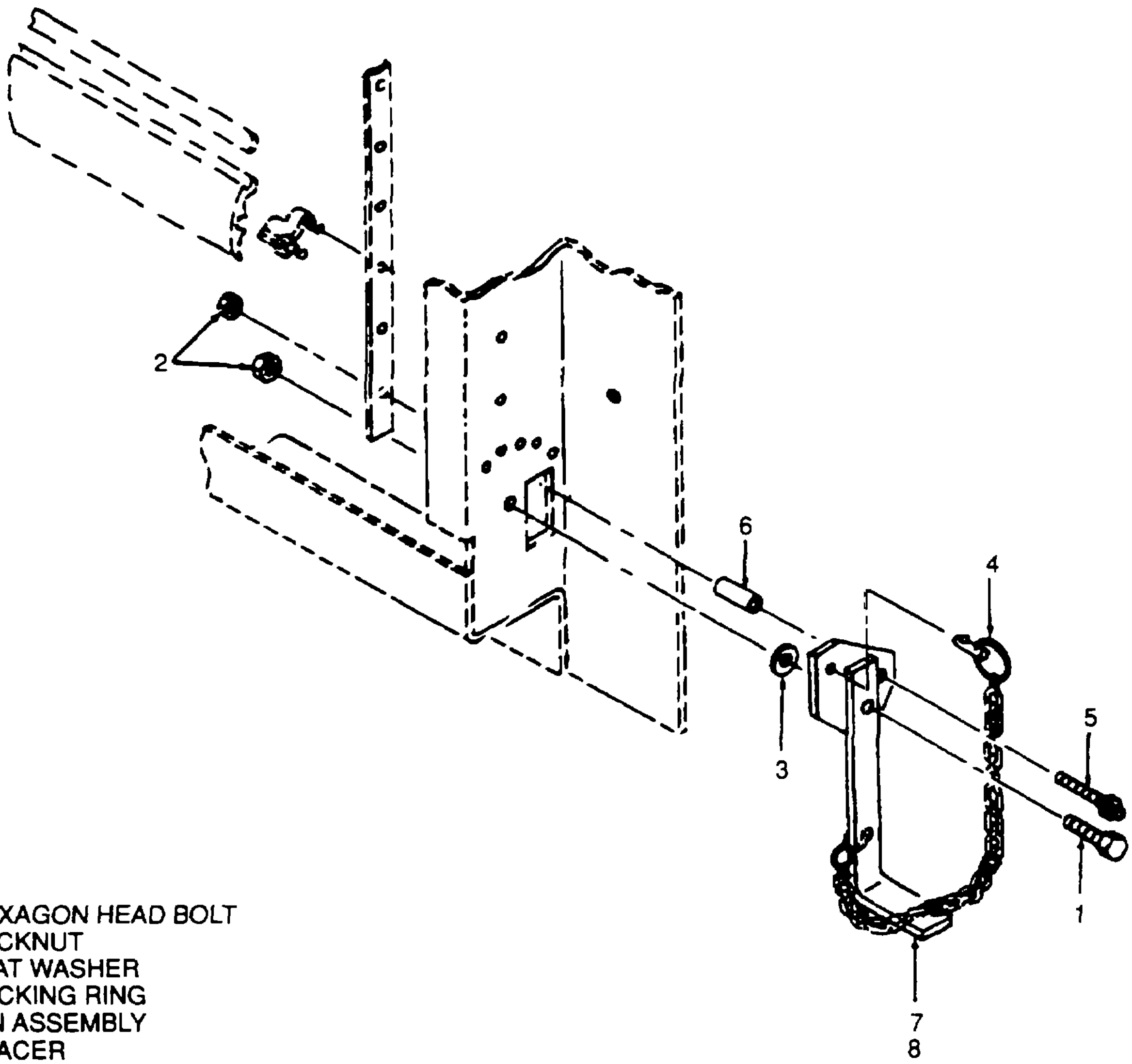
(5) Repaint as required In accordance with MIL-T-704.

j. Assembly of Radiator Shutter (3. Figure 4-16). Mount right hand and left hand control lever assemblies (7 and 8, Figure 4-24) using spacer (6), pin assembly (5), locking ring (4), flat washer (3), locknut (2), and hexagon head bolt (1).

k. Assembly of Cover Assembly (26. Figure 4-15).

(1) Install door latch rod (5, Figure 4-23) onto cover (6).

(2) Mount rubber strip (4) and retainer (3) using screw and captive washer assemblies (1) and nut and captive washer assemblies (2).



1 HEXAGON HEAD BOLT
2. LOCKNUT
3. FLAT WASHER
4. LOCKING RING
5. PIN ASSEMBLY
6. SPACER
7 RIGHT HAND CONTROL LEVER ASSEMBLY
8. LEFT HAND CONTROL LEVER ASSEMBLY

Figure 4-24. Radiator Shutter Control Lever Assembly

l. <u>Assembly of Rear Door Assembly (33. Figure 4-15</u>).

(1) Assemble frame assembly (29, Figure 4-22) by attaching top and bottom frame sections (33 and 34) and right and left hand frame sections (31 and 32) with rivets (30).

(2) Position the right and left hand control bars (27 and 28) and secure by assembling the right and left hand cranks (23 and 24) and vinyl seals (25) on each of the vane stocks (26) and installing each of the 13 vane assemblies (22).

(3) Mount the control lever assembly (21) and lever mounting bracket (20) with the pin assembly (19), locking ring (18), connecting pin (17), flat washer (16), locknut (15), and hexagon head bolt (14).

(4) Attach chain assembly (11) to air filter mounting shroud (12). Mount the assembled rear door shutter assembly (13) and air filter mounting shroud (12) with hexagon head cap screws (8), hexagonal nuts (9) and lock washers (10) Install air filter (7).

(5) Attach striker (5) to door lock support (4) with screw and captive washer assemblies (2) and nut and captive washer assemblies (3), then mount using additional screw and captive washer assembly (2).
(6) Install door seal (6) and attach bar (1).
(7) Install grab handle (36) using hexagon head cap screws (8) and lock washers (10)

m. <u>Assembly of Right Hand (4. Figure 4-20) and Left Hand (4. Figure 4-19) Shutter Door Assemblies</u>. Mount the right hand/left hand control lever (8, Figure 4-21) and lever mounting bracket (7) using pin assembly (6), locking ring (5), connecting pin (4), flat washer (3), locknut (2) and hexagon head bolt (1).

n. <u>Assembly of Right Hand Shutter Door Assembly (54. Figure 4-15).</u>
(1) Install door seal (11, Figure 4-20) onto right hand door (12).
(2) Attach striker (10) to door lock support (9) with screw and captive washer assemblies (7) and nut and captive washer assemblies (8), then mount using additional screws and captive washer assemblies (7).
(3) Attach bar (6) and door holder rod (5).
(4) Install right hand shutter assembly (4) using hexagon head cap screws (1), lock washers (2), and hexagonal nuts (3).

o. <u>Assembly of Left Hand Shutter Door Assembly (14. Figure 4-15</u>).
(1) Install door seal (11, Figure 4-19) onto left hand door (12)
(2) Attach striker (10) to door lock support (9) with screw and captive washer assemblies (7) and nut and captive washer assemblies (8), then mount using additional screw and captive washer assemblies (7).
(3) Attach bar (6) and door holder rod (5).
(4) Install left hand shutter assembly (4) using hexagon head cap screws (1), lock washers (2), and hexagonal nuts (3).

p. <u>Assembly of Fixed Frame Shutter Assemblies (18 and 12. Figure 4-15).</u>
(1) Mount right and left hand angles (17 and 18, Figure 4-18) onto frame assembly (19) using round head screws (16).
(2) Assemble the right and left hand cranks (10 and 11) and vinyl seals (12) onto each of the vane stocks (13). Position the right and left hand control bars (14 and 15) and secure by installing each of the 23 vane assemblies (9).
(3) Mount the right hand control lever (8) and lever mounting bracket (7) with the pin assembly (6), locking ring (5), connecting pin (4), flat washer (3), locknut (2), and hexagon head bolt (1)

q. <u>Assembly of Door Assemblies (10. Figure 4-15).</u>
(1) Mount the door seal (7, Figure 4-17) onto door panel assembly (8)
(2) Attach striker (6) to door lock support (5) with screw and captive washer assemblies (3) and nut and captive washer assemblies (4), then mount using additional screw and captive washer assemblies (3).
(3) Install door holder assembly (2) and bar (1).

416. INSTALLATION OF RADIATOR SHUTTER ASSEMBLY.

a. Mount support (14, Figure 4-16) and secure with hexagon head cap screws (13), lock washers (8), and hexagonal nuts (9).
b. Mount support (12) and secure with hexagon head cap screws (6), flat washers (7), and lock washers (8).
c. Install shutter mounting supports (10 and 11) and secure with hexagon head cap screws (1 and 6), flat washers (4 and 7), lock washers (2 and 8), and hexagonal nuts (5 and 9).
d. Mount the radiator shutter assembly (3) and secure with hexagon head cap screws (1), lock washers (2), and flat washers (4)

4-17. INSTALLATION OF ACCESS DOORS, SHUTTERS, AND ROOF PANELS..

a. Installation of Access Doors and Shutters.

NOTE

The seams of all roof panels, access doors and shutter must be caulked with RTV sealant when reinstalling panel

(1) Install the #1, #2, and #3 right lower supports (60, 59, and 58, Figure 4-15), front corner post (57), right hand shutter assembly (18), #2 right side panel (56), two door assemblies (10), #3 right side panel (55), and right hand shutter door assembly (54) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3), and screw and captive washer assemblies (8) and nut and captive washer assemblies (9).

(2) Install the #4, #5, and #6 lower right supports (52, 48, and 47) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3) Attach left hand shutter assembly (12), door seal (19), and door holder rod (20) to right hand door (53).

(3) Install #7 right rear corner post (44), #6 and #5 right side panels (45 and 46), #4 upper right side panel (49) and #4 lower right side panel (51) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3), screw and captive washer assemblies (8) and nut and captive washer assemblies (9). Insert conduit box sealing frame (50) and secure with screw and captive washer assembly (8).

(4) Install cover assembly (43) and floor plates (42, 41, and 40) using countersunk flat head machine screws (39).

(5) Install rear door stop plate (38), door holder clip (37), right hand rear panel (36), drip channel (35), left hand rear panel (34), and door assembly (33) with hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3), screw and captive washer assemblies (8), and nut and captive washer assemblies (9).

(6) Install #6 left lower support (32), #7 left rear corner post (31), and #5 and #4 left lower supports (30 and 29) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3).

(7) Install door gasket (27) and cover assembly (26) onto the #4 bottom left side panel (28) with screw and captive washer assembly (24) and nut and captive washer assembly (25).

(8) Attach the right hand shutter assembly (18) and door seal (19) to left hand door (17) and install with the #6 and #5 left side panels (23 and 22), #4 bottom left side panels (28) and #4 upper left side panel (21) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3), screw and captive washer assemblies (8), and nut and captive washer assemblies (9).

(9) Attach left hand shutter assembly (12) to #2 left side panel (11), and Install #3 and #2 left lower supports (16 and 15), left hand shutter door assembly (14), #3 left side panel (13), and two door assemblies (10) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3), screw and captive washer assemblies (8), and nut and captive washer assemblies (9).

(10) Install #1 left lower support (5), ladder assembly (6), and #1 L2 side panel (7) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3).

b. Installation of Roof Panels.

(1) Mount floating receptacle (21, Figure 4-14) onto #1 top roof panel (8) using rivet (20). Install door seal (19). Install radiator fill access door (18) with nut and captive washer assembly (17) and screw and captive washer assembly (16) Install quarter-turn stud (15) and secure with cross pin (14) Mount handle (13) using screw and captive washer assembly (12).

(2) Install right and left hand upper front stiffeners (24 and 25), wiring support (10), #1 top roof panel (8), #2 top roof panel (7), and #3 top roof panel (6), gaskets (9), using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3).

(3) Install right and left hand upper center stiffeners (22 and 23), wiring support (11), the #4 top roof panel (5) and #5 and #6 top roof panels (4), gaskets (9) using hexagon head cap screws (1), hexagonal nuts (2), and lock washers (3).

(4) Install right and left hand upper rear stiffeners (5 and 6, Figure 4-12), the #7-#11 top roof panel (7), the #12 top roof panel (4), gaskets (8), gasket (12, Figure 4-13), and roof angles (4 through 8) using hexagon head cap screws, hexagonal nuts, and lock washers (1, 2, and 3, Figure 4-12), and screw and captive washer assemblies (1, Figure 4-13).
(5) Install hexagon head cap screws (16, Figure 4-13), lock washers (17), and hexagonal nuts (18), securing roof angles (4 through 8).
(6) Install hexagon head cap screws (16, Figure 4-13), flat washers (18), lock washers (17), and hexagonal nuts (19), and install conduit support assembly (13).
(7) Install hexagon head cap screws (16), lock washers (17), flat washers (18), and hexagonal nuts (19), and install support brackets (15) and conduit support hanger (14).
(8) Install mufflers In accordance with paragraph 3-15.

4-18. MAINTENANCE OF SOUND INSULATION PANELS. See Figure 4-13. Interior roof and wall panels of the control room are lined with sound insulation material comprised of acoustic dampers and absorbers. To minimize transmission of engine noise and vibration into the control room and switchgear compartments, the rear control cabinet panels and supporting hardware are likewise acoustically insulated with acoustic barriers, absorbers, and dampers Repair of sound insulation panels generally consists of patching minor tears and holes on the exterior fabric lining or replacement of sound insulation layers where damage or deterioration is evident.

a. Repair. Repair minor tears and holes on the grey fabric lining by patching over with fabric mending tape.

b. Replace. Replacement of sound insulation layers consists of removal of all components mounted on the affected housing panel, removal and replacement of sound insulation material on housing panels, and reinstallation of components and panels. It is recommended that replacement sound insulation layers be precut to proper dimensions prior to installation.

(1) Determine area requiring sound insulation replacement Remove all mounted assemblies or components from affected panel(s) as needed If electrical components require removal, tag and disconnect all wiring connections prior to removal.

(a) For removal of AC components such as distribution panels, 120 V ac receptacles, junction boxes, control room heater, light fixtures and switches, refer to the appropriate paragraphs In Section IX of this Chapter (b) For removal of fan and motor assembly B1 03, fire extinguisher brackets, fan shutter assembly, desk top, and document component, refer to paragraph 4-12 of this section.

(2) Remove housing panels requiring sound insulation replacement.

(a) To remove roof panels, refer to paragraph 4-13, step a, and Figure 4-12 and Figure 4-14. Note that only the first three roof panels (4 and 7, Figure 4-12) directly above the control room are acoustically insulated.

(b) To remove control room panels requiring sound insulation replacement, refer to paragraph 4-13 and Figure 4-15.

(c) To remove engine/generator compartment sound insulations (at rear of switchgear cabinets only), refer to step d, below.

(3) Roof Panel Insulation Replacement.

(a) Remove roof angles (4 and 5, Figure 4-13) from #12 roof panel (4, Figure 4-12) by removing screw and captive washer assemblies (1, Figure 4-13) at both panel ends. Remove roof strips (2 and 3, Figure 4-13) and roof angles (6, 7, and 8) from #10 and #11 roof panels by removing screw and captive washer assemblies (1) at panel comers.

WARNING

Dry cleaning solvent, P-D-680, Type II, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eyes and respiratory tract protection is required to avoid injury to personnel.

(b) Strip off damaged acoustic absorber layer (10) and damper layers (9) from roof panels. Clean panel inner surfaces with cleaning solvent P-D-680, Type II, or equivalent, and let dry.

(c) Peel off paper backing from precut layer of self-adhesive acoustic damper (9) and Install new layer on Inner surface of roof panel being worked on.

(d) With brush or roller, apply a uniform coat of water base adhesive on Installed acoustic damper (9) and allow to dry.

(e) With adhesive coating on damper layer dry, install precut layer of acoustic absorber, with its unfaced side (without fabric lining) flush against the adhesive coat. Apply pressure on quilted side of absorber layer with a roller to ensure uniform adhesion.

(f) Using roof strips (2 and 3, Figure 4-13) mounting holes on #5 roof panel corners as guides, punch holes through sound insulation layers to accommodate Installation of roof angles (6, 7, and 8) and roof strips (2 and 3). Use roof angle mounting holes on #12 roof panel (4, Figure 4-12) to align and punch mounting holes through sound insulation layers.

(g) Reinstall roof angles (6 and 7, Figure 4-13) and roof strips (2 and 3) on #11 roof panel such that the roof strip ends are Imposed over those of the roof angles. Secure roof angles and roof strips to roof panels by tightening screw and captive washer assemblies (1). Install roof angles (6, 7, and 8) and roof strips (2 and 3) on #10 roof panel as described for first #5 roof panel. Position one roof angle (8) to allow attachment to switchgear cabinet upper plate (11) and to accommodate installation of wiring support hardware above control cabinet C. Install roof angles (4 and 5) on #12 roof panel. Tighten all screw and captive washer assemblies (1).

c. Reinstall roof panels in accordance with paragraph 4-17.

d. Repair of Switchgear Access Panels and Related Parts. This step contains disassembly, repair, and reassembly procedures for acoustical insulation materials installed between the switchgear and the generator compartment. Disassemble only to the extent required for repair.

(1) Removal.

(a) Remove switchgear access panels (4 through 8, Figure 3-24) in accordance with paragraph 3-16.

(b) If damaged, thoroughly remove gaskets (9, Figure 3-24) from cabinet C.

(c) Remove hexagon head cap screws (1), lock washers (2), and washers (3) to remove acoustical panels (10, 11, and 12).

(d) If damaged, thoroughly remove gaskets (13 and 14).

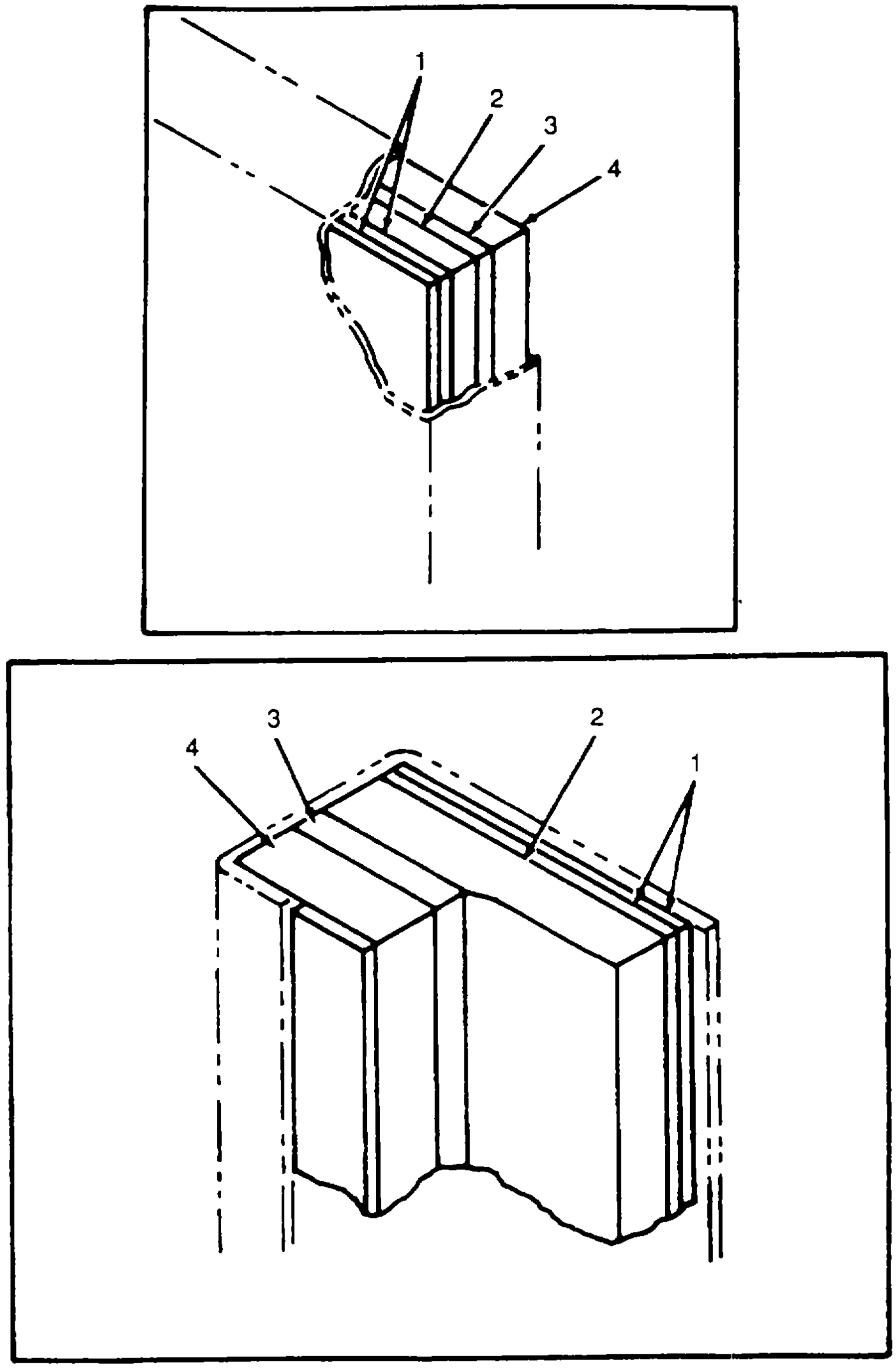
(e) Remove screw and captive washer assemblies (17) and flat washers (18) to remove acoustical panel covers (19 and 20).

(f) Remove hexagon head cap screws (21), lock washers (2), and flat washers (3) to remove acoustical panels (22 and 23).

(g) If damaged, thoroughly remove gaskets (24).

(2) Repair. To replace the acoustical insulation material In any acoustical panel or switchgear access panel, thoroughly remove the existing material and proceed in accordance with the following general procedure.

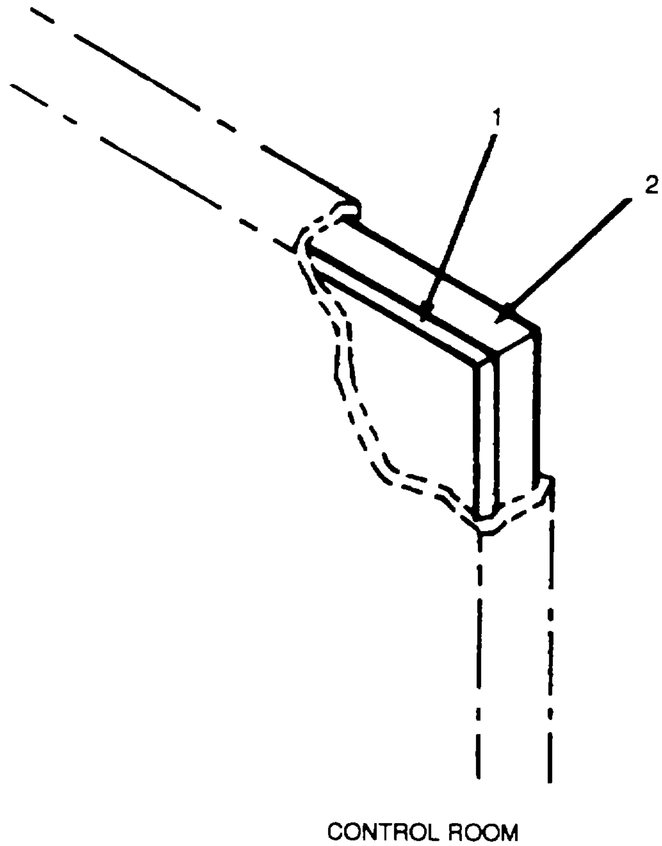
(a) Cut Insulation materials from bulk stock to fit panel being repaired.
(b) Install two layers of damper (1, Figure 4-25).
(c) Apply one coat of water base, pressure sensitive acrylic adhesive to entire surface of damper (1).
(d) Install one layer of unfaced fiberglass absorber (2) onto coated surface
(e) Apply one coat of water base, pressure sensitive acrylic adhesive to entire surface of unfaced fiberglass absorber (2).
(f) Install one layer of barrier (3) onto coated surface.
(g) Apply one coat of water base, pressure sensitive acrylic adhesive to entire surface of barrier (3).
(h) Install faced fiberglass absorber (4) onto coated surface so that unfaced side Is against adhesive coat.



ENGINE COMPARTMENT

1. DAMPER
2. UNFACED FIBERGLASS ABSORBER
3 BARRIER
4. FACED FIBERGLASS ABSORBER

Figure 4-25. Acoustical Panel Repair (Sheet 1 of 2)



1 ACOUSTICAL DAMPER 2. ACOUSTICAL ABSORBER

Figure 4-25. Acoustical Panel Repair (Sheet 2 of 2)

SECTION VIII . MAINTENANCE OF DC ELECTRICAL AND CONTROL SYSTEM

4-19. GENERAL. The DC electrical and control system starts, stops, and monitors the diesel engine which drives the generator. The relays, solenoids, motors, indicators, and other components which form the DC electrical and control system are located at various points throughout the generator set. This paragraph describes in detail how the generator set is started, protected, and stopped. Throughout the following discussion, it is assumed that OPERATION SELECTOR SWITCH S3 is set to MANUAL, unless stated otherwise. Refer, as necessary, to the generator set DC schematic, FO-1.

a. Arming Engine Starting Circuit. The engine starting circuit is armed when MAINTENANCE LOCKOUT switch S100 is set to OPERATE. This applies battery positive to MASTER SWITCH S9 through 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 and LOCAL REMOTE SW S2.

(1) 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 is normally set to ON. CB1 is a 20 ampere dc circuit breaker which serves to protect the generator set dc control system from overload. The circuit breaker is panel mounted on cabinet C door.

(2) MAINTENANCE LOCKOUT switch S100 is used to disarm the start circuit during generator set maintenance. Battery charger BC1, emergency lights DS20 through DS23, and the trip coil of load circuit breaker CB101 are the only elements capable of operating with power from batteries BT1 through BT4 when MAINTENANCE LOCKOUT switch S100 is15 set to MAINTENANCE. EMERGENCY LIGHTING CB CB2 operates the emergency lights. S100 and CB2 are both mounted on cabinet C door.

(3) Arming the start circuit activates several circuits before the engine is started.

(a) Cabinet C door engine panel lights DS26 through DS29 will light if PANEL LT SW S1 Is set to ON.

(b) OPEN indicator DS33 will light to indicate the condition of load circuit breaker CB101 CLOSED indicator DS34. will be off when the engine is not running since the trip coil of load circuit breaker CB101 is energized through the normally closed contacts of engine run relay K15D. This prevents CB101 from closing.

(c) PARALLEL indicator DS35 or SINGLE SET indicator DS36 will light to Indicate the setting of PARALLEL SWITCH S6. If S6 is at SINGLE SET, SINGLE SET indicator DS36 will light through the normally closed contacts of parallel relay K4A If S6 is set at PARALLEL and LOCAL REMOTE switch S2 is set to LOCAL, parallel self-latching relay K4A will be energized, effecting contact transfers so that SINGLE SET indicator DS36 is off, and PARALLEL indicator DS35 is illuminated.

(d) The fuel transfer system will operate if the generator set has been connected to an external source of AC utility power and If FUEL PUMP switch S8 has been set to AUTO or HAND If set to HAND, fuel transfer pump slave relay K12 will energize if float switch FL2 is closed FL2 is normally closed unless the fuel level in the generator set fuel tank is too high to merit bringing in additional fuel If FUEL PUMP switch S8 is set to AUTO, relay K12 will be energized If both FL1 and FL2 are closed. Thereafter, the relay will remain energized until both FL1 and FL2 are open Relay K13, the fuel transfer pump contactor, will receive battery positive through the self-latching contacts of relay K12. As the generator set fuel tank fills, FL1 will open, but relay K12 will still receive battery positive through Its self-latching contacts and diode CR2. When the tank is full, FL2 will open, and relay K12 will deenergize. Diode CR1 prevents back-EMF from developing across the FL1 contacts when relay K12 deenergizes. Diode CR2 prevents relay K13 from receiving battery positive through FL1 Note that If a high-fuel fault condition occurs, high fuel level fault relay K5 will be energized breaking the NC contact. Relay K13, the fuel transfer pump contactor, is then cut off from battery positive under all conditions until the high fuel annunciator circuit is reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A in the control room.

(e) If LOCAL REMOTE Switch S2 is set to LOCAL, START AID switch S10 will be connected to battery positive and the ether priming circuit will be enabled If the ambient engine temperature is below 40°F (40C). Thermoswitch S17 is closed if the ambient temperature is low enough. Solenoid valve L5 can then be energized If the START AID switch S10 is set to ON. When the switch is released, solenoid L5 is deenergized, causing a metered amount of ether to be injected into the engine intake manifold. Note that START AID switch S10 should be used only when the engine is cranking.

(f) ANNUNCIATOR RESET pushbutton S12, ALARM SILENCE pushbutton S16, and ANNUNCIATOR TEST pushbutton S15 will all be operable. After a generator set fault shutdown occurs, the fault circuits must be reset before the generator set can be restarted Pushing ANNUNCIATOR RESET pushbutton S12 will deenergize the latched fault relay (A10K1 through A10K9 or A11K1 through A11K9) that tripped the alarm circuit. Additionally, annunciator horn LS1 will silence, annunciator display panel A9 will go dark, and the engine start circuit will be reenabled. If ALARM SILENCE pushbutton S16 is pushed instead, annunciator horn LS1 will silence, the appropriate fault indicator on annunciator display panel A9 will cease flashing (but remain lit), and the engine start circuit will still be disabled. ANNUNCIATOR TEST pushbutton S15 can be used, once the system is reset, to test annunciator horn LS1 and the lights in annunciator display panel A9.

(g) Prelube pump B3 is also operable once 24 V dc battery power is made available through the MAINTENANCE LOCKOUT switch S100. The prelube pump B3 provides initial lubrication to the engine prior to engine start and is manually operated using PRELUBE SYS switch S5 on engine control cabinet C. Once engine oil pressure, as monitored, on the LUBE OIL PRESSURE GAGE, is stabilized and the engine is running, the prelube pump is manually deenergized by releasing PRELUBE SYS switch S5.

b. Initialization of Starting Circuit. If LOCAL REMOTE Switch S2 is set to LOCAL and the engine starting circuit has been armed, the generator set can be started (unless it is in a fault shutdown condition). Setting MASTER SWITCH S9 to START and releasing it to RUN applies battery positive to the generator set DC control circuits. The following events occur Immediately and simultaneously.

(1) Engine run relay K15B will energize to latch in the engine start circuit so that battery positive remains available after MASTER SWITCH S9 is released from START to RUN. A second set of K15B contacts closes to apply battery positive to engine fuel solenoid L1. Engine fuel solenoid L1 energizes to open a fuel line into the fuel block manifold.

(2) DC operating power is applied to synchronizer A105, load sharing panel A104, LUBE OIL PRESSURE gage M1, LUBE OIL TEMP gage M2, COOLANT TEMP gage M3, FUEL LEVEL gage M4, and TIME TOTALIZING meter M5.

(3) Engine run relay K15A is energized Its normally closed contacts open to remove 240 V ac power from generator GI heaters H109 and H110 (K15A contact sets are shown on the AC schematic, FO-2.).

(4) Engine run relay K15C is energized. Its normally closed contacts open to remove 120 V ac power from the coils of coolant and lube oil heater contactors K104A and K104B (K15C contact sets are shown on the AC schematic, FO-2.)

(5) Engine run relay K15D is energized. Its normally closed contacts open to remove battery positive from the trip coil of load circuit breaker CB101. This action prepares CB101 for arming. Arming of the circuit breaker is accomplished by synchro-check relay K116. The operation of synchro check relay K116 is explained in paragraph 4-34.

(6) Battery positive is applied to coolant level warning switch S13 and coolant level shutdown switch S14. Unless coolant level is low, both switches will be open if not, a warning circuit and possibly a shutdown circuit will be activated in accordance with step d, below.

(7) Battery positive is applied to OVERCURRENT relay K114. The operation of K114 is explained in paragraph 4-34.

(8) Crank cycle timer relay M7 receives battery positive and begins to operate as described in step c, below.

c. Engine Cranking. Crank cycle timer relay M7 controls starter motors B1 and B2. The timer will cause the starter motors to crank for 15 seconds (nominal), then rest for 15 seconds (nominal), for a total of four crank cycles. If at the end of the fourth cranking cycle the engine has not started, the EXCESSIVE CRANKING fault circuit will trip, putting the generator set into a fault shutdown condition. The circuit works as follows:

(1) Battery positive is applied to M7 pin 4 when MASTER SWITCH S9 is set to START and released to RUN. When this occurs, battery positive appears immediately at M7 pin 7, energizing crank relay K3.

(2) Normally open contacts of crank relay K3 close to apply battery positive to the field flashing terminals (F+ and F-) of voltage regulator VR101. Voltage regulator VR101 applies field flashing current to the exciter of generator G1.

(3) A second set of normally open contacts In crank relay K3 closes to apply battery positive to starter slave relays K1 and K2. The normally open contacts of starter slave relays K1 and K2 close to apply battery positive to starter solenoids L3 and L4, respectively.

(4) Starter solenoids L3 and L4 energize and their normally open contacts close to apply battery positive to starter motors B1 and B2, respectively. The starter motors begin cranking the engine for 10 to 20 seconds. The engine accelerates.

(5) If the engine fails to reach 600 rpm before M7 times out (10 to 20 seconds), battery positive will be cut off from M7 pin 7, and crank relay K3 will deenergize. The contacts of relay K3 will open, cutting off battery positive from the voltage regulator field flashing terminals and from starter relays K1 and K2. The contacts of relays K1 and K2 will open, cutting off battery positive from starter solenoids L3 and L4. Solenoids L3 and L4 will cut off starter motors B1 and B2, ending the cranking cycle. The starter motors will then have 10 to 20 seconds to cool down before M7 pin 7 again delivers battery positive to crank relay K3, whereupon steps (2), (3), and (4), above, are repeated. Note that if the generator set enters a second, third, or fourth crank cycle, the operator should use START AID switch S10 to inject ether into the engine intake manifold. Ether will not be injected, however, if the ambient engine temperature is above 40°F (4°C) because thermoswitch S17 will be open. If the engine fails to start after four crank cycles, the generator set will go into a fault shutdown condition.

(6) Speed switch SS1/SS2/SS3 is connected to the tachometer drive on the engine fuel pump and senses engine speed at all times. When engine speed rises above 600 rpm, SS1 trips to simultaneously connect battery positive to M7 pin A and disconnect battery positive from M7 pin 4. Loss of battery positive at K7 pin 4 results in loss of power at M7 pin 7, crank relay K3 deenergizes and starter motors B1 and B2 are cut off as described in step (5), above. The engine will rapidly continue to accelerate under its own power.

(7) SS2 will close when engine speed reaches 1200 rpm. Thereafter, shutdown relay K14 is self-latching if EMERGENCY SHUTDOWN pushbutton S7 is pressed or MASTER SWITCH S9 is set to STOP while engine speed is above 1200 rpm. When the relay is energized, the normally closed contacts of relay K14 open to cut off battery positive from the DC control circuits. Crank timer relay M7 Is Inhibited, preventing the operator from attempting to restart the engine while it is freewheeling at 1200 rpm or higher. The operator should wait until the engine comes to a complete halt before restarting.

(8) Engine speed stabilizes at 1500 rpm (50 hertz operation) or 1800 rpm (60 hertz operation) Engine speed is controlled thereafter by load sharing module A104.

(9) 15 to 25 seconds after the appearance of battery positive at M7 pin A (refer to step (6), above), battery positive appears at M7 pin B to energize relays K17A and self-latching relay K17B. Normally open contacts of K17A close to arm oil pressure shutdown relay K18. A second set of normally open K17A contacts close to arm undervoltage annunciator fault relay A10K8, low oil pressure annunciator fault relay A10K2, and underfrequency annunciator fault relay. All K5 Battery positive remains available at K7 pin B for about 40 seconds, then switches off with no effect upon the circuitry.

(10) The engine will continue to run at operating speed until manually shut down (refer to step f, below) or automatically shut down by a protective circuit (refer to step d, below). Control of of the engine at operating speeds is accomplished via the AC power generation and electrical control circuits. Refer to paragraph 4-32 for details.

d. Generator Set Protective Circuits. There are nine fault sensors used to monitor conditions in the engine, cooling system, lubricating system, and fuel system. They are the fuel level switches FL3 and FL4; oil pressure alarm switch OP2, and oil pressure shutdown switch OP1, high oil temperature switch OT2, overspeed switch SS3, coolant level switches S13 and S14; coolant temperature warning switch WT2, and coolant temperature shutdown switch WT1. On a fault condition, these sensors cause a warning to be displayed to the operator. Additionally, some of them cause a generator set shutdown. These sensors function In the DC control circuit as follows:

(1) Low Fuel Level Switch FL3. Low fuel level switch FL3 is mounted through the top of the generator set fuel tank and is accessible through the floor of the control room. FL3 will close on a low fuel condition to energize self-latching relay A10K5 in the annunciator alarm system. Annunciator horn LS1 sounds and annunciator panel light A9DS5 flashes while the generator set continues to run. A10K5 also energizes low fuel level time delay relay K23. After a preset time delay (normally 35 minutes) relay K23 will energize fault shutdown relays K20A and K20B. Relay K20A deenergizes self-latching engine run relay K15B. As a result, engine fuel solenoid L1 loses power, closes, and cuts off fuel to the engine; the engine shuts down. Relay K20B energizes circuit breaker trip relay K30. Relay K30 energizes the trip coil n load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The generator set cannot be restarted until the annunciator alarm system is reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A. Theoretically, low fuel level fault shutdown will not occur because the operator will replenish the generator set fuel supply and reset the alarm circuit before the time delay (normally 35 minutes) elapses. Note that If the operator replenishes the fuel supply, but fails to reset the alarm circuit via ANNUNCIATOR RESET pushbutton S12, low fuel level time delay relay K23 will still time out and cause a generator set shutdown. The operator will not be able to reset the alarm circuit before replenishing the fuel, but failure to reset the circuit after refueling will result in a shutdown. The purpose of this circuit is to back up the fuel transfer system circuit. If the fuel transfer system circuit is operational and set to AUTO, low fuel level alarm relay A10K5 will not trip. If the generator set is connected to an adequate external fuel supply.

(2) High Fuel Level Switch FL4 High fuel level switch FL4 is mounted through the top of the generator set fuel tank and is accessible through the floor of the control room FL4 will close on a high fuel condition to energize self-latching relay A 10K6 in the annunciator alarm system. Horn LS1 sounds and annunciator panel light A9DS6 flashes while the generator set continues to run. A10K6 will energize high fuel level fault slave relay K5. Relay K5 will open its normally closed contacts to deenergize fuel pump contactor K13. Transfer pump contactor K13 will open its normally closed contacts to cut off 120 V ac from fuel transfer solenoid L102 and fuel transfer pump contactor K106. Contactor K106 will deenergize, cutting off 240 V ac from fuel transfer pump motor B102. Solenoid valve L102, deenergized will close to block the fuel inlet line, preventing any more fuel from entering the generator set fuel tank. This protection circuit primarily prevents overfilling of the generator set fuel tank by gravity feed (siphoning) from the external fuel supply. Secondarily, the circuit guards against fuel transfer system "runaway" which could occur if high fuel level float switch FL2 failed to open upon a high fuel level condition.

(3) Oil Pressure Alarm Switch OP2. Oil pressure alarm switch OP2 is mounted on the right end of the lube filter head assembly. To allow time for oil pressure to build up in the engine block, the low oil pressure alarm circuit is not armed until 15 to 25 seconds after engine speed has exceeded 600 rpm. Oil pressure in the engine block causes the normally closed switch OP2 to open. If oil pressure should fall below 37 to 41 psi (255 to 283 kPa) during engine operation, OP2 will close to energize self-latching relay A10K2. Annunciator horn LS1 sounds and annunciator panel light A9DS2 flashes while the generator set continues to run. The operator is expected to investigate the cause of the low oil pressure warning. Generally, the cause will be insufficient crankcase oil in the engine. Failure to find and correct the cause of the warning may result in a generator set shut down caused by oil pressure shutdown switch OP1.

(4) Oil Pressure Shutdown Switch OP1. Oil pressure shutdown switch OP1 is mounted on the right end of the lube filter head assembly (OP1 and OP2 are in the same housing). To allow time for oil pressure to build up in the engine block, the oil pressure shutdown circuit is not armed until 15 to 25 seconds after engine speed has exceeded 600 rpm. Oil pressure in the engine block causes normally closed switch OP1 to open. If oil pressure should fall below 28 to 32 psi (193 to 221 kPa) during engine operation, OP1 will close to energize oil pressure shutdown relay K18. Relay K18 will energize fault shutdown relays K20A and K20B Relay K20A deenergizes self-latching engine run relay K15B. As a result, engine fuel solenoid L1 loses power, closes, and cuts off fuel to the engine; the engine shuts down. Relay K20B energizes circuit breaker trip relay K30. Relay K30 energizes the trip coil in load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The generator set cannot be restarted until the annunciator alarm system is reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(5) Oil Temperature Switch OT2. Oil temperature switch OT2 is mounted on the left side of the engine oil pan. If the oil temperature in the engine sump rises to 242 to 248°F (117 to 120°C) or higher, the normally open switch OT2 will close to energize self-latching relay A10K4 in the annunciator alarm system. Annunciator horn LS1 sounds and annunciator panel light A9DS4 flashes.

(6) Overspeed Switch SS3. Overspeed switch SS3 is connected to the tachometer drive of the engine fuel pump, which is located on the left side of the engine. Overspeed switch SS3 senses engine speed at all times. If engine speed uses above 2200 rpm, the normally open contacts of switch SS3 will close to energize overspeed shutdown relays K19A and K19B. Relay K19A energizes fault shutdown relays K20A and K20B and air shutdown solenoids L2A and L2B. Relays K20A and K20B shut down the generator set as described in step (4), above. Solenoids L2A and L2B close the air control valves to cut off air to the engine air intake manifolds. Relay K19B energizes self-latching relay A10K1 in the annunciator alarm system. Annunciator horn LS 1 sounds and annunciator panel light A9DS1 flashes. With both fuel and air cut off, the engine shuts down. Solenoids L2A and L2B remain energized only as long as engine oil pressure keeps normally open air shutdown solenoid disconnect switch OP3 closed. OP3 serves to automatically deenergize solenoids L2A and L2B after the engine shuts down. This automatic deenergization is required because solenoids L2A and L2B are not rated for continuous duty. Once an overspeed fault shutdown occurs, the engine can be restarted only after the fault circuit is reset through the ANNUNCIATOR RESET switch on generator control cabinet A and the two air control valves mounted near the turbocharger are manually reset to the open positions and the speed switch button is reset.

(7) Coolant Level Warning Switch S13. Coolant level warning switch S13 is a solid state capacitor activated device that is mounted near the top front of the radiator and is visible when the radiator shutter is opened. Proper radiator coolant level holds the normally closed switch open. If coolant falls below proper level, switch S13 closes to energize coolant level alarm slave relay K22 Relay K22 will energize annunciator alarm system. Annunciator horn LS1 sounds and annunciator panel light A9DS15 flashes while the generator set continues to run.

(8) Coolant Level Shutdown Switch S14. Coolant level shutdown switch S14 is a solid state capacitor activated device that is mounted near the top front of the radiator and is visible when the radiator shutter is opened. Proper radiator coolant level holds the normally closed switch open. To an extent, a below normal coolant level will also hold the switch open. If coolant level falls to a level that the coolant temperature switch WT2 is compromised, coolant level shutdown switch S14 will close to energize coolant level shutdown relay K21. Relay K21 does not trip an annunciator system circuit. An alarm will have already been annunciated as a result of the closing action of coolant level warning switch S13. Instead, relay K21 energizes fault shutdown relays K20A and K20B directly. Relays K20A and K20B shut down the generator set as described in step (4), above.

(9) Coolant Temperature Warning Switch WT2. Coolant temperature warning switch WT2 is mounted on the thermostat housing on the left side of the engine. If coolant temperature rinses to 206 to 216°F (97 to 99°C), the normally open switch WT2 will close to energize self-latching relay A10K3 in the annunciator alarm system. Horn LS1 will sound and annunciator panel light A9DS3 will flash while the generator set continues to run. The operator is expected to investigate the cause for the alarm and, If possible, effect a remedy before coolant temperature rises high enough to trigger a generator set shutdown via coolant temperature shutdown switch WT1. Probable causes for high coolant temperature include restricted air flow to the radiator, a broken engine fan belt, blockage In the cooling system, a malfunctioning water pump, or overload. Regarding air flow restrictions, the operator should be sure that the radiator louvers are open to allow exhaust air to exit and that the shutter door assemblies are open to admit air.

(10) Coolant Temperature Shutdown Switch WT1. Coolant temperature shutdown switch WT1 is mounted on the thermostat housing on the left side of the engine. If coolant temperature rises to 215 to 219°F (102 to 104°C), the normally open switch WT1 will close to energize fault shutdown relays K20A and K20B. Relays K20A and K206 shut down the generator set as described in step (4), above. Coolant temperature shutdown switch WT1 does not trip an annunciator alarm system circuit. An alarm will have already been annunciated as a result of the closing action of coolant temperature alarm switch WT2.

e. <u>Fuel Level Transmitter MT4</u>. Fuel level transmitter MT4 is mounted through the top of the generator set fuel tank and is accessible through the floor of the control room. MT4 is a float-actuated potentiometer in series between battery ground and FUEL LEVEL gage M4 on cabinet C door. The resistance of MT4 will vary from 0 ohms to 30 ohms as the fuel level vanes from full to empty. The resultant variation in dc current through FUEL LEVEL gage M4 is used to provide a visual indication of fuel level.

f. Generator Set Shutdown Circuits. The generator set may shut down automatically in response to a fault condition signal from the DC or AC system, or it may be shut down manually. DC shutdown circuits are described in step d, above. AC shutdown circuits are described in paragraph 4-33. Manual shutdown methods are explained below. There are three ways to manually shut down the generator set by using MASTER SWITCH S9 on cabinet C door; by using EMERGENCY SHUTDOWN pushbutton S7 on cabinet C door, and by using the EMERGENCY SHUT- DOWN control on the skid base. The following steps describe the operation of these shutdown methods.

g. MASTER SWITCH S9. MASTER SWITCH S9 is located on cabinet C door and is used to shut down the generator set in accordance with Chapter 2 of this manual. Setting switch S9 to STOP will disconnect battery positive from generator set DC control circuits.

(1) The following events occur immediately and simultaneously.

(a) Shutdown relay K14 will be connected to battery positive through switch S9, the relay will energize and latch for as long as engine speed remains above 1200 rpm. Normally closed contacts of relay K14 will open to cut off battery positive from generator set DC control circuits.

(b) Self-latching engine run relay K 15B will deenergize to disconnect battery positive from engine fuel solenoid L1. Engine fuel solenoid L1 will deenergize; the back-EMf from its collapsing field will be shorted to ground through diode CR4. Fuel flow to the engine fuel pump will be blocked and the engine will start slowing down.

(c) DC operating power is removed from synchronizer A105, load sharing panel A104, LUBE OIL PRESSURE gage M1, LUBE OIL TEMP gage M2, COOLANT TEMP meter M3, FUEL LEVEL gage M4, and TIME TOTALIZING meter M5.

(d) Engine run relay K1 5A is deenergized. Its normally closed contacts close to apply 240 V ac power to generator G1 heaters H109 and H110. (K15A contacts are shown on the AC schematic, FO-2.)

(e) Engine run relay K1 5C is deenergized. Its normally closed contacts close to apply 120 V ac power to the coils of coolant heater contactors K104A and K104B. (K15C contact sets are shown on the AC schematic, FO-2)

(f) Engine run relay K15D 5s deenergized. Its normally closed contacts close to energize the trip coil of load circuit breaker CB101, causing the circuit breaker to open and disconnect generator G1 from the bus.

(g) Battery positive is removed from coolant level warning switch S13; coolant level shutdown switch S14; OVERCURRENT relay K114, crank cycle timer M7; fault by-pass relays K17A and K17B. When K17A deenergizes, its normally open contacts open to disconnect battery positive from oil pressure shutdown relay K18, undervoltage annunciator fault relay A1 0K8, low oil pressure fault relay A10K2, and underfrequency annunciator fault relay A11 K5. This serves to disable automatic shutdown circuits that would otherwise put the generator set into a fault-shutdown condition as the engine loses speed.

(2) When engine fuel solenoid L1 loses power (see step (1)(b), above), the engine will be cut off from its fuel supply and will slow to a halt. During and after this slowing-down period, battery positive will be unavailable to any of the DC circuits and instruments normally activated when MASTER SWITCH S9 is set to START and released to RUN. Battery positive will, however, be available to all elements described in step a, above.

(3) The operator is not expected to restart the generator set until the engine has completely stopped. Note, however, what will occur after a normal shutdown, if MASTER SWITCH S9 is set to START and released to RUN under the following speed conditions.

(a) Above 1200 rpm, nothing will happen The normally closed contacts of shutdown relay K14 will be open to prevent battery positive from reaching DC control circuits

(b) Between 600 and 1200 rpm, engine run solenoid K15B will be energized and latched. Normally open contacts of relay K15B will close to connect battery positive to engine fuel solenoid L1. The engine will receive fuel and begin to accelerate.

(c) Below 600 rpm, the engine will crank as described in step c, above

h. <u>EMERGENCY SHUTDOWN Pushbutton S7</u>. EMERGENCY SHUTDOWN pushbutton S7 is located on cabinet C door and is used to shut down the generator set in accordance with Chapter 2 of this manual. Pressing pushbutton S7 will disconnect battery positive from generator set DC control circuits, open load circuit breaker CB101, and cut off the air supply to the engine air Intake manifold. When pushbutton S7 is pressed, the following occur immediately and simultaneously.

(1) Shutdown relay Kl14 will energize (and latch if engine speed is above 1200 rpm). The normally closed contacts of relay K14 will open to cut off battery positive from generator set DC control circuits. Additionally, all the events detailed under step g(1), above, will occur.

(2) Relay K30 will be energized. The normally open contacts of relay K30 will close to energize the trip coil in load circuit breaker CB101 Note that the trip coil will also become connected to battery positive by the normally closed contacts of engine run relay K15D when K15D is cut off from battery positive by shutdown relay K14.

(3) Air box shutdown relays L2A and L2B will energize to close the air control valves in the air intake duct lines to the engine air intake manifold. The engine, cut off from its air supply, will decelerate very rapidly. Solenoids L2A and L2B are not rated for continuous duty, air box disconnect switch OP3 will disconnect the solenoids from ground as soon as failing engine oil pressure allows OP3 to open. When OP3 does open, solenoids L2A and L2B deenergize. The back-EMf caused by their collapsing fields will be shorted by diode CR3. This prevents arcing from occurring at the contacts of pushbutton S7.

i. EMERGENCY SHUTDOWN Control. The EMERGENCY SHUTDOWN control is mounted on the left side of the skid base below the engine compartment access doors. It is a mechanical pull which cuts off fuel to the engine. The resulting loss of engine speed rapidly leads to the tripping of a shutdown circuit as the voltage and frequency output of generator G1 falls.

4-20. MAINTENANCE OF BATTERY CHARGER . Battery charger BC1 provides 24 V dc to charge the generator set batteries. Maintenance of the battery charger consists of testing, adjustment, and replacement.

a. Test See Figure 4-26.

(1) Test the ac input fuse ACF and dc output fuse DCF as follows:

(a) Set BATTERY CHARGER circuit breaker CB116 to OFF.

(b) Remove the ac input fuse ACF and dc output fuse DCF from the fuse board inside the battery charger BC1.

(c) Using a multimeter set to the RX1 scale, check continuity across both fuses. Multimeter should indicate zero resistance.

(2) Test the dc AMMETER A as follows.

(a) Set BATTERY CHARGER circuit breaker CB116 to OFF.

(b) Remove battery charger leads from the battery.

(c) Install a multimeter set to read dc amps across + and - output leads from the battery charger BC1.

(d) Set BATTERY CHARGER circuit breaker CB116 to ON and set equalizer TIMER ET to ON.

(e) DC AMMETER A reading should be within 5 percent of multimeter installed In step b, above.

(f) Reinstall battery charger leads.

(3) Test Input and output voltages as follows:

(a) Set BATTERY CHARGER circuit breaker CB116 to OFF.

(b) Install a multimeter set to read AC volts across the input leads to battery charger BC1.

(c) Set BATTERY CHARGER circuit breaker CB116 to ON.

(d) AC multimeter reading should be 120 V ac.

(e) Set BATTERY CHARGER circuit breaker CB116 to OFF.

(f) Install a multimeter set to read dc volts across the + and - output leads from battery charger BC1.

(g) Set BATTERY CHARGER circuit breaker CB116 to ON and set equalizer TIMER ET to ON.

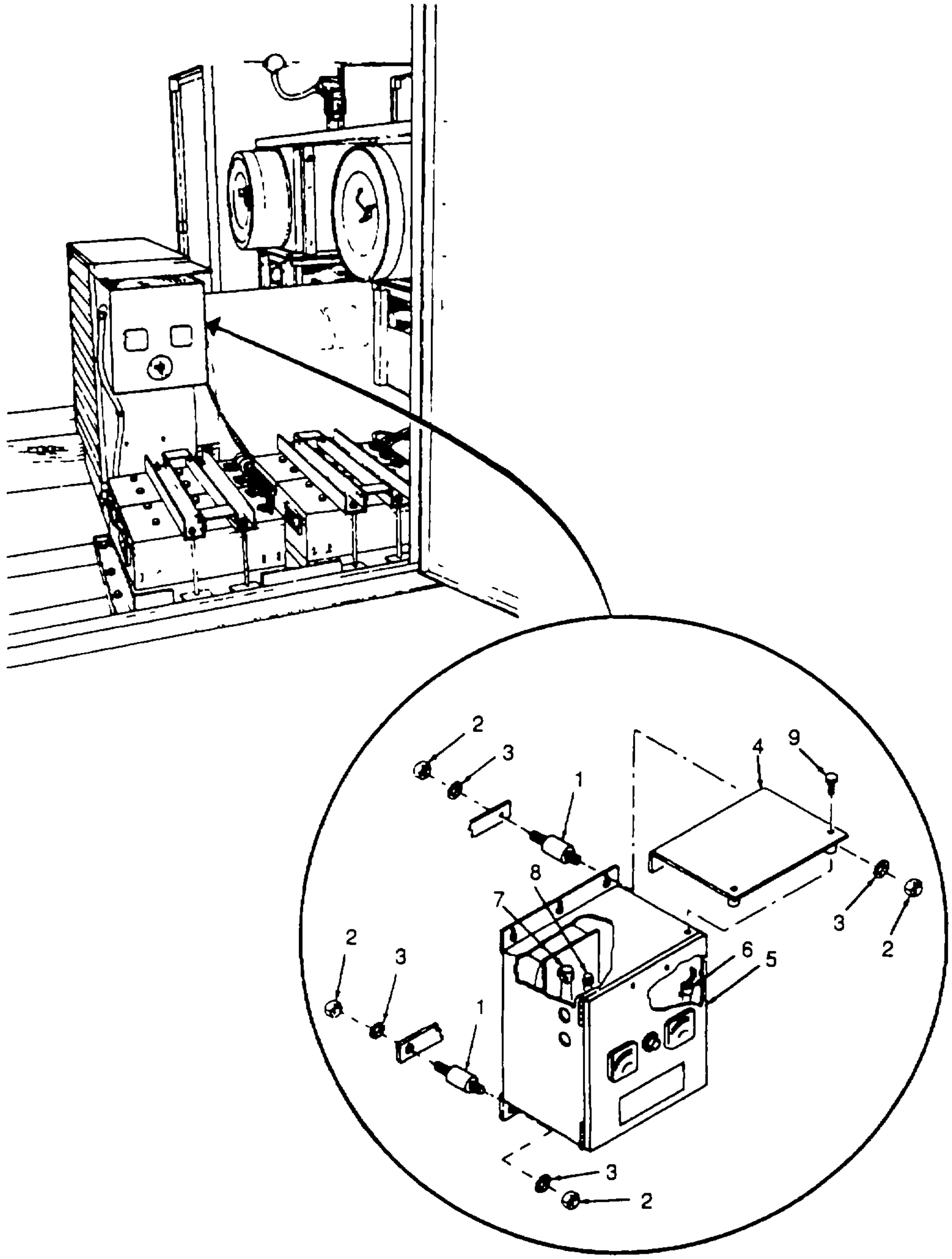
(h) Multimeter should read 27 ± 2 V dc.

b. Remove. See Figure 4-26.

(1) Set BATTERY CHARGER circuit breaker CB116 to OFF.

(2) Tag and disconnect wiring to the battery charger BC1 (5).

(3) Remove the battery charger BC1 (5) and drip shield cover (4) by removing hexagonal nuts (2), lock washers (3), and vibration isolators (1) at base of the battery charger BC1. Loosen the hexagonal nuts (2) and lock washers (3) at the top of the battery charger BC1, and lift the battery charger BC1 upward and away from the upper vibration isolators (1).



1. VIBRATION ISOLATOR
2. HEXAGONAL NUT
3. LOCKWASHER
4. DRIP SHIELD
5. BATTERY CHARGER BC1

6 VARIABLE RESISTOR
7 FUSE
8 FUSE
9 HEXAGON HEAD SCREW

Figure 4-26. Battery Charger BC1

c. Install. See Figure 4-26.
   (1) Install battery charger BC1 (5) and drip shield cover (4) over the upper vibration isolators (1), and secure with the upper hexagonal nuts (2) and lock washers (3). Install the hexagonal nuts (2), lock washers (3), and vibration isolators (1) at the base of the battery charger BC1.
   (2) Connect wiring as tagged in step b, above Discard tags.
   (3) Test new battery charger BC1 in accordance with step a, above.

d. Adjust. See Figure 4-26. To adjust the battery charger BC1 float and equalizer output voltages proceed as follows:
   (1) Connect the negative lead of the dc voltmeter to the red slider band. Connect the positive lead to the red wires on the bottom of the resistor which is positioned vertically on the right side wall of the battery charger housing. Turn equalizer timer to the OFF position. Adjust the red slider band for a 4 V dc reading on the voltmeter. Moving the red slider band toward the green slide band will raise the taper and shutdown point.
   (2) Connect the negative lead of the dc voltmeter to the black wires on the top of the resistor and the positive lead to the green slider band. Turn the equalizer timer to the ON position. Adjust the green slider band until the voltmeter reads 24.5 V dc. Voltage readings across the black wires and the green slider band should be approximately 23 V dc with equalizer timer off and 24.5 V dc with the equalizer timer on.

4-21. MAINTENANCE OF STARTER SLAVE RELAYS K1/K2. See Figure 3-3 Starter relays K1/K2 are located near the starter motors on the right side of the engine. They are used as slave relays to energize starter solenoids energize starter L3 and L4 which motors B1 and B2.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. Test.
   (1) Perform a functional test of the relays K1/K2 by operating the generator set. If the operational test indicates that the relays are bad, remove the relays and bench test as follows.
      (a) Using a power supply, apply 24 V to the coil
      (b) Using a multimeter set to RX1 scale, test for continuity of the contactors with 24 V applied When contactors close, multimeter should read zero.
      (c) Remove test equipment. Replace defective starter relays in accordance with steps b and c, below:

b Remove. See Figure 3-3.
   (1) Disconnect battery power.
   (2) Tag and disconnect wiring from defective component.
   (3) Remove relays K1/K2 by removing screws, lock washers, and nuts.

c. Replace. See Figure 3-3.
   (1) Install serviceable relays K1/K2 and secure with screws, lock washers, and nuts.
   (2) Connect wiring and perform a functional test Discard tags.
   (3) Reconnect battery cables.

4-22. MAINTENANCE OF CRANK CYCLE TIMER M7 AND CRANK RELAY K3 . The crank cycle timer puts the engine through four consecutive start cycles whenever the MASTER SWITCH is set to RUN If the engine fails to crank after four consecutive crank cycles, the crank cycle timer opens crank relay K3, to prevent any further attempts at cranking, and lights the EXCESSIVE CRANKING indicator on the annunciator alarm panel. After the EXCESSIVE CRANKING indicator has been reset, the MASTER SWITCH may be set to RUN and the cranking process will be restarted.

a. Test.
  (1) Perform a functional test of the crank cycle timer M7 by operating the generator set.
  (2) Test crank relay K3 by applying 24 V dc to the solenoid and observing proper operation.

b. Remove.
  (1) Disconnect battery power.
  (2) Tag and disconnect wiring from defective component.
  (3) Remove screws, nuts, and washers, and remove relay.

c. Replace.
  (1) Install new relay and secure with screws, nuts, and washers.
  (2) Reconnect wiring.
  (3) Reconnect battery power.

4-23. MAINTENANCE OF WIRING HARNESS . The function of the wiring harnesses is to provide electrical continuity between all electrical components associated with generator operation.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. Disconnect battery power

b. Test. Where there is indication that a given harness is causing a malfunction, test the wires relating to the malfunctioning circuit both for continuity and internal shorts. Check all suspect wires for continuity. Refer to FO-4 through FO-12.

c. Repair.
  (1) Splicing. Expose damaged wires by cutting harness sleeving as necessary, being careful not to cut the insulation of serviceable wires when cutting the sleeving. It is normally most efficient to guide the tip of the cutting instrument between parallel wires in the harness. The cuts In the sleeving should always be made parallel with the harness assembly When the wires to be spliced are exposed, proceed as follows

WARNING

To avoid Injury to personnel, do not breathe fumes generated by soldering. Eye protection is required. Remove rings and watches while soldering.

    (a) Install shrink-down sleeve PO-135 of adequate length and diameter to cover finished splice, over one end of broken or cut wire. Position shrink-down sleeve far enough from break so that it will not interfere with splicing or soldering operations.

(b) Strip end of each wire to be spliced approximately 0.5 inch (13 mm). If a piece of wire is to be spliced into an existing wire, ensure the new section is of the same color and AWG size.
(c) Twist all stripped ends tightly together, so as to form neat joints of uniform size. Solder joints in accordance with MIL-S-6872 using solder with rosin flux.
(d) Position shrink-down sleeve over solder joint, and heat sleeve to 250°F (121°C) so that it shrinks to form a tight seal around soldered joint.
(e) If harness sleeving was cut to expose broken wire, repair sleeving with three layers of half-lapped insulating tape MIL-T-638.

(2) Replace damaged lugs as follows:
(a) Remove damaged lugs by cutting wire as close as possible to lug. If wires are too short, splice in accordance with step (1), above.
(b) Install shrink-down sleeve PO-135 of adequate diameter and length to cover shank of lug, over cut wire.
(c) Strip 0.15 Inch (3.8 mm) of insulation from end of wire. Crimp new lug in place, and solder in accordance with MIL-S-6872, using solder with rosin flux.
(d) Position shrink-down sleeve over shank of lug and shrink as In step (d), above.

(3) Replace damaged electrical connections as follows:
(a) Before removing any damaged connector, prepare a diagram showing the location of each wire in relation to the connector by matching the wire number and the pin letter on the connector.
(b) Remove pins and wires from connector. Cut wires as close to pins as possible.
(c) Strip 0.25 inch (6.4 mm) of insulation from the end of each wire.
(d) Remove pins from new connector. Crimp pins to wire ends.
(e) Insert pins In proper location in connector.

(4) All soldering will be performed in accordance with standard shop practices using solder MIL-S-6872.

d. <u>Replace</u>. Harnesses are usually repairable. Replacement is necessary only d substantial damage (such as by fire) has occurred. If inspection of the damaged harness indicates replacement is necessary, proceed as follows:
(1) Tag and identify wires.
(2) Start at the end of the harness. Remove all hangers, clamps, ties, and hardware attaching the harness to the generator set. Disconnect connectors as required. When 3 to 6 feet (1 to 2 meters) of the harness is free, go to step (3), below.
(3) Begin to Install the replacement harness Use existing hangers, clamps, ties, and hardware where serviceable. Use replacement parts as necessary. Connect connectors as required. Install up to the point where the defective harness is still fastened down.
(4) Remove another 3 to 6 feet (1 to 2 meters) of the defective harness as in step (2), above. Then install more of the replacement harness in accordance with step (3), above. Repeat the procedure until the replacement harness has been completely installed. Remove tags.
(5) Reconnect battery power.

4-24. MAINTENANCE OF COOLANT TEMPERATURE SWITCHES WT1/WT2 . The coolant temperature switch WT2 (see Figure 3-3) senses engine coolant temperature. When coolant exceeds 208 ± 2°F (98 ± 1°C), contacts 8 and C close. When coolant exceeds 217 ± 2° F (103 ± 1° C), contacts A and D close. The first condition activates a warning alarm; the second condition results in automatic shutdown of the engine.

a. Remove.

(1) Using a drain or sump, drain the radiator in accordance with paragraph 3-12.

(2) Disconnect electrical connector from switch. Remove switch.

b. Test. See Figure 4-27.

(1) Connect multimeter set to RX1 scale across switch contacts A and D.

(2) Suspend switch in a container of antifreeze. Switch should be inserted so that sensing element is completely immersed but connector end is out of antifreeze.

(3) Heat antifreeze gradually and stir so that heat is evenly distributed.

(4) Check temperature of antifreeze with a reliable thermometer.

(5) When antifreeze has reached 217°F (103°C), the switch should close and the multimeter should read less than 1 ohm.

(6) Allow antifreeze to cool. As the temperature drops the switch should open and the multimeter should read infinite ohms.

(7) Repeat steps (1) through (6), above, for contacts B and C. The switch should activate at 208°F (98°C).

(8) The switch is not repairable if It does not operate within the above limits it must be replaced.

C Install.

(1) Install switch (see Figure 3-3) Torque to maximum 15 pound-feet (20 newton-meters). Connect electrical connectors.

(2) Refill radiator in accordance with paragraph 3-12.

4-25. MAINTENANCE OF COOLANT LEVEL SWITCHES S13 AND S14 . Coolant level switches S13 and S14 (see Figure 3-3) are immersion sensitive switches. When above the radiator water line, the normally open contacts close. Actuation of switch S13 results in a warning alarm. Actuation of switch S14 results in automatic shutdown of the engine

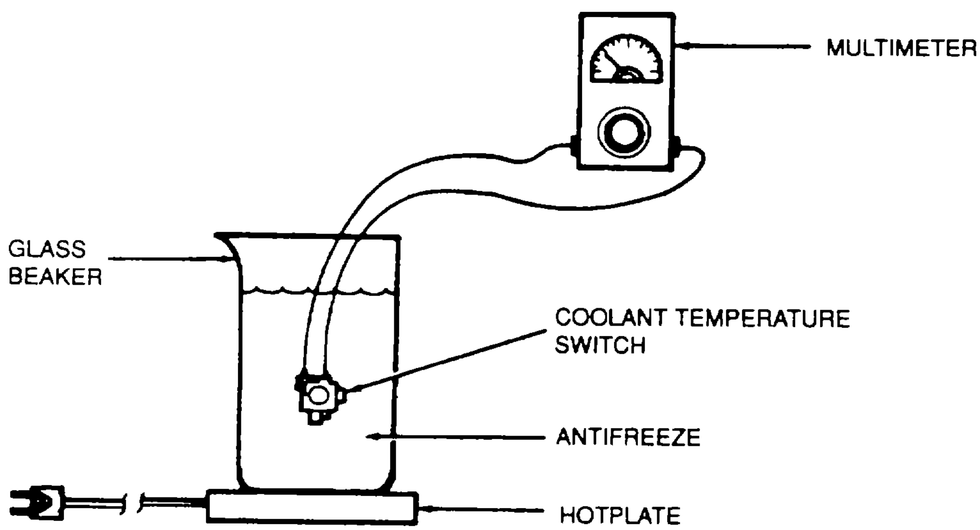


Figure 4-27. Test of Coolant Temperature Switch

a. Remove.
(1) Using a drain or sump, drain the radiator partially in accordance with paragraph :3-12.
(2) Tag and disconnect electrical connectors from switch. Remove switch.
b. Test.
(1) Connect a multimeter set to RX1 scale across switch contacts.
(2) Suspend switch in a container of antifreeze. Switch should be inserted so that sensing element is completely immersed but connector end is out of antifreeze. Put positive lead of a 24 V dc power supply to positive (+) terminal and the negative (-) lead of a 24 V dc power supply to the switch metal frame (ground).
(3) Switch should be open and the multimeter should read infinite ohms.
(4) Remove the switch from the antifreeze. The contacts should close and the multimeter should read less than 1 ohm.
(5) The switches are not repairable. If they do not operate within above limits, they must be replaced.
c. Install.
(1) Install switch and restore electrical connections as tagged. Discard tags.
(2) Refill radiator. Check for leakage around switch and tighten as necessary.

4-26. MAINTENANCE OF LUBRICANT OIL TEMPERATURE SWITCH OT2 . Lubricant oil temperature switch OT2 (see Figure 3-3) senses engine lubricating oil temperature. When lubricating oil temperature exceeds 245 ± 3°F (118.3°C) the normally open contacts close. This action results in a warning only.
a. Remove.
(1) Drain the oil pan in accordance with paragraph 3-3.
(2)Tag and disconnect electrical connectors from switch. Remove switch.
b. Test.
(1) Connect a multimeter set to RX1 scale across switch contacts.
(2) Suspend switch in a container of antifreeze. Switch should be inserted so that the sensing element is completely Immersed but connector end is out of antifreeze.

WARNING

Exercise extreme care when heating antifreeze or handling antifreeze. Avoid spilling. Antifreeze may cause severe burns.

(3) Heat antifreeze gradually and stir so that heat is evenly distributed.
(4) Check temperature of antifreeze with a reliable thermometer.
(5) When antifreeze has reached 245 ± 3°F (118.3°C) the switch should close and the multimeter should read less than 1 ohm.
(6) Allow antifreeze to cool. As the temperature drops the switch should open and the multimeter should read infinite ohms.
(7) The switch is not repairable. If It does not operate within the above limits, it must be replaced.
c. Install . Clean switch thoroughly and proceed as follows:
(1) Install switch and restore electrical connections. Discard tags.
(2) Refill oil pan in accordance with paragraph 3-3.
(3) Check for leakage around switch; tighten as necessary.

4-27. MAINTENANCE OF OIL PRESSURE ALARM AND SHUTDOWN SWITCH OP1/OP2 . Oil pressure alarm and shutdown switch OP1/OP2 (see figure 3-3) senses engine lubricating oil pressure. When lubricating oil pressure falls below 39 ± 2 psi (269 ± 14 kPa), the normally closed contacts of switch OP2 trip the low oil pressure alarm. If pressure continues to fall to 30 ± 2 psi (207 ± 14 kPa), switch OP1 will shut the set down.

a. Remove.
   (1) Disconnect electrical connector from switch.
   (2) Remove switch from engine tee.

b. Test.
   (1) Set multimeter to RX1 scale and connect across switch contacts B and C.
   (2) Connect switch to a source of pressurized lubricating oil or air. Pressurize to 50 psi (345 kPa). Multimeter should read infinity.
   (3) Decrease pressure gradually When pressure has fallen to 39 ± 2 psi (269 ± 14 kPa), the switch should open. Multimeter should read zero
   (4) Connect the multimeter across switch contacts A and D.
   (5) Decrease pressure gradually. When pressure has fallen to 30 ± 2 psi (207 ± 14 kpa), the switch should close. Multimeter should read zero ohms.

c. Install. See Figure 3-3.
   (1) Install switch on tee.
   (2) Install electrical connections to switch.
   (3) Run the engine and check for leakage around switch, tighten as necessary.

4-28. MAINTENANCE OF SPEED SWITCH SS1/SS2/SS3. The speed switch SS1, SS2, and SS3 is in one cylindrical housing and mounted on the tachometer drive of the engine fuel pump. The switch functions to disconnect the starters (SS1), arm the under frequency and under voltage circuits (SS2), and to shut down the engine upon an overspeed condition (SS3).

a. Remove. Refer to Figure 1-8.
   (1) Disconnect electrical connector J1 from the speed switch.
   (2) Loosen neoprene coupling and remove switch.

b. Test.
   (1) Connect the speed switch to a variable speed motor equipped with a tachometer.
   (2) Drive the speed switch at rotational speeds between 0 and 1134 rpm. Using a multimeter check performance of SS1/SS2/SS3 against data given in Figure 4-28.
   (3) Run RPM to 1200 to ensure it trips and resets properly.
   (4) The switch is adjustable but not repairable If it can not be adjusted to operate within the above limits, replace the switch.

c. Adjust . See Figure 4-28.
   (1) Remove cover screw for switch to be adjusted.
   (2) Insert 1/16 inch (1 59 mm) Allen wrench into adjusting screw.

CAUTION

Too many counterclockwise turns will remove setscrew from locknut assembly.

   (3) Turn clockwise to Increase trip point; counterclockwise to decrease trip point.
   (4) Test in accordance with step b, above.
   (5) Replace cover.

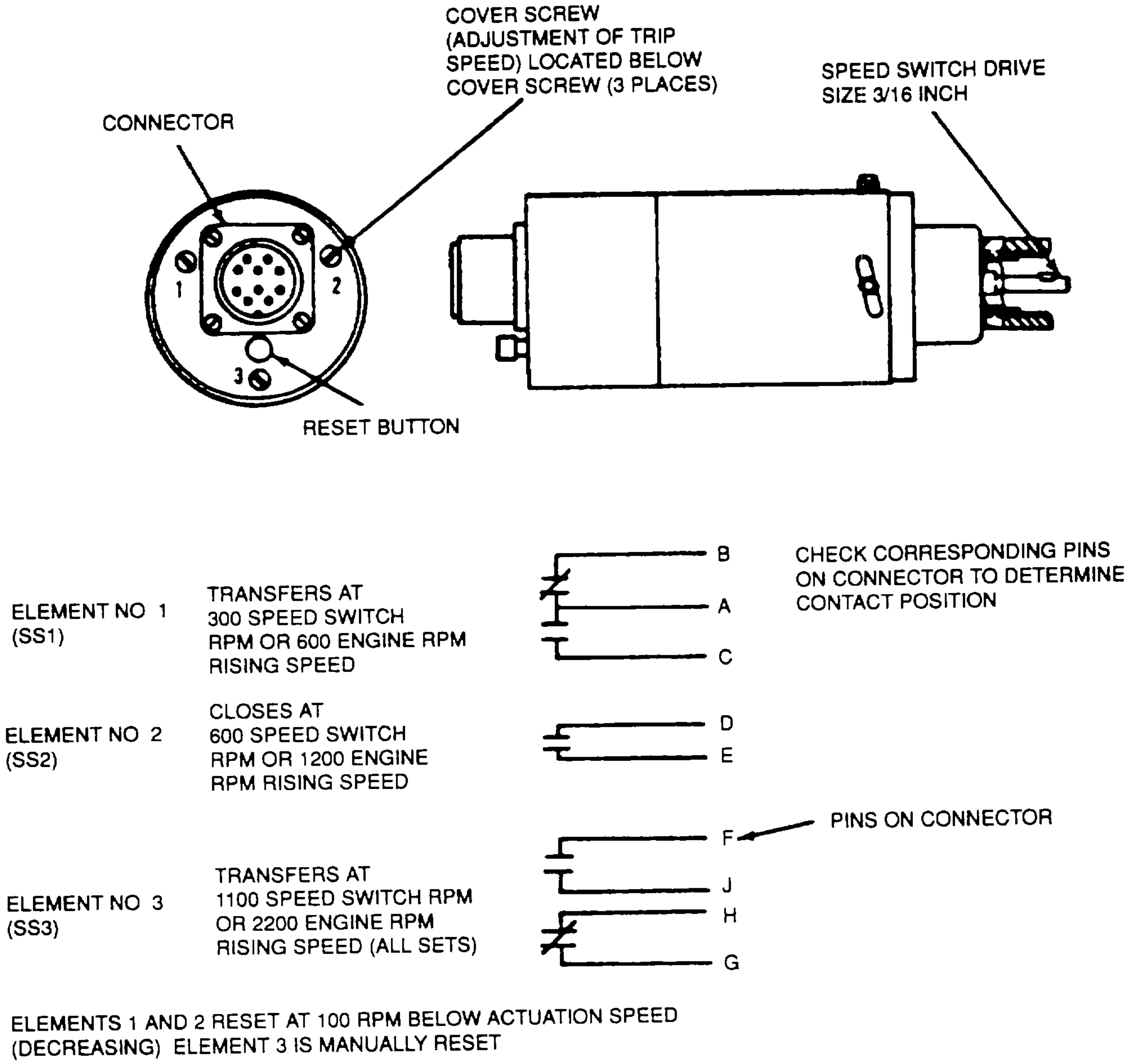


Figure 4-28. Speed Switch Sensitivity Tests

d. Install. See Figure 1-8.
   (1) Insert speed switch on tachometer drive of engine fuel pump, and tighten neoprene coupling.
   (2) Attach connector J1 to switch.

4-29. MAINTENANCE OF DC-CIRCUIT BREAKERS CB1 AND CB2. See Figure 4-29. Both circuit breakers provide an automatic safety disconnect of battery power from their respective circuits IN the event of a short circuit or circuit overload.

a. Remove.
(1) Disconnect battery power and turn off battery charger circuit breaker CB7 (7, Figure 2-7).
(2) Tag and disconnect wiring to circuit breaker CB1 or CB2 (6 or 7, Figure 4-29).
(3) Remove screw and captive washer assembly (1 or 2), nut and captive washer assembly (3), flat washer (4), and mounting bracket (5).
(4) Remove circuit breaker CB1 or CB2 (6 or 7) b. A. Test each circuit breaker using a MSIA circuit breaker tester. Ensure dc power circuit breaker, CB1, trips at 20 amps and emergency lights circuit breaker, CB2, trips at 15 amps.

c. Install.
(1) Position circuit breaker CB1 or CB2 (6 or 7, figure 4-29) into mounting bracket (5).
(2) Attach mounting bracket (5) using screw and captive washer assembly (1 or 2), nut and captive washer assembly (3), and flat washer (4).
(3) Connect electrical wiring and discard tags.
(4) Reconnect battery power and turn on battery charger CB7.

4-30. MAINTENANCE OF FUEL LEVEL SWITCHES FL1 THROUGH FL4 . See Figure 4-30. The switch assembly, containing FL1 FL2 FL3, and FL4 (10, figure 3-16) is mounted in top of the fuel tank. The switches are used to turn the fuel transfer pump on and off, to give a warning indication if fuel is low, and to give a warning indication and disconnect fuel transfer pump system If fuel level becomes too high.

WARNING

The fuel tank, even when empty, may contain explosive fumes or vapors. Do not expose tank in vicinity of any source of intense heat. Smoking is prohibited within 50 foot (15 meters) of the work area. Failure to heed this warning may result In death or injury.

a. Remove. See figure 4-31.

WARNING

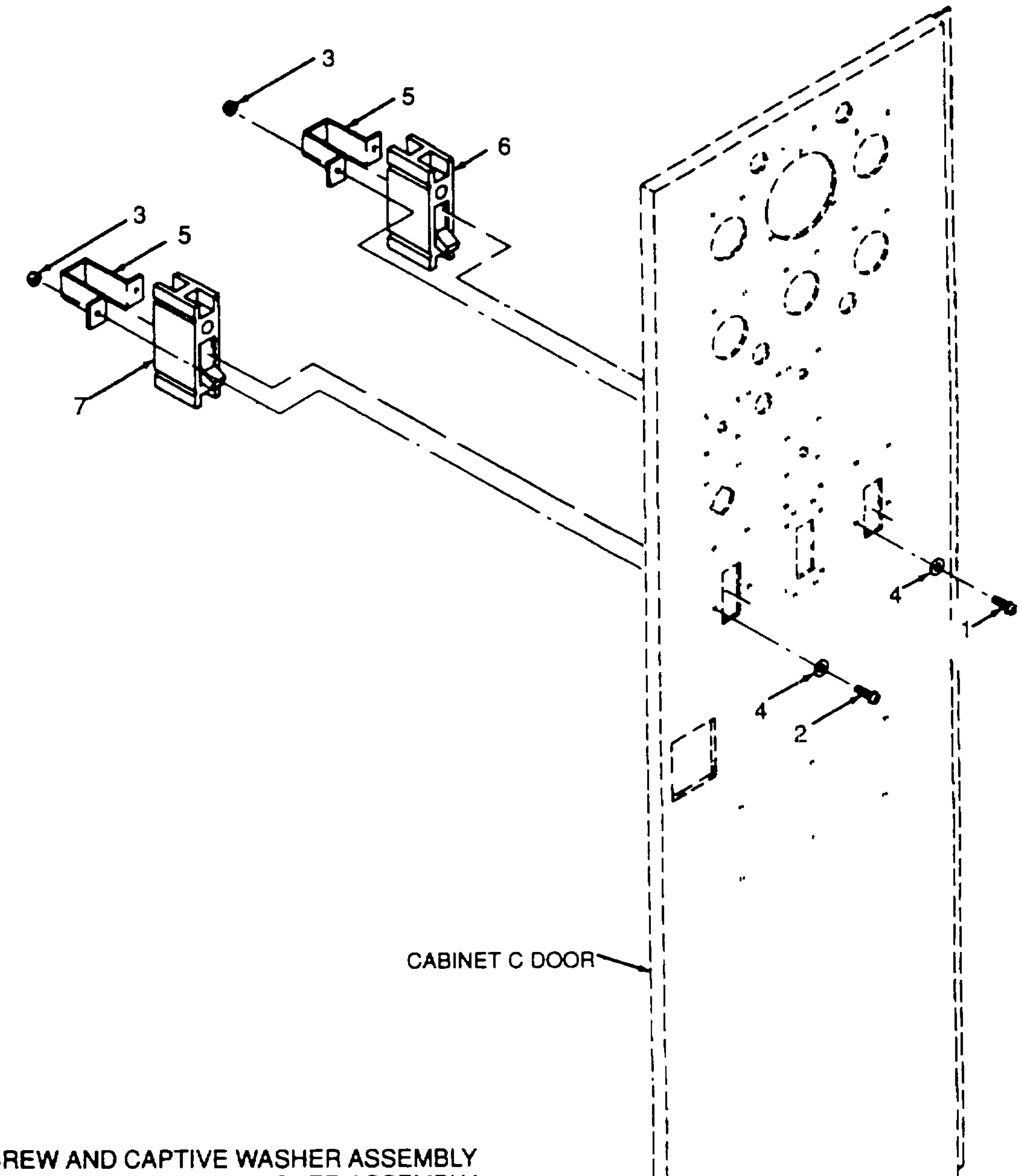
The fuel tank, even when empty, may contain explosive fumes and vapors. Do not work on tank in the vicinity of any source of intense heat. Smoking is prohibited within 50 feet (15 meters) of the work area. Failure to heed this warning may result in death or serious injury.

(1) Turn FUEL PUMP switch S8 on generator control cabinet C to OFF position.

CAUTION

Fuel which is to be reused must be kept tree from contaminants. Drain fuel to be reused only Into a container which has been thoroughly cleaned.

(2) Open the fuel drain valve (34) and drain fuel into a suitable container.
(3) Remove the control room fire extinguisher and bracket In accordance with paragraph 4-12.
(4) Remove hexagon head cap screws (44), hexagonal nuts (45), and lock washers (46), and remove rear door stop door plate (47).



1. SCREW AND CAPTIVE WASHER ASSEMBLY
2. SCREW AND CAPTIVE WASHER ASSEMBLY
3. NUT AND CAPTIVE WASHER ASSEMBLY
4. FLAT WASHER
5. MOUNTING BRACKET
6. EMERGENCY LIGHTING CIRCUIT BREAKER CB2
7. 24 V DC CONTROL POWER CIRCUIT BREAKER CB1

Figure 4-29. DC Circuit Breakers CB1 and CB2.

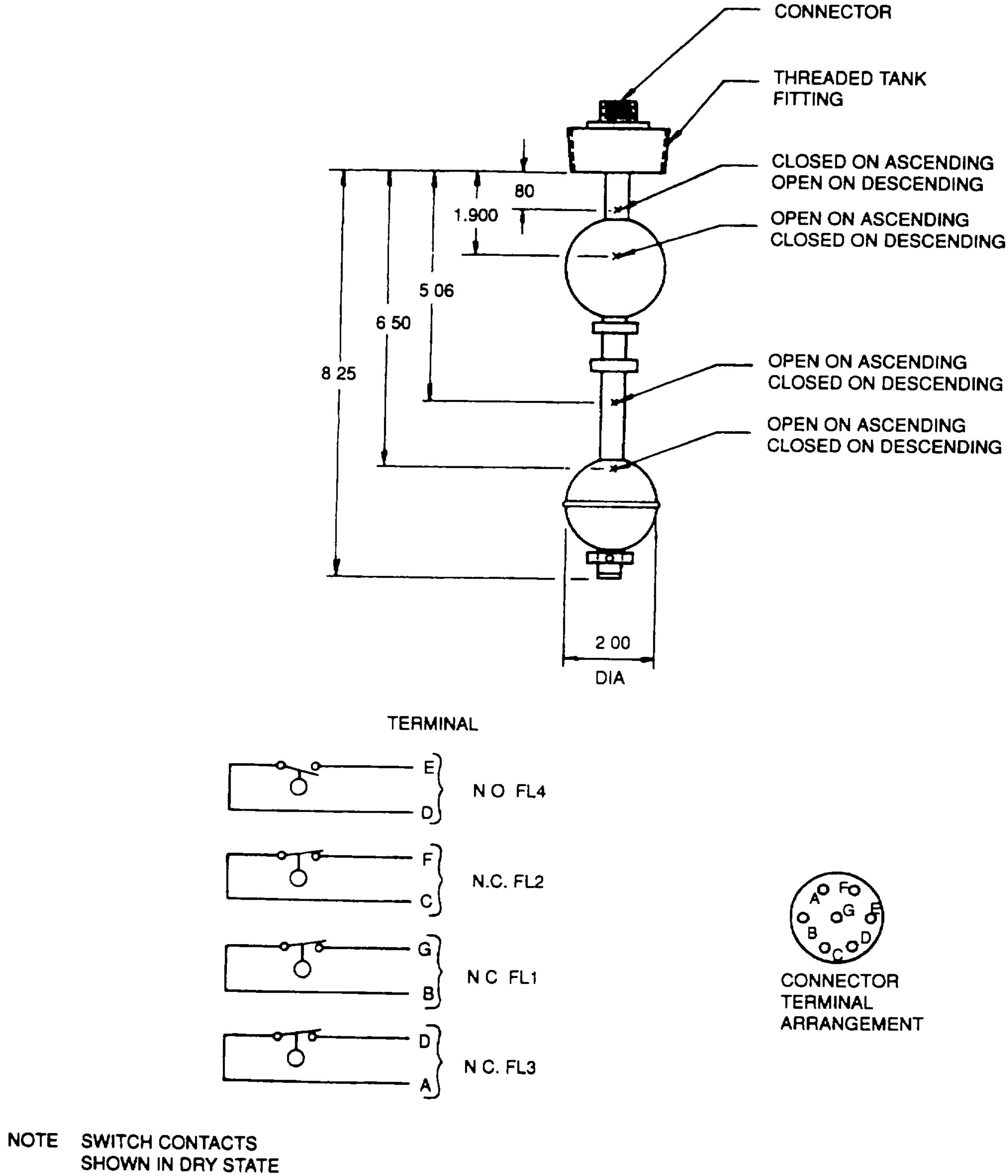


Figure 4-30. Fuel Level Switches FL1 through FL4.

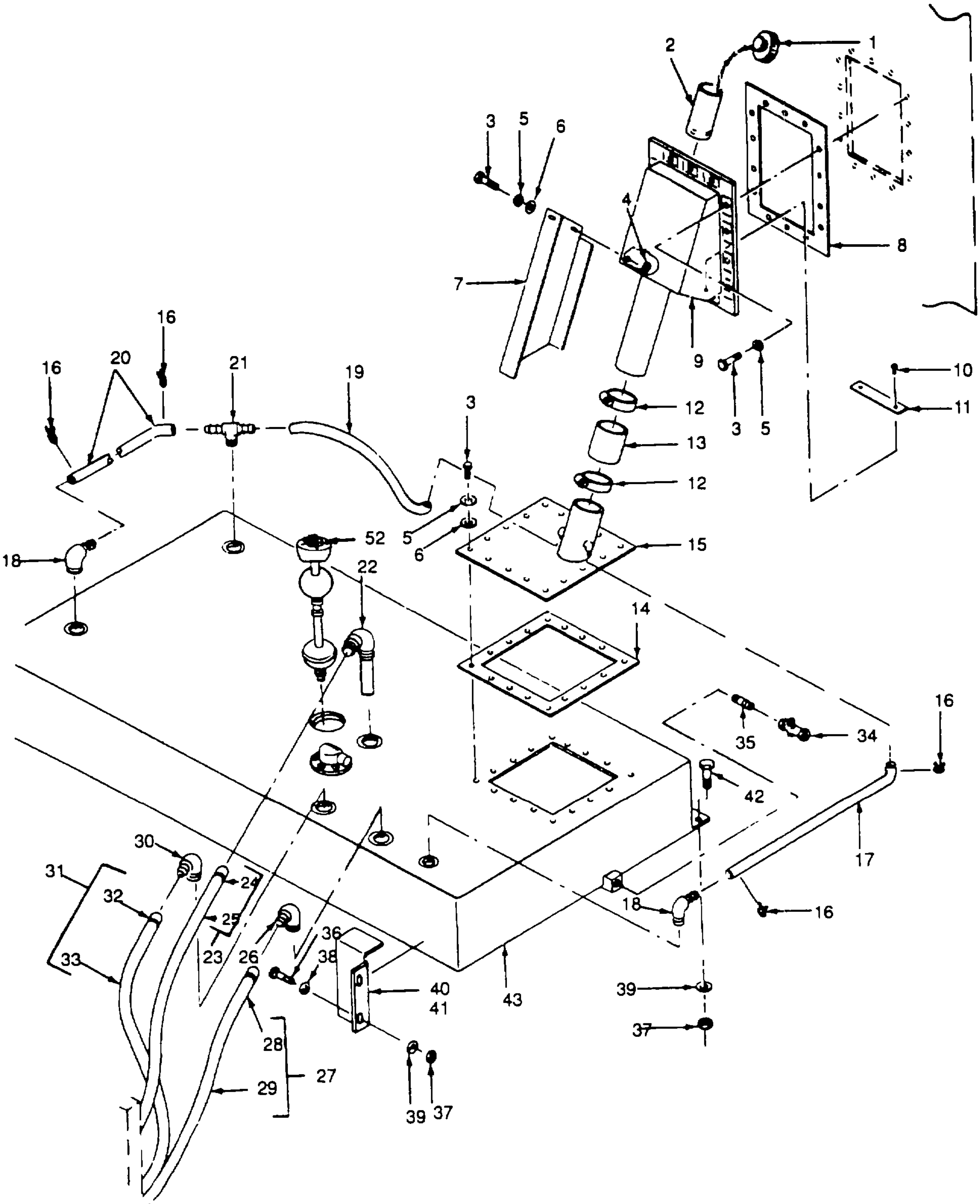
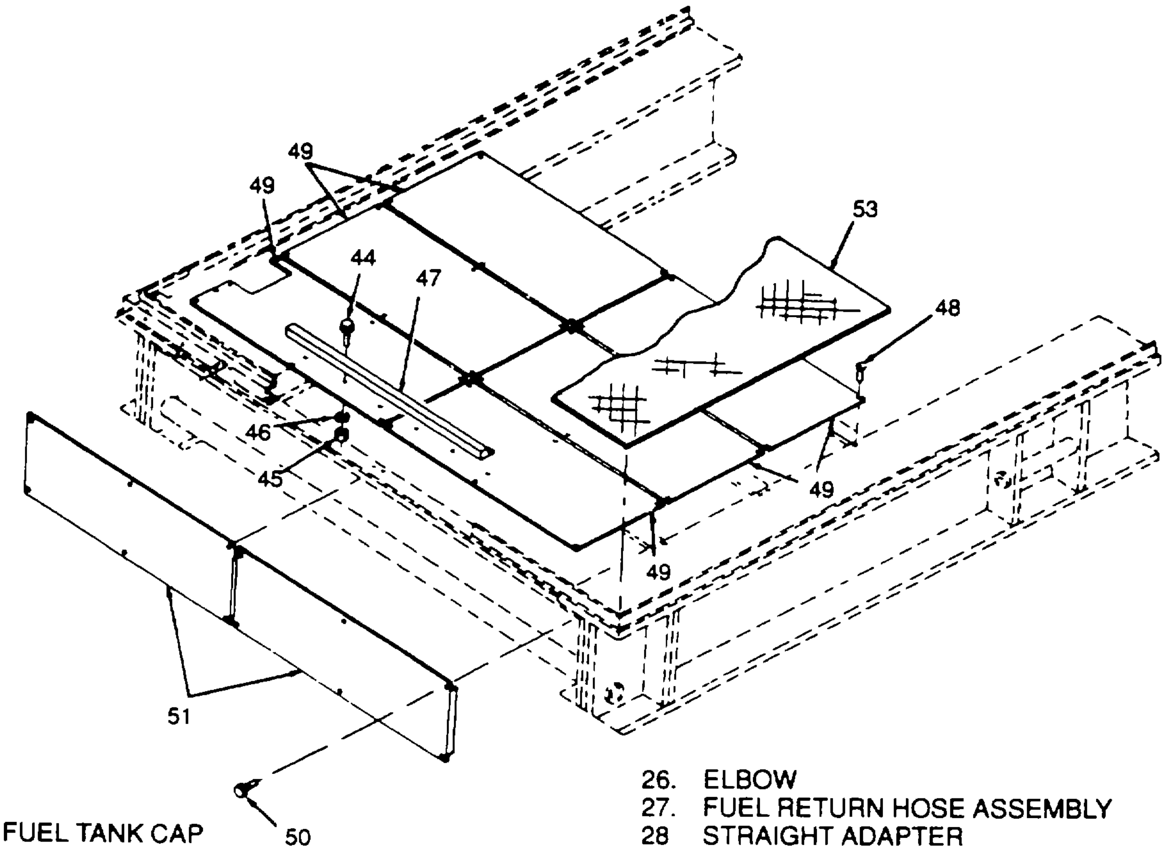


Figure 4-31. Fuel Tank (Sheet 1 of 2)



1 FUEL TANK CAP
2. ELEMENT STRAINER
3. HEXAGONAL HEAD CAPSCREW
4. HEXAGONAL NUT
5. LOCKWASHER
6. FLAT WASHER
7. FUEL FILL GUARD
8. FUEL FILL GASKET
9. FILLER NECK AND HOUSING
10. RIVET
11. FUEL TANK IDENTIFICATION PLATE
12. HOSE CLAMP
13 FUEL FILL HOSE
14. COVER GASKET
15 FILL PIPE
16. SPRING CLAMP
17. VENT HOSE
18. ELBOW
19. VENT HOSE
20. VENT HOSE
21 TEE FITTING
22. FUEL SUCTION TUBE ASSEMBLY
23. FUEL SUCTION HOSE ASSEMBLY
24. STRAIGHT ADAPTER
25. HOSE
26. ELBOW
27. FUEL RETURN HOSE ASSEMBLY
28 STRAIGHT ADAPTER
29 HOSE
30 ELBOW
31 FUEL TRANSFER HOSE ASSEMBLY
32 STRAIGHT ADAPTER
33 HOSE
34. DRAIN VALVE
35 PIPE NIPPLE
36. HEXAGONAL HEAD CAPSCREW
37 HEXAGONAL CAPNUT
38. FLAT WASHER
39. LOCKWASHER
40 RETAINER
41 RETAINER
42 HEXAGONAL HEAD SCREW
43 FUEL TANK
44 HEXAGON HEAD CAPSCREW
45. HEXAGONAL NUT
46. LOCKWASHER
47 REAR DOOR STOP PLATE
48 MACHINE SCREW
49 FLOOR PLATE
50. SCREW
51 COVER PLATE
52 FUEL LEVEL SWITCHES FL1 THROUGH FL4
53. FLOOR MAT

Figure 4-31. Fuel Tank (Sheet 2 of 2)

(5) Remove floor mat (53). Remove machine screws (48), and remove floor plates (49) from the skid base.
(6) Remove electrical connector from fuel level switch FL1 through FL4 assembly (52).
(7) Remove fuel level switch FL1 through FL4 assembly (52) from the fuel tank using spanner 383.

b. TEST. See figure 4-30

(1) Set multimeter to RX1 scale and test switch In dry state across terminal sets E and D; F and C; G and B; and D and A. Hold switch in upright vertical position. Resistance reading across terminals E and D should be infinite ohms, while terminal sets F and C; G and B; and D and A should read zero ohms in the dry state.
(2) Immerse fuel level switch assembly (in upright vertical position) into a suitable graduated cylinder, or equivalent, containing diesel fuel. Immerse switch to a level immediately below the threaded tank fitting. Do not immerse connector end of the switch assembly. Connect multimeter (RX1 scale) across same terminal sets in step (1), above. Terminals E and D should now read zero ohms. All other terminal sets (F and C, G and B; and D and A) should now read Infinite ohms.
(3) Connect multimeter leads across terminals E and D and slowly raise switch assembly to a level approximately 0.8 inch below the bottom of the threaded tank fitting. Resistance across terminals E and D should now read Infinite ohms as well as all other terminal sets.
(4) Continue raising switch to a level approximately 1.9 Inches (5 mm) below threaded tank fitting. Terminal sets D and E; G and B; and D and A should now read infinite ohms. Terminal sets F and C should read zero ohms.
(5) Continue raising switch to a level approximately 5 06 Inches (129 mm) below the threaded tank fitting. Terminal sets E and D, and D and A should read infinite ohms Terminal sets F and C, and G and B should read zero ohms.
(6) Continue raising switch to a level approximately 6.5 inches (152 mm) from the bottom of the threaded tank fitting Terminal sets F and C; G and B; and D and A should read zero ohms. Terminals C) and E should read infinite ohms.
(7) Replace fuel level switch assembly if it fails any test as described above.

c. Install. See Figure 4-31.

(1) Install fuel level switch FL1 through FL4 assembly (52) in fuel tank using spanner 383.
(2) Install electrical connector to fuel level switch FL1 through FL4 assembly (52).
(3) Install floor plates (49) to the skid base with machine screws (48) install floor mat (53).
(4) Install rear door stop plate (47) with hexagon head cap screws (44), hexagonal nuts (45), and lock washers (46).
(5) Install the control room fire extinguisher and bracket in accordance with paragraph 4-12.
(6) Close fuel drain valve (34) and refill fuel tank.
(7) Turn FUEL PUMP switch S8 on generator control cabinet C to HAND or AUTO as necessary.

4-31. MAINTENANCE OF FUEL QUANTITY TRANSMITTER MT4. The fuel quantity transmitter MT4 (12, Figure 3-6) is mounted In top of the fuel tank. The transmitter is a variable resistor which vanes resistance according to the fuel float position. The transmitter is connected to FUEL LEVEL gage M4.

a. Remove.

WARNING

The fuel tank, even when empty, may contain explosive fumes or vapors. Do not expose tank In vicinity of any source of intensive heat. Smoking is prohibited within SO feet (15 meters) of the work area. Failure to heed this warning may result in death or serious injury.

CAUTION

Fuel which is to be reused must be kept free from contaminants. Drain fuel to be reused only into a container which has been thoroughly cleaned.

(1) Open the fuel drain valve (34, Figure 4-31) and drain fuel into a suitable container.
(2) Remove the control room fire extinguisher and bracket in accordance with paragraph 4-12.
(3) Remove hexagon head cap screws (44), hexagonal nuts (45), and lock washers (46), and remove rear door stop plate (47).
(4) Remove floor mat (53) Remove machine screws (48), and remove floor plates (49) from the skid base.
(5) Remove electrical connector from fuel quantity transmitter MT4 (12, figure 3-16).
(6) Remove screw and captive washer assemblies (11), and remove fuel quantity transmitter MT4 (12) and gasket (13) from fuel tank. Discard gasket (13).

b. Test.
(1) Set multimeter to RX1 scale. Connect one multimeter lead to connector terminal and the other multimeter lead to the fuel quantity transmitter body (ground).
(2) With float at end of pivot mechanism point at full downward position (empty position) multimeter reading should be 0.000 to 0.50 ohms. Gradually raise the float at end of the pivot mechanism fully upwards to the “full” position and monitor resistance reading. Multimeter reading should increase smoothly from the minimum resistance (0 to 0.5 ohms) to 30.5 ± 1 ohms maximum with the float at the full upwards (FULL) position. There should be no erratic jumps in resistance reading while float Is gradually being raised.
(3) Replace fuel quantity transmitter MT4. If it falls testing as described above.

c. Install.
(1) Install replacement gasket (13, figure 3-16) and fuel quantity transmitter MT4 (12) in fuel tank using sealant compound MIL-S-7916. Secure with screw and captive washer assemblies (11).
(2) Install electrical connector to fuel quantity transmitter MT4 (12).
(3) Install floor plates (49, Figure 4-31) to the skid base with machine screws (48). Install floor mat (53).
(4) Install rear door stop plate (47) with hexagon head cap screws (44), hexagonal nuts (45), and lock washers (46).
(5) Install the control room fire extinguisher and bracket in accordance with paragraph 4-12.
(6) Close fuel drain valve (34) and refill fuel tank.

4-32. MAINTENANCE OF AIR CONTROL BOX DISCONNECT SWITCH OP3 . Air control box disconnect switch OP3 senses engine lubricating oil pressure. When lubricating oil pressure rises above 40 psi (276 kPa), the normally open contacts close. The switch is used to disconnect air box solenoids L2A and L2B once the engine has stopped and oil pressure drops.

a. Test.
(1) See figure 3-3 Tag and disconnect wiring from air control box disconnect switch OP3.
(2) Using a multimeter set to RX1 scale, check continuity across air control box disconnect switch OP3 contacts.
(3) Multimeter should indicate infinite resistance.
(4) See figure 2-13. Start the generator set and operate at rated speed. Ensure that LUBE OIL PRESSURE gage M1 indicates a minimum of 60 psi (414 kPa).
(5) Multimeter should indicate zero resistance.

b. Remove. See figure 3-3.
   (1) Tag and disconnect electrical connection from switch.
   (2) Remove switch from tee
c. Install.
   (1) Screw In switch and Install electrical connection as tagged
   (2) Run the engine and check for leakage around switch, tighten as necessary.

4 33. MAINTENANCE OF STARTER MOTORS 81 AND B2 AND ELECTRICAL SOLENOIDS B1L3 AND B2L4. Starter motors are used to rotate engine until combustion occurs.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. Remove. See figure 4-32.
   (1) Disconnect battery power.
   (2) Tag and disconnect wiring from electrical solenoids L3 and L4 (1) and starter motors B1 and B2, and starter slave relays K1 and K2.

1 ELECTRICAL SOLENOIDS B1L3 AND B1L4
2 STARTER MOTORS B1 AND B2
3. MACHINE BOLT

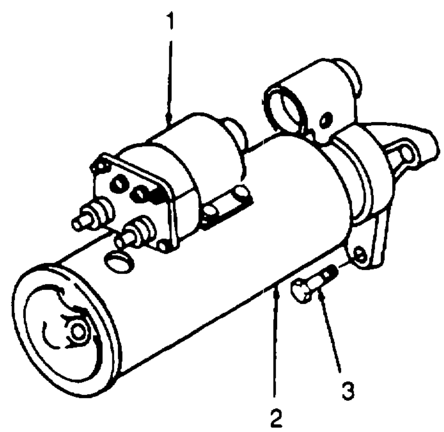


Figure 4-32. Starter Motor Assembly

   (3) Remove starter motors from flywheel housing by removing machine bolts, washers, and lock washers. Remove bottom starter first to gain access to starter bolts. Starter slave relays K1 and/or K2 will also come free with their brackets.

b. Test. Testing of the starter motor and electrical solenoid assembly consists of a no-load test of the complete unit followed by a pinion clearance check and adjustment. Before conducting the no-load test check the armature for freedom of rotation. Use a screw driver to turn the pinion on the exposed drive assembly in the drive housing. Tight bearings bent armature shaft, or a loose pole shoe screw will cause armature binding. If the armature does not turn freely, replace the starter. If the armature rotates freely, conduct the no-load test below.

CAUTION

Do not allow the starter motor to operate more than 30 seconds. Allow It to cool at least 2 minutes before deenergizing the motor. Overheating will damage the motor.

(1) Connect the starter assembly, see figure 4-33.
(2) Use power supply to obtain 20 V dc on the voltmeter.
(3) Using RPM gage and ammeter, check starter motor speed. At a minimum current draw of 95 amperes rpm should be at 5500 Motor speed at the maximum current draw of 120 amperes should be 7500 rpm
(4) Connect the starter motor See figure 4-34.

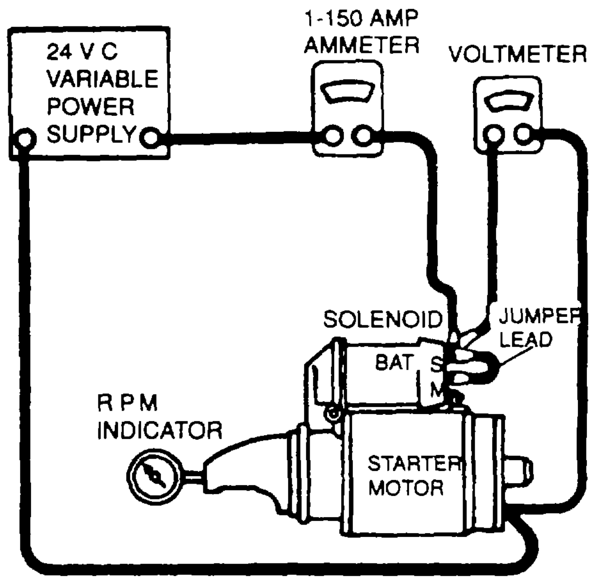


Figure 4-33. No Load Test Circuit

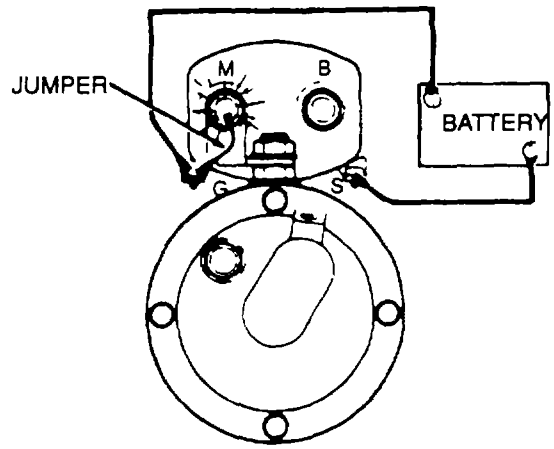


Figure 4-34. Circuit For Checking Pinion Clearance

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(5) Momentarily flash a jumper lead between terminals M and G. The dove will shift Into cranking position and remain so until the battery Is disconnected.
(6) See Figure 4-35. Push on drive to eliminate slack.
(7) Measure the distance between the pinion and the interior nose housing wall with a feeler gage. Distance should be within the 21/64 to 25/64 inch range.
(8) Disconnect test set up.
(9) Replace entire starter assembly if solenoid is bad.

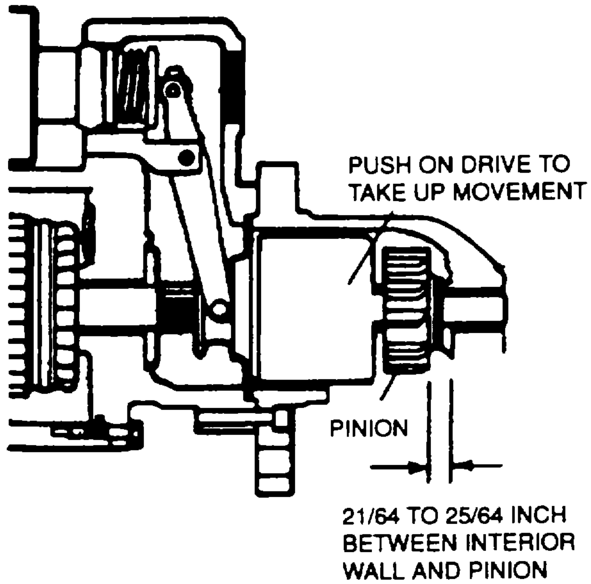


Figure 4-35. Checking Pinion Clearance

c. Install.

(1) Replace starter motors B1 and B2 and starter slave relays K1 and K2, and secure to engine assembly with machine bolts, washers, and lock washers.

(2) Connect wiring as tagged In step a, above, to electrical solenoids, starter motors, and starter relays. Discard tags.

(3) Reconnect battery power.

SECTION IX. MAINTENANCE OF AC ELECTRICAL POWER GENERATION AND CONTROL SYSTEM

4-34. GENERAL.

a. Generator G1 Operation. See FO-2.

(1) The generator is a brushless, 4-pole type, producing 60 Hz power at 1800 rpm or 50 Hz power at 1500 rpm. For 60 Hz operation, the generator produces 2400/4160 volts of 3-phase power in wye configuration (2400 volts line-to-neutral, 4160 volts line-to-line). For 50 Hz operation, the generator produces 2200/3800 volts of 3-phase power in wye configuration (2200 volts line-to-neutral, 3800 volts line-to-line).

(2) AC generators require direct current flow through the rotor winding to set up the magnetic flux which allows the unit to generate. A small exciter provides this direct current. The exciter is mounted on the same shaft as the generator rotor. The main generator field rotates and the armature is fixed while the exciter field is fixed and the armature rotates. The output from this exciter is fed into the rectifying elements mounted on a heat sink. This rectifier assembly is located on the end of the main shaft, opposite the drive end.

(3) The ac exciter requires direct current for its excitation. This excitation is suppliers by rectifying a portion of the output of the main generator by means of a static voltage regulator. The amount of current going into the field of the exciter will determine the output voltage of the exciter, and this in turn will control the output voltage of the main generator.

(4) Current boost module A101 provides additional exciter field current if the generator output voltage should fall below a set level.

b. Single Unit Generator Set Operation.

(1) The engine is started and brought up to speed.

(2) As the engine approaches operating speed, magnetic pickup PU1 on the flywheel housing transmits pulses to load sharing panel A104. The governing circuits begin steadying engine speed.

(3) If FREQUENCY SEL SW S118 has been set to 50 hertz, load sharing panel A104 will stabilize engine speed at 1500 rpm. If set to 60 hertz, engine speed stabilizes at 1800 rpm.

(4) It the FREQUENCY SEL SW S118 has been set to 50 Hertz, CLOCK 50 HZ M110 will function and 50 hertz frequency relay K108 will energize. If FREQUENCY SEL SW S118 has been set to 60 hertz, CLOCK 60 HZ M111 will function and 60 hertz frequency relay K107 will energize.

(5) If synchro check relay K116 senses a dead bus at the load terminals, load circuit breaker CB101 will be armed. Setting BREAKER CONTROL switch S4 on cabinet B door to CLOSE will close load circuit breaker CE)101. The output of generator G1 will then pass through main disconnect switch S120 and appear at output terminals L1, L2, L3, and L0.

c. Parallel Generator Set Operation.

(1) The operating sequence of events for manual, parallel operation begins as described In steps b(1) through b (4), above.

(2) When OPERATION SELECTOR SWITCH S3 is set to MANUAL, synchro check relay K116 will arm load circuit breaker CB101 only if generator G1 output voltage, frequency, and phase are identical to bus voltage, frequency, and phase. The operator must adjust generator G1 voltage and frequency to bring this about. By using PHASE SEQ SEL. SW. S119 and phase sequence lights (1-2-3, 3-2-1) DS112 and DS113, the operator can check the generator G1 and bus phase relationship GEN/BUS VOLTMETER switch S112 and AC KILOVOLTS meter M101 allow the operator to compare generator G1 and bus voltages for each phase. Using VOLT ADJ rheostat R101, generator G1 voltage can be matched to the bus FREQ ADJ rheostat R102, SYNCHROSCOPE M106, and SYNCHRONIZING LIGHTS DS110 and DS111 are used to match the frequency of generator G1 to the bus frequency. The frequency of the generator will be set only slightly higher than the bus; that is, so that the needle of SYNCHROSCOPE M106 rotates slowly clockwise (the direction labeled FAST on the face of M106). As the needle rotates to the 12 o'clock position, SYNCHRONIZING LIGHTS DS110 and DS111 will go out and synchro check relay K116 arms load circuit breaker CB101. At that moment, the BREAKER CONTROL switch S4 is activated to close load circuit breaker CB101 and connect the load to generator G1.

d. Protective Relays. Protective relays monitor the output lines of generator G1 for underfrequency, reverse powers, overvoltage, undervoltage, overcurrent, ground faults, and synchronism with the bus (when paralleling). The relays and their functions are as follows:

(1) Underfrequency Relays K107 and K108. Underfrequency relays K107 and K108 are located inside the upper part of cabinet B. K107 monitors the frequency through generator instrument transformer T107. K108 monitors the frequency through generator instrument transformer T106. Transformer T107 is tied to generator G1 output line T2. T106 is tied to generator G1 output line T2. Only one underfrequency relay is in circuit at any given time, as determined by the setting of FREQUENCY SEL SW S118. K107 is in circuit for 60 hertz operation, K108 for 50 hertz operation. During generator set startup, fault by-pass relay K17A prevents the normally closed contacts of relay K107 or K108 from causing a generator set underfrequency. Indication until approximately 10 seconds after engine speed has climbed above 600 rpm. 10 seconds after the engine reaches 600 rpm, generator G1 line frequency will exceed 46.5 ± 1 hertz (50 Hz), and 56.5 ± 1 hertz (60 Hz), causing underfrequency relay K107 or K108 to energize and open their contacts. 10 seconds after the engine reaches 600 rpm, crank cycle timer M7 energizes fault by-pass relay K17A, and the underfrequency fault shutdown circuits are armed. If the line frequency of generator G1 subsequently falls below 46.5 ± 1 or 56 ± 1 hertz depending on selected frequency the appropriate underfrenquency relay will energize annunciator alarm system self-latching relay A11K5. Annunciator horn LS1 will sound and UNDERFREQUENCY fault light A9DS14 on the annunciator panel will flash. Relay A11K5 also energizes circuit breaker trip relay K30. Relay K30 energizes the trip coil of load circuit breaker CB101 opening the breaker to disconnect generator G1 from the bus. The engine will continue to run, but load circuit breaker CB101 cannot be closed until the annunciator alarm system has been reset via the ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(2) Reverse Power Relay K109 Reverse power relay K109 is located in the upper section of cabinet B and protects generator G1 against motoring on loss of drive power from the engine (the engine shuts down). The relay compares the phase angle relationship of voltage and current that determines direction of power in the generator. When power is sensed flowing into the generator set at 13 to 26 amperes (or more), relay K109 will pick up within 12 cycles to energize self-latching relay A11K1 in the annunciator alarm system. Annunciator horn LS1 sounds and REVERSE POWER fault light A9DS10 on the annunciator panel flashes. A11K1 also energizes circuit breaker trip relay K30. Relay K30 energizes the trip coil in load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The engine will continue to run but load circuit breaker CB 101 cannot be closed until the annunciator alarm system has been manually reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(3) Overvoltage Relay K110. Overvoltage relay K110 is located inside the upper part of cabinet B and monitors the voltages at the secondaries of generator instrument transformers T104, T106, and T107. The generator instrument transformers are high accuracy (0.6 percent) 20:1 step-down transformers. Each transformer is tied to an output line of generator G1 (T104 to phase T1, T107 to phase T2, and T106 to phase T3). Overvoltage relay K110 monitors the three phases and tops whenever the highest voltage input exceeds 239 ~ 5 V ac for more than 3 ± 1 seconds (higher overvoltages will result in shorter tripping times). TIME DELAY ADJUST, on the face of the relay, is normally set to "A". Higher settings ("B", "C", or "D") result in greater delay before the relay trips (normally 5, 7, and 9 seconds, respectively). 239 V ac at the secondary of transformer T104, T106, or T107 represents a generator G1 line voltage of 4780 V ac, equivalent to 115 percent overvoltage at 60 hertz, or a 126 percent overvoltage at 50 hertz. When tripped, relay K110 energizes a slave relay, K9. Relay K9 energizes self-latching relay A10K7 in the annunciator alarm system. Annunciator horn LS1 sounds and OVERVOLTAGE fault light A9DS7 on the annunciator panel flashes. A10K7 also energizes fault shutdown relays K20A and K20B Relay K20A deenergizes self-latching engine run relay K15B. As a result engine fuel solenoid L1 loses power, closes, and cuts off fuel to the engine; the engine shuts down. Relay K20B energizes circuit breaker tap relay K30. Relay K30 energizes the trip coil in load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The generator set cannot be restarted until the annunciator alarm system is reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(4) Undervoltage Relay K111. Undervoltage relay K111 is located inside the upper part of cabinet B, is normally energized, and, like overvoltage relay K110, monitors the voltages at the secondaries of generator instrument transformers T104, T106, and T107. These transformers are described in step (3), above. Undervoltage relay K111 will deenergize whenever the lowest input voltage to the relay falls below 177 V ac for more than 1.5 ± 1 seconds (lower undervoltages will result in shorter tripping times). TIME DELAY ADJUST, on the face of the relay, is normally set to "A". Higher settings ("B", "C", "D", or `"E") result in greater delay before the relay trips (nominally 2 5, 4, 6, and 10 seconds, respectively). 177 V ac at the secondary of transformer T104, T106, or T107 represents a generator G1 line voltage of 3540 V ac, equivalent to 15 percent undervoltage at 60 hertz, or 7 percent undervoltage at 50 hertz. During generator startup, fault bypass relay K17A prevents relay K111 from causing a generator set undervoltage indication until approximately 10 seconds after engine speed has climbed above 600 rpm. 10 seconds after the engine reaches 600 rpm, generator G1 line voltage will exceed 3540 V ac, causing the undervoltage relay K111 to energize and close its contacts. Ten seconds after reaching 600 rpm, relay K17A energizes, thus arming the undervoltage fault shutdown circuits. If generator G1 line voltage subsequently falls below 3540 V ac, relay K111 will deenergized, and open its contacts so that annunciator alarm system self-latching relay A10K8 is energized. Annunciator horn LS1 will sound and UNDERVOLTAGE fight A9DS8 on the annunciator panel will flash. Relay A10K8 also energizes circuit breaker trip relay K30. Relay K30 energizes the trip coil In load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus The engine will continue to run, but load circuit breaker CB101 cannot be closed until the annunciator alarm system has been reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(5) Overcurrent Relay K114. Solid state overcurrent relay K114 is panel mounted on upper cabinet A door and monitors the current through instrument current transformers CT10, CT11, and CT12. Instrument current transformers CT10, CT11, and CT12 sense the current through generator G1 output lines T3, T2, and T1, respectively. At rated load, each output line carries 130 amperes, Inducing a current of 3.71 amperes in each current transformer. To properly monitor each phase, the current pickup taps on the front panel of relay K114 must be set to "4" for each phase, "4" being the approximate output, in amperes, of each instrument current transformer CT10 through CT12. The TIME dial on the front panel of K114 is set to "10" with its associated vernier, marked ADJ, set fully counterclockwise These settings establish the time delay curve that K114 trips on. a continuous 130 percent overload (line current 169 amperes, current transformer current 4 83 amperes) will cause overcurrent relay K114 to trip after 15 to 25 seconds. Tripping is accomplished by the gating of an SCR

circuit inside K114. The anode of the SCR (K114 terminal 7) is tied to the positive terminal of the battery in the generator set start circuit. When gated on the SCR cathode (K114 terminal 12) energizes a slave relay, K10 Relay K10 energizes self-latching annunciator alarm relay A1K9 and circuit breaker trip relay K30. Annunciator horn LS1 sounds and OVERCURRENT fault light A9DS9 on the annunciator panel flashes. Relay K30 energizes the trip coil in load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The engine will continue to run, but load circuit breaker CB101 cannot be closed until the annunciator alarm system has been manually reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A. To protect generator G1 from the possibility of a dead short across its output lines, overcurrent relay K114 has a second SCR (SCR-B) parallel connected to that described above. Gating of this SCR is controlled by the INST dial on the front panel of the relay. The dial is normally set at “3” with its associated vernier, marked ADJ, set fully counterclockwise. Instantaneous tripping of K114 occurs when input current rises to current pickup tap setting (4 for each phase) multiplied by the INST factor (normally set at "3”). Hence, an input current of 12 amperes on any phase will instantaneously trip the relay, whereas a time delay of about 2.5 seconds would transpire if only SCR-A were in the circuit to trip the relay . (A12 ampere input would represent a 420 ampere line current. Such a current might damage generator G1 if applied as long as 2 5 seconds). After SCR-B trips the relay, slave K10 is energized, and events proceed as described above.

(6) GROUND FAULT Relay K115. GROUND FAULT relay K115, panel mounted on upper cabinet A door, is an overvoltage relay configured for ground fault detection in conjunction with ground fault transformer T100 and ground fault resistor assembly R100. Both of the latter are located in the rear section of cabinet A. The neutral phase of generator G1 (TO) is tied to generator set ground through the primary of ground fault transformer T100. Ground fault resistor assembly R100 is connected across the secondary of T100. GROUND FAULT relay K115 senses the voltage across R100. The relay trips when voltage across R100 increases to a value determined by a tap block in the relay. The tap plug, located at the top of relay K115, behind the plastic cover, is normally set in the "A" position. The time dial, centered and just below the tap, is normally set to “1". These settings result in contact closures within 1 second. If the relay senses 28 V ac or more across R100 28 V ac across R100 corresponds to a ground fault potential of 506 V ac at 0 92 ampere across the primary of T100. When GROUND FAULT relay K115 is topped, it energizes a slave relay, K11 Relay K11 energizes self-latching annunciator alarm relay A11K2 and circuit breaker trip relay K30. Annunciator horn LS1 sounds and GROUND FAULT light A9DS11 on the annunciator panel flashes. Relay K30 energizes the trip coil in load circuit breaker CB101, opening the breaker to disconnect generator G1 from the bus. The engine will continue to run, but load circuit breaker CB101 cannot be closed until the annunciator alarm system has been reset via ANNUNCIATOR RESET pushbutton S12 on the upper door of cabinet A.

(7) Synchro Check Relay K116. Synchro check relay K116 is located inside the upper part of cabinet B. When manually paralleling the generator set with an energized bus, synchro check relay K116 is used in conjunction with SYNCHROSCOPE M106 and SYNCHRONIZING LIGHTS DS110 and DS111 to ensure that load circuit breaker CB101 is not closed until the voltage, frequency, and phase of generator G1 and the bus are in close agreement. When PARALLEL Switch S6 is set to PARALLEL, parallel relay K4B is energized to place SYNCHROSCOPE switch S115 in the arming circuit for load circuit breaker CB101. When SYNCHROSCOPE SWITCH S115 is set to ON, SYNCHROSCOPEM106 is actuated. SYNCHRONIZING LIGHTS DS110 and DS111 flash to show voltage differences between generator G1 line L1 and bus line L1, and generator G1 line L2 and bus line L2, respectively. Synchro check relay K116 senses bus line L1, and generator line L1. All elements sense bus voltage through bus instrument transformers T108 (line L1) and T109 (line L2). Generator G1 lines are sensed through generator instrument transformers T104 (line L1) and T107 (line L2). The generator instrument transformers are high accuracy (0 6 percent) 20:1 step-down transformers. To parallel the generator set with the bus, the operator checks for proper phase connections using PHASE SEQ. SEL. SW S119, then adjusts the voltage and frequency output of generator G1 using VOLT ADJ rheostat R101 and FREQ ADJ rheostat R102. SYNCHROSCOPE M106 and SYNCHRONIZING LIGHTS DS110 and DS111 indicate to the operator when the generator set is ready to parallel. Synchro check relay K116 ensures generator G1 output agrees with the bus by preventing load circuit breaker CB101 closure until the difference between the generator output voltage and bus voltage is less than 5 percent, the difference between the two frequencies is less than 0.5 hertz, and the phase angle between the two voltages is less than a pre-set value between 6 and 18 degrees (normally 10 degrees). When these three conditions are met, relay K116 energizes and arms the closing circuit for load circuit breaker C8101. If the operator then sets BREAKER CONTROL SWITCH S4to CLOSE, the breaker will close to connect generator G1 to the bus. Synchro check relay K116 will also energize when voltage is sensed at generator G1, but not at the bus. This “dead bus" feature enables load circuit breaker CB101 closure to connect generator G1 to a dead bus. When OPERATION SELECTOR SWITCH S3 is set to AUTO, Synchro check relay K116 is removed from the load circuit breaker CB101 arming circuit and breaker closure Is controlled by synchronizer A105.

e. <u>Lightning Arresters EI01. E102. and E103</u>. Lightning arresters E101, E102, and E103 are connected between generator set ground and generator G1 lines T1, T2, and T3, respectively. They provide a path to ground for high voltage transients on the output lines of generator G1 and any bus the generator set may be connected to while load circuit breaker CB101 is closed.

f. <u>Main Disconnect Switch S120</u>. Main disconnect switch S120 is a frame-mounted, three pole switch with group-operating parts, mechanism operating assembly, and switch handle. The switch handle and the mechanism operating assembly are linked by a drive chain. Raising the handle to the up position closes the switch. To prevent switch opening or closure while tied to generator G1, main disconnect switch S120 is kirk-key interlocked with load circuit breaker CB101. The interlock prevents switch handle operation unless CB101 is racked out. Main disconnect switch S120 is directly connected to generator set output terminals L1, L2, and L3.

g. <u>Lights. Switches. and Receptacles</u>. 120 V ac lights, switches, and receptacles are found in the control room, engine compartment, and generator compartment. Utility power is normally used to power these circuits, but generator G1 may be used if SET STATION POWER circuit breaker CB124 is set TM ON and the generator set is operating. The receptacles are protected by 20 amp circuit breakers. The lighting circuits are protected by 15 amp circuit breakers. All of these circuit breakers are part of the control room distribution panel DP2 (See figure 2-11).

h. <u>Wiring and Harnesses</u>. Harnesses interconnect elements of the AC electrical power generation and control system. Refer to wiring diagrams FO4-29. All wires in the generator set have wire number markings along their lengths. The DC and AC schematics (FO-1 and FO-2) provide functional representations of component and circuit interconnection within the generator set.

i. <u>Cable Assemblies.</u> Cable assemblies are used to interconnect the generator set to an external bus, to other generator sets, and to utility power. The cables and their functions are as follows:

(1) Outgoing Power Cable Assembly Four outgoing power cable assemblies are provided, one for each phase line of generator set output (L1, L2, and L3) and one for neutral (10). Each cable is 100 feet (30 meters) long. Wire identification straps along the lengths of the cables identify the cables by line number. Terminal elbows at one end of each cable are used to connect the cables to the generator set output terminals. Each output terminal consists of a shedwell bushing which mates with the terminal elbow of an outgoing power cable. The output terminals are labelled L1, L2 L3, and L0 so that the cables can be properly connected. Tie-down loops on the cable grips near the elbow end of the cables allow the cables to be hitched to a hook on the skid base while they are connected to the output terminals. The cable grips maintain slack in the cable to prevent undue stress at the cable-to-generator set connections. At the opposite end of each cable is a terminal lug for connecting the cables to a load bus. A stress cone kit installed between the cable and the terminal lug relieves corona effects at this end that could weaken the insulation electrically. At the generator set end of each cable, an 18 inch (46 cm) 12 gage insulated wire is used to ground the shielding of the cable to the generator set housing. Shield grounding wires are also provided near each terminal lug end for connection to the appropriate load ground terminals. Adjacent to each output terminal is a standoff insulator assembly. Like the output terminals, these standoffs also mate with the output terminals. These standoffs are used to “park” the cables when the elbows are removed from the output terminals.

(2) SRM Cable Assemblies J28 and J29. These cables are required for paralleling generator sets if using the site requirement module (SRM). The cables carry control signals necessary for automatic paralleling. Each cable is 100 feet (30 meters) long.

(3) Reactive Gable Assembly. This cable assembly is used to interconnect the generator set to another generator set for isochronous paralleling. The two element cable interconnects generator set paralleling current transformers CT114 and voltage regulators VR101. The cables are 100 feet (30 meters) long and connect to the REACTIVE LOAD receptacles J21, J22, or J23 (3, figure 2-17) on the right side of the generator set.

(4) Governor Circuit Cable Assembly. This cable is used to interconnect generator set governor control circuits for isochronous paralleling. The two element shielded cable interconnects generator set load sharing panels A104. The cable is 100 feet (30 meters) long and connects to GOVERNOR CONT receptaclesJ18, J19, orJ20 (Figure 2-17) on the right she of the generator set.

(5) Station Power Cable Assembly. The station power (utility power) cable assembly is used to connect the generator set to an external single phase, 240 V ac power, or 380 V ac power source. The 100 foot (30 meter) cable is connected to UTILITY POWER receptacle J101 (Figure 1-4) on the right side at the generator set to bring in power to connection board assembly TB103. TB103 is set to connect the power to generator set 120 V ac circuits directly, or through utility station power transformer T103, depending on whether the utility power is 240 V ac or 380 V ac, respectively. Cable ends at the opposite end of the station power cable assembly allow for connection to three chase or single phase power.

4-35. MAINTENANCE OF WIRING HARNESSES. Wiring harnesses are used for electrical connections, in the generator set.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Verify that the load cables are disconnected and "parked" and that MAIN DISCONNECT switch S120 is set to OPEN. Ensure equipment is 'tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper Insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. Remove.

(1) Remove all hangers, clamps, and ties attaching the harness to be replaced on the generator set.

(2) Tag and disconnect all wires terminating In lugs from their mountings by removing nuts and washers attached to their lugs

(3) Where wires are soldered to a connector, the connector is considered part of the harness and is replaced with the harness. Remove screws, nuts, and washers, as necessary, to remove multiple connectors.

(4) Remove harness from generator set by withdrawing wires past any obstruction until wires are free of the generator set

b. Test.

(1) Note carefully any malfunction of the generator set traceable to components that are electrically connected to the harness being tested.

(2) Where there is indication that a given harness is causing a malfunction, test the wires relating to the malfunctioning circuit both for continuity and internal shorts. Check all suspect wires for continuity to grocers. See to the applicable wiring diagram FO-4 through FO-12.

c. <u>Repair</u>.

(1) Splicing. Expose damaged wires by cutting harness sleeving as necessary, being careful not to cut the insulation of serviceable wires when cutting the sleeving. It Is normally most efficient to guide the tip of the cutting instrument between parallel wires in the harness. The cuts in the sleeving should always be made parallel with the harness assembly. When the wires to be spliced are exposed, proceed as follows:

WARNING

To avoid injury to personnel, do not breathe fumes generated by soldering. Eye protection is required. Remove rings and watches while soldering.

(a) Install shrink-down sleeve PO-135 of adequate length and diameter to cover finished splice, over one end of broken or cut wire. Position shrink-down sleeve far enough from break so that it we not interfere with splicing or soldering operations.

(b) Strip end of each wire to be spliced approximately 0.55 inch (13 mm). If a piece of wire Is to be spliced into an existing wire, ensure the new section is of the same AWG size.

(c) Twist all stepped ends tightly together, so as to form neat joints of uniform size. Solder joints in accordance with MIL-S-6872, using solder with rosin flux.

(d) Position shrink-down sleeve over solder joint, and heat sleeve to 250°F (121°C) so that sleeve shrinks to form a tight seal around soldered joint.

(e) If harness sleeving was cut to expose broken wire, repair sleeving with three layers of half-lapped insulating tape MIL-T-638.

(2) Replace damaged lugs as follows:

(a) Remove damaged lugs by cutting wire as close as possible to lug. If cutting leaves wires too short, splice in accordance with step (1), above.

(b) Install shrink down sleeve PO-135, of adequate length and diameter to cover shank of lug, over cut wire.

(c) Strip 0.15 inch (3.8 mm) of insulation from end of wire. Crimp new lug In place, and solder in accordance with MIL-S-6872, using solder with rosin flux.

(d) Position shrink-down sleeve over shank of lug and shrink as in step (1), above.

(3) Replace damaged electrical connectors as follows:

(a) Before removing any damaged connector, prepare a diagram showing the location of each wire in relation to the connector by matching the wire number to the pin letter on the connector.

(b) Remove pins and wires from connector. Cut wire as close to pins as possible.

(c) Strip 0.25 Inch (6.4 mm) of insulation from the end of each wire.

(d) Remove pins from new connector. Crimp pins to wire ends.

(e) Insert pins into connector. Reassemble connector.

(4) All soldering will be performed in accordance with standard shop practices and MIL-S-6872.

d. <u>Install</u>.

(1) See the appropriate wiring diagram FO-4 through FO-12 for the routing of harness being replaced.

(2) Carefully feed replacement wires in the harness past any obstruction into positions noting the following:

(a) There should be no strain on any wire when it is in place and its connectors and mounting lugs are attached to the generator set

(b) No wire should be bent over any sharp surface that might wear through the wire in normal service.
(c) No wire should be in contact with any heat producing part of the engine or exhaust system.
(3) Attach multiple connectors using screws, nuts, and washers removed In step a, above.
(4) Attach all wires terminating In lugs to the correct stud or terminal by replacing washers, lock washers, and nuts removed in step a, above:

4-36. MAINTENANCE OF LIGHTS AND SWITCHES . Used to provide lighting in engine compartment in order to perform maintenance functions.

a. Light fixtures DS102. DS103. and DS104.

(1) Replace.
(a) Open CB124.
(b) Tag and disconnect wiring to AC light fixture (5, figure 3-11).
(c) Remove the screw and captive washer assemblies (1), nut and captive washer assemblies (2), and flat washers (3), and remove the AC light fixture (5) from the fixture mounting bracket (4).
(d) Remove the guard (9) and globe (8) and remove the bulb (7) and socket from the base (6).

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III of this manual and equipment is NOT energized. Residual voltage is present at the generator lead. with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator sort. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

(2) Test. See Figure 3-11.
(a) Remove the guard (9) and globe (8) and remove the bulb (7) from the base of the AC light fixture (5).
(b) Ensure that engine room lighting circuit breaker CB108 and control room lighting circuit breaker CB104 are set to ON.
(c) Using a multimeter set to read AC voltage, check the socket for the presence of 120 V ac current.

(3) Install.
(a) Install the socket in the base, and install the bulb (7) in the socket install the guard (9) and globe (8) in the base.
(b) Install the AC fight texture (5) in the mounting bracket (4) with the screw and captive washer assemblies (1), nut and captive washer assemblies (2), and flat washers (3).
(c) Connect wiring to the AC fight fixture (5) and discard the tags.
(d) Close CB124.

b. Single Pole Switch S102 and 3-Way Switches S103 and S104.

(1) Replace.
(a) Open CB124.
(b) Remove screw and captive washer assemblies (10, figure 3-11) and remove switch plate (11).
(c) Remove screw and captive washer assemblies (12) and pull 120 V ac switch (13) just far enough from the receptacle box (15) so that the wiring to the 120 V ac switch can be disconnected and tagged.

(2) Test
- (a) Remove 120 V ac switch (13, figure 3-11) in accordance with step (1), above.
- (b) Using a multimeter set to the RX1 scale, check continually across contacts of 120 V ac switch in one of the switching positions.
- (c) Place the 120 V ac switch in the other switching position and check continuity as in step (b), above.
- (d) Compare the results of the continuity checks made in steps (b) and (c), above. Multimeter should indicate infinite resistance in one of the switching positions and zero resistance in the other switching position.

(3) Install.
- (a) Connect wiring to the 120 V ac switch (13, Figure 3-11) discard tags, and install 120 V ac switch in the receptacle box (15) with the screw and captive washer assemblies (12).
- (b) Install the switch plats (11) with the screw and captive washer assemblies (10).
- (c) Close CB124.

4-37. INSPECT GENERATOR ASSEMBLY. Generator G1 provides all main AC electrical power (750 kW) to output load terminals L1, L2, L3, and L0. Inspect the generator assembly (see figure 1-7) for signs of excessive heat, such as peeling paint, excessive noise, smoke, or abnormal odors.

4-38. MAINTENANCE OF LIGHTNING ARRESTERS (SURGE).

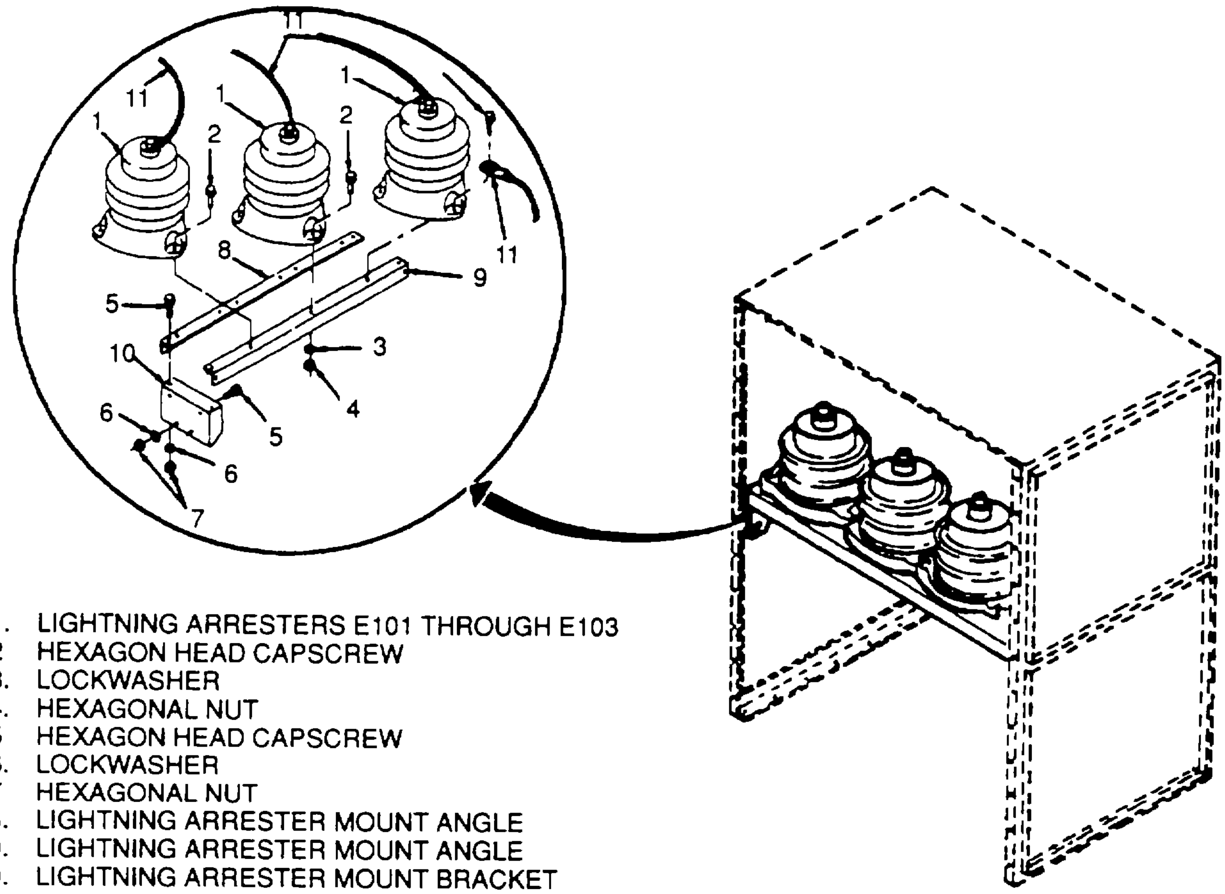
WARNING

To avoid death or Injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" In accordance with Chapter 1, Section III. of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned on, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. General. Lightning arresters E101, E102, and E103 are connected between generator G1 phase lines L1, L2 and L3, respectively, and ground L0 Each arrester consists of porcelain clad units and required electrical attachments. A master nameplate located on the bottom of the lightning arrester casting gives pole voltage rating.

b. Inspect. See figure 3-28 and figure 4-36.
- (1) Inspect base casting of arresters for cracks. Cracks In the base may indicate uneven tightening of hardware or uneven mounting surface. Replace if damaged.
- (2) Wipe down porcelain surfaces to remove soot, dirt, salt, etc. then inspect porcelain areas for fissures. Replace any lightning arresters with fissures.
- (3) Inspect line terminal and surrounding porcelain for damage. Check electrical connections at terminals for security. Replace any arresters with damaged porcelain. Tighten any loose connections.

c. Removal. See Figure 4-36
- (1) Tag and disconnect cables (11) from line terminals.
- (2) Remove lightning arrester (1) by removing hexagon head screws (2), lock washers (3), and hexagonal nuts (4). Tag and disconnect ground cables (11).



1. LIGHTNING ARRESTERS E101 THROUGH E103
2 HEXAGON HEAD CAPSCREW
3. LOCKWASHER
4. HEXAGONAL NUT
5 HEXAGON HEAD CAPSCREW
6. LOCKWASHER
7 HEXAGONAL NUT
8. LIGHTNING ARRESTER MOUNT ANGLE
9. LIGHTNING ARRESTER MOUNT ANGLE
10. LIGHTNING ARRESTER MOUNT BRACKET
11 LINE AND GROUND TERMINAL CABLE

Figure 4-36. Lightning Arresters E101. E102. and E103

(3) If necessary, replace lightning arrester mount angles and related parts as follows:

(a) Remove lightning arrester mount angles (8 and 9) by removing hexagon head screws (5), lock washers (6), and hexagonal nuts (7).

(b) Remove lightning arrester bracket (10) by removing hexagon head screws (5), lock washers (6), and hexagonal nuts (7).

d. Installation. See figure 4-36.

CAUTION

When installing lightning arresters, all mounting feet must be flush before tightening bolts. The line terminal must not be used to lift lightning arrester. Lightning arrester exhaust ports must be directed away from unprotected equipment.

(1) If previously removed, install lightning arrester mount angles and related parts as follows:

(a) Install lightning arrester bracket (10) using hexagon head screws (5), lock washers (6), and hexagonal nuts (7).

(b) Install lightning arrester mount angles (8 and 9) to lightning arrester mount bracket (10) using hexagon head screws (5), lock washers (6), and hexagonal nuts (7).

(2) Install lightning arrester (1) and check mounting surface of base castings for flushness. Arrester must sit firmly without rocking.
(3) Discard tags and Install ground terminal cables (11) under one of the mounting bolts but over the mounting foot of the base casting. Each lightning arrester must be grounded In this manner.
(4) Using hexagon head screws (2), lock washers (3), and hexagonal nuts (4), secure base casting of lightning arrester (1) to lightning arrester mount angles (8 and 9).
(5) Discard tags and bolt cables (11) to line terminals.

4-39. MAINTENANCE OF MAIN DISCONNECT SWITCH S120 . Main disconnect switch S120 is used to isolate any voltage that may be available at the bus from being fed into the unit while maintenance functions are being performed.

a. Test. See Figure 4-6.
(1) Remove racking handle (7) from its stowage position on left side of load circuit breaker CB101. Using racking handle, crank circuit breaker RACKING crank OUT as far as it will go.
(2) Lock load circuit breaker CB101 kirk-key Interlock (6) and remove key.
(3) Insert key in main disconnect switch S120 kirk-key interlock (5) and unlock. Leave key in lock.
(4) Move main disconnect switch handle (4) to OPEN (down) position and then return handle to CLOSED (up) position. Ensure handle moves smoothly with no binding noted.
(5) Lock main disconnect switch S120 kirk-key interlock (5) and remove key.
(6) Insert key In load circuit breaker CB101 kirk-key interlock (6) and unlock. Leave key in lock.
(7) Using racking handle, crank LOAD circuit breaker RACKING crank (3) in as far as it will go. Return racking handle to its stowage position on left side of load circuit breaker CB101.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is ``tagged out" in accordance with Chapter 1, Section III of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned On, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

WARNING

Do not touch exposed electrical connections when circuits are energized. DC CONTROL and UTILITY POWER CIRCUIT BREAKERS must be deenergized and MAINTENANCE LOCKOUT switch set to MAINTENANCE before starting any procedure.

NOTE

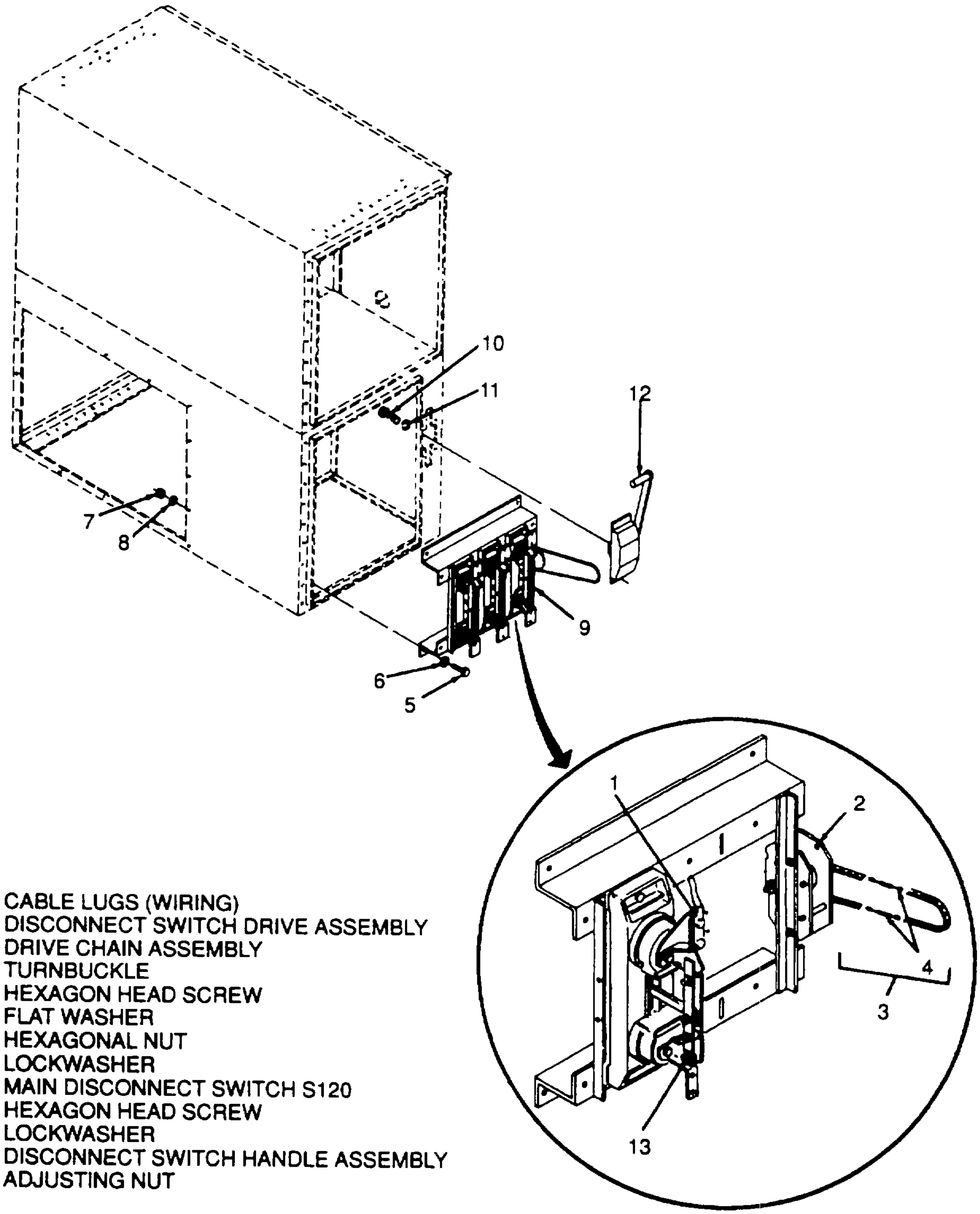
Main disconnect switch S120 removal or installation may require the services of two or more persons.

b. Remove.
(1) Shut down the generator set in accordance with Chapter 2 of this manual.
(2) Disconnect load cables L1, L2 L3, and L0 at the load cable bay and park on the corresponding standoffs to ensure that the set Is Isolated from any external power source
(3) Open lower front cabinet A compartment and remove cabinet A rear access panel. Use grounding stick to discharge any residual voltages that may be present at the rear cabinet components. Also apply grounding stick on switch terminals inside the front lower cabinet.

(4) Carefully tag and disconnect cable lugs (1, figure 4-37) from top and bottom switch terminals according to phase.
(5) Remove chain drive assembly (3) from switch drive assembly (2) at side of the disconnect switch frame, loosen one chain turnbuckle (4) and remove chain assembly from sprocket gear on switch drive assembly (2).
(6) Remove hexagon head screws (5), flat washers (6) from lower cabinet A compartment and hexagon nuts (7) and lockwashers (8) from rear cabinet A interior to remove main disconnect switch S120 (9). Lift out main disconnect switch from lower cabinet A.
(7) Remove four hexagon head screws (10) and lockwashers (11) holding the main disconnect switch handle assembly (12) to the cabinet frame. Remove main disconnect switch handle assembly (12).

c. Install.
(1) Mount replacement main disconnect switch S120 (9) Inside lower cabinet A compartment using four hexagon head screws (5) and flat washers (6). Install and tighten hexagon nuts (7) and lockwashers (8) at rear cabinet A interior Reinstall rear cabinet A access panel.
(2) Install main disconnect switch handle assembly (12) with chain (3) attached, on front right exterior of compartment using four hexagon head screws (10) and lockwashers (11). Install and tighten switch handle mounting hardware (10 and 11) from inside the compartment.
(3) With switch handle assembly (12) In CLOSED (up) position and the main disconnect switch S120 (9) closed, position the drive chain assembly (3) over the drive sprockets Inside both the switch handle assembly (12) and on the disconnect switch drive assembly (2). Ensure that the chain links are engaged on the sprocket teeth when securing drive chain assembly (3) with the turnbuckles (4). Position drive chain assembly (3) so that the two turnbuckles (4) are aligned with each other and positioned midway between the switch handle assembly (12) and main disconnect switch S120 (9). Tighten turnbuckles (4) as needed to hold the drive chain assembly (3) in position. This may require further adjustment to ensure proper chain tension.
(4) Install CLOSED (up) and OPEN (down) plate indicators on switch handle assembly (12) it removed.
(5) Open and close main disconnect switch S120 several times using switch handle assembly (12) to check chain drive operation. Loosen or tighten the turnbuckles (4) as needed to ensure smooth switch handle operation.
(6) Reconnect switch cables according to phase as tagged. Remove and discard tags.
(7) Close lower cabinet A compartment.

d. Align.
(1) Perform substeps b(1) through (4), above.
(2) Open switch by pulling switch handle assembly (12) downward to OPEN position.
(3) Tighten pressure adjusting nut (13, Figure 4-37) one-half turn at a time on each switch blade, If needed.
(4) Move blades back and forth 90 degrees to centerline of base to observe contacts with the hinge. The blades should be moderately snug against both sides of the hinges at all times. Use thin shim to check for blade contact.
(5) Connect wires as tagged. Remove and discard tags.
(6) Close cabinet A compartment.



1. CABLE LUGS (WIRING)
2. DISCONNECT SWITCH DRIVE ASSEMBLY
3. DRIVE CHAIN ASSEMBLY
4. TURNBUCKLE
5. HEXAGON HEAD SCREW
6. FLAT WASHER
7. HEXAGONAL NUT
8. LOCKWASHER
9. MAIN DISCONNECT SWITCH S120
10. HEXAGON HEAD SCREW
11. LOCKWASHER
12. DISCONNECT SWITCH HANDLE ASSEMBLY
13. ADJUSTING NUT

Figure 4-37. Main Disconnect Switch S120 Assembly

4-40. TEST OF PARALLEL CABLE ASSEMBLIES. The paralleling cable assemblies are used to interconnect generator sets via paralleling receptacles when isochronous paralleling is desired. These procedures apply for both the reactive load and governor control cables. See figure 3-9.

a. Disconnect the parallel cable assemblies.

b. Using a multimeter test each cable assembly as follows:

(1) Check for isolation between adjacent conductors, and between any conductor and ground. There should be Infinite resistance for each test.

(2) Check each conductor for continuity from one connector to the other. There should be zero resistance from one end of any conductor to the other.

c. If tests fail to show isolation or continuity, refer to the next higher level of maintenance for repair and overhaul of the detective parallel cable assemblies.

4-41. TEST OF UTILITY POWER CABLE. Test utility power cable as follows:

a. With multimeter set for resistive reading check each conductor A, B, and C, inside the cable for continuity between its terminal lug end and its plug connector terminal Meter reading should be zero ohms for each conductor.

b. Using a 500 V dc megohmmeter, check resistance reading across cable conductors A, B, and C. Meter should register Infinite resistance.

4-42. MAINTENANCE OF MAGNETIC PICKUP PU1. The magnetic pickup PU1 (Figure 3-3) Ii an electromagnetic device that is mounted in the flywheel housing. As the flywheel gear teeth pass the magnetic pickup, ac voltage is induced, one cycle per tooth. This signal Is passed to the electronic speed control to provide an indication of the engine speed.

a. Test.

(1) Using a digital multimeter measure the voltage signal from the magnetic pickup PU1 (Figure 3-3) at the electronic speed control (refer to paragraph 4-51) across terminals C and D. With the engine at operational speed, the signal can range from 0.5 to 30 V rms. If the signal being generated is not within this range, attempt to adjust the magnetic pickup PU1 In accordance with step (2), below, to obtain the optimal signal of 30 V rms. If signal Is not present, or less than 0.3 V rms after best adjustment, replace the magnetic pickup PU1.

CAUTION

Do not attempt to adjust or replace the magnetic pickup PU1 with the engine

(2) Raise the magnetic pickup voltage by reducing the gap between the pickup and the ring gear no closer than 0.030 inch (0.75 mm). This is equivalent to backing the pickup out by one-half turn after it touches the ring gear tooth on the flywheel

b. Remove. See figure 3-3.

(1) Disconnect plug from magnetic pickup PU1

(2) Loosen locknut, then unscrew and remove the magnetic pickup.

c. Install.

(1) With the engine stopped, screw the magnetic pickup PU1 (Figure 3-3) into the threaded recess until the tip touches the top of the ring gear tooth. Then back out the magnetic pickup PU1 one-half turn to three-quarters of a turn and secure with the locknut.

(2) Reconnect plug on magnetic pickup PU1.

(3) Test in accordance with step a, above.

4-43. MAINTENANCE OF LOAD TERMINALS. The load terminals are located inside the load (output) cable bay at the left exterior housing and are used to connect the load (output) cables to the generator set.

a. Inspect.

(1) Shut down generator set in accordance with Chapter 2 of this manual.

(2) See Figure 1-3. Open load cable bay cover assembly. Disconnect load cables L1, L2, L3, and L0 inside load cable bay and park on the corresponding standoff.

(3) See figure 3-26. Remove cabinet A rear access panel. Apply grounding stick momentarily at all load terminal conductor ends inside cabinet to discharge any residual voltages that may be present. Apply grounding stick to all other cabinet components.

(4) Visually inspect rear load terminal bushings for cracks, signs of overheating, and other damage. Check terminal lug connections at rear for secure mounting. Check wiring for signs of Insulation breakdown such as cracked sleeves and burned Insulation. Reinstall rear cabinet A access panel.

(5) Open load (output) cable bay cover assembly (See figure 1-3). Inspect load cable terminal bushings L0, L1, L2, and L3 for cleanliness, cracks, signs of overheating, and secure mounting. Check that the conductor terminal inside each bushing is clean and free from any obstruction.

(6) Reconnect load cables L1, L2, L3, and L0, if needed. Close cover assembly.

4-44. MAINTENANCE OF CURRENT BOOST TRANSFORMERS CT2 AND CT3.

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

a. Test.

(1) Shut down generator set in accordance with Chapter 2 of this manual.

(2) Open main disconnect switch S120 in accordance with paragraph 4-3.

(3) See figure 1-7. Remove generator conduit box cover assembly by removing hexagon head screws.

(4) Tag and disconnect wiring from current transformers CT2 and CT3 located on either interior side of the conduit box assembly.

(5) With multimeter set for resistive reading (RX1) check winding of each current transformer for continuity. Resistance reading should be less than 1 ohm (typical).

(6) Connect a 500 V dc megohmmeter across ether transformer lead and to ground. Operate megohmmeter for 60 seconds and monitor resistance reading. Perform this procedure on both transformers.

(7) Megohmmeter resistance reading for each transformer should be no less than 100 megohms.

(8) Reinstall conduit box cover assembly using hexagon head screws.

4-45. MAINTENANCE OF AC CIRCUIT BREAKERS. These circuit provide an automatic safety disconnect of ac power from their respective circuits.

a. Remove.
   (1) Disconnect ac power
   (2) Tag and disconnect wiring to circuit breaker.
   (3) Remove screw and captive washer assembly, flat washer, and mounting bracket.
   (4) Remove circuit breaker.

b. Test. Test each circuit breaker using a MSIA circuit breaker tester

c. Install.
   (1) Position circuit breaker into mounting bracket.
   (2) Attach mounting bracket using screw and captive washer assembly, nut and captive washer assembly, and flat washer.
   (3) Connect electrical wiring and discard tags.
   (4) Reconnect ac power

SECTION X. MAINTENANCE OF FUEL SYSTEM

4-46. GENERAL. See Figure 1-11 Fuel from an external source is supplied to the generator set fuel tank by a fuel transfer pump. A solenoid valve prevents fuel from flowing through the fuel transfer pump when it Is not operating. A fuel strainer Is located incline ahead of the fuel transfer pump, and two duplex fuel filter sets are arranged in parallel between the fuel transfer pump and the generator set fuel tank. An engine driven fuel injection pump draws fuel from the generator set fuel tank. A single duplex fuel filter set is located between the generator set fuel tank and the fuel injection pump. A magnetic pickup mounted in the engine flywheel housing sends a signal to the electronic speed control located inside panel B in the generator set control room. The electronic speed control governs the operation of an actuator mounted on the fuel pump. The actuator regulates the pressure of the fuel supplied to the fuel injectors, thereby regulating engine speed and horsepower. Fuel leaving the fuel injection pump flows into the fuel manifolds and then to the fuel injectors located in each cylinder head.

CAUTION

When disconnecting fuel hoses, ensure that a suitable container is provided to caps ture fuel runoff from the hoses. If it is necessary to close the manual fuel shutoff valve, pull the push/pull emergency control on the exterior of the generator set. Push the push/pull emergency control in to restore fuel flow.

4-47. MAINTENANCE OF FUEL TRANSFER PUMP . The fuel transfer pump is used to transfer fuel from an external fuel source to the generator set fuel tank.

a. Test.

NOTE

The following test should not be performed if the generator set fuel tank is more than half full. Performing this test when the generator set fuel tank is more than half full may provide inaccurate results due to fuel level sensor FL2 sensing sufficient fuel in the generator set fuel tank and deenergizing the fuel transfer pump automatically. If it becomes necessary, fuel must first be drained from the generator set fuel tank.

   (1) Ensure that the generator set is properly configured for utility ac power, and that an external fuel source is connected to the generator set.
   (2) Turn FUEL PUMP switch S8 to OFF.
   (3) Open fuel tank drain valve and completely drain fuel into suitable container. Close drain valve.

(4) Turn FUEL PUMP switch S8 to HAND. Tank should fill and level switch should shut off pump in approximately 10 to 13 minutes. If tank does not fill in 10 to 12 minutes, investigate cause. Check for too much negative head to pump, faulty solenoid, dirty strainer or filters, and defective pump coupling.
(5) Turn FUEL PUMP switch S8 to AUTO. Set fuel transfer pump circuit breaker CB121 to OFF.
(6) Tag and disconnect wires from fuel transfer pump motor.
(7) Using a multimeter set to RX1 scale, perform a continuity check of the motor. Meter should read continuity across windings.

b. Remove. See Figure 4-38.
(1) Turn FUEL PUMP switch S8 to OFF.
(2) Remove screw and captive washer assemblies (4) and nut and captive washer assemblies (5).
(3) Lift off coupling shield (6).
(4) Loosen setscrews In pump to motor coupling (7).
(5) Disconnect hose assemblies (pump output and pump input) (1 and 3) from pipe to elbow fitting (2).
(6) Remove hexagon head capscrews (8), lockwashers (10), and hexagonal nuts (9).
(7) Slide pump shaft out of pump to coupling (7) and let fuel transfer pump assembly (11) free.
(8) Tag and disconnect wires from motor.
(9) Remove bolts (22), lockwashers (23), flat washers (24), and nuts that secure motor (18) to bracket (12) and remove motor.

c. Install. See figure 4-38
(1) Position pump base on fuel pump bracket (12), siding shaft Into pump to motor coupling (7). Adjust pump housing position to align shaft with the coupling and the keyway with the locking setscrew. Do not secure setscrew at this stage.
(2) Install hexagon head capscrews (8), lockwashers (10), and secure fuel transfer pump assembly (11) with hexagonal nuts (9).
(3) Secure hose assembly (pump input) (3) to inlet port of pump.
(4) Secure hose assembly (pump output) (1) to outlet port of pump.
(5) Install motor Align motor to pump using shims (26) under motor mounts. Secure motor to base with bolts, washers, and nuts.
(6) Secure pump to motor coupling (7) setscrew in keyway of pump shaft.
(7) Replace coupling shield (6) and secure with screw and captive washer assemblies (4) and nut and captive washer assemblies (5).

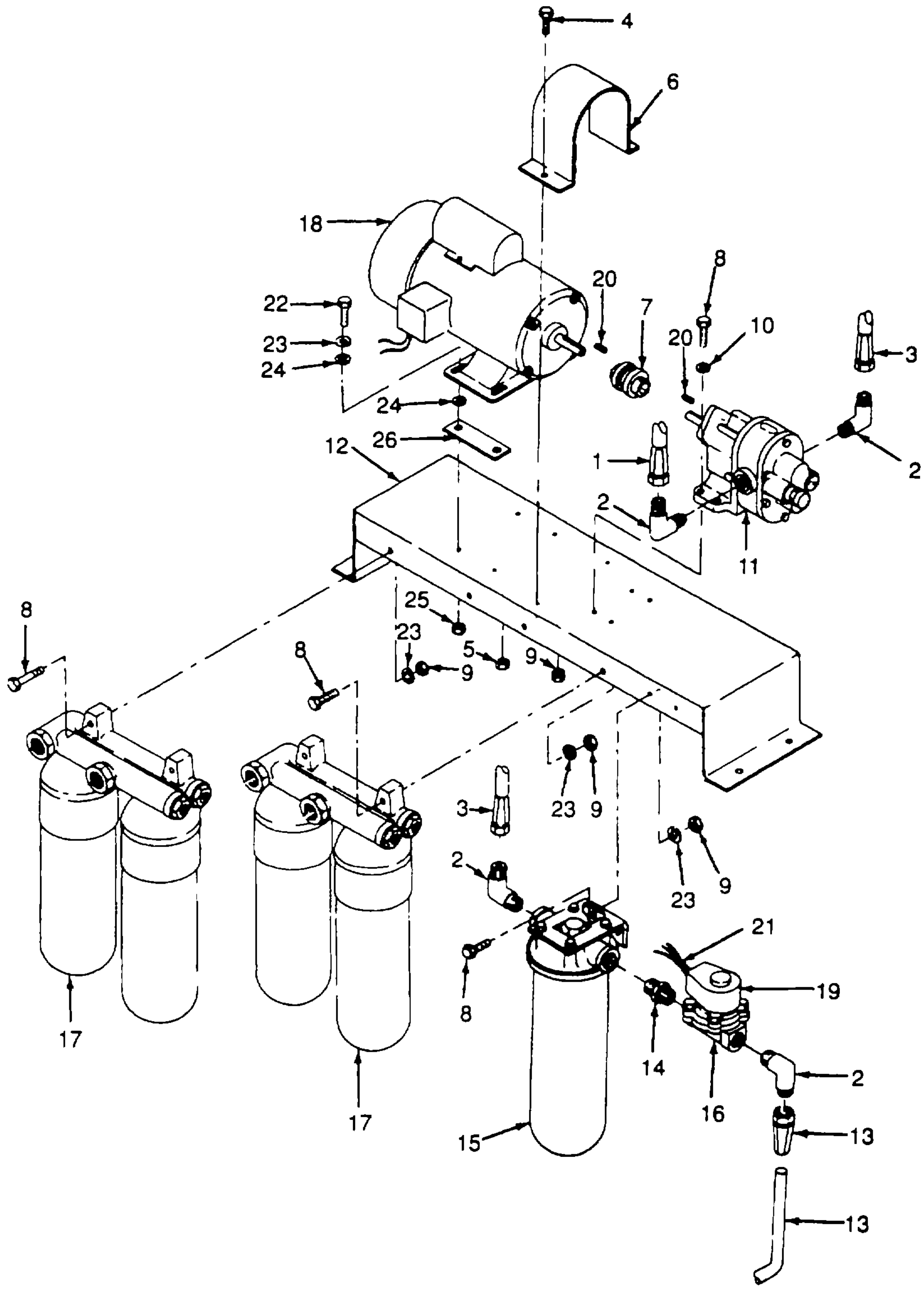


Figure 4-38. Fuel Transfer Pump and Solenoid Valve (Sheet 1 of 2)

1. HOSE ASSEMBLY (PUMP OUTPUT)
2. PIPE TO HOSE ELBOW
3. HOSE ASSEMBLY (PUMP INPUT)
4. SCREW AND CAPTIVE WASHER ASSEMBLY
5. NUT AND CAPTIVE WASHER ASSEMBLY
6. COUPLING SHIELD
7. PUMP TO MOTOR COUPLING
8. HEXAGON HEAD CAPSCREW
9. HEXAGONAL NUT
10. LOCKWASHER
11. FUEL TRANSFER PUMP
12. FUEL PUMP BRACKET
13. HOSE ASSEMBLY
14. NIPPLE
15. FILTER-STRAINER
16. SOLENOID VALVE L102
17. FUEL FILTER HEAD ASSEMBLY
18. MOTOR B102
19. CAP
20. SHAFT KEY
21. WIRING
22 BOLT 23. LOCKWASHER
24. FLAT WASHER
25. HEXAGONAL NUT
26. SHIM

Figure 4-38. Fuel Transfer Pump and Solenoid Valve (Sheet 2 of 2)

4-48. MAINTENANCE OF SOLENOID VALVE. The solenoid valve L102 is a Conway normally closed brass valve. When energized, the solenoid valve opens and allows the passage of fuel into the fuel tank.

a. Test.

NOTE

The following test should not be performed if the generator set fuel tank is more than half full. Performing this test when the generator set fuel tank is more than half full may provide inaccurate results due to fuel level sensor FL2 sensing sufficient fuel in the generator set fuel tank and deenergizing the fuel transfer pump automatically. If it becomes necessary, fuel must first be drained from the generator set fuel tank.

(1) Remove hose assembly (13, Figure 4-38) and place suitable container under solenoid valve.

NOTE

Two people are required to perform this task.

(2) Set FUEL PUMP switch so to HAND. Hold sheet of rubber over inlet and check for suction. Check for sound of solenoid energizing.

(3) Replace solenoid valve L102 if it fails the above test

b. Remove.

(1) Set fuel transfer pump circuit breaker CB121 (10, figure 2-7) and fuel transfer system and coolant heater circuit breaker CB122 (8) to OFF. Remove cover by prying off red cap (19, Figure 4-38) on top of solenoid (16). Tag and disconnect wiring (21) to the solenoid valve L102 (16).

(2) Remove supply hose assembly (13) from pipe to hose elbow (2).

(3) Using an suitable open-end wrench, unscrew nipple (14) from filter strainer (15), and remove the solenoid valve L102 (16).

c. Install.

(1) Assemble nipple (14) to filter strainer (15), applying sealing compound TT-S-1732, or equivalent, to the male pipe threads.

CAUTION

When tightening the connections, do not use the valve as a lever. Wrenches applied to valve body or piping are to be located as closely as possible to the connecting point.

(2) Thread new solenoid valve L102 (16) onto nipple (14) and then thread pipe to elbow (2) onto the solenoid valve.

(3) Reattach hose assembly (13) to pipe to elbow (2).

(4) Connect wiring (21) as tagged, and discard the tags.
(5) Install cover and red cap (19).

4-49. MAINTENANCE OF FUEL FILTER ASSEMBLIES . The following procedures apply to the fuel filter assemblies associated with the fuel transfer pump (See figure 4-38) and fuel filter assemblies associated with the engine fuel supply from the tank (See Figure 3-3). Filters are supplied to filter the fuel from the external supply into the generator set tank and to filter fuel from the generator set tank to the engine.

a. Remove.
(1) Remove all hoses connected to the filter being replaced.
(2) Remove hexagon head capscrews (8, figure 4-38) and carefully lift off the fuel filter head assembly (17).

b. Repair. See figure 4-38 Repair by replacement with new parts Replace all worn, damaged, or suspect items.

c. Install.
(1) Position new fuel filter head assembly (17) and secure with hexagon head capscrews (8).
(2) Connect all hoses.

4-50. REPLACE FUEL LINES. See figure 3-16 and Figure 3-14. Fuel lines provide paths for fuel to flow throughout the fuel system.

WARNING

Diesel fuel, while not as volatile as gasoline, will burn when it contacts a sufficiently hot surface or an open flame. Ensure that all hot surfaces under fuel lines to be replaced are covered. Ensure that buckets or pans are provided to catch any spilled fuel. Failure to observe this warning could cause injury to personnel or damage to equipment.

a. Inspect.
(1) Fuel lines must not be close to any heat producing part of the engine or exhaust system, and must not be allowed to rub or chafe against any surface.
(2) Fuel lines must be supported for their full length. Flexible sections should not be left unsecured.
(3) Fuel lines must be not kinked or otherwise damaged by the installation process.
(4) Fuel lines must not be under any mechanical strain, nor should any flexible sections be bent excessively.
(5) Replace any fuel lines which do not conform to these standards.

b. Remove.
(1) Disconnect connections at each end of the line to be replaced. Drain fuel into hand held container, then cap the line.
(2) Remove all clamps and attaching hardware.
(3) Work the line out of the generator set.

c. Install.
(1) Match the new line to the old, if available, to ensure that all fittings are correct and that the length is correct.
(2) As far as possible, match the bends of the original line
(3) Place the line in its correct position in the generator set.
(4) Connect, but do not tighten, both ends of the line (5). Secure the line with clamps or other means of attachment removed during step b (2), above (6). Tighten the fittings at both ends of the new line.

4-51. MAINTENANCE OF ELECTRONIC SPEED CONTROL. The electronic speed control is one of three components located on load sharing panel A104 inside engine control cabinet B. The electronic speed control receives a signal from the magnetic pickup located on the engine flywheel housing; it then operates the actuators located on the engine fuel pump, in response to changes in engine speed.

WARNING

Do not touch exposed electrical connections when circuits are energized. DO CONTROL and UTILITY POWER CIRCUIT BREAKERS must be deenergized and MAINTENANCE LOCKOUT switch S100 set to MAINTENANCE before starting any process QUIT.

Inspect the electronic speed control (Figure 2-6) on the upper rear wall inside engine control cabinet B, for security of wiring connections and signs of damage.

4 52. MAINTENANCE OF THE ETHER INJECTION ASSEMBLY. The ether kit contains a solenoid actuated ether tank to feed ether into the engine intake manifold for cold weather starting. It Is mounted on the righthand center support frame of the generator set.

a. Test.

WARNING

Do not perform test on a hot engine. Ether is highly flammable, explosive, and mildly toxic to the akin, eyes, and respiratory tract. Use in an adequately ventilated area skin eye. and respiratory protection is required to avoid injury to personnel.

(1) Use soap and water solution and look for bubbles at solenoid valve assembly L5 (7, Figure 3-1 5), and at ail lines and fittings which would indicate a leakage in the ether injections assembly. Leakage may also be indicated if a distinct odor of ether is detected.
(2) Remove ether start tank (1). Install replacement tank.
(3) Jumper the two terminals of ether lockout temperature switch S17 mounted on the right thermostat housing on the engine block. See figure 3-3.
(4) Toggle START AID switch S10 (See figure 2-13) to the ON position with ether injection lines disconnected from engine.
(5) Check ether solenoid valve assembly L5 (7) for 24 V dc using a voltmeter. Listen for the sound of the coil energizing. Check for passage of gas through valve.
(6) Replace solenoid valve assembly L5 (7) if it falls testing as described above. Reconnect ether injection lines to engine.

b. Remove.

(1) Remove ether line tubes (4, figure 3-15) from compression tee (6). Remove ether start tank (1) by loosening cylinder clamp (3).
(2) Disconnect compression tee (6) and receptacle connector J9 (8) from 24 volt solenoid valve assembly L5 (7). Remove solenoid valve assembly L5 by removing hexagon head capscrews (9) and bracket (10).
(3) Remove ether line tubes (5) from engine fuel atomizers (11) and tee (12). Remove engine fuel atomizers (11).

c. Install.
(1) Install 24 volt solenoid valve assembly L5 (7) on frame and secure with hexagon head capscrews (9) and bracket (10).
(2) Install compression tee (6) on 24 volt solenoid valve assembly L5 (7) and connect ether line tubes (4).
(3) Reconnect the receptacle connector J9 (8).
(4) Install engine fuel atomizers (11) in the engine intake manifold. Connect ether line tubes (5) to engine fuel atomizers.
(5) Connect ether line tubes (5) to compression tee (12).
(6) Install ether start tank (1) and secure with cylinder clamp (3).

d. Repair. Repair leaks or other defects in the ether injection assembly by tightening connections or fittings where leakage is detected, or by replacing defective components in accordance with steps b and c, above.

4-53. MAINTENANCE OF EMERGENCY MANUAL FUEL SHUT OFF VALVE . The manual fuel shut off valve is located in the fuel discharge hose from the fuel injection pump. It is cable operated by a knob accessible from outside the generator set housing. The manual fuel shut off valve provides a means of stopping the engine in emergencies. See Figure 4-9.

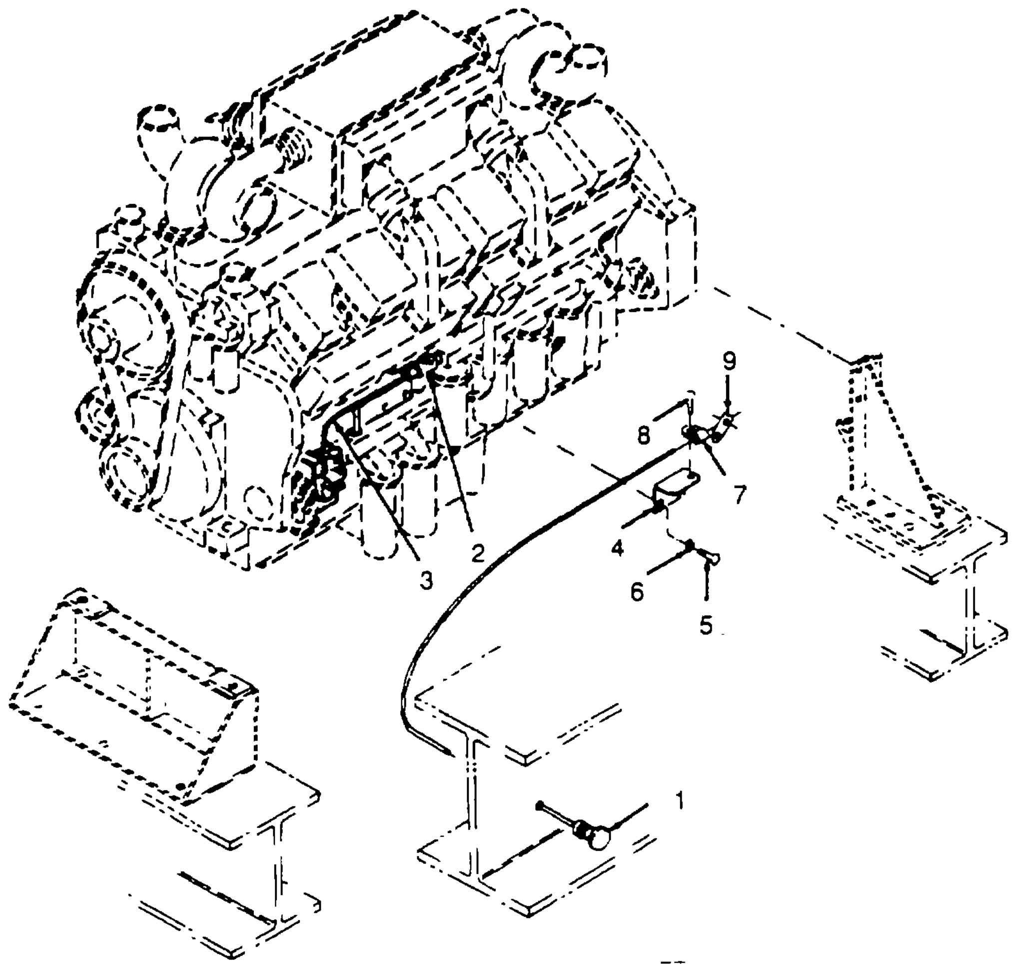
a. Inspect.
(1) Inspect control cable sheath for signs of damage such as kinks or breaks that may restrict the movement of the cable inside it.
(2) Ensure that control cable (1) is routed so that it does not chafe or rub on nearby components, and that it is anchored at one or more points along its length.

b. Test.

CAUTION

Do not perform the following test on a hot engine. If the engine has been running for some time, allow to run without load at least 5 minutes before it is shut down. Failure to do so will cause excessive temperatures to develop in the engine and may result in serious engine damage.

(1) Ensure that push/pull emergency control (1) on the exterior of the generator set housing is pushed in as far as it will go "with reset button depress”.
(2) Start engine (See figure 2-13) and run at normal operating speed.
(3) Pull push/pull emergency control (1) out as far as it will go. The engine should stop.
(4) If engine falls to stop, check to ensure that the control cable is securely attached to the emergency shutdown lever on the manual fuel shut off valve (2). Move the push/pull emergency control fully in and out and verify that the emergency shutdown lever moves a corresponding amount.
(5) Replace control cable if moving the push/pull emergency control (1) falls to operate the emergency shutdown lever.
(6) Replace manual fuel shut off valve (2) if the emergency shutdown lever is operated by the control cable and the engine falls to stop.



1. PUSH/PULL EMERGENCY CONTROL
2. MANUAL FUEL SHUT OFF VALVE
3. DISCHARGE HOSE
4. EMERGENCY CABLE MOUNTING BRACKET
5. CAPSCREW
6. WASHER
7. CLAMP LOOP
8. SCREW AND CAPTIVE WASHER ASSEMBLY
9. EMERGENCY SHUTDOWN LEVER

Figure 4-39. Emergency Manual Fuel Shut Off Valve

c. Remove.

WARNING

Diesel fuel, while not as volatile as gasoline, will burn when it contacts a sufficiently hot surface or an open flame. Ensure that all hot surfaces under fuel lines to be replaced are covered. Ensure that buckets or pans are provided to catch any spilled fuel. Failure to observe this warning could cause injury to personnel or damage to equipment.

(1) Disconnect the control cable from its attachment point on the generator set housing, the manual fuel shut off valve (2), the emergency cable mounting bracket (4) and any other points where it is anchored.

(2) Remove the fuel discharge hose (3) from the manual fuel shut off valve (2), and remove the manual fuel shut off valve from the fuel junction block on the engine.

d. Replace.

(1) Install the manual fuel shut off valve (2) in the fuel junction block on the engine, and reconnect the fuel discharge hose (3) to the manual fuel shut off valve (2).

(2) Install the control cable to its attachment point on the generator set housing, to the emergency shutdown lever, and to the emergency cable mounting bracket (4). Anchor the control cable at one or more points along its length.

e. Repair. Repair of the manual fuel shut off valve (2) is limited to ensuring that the control cable is properly routed and anchored, and to replacement of the push/pull emergency control, control cable, and the manual fuel shut off valve.

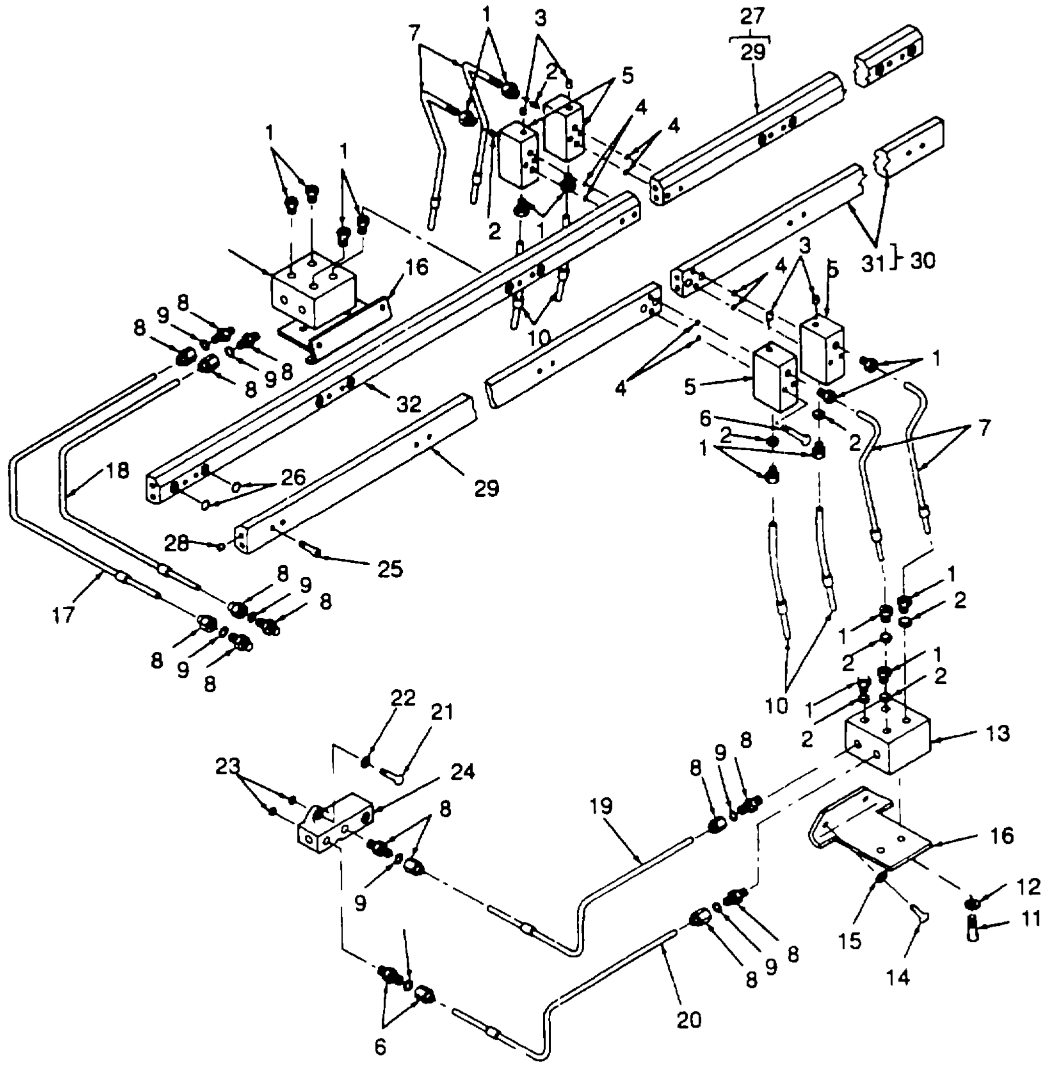
4-54. INSPECT FUEL MANIFOLDS. The fuel manifolds are common points of pressurized fuel which provide fuel delivery to both cylinder banks.

a. Inspect all fuel lines, manifolds, and fuel block (5, 13, and 24, figure 4-40) for cleanliness and evidence of leakage.

b. Inspect condition of right bank fuel supply tube (17), right bank fuel drain tube (18), left bank fuel drain tube (19). and left bank fuel supply tube (20).

c. Fuel block connections (5, 13, and 24) should be securely mounted.

d. Fuel manifold assemblies (27 and 30), machine thread pipes (3 and 28), and fuel manifolds (29 and 31) should be securely mounted and free of any damage.



1. FITTING AND FERRULE ASSEMBLY
2. RUBBER FERRULE
3. PIPE PLUG
4 PREFORMED PACKING
5. FUEL BLOCK CONNECTION
6. SOCKET HEAD CAPSCREW
7. FUEL SUPPLY TUBE
8. CONNECTOR ASSEMBLY
9. RUBBER FERRULE
10. FUEL DRAIN TUBE
11. HEXAGON HEAD CAPSCREW
12. LOCKWASHER
13. FUEL BLOCK CONNECTION
14. HEXAGON HEAD CAPSCREW
15. WASHER
16. FUEL BLOCK BRACKET
17. RIGHT BANK FUEL SUPPLY TUBE
18. RIGHT BANK FUEL SUPPLY TUBE
19 LEFT BANK FUEL DRAIN TUBE
20. LEFT BANK FUEL SUPPLY TUBE
21. CAPSCREW
22. LOCKWASHER
23. PREFORMED PACKING
24. FUEL BLOCK
25. SOCKET
26. PREFORMED PACKING
27. FUEL MANIFOLD
28. PIPE PLUG
29. FUEL MANIFOLD
30. FUEL MANIFOLD ASSEMBLY
31. FUEL MANIFOLD

Figure 4-40. Fuel Manifold and Related Parts

SECTION XI. MAINTENANCE OF COOLING SYSTEM

4-55. GENERAL. See Figure 1-12. Engine coolant is circulated through two filter assemblies and the engine by the water pump. Hot coolant is returned to the radiator where it is cooled by a belt driven fan. A tensioned idler pulley assembly maintains fan belt tension. Circulation of coolant Is regulated by the coolant thermostats. Radiator coolant level is checked using a sight gage, and cannot be monitored from the control compartment. A preheat system heats the engine coolant when the engine is not operating.

4-56. REPLACE WATER PUMP. See Figure 1-6 and Figure 4-41. The water pump is a gear driven pump used to circulate coolant throughout the engine and radiator.

a. Remove.

(1) Drain the radiator in accordance with paragraph 3-12. Store uncontaminated coolant for future use Drain coolant drain cock (26, Figure 4-41).

(2) Remove preheat hose assembly in accordance with paragraph 4-63.

(3) Remove hose assembly from radiator top tank in accordance with paragraph 4-57.

(4) Remove hose (1) by removing hose clamps (2).

(5) Remove the by-pass tube assembly (3) by removing capscrews (4) and lockwashers (5). Remove and discard gasket (6).

(6) Remove water inlet connection (7) by removing capscrews (8) and lockwashers (9). Remove and discard tube gasket (10).

(7) Remove water pump support (13) by removing capscrews (14 and 16), lockwashers (15), and plain washers (17).

(8) Remove water pump inlet connection (11) and connection preformed packing (12).

CAUTION

Back water pump directly off water pump drive support to avoid damage to splined couplings.

(9) Remove capscrews (14) and lockwashers (15) from pump adapter plate (23). Leave plate on pump.

(10) Remove water pump assembly (20) by removing capscrews (18) and lockwashers (19). Back water pump directly off drive support.

(11) Remove water pump gasket (21), pump adapter gasket (24), pump adapter plate (23), preformed packing (22), and spline coupling (25).

b Install.

(1) Install water pump gasket (21), pump adapter plate (23), preformed packing (22), pump adapter gasket (24), and spline coupling (25).

(2) Install water pump assembly (20) with capscrews (18) and lockwashers (19).

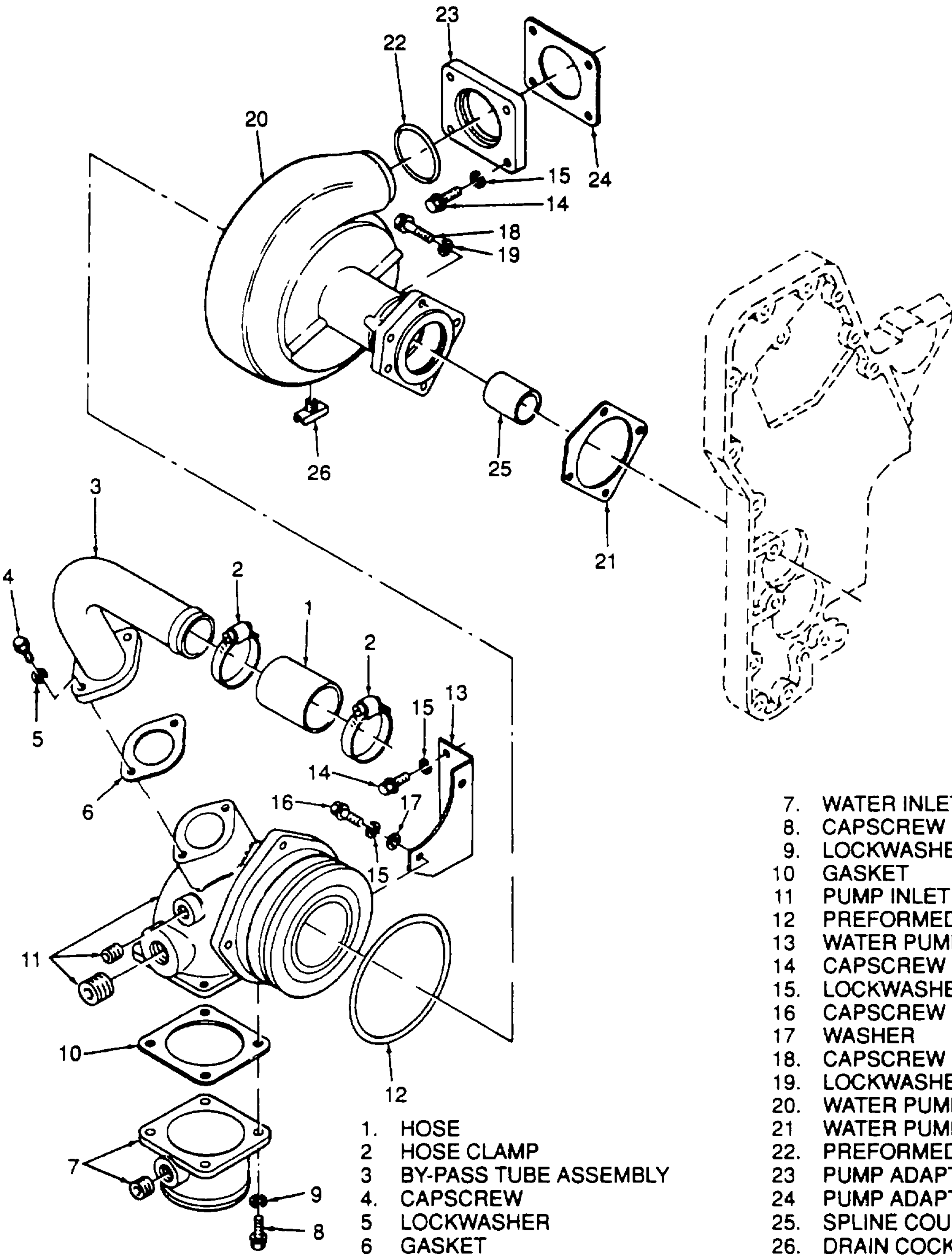
(3) Install capscrews (14) and lockwashers (15).

(4) Install water pump support (3) capscrews (14 and 16), lockwashers (15), and plain washers (17).

(5) Install the pump inlet connection (11) and preformed packing (12).

(6) Install water inlet connection (7), gasket (10), secure with capscrews (8) and lockwashers (9).

(7) Install by-pass tube assembly (3), tube gasket (6), capscrews (4) and lockwashers (5).



1. HOSE
2 HOSE CLAMP
3 BY-PASS TUBE ASSEMBLY
4. CAPSCREW
5 LOCKWASHER
6 GASKET
7. WATER INLET CONNECTION
8. CAPSCREW
9. LOCKWASHER
10 GASKET
11 PUMP INLET CONNECTION
12 PREFORMED PACKING
13 WATER PUMP SUPPORT
14 CAPSCREW
15. LOCKWASHER
16 CAPSCREW
17 WASHER
18. CAPSCREW
19. LOCKWASHER
20. WATER PUMP ASSEMBLY
21 WATER PUMP GASKET
22. PREFORMED PACKING
23 PUMP ADAPTER PLATE
24 PUMP ADAPTER GASKET
25. SPLINE COUPLING
26. DRAIN COCK

Figure 4-41. Water Pump

(8) Install hose (1) and secure with hose clamps (2).
(9) Install hose assembly from radiator top tank In accordance with paragraph 4-57.
(10) Install preheat hose assembly in accordance with paragraph 4-63.
(11) Fill radiator with coolant In accordance with paragraph 3-12.

4-57. MAINTENANCE OF RADIATOR. The radiator is a heat exchanger where heat is removed from the coolant by air passing across the radiator core.

a. Test. See Figure 3-17

(1) Preliminary tests consist of checking for leaks, especially at hose connections. Coolant level may be checked at sight glass assembly. If coolant level is low, refill radiator to approximately 2 inches (50 mm) below filler neck level, In accordance with Table 3-1.

CAUTION

Do not exceed 15 psi (104 kPa) pressure or damage to the engine or radiator may result.

(2) Using radiator tester, test the radiator by applying 15 psi (104 kPa) air pressure to radiator cap adapter. Observe the radiator for leaks. Refer to the next higher level of maintenance for repair.

b. Remove

(1) Remove #1 top roof panel, ladder assembly, #112 side panel, and front corner post in accordance with paragraph 4-13.
(2) Remove radiator shutter assembly In accordance with paragraph 4-14
(3) Drain engine and radiator In accordance with paragraph 3-12.
(4) Remove radiator filler cap (see Figure 3-17).
(5) Remove coolant level switches in accordance with paragraph 4-25.
(6) Remove right and left fan shrouds (1 and 2, Figure 3-17) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(7) Remove top and bottom grill (6) and center grill (7) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(8) Remove overflow hose (8) by removing hose clamps (9).
(9) To remove hose assembly (10), remove associated hose clamps (11), marker band (12), reducer (13), and pipe adapter (14). Remove hexagon head capscrew (15), hexagonal nut (16), and lockwasher (17) to remove hose clamp (18).
(10) To remove radiator drain hose (19), remove hose clamps (20), unscrew straight adapter (21), shut off cock (22), pipe nipple (23), and elbow (24).
(11) To remove hose assembly (25), remove hose clamps (26), unscrew pipe bushing (27), elbow (28), and straight adapters (29).
(12) Remove hose clamps (30), radiator outlet hoses (31), and water outlet tubes (32).
(13) Remove hose clamps (11), radiator inlet hoses (33), and water inlet tube (34).

WARNING

Injury to personnel may result it hoist and rigging with a capacity of less than 1200 pounds (540 kg) are used.

NOTE

The clevises should be installed into the forward lifting eyes only. This permits the bottom of the radiator to rock slightly forward during lifting, away from the engine and cooling fan.

(14) See Figure 4-42. Install a 7 inch (178 mm) clevis, with a 3/4 inch (20 mm) pin, into each of the lifting eyes of the forward upper radiator flanges.
(15) Install a metal or fabric sling through each clevis. Allow a maximum of 4 inches (102 mm) of slack between the sling and the center of the top of the radiator. The length of the sling should be a minimum of 78 to 80 inches (1981 to 2032 mm) so that it will span the radiator.
(16) Hook an overhead hoist with a capacity of 1200 pounds (540 kg), and a minimum lift of 112 inches (2845 mm), under the center of the sling.
(17) Remove hexagon head capscrews (35 and 39, Figure 3-17), hexagonal nuts (36 and 40), flat washers (37), and lockwashers (38 and 41) to remove radiator (42) and left and right hand radiator supports (43 and 44).
(18) Lift the radiator 1 to 2 inches (25 to 50 mm), or until just clear of the skid bases and withdraw it from the generator set housing.

c. Install.

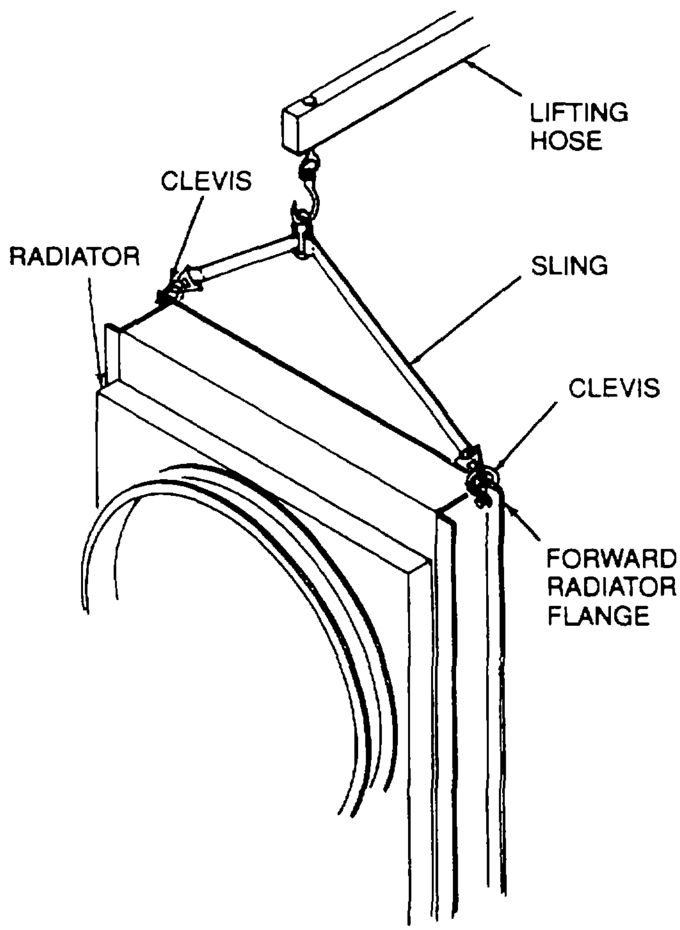


Figure 4-42. Lifting of Radiator

NOTE

The clevises should be Installed into the forward lifting eyes only This permits the bottom of the radiator to rock slightly forward during installation, away from the engine and cooling fan.

(1) See Figure 4-42. Install a 7 inch (178 mm) clevis, with a 3/4 inch (20 mm) pin, into each of the lifting eyes of the forward upper radiator flanges
(2) Install a metal or fabric sling through each clevis. Allow a maximum of 4 inches (102 mm) of slack between the sling and the center of the top of the radiator. The length of the sling should be a minimum of 78 to 80 inches (1981 to 2032 mm) so that it will span the radiator.
(3) Hook an overhead hoist with a capacity of 1200 pounds (540 kg), and a minimum lift of 112 inches (2845 mm), under the center of the sling.
(4) Install the radiator In the generator set housing, lifting it only as high as necessary to clear the generator set skid base.
(5) Install right and left hand radiator supports (43 and 44, Figure 3-17) and secure with hexagon head capscrews (39 and 35), hexagonal nuts (40 and 36), flat washers (37), and lockwashers (38 and 41) Remove hoist.
(6) Attach radiator inlet hoses (33) and water inlet tube (34) using hose clamps (11).
(7) Attach radiator outlet hoses (31) and water outlet tubes (32) using hose clamps (30).
(8) Install hose assembly (25) using straight adapters (29), pipe bushing (27), and elbow (28). Secure with hose clamps (26).
(9) Install radiator drain (19) using elbow (24), pipe nipple (23), shut off cock (22), straight adapter (21), and hose clamps, (20)
(10) Install hose assembly (10) using reducer (13) and pipe adapters (14) Secure with hose clamps (11, 12, and 18).
(11) Install overflow hose (8) and secure with hose clamp (9).
(12) Mount top and bottom grill (6) and center grill (7) using hexagon head capscrews (3), lockwashers (5) and hexagonal nuts (4).
(13) Mount right and left fan shrouds (1 and 2) using hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(14) Install coolant level switches In accordance with instructions In paragraph 4-25.
(15) Install #1 top roof panel, ladder assembly, #1 L2 side panel, and front corner post in accordance with paragraph 4-17.
(16) Install radiator shutter assembly in accordance with paragraph 4-15.
(17) Fill radiator with coolant in accordance with paragraph 3-12 Install radiator filler cap Test radiator in accordance with step a, above.
(18) Perform functional test of radiator assembly.

4-58. TEST RADIATOR CAP. The radiator cap pressurizes the cooling system, thereby increasing the boiling point of the coolant. Test radiator cap using a cap tester Cap setting should be approximately 7 psi (46.3 kPa) Check condition of locking tabs.

4-59. MAINTENANCE OF COOLANT THERMOSTAT. Four thermostats control the temperature of the coolant by controlling the flow of coolant through the radiator.

a. Inspect. The thermostats (18, Figure 4-43) are inside the thermostat housing (20) mounted at the top front of the engine. Inspect the thermostat housing for signs of coolant seepage.

b. Remove.

(1) Drain the engine and radiator in accordance with paragraph 3-12.

(2) Loosen hose clamps (30, Figure 3-17) which secure radiator outlet hoses (31) to the thermostat housing (20, Figure 4-43).

(3) Remove capscrew (1) and lockwasher (2) to remove water filter assembly (3) from face of thermostat housing (20). Remove and discard preformed packing (11).

(4) Remove hexagon head capscrews (13 and 15) and lockwashers (14), to free thermostat housing (20) from unit.

(5) Remove thermostat (18) from rear of thermostat housing (20) Remove and discard housing gasket (17) and thermostat seal (19).

(6) Remove pipe plugs (16) as needed for repair or replacement.

c. Test.

WARNING

To avoid Injury to personnel which may result from contact with hot engine coolant, exercise caution during the following procedure.

(1) Suspend thermostat in a container of antifreeze. Heat the solution slowly. Stir to maintain even heating.

(2) Using a thermometer, monitor the temperature. The thermostat should open fully at 190°F (88°C).

(3) The coolant thermostat is not repairable If It does not meet the above test it must be replaced.

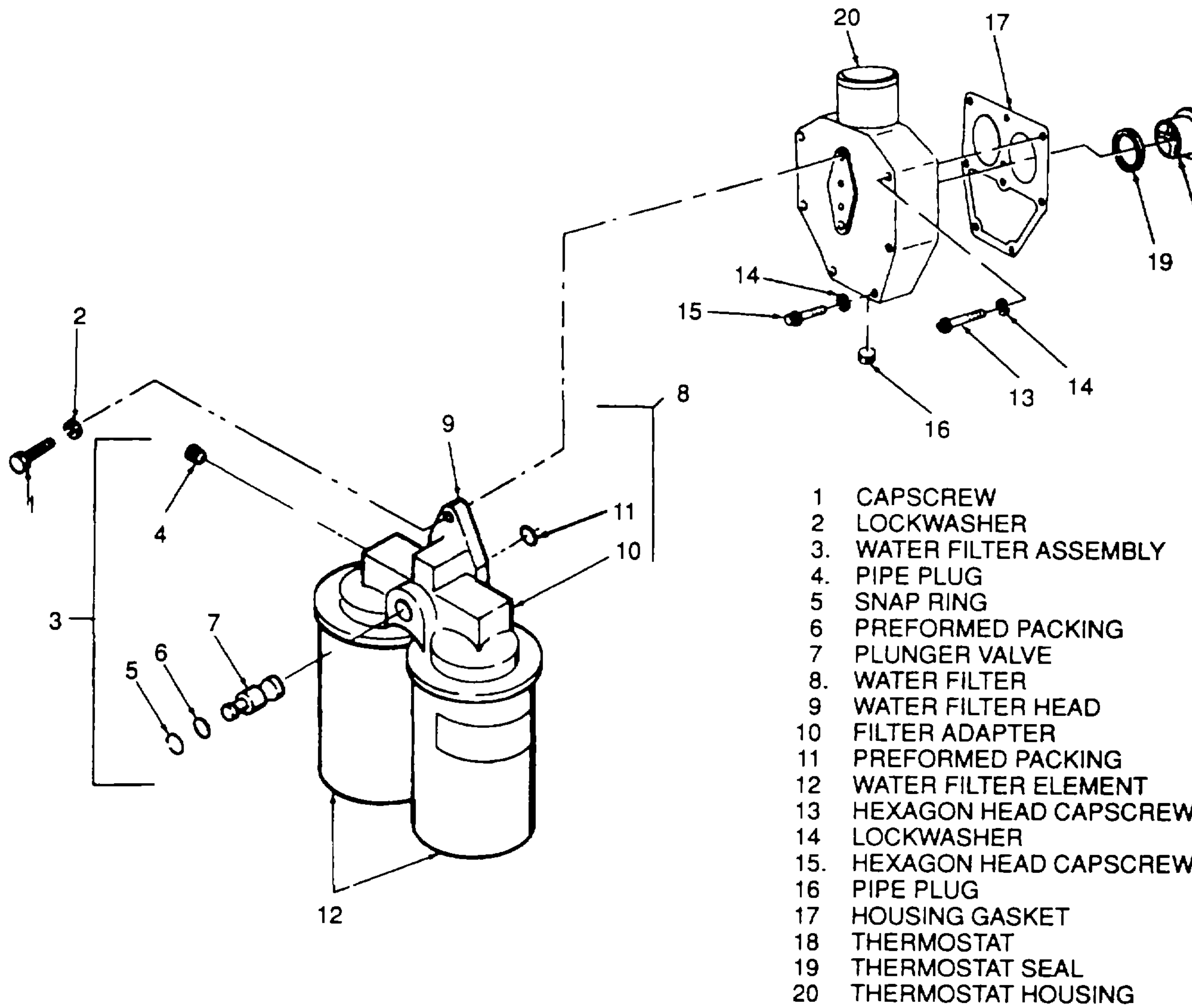


Figure 4-43. Water Filter Assembly and Coolant Thermostat

d. install.

(1) Install pipe plugs (16) if removed in step b(6), above.
(2) Install new housing gasket (17, Figure 4-43), new thermostat seal (19), and thermostat housing (20).
(3) Mount thermostat housing (20) using hexagon head capscrews (13 and 15) and lockwashers (14).
(4) Install new preformed packing (11) on thermostat housing and mount water filter assembly (3) to face of thermostat housing (20) using capscrew and lockwasher (1 and 2).
(5) Attach radiator outlet hose (31, Figure 3-17) to the coolant thermostat housing (20, Figure 4-43) and secure with clamps (30, Figure 3-17).
(6) Refill radiator In accordance with paragraph 3-12.

4-60. SIGHT GLASS. The sight glass assembly (Figure 4-44) is mounted on the left side of the radiator, near the top of the unit. The sight glass assembly is provided with half-inch NPT fittings on each end to facilitate replacement. It is used to visually monitor coolant level within the radiator.

a. Remove.
   (1) Refer to paragraph 3-12. Drain the engine and radiator until no coolant is present at the lowest point of the sight gage.
   (2) Loosen nuts (4, Figure 4-44), and remove sight glass (5), rubber preformed packings (2), and brass washers (3).
   (3) Remove top elbow (1) and bottom elbow (6) from the radiator.
   (4) Remove drain (7).

b. Repair. Install new rubber preformed packing and install new sight glass.

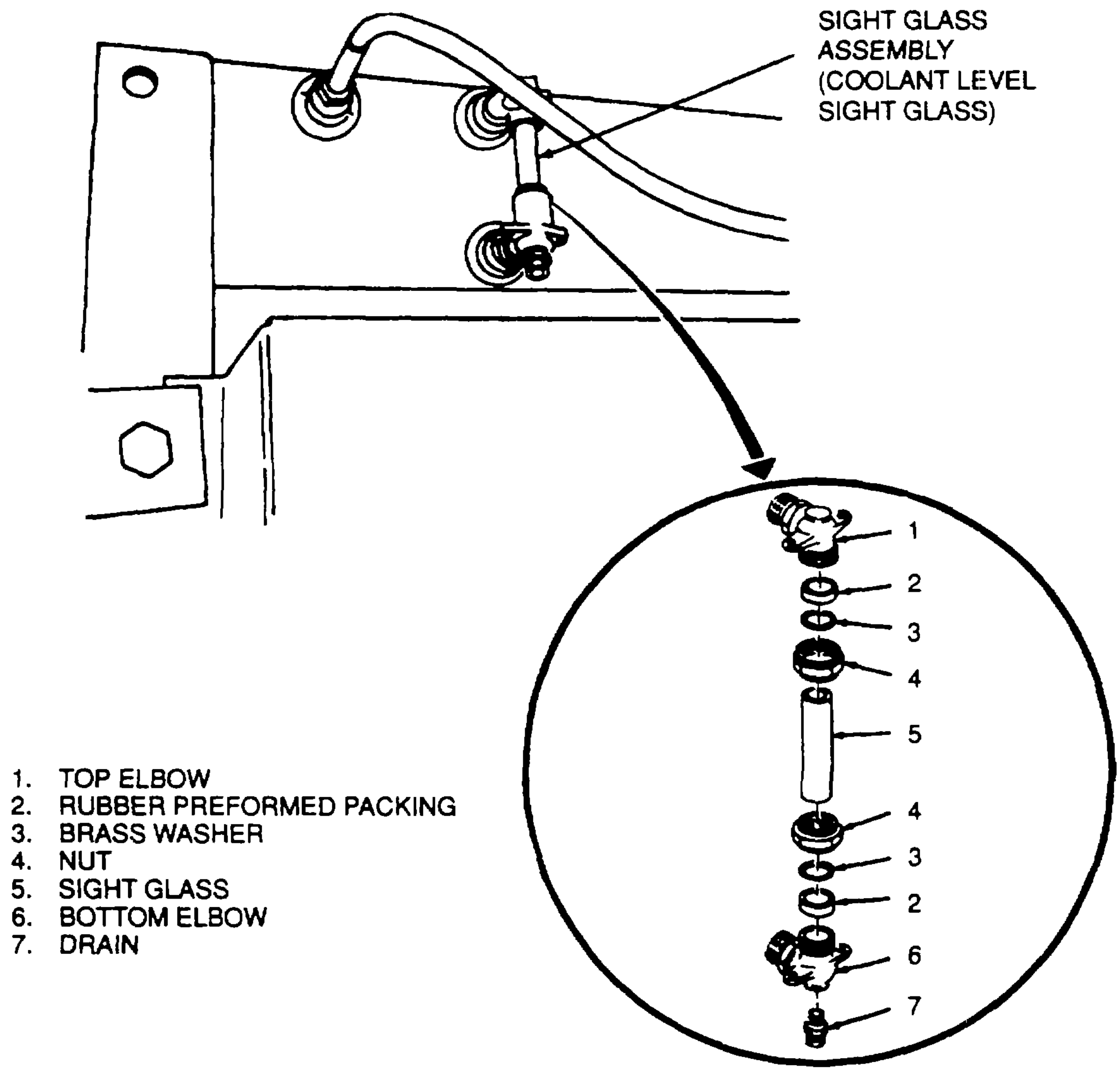


Figure 4-44. Sight Glass Assembly

c. Install.

(1) Install drain (7, Figure 4-44).
(2) Install top elbow (1) and bottom elbow (6) Into radiator.
(3) Install sight glass (5), rubber preformed packings (2), and brass washers (3), and tighten nuts (4).
(4) Refill radiator in accordance with paragraph 3-12

4-61. MAINTENANCE OF FAN. The fan hub and pulley assembly Is belt driven and develops air flow across the radiator to cool engine coolant.

a. Inspect.

(1) Remove right and left hand shrouds (1 and 2, Figure 3-17) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(2) Remove top and bottom grill (6) and center grill (7) by removing hexagon head capscrews 3), lockwashers (5), and hexagonal nuts (4).
(3) Inspect fan blades for secure installation Inspect hub for signs of looseness. Inspect fan blades for signs of cracking, chipping, or bending.
(4) Install top and bottom grill (6) and center grill (7) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(5) Install right and left hand shrouds (1 and 2) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).

b. Remove

(1) Remove right and left fan shrouds (1 and 2, Figure 3-17) by removing hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(2) Remove top and bottom grills(6) and center grill (7) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(3) Remove radiator assembly in accordance with paragraph 4-57.
(4) See Figure 4-45 Remove ribbed V belt (51), as follows

WARNING

Do not allow fingers to slip between the ribbed V belt and pulleys when removing or Installing the belt.

WARNING

Do not immediately let go or remove wrench from pivot arm cap once the ribbed V belt is removed, otherwise, built up spring tension will cause the tan Idler arm and pulley assembly to snap back (upwards) and cause possible injury.

NOTE

Two people are required to perform this task.

(a) Apply a wrench to the bossed end of pivot arm cap (39) and pry upwards clockwise until spring tension on the ribbed V belt (51) is relieved enough to allow Its removal.
(b) With spring tension or belt removed and sufficient slack available, slip the ribbed V belt (51) away from the pulley assemblies.
(c) With belt removed and with wrench (pressure) still applied to the pivot arm cap (39) allow spring tension to gradually bring the fan idler and pulley assembly (22) counterclockwise to reset at approximately 1 o'clock position.

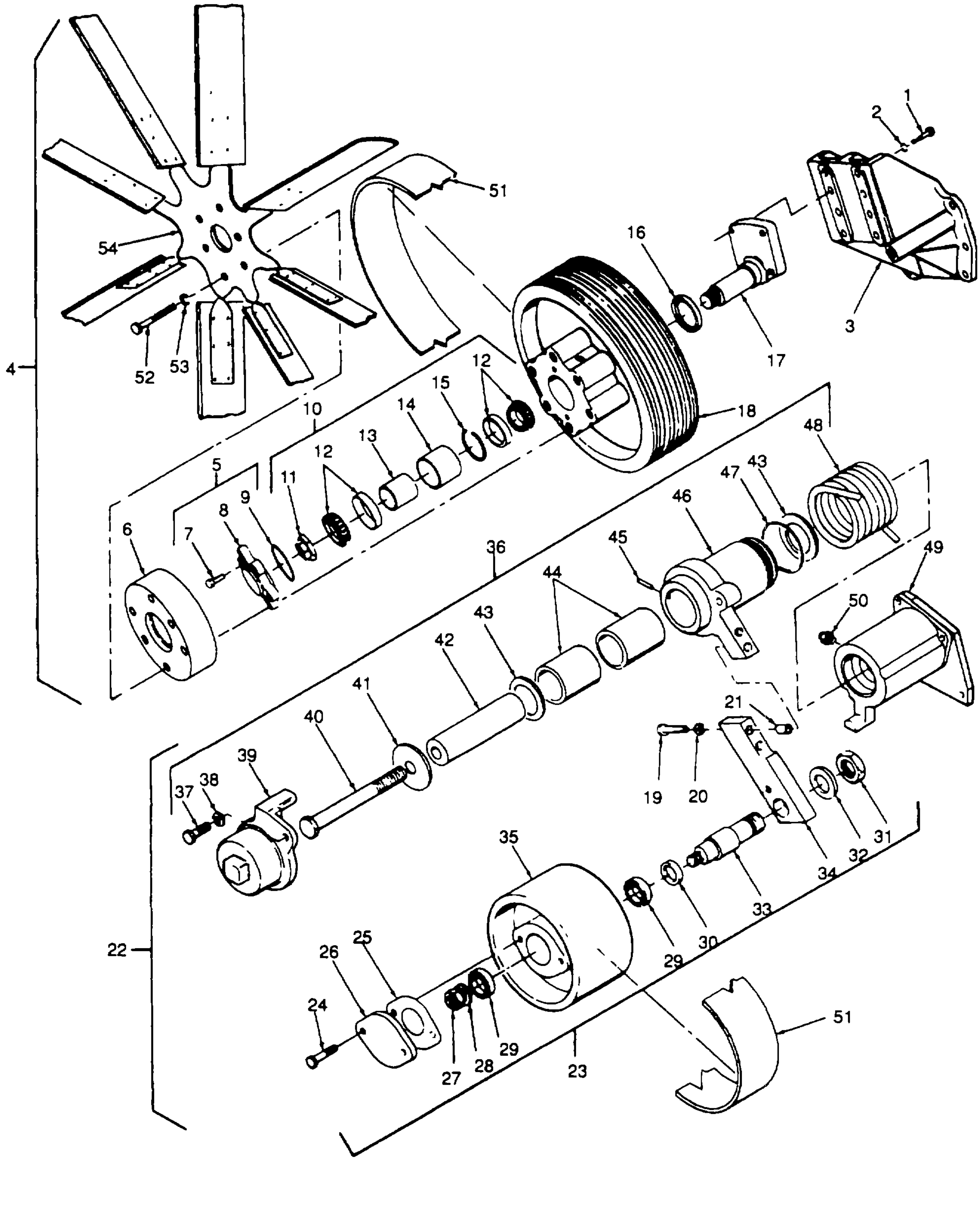


Figure 4-45. Fan Hub and Related Parts (Sheet 1 of 2)

1 CAPSCREW
2. LOCKWASHER
3. FAN SUPPORT
4. FAN HUB AND PULLEY ASSEMBLY
5. FAN HUB ASSEMBLY
6. FAN SPACER
7. CAPSCREW
8 FAN PILOT
9 PREFORMED PACKING
10 FAN HUB
11 LOCKING NUT
12. BEARING AND RACE
13. SPACER BEARING
14. SPACER BEARING
15 SNAP RING
16 OIL SEAL
17. FAN HUB SHAFT
18. FAN HUB PULLEY
19. HEXAGON HEAD CAPSCREW
20 LOCKWASHER
21 RING DOWEL
22. FAN IDLER ARM AND PULLEY ASSEMBLY
23. FAN IDLER AND ARM ASSEMBLY
24. HEXAGON HEAD CAPSCREW
25 GASKET
26 COVER
27 TORQUE LOCK NUT
28 FLAT WASHER
29 BEARING ASSEMBLY
30. OIL SEAL
31. HEXAGONAL JAM NUT
32. WASHER
33 FAN IDLER SHAFT ARM
34 FAN IDLER ARM
35 FAN IDLER PULLEY
36. PIVOT ARM ASSEMBLY
37 CAPSCREW
38 LOCKWASHER
39 PIVOT ARM CAP
40. CAPSCREW
41. WASHER
42 PIVOT ARM SHAFT
43 THRUST WASHER
44 SHAFT BUSHING
45. ROLL PIN
46. PIVOT ARM
47 PREFORMED PACKING
48 TORSION SPRING
49 PIVOT ARM SUPPORT
50 GREASE FITTING
51 V RIBBED BELT
52 HEXAGON HEAD CAPSCREW
53. LOCKWASHER
54 ENGINE COOLING FAN

Figure 4-45. Fan Hub and Related Parts (Sheet 2 of 2)

(5) Remove engine cooling fan (54, Figure 4-45), and fan spacer (6) from fan hub pulley (18) by removing hexagon head capscrews (52), and lockwashers (53).
(6) Remove capscrews (7), preformed packing (9), and fan pilot (8)
(7) Remove locking nut (11) and outer bearing (12) Remove fan hub pulley (18)
(8) Remove oil seal (16) and inner bearing (12). Remove Inner and outer bearing races (12).
(9) Remove snap ring (15) and remove bearing spacers (13 and 14).

c. Install
(1) See Figure 4-45 Thoroughly pack bearing with grease before installing.
(2) Install snap ring (15) and install bearing spacers (13 and 14) into fan hub pulley (18).
(3) Install inner and outer bearing races (12).
(4) Install Inner bearing (12) and oil seal (16), and install fan hub pulley (18) onto fan hub shaft (17). Install outer bearing (12) and secure fan hub pulley (18) into fan hub shaft (17) with locking nut (11).
(5) Install fan pilot (8) and preformed packing (9) and secure with capscrews (7).
(6) Install V ribbed belt (51). See paragraph 3-12
(7) Install fan spacer (6) and engine fan (54) Secure with hexagon head capscrews (52), and lockwashers (53).
(8) Install radiator assembly, in accordance with paragraph 4-57.
(9) Install top and bottom grill (6, Figure 3-17) and center grill (7) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).
(10) Install right and left fan shrouds (1 and 2) and secure with hexagon head capscrews (3), lockwashers (5), and hexagonal nuts (4).

462. MAINTENANCE OF IDLER PULLEY ASSEMBLY. The fan Idler arm and pulley assembly consists of the fan Idler arm and pivot arm subassemblies. The fan Idler arm and pulley assembly is spring loaded to maintain proper tension on the fan belt.

a. Replace.

(1) Remove the shrouds and grill assemblies from the radiator assembly in accordance with paragraph 4-61

(2) Remove engine fan (54, Figure 4-45) and ribbed V belt (51) in accordance with paragraph 4-61.

(3) Close the valve on water filter head and remove the DCA water filter elements to gain access to the mounting bolts holding the pivot arm support (49) to the engine block flange.

(4) Unbolt the pivot arm support (49) and remove the fan idler and pulley assembly (22) from the engine block

b. Repair. Repair the fan idler arm and pulley assembly (22, Figure 4-45) by replacement of damaged or defective parts.

(1) If necessary, remove entire fan idler and pulley assembly (22) following step a, above. Otherwise the pivot arm subassembly (36) may be separated from the fan idler subassembly (23) by removing hexagon head capscrews (19), lockwashers (20), and ring dowels (21).

(2) Disassemble fan idler arm and pulley assembly (22) as follows:

(a) Remove hexagon head capscrews (24), cover (26), and gasket (25) from fan idler pulley (35). Discard gasket (25).

(b) Remove left hand threaded torque locknut (27), flat washer (28), hexagonal jam nut (31), plain washer (32), fan idler arm (34), fan idler shaft (33), bearing assemblies (29), and oil seal (30) from the fan idler pulley (35).

(c) Remove capscrew (37), lockwasher (38), and pivot arm cap (39).

(d) Remove capscrew (40), plain washer (41), pivot arm shaft (42), thrust washer (43), shaft bushings (44), and roll pin (45) from pivot arm (46).

(e) Separate pivot arm (46), preformed packing (47), thrust washer (43), torsion spring (48), and pivot arm support (49). Remove grease fitting (50) from pivot arm support.

(3) Assemble fan Idler arm and pulley assembly (22) as follows'

(a) Install new grease fitting (50) into pivot arm support (49).

(b) Assemble torsion spring (48), thrust washer (43), new preformed packing (47), and pivot arm (46), onto pivot arm support (49).

(c) Assemble shaft bushings (44), thrust washer (43), pivot arm shaft (42), and roll pin (45) and secure with capscrew (40) and plain washer (41).

(d) Install pivot arm cap (39) with capscrew (37), and lockwasher (38)

(e) Assemble fan Idler arm (34) and fan idler shaft (33) with hexagonal jam nut (31) and plain washer (32).

(f) Install bearing assemblies (29), and oil seal (30) into fan idler pulley (35) and mount onto fan idler shaft (33). Secure with flat washer (28), and left hand threaded locknut (27). Tighten torque locknut to 145 to 155 pound-feet (197 to 210 newton-meters).

(g) Install cover (26) and gasket (25) with hexagon head capscrew (24).

(h) Attach fan idler arm assembly (23) to pivot am assembly (36) with ring dowel (21), lockwashers (20), and hexagon head capscrew (19).

c. Install.
(1) Bolt the replacement fan Idler arm and pulley assembly (22) through the pivot arm support (49) to the engine block flange.
(2) Install the ribbed V belt (51) in accordance with paragraph 3-12.
(3) Install the shroud and grill assemblies onto the radiator assembly in accordance with paragraph 4-61.
(4) Reinstall the water filter elements and open valve on water filter head.

4-63. MAINTENANCE OF THE ENGINE PREHEAT. The engine preheat assembly (Figure 4-46) is mounted to the skid base under the engine The preheat system heats the engine coolant to about 100 to 120°F (38 to 49°C) when the engine is not operating.

a. Inspect. Inspect heater assemblies H101, H102 (33, Figure 4-46) for loose mountings, loose electrical connections, loose hose assemblies on the pump, and damage Inspect hoses for loose connections, leakage, wear or deterioration. Check fittings for loose connections or damage.

b. Remove.
(1) Close all three shutoff valves (2 and 11, Figure 4-46). Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
(2) Tag and disconnect wiring to thermostat sensing units (40) and heating elements (34) on heater assemblies H101 and H102 (33).
(3) Disconnect hose assemblies (19) from heater assemblies H101 and H102 (33) by loosening straight adapters (20) at ends of hose assemblies (19). Detach center hose assembly (25) and associated plumbing hardware from the heater assemblies by loosening nipple (22) and adapter (24) from thermostat burrs (41) on heater assemblies (33). Cap all hose assemblies to prevent coolant contamination.
(4) Remove hose assemblies (6, 19, and 25) from engine block plumbing only if they are damaged or deteriorated. Remove by loosening hose adapters (7, 20, and 26) from attached plumbing hardware.
(5) Remove heater assemblies H101 and H 102 (33) by removing capscrews (28), nuts (29), and lockwashers (30) holding heater assemblies to mounting brackets (32). Slide out heater assemblies from beneath brackets.
(6) Remove nut (38), fill cap (39), thermostat sensing unit (40), and thermostat burr (11) as a subassembly from each heater assembly (33), and test in accordance with step c, below.
(7) Remove heating elements (34) from heating tank (46) by unscrewing, and test in accordance with step c, below.

c. Test
(1) Set multimeter on RX1 scale and connect across contacts of thermostat unit.
(2) Using a standard thermometer to track the temperature, put the thermostat unit into a container of engine coolant at room ambient temperature. The multimeter should show zero ohms (continuity), indicating that the thermostat contacts are closed.
(3) Raise the temperature of the engine coolant to 120°F (48°C) The multimeter should show infinite ohms indicating that the thermostat contacts have opened.
(4) Allow the coolant to cool down to 100°F (380C). The contacts should close again and the multimeter should show zero ohms (continuity).
(5) Set multimeter to RX100 scale and connect across heating elements (34) Resistance must be between 8 and 13 ohms.

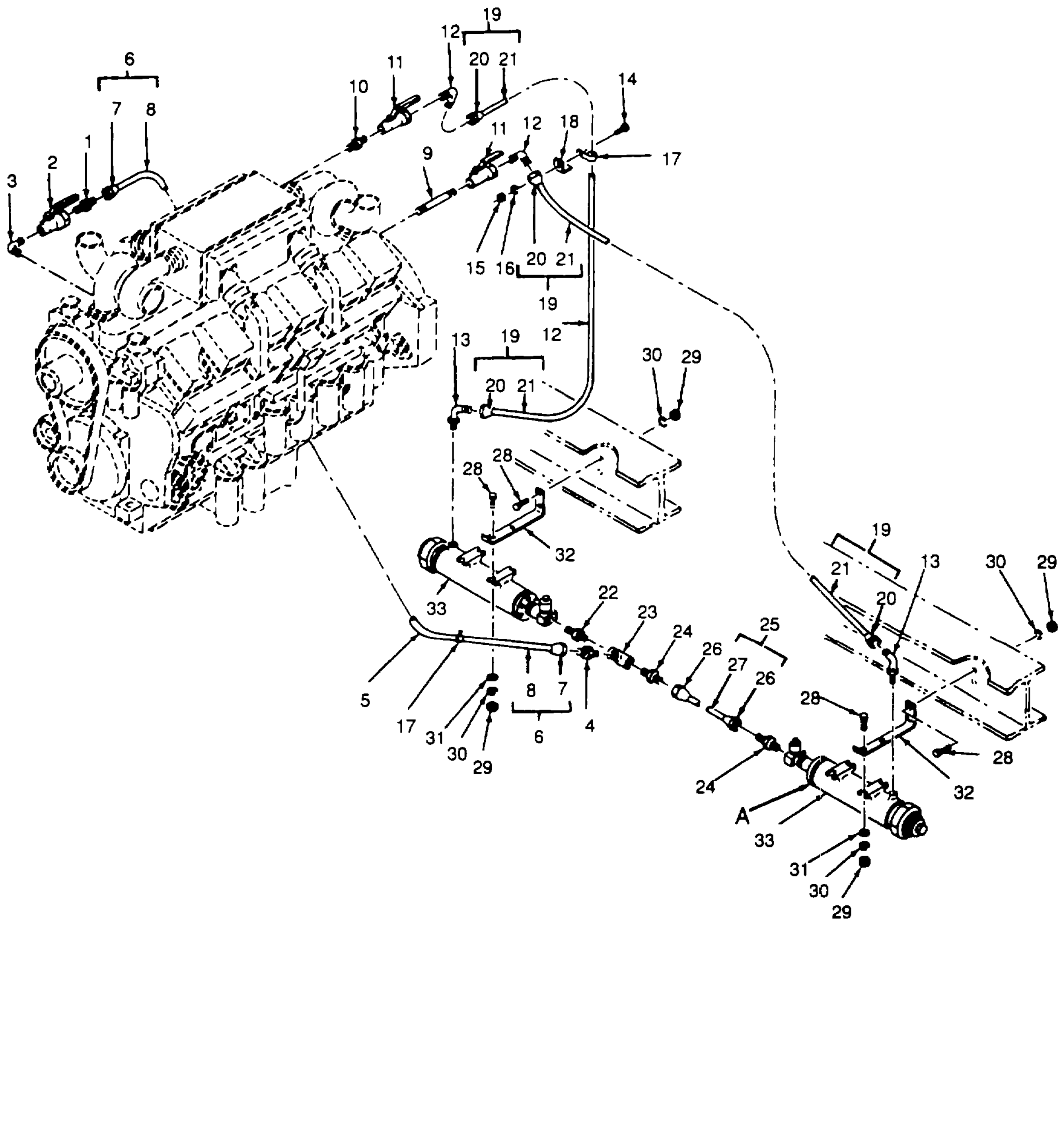


Figure 4-46. Engine Preheat Assembly (Sheet 1 of 3)

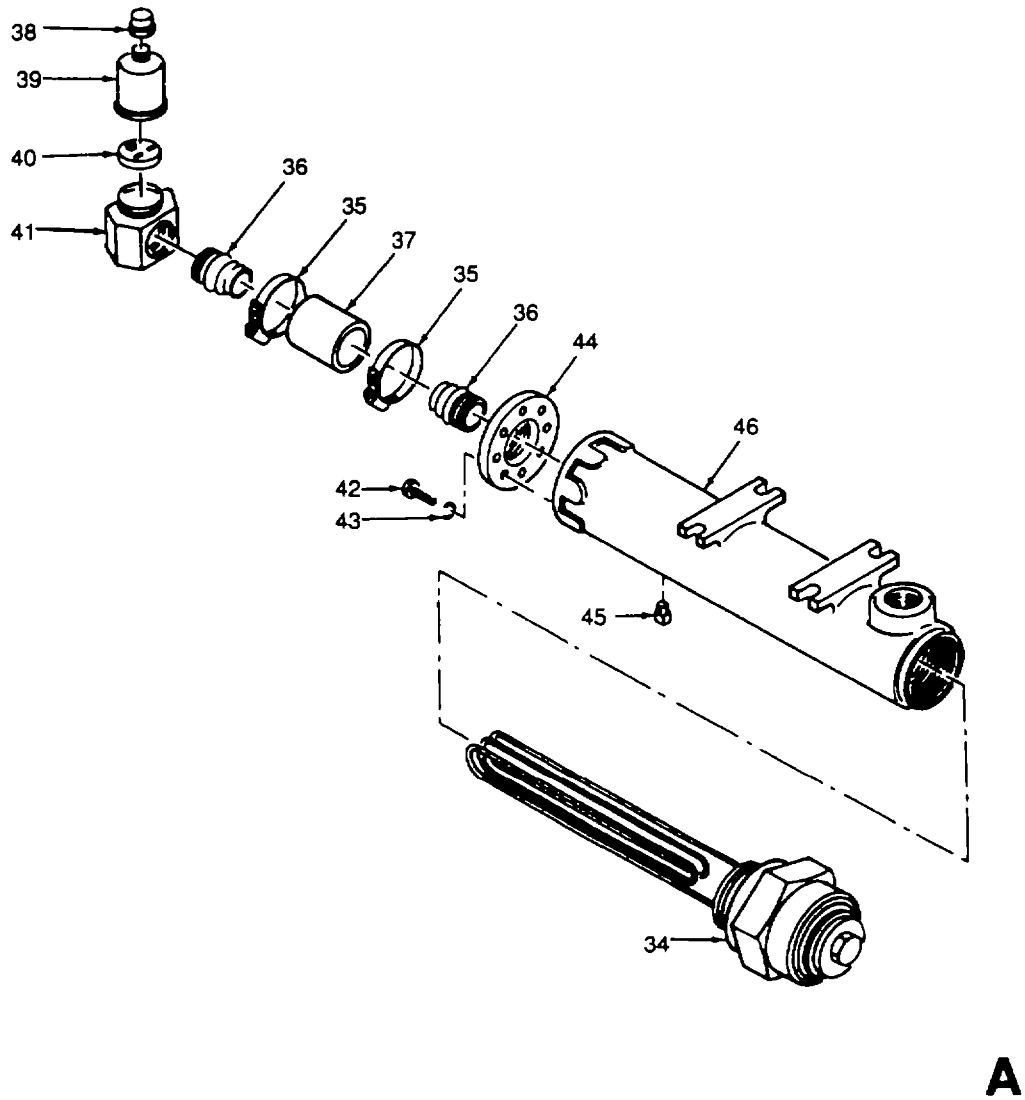


Figure 4-46. Engine Preheat Assembly (Sheet 2 of 3)

1. ADAPTER
2. SHUT OFF VALVE
3. ELBOW
4. ADAPTER
5. COOLANT BAND MARKER
6. HOSE ASSEMBLY
7 STRAIGHT ADAPTER
8. HOSE ASSEMBLY
9. NIPPLE
10. NIPPLE
11. SHUT OFF VALVE
12. ELBOW
13. ELBOW
14 CAPSCREW
15. HEXAGONAL NUT
16. LOCKWASHER
17. CLAMP
18. BRACKET
19. HOSE ASSEMBLY
20 STRAIGHT ADAPTER
21. HOSE
22. NIPPLE
23 TEE
24 ADAPTER
25. HOSE ASSEMBLY
26 STRAIGHT ADAPTER
27 HOSE
28. CAPSCREW
29. HEXAGONAL NUT
30 LOCKWASHER
31 FLAT WASHER
32 BRACKET
33 HEATER ASSEMBLY H101, H102
34. HEATING ELEMENT
35. HOSE CLAMP
36 NIPPLE
37 HOSE
38. HEXAGONAL NUT
39. BELL CAP
40 THERMOSTAT SENSING UNIT
41 THERMOSTAT BURR
42 HEXAGON HEAD CAPSCREW
43. LOCKWASHER
44 HEAD AND VALVE ASSEMBLY
45. DRAIN PLUG
46. HEATING TANK

Figure 4-46. Engine Preheat Assembly (Sheet 3 of 3)

d. Install.

(1) Apply sealing compound MIL-S-45180, Type II, to all male pipe threads prior to installation.
(2) Thread heating elements (34) into heating tanks (46) and tighten.
(3) Install thermostat sensing assemblies consisting of thermostat burr (41), thermostat sensing unit (40), fill cap (39), and nut (38) on nipples (36) at ends of heater assemblies (33).
(4) Install replacement hose assemblies (6, 19, and 25) on engine block plumbing hardware by tightening hose adapters (7, 20, and 26).
(5) Slide heater assemblies H101 and H102 (33) under mounting brackets (32) and attach using capscrews (28), nuts (29), and lockwashers (30).
(6) Reconnect center hose assembly (25) and associated plumbing hardware to thermostat burrs (41) at end of each heater assembly (33) using adapter (24) and nipple (22).
(7) Reconnect hose assemblies (19) to elbows (13) on each heater assembly and tighten hose adapters (20).
(8) Reconnect wiring to thermostat sensing units (40) and heating element (34) on each heater assembly (33). Remove tags and discard.
(9) Open all shutoff valves (2 and 11).
(10) Check coolant level and fill as required.

SECTION XII . MAINTENANCE OF LUBRICATION SYSTEM

4-64. GENERAL. See Figure 1-3 Unit maintenance of the lubrication system consists of maintaining the lubrication oil temperature and pressure senders, filter and by-pass filter assembly, lube oil cooler, drain valve and hose, and oil sight gage. This section also contains replacement procedures for lube oil lines.

4-65. MAINTENANCE OF OIL TEMPERATURE SENDER MT2. The oil temperature MT2 is located on the left side of the engine block on the oil filter head. Its function is to vary resistance with temperature and to permit meter M2 to register properly.

a. Inspect (see Figure 3-2). Inspect the sender for secure attachment of wires and leakage.

b. Remove (see Figure 3-2).

(1) Tag and disconnect wires to sender.

(2) Remove sender.

c. <u>Test.</u>

(1) Set multimeter to RX1 K scale and connect to terminal and body of sender

WARNING

Burns may result It proper care is not used when handling hot antifreeze.

(2) Suspend the sender In a container of antifreeze. Do not submerge sender terminal. Heat the antifreeze while monitoring the temperature with an accurate thermometer.

(3) At 230°F (110°C), the resistance across the sender shall be 340 ± 30 ohms.

(4) Replace the sender if it does not meet the above specifications.

d. <u>Install (see Figure 3-2).</u>

(1) Install replacement sender and bushing using sealing compound MIL-S-45180, Type II, or equivalent.

(2) Connect wiring as tagged

4-66. MAINTENANCE OF OIL PRESSURE SENDER MT1. The oil pressure sender MT1 is mounted on the right side of the engine at center of the block Its function is to vary resistance as oil pressure is varied to permit M1 to register engine oil pressure.

a. <u>Inspect (see Figure 3-2)</u>. Inspect the sender for signs of leakage and secure attachment of wires.

b. <u>Test.</u>

(1) With the sender Installed, and the generator set shut down, tag and disconnect wires from sender terminal. Set multimeter to RX1 K scale and connect to sender body and terminal The resistance shall be 242 ± 15 ohms.

(2) Operate the generator set for 15 minutes Observe the multimeter. Resistance at 25 psi is 152 ± 10 ohms and at 75 psi Is 66 ± 6 ohms The resistance shall drop as the engine oil pressure Increases. Shut down the generator, remove multimeter and reconnect wire to sender.

(3) The sender Is not repairable. If it does not meet the above specifications, it shall be replaced.

c. <u>Remove.</u>

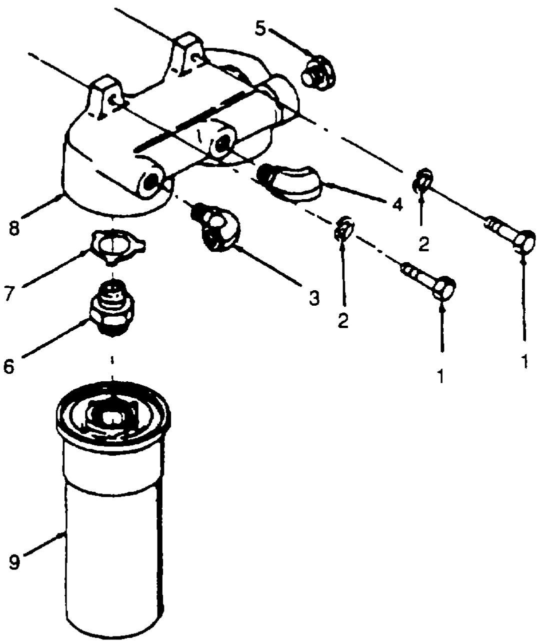
(1) Tag and disconnect wire from sender.

(2) Remove sender.

d. Install.
   (1) Install replacement sender using sealing compound MIL-S- 45180, Type II, or equivalent.
   (2) Connect wire to sender as tagged.

4-67. MAINTENANCE OF LUBE OIL FILTER ASSEMBLY AND LUBE OIL BY-PASS ASSEMBLY. The filter and by-pass filter assembly allows oil to be filtered In the event that main oil filters become clogged or restricted. Check filter by-pass for proper operation by placing hand on filter; if they are warm, oil by-pass is working.

a. Remove By-pass Filter (see Figure 4-47.
   (1) Using a suitable container, drain the oil pan.
   (2) Using a suitable container to catch any excess oil, remove supply and return lines from elbows (3 and 4).
   (3) Remove by-pass filter assembly by removing hexagon head capscrews (1) and lockwashers (2).
   (4) Remove elbows (3 and 4) and plug (5) from oil filter head (8).



1 HEXAGON HEAD CAPSCREW
2 LOCKWASHER
3 OUTLET ELBOW
4 INLET ELBOW
5. PLUG
6. FILTER HEAD ADAPTER
7 LOCKPLATE
8. OIL FILTER HEAD
9. ELEMENT

Figure 4-7. By-Pass Filter Assembly

   (5) Unscrew element (9) from oil filter head (8). Remove filter head adapter (6), and lockplate (7).

b. Install By-Pass Filter.

WARNING

Dry cleaning solvent P-D-680, Type 11, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory tract protection is required to avoid injury to personnel.

   (1) Clean the oil filter head (8), lockplate (7), and filter head adapter (6) with dry cleaning solvent P-D-680, Type II, or equivalent.

(2) Install plug (5) in oil filter head (8).
(3) Install oil filter head (8) and secure with hexagon head capscrews (1) and lockwashers (2).
(4) Install filter head adapter (6), lockplate (7), and elements (9) into oil filter head (8)
(5) Fill oil pan In accordance with paragraph 3-3.

WARNING

Do not perform this procedure while engine is running or during engine cool down after operation. Ensure that engine is cold before starting this procedure. Failure to observe this warning could result In **second- or third-degree bums.**

c. Remove Lube Oil Filter.
(1) Unscrew spin-on filter (1, Figure 4-48)
(2) Remove center bolt (2), lockwasher (3), plain washer (4), fluid filter head (5), and gaskets (6 and 7) from lube oil filter head (8).
d. Install Lube O11 Filter.
(1) Install new gaskets (6 and 7).
(2) Reinstall fluid filter head (5) and secure with bolt (2), lockwasher (3), and plain washer (4).
(3) Install new spin-on filter (1).

4-68. INSPECT LUBE OIL COOLER. The lube oil cooler is a heat exchanger which cools engine oil passing through it. The lube oil cooler is mounted under the aftercooler Inspect for external leaks and contaminated oil.

4-69. MAINTENANCE OF DRAIN VALVE AND HOSE. See Figure 3-3. The function of the drain valve and hose is to permit oil to be drained from the engine pan to outside the housing.

WARNING

Do not perform this procedure while engine is running or during engine cool down after operation. Ensure that engine is **cold before starting this procedure. Failure to observe this warning could result** in **second- or third-degree bums.**

a. Remove.
(1) Open oil drain valve and drain oil Into a suitable container.
(2) Unscrew pipe adapters and remove the oil drain hose assembly.
(3) Remove marker band from hose if hose is to be replaced.
(4) Unscrew nipple and oil drain valve from the oil pan.
b. Repair

WARNING

Compressed air used for cleaning or drying can create airborne particles that may enter the eyes. Wearing of goggles is required to avoid Injury to personnel.

(1) Remove obstruction or debris from hose assembly by blowing clear with compressed air. Use 30 psi (207 kPa) compressed air maximum.
(2) Repair damaged hose assembly by replacement of damaged parts.

c Install.

NOTE

Apply thread sealing compound conforming to MIL-S45180, Type II, to threads prior to Installation.

(1) Screw nipple and oil drain valve into oil pan.
(2) If hose assembly was replaced, position marker band onto hose
(3) Attach hose assembly using pipe adapters.
(4) Check to ensure that valve Is closed and refill crankcase oil in accordance with paragraph 3-3.

470. MAINTENANCE OF OIL SIGHT GAGE. The oil sight gage is a visual aid used to determine the oil level while the engine is running.

a. Remove. The oil sight gage is mounted next to the by-pass filter assembly (see Figure 3-3).
(1) Using a suitable container, drain the oil pan.
(2) Remove oil sight gage by removing top and bottom mounting studs.

WARNING

Dry cleaning solvent P-D-680, Type II, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory tract protection is required to avoid Injury to personnel.

WARNING

Compressed air used for cleaning or drying can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psi (207 kPa). Wearing of goggles Is required to avoid injury to personnel.

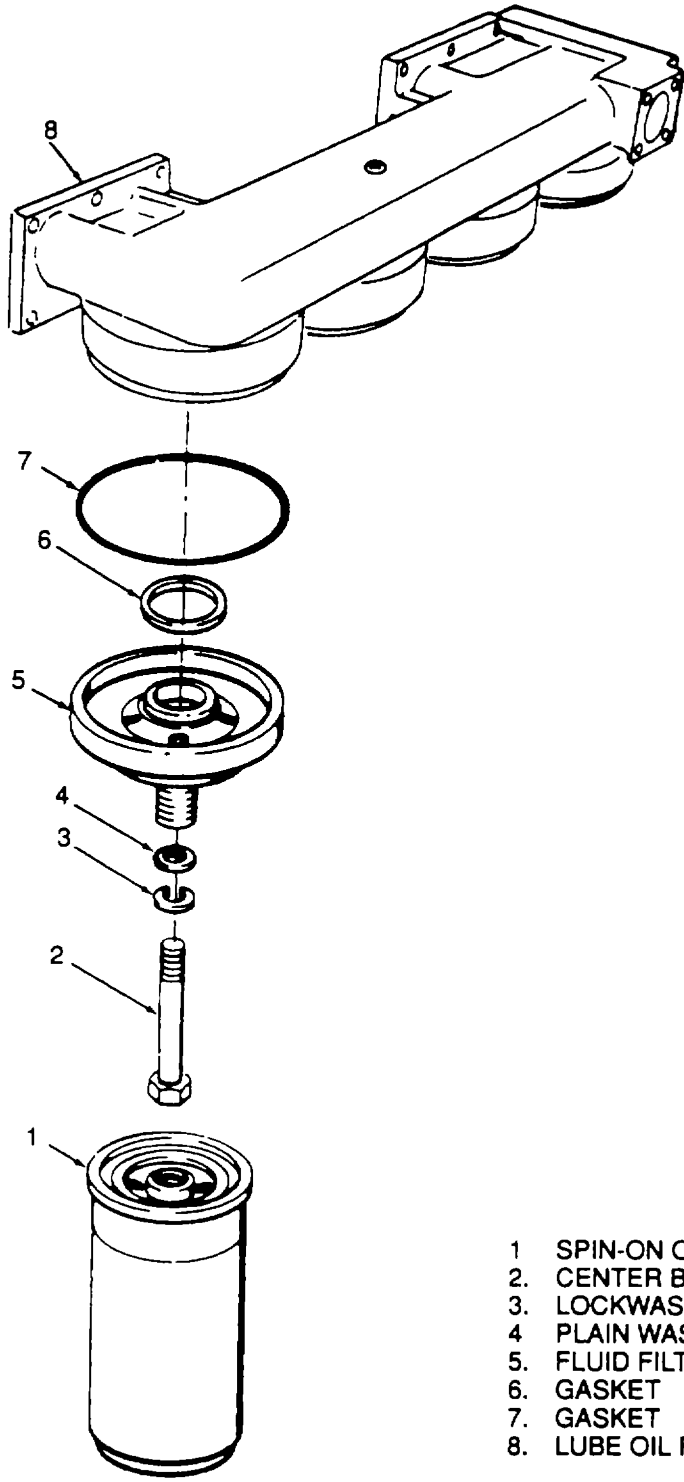
b. Repair. Remove the oil sight gage in accordance with step a, above. Clean with dry cleaning solvent P-D-680, Type II, or equivalent Dry with compressed air (If damaged, replace entire gage.)

c. Install.
(1) Install replacement oil sight gage and secure with hex head mounting studs. Replace seals.
(2) Fill oil pan in accordance with paragraph 3-3.

4-71. REPLACE LUBE AND PRELUBE OIL LINES. The lube oil lines are used to direct the flow of oil through by-pass filters. See Figure 3-3.

a. Remove.
(1) Using a suitable container, drain the oil pan.
(2) Remove damaged hose assemblies, nipples, pipe adapters, bushings, elbows, and other fittings, and replace in accordance with step b, below.

b. Install.
(1) Use sealing compound MIL-S-45180, Type II, or equivalent, on all male threads during installation.
(2) Install replacement hose assemblies, nipples, pipe adapters, bushings, elbows, and other fittings.
(3) Fill oil pan in accordance with paragraph 3-3.



1 SPIN-ON OIL FILTER
2. CENTER BOLT
3. LOCKWASHER
4 PLAIN WASHER
5. FLUID FILTER HEAD
6. GASKET
7. GASKET
8. LUBE OIL FILTER HEAD

Figure 4-48. Lube Oil Filter

4-72. MAINTENANCE OF OIL HEATER H113 AND LUBRICANT TEMPERATURE THERMOSTAT S101. The oil heater H113 and lubricant temperature thermostat S101 are used to preheat oil in the engine sump to aid in cold weather starting. See Figure 3-3.

a. Remove. The oil heater H113 is threaded into the left side of the oil pan, and the thermostat S101 is threaded into the right side of the oil pan.
   (1) Using a suitable container, drain the oil pan.
   (2) Remove oil heater H 113 and thermostat S101 by tagging and disconnecting wires, and unthreading heater and thermostat from oil pan.

b. <u>Test.</u> Set multimeter to RX1 K scale and connect leads across two black wires on heater H113. Resistance should be 175 ± 27 ohms.

c. <u>Install.</u>
   (1) Install oil heater H113 and thermostat S101 by threading into pan. Reconnect wires and remove tags.
   (2) Refill crankcase In accordance with paragraph 3-3.

4-73. MAINTENANCE OF PRELUBE PUMP. See Figure 3-3. The prelube pump provides initial lubrication to the engine prior to engine start and is manually operated by PRELUBE SYS switch S5 on panel C in the generator set control room. The prelube pump is bolted to the skid base by the right rear engine mount; when operated, it draws oil from the engine oil sump and delivers it under pressure to the engine oil passages

a. Test Perform STEP 1 through STEP 6, Figure 2-13, and ensure that oil pressure rises steadily and then stabilizes. Do not start engine.

b. Replace See Figure 3-3.
   (1) Disconnect oil lines at pump and plug to prevent contamination Raise oil lines above oil pan and secure.
   (2) Remove elbow, and pipe adapter from the prelube pump.
   (3) Disconnect electrical plug.
   (4) Remove the hexagon head capscrews, lockwashers, and hexagonal nuts securing the prelube pump to the pump bracket.
   (5) Install the new prelube pump on the bracket with the hexagon head capscrews, lockwashers, and hexagonal nuts.
   (6) Install the elbow, pipe adapter, and hose assemblies to the prelube pump.
   (7) Reinstall electrical plug. Check engine oil level and add lube oil If necessary.
   (8) Test the prelube pump In accordance with step a, above.

SECTION XIII. MAINTENANCE OF ENGINE

4-74. GENERAL. See Figure 3-3 The engine is a V configuration 12-cylinder diesel with a displacement of 2300 cubic inches (37 7 liters). The engine operates on the four stroke cycle principle and has two exhaust valves and two Intake valves for each cylinder Turbochargers are used to Increase power output by improving air Induction. The turbocharged air is aftercooled to provide denser air for combustion, and to reduce exhaust temperatures Replaceable cartridge-type filters are provided for the fuel, lubricating, and coolant systems. In the four stroke cycle diesel engine the following series of events take place during the intake, compression, power, and exhaust strokes.

a. Intake Stroke. The exhaust valves are closed, the Intake valves are open, and downward movement of the piston creates a partial vacuum in the cylinder. Air moves through the Intake manifold and open Intake valves to fill the cylinder. (At engine operating speeds, additional air is forced into the cylinder by the turbocharger. This air is in addition to what would normally be taken in at atmospheric pressures and greatly increases cylinder filling efficiency and power output.).

b. Compression Stroke. Both intake and exhaust valves are closed, and upward movement of the piston compresses the air to a mechanical ratio of 14.5'1 at the top of the compression stroke. This high compression raises the temperature of the air above the ignition point of the fuel. At engine operating speeds, the effective compression ratio is even higher due to the increased cylinder filling efficiency derived from turbocharging.

c. Power Stroke. Both Intake and exhaust valves are closed. During the last part of the compression stroke, before the piston reaches TDC (top dead center), fuel is injected into the cylinder In a metered amount. Because of the small orifice in the injector nozzle and the high pressure created by the injector, the fuel is finely atomized. The high temperature compressed air rapidly ignites the incoming atomized fuel and, as the piston passes TDC, the rapidly burning air and fuel mixture forces the piston downward on the power stroke. This lineal movement of the piston on the power stroke is converted to rotary motion by the connecting rod and crankshaft, and is used to power the generator Because the 12 cylinders fire In sequence, the power impulses are close together, and the rotary motion Imparted to the generator is smooth and even.

d. Exhaust Stroke. The Intake valves are closed, the exhaust valves are open and the piston is moving up in the cylinder. This upward movement of the piston forces the burned gasses out of the cylinder and through the exhaust valves, turbocharger, exhaust system, and into the atmosphere. Near the end of the exhaust stroke, the Intake valves open and the cycle is repeated through the four strokes as outlined above. The valve and injector timing during the sequence of the Intake, compression, power, and exhaust strokes is controlled by the camshaft. The camshaft is geared to the crankshaft, and turns at 1/2 engine speed (rpm). Lobes on the camshaft time the opening and closing of the valves and injectors in accordance with piston position In the cylinder. Proper engine operation depends on two main factors.
   (1) Compression The compression must be high enough to ignite the fuel Burned, improperly adjusted valves, or worn piston rings will prevent the high compression and heat needed to Ignite the fuel.
   (2) Timing. The fuel must be Injected In the correct amount and at the correct time for proper Ignition and burning during the power stroke Therefore wear or Improper functioning of any components that affect compression injection, or timing will result In Improper engine operation, or failure of the engine to start.

4-75. ENGINE TEST. An operational performance test of the engine is conducted as follows:

a. Start and warm-up engine in accordance with Chapter 2.

b. During engine warm-up, observe the following:
   (1) Oil pressure. If oil pressure falls below 45 psi (310 kPa), stop engine and troubleshoot lubrication system in accordance with Table 4-3.
   (2) Oil temperature Normal oil temperature should be between 180 and 225°F (82 and 107°C). If oil temperature is not within the normal range, troubleshoot in accordance with Table 4-3.
   (3) Coolant temperature. After thermostat opening, coolant temperature should remain In the range of 175 to 1 95°F (79 to 91 °C). If coolant does not remain within normal range, troubleshoot in accordance with Table 4-3.

c. If engine does not run smoothly after normal operating temperature is reached, or exhaust smoke is excessive, troubleshoot In accordance with Table 4-3.

d. During operation and shut down, observe engine for unusual noise or vibration If unusual noise or vibration occurs, shut down engine and refer to the next higher level of maintenance.

e. Shut down engine immediately If any of the following conditions are noted.
   (1) Low oil pressure Minimum oil pressure should be 40 psi (276 kPa) at rated load of 750 kW at 60 Hz and at 50 Hz.
   (2) High oil temperature Maximum oil temperature should be 235°F (113°C).
   (3) High coolant temperature Maximum coolant temperature should be 219°F (104°C).
   (4) Any unusual noise or vibration.

f. If engine does not accelerate smoothly to rated load, or exhaust smoke Is excessive, troubleshoot In accordance with Table 4-3

g. If engine does not achieve or run smoothly at rated load, or exhaust smoke is excessive, troubleshoot In accordance with Table 4-3.
h. Return engine to no load for a minimum of 3 to 5 minutes, then shut down engine.
i. If malfunction cannot be repaired, refer to the next higher level of maintenance.

4-76. MAINTENANCE OF AIR FILTER ASSEMBLY (Figure 4-49) PIPES, HOSES, AND CLAMPS. The purpose of the air cleaner assembly is to filter combustion air before entering engine to prolong life of engine.

a. Remove.

NOTE

If required, remove side panels (refer to paragraph 4-13), ether injection system (refer to paragraph 4-52), and disconnect overhead wiring harness run.

(1) Remove hexagon head capscrews (15, 18, and 21, Figure 4-49), lockwashers (17 and 19), hexagonal nuts (16) to remove support channels (20) and air shut off valve support brackets (22).
(2) Loosen and remove hose clamps (1 and 3), molded rubber adapters (2, 5, 7, and 8), 6 and 4 Inch tubing sections (6 and 13), and 10 inch tubing (4) to remove air control valve assemblies (52).
(3) Remove hexagon head capscrews (9), lockwashers (11), and hexagonal nuts (10) to remove air cleaner tube hanger (12) before removing 58 inch tubing (14).
(4) Remove hexagon head capscrews (23) and lockwashers (24) to remove air cleaners (27 and 28).

b. Repair. Make sheet metal repairs to the 4, 6, 10, and 58 inch tubing sections (13, 6, 4, and 14), air cleaner tube hanger (12), support channels and air shut off valve support brackets (20 and 22).

c. Install.
(1) Mount replacement air cleaners (27 and 28, Figure 4-49) on right and left hand brackets and secure with hexagon head capscrews (23) and lockwashers (24).
(2) Mount air cleaner tube hanger (12) using hexagon head capscrews (9), lockwashers (11), and hexagonal nuts (10), and Install 58 Inch tubing section (14).
(3) Install 10 Inch tubing section (4), molded rubber adapters (2, 5, 7, and 8), 6 and 4 inch tubing sections (6 and 13), air control valve assembly (52) and 10 Inch tubing section (4) using hose clamps (1 and 3).
(4) Mount support channels and air shut off valve support brackets (20 and 22) and secure with hexagon head capscrews (15, 18, and 21), lockwashers (17 and 19), and hexagonal nuts (16).

d. Replace Air Cleaner Elements. See Figure 4-49. Cleaner elements should be replaced or serviced only when the service Indicators are in the amber or red positions.
(1) Remove.
(a) Loosen the coupling clamp (44, figure 4-49) and remove the cup assembly (48) and preformed packing (45) and gaskets (46 and 47) Discard the preformed packing and gaskets.
(b) Remove the nut (29), gasket (30), and primary element assembly (35). Discard the gasket.

NOTE

Do not remove the safety filter element unless the safety signal indicator shows red. The safety signal indicator is built into the nut assembly (33).

(c) If the safety signal indictor shows red, remove the clip (31), pin (32), nut assembly (33), gasket (30), and safety element assembly (34). Discard the gasket and safety element assembly.
(d) If the safety element assembly (34) has been left In place, cover it with a clean, plastic bag to protect it from contamination.

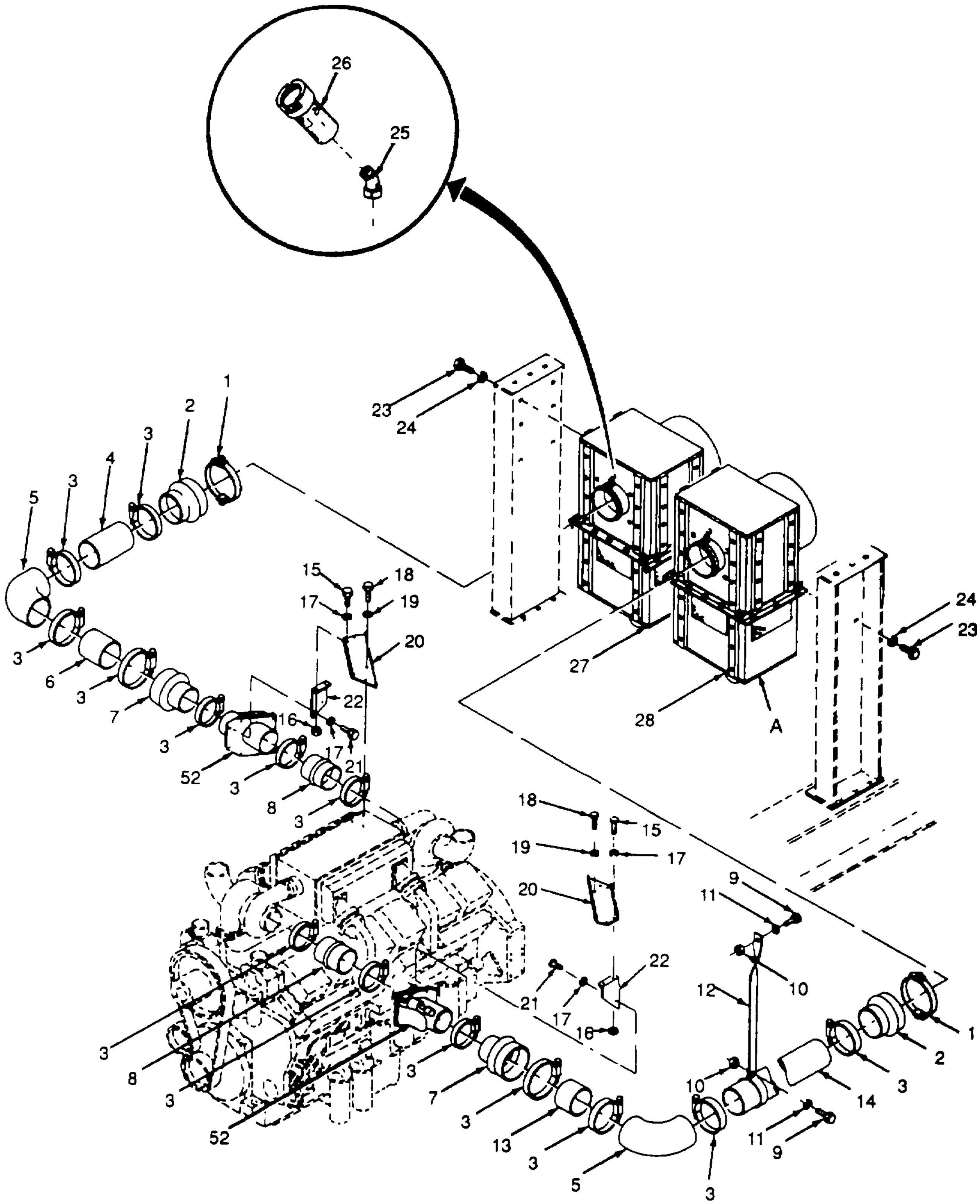


Figure 4-49. Air Cleaner and Related Parts (Sheet 1 of 3)

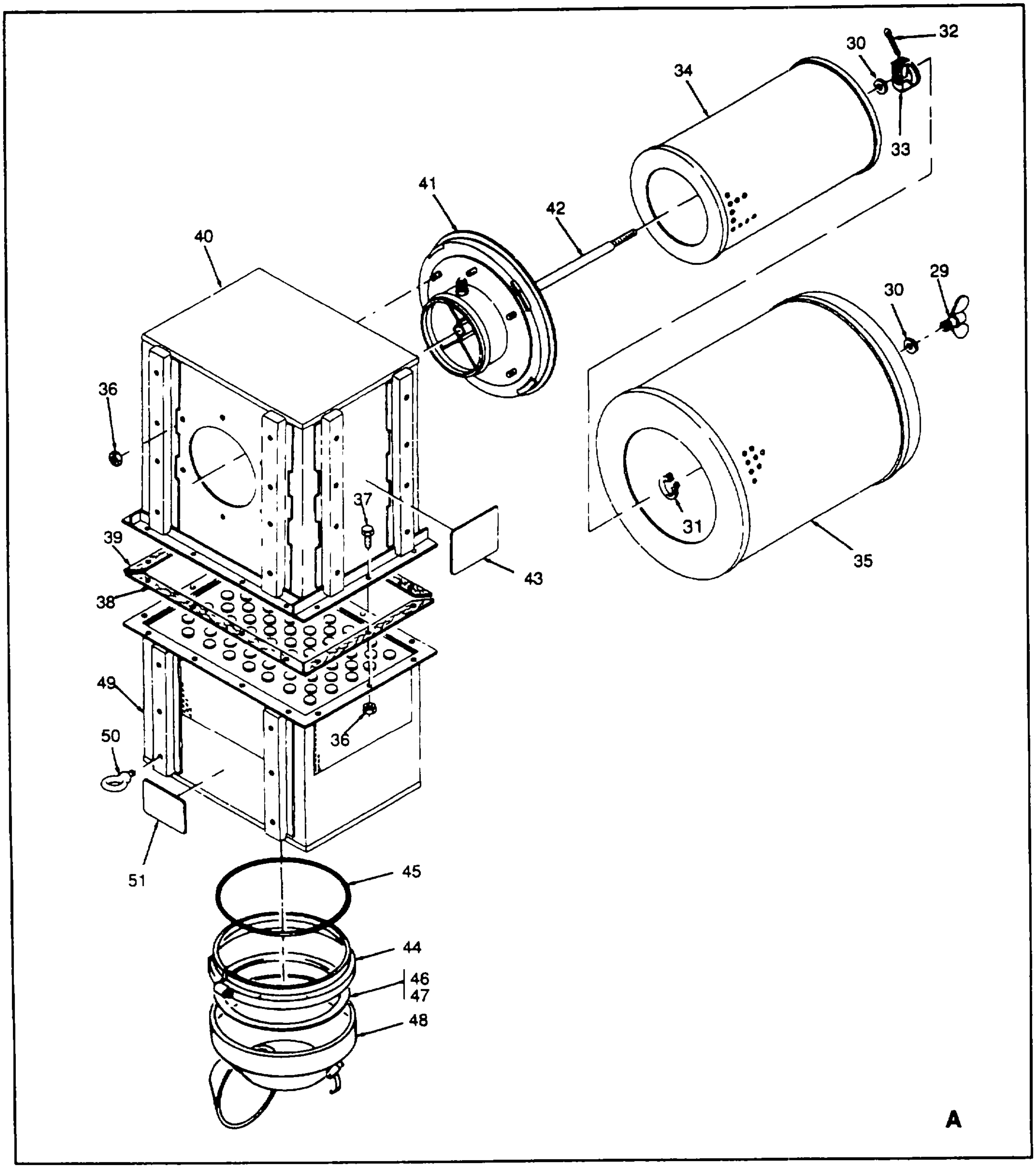


Figure 4-49. Air Cleaner and Related Parts (Sheet 2 of 3)

1. HOSE CLAMP
2. MOLDED RUBBER ADAPTER
3 HOSE CLAMP
4. 10 INCH TUBING
5. MOLDED RUBBER ADAPTER
6. 6 INCH TUBING
7. MOLDED RUBBER ADAPTER
8. MOLDED RUBBER ADAPTER
9. HEXAGON HEAD CAPSCREW
10. HEXAGONAL NUT
11 LOCKWASHER
12. AIR CLEANER TUBE HANGER
13. 4 INCH TUBING
14. 58 INCH TUBING
15. HEXAGON HEAD CAPSCREW
16 HEXAGONAL NUT
17. LOCKWASHER
18. HEXAGON HEAD CAPSCREW
19. LOCKWASHER
20. SUPPORT CHANNEL
21 HEXAGON HEAD CAPSCREW
22. AIR SHUTOFF VALVE BRACKET
23. HEXAGON HEAD CAPSCREW
24. LOCKWASHER
25. ELBOW
26. INDICATOR ASSEMBLY
27. AIR CLEANER
28. AIR CLEANER
29. NUT
30. GASKET
31. CLIP
32. PIN
33. NUT ASSEMBLY
34. SAFETY ELEMENT ASSEMBLY
35. PRIMARY ELEMENT ASSEMBLY
36. NUT
37. BOLT
38. GASKET
39 GASKET
40. BODY ASSEMBLY
41. FLANGE ASSEMBLY
42. RESTRICT ADAPTER
43 MARKING
44 COUPLING CLAMP
45 PREFORMED PACKING
46 GASKET
47. GASKET
48. CUP ASSEMBLY
49. BODY ASSEMBLY
50. BOLT
51 MARKING
52 AIR CONTROL VALVE ASSEMBLY

Figure 4-49. Air Cleaner and Related Parts (Sheet 3 of 3)

CAUTION

To protect the engine from contamination, plug the outlet opening in the upper body (40) of air cleaner to prevent dust and dirt from entering the inlet pipes to the turbochargers. Do not run the generator set without a complete set of safety element assemblies properly installed.

(e) If the safety element assembly has been removed, plug the outlet opening in the upper body (40) of air cleaner.

(2) Service.

(a) Working from the bottom, use a bristle brush to loosen dust and contaminants from the tubes in the lower body.

WARNING

Compressed air used for cleaning or drying can create airborne particles that may enter the eyes. Pressure should not exceed 30 psi (207 kPa). Wearing of goggles Is required to avoid injury to personnel.

(b) Working from the top, use compressed air to blow out all loose dust from the tubes In the lower body.

(c) Use a water-dampened cloth to remove loose dust from the upper body.

(d) Empty the dust cup assembly (48) and clean it with a water-dampened cloth.

(e) Check the metal surfaces and gaskets of the primary element assembly (35) for cracks or damage. Dust trails or cutting on the gasket surface is an Indication of leakage. Replace physically damaged elements.

(f) Working from the inside, use compressed air to blow out all loose dust from the primary element. Do not hold the air nozzle closer than 1 Inch (25.4 mm) to the inner surface of the filter element and do not exceed 30 psi (207 kPa) air pressure.

(g) Hold a light (at least 60 W) Inside the primary element assembly (35) and look through the element from the outside, and check for breaks, punctures, or tears in the filter paper. Replace the element If it is defective.

(h) If inspection shows the primary element assembly (35) to be sound, clean the element as follows:

CAUTION

To avoid engine contamination and improper operation do not clean the safety element assemblies. The safety elements should be replaced when the Indicator assembly shows red, after three servicings or changes of the primary element assembly (35) or after 1 year regardless of the safety signal indication. The primary element assemblies may be serviced and cleaned up to six times.

1. In a container of sufficient size to completely submerge the primary element assembly (35), mix a cleaning solution using 1 ounce (28.4g) of non-sudsing, synthetic detergent, such as A-A-1 376, for each 2 gallons (7 6 liters) of water Do not use hot water.
2. Submerge the element In the cleaning solution, and add more solution as necessary to completely submerge the element.
3. Allow the element to soak for at least 15 minutes. During the soaking period, turn and gently agitate the element occasionally to aid the cleaning action.

CAUTION

To avoid damage to the element, water pressure must not exceed 40 psi (275 kPa), and the flow must be unrestricted. Do not use a nozzle on the end of the hose.

4. Remove the element from the cleaning solution, and rinse thoroughly, inside and out, with running water.

CAUTION

To avoid damage to the element, heated air used for drying must not exceed 160°F (71°C). Do not use any other form of heat to dry the element. Do not dry with compressed air.

5. Allow the element to air dry. Heated air, not to exceed 160°F (71 °C), may be gently circulated through the element to speed drying, If available. Do not use compressed air.
6. After drying, examine the element for breaks, punctures, or tears In the filter paper In accordance with step (g), above.

(i) Reset the air restriction indicator assemblies (Figure 1-5) by pressing the reset button on top of the indicator. If the indicator will not reset properly, replace indicator In accordance with paragraph 4-77.

CAUTION

To avoid damage to the safety signal indicators, do not use compressed air over 30 psi (207 kPa) for resetting.

(j) If removed, reset the safety signal indicator in the nut assembly (33, Figure 4-49) by blocking the outer hole, and pressurizing the Inner hole with 30 psi (207 kPa) air. Replace the nut assembly If the Indicator will not reset properly.

(3) Install.
   (a) Remove any protective covering or plugs used in the upper body.
   (b) If removed, install the safety element assembly (34), gasket (30), and nut assembly (33). Tighten the nut to a maximum of 10 pound-feet (13.6 newton-meters), back off the nut assembly as necessary, and install the pin (32).
   (c) Install the clip (31), primary element assembly (35), gasket (30), and nut (29). Tighten the nut securely.
   (d) Install the preformed packing (45), gaskets (46 and 47), cup assembly (48), and secure with the coupling clamp.

4-77. REPLACE AIR RESTRICTION INDICATOR. Air restriction Indicators Indicate if air filters are restricted. Replace a defective air restriction indicator as follows (see Figure 4-49).

a. Unscrew service Indicator assembly (26) on air cleaners (27 and 28).
b. Install replacement service indicator (26) in elbow (25) on air cleaners (27 and 28) and tighten securely.

NOTE

Service indicator should be positioned so that indicator is readable from side of unit It is mounted on.

4-78. MAINTENANCE OF AIR CONTROL VALVE ASSEMBLY. See Figure 3-21. The air control valve assemblies block air from entering the engine when an overspeed or emergency shutdown condition occurs.

a. Remove.
   (1) Disconnect electrical connections from 24 V solenoids L2A and L2B (15, Figure 4-50) and remove cushion clamp on bracket (12).
   (2) Loosen hose clamps (3, Figure 4-49) and remove molded rubber adapters (7 and 8) from air control valve assembly (52).
   (3) Remove hexagon head capscrews (15, 18, and 21), lockwashers (17 and 19), and hexagonal nuts (16), and remove support channels and air shut off support brackets (20 and 22).
   (4) Remove air control valve assembly (52).
   (5) Place protective covers over turbocharger and air inlet tube openings.
   (6) Repair air control valve In accordance with step b, below.
b. Repair.
   (1) Disassembly.
      (a) Remove the air control valve (1, Figure 4-50) In accordance with step a, above.
      (b) Remove capscrews (7), lockwashers (8), and remove air shutdown bracket (12) and 24 V solenoids L2A and L2B (15) from air shutdown housing (31).
      (c) Remove roll pin (14), and throttle block (13), then remove air shutdown shaft (16), air shutdown spring (17), and washer (18) from 24 V solenoids L2A and L2B (15).
      (d) Remove screws (9), nuts (10), clamp (11), and remove 24 V solenoids L2A and L2B (15) from air shutdown bracket (12).
      (e) Remove capscrews (2), lockwashers (3), washers (4), air shutdown cover (6), and air shutdown gasket (5). Discard gasket.
      (f) Remove roll pin (20) and air shutdown lever (21).
      (g) Remove roll pin dowel (28) and air shutdown shaft (30) out of air shutdown housing (31) to remove air shutdown valve (29), plain washer (27), air shutdown spring (26), and preformed packing (25). Discard packing.

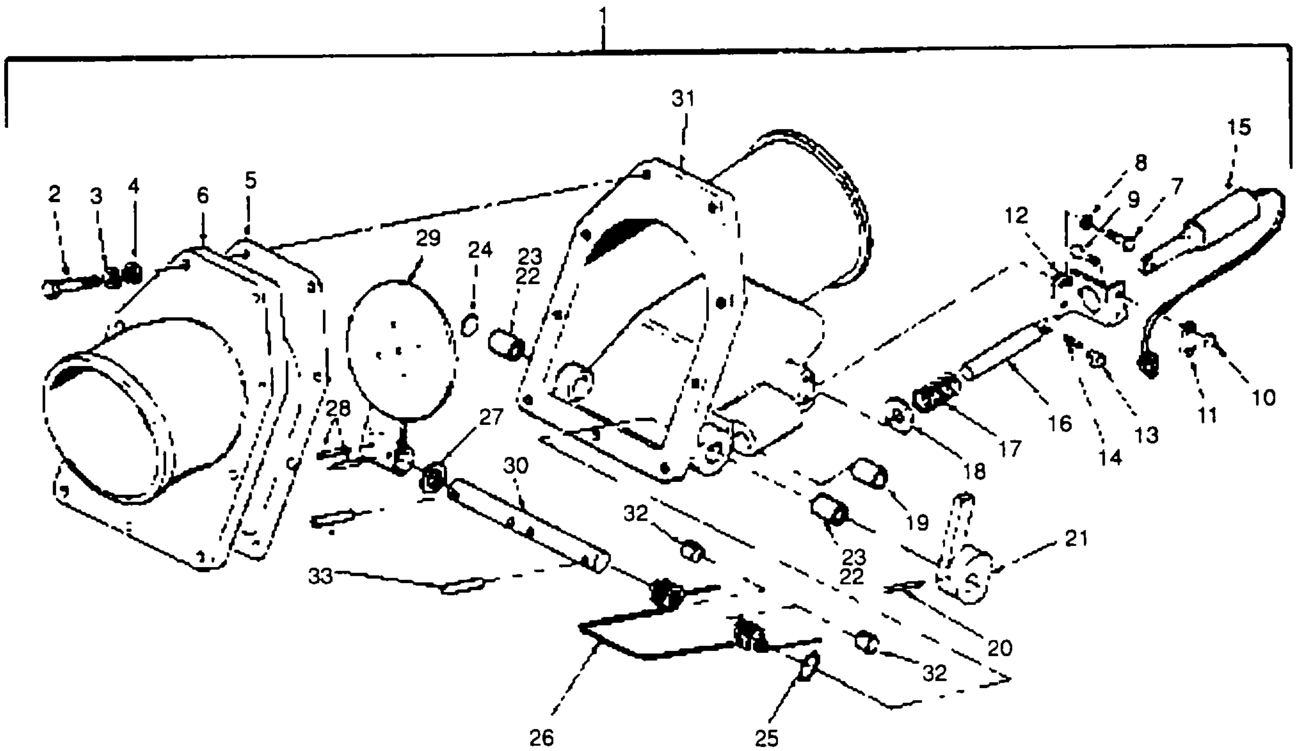
(2) Inspect and replace defective parts as follows:

(a) Inspect air shutdown housing (31) and air shutdown cover (6) for cracks, warpage at the gasket area, and stripped threads. Discard housing or cover if cracked or warped, or if threads are stripped in housing.

(b) Inspect bushing sleeve (22) and air nylined bearing (19) in air shut down housing (31) for wear. Replace worn bushings and bearings using a bushing driver. Insert cup plug (24) over bushing sleeve.

(c) Inspect air shutdown shafts (16 and 30) for wear and elongation of pin holes. Discard defective shafts.

(d) Inspect air shutdown springs (17 and 26) for warpage and loss of tension. Discard defective springs.



1 AIR CONTROL VALVE
2 CAPSCREW
3. LOCKWASHER
4 WASHER
5. AIR SHUTDOWN GASKET
6. AIR SHUTDOWN COVER
7 CAPSCREW
8 LOCKWASHER
9. SCREW
10. NUT
11. CLAMP
12. AIR SHUTDOWN BRACKET
13. THROTTLE BLOCK
14 ROLL PIN
15. 24 V SOLENOID L2A AND L2B
16 AIR SHUTDOWN SHAFT
17 AIR SHUTDOWN SPRING
18 WASHER
19 NYLINED BEARING
20 ROLL PIN
21. AIR SHUTDOWN LEVER
22. BUSHING SLEEVE
23 SLEEVE BEARING
24 CUP PLUG
25 PREFORMED PACKING
26 AIR SHUTDOWN SPRING
27 PLAIN WASHER
28 ROLL PIN DOWEL
29. AIR SHUTDOWN VALVE
30 AIR SHUTDOWN SHAFT
31 AIR SHUTDOWN HOUSING
32. NYLON BUSHING
33. ROLL PIN

Figure 4-50. Air Control Valve Assembly

(e) Inspect washer (18) and plain washer (27) for wear. Discard defective washers.
(f) Inspect air shutdown valve (29) for wear, cracks, and elongated pin holes. Discard valve if defective.
(g) Inspect throttle block (13) for wear and security of roll pin (14). Check that roll pin is not worn or bent. Replace defective throttle block or roll pin, using pin punch.
(h) Inspect air shutdown bracket (12) and clamp (11) for cracks or deformity Discard defective bracket or clamp.
(i) Inspect roll pins and all mounting hardware for wear and damaged threads. Discard defective mounting hardware or roll pins.

(3) Assembly.

(a) Position preformed packing (25), air shutdown spring (26), air shutdown valve (29), and plain washer (27) in air shutdown housing (31). When properly positioned, round portion of valve should extend out of housing, and spring should lay flat on top of valve.
(b) Insert air shutdown shaft (16) through housing (31), preformed packing (25), air spring (26), plain washer (27), and air shutdown valve (29) If necessary, tap shaft into place using a soft hammer.
(c) Pivot air shutdown valve (29) toward air shutdown housing (31), turn air shutdown shaft (30) to align pin holes In shaft and valve, and Install dowel roll pins (28). Test for proper installation by pivoting valve toward housing and releasing valve. Valve should snap freely toward air shutdown cover (6) end of housing when released.
(d) Install air shutdown lever (21) using roll pin (20).
(e) Position 24 V solenoids L2A and L2B (15) In bracket (12), and retain in position using clamp (11), screws (9), and nuts (10).
(f) Install air shutdown shaft (16), air shutdown spring (17), and washer (18) on 24 V solenoids L2A and L2B (15), and realign with roll pin (14), and throttle block (13).
(g) Install air shutdown bracket (12) on air shutdown housing (31) using capscrews (7), and lockwashers (8).
(h) Turn air shutdown lever (21) until shaft (16) locks air shutdown valve (29) In the open position.
(i) Using a new air shutdown gasket (5), position cover (6) to housing (31) and secure in place using capscrews (2), lockwashers (3), and washers (4).
(j) Test action of valve by turning throttle block Valve should snap shut against cover without binding.
(k) Latch valve In the open position and Install the air shutoff valve assembly.

c. Install.

(1) Remove protective covers from turbocharger and air inlet tube openings. Install molded rubber adapters (7 and 8, Figure 4-49) on housing, and secure with hose clamps (3).
(2) Slide clamps (3) over molded rubber adapter (7) and start adapter on air inlet tube. Position air control valve assembly (52) with 24 V solenoids L2A and L2B (15, Figure 4-50) facing up.
(3) Slide clamps (3, Figure 4-49) over molded rubber adapter (8), and Install adapter on air control valve assembly (52).
(4) Twist air control valve assembly (52) as necessary so that 24 V solenoids L2A and L2B (15, Figure 4-50) are facing up, and tighten all clamps (3).
(5) Restore electrical plug, cushion clamp, nut, bolt, and washer.

4-79. REPAIR ROCKER HOUSING COVERS. The rocker housing covers prevent dirt from entering and oil from leaving rocker assembly.

a. Remove the rocker housing covers in accordance with paragraph 3-14.

b. Remove minor nicks and warpage from gasket surface using a flat mill file.

c. Install rocker housing covers In accordance with paragraph 3-14.

4-80. ADJUST INTAKE AND EXHAUST VALVES. Intake and exhaust valves permit entering of combustion gases and exiting of exhaust gases from cylinders. Adjustment of the intake and exhaust valve clearance is accomplished by adjusting the valve crossheads and rocker levers. Refer to paragraph 4-81.

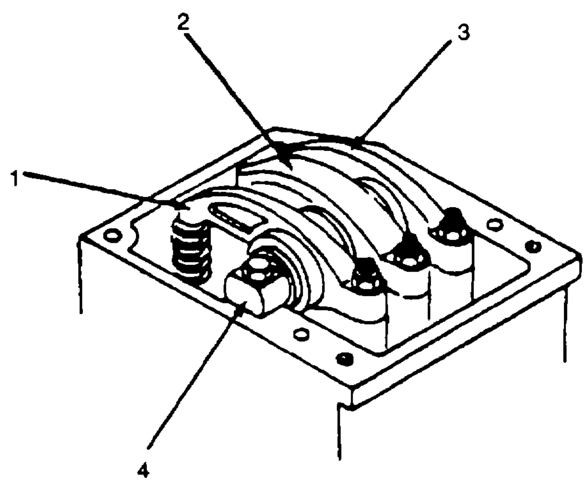
4-81. MAINTENANCE OF ROCKER LEVERS AND CROSSHEADS. Rocker levers and crossheads insure proper opening clearances of exhaust and intake valves.

a. Inspect.

(1) Remove rocker housing covers in accordance with paragraph 3-14.

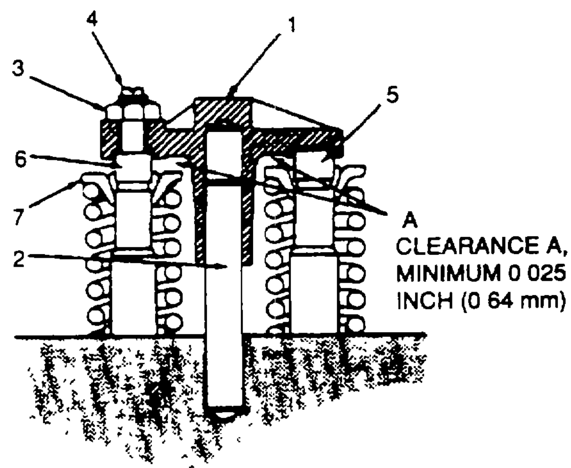
(2) Visually examine rocker levers (1, 2, and 3, Figure 4-51) and valve crosshead (1, Figure 4-52) for cracks. Inspect adjusting screws and nuts for signs of visible damage.

(3) Remove clip on barring nut and install barring tool Rotate engine using barring nut and socket with breaker bar until some clearance exists at rocker levers on the cylinder being inspected.



1. EXHAUST ROCKER LEVER
2. INJECTOR ROCKER LEVER
3. INTAKE ROCKER LEVER
4. ROCKER LEVER SHAFT

Figure 4-51. Inspection of Rocker Levers



1. VALVE CROSSHEAD
2 CROSSHEAD GUIDE
3 NUT
4 SCREW
5. VALVE
6. VALVE
7. HELICAL COMPRESS SET

Figure 4-52. Valve Crosshead, Cross Sectional View

(4) Grasp rocker levers (1, 2, and 3, Figure 4-51) on each end and rock levers from side to side to detect bushing or rocker lever shaft (4) wear.
(5) Rock valve crosshead (1, Figure 4-52) on crosshead guide (2) to detect wear between crosshead and guide.
(6) Using a wire gage, measure clearance A. Clearance A should be a minimum of 0 025 inch (O 64 mm).
(7) If wear or damage is detected, or if clearance A is under 0.025 Inch (0.64 mm), refer to the next higher level of maintenance.
(8) Replace rocker housing covers in accordance with paragraph 3-14.

b. Adjust.

(1) General. Rocker lever crosshead adjustment must be performed in accordance with engine firing order (Figure 4-53). VS (valve set) marks are provided to ensure that adjustments will be made only to the proper cylinders. Access to VS marks is provided on the vibration damper (Figure 4-54) on the right and left side of the flywheel housing (Figure 4-55). Each VS mark is encoded with the number and location of two cylinders to which adjustments may be possible. Note that adjustments may be made to only one of the two indicated cylinders. It will be necessary to rotate the flywheel through two complete revolutions In order to make adjustments to all the cylinders. Rocker adjustment should be done at a stabilized temperature of 140°F (60°C), or below. The Injector plungers and valve crossheads must be adjusted before adjusting the valve rocker levers. Therefore, the sequence of adjustments must be in the order presented In the steps that follow.

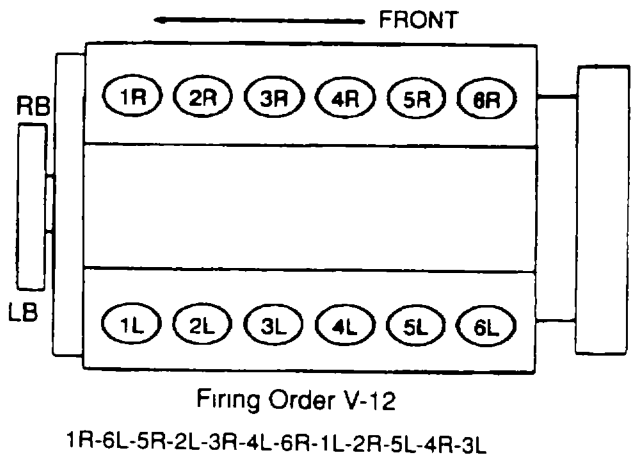


Figure 4-53. Cylinder Arrangement and Firing Order

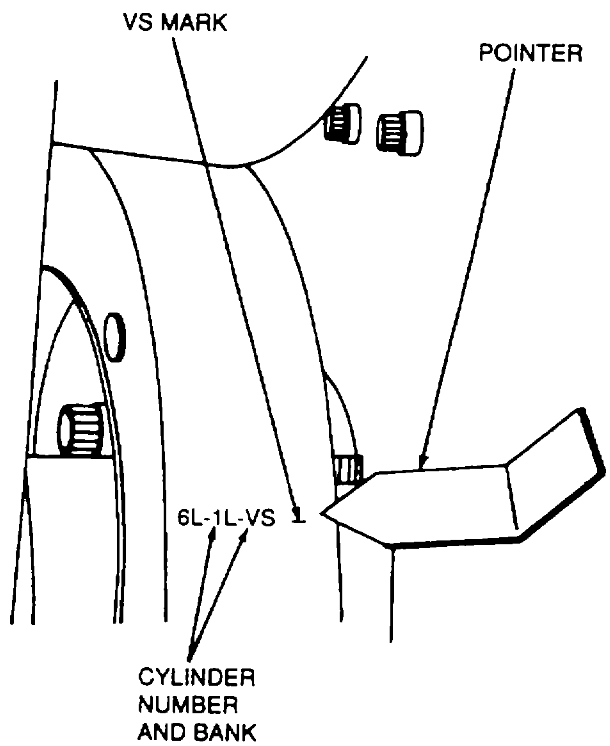


Figure 4-54. Vibration Damper Timing Marks

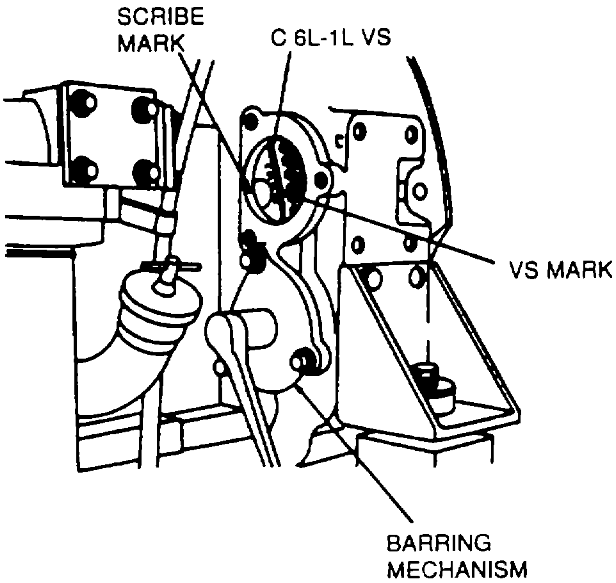


Figure 4-55. Flywheel Timing Marks

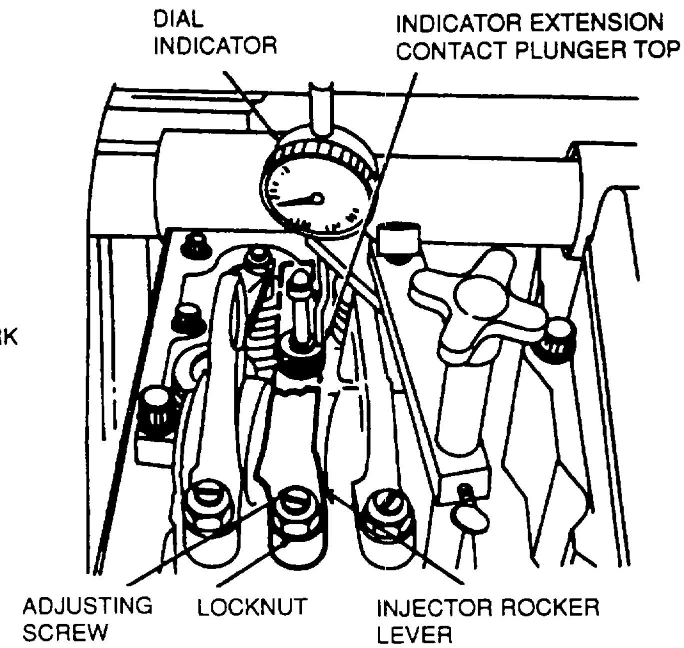


Figure 4-56. Dial Indicator Setup, Injector Timing

NOTE

Two sets of VS marks are provided on the flywheel. those preceded by the letter A are used when viewing from the right bank side of the flywheel housing, those preceded by the letter C are used when viewing from the left bank side of the flywheel housing (Figure 4-54) Because both starter motors are installed on the right bank flywheel housing, the VS marks preceded by the letter A will not be used When using flywheel VS marks for valve and Injector adjustment, align the marks at the left flywheel housing, and use only those marks pre- ceded by the letter C.

(2) Adjustment of Injector Plungers
  (a) Remove the rocker housing covers In accordance with paragraph 3-14.
  (b) Align one of the VS marks on the vibration damper with the pointer (Figure 4-54) or, when using the barring mechanism to turn the engine, remove the access cover and align one of the VS marks with the scribe mark on the left bank side of the flywheel housing (Figure 4-55).
  (c) Determine which of the two cylinders indicated is to be adjusted by checking the valve rocker levers for clearance. Clearance at the valve rocker levers denotes the cylinder to be adjusted.
  (d) Attach the dial Indicator support and dial indicator, from tool set 3375004, to rocker housing of cylinder to be adjusted. Ensure indicator extension is tight in indicator stem (see Figure 4-56).

NOTE

Ensure that the dial indicator extension remains In contact with the Injector plunger at all times during the checking procedure. Do not allow the dial indicator extension to rub against the rocker levers.

  (e) With indicator extension resting on Injector plunger top, load indicator to a dial reading of approximately 0.325 inch (8.26 mm).

(f) Using rocker lever actuator 3375010, move rocker lever until injector plunger is bottomed in cup (see Figure 4-57). This will remove oil from Injector that could cause a false indicator reading.
(g) Allow the injector plunger to rise slowly to its fully extended position and bottom it again.
(h) While holding the Injector plunger fully bottomed, set the dial indicator to zero.
(i) Allow Injector plunger to rinse slowly to Its fully extended position, and remove actuator tool.
(j) Using a torque wrench and torque wrench adapter ST-669, loosen locknut (Figure 4-56) and turn adjusting screw to give a dial indicator reading of 0.308 ± 0.001 inch (7 82 + 0.03 mm). Maintain indicator reading while tightening locknut to a torque of 30 to 35 pound-feet (41 to 47 newton-meters).

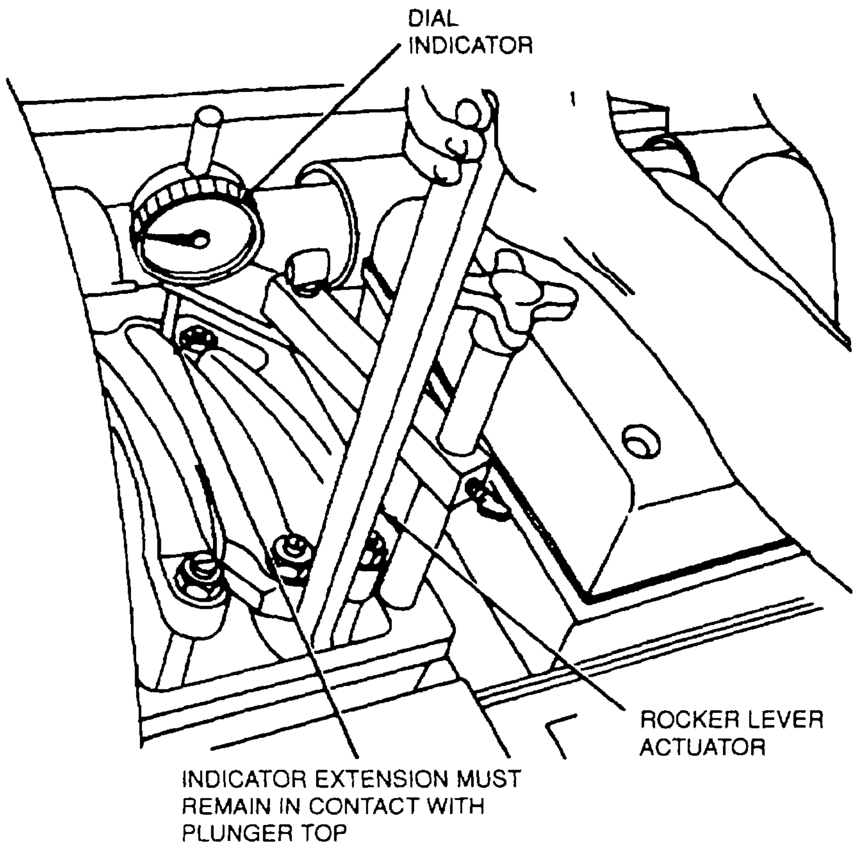


Figure 4-57. Bottom Injector Plunger

NOTE

If adapter ST-669 is not used, hold adjusting screw with screwdriver, and tighten locknut to a true torque of 40 to 45 pound-feet (54 to 61 newton-meters).

(k) Use actuator tool and actuate plunger several times to recheck adjustment Dial indicator must indicate a reading of 0.308 i 0 001 inch (7 82 ± 0.03 mm) as before.

(3) Adjustment of Valve Crossheads.

NOTE

Do not turn engine Complete the valve crosshead and valve rocker lever adjustments on the cylinder selected for Injector plunger adjustment before turning engine to next set of VS marks.

(a) Loosen the adjusting nut (3, Figure 4-52) and back off adjusting screw (4) one complete turn.

(b) Using light finger pressure at the rocker lever contact surface, hold valve crosshead (1) in contact with valve (5).
(c) Tighten adjusting screw (4) until it just contacts valve stem (6).
(d) Using torque wrench adapter ST-669 hold adjusting screw in position and tighten nut (3) to a torque of 22 to 26 pound-feet (30 to 355 newton-meters).

NOTE

If adapter ST-669 is not used, hold adjusting screw with screwdriver and tighten locknut to a true torque of 25 to 35 pound-feet (34 to 47 newton-meters).

(e) Using a wire gage, check the clearance between helical compress set (7) and valve crosshead (1) clearance. Clearance A must be a minimum of 0 025 Inch (0.64 mm). If clearance A Is incorrect, refer to the next higher level of maintenance.

(4) Adjustment of Valve Rocker Levers

NOTE

Ensure valve crossheads are adjusted in accordance with step (3), above, before adjusting valve rocker levers. The exhaust valves for the left bank are located at the front of each cylinder head The exhaust valves for the right bank are located at the rear of each cylinder head.

(a) Loosen the rocker lever adjusting screw locknuts. Using a feeler gage, adjust the clearance between the contact surfaces of the rocker lever and crossheads to 0.014 inch (0.36 mm) Intake clearance, and 0 027 inch (0.69 mm) exhaust clearance (Figure 4-58).
(b) Using a torque wrench and adapter ST-669 (Figure 4-59), hold adjusting screw in position and tighten locknut to a torque of 30 to 35 pound-feet (41 to 47 newton-meters).

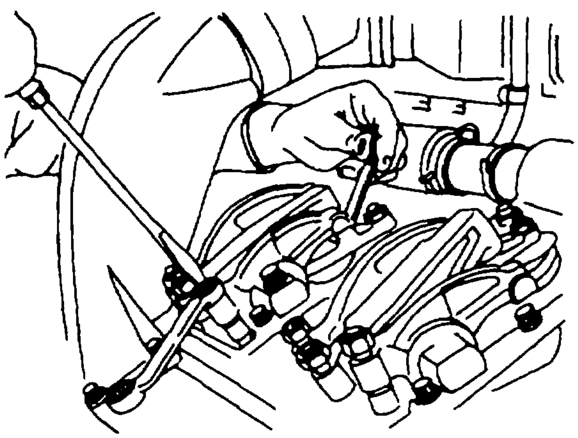


Figure 4-58. Adjusting Valve Rocker Lever Clearance

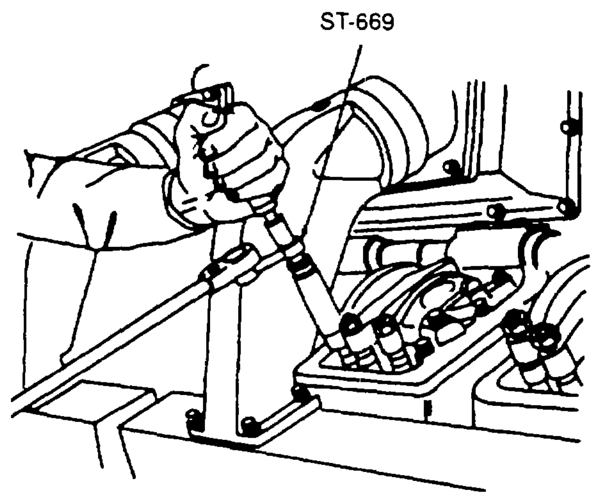


Figure 4-59. Tightening Rocker Lever Adjusting Screw Locknuts

NOTE

If adapter ST-669 is not used, hold adjusting screw with screwdriver and tighten locknut to a true torque of 40 to 45 pound-feet (54 to 61 newton-meters).

(c) To be sure clearance has not changed due to tightening the locknut, recheck clearance In accordance with step (a), above.

(5) Turn the engine to the next set of VS marks in the firing order (Figure 4-53), and carry out the adjustments on that cylinder in accordance with steps (2), (3), and (4), above Repeat this procedure until the rocker levers on all 12 cylinders have been adjusted.

(6) Install the rocker housing covers in accordance with paragraph 3-14 Remove barring tool and Install clip in barring nut.

4-82. INSPECT VIBRATION DAMPER. The vibration damper is a counter balance located at the front of the engine crankshaft used to smooth out critical engine vibrations.

NOTE

Be careful not to mistake engine lubricant leakage from the crankshaft seal for vibration damper leakage. The vibration damper Is filled with a thick, heavy, viscous fluid, while engine lubricant flows freely.

Visually Inspect the vibration damper for dents and evidence of fluid leakage Check the pulley for excessive or uneven wear of the belt surface

4-83. MAINTENANCE OF TURBOCHARGERS. Turbochargers provide additional air flow to cylinders to increase engine horsepower.

a. Inspect.

(1) Remove the hose clamps (6, Figure 4-60) and molded rubber adapter (7) from the air inlet of the turbocharger assembly (17).

(2) Remove "V" band clamp (8) and turbine exhaust connection (9).

(3) Examine the turbocharger assembly (17) for cracked or chipped vanes.

(4) Rotate the rotor by hand while feeling and listening for evidence of bearing roughness or rotor rub. Create a back-and-forth loading on bearings to remove end play while checking.

NOTE

A thin, even coating of oily dust on the compressor wheel, and a thin, even coating of car- bon on the turbine wheel is normal and should not be disturbed. Disturbance of these coatings may upset the balance of the rotor assembly..

(5) Examine compressor wheel and turbine wheel for excessive buildup of dirt or carbon deposits.

(6) Mount a dial indicator on the air inlet flange of the turbocharger and center the indicator button on the rotor shaft.

(7) Move the rotor assembly back and forth to check the total end clearance Total end clearance must not exceed 0 009 inches (0.23 mm).

(8) If turbocharger Is satisfactory, remove the dial indicator, and replace turbine exhaust connection (9), V band clamp (8), molded rubber adapter (7), and hose clamps (6).

WARNING

Do not place hands or allow other personnel to place hands near the rotating vanes of the compressor wheel. Serious injury or dismemberment could occur.

(9) Restart the engine and apply load when available.

(10) Ensure all connections and piping are not leaking.

NOTE

Do not mistake the normal whine of turbocharger operation for bearing squeal or rotor rub.

(11) Listen for high pitched bearing noise or sounds of compressor wheel or turbine wheel rub.

(12) Observe exhaust for excessive blue smoke Blue smoke from one exhaust stack may indicate defective turbocharger.

(13) Shut down engine immediately If unusual noises are heard or blue smoke is abnormal.

(14) If any defects are noted during the performance of the above steps, remove the turbocharger in accordance with step b, below Refer defective turbocharger to the next higher level of maintenance.

b. Remove
(1) Unscrew fitting and remove oil hose assembly (1, Figure 4-60) from turbocharger oil inlet.
(2) Remove capscrews (2), lockwashers (3), and remove oil drain tube assembly (4) from turbocharger Discard flange gasket (5)
(3) Remove hose clamps (6) and molded rubber adapter (7) from turbocharger air inlet.
(4) Remove V band clamp (8) and turbine exhaust connection (9) from turbocharger exhaust outlet.
(5) Remove capscrews (10), lockwashers (11), washer (12), and remove retaining brace (13) from turbocharger air outlet.
(6) Remove locknuts (14) and capscrews (15) from turbocharger exhaust inlet. Remove and discard turbine to exhaust gasket (16).
(7) Remove turbocharger assembly (17), air tube (18), and preformed packing (19) Discard preformed packing.

c. Install
(1) Lubricate preformed packings (19, Figure 4-60) with clean engine lubricating oil MIL-L-9000, and install on air tube (18). Install air tube In aftercooler housing.
(2) Coat turbine to exhaust gasket (16) with high temperature anti-seize compound MIL-A-907, and position gasket on exhaust manifold flange.
(3) Start air outlet of turbocharger assembly (17) on air tube (18) and position exhaust inlet on exhaust manifold outlet.
(4) Push turbocharger assembly (17) onto air tube (18) until exhaust manifold flange is In proper alignment with turbocharger exhaust inlet.
(5) Ensure turbine to exhaust gasket (16) Is In alignment Install, but do not tighten capscrews (15) and locknuts (14).
(6) If inlet and exhaust connections do not align properly, or the oil drain hole does not point downward to within 30 degrees of vertical, loosen the turbine housing flange clamp bolts and the compressor housing V band and twist the turbine housing, compressor housing, or center housing until correct alignment has been achieved.
(7) If realignment of the turbocharger housing was necessary, tighten V band clamp nut to 40 to 60 pound-inches (4 5 to 6 8 newton-meters) torque, and the flange clamp bolts to 100 to 110 pound-inches (11 5 to 12.5 newton-meters) torque.
(8) Install the retaining braces (13) using capscrews (10), lockwashers (11), and plain washers (12) Do not tighten capscrews (10) at this time.
(9) Tighten locknuts (14) and capscrews (15) to a torque of 30 to 35 pound-feet (41 to 47 newton-meters).
(10) Tighten retaining brace capscrews (10) to torque of 40 to 45 pound-feet (54 to 61 newton-meters).
(11) Using a new flange gasket (5), install oil drain tube assembly (4) using capscrews (2) and lockwashers (3), and tighten to a torque of 50 pound-feet (68 newton-meters).
(12) Install the turbo exhaust connection (9) and V band clamp (8), and tighten clamp nut securely.
(13) Using a small funnel pour 2 to 3 ounces (59 to 89 ml) of clean lubricating oil MIL-L-9000, through the oil inlet opening of turbocharger housing. Turn compressor wheel slowly by hand while adding oil to distribute oil around bearings.
(14) Install oil hose assembly (1) on turbocharger inlet, and tighten to a torque of 20 pound-feet (27 newton-meters).
(15) Install molded rubber adapter (7), and secure with hose clamps (6).
(16) Start engine and Inspect for proper operation in accordance with steps a (9) through (14), above.

4-84. INSPECT INTAKE AND EXHAUST MANIFOLDS AND SEALS. Intake and exhaust manifolds provide passageways for air to enter and exit the engine.

a. Intake Manifolds. Two air Intake manifolds are bolted to the cylinder heads on each side of the engine On each side, the two manifolds are joined by an air balance connector. A crossover housing also connects each manifold to the aftercooler cover. Inspect the intake manifolds as follows:

(1) Carefully examine each air intake manifold (see Figure 3-3) air balance connection and crossover housing for cracks or physical damage that could cause leaks. Refer all damages to the next higher level of maintenance.

(2) Inspect for air leaks or blown gaskets.

b. Exhaust Manifolds. Two exhaust manifolds are used on the engine. Each manifold is a three piece assembly consisting of two end sections and one center section. Inspect the exhaust manifolds as follows:

(1) Carefully examine each exhaust manifold (see Figure 3-3) for cracks or physical damage that could cause leaks.

(2) With the engine running, carefully examine each manifold section, and the joints of each section, for evidence of exhaust leakage.

4-85. INSPECT WATER TRANSFER TUBES. Water transfer tubes provide passageways for water to flow throughout the cooling system. Each rocker lever housing is connected to a water transfer tube (see Figure 3-3). Inspect the water transfer tubes as follows:

a. Inspect for coolant leaks. Refer any leaks detected to the next higher level of maintenance

b. With the engine running at normal operating temperature, check around each joint for evidence of coolant leakage. Refer all leaks to the next higher level of maintenance

4-86. FRONT ENGINE SUPPORT. Inspect front engine support (6, Figure 4-61) for cracks or other defects that could weaken the support.

1 HEXAGON HEAD CAPSCREW
2. HEXAGONAL NUT
3. LOCKWASHER
4. BEVEL WASHER
5. REAR ENGINE SUPPORT
6. FRONT ENGINE SUPPORT
7 LEVELING SHIM
8 FRONT SUPPORT ASSEMBLY
9. CAPSCREW
10. PLAIN WASHER
11 GREASE FITTING
12. FRONT SUPPORT
13. FRONT SUPPORT
14. TRUNNION BUSHING
15 OIL SEAL

A

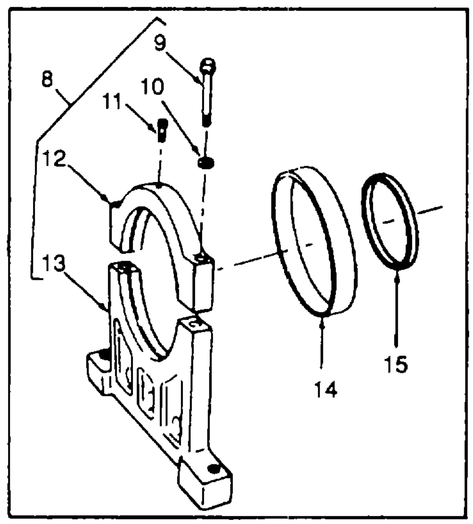


Figure 4-61. Engine Assembly and Related Parts (Sheet 1 of 2)

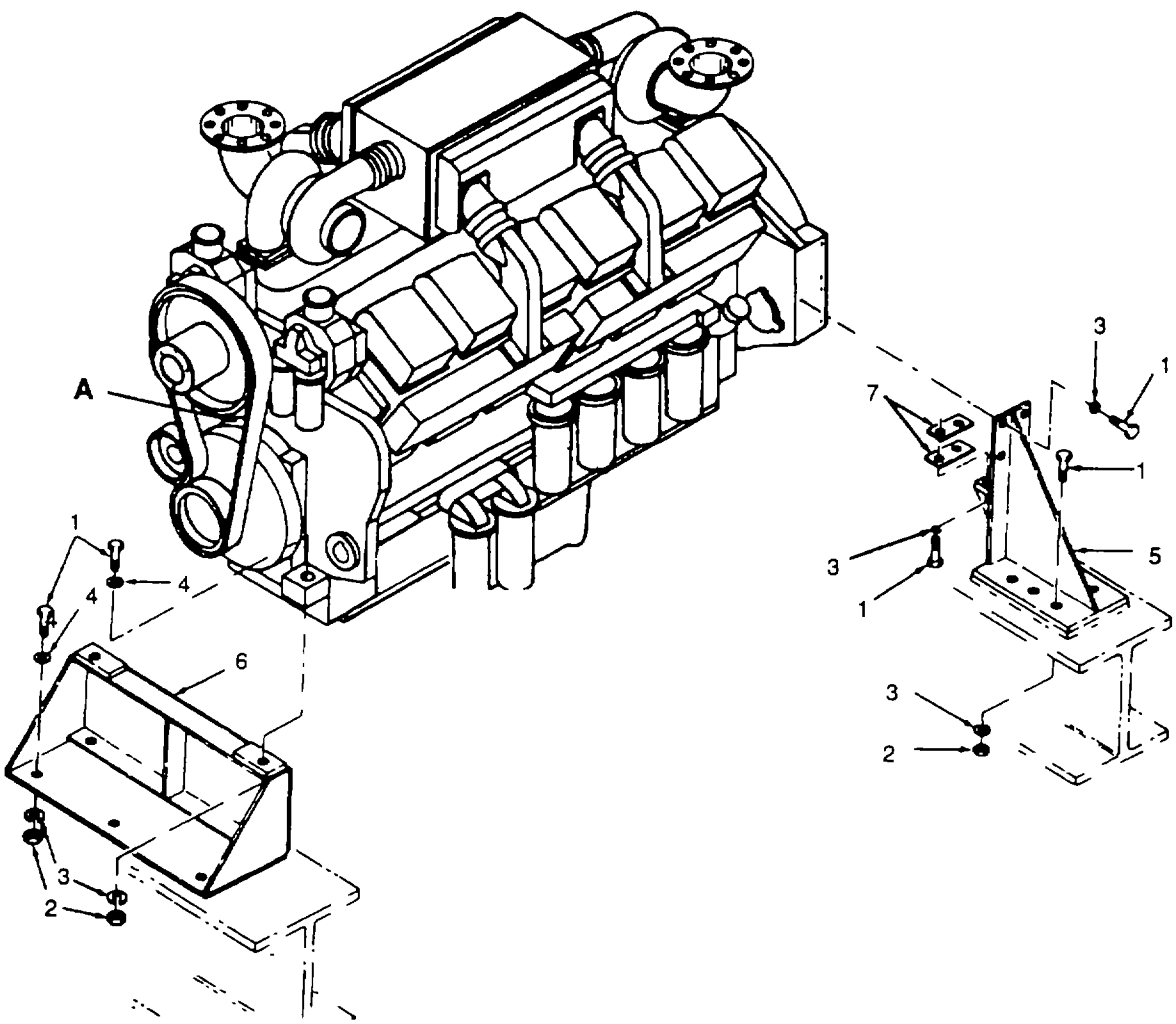


Figure 4-61. Engine Assembly and Related Parts (Sheet 2 of 2)

SECTION XIV. MAINTENANCE OF CONTROLS, INSTRUMENTS, AND SWITCHGEAR

WARNING

Failure to observe and comply with all safety requirements may result in death by electrocution. Maintenance procedures for high voltage equipment are contained in this section. Read and be thoroughly familiar with the safety procedures contained in Chapter 1, Section III , of this manual.

4-87. GENERAL. Generator set controls, instruments, and switchgear are panel mounted in the control compartment. unit maintenance consists of testing and replacing controls, instruments, and switchgear. Repair procedures for the panels are found In paragraph 4-88, below.

4-88. MAINTENANCE OF ANNUNCIATOR, GENERATOR, AND ENGINE CONTROL PANELS . Repair control panels. Repaint in accordance with MIL-T- 704 as necessary. Repair and replace gages, switches, and indicators in accordance with applicable paragraphs in this section.

4-89. CONTROL ROOM HEATERS HR103 AND HR104. Wall-mounted heaters (2, Figure 4-62) are parallel-connected and supplied with 240 V ac through circuit breaker CB118 (located In distribution panel DP2). Each heater is supplied with an integral ON/OFF switch and temperature level control and is used to heat the control room.

a. Test.
   (1) Set circuit breaker CB118 (12, Figure 2-7) in the OFF position.
   (2) Set multimeter to RX1 scale and check ON/OFF function of thermostat switch The multimeter should Indicate infinite resistance when thermostat switch is set to the OFF position and zero resistance when thermostat switch is set to the ON position.
   (3) Check heater coil for continuity. Resistance indicated should be 45 $\pm$ 8 ohms.

b. Remove.
   (1) Set circuit breaker CB118 (12, Figure 2-7) in the OFF position
   (2) Remove heater cover (7). Tag and disconnect wiring to the radiant heaters HR103 and HR104 (2, Figure 4-62).
   (3) Remove the hexagon head capscrews (1) and hexagonal nuts (5) that secure the heaters (2) to the left and right mounting brackets (3 and 4), and remove the heaters.
   (4) Remove the hexagon head capscrews (1) and lockwashers (6) that secure the left and right mounting brackets (3 and 4) to the wall, and remove the brackets.

c. Install.
   (1) Secure the left and right mounting brackets (3 and 4) to the wall with hexagon head capscrews (1) and lockwashers (6).
   (2) Place the heaters (2) In position and secure to brackets with hexagon head capscrews (1) and hexagonal nuts (5).
   (3) Connect wires and discard tags.
   (4) Attach heater cover (7) to close unit.
   (5) Close circuit breaker CB118 and check for proper operation.

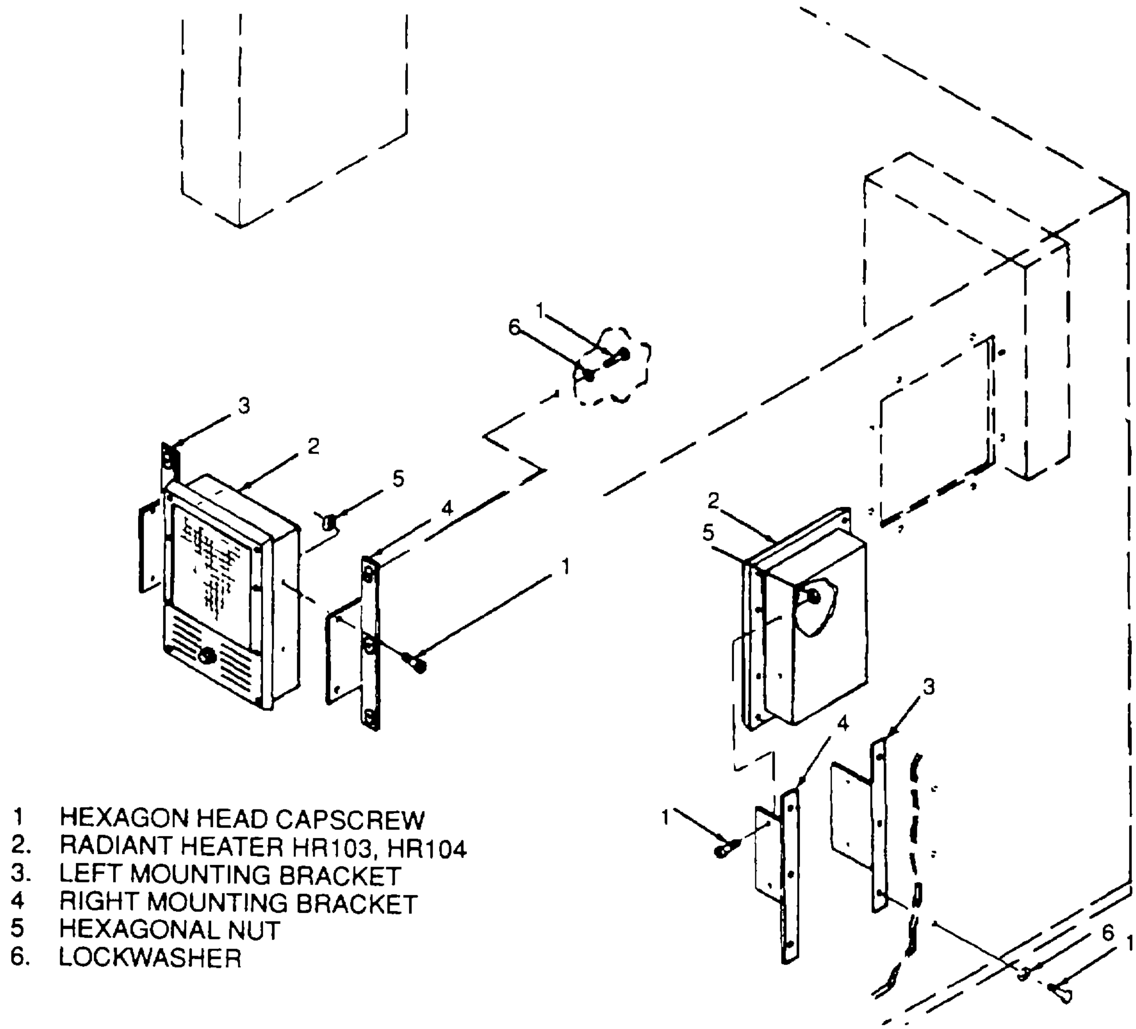


Figure 4-62. Control Room Components and Related Parts

4-90. 60 HZ AND 50 HZ CLOCKS M110 AND M111.

a. Remove.

(1) 60 Hz and 50 Hz clocks (4 and 5, Figure 4-63) are mounted on the upper front panel, control cabinet A.
(2) Tag and disconnect wires from clock terminals.
(3) Remove nut and captive washer assemblies (1), flat washers (2), and threaded spacers (3) while holding the clock face on the other side of the panel.
(4) Carefully remove defective clock (4 or 5).

b. Install.

(1) Install clock (4 or 5) and attach at rear of panel with nut and captive washer assemblies (1), flat washers (2), and threaded spacers (3).

(2) Connect wiring to clock terminals and discard tags.

4-91. KILOWATT HOURS COUNTER (CNTR). The KILOWATT HOURS counter indicates total accumulated kilowatt hours output of the generator set.

a. Test

WARNING

Do not conduct the following test when the generator set is operating.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(1) Tag and disconnect wires from rear of KILOWATT HOURS counter CNTR (8, figure 4-63).

(2) Momentarily connect and then disconnect a 120 V ac power source across the two terminals at the rear of KILOWATT HOURS counter CNTR The KILOWATTS HOURS counter CNTR drum should advance two half steps, indicating the next digit in the display sequence on the face of KILOWATT HOUR counter CNTR.

(3) Repeat step (2), above, as many times as needed to ensure that KILOWATT HOURS counter CNTR display advances one digit each time the 120 V ac power source is momentarily connected and then disconnected from KILOWATT HOURS counter CNTR.

(4) Replace KILOWATT HOURS counter CNTR if display falls to advance when energized, or does not advance as indicated.

b. Remove. See Figure 4-63.

(1) Open cabinet A front panel. Tag and disconnect wiring at rear of KILOWATT HOURS counter (8).

(2) Remove KILOWATT HOURS counter (8) by removing flat head screws (6) from front panel of cabinet A and nut and captive washer assemblies (7).

c. Install . See Figure 4-63.

(1) Install replacement KILOWATT HOURS counter (8) on front panel of control cabinet A using flat head screws (6) and nut and captive washer assemblies (7). Connect wiring and discard tags. Repeat test procedures In step a, above.

(2) If replacement KILOWATT HOURS counter exhibits similar inaccuracies in test, WHT transducer may be at fault.

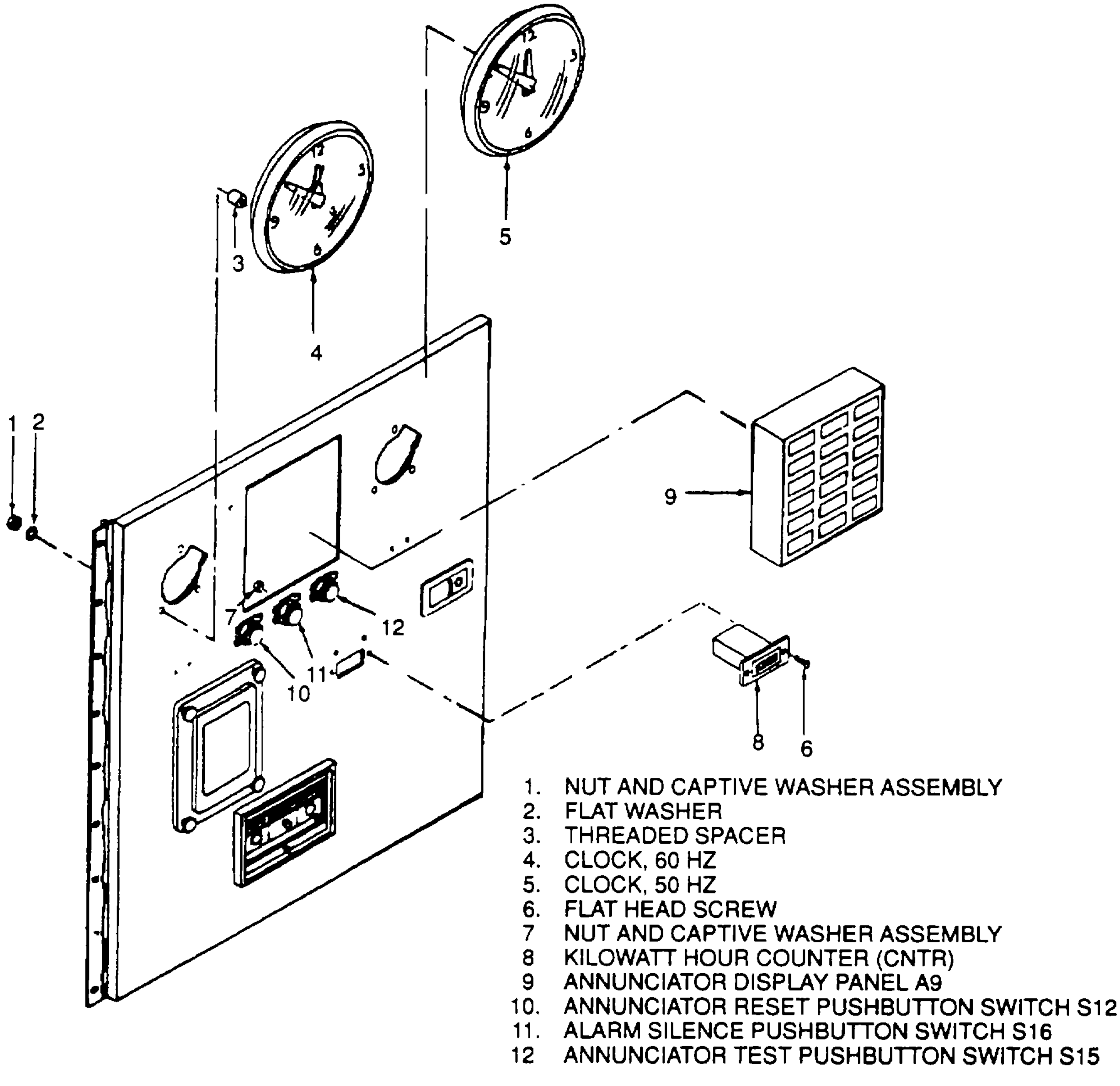


Figure 4-63. Cabinet A Upper Front Door Assembly

4-92. ANNUNCIATOR ALARM SYSTEM. The generator set annunciator alarm system consists of fault Indicator lights, relays, an audible alarm, a pushbutton TEST switch, and an alarm silencing switch. The annunciator alarm system indicates faults associated with generator set operation. See figure 4-63 Refer to paragraph 4-19.

a. Test.

(1) Press and hold ANNUNCIATOR TEST pushbutton S15 (5, Figure 2-3).

(a) Audible alarm LS1 should sound. If horn does not sound, check horn in accordance with paragraph 4135.

NOTE

Do not remove printed circuit board. All indicator boxes will fall from housing.

(b) All indicator lights on the annunciator panel A9 (4) should light Note that each Indicator box has two lights. Replace burned out lights by turning counterclockwise.

(2) Release ANNUNCIATOR TEST pushbutton S15.

(a) Audible alarm should silence. If ALARM does not silence, replace panel In accordance step b, below.

(b) All lights on annunciator panel A9 should go out when test button is released.

b. Remove. See Figure 4-63.

(1) Tag and unsolder wiring from the annunciator panel A9 (9) using heat sink as necessary.

(2) Remove and retain hardware which holds the panel in place, and remove panel.

c. Install. See Figure 4-63.

(1) Install annunciator panel A9 (9) and secure it with the securing hardware removed in step (2), above.

(2) Solder wires in position as tagged. Remove and discard tags

(3) Test in accordance with step a, above.

4-93. FLASHER DS19. The flasher DS19 is energized when a fault condition exists and causes the appropriate fault indicator light on annunciator panel A9 to flash.

a. Inspect. Inspect the flasher DS19, located on the lower rear wall of upper cabinet A, for proper mounting, security of wiring connections, and signs of damage. Tighten loose wiring connections, and replace a unit which shows signs of damage.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

b. Test.

(1) Ensure that 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 is set to ON, and MAINTENANCE LOCKOUT switch S100 is set to OPERATE

(2) Simulate an overvoltage fault by momentarily lumping terminals 11 and 13 on terminal board TB16, located on the rear wall of upper cabinet B In the generator set control room. OVERVOLTAGE indicator A9DS9 should flash.

(3) Replace flasher DS19 if OVERVOLTAGE indicator A9DS9 falls to flash.

c. Remove.

(1) Tag and disconnect wires to flasher DS19.

(2) Remove the screw and captive washer assemblies securing flasher DS19 to the upper wall of lower cabinet A.

d Install.

(1) Secure flasher DS19 to the upper wall of lower cabinet A with screw and captive washer assemblies.

(2) Connect wiring and discard tags.

4-94. CROSS CURRENT ADJUST RHEOSTAT R105. CROSS CURRENT ADJUST rheostat R105 controls the load sharing capabilities of the generator set voltage regulators when in a parallel condition.

a. Test
   (1) Remove wire from terminal 3 of CROSS CURRENT ADJUST rheostat R105 (9, Figure 2-3).
   (2) Rotate knob fully counterclockwise.
   (3) Using a multimeter on RX1 scale, check for continuity across terminals 1 and 2. The reading should be 1 ohm.
   (4) While observing the multimeter, slowly rotate knob in a clockwise direction. Meter resistance Indication should decrease smoothly, with no erratic jumps at any point in travel.
   (5) When knob (wiper arm terminal 2) is In the fully clockwise stop position, total resistance indication shall be continuity.
   (6) Connect wire removed from terminal 3.
   (7) Replace CROSS CURRENT ADJUST rheostat R105 if It does not meet the specifications above.

b. Remove.
   (1) Tag and disconnect wiring to CROSS CURRENT ADJUST rheostat R105 (9, Figure 2-3).
   (2) Remove knob.
   (3) Loosen and remove locking nut at front of bracket and rheostat from the rear.

c. Install.
   (1) Install CROSS CURRENT ADJUST rheostat R105 (9, Figure 2-3) to the bracket Position CROSS CURRENT ADJUST rheostat (9) so that the arrow will be in the 9 o'clock position once the knob is attached and the shaft is rotated fully counterclockwise.
   (2) Attach the knob.
   (3) Connect wires and discard tags.

4-95. FREQUENCY SEL SW S118. FREQUENCY SEL SW S118 Is used to select 50 or 60 hertz operation of the generator set.

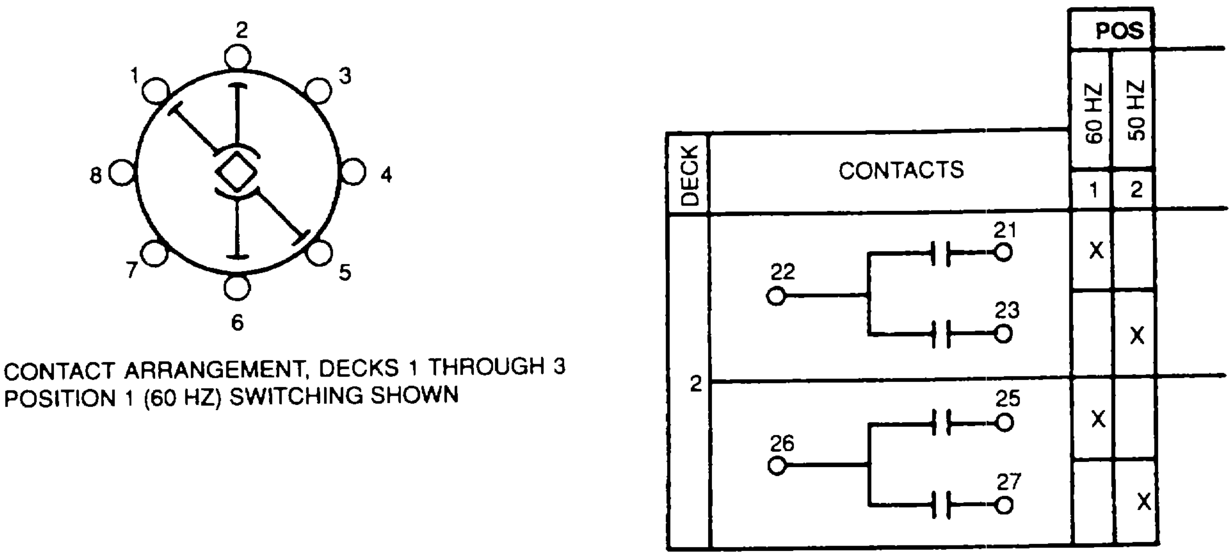
a. Remove.
   (1) Tag and disconnect wires.
   (2) Loosen screw In center of FREQUENCY SEL SW S118 (8, Figure 2-3) knob and slide knob off shaft.
   (3) Remove mounting screws at front of panel and slide switch out from the rear.

b. Test
   (1) Tag and disconnect all wiring to switch contacts.
   (2) Set FREQUENCY SEL SW S118 to 60 Hz position. Set multimeter to RX1 scale and check resistance across contacts 22 and 21, and 22 and 23, and across contacts 26 and 25, and 26 and 27 on deck 2. Compare results with figure 4-64.
   (3) Set FREQUENCY SEL SW S118 to 50 Hz position. Set multimeter to RX1 scale and check resistance across contacts 22 and 21, and 22 and 23, and across contacts 26 and 25, and 26 and 27 on deck 3, as above. Compare results with figure 4-64.

c. Install.
   (1) Install FREQUENCY SEL SW S118 (8, Figure 2-3) in panel from rear, and attach with mounting screws.

NOTE

Verify position of STOP screws on rear of switch to limit switch rotation to two positions.



SWITCH HAS 3 DECKS

DECK 2 IS SHOWN ABOVE, DECK 3 IS IDENTICAL EXCEPT FOR TERMINAL NUMBERS

ALL DECKS HAVE IDENTICAL CONTACT ARRANGEMENTS AS SHOWN LEFT

NOTE THAT THE FIRST DIGIT OF THE TERMINAL NUMBERS SHOWN ABOVE, INDICATES THE DECK NUMBER FROM THE HANDLE END OF THE SWITCH, AND THE SECOND DIGIT INDICATES THE CONTACT NUMBER ON THAT DECK, LEFT. 22 REFERS TO DECK 2, CONTACT 2, 26 REFERS TO DECK 2, CONTACT 6, ETC

MULTIMETER SHOULD INDICATE ZERO RESISTANCE BETWEEN CONTACTS MARKED X, AND INFINITE RESISTANCE BETWEEN CONTACTS LEFT BLANK, IN RIGHT HAND COLUMNS ABOVE

Figure 4-64. Test Data for FREQUENCY SEL SW S118

(2) Switch shaft should be rotated to the clockwise position (50 Hz) and the knob, when attached, should be aligned with the 50 Hz marking.
(3) Install knob on shaft and tighten screw in center of switch.
(4) Connect wires and discard tags.

4-96. SWITCHGEAR HEATERS H105, H106, AND H107. Strip heaters provide heat to switchgear cabinets to prevent moisture from forming. See Figure 3-26, Figure 3-28, and Figure 3-29 for locations of strip heaters Remove switchgear access panels in accordance with paragraph 4-18 and proceed as follows:

WARNING

Burns may result, if heaters are not allowed to cool before attempting any maintenance.

a. Test.
(1) Tag and disconnect wires from heater terminals.
(2) Set multimeter to RX1 K scale and check heater for continuity (not open or shorted) and to ensure that resistance is approximately 290 f 45 ohms.
(3) With multimeter, check for infinite resistance between heater terminals and case. Reading should be Infinity.
(4) Connect wires and discard tags.

b. Remove. See Figure 4-65.
   (1) Tag and disconnect wires from heater terminals.
   (2) Remove hexagon head capscrews (1), lockwashers (2), and hexagonal nuts (3) to remove strip heater H105, H106, or H107 (4).

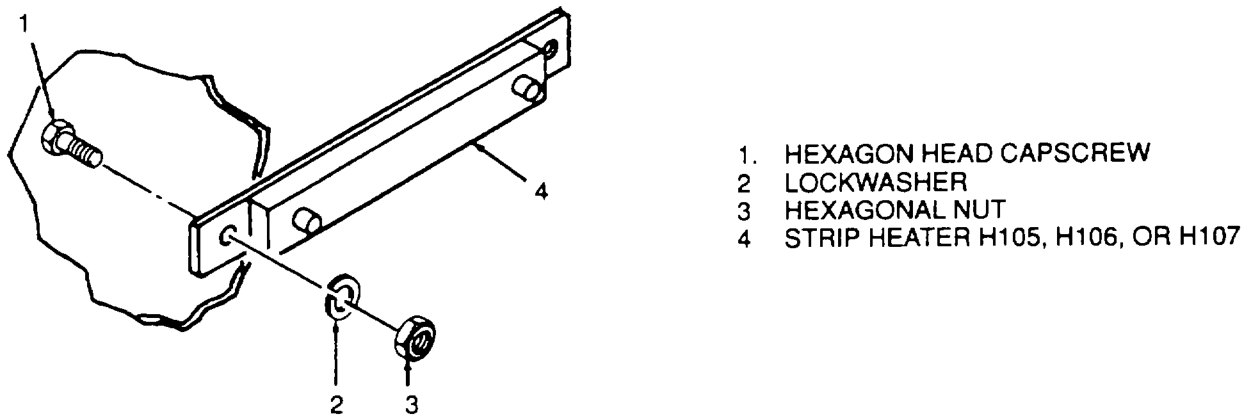
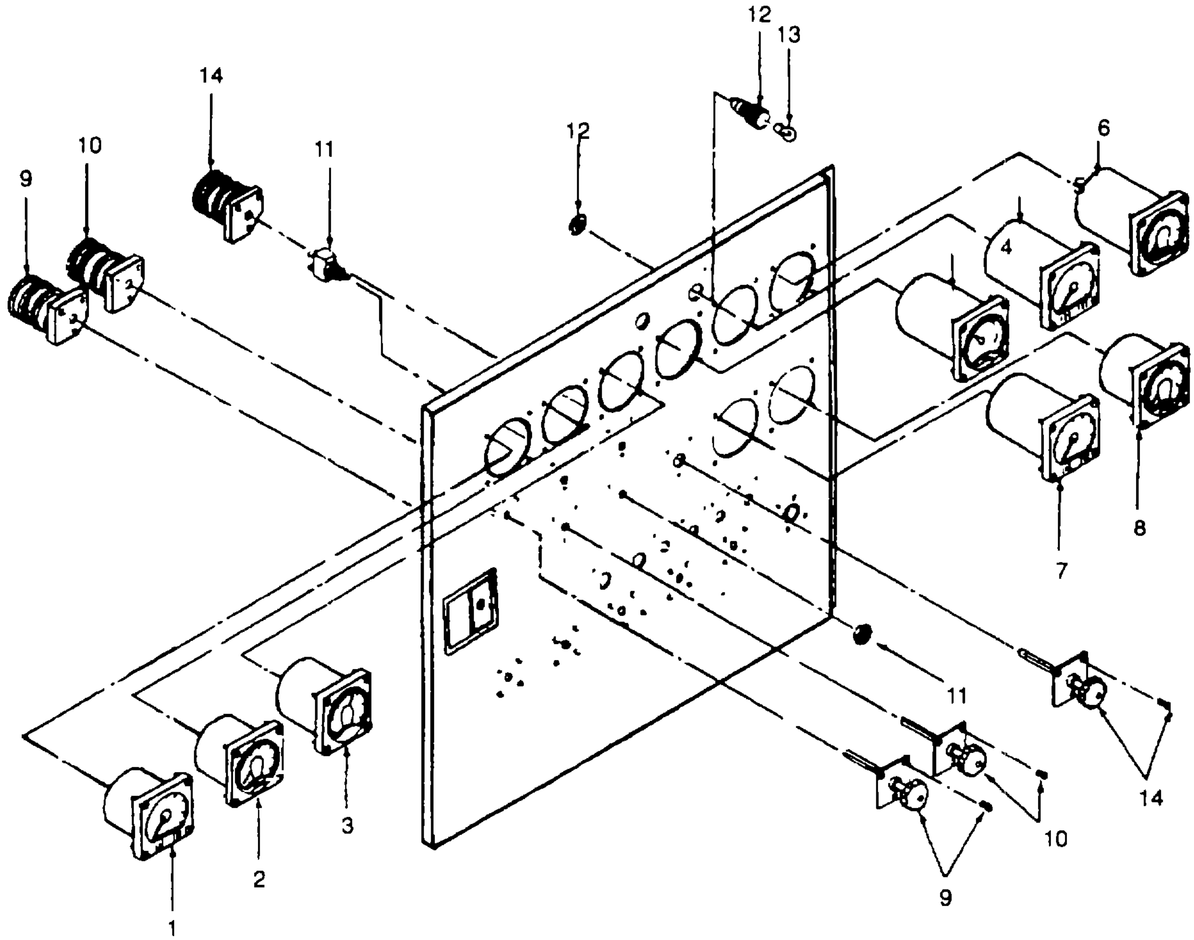


Figure 4-65. Removal and Installation of Strip Heaters

c. Install. See Figure 4-65.
   (1) Position heater (4).
   (2) Secure heater using hexagon head capscrews (1), lockwashers (2), and hexagonal nuts (3). Connect wires to terminals and discard tags.

4-97. AC AMPERES METER M102 (1, Figure 2-2). AC AMPERES meter M102 indicates the amount of current flowing through each individual phase of generator G1.

a. Adjust. With generator set shut down, check that needle on AC AMPERES meter M102 Indicates at the zero adjust point marked on the face of the meter If necessary, adjust the screw on the face of the meter to align the needle with the mark.
b. Remove. See 4-66.
   (1) Open cabinet B door. Tag and disconnect wiring from AC AMPERES meter M102 (1).
   (2) Remove screws and remove AC AMPERES meter M102 (1) from front of cabinet B door.
c. Test.
   (1) Connect AC AMPERES meter to a variable output current power supply. The meter movement requires one milliamperer DC for full scale meter deflection.
   (2) Turn on power supply.
   (3) Increase output of power supply and note reading on AC AMPERES meter being tested. If value on meter differentiates from known output of power supply by more than 2 percent of output value, replace meter.
   (4) Turn off power supply.
   (5) Disconnect meter.



1 AC AMPERES METER M102
2 AC KILOVOLTS METER M101
3 FREQUENCY METER M103
4 SYNCHROSCOPE M106
5 AC KILOWATTS METER M107
6. AC KILOVARS METER M108
7 POWER FACTOR METER M104
8. GEN TEMP GAGE M105
9. AMMETER SWITCH S114
10 GEN/BUS VOLTMETER SWITCH
11. FREQUENCY DROOP/ISOCHRONOUS SWITCH S117
12. LAMP HOLDER
13. INCANDESCENT LAMP
14. SYNCHROSCOPE SWITCH S115

Figure 4-66. Cabinet B Upper Front Door

d. Install. See Figure 4-66.
   (1) Install AC AMPERES meter M102 (1) and secure with screws provided.
   (2) Connect wiring and discard tags. Close cabinet B door.
   (3) Test again in accordance with step c, above. If meter fails test, refer problem to the next higher level of maintenance.

4-98. AC KILOVOLTS METER M101 (2, Figure 2-2). AC KILOVOLTS meter M101 indicates generator output voltage or bus voltage depending on the setting of GEN/BUS VOLTMETER switch S112.

a. Remove. See Figure 4-66

(1) Open cabinet B door Tag and disconnect wiring to AC KILOVOLTS meter M101 (2).

(2) Remove screws and remove AC KILOVOLTS METER M101 (2) from front of cabinet B door.

b. Test

WARNING

Be sure power supply is deenergized before connecting meter. Death by electrocution may result.

(1) Connect AC KILOVOLTS meter to power supply with variable voltage output. The meter movement requires 262 5 Vac 50/60 Hz for full scale meter deflection.

(2) Turn on power supply.

(3) Compare reading on AC KILOVOLTS meter against known output of power supply If reading differentiates more than 2 percent, replace meter.

(4) Turn off power supply.

(5) Disconnect meter.

c. Install. See Figure 4-66.

(1) Install AC KILOVOLTS meter M101 (2) and secure with screws provided.

(2) Connect wiring and discard tags Close cabinet B door.

4-99. FREQUENCY METER M103 (3, Figure 2-2). FREQUENCY meter M103 indicates frequency output of generator G1.

a. Adjust With generator set shut down, check that needle on frequency meter M103 indicates at zero-adjust point marked on face of meter If necessary, adjust the screw on the face of the meter to align the needle with the mark.

b. Test.

(1) Tag and disconnect wires from terminals 1 and 2 of frequency transducer A103 (See Figure 3-29).

(2) Ensure that wires from terminals + and - of frequency transducer A103 are connected securely.

(3) Connect a 120 V ac power source known to have a steady frequency across terminals 1 and 2 of frequency transducer A103, and monitor FREQUENCY meter M103, located on cabinet B upper front door.

(4) FREQUENCY meter M103 should Indicate a steady Hz value.

(5) Replace FREQUENCY meter M103 If the Hz value indicated vanes by more than + 2 percent.

c. Remove. See Figure 4-66.

(1) Open cabinet B door. Tag and disconnect wiring to FREQUENCY meter M103 (3)

(2) Remove attaching screws and remove FREQUENCY meter M103 (3) from cabinet B door.

d. Install. See Figure 4-66.

(1) Install FREQUENCY meter M103 (3) and secure In cabinet B door.

(2) Connect wiring and discard tags. Close cabinet B door.

NOTE

If replacement is needed, FREQUENCY meter M103 and frequency transducer A103 are a matched set and should be replaced as a unit.

4-100. AC KILOWATTS METER M107 (6, Figure 2-2). AC KILOWATTS meter M107 Indicates the power output of the generator set.

a. Adjust With generator set shut down, check that AC KILOWATTS meter M107 Indicates at zero-adjust point marked on the face of the meter. If necessary, adjust the screw on the face of the meter to align the needle with the mark.

b. Test.

(1) Start the generator set and place In SINGLE SET operation mode with constant output applied to available and stable load.

(2) Monitor kilowatt output on AC KILOWATTS meter M107 and record.

(3) Monitor current output on AC AMPERES meter M102 and record.

(4) Set GEN/BUS VOLTMETER switch S112 to any GEN position and record voltage output on AC KILOVOLTS meter M1 01.

(5) Monitor power factor on POWER FACTOR meter M104 and record.

(6) Determine accuracy and serviceability of AC KILOWATTS meter M107 by calculation. Using the 3 phase power equation P = E x square root of 3 pf, substitute the values obtained In steps (3) through (5), above, and determine theoretical kilowatt output in watts.

(7) Compare the kilowatt output obtained In step (2), above, and the theoretical kilowatt output calculated in step (6), above. The kilowatt output of AC KILOWATTS meter M107 should be within ± 5 percent of the calculated kilowatt output.

(8) If kilowatt output of AC KILOWATTS meter Ml 107 varies by more than i 5 percent, AC KILOWATTS meter M107 or WMT transducer may require replacement. The meter movement requires one milliampere DC for full scale meter deflection.

c. Remove. See Figure 4-66.

(1) Open cabinet B door. Tag and disconnect wiring from AC KILOWATTS meter M107 (5).

(2) Remove mounting screws and remove AC KILOWATTS meter M107 (5) from cabinet B door.

d. Install

(1) Install and secure AC KILOWATTS meter M107 (5) in cabinet B door

(2) Connect wiring and discard tags. Close cabinet B door.

(3) Test again in accordance with step b, above If meter also fails test, refer problem to the next higher level of maintenance for replacement of wattmeter transducer WMT

4-101. AC KILOVARS METER M108 (7, Figure 2-2). AC KILOVARS meter M108 indicates kilovar load on the generator G1.

a. Adjust. With generator set shut down, check that needle on AC KILOVAR meter M1 08 indicates at zero-adjust point marked on face of meter. If necessary, adjust the screw on the face of the meter to align the needle with the mark.

b. Test.

(1) Start the generator set and place in SINGLE SET operation mode with stable load.

(2) Monitor kilovar output on AC KILOVARS meter Ml 08 and record.

(3) Monitor kilowatt output on AC KILOWATTS meter M107 and record.

(4) Monitor power factor on POWER FACTOR meter M104 and record.

(5) Determine accuracy and serviceability of AC KILOVARS meter M108 by calculation. Using the equation KVA = KW/pf, substitute the values obtained in steps (3) through (4), above, and determine theoretical kilovar amperes.

(6) Using the equation KVAR = the square root of ($KVA2 - KW^{2)}$, substitute the values obtained in steps (3) and (5), above, and determine theoretical kilovar output.
(7) Compare the kilovar output obtained in step (2), above, and the theoretical kilovar output calculated in steps (5) and (6), above. The kilovar output of AC KILOVARS meter M108 should be within ± 5 percent of the calculated kilovar output.
(8) If kilovar output of AC KILOVARS meter M108 varies by more than ± 5 percent, replace AC KILOVARS meter M108.

c. Remove. See Figure 4-66.
(1) Open cabinet B door. Tag and disconnect wiring from AC KILOVARS meter M108 (6).
(2) Remove mounting screws and remove AC KILOVARS meter M108 (6) from front of cabinet B door.

d. Install See Figure 4-66.
(1) Install AC KILOVARS meter M108 (6) and secure in cabinet B door.
(2) Connect wiring as tagged and discard tags.
(3) Test AC KILOVARS meter M108 again as in step b, above. If AC KILOVARS meter M108 fails test again, refer to paragraph 4-143 and test INSTRUMENT CURRENT transformers CT10 through CT12.

4-102. POWER FACTOR METER M104 (9, Figure 2-2). POWER FACTOR meter M104 indicates the power factor of the load on generator G1.

a. Adjust. Adjust with generator set shut down. Check that needle on POWER FACTOR meter M104 indicates at zero-adjust point marked on face of meter If necessary, adjust the screw on the face of the meter to align the needle with the mark.

b. Test.
(1) Start generator set, place in SINGLE SET operation mode and connect to a stable load.
(2) Monitor current output on AC AMPERES meter M102 and record.
(3) Set GEN/BUS VOLTMETER switch S112 to any GEN position and record voltage output on AC KILOVOLTS meter M101.
(4) Substitute the values obtained In steps (2) and (3), above, and determine theoretical kilovar-amperes using the equation $KVA=\frac{V\,A\sqrt{3}}{1000}$
(5) Monitor power factor on POWER FACTOR meter M104 and record
(6) Monitor kilowatt output on AC KILOWATT meter M107 and record.
(7) Determine accuracy and serviceability of POWER FACTOR meter M104 by calculation. Using the equation pf = KW/KVA, substitute the values obtained in steps (4) and (6), above, and determine theoretical power factor. The meter movement requires plus and minus 0 5 milliamperes DC for full scale deflection.

c. Remove. See Figure 4-66.
(1) Open cabinet B door. Tag and disconnect wiring from POWER FACTOR meter M104 (7).
(2) Remove attaching hardware and remove POWER FACTOR meter M104 (7) from front cabinet B door.

d. Replace. See Figure 4-66.
(1) Install POWER FACTOR meter M104 (7) and secure In cabinet B door.
(2) Connect wiring and discard tags. Close cabinet B door.
(3) Test again In accordance with step b, above. If test falls, notify higher level maintenance that power factor transducer PFT requires testing and possibly replacement.

4-103. SYNCHROSCOPE METER M106 (5, Figure 2-2). SYNCHROSCOPE meter M106 indicates the phase angle difference between the bus and a generator to be paralleled.

a. Test. SYNCHROSCOPE meter M106 can be checked while Installed by comparing operation with the synchronizing lights.
   (1) Start the generator set and place in parallel operation mode. Parallel generator set will provide bus voltage for phase comparison against output voltage of generator set being tested.
   (2) With incoming unit operating at a higher frequency than the bus, SYNCHRONIZING LIGHTS DS110 and DS111 should be glowing light and dark. SYNCHROSCOPE meter M106 pointer should rotate in the clockwise (FAST) direction and should pass through the 12 o'clock position when the SYNCHRONIZING LIGHTS are dark (center of dark period).
   (3) Lower frequency of incoming set using FREQ ADJ rheostat R102. SYNCHROSCOPE pointer should rotate in the counterclockwise (SLOW) direction but still pass through the 12 o'clock position when the SYNCHRONIZING LIGHTS are dark.
   (4) When the load circuit breaker CB101 is closed, and the generator set is In parallel with the bus, the SYNCHROSCOPE needle should be in the 12 o'clock position

b. Remove. See Figure 4-66.
   (1) Open cabinet B door Tag and disconnect wiring to SYNCHROSCOPE meter M106 (4)
   (2) Remove screws and remove SYNCHROSCOPE meter M106 (4) from front of cabinet B door.

c. Install. See Figure 4-66.
   (1) Install SYNCHROSCOPE meter M106 (4) and secure In cabinet B door with screws provided.
   (2) Connect wiring and discard tags. Close cabinet B door.

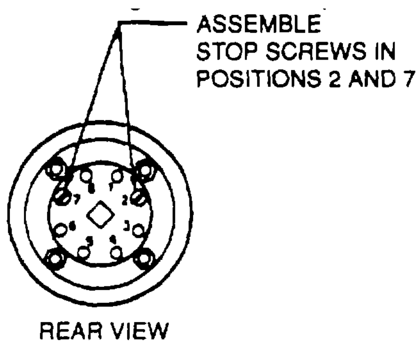
4-104. GEN TEMP GAGE M105 (10, Figure 2-2). GEN TEMP gage M105 indicates the temperature of any one of six detectors imbedded in generator G1 windings.

a. Test.
   (1) Tag and disconnect wires to terminals 1 and 2 on rear of GEN TEMP gage M105.
   (2) Connect a 120V AC power source across terminals 1 and 2 on rear of GEN TEMP gage M105.
   (3) Set TEMPERATURE INDICATOR switch S113 to CAL, and note movement of indicator in GEN TEMP gage M105 Indicator should rest within the green area on the dial face of GEN TEMP gage M105.
   (4) If indicator of GEN TEMP gage M105 does not rest within the green area of the dial face, adjust GEN TEMP gage M105 In accordance with step c, below.
   (5) Replace GEN TEMP gage M105 if adjustment is not possible, or If indicator shows no signs of movement when tested.

b. Remove. See Figure 4-66.
   (1) Tag and disconnect wires from GEN TEMP gage M105 (8).
   (2) Remove attaching hardware and remove GEN TEMP gage M105 (8) from front of cabinet B door.

c. Install. See Figure 4-66.
   (1) Install GEN TEMP gage M105 (8) and secure in cabinet B door using mounting hardware provided.
   (2) Connect wiring and discard tags. Close cabinet B door.
   (3) While set Is operating, set TEMPERATURE INDICATOR switch S113 (13, Figure 2-2) to CAL, and adjust screw on GEN TEMP gage M105 until needle is on green mark.

4-105. BREAKER CONTROL SWITCH S4 (20, Figure 2-2). BREAKER CONTROL switch S4 is a three-section (or deck) rotary, dual contact design. The chart In Figure 4-67 specifies contact continuity in both positions, TRIP and CLOSE. BREAKER CONTROL switch S4 is used to energize close and trip coils of load circuit breaker C8101.



	SEC 1		SEC 2				SEC 3	
	POLE 1		POLE 2		POLE 3		POLE 4	
POSITION	11	18	22	23	26	27	31	35
PULL-TO-LOCK	X	X						
TRIP	X	X					X	X
NORMAL							X	X
CLOSE			X	X	X	X	X	X

SECTIONS 1 AND 3 MAKE-BEFORE-BREAK
SECTION 2 BREAK-BEFORE-MAKE

Figure 4-67. Test Data For BREAKER CONTROL Switch S4

a. Test.

(1) Tag and disconnect wiring to BREAKER CONTROL switch S4.

NOTE

Switch wirng position numbers are translated as follows: the first digit defines the section, or deck, in relation to the handle end, the second digit is a specific terminal on that deck. For example position 23 is located on the second deck, the contact is terminal number three.

(2) Set a multimeter to RX1 scale and, test for contact continuity in the switch positions specified. Meter should indicate zero OHMS at the points marked in chart in Figure 4-67.

(3) Multimeter should indicate Infinity at all open contacts In chart in Figure 4-67.

NOTE

An integral spring return mechanism returns the handle to the normal-vertical position except in the pull-to-lock position Slip contacts are Incorporated to maintain contact closure in the last commanded position. These slip contacts are also used for the green and red breaker Indicator lights DS33 (OPEN) and DS34 (CLOSED).

(4) The target window opening on the face of the switch plate should show green when last command operation was TRIP.

(5) Target window should show red when last command operation was CLOSE.

(6) Switch handle should always return to normal-vertical position following either command operation, TRIP or CLOSE.

(7) Failure to meet any of the above requirements necessitates replacement of BREAKER CONTROL switch S4 (20, Figure 2-2).

b. Remove. See Figure 4-68.
   (1) Tag and disconnect wires.
   (2) Remove screw In center of handle and slide handle off switch (3) shaft.
   (3) Remove three screws from face of mounting plate on front of door Switch (3) sections can be removed at rear of cabinet B door as an assembly.
c. Install. See Figure 4-68.
   (1) Install BREAKER CONTROL switch S4 (3) by positioning the switch sections at the rear of cabinet B door and assemble the mounting plate from the front, while securely attaching the entire assembly with the three mounting screws.
   (2) Replace handle In the normal-vertical position and secure with attaching screw.
   (3) Connect wires and discard tags.

4-106. AMMETER SWITCH S114 (25, Figure 2-2). AMMETER switch S114 is a six-section rotary tap-switch contact design. An integral detent assembly provides positive click stops at operational switch positions. The switch is used in conjunction with AC AMPERES meter M102 to select any of three phases for a current output indication.

a Test.
   (1) Rotate switch handle In both directions to ensure that switch clicks into all five positions See Figure 4-69.

NOTE

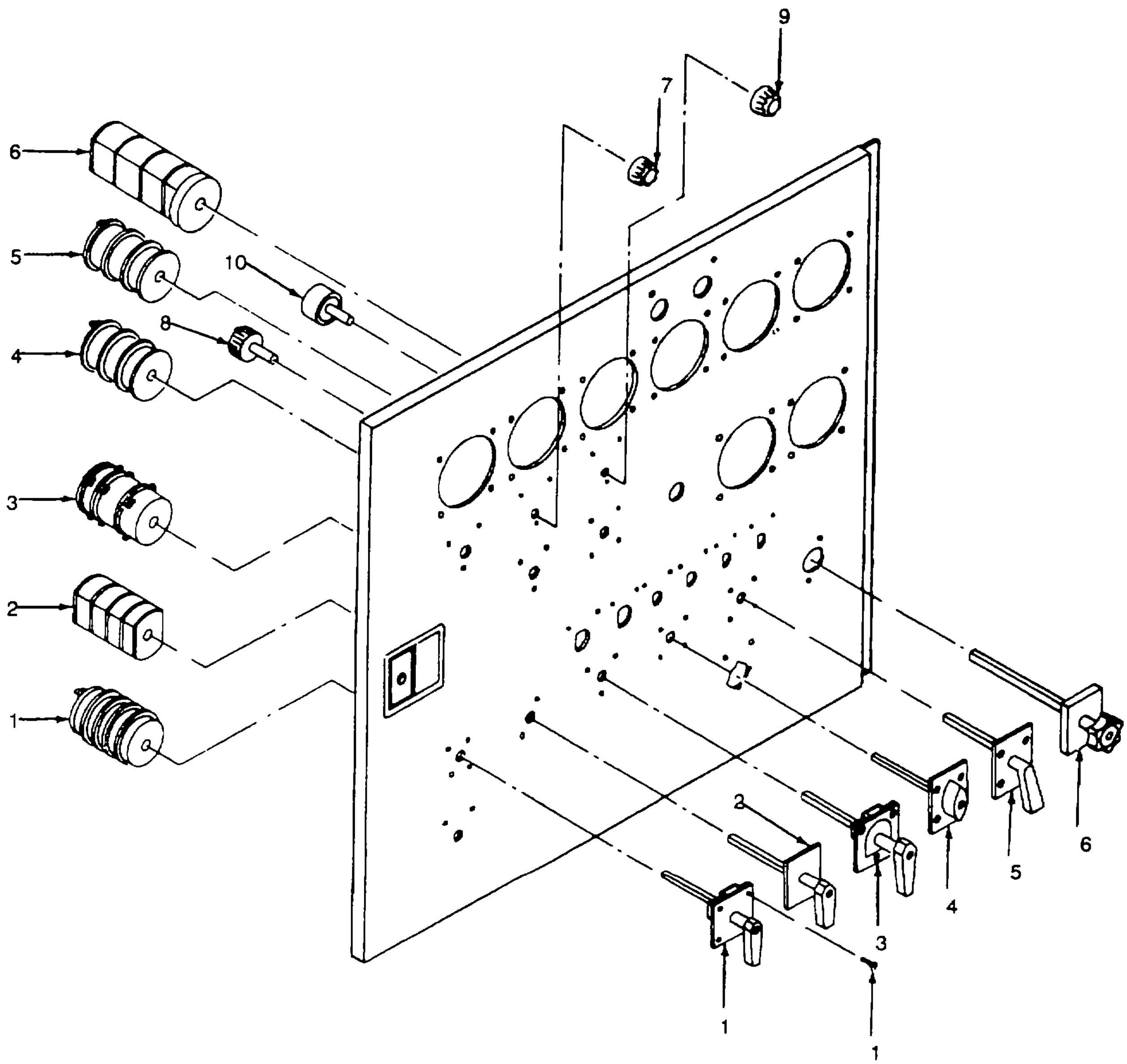
Switch wlnng position numbers are translated as follows. the first digit defines the section, or deck, In relation to the handle end; the second digit is a specific terminal on that deck. For example position 23 is located on the second deck, the contact is terminal number 3.

   (2) With generator set shut down, tag and disconnect wiring to switch contacts. Do not remove internal jumper wires.
   (3) Set a multimeter on RX1 scale and test for contact continuity in the switch positions specified in chart in Figure 4-69 Meter should indicate zero ohms at all points marked in the chart.
   (4) Multimeter should indicate infinity at all blank contacts In the chart.
b Remove. See Figure 4-66.
   (1) Remove screw In center of handle and slide handle off the shaft.
   (2) Remove screws from face of mounting plate on front of cabinet B door Switch (9) can be removed at rear of door.

NOTE

Before Installing replacement switch transfer black jumper wires.

c. Install. See figure 4-66.
   (1) Install AMMETER switch S114 (9) by positioning the switch sections at the rear of door and assembling the mounting plate from the front Secure the entire assembly with the three mounting screws.
   (2) Replace handle In the normal dial-vertical position and secure with Its attaching screw.
   (3) Connect wires and discard tags.

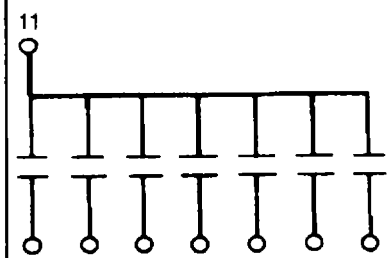


1 LOCAL REMOTE SWITCH S2
2 OPERATION SELECTOR SWITCH S3
3. BREAKER CONTROL SWITCH S4
4. PARALLEL SWITCH S6
5 PHASE SEQ. SEL. SW. S119
6. TEMPERATURE INDICATOR SWITCH S113
7 KNOB
8. VOLT ADJUST RHEOSTAT R101
9. KNOB
10. FREQ ADJ RHEOSTAT R102

Figure 4-68. Cabinet B Upper Front Door

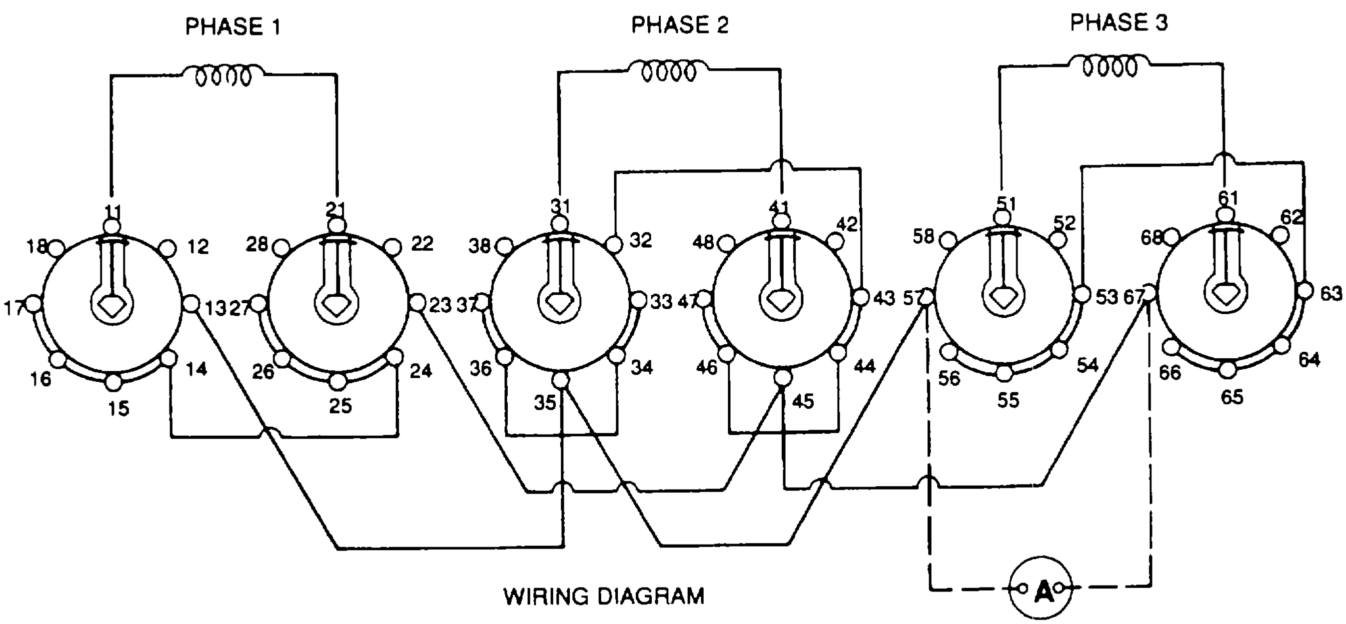
DECKS 2 THROUGH 6 SAME AS 1 EXCEPT FOR TERMINAL NUMBERS

DECK 1



POSITION	12	13	14	15	16	17	18
OFF							
*		X					
PHASE 1		X	X				
*		X	X	X			
PHASE 2			X	X	X		
*				X	X	X	
PHASE 3					X	X	
*						X	

* DENOTES MAKE-BEFORE-BREAK CONTACTING



WIRING DIAGRAM

Figure 4-69. Test Data for AMMMETER Switch S114

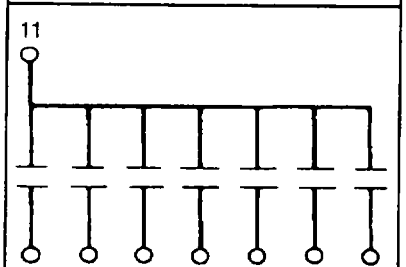
4-107. GEN/BUS VOLTMETER SWITCH S112 (24, Figure 2-2). GEN/BUS VOLTMETER switch S112 is a two-section, rotary tap-switch contact design An integral detent assembly provides positive click stops at all eight positions. The switch is used in conjunction with AC KILOVOLTS meter M101 to select any one of the three generator phases at either the generator G1 or at the bus to check for voltage levels.

NOTE

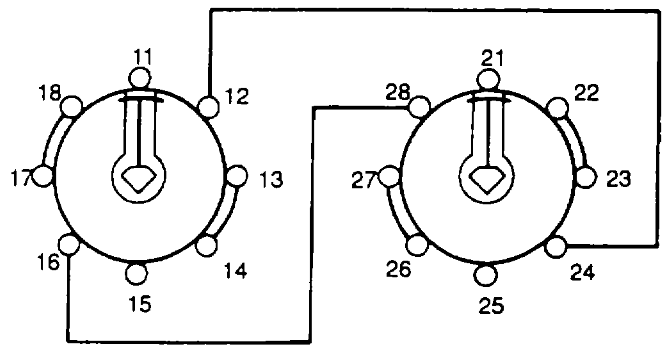
Switch wirng position numbers are translated as follows. the first digit defines the section, or deck, in relation to the handle end; the second digit Is a specific terminal on that deck. For example, position 23 is located on the second deck, the contact is terminal number 3.

a. Test.
   (1) Tag and disconnect wiring to switch contacts See Figure 4-70.
   (2) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in chart in Figure 4-70. Meter should indicate zero ohms at all points marked in the chart.
   (3) Multimeter should indicate Infinity at all blank contacts in the chart.

b. Remove. See Figure 4-66.
   (1) Remove screw in center of handle and slide handle off shaft.
   (2) Remove three screws from face of mounting plate on front of door (10) Switch sections can be removed at rear of cabinet B door as an assembly.



	DECK 1						
POSITION	12	13	14	15	16	17	18
OFF							
BUS 1-2	X	X					
BUS 2-3	X		X				
BUS 3-1	X			X			
OFF							
GEN 1-2	X				X		
GEN 2-3	X					X	
GEN 3-1	X						X



DECK 2 SAME AS DECK 1 EXCEPT FOR TERMINAL NUMBERS

Figure 4-70. Test Data for GEN/BUS VOLTMETER Switch S112

c. Install. See Figure 4-66.
 (1) Install GEN/BUS VOLTMETER switch Si12 (10) by positioning switch sections at rear of cabinet B door and assemble the mounting plate from the front. Secure the entire assembly with the three mounting screws.
 (2) Replace switch handle in the OFF position ensuring that shaft is In the OFF position. Secure handle with attaching screw.
 (3) Connect wires and discard tags.

4-108. VOLT ADJ RHEOSTAT R101 (26, Figure 2-2). VOLT ADJ rheostat R101 is used to manually adjust voltage out-put of generator G1.

a. Test.
 (1) Remove wire from terminal 3 of VOLT ADJ rheostat R101.
 (2) Rotate knob fully counterclockwise.
 (3) Set a multimeter to RX1 scale and check for continuity across terminals 1 and 2. Maximum resistance should be 1 ohm.
 (4) Reset multimeter to RX1 K scale. While observing the multimeter indication, slowly rotate knob in a clockwise direction. Meter resistance indication should increase smoothly, with no erratic jumps at any point in travel.
 (5) When knob (wiper arm-terminal 2) is in the fully clockwise stop position, total resistance indication should be 500 ± 50 ohms.
 (6) Connect wire removed from terminal 3.

b. Remove. See Figure 4-68.
 (1) Tag and disconnect wiring to rheostat (8).
 (2) Remove knob (7).
 (3) Loosen and remove locking nut at front of cabinet B door and remove assembly from the rear.

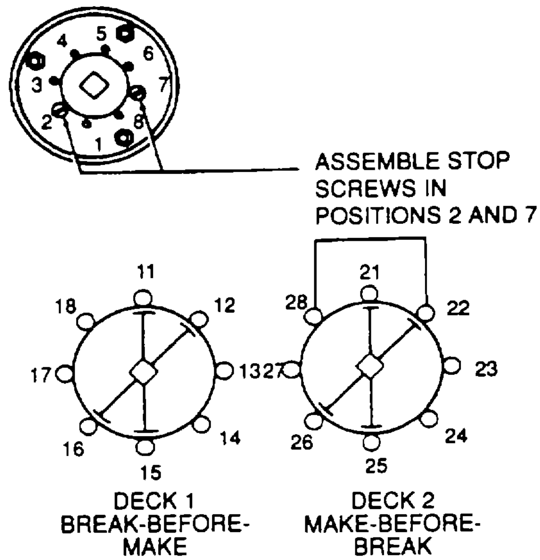
c. Install. See Figure 4-68
 (1) Install VOLT ADJ rheostat R101 (8) from the rear of cabinet B door and secure in position so that when knob (7) is attached, with shaft rotated fully counterclockwise, the arrow Is at 9 o'clock position.
 (2) Secure knob (7).
 (3) Connect wires and discard tags.

4-109. PARALLEL SWITCH S6 (18, Figure 2-2). PARALLEL Switch S6 is a two-section, or deck, rotary switch with handle spring return to normal-vertical position following a command operation. The switch is used to select either single or parallel generator set operation.

NOTE

Switch wiring position numbers are translated as follows: the first digit defines the section, or decks, In relation to the handle end, the second digit is a specific terminal on that deck. For example, position 23 is located on the second deck, the contact is terminal number 3.

a. Test.
 (1) Tag and disconnect wiring to switch contacts. See Figure 4-71
 (2) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in chart in Figure 4-71 Meter should indicate zero ohms at all points marked in the chart.
 (3) Multimeter should indicate infinity at all blank contacts in the chart.
 (4) Rotate handle to the SINGLE position and release handle. Handle should return to the normal-vertical position automatically.
 (5) Repeat step (4), above, with handle rotated to the PARALLEL position.



DECK	CONTACTS HANDLE END	PARALLEL 1	NORMAL 2	SINGLE 3
1	18 — 11	x		
	11 — 12		x	
	12 — 13			x
	15 — 14	x		
	16 — 15		x	
	17 — 16			x
2	28 — 21	x		
	21 — 22		x	
	22 — 23			x
	25 — 24	x		
	25 — 26		x	
	26 — 27			x

Figure 4-71. Test Data for PARALLEL Switch S6

b <u>Remove</u>. See Figure 4-68.

(1) Remove screw in center of handle (4) and slide handle off shaft.

(2) Remove four screws from face of mounting plate on door PARALLEL Switch S6 (4) sections can be removed at rear of cabinet B door as an assembly.

c. <u>Install</u>. See Figure 4-68.

(1) Install PARALLEL Switch S6 (4) by positioning switch sections at rear of cabinet B door and assemble the mounting plate from the front Secure the entire assembly with the four mounting screws.

(2) Replace switch handle In the NORMAL position ensuring that shaft Is in the NORMAL condition. Secure handle with attaching screw.

(3) Connect wires and discard tags.

4-110. PHASE SEQUENCE INDICATOR LIGHTS (1 2 3, 3 2 1) DS112 AND DS113 (14, Figure 2-2). These lights indicate the phase sequence of generator G1 and the bus.

WARNING

Dangerous voltage levels may be present within upper cabinet B. Follow all applicable safety precautions outlined In Chapter 1, Section III , of this manual.

a. Test. Push PHASE SEQ. LAMP TEST button (16, Figure 2-2). If a lamp fails to light when expected, proceed as follows:

(1) See Figure 4-72. Set multimeter at 1 20V AC scale and check for presence of power at lamp holder (3) terminals. If power is not present when lamp should light, use wiring diagram FO-1 to trace back through circuit until defective wire or item is found. Repair or replace as required.
(2) If power exists at lamp holder (3) terminals, replace lamp (2) with a known good lamp. Refer to step c, below.
(3) If known good lamp (2) does not light, replace lamp holder (3). Refer to step c, below.
(4) Using a multimeter set to RX100K scale, check the resistance of the resistors at the back of the lamp holders. Resistance should be 27,000 ohms ± 10%.
(5) Replace resistors which do not meet these specifications.

b. Remove. See Figure 4-72.

(1) Remove clear lens (1) covering lamp (2). Remove lamp (2).
(2) Disconnect wires and resistor by unsoldering in accordance with MIL-STD-454H Standard General Requirements for Electronic Equipment from lamp holder (3)
(3) Remove lamp holder (3) from panel by removing attaching hardware.

c Repair . Repair consists of replacing defective lampholders (3) and lamps (2). Refer to steps b and d.

d Install. See Figure 4-72

(1) Install lamp holder (3) In panel Secure with attaching hardware
(2) Connect wiring and resistor by soldering In accordance with MIL-STD-454H Standard General Requirements for Electronic Equipment to lamp holder (3) as required
(3) Install lamp (2)
(4) Install clear lens (1)

4-111. FREQ ADJ RHEOSTAT R102 (8, Figure 2-2). FREQ ADJ rheostat R102 is used to manually adjust the frequency level of the output of generator G1.

a. Test.

(1) Remove wire from terminal 3 of FREQ ADJ rheostat R102
(2) Rotate knob fully counterclockwise
(3) Set a multimeter to RX100 scale and check resistance across terminals 1 and 2 Maximum resistance should be 10 ohms
(4) Reset multimeter to RX10K. While observing the multimeter Indications slowly rotate knob In a clockwise direction Meter resistance indication should Increase smoothly, with no erratic jumps at any point in travel.
(5) When knob (wiper arm-terminal 2) Is In the fully clockwise stop position, total resistance indication should be 5000 ± 500 ohms.
(6) Connect wire removed from terminal 3.

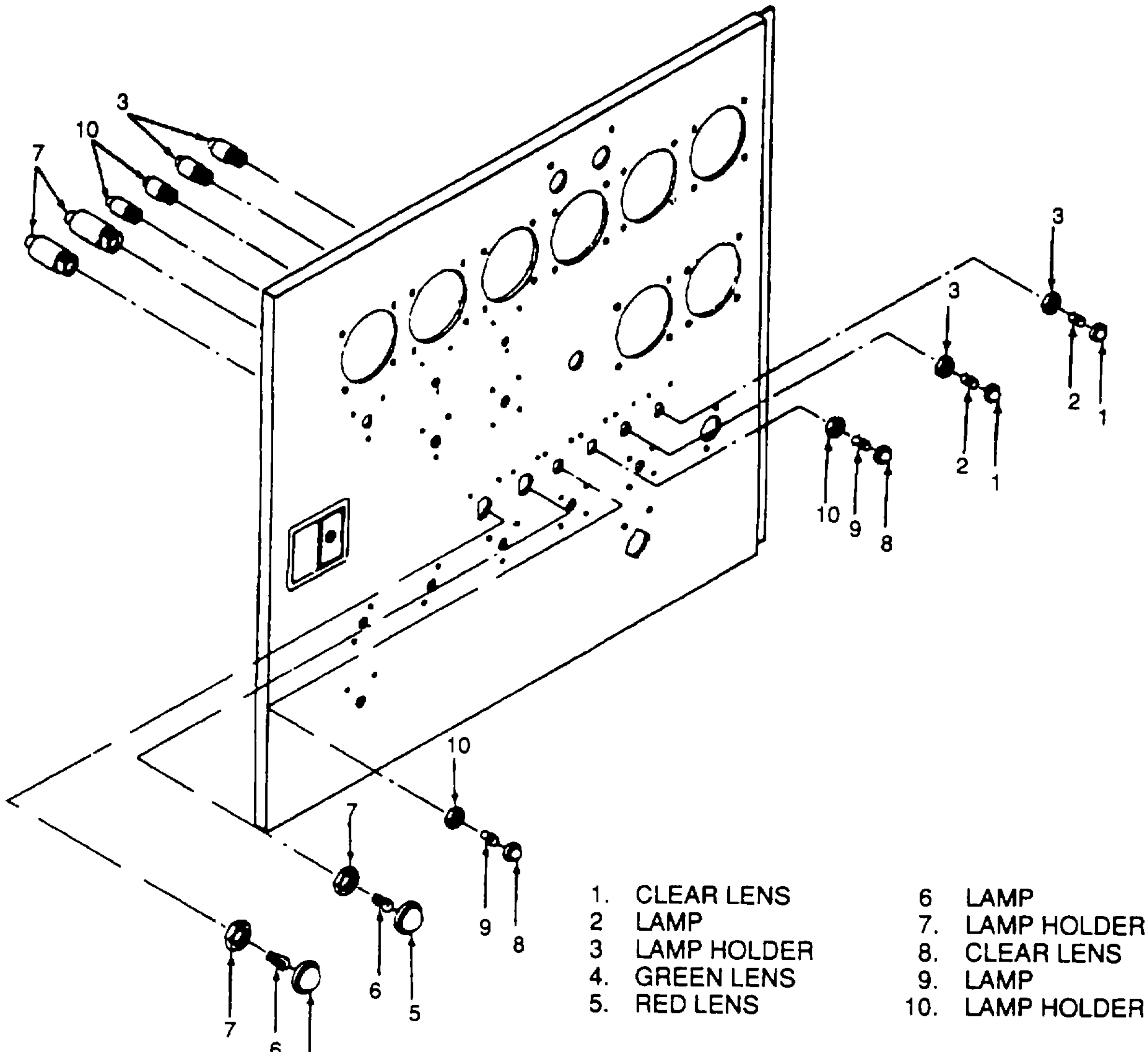


Figure 4-72. Cabinet B Upper Front Door

b. <u>Remove.</u> See Figure 4-68.
   (1) Tag and disconnect wiring to FREQ ADJ rheostat R102 (10).
   (2) Remove knob (9).
   (3) Loosen and remove locking nut at front of cabinet B door and remove the rheostat from the rear.

c. <u>Install.</u> See Figure 4-68
   (1) Position rheostat In panel so that slot aligns with notch in panel.
   (2) Install FREQ ADJ rheostat R102 (10) from the rear of cabinet B door and secure in a position such that when knob is attached, with shaft rotated fully counterclockwise, the arrow is at the 9 o'clock position.
   (3) Secure knob (9).
   (4) Connect wires and discard tags.

4-112. FREQUENCY DROOP/ISOCHRONOUS SWITCH S117 (12, Figure 2-2). This is a double pole, double throw switch. The switch is used to select Isochronous or droop generator set operation.

a. Test.
  (1) Tag and disconnect wiring from the FREQUENCY DROOP/ISOCHRONOUS switch S117.
  (2) Place switch In FREQUENCY DROOP position.
  (3) Set a multimeter to RX1 scale and test for continuity across terminals. Multimeter should indicate zero ohms across terminals 1-2 and 4-5. Multimeter should indicate infinity across terminals 2-3 and 5-6.
  (4) With switch in ISOCHRONOUS position, multimeter should indicate Infinity across terminals 1-2 and 4-5 and zero ohms across terminals 2-3 and 5-6.
  (5) Mechanical operation should display positive latching In both positions.

b. Remove. See Figure 4-66.
  (1) Tag and disconnect wiring from the FREQUENCY DROOP/ISOCHRONOUS switch S117 (11).
  (2) Unscrew ring nut at front of cabinet B door.
  (3) Remove switch (11) from rear of cabinet B door.

c. Install. See Figure 4-66.
  (1) Position switch (11) in door cabinet B and secure with ring nut provided.
  (2) Repeat test of step a, above, to be sure switch has not been Installed upside down.
  (3) Connect wires and discard tags.

4-113. LOCAL REMOTE SWITCH S2 (23, Figure 2-2). LOCAL REMOTE switch S2 Is a ten-section rotary, double-pole switch. Detent action provides positive indexing In the LOCAL or REMOTE position. The switch is used to select whether controlling functions of generator set are to be at generator set control room or remote control module.

NOTE

Switch wirng position numbers are translated as follows the first digit defines the section, or deck, in relation to the handle end; the letter that follows this digit defines the specific contact on that deck For example position 3H is located on the third deck from the handle end, the contact is terminal H.

a. Test.
  (1) Tag and disconnect wiring to switch contacts.
  (2) Set a multimeter to RX1 scale and test for contact continuity across terminals A-H and D-E on all decks when switch is in LOCAL position. Test for contact continuity across terminals A-B and E-F on all decks when switch is In the REMOTE position.
  (3) Multimeter should indicate Infinity across all terminal pairs not specified for continuity in step (2), above.
  (4) Rotation of handle should exhibit positive latching action in both the LOCAL and REMOTE positions.

b. Remove. See Figure 4-68.
  (1) Tag and disconnect wiring to switch (1) contacts
  (2) Remove screw in center of handle and slide handle off shaft.
  (3) Remove four screws from face of mounting plate on front of cabinet B door and remove switch as an assembly.

c. Install. See Figure 4-68.
   (1) Install LOCAL REMOTE switch S2 (1) by positioning switch sections at rear of cabinet B door and assemble the mounting plate from the front. Secure the entire assembly with the three mounting screws.
   (2) Replace switch handle in the LOCAL position, attach and secure handle to indicate LOCAL..
   (3) Connect wires and discard tags.

4-114. CIRCUIT BREAKER POSITION OPEN INDICATOR DS33 AND CLOSED INDICATOR DS34 (19, Figure 2-2). The DS33 (green) lights indicate whether load circuit breaker CB101 is open and lights DS34 (red) indicate when circuit breaker is closed.

a. Test. See Figure 4-72. When a lamp fails to light when expected, proceed as follows:
   (1) Set multimeter to 120 VAC scale and check for presence of 120 VAC at lamp holder (12) terminals. If power is not present when lamp should light, check wiring to the lamp using FO-2. If power does exist at lamp holder (12) terminals, replace lamp (13) with a known good lamp. Refer to step c, below.
   (2) Each indicator DS110 and DS111 is connected in series with a voltage dropping resistor (R110 or R111) mounted on the rear of the cabinet B door. If 120 VAC is not present at lamp holder (12) terminals, deenergize the circuit and test resistors R110 and R111 for continuity using a multimeter set to RX 1000 scale. Resistance reading for each resistor should be 3000 ohms ± 10 percent. Replace resistors if they do not meet this specification.
   (3) If known good lamp (6) does not light, replace lamp holder (7). Refer to step c, below.

b. Remove. See Figure 4-72.
   (1) Remove green or red lens (4 or 5) covering lamp (6). Remove lamp (6).
   (2) Tag, unsolder, and disconnect wires from lamp holder (7)
   (3) Remove lamp holder (7) from panel by removing attaching hardware.

c. Repair. Repair consists of replacing defective lamp holders (7) and lamps (6). Refer to steps b and d.

d Install. See Figure 4-72.
   (1) Install lamp holder (7) in panel. Secure with attaching hardware.
   (2) Connect wiring using shrink tubing as needed to lamp holder (7)
   (3) Install lamp (6).
   (4) Install green or red lens (4 or 5)

4-115. SYNCHRONIZING LIGHTS DS110 AND DS111 (4, Figure 2-2). The lights indicate phase relationship of bus and generator set to be paralleled. The lamps are off when the generator set and the bus are in phase.

a. Test See Figure 4-66 When a lamp falls to light when expected, proceed as follows.
   (1) Set multimeter to 120 V ac scale and check for presence of 120 V ac at lamp holder (12) terminals. If power is not present when lamp should light, check wiring to the lamp using FO-2. Trace back through circuit until defective wire or Item is found. Repair or replace as required.
   (2) If power exists at lamp holder (12) terminals, replace lamp (13) with a known good lamp. Refer to step c, below.
   (3) If known good lamp (13) does not light, replace lamp holder (12). Refer to step c, below.

b. Remove. See Figure 4-66.
   (1) Remove lens covering lamp (13). Remove lamp.
   (2) Tag and disconnect wires from lamp holder (12)
   (3) Remove lamp holder (12) from panel by removing attaching hardware.

c. Repair. Repair consists of replacing defective lamps (13, Figure 4-66) and lamp holders (12). Refer to steps b and d.

d. Install. See Figure 4-66.
(1) Install lamp holder (12) In panel. Secure with attaching hardware.
(2) Connect and solder wiring. Cover soldered connection with shrink tubing as needed on lamp holder (7).
(3) Install lamp (13).
(4) Install lens to secure lamp (13).

4116. SYNCHROSCOPE SWITCH S115 (14, Figure 4-66). SYNCHROSCOPE switch S115 is a two-position switch with three decks. This switch actuates the synchronizing lights and SYNCHROSCOPE meter M106 and must be set to ON when attempting to parallel.

a. Test.

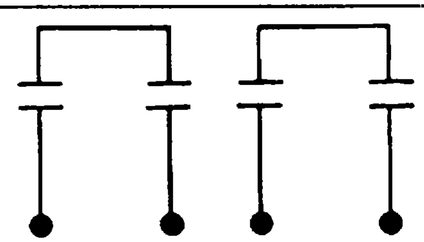
NOTE

Switch wiring position numbers are translated as follows. the first digit defines the section or deck, in relation to the handle end; the second digit is a specific terminal on that deck. For example. position 23 is located on the second deck, the contact is terminal number 3.

(1) Tag and disconnect wiring to switch contacts See Figure 4-73
(2) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in the chart In Figure 4-73. Meter should indicate zero ohms at all points marked in the chart.
(3) Multimeter should indicate infinity at all blank contacts in the chart.

b. Remove. See Figure 4-66.
(1) Tag and disconnect wiring to switch (14) contacts.
(2) Remove screw In center of handle and slide handle off shaft.
(3) Remove three screws from face of mounting plate on front of door. Switch (4) sections can be removed at rear of cabinet B door as an assembly.

TYPICAL OF ALL DECKS



	POLE 1		POLE2	
POSITION	12	13	16	17
OFF				
ON	X	X	X	X

Figure 4-73. Test Data for SYNCHROSCOPE Switch S115

c. Install.
   (1) Install SYNCHROSCOPE switch S115 (14) by positioning switch sections at rear of cabinet B door and assemble the mounting plate from the front. Secure the assembly with the three mounting screws.
   (2) Replace switch handle In the OFF position and secure with the attaching screw.
   (3) Connect wires and discard tags

4-117. PARALLEL/SINGLE SET LIGHTS DS35 AND DS36 (17, Figure 2-2). PARALLEL/SINGLE SET lights DS35 and DS36 indicate mode of operation select by PARALLEL switch S6.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

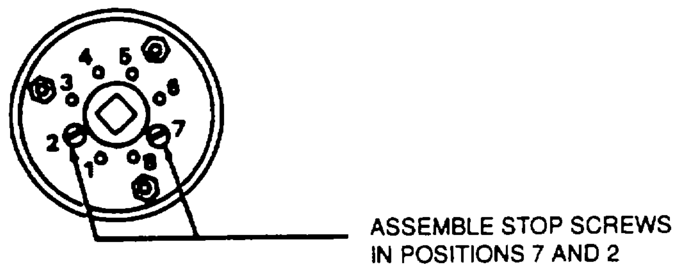
a. Test. See Figure 4-72 When a lamp falls to light when expected, proceed as follows:
   (1) Set multimeter to 120 V ac scale and check for presence of 120 V ac at lamp holder (10) terminals. If power is not present when lamp should light, check wiring to the lamp using FO-2; trace back through circuit until defective wire or Item is found. Repair or replace as required.
   (2) If power exists at lamp holder (10) terminals, replace lamp (9) with a known good lamp Refer to step c, below.
   (3) If known good lamp (9) does not light, replace lamp holder (10) Refer to step c, below.
b. Remove See Figure 4-72.
   (1) Remove clear lens (8) covering lamp (9). Remove lamp
   (2) Tag and disconnect wires from lamp holder (10).
   (3) Remove lamp holder (10) from panel by removing attaching hardware.
c. Repair. Repair consists of replacing defective lamp holders (10) and lamps (9). Refer to steps b and d.
d. Install See Figure 4-72.
   (1) Install lamp holder (10) in panel Secure with attaching hardware.
   (2) Connect wiring to lamp holder (10), remove and discard tags
   (3) Install lamp (9)
   (4) Install clear lens (8).

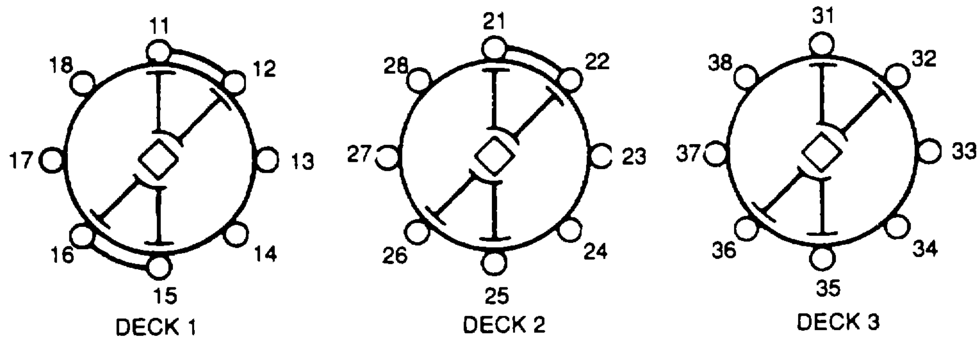
4-118. PHASE SEQ. SEL. SW. S119 (15, Figure 2-2). PHASE SEQ SEL SW. S119 is a three-section, rotary switch. It is used to check the phase sequence of the bus and generator set In conjunction with phase sequence indicators DS112 and DS113.
a. Test. See Figure 4-74.

NOTE

Switch wiring position numbers are translated as follows the first digit defines the section or decks In relation to the handle end, the second digit is a specific terminal on that deck. For example position 23 is located on the second deck, the contact is terminal number 3.

   (1) Tag and disconnect wires from switch contacts.
   (2) Set a multimeter at RX1 scale and test for contact continuity in the switch positions specified in the chart in Figure 4-74. Meter should Indicate zero ohms at all points marked In the chart.
   (3) Multimeter should Indicate Infinity at all blank contacts In the chart





	CONTACTS HANDLE END	POSITION		
		OFF	BUS	GEN
		1	2	3
DECK 1	11 — 12	X		
	12 — 13		X	
	13 — 14			
	14 — 15			X
	15 — 16	X		
	16 — 17		X	
	17 — 18			
	18 — 11			X
DECKS 2 AND 3 SAME AS 1 EXCEPT TERMINAL NUMBERS				

Figure 4.74. Test Data for PHASE SEQ. SEL. SW. S119

b. Remove. See Figure 4-68.
   (1) Tag and disconnect all wiring to switch (5) contacts.
   (2) Loosen setscrew on handle and slide handle off shaft.
   (3) Remove four screws from face of mounting plate on front of cabinet B door Switch (5) sections can be removed at rear of cabinet B door as an assembly.
c. Install. See Figure 4-68.
   (1) Install PHASE SEQ. SEL. SW S119 (5) by positioning switch sections at rear of cabinet B door and assemble the mounting plate from the front. Secure the assembly with the four mounting screws.
   (2) Install switch handle In the OFF position and secure with the attaching screw.
   (3) Connect wires and discard tags.

4-119. REMOTE VOLTAGE ADJUST RHEOSTAT R106. Remote voltage adjust rheostat R106 is used In conjunction with voltage regulator VR101 to trim generator output voltage and is normally set at midrange position.

a. Test. See Figure 3-27.
   (1) Open generator control cabinets A and B to gain access to the voltage adjust rheostat R106.
   (2) Tag and disconnect wiring from the rheostat terminals 1 and 2 Rheostat body is located In cabinet B. Do not remove jumper wire across terminals 2 and 3.
   (3) Set multimeter to RX1 K scale and connect across terminals 1 and 2.
   (4) Rotate rheostat shaft (in cabinet A) counterclockwise full scale Multimeter should read 500 ohms Rotate rheostat shaft full clockwise Resistance reading should read no more than 1 ohm.
b. Remove.
   (1) Tag and disconnect wiring from rheostat R106.
   (2) Remove rheostat mounting nut from inside generator cabinet A, and remove rheostat R106 from generator control cabinet B.
c. Install. Prior to Installation, verify that rheostat terminals 2 and 3 are jumpered.
   (1) Position rheostat R106 from Inside cabinet B using guide tab on rheostat. Secure rheostat from Inside cabinet A using mounting nut.
   (2) Connect wires as tagged. Remove and discard tags.
   (3) Set rheostat shaft at approximately mid-range. Close and secure generator control cabinets A and B.

4-120. LUBE OIL PRESSURE GAGE M1 (7, Figure 2-1). LUBE OIL PRESSURE gage M1 indicates oil pressure within the engine

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

NOTE

Two persons may be required to perform the following procedure.

a. Test.
   (1) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to ON.
   (2) Disconnect sender lead from OIL PRESSURE SENDER MT1 mounted on the engine block (see Figure 3-3). LUBE OIL PRESSURE gage M1 pointer should go to zero.

(3) Short to engine ground the disconnected sender lead from OIL PRESSURE SENDER MT1 (see Figure 3-3). LUBE OIL PRESSURE gage pointer should now deflect full scale upwards.
(4) Replace LUBE OIL PRESSURE gage (12, Figure 4-75) that fails this test Reinstall sender lead on OIL PRESSURE SENDER MT1 on the engine block (see Figure 3-3) after test.
(5) Replace oil pressure sender if gage operates properly.
(6) Check wiring using FO-2, and check sender in accordance with paragraph 4-66 if gage is good.

b. Remove.
(1) Shut off power. Tag and disconnect wiring and resistor from LUBE OIL PRESSURE gage M1 (12, Figure 4-75).
(2) Remove hexagonal nuts and lockwashers at rear of cabinet C door. Mounting bracket can be removed and LUBE OIL PRESSURE gage M1 (12) will slide out from front of door.

c. Install
(1) Install LUBE OIL PRESSURE gage M1 from front of door (12, Figure 4-75) while assembling bracket from the rear.
(2) Secure with hexagonal nuts and lockwashers provided.
(3) Connect wires and resistors and discard tags.
(4) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to ON.

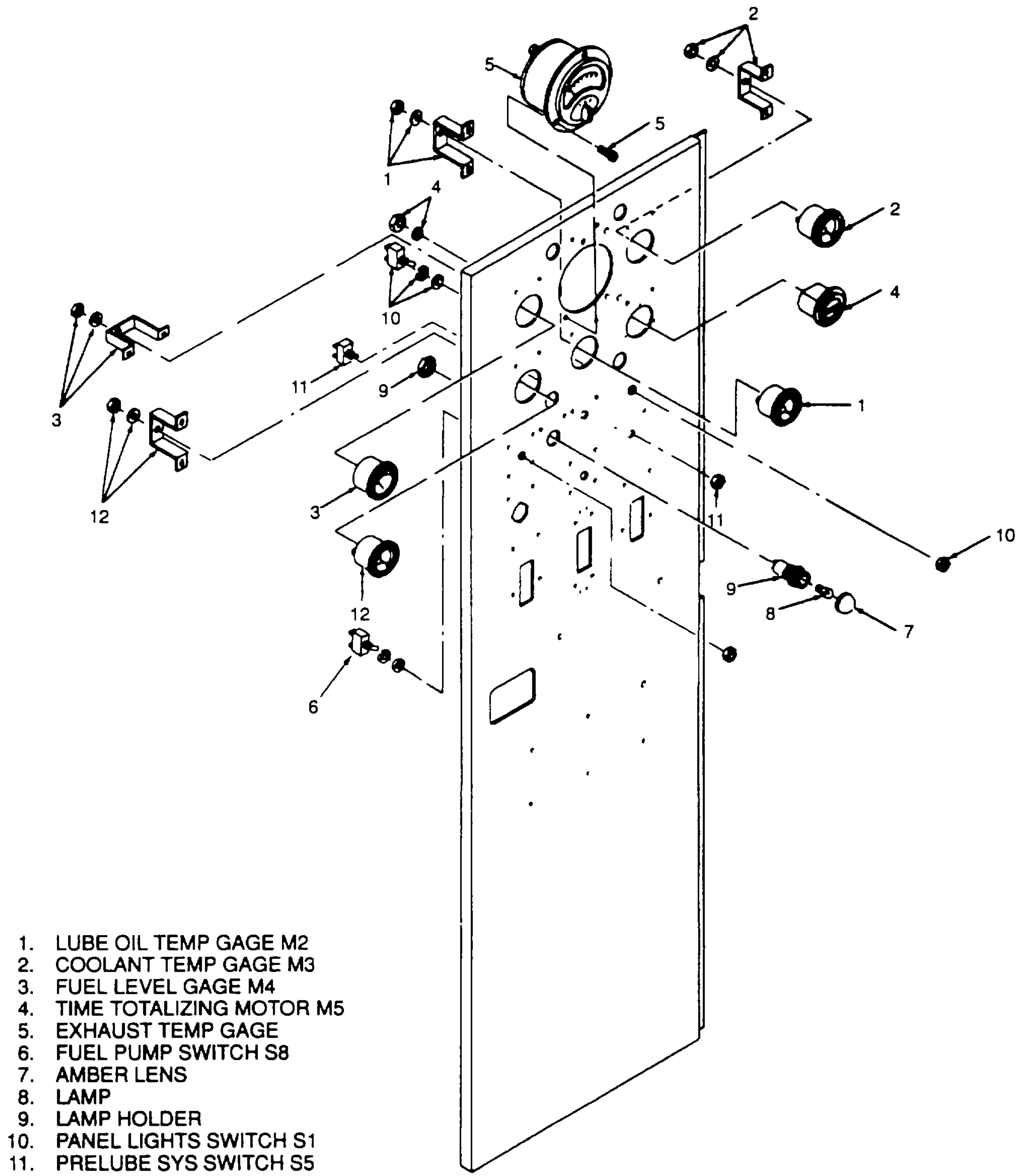
4-121. LUBE OIL TEMP GAGE M2 (11, Figure 2-1). LUBE OIL TEMP gage M2 indicates engine oil temperature.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

a Test.
(1) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to ON.
(2) Disconnect sender lead from OIL TEMP sender MT2 mounted on the engine block (see Figure 3-3) LUBE OIL TEMP gage M1 (11, Figure 2-1) pointer should to zero.
(3) Short to engine ground the disconnected lead from OIL TEMP sender MT2. LUBE OIL TEMP gage M2 (11) pointer should now deflect upwards full scale.
(4) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to OFF.
(5) Replace LUBE OIL TEMP gage M2 (11, Figure 2-1) that falls this test. Reinstall lead on OIL TEMP sender MT2 after test.
(6) Replace oil temperature sender If gage operates correctly.
(7) Check wiring using FO-2, and check sender in accordance with paragraph 4-65 if gage is good.

b. Remove. See Figure 4-75.
(1) Turn off power. Tag and disconnect wiring and resistor from LUBE OIL TEMP gage M2 (1).
(2) Remove hexagonal nuts and lockwashers at rear of cabinet C door. Mounting bracket will come free and LUBE OIL TEMP gage M2 will slide out from front of door.



1. LUBE OIL TEMP GAGE M2
2. COOLANT TEMP GAGE M3
3. FUEL LEVEL GAGE M4
4. TIME TOTALIZING MOTOR M5
5. EXHAUST TEMP GAGE
6. FUEL PUMP SWITCH S8
7. AMBER LENS
8. LAMP
9. LAMP HOLDER
10. PANEL LIGHTS SWITCH S1
11. PRELUBE SYS SWITCH S5
12. LUBE OIL PRESSURE GAGE M1

Figure 4-75. Cabinet C Front Door Assembly

c. Install. See Figure 4-75.
   (1) Install LUBE OIL TEMP gage M2 from front of cabinet C door while assembling bracket from the rear.
   (2) Secure with hexagonal nuts and lockwashers provided.
   (3) Connect wires and resistor and discard tags

.

4-122. COOLANT TEMP GAGE M3 (10, Figure 2-1). COOLANT TEMP gage M3 indicates engine coolant temperature.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III, of this manual.

NOTE

Two persons may be required to perform the following procedure:

a. Test
   (1) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to ON.
   (2) Disconnect sender lead from COOLANT TEMP sender MT3 on the left thermostat housing on the engine block (see Figure 3-3) COOLANT TEMP gage M3 pointer should go to zero.
   (3) Short to engine ground the disconnected sender lead from COOLANT TEMP sender MT3 COOLANT TEMP gage M3 pointer should now deflect full scale upwards.
   (4) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to OFF.
   (5) Replace COOLANT TEMP gage M3 if It fails to pass this test. Reinstall disconnected sender lead on COOLANT TEMP sender MT3 after test.
   (6) Check wiring using FO-1, and check sender in accordance with paragraph 4-123 if gage is good.
b. Remove See Figure 4-75.
   (1) Tag and disconnect wiring and resistor from COOLANT TEMP gage M3 (2)
   (2) Remove hexagonal nuts and lockwashers at rear of cabinet C door Mounting bracket can be removed and COOLANT TEMP gage M3 will slide out from front of door.
c. Install. See Figure 4-75.
   (1) Install new COOLANT TEMP gage M3 (2) from front of cabinet C door while assembling bracket from the rear.
   (2) Secure with hexagonal nuts and lockwashers provided.
   (3) Connect wires and resistor. Discard tags.

4-123. COOLANT TEMPERATURE SENDER MT3. Coolant temperature sender MT3 senses coolant temperature and sends a voltage signal to COOLANT TEMP GAGE M3.

a. Test

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III, of this manual.

NOTE

Two persons may be required to perform the following procedure.

(1) Disconnect sender lead from coolant temperature sender MT3 on the left thermostat housing on the engine block (see Figure 3-3).

(2) Connect a multimeter between the temperature sender MT3 and ground. The resistance reading of the sending unit should be as follows:

at 30°F .... approximately 1K ohms
at 70°F .... approximately 580 ohms
at 120°F................................... approximately 300 ohms
at 190°F .... approximately 145 ohms

(3) Replace coolant temperature sender MT3 that falls test. Reinstall lead on coolant temperature sender MT3 after test.

b Remove. Drain coolant.
(1) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to OFF.
(2) Tag and disconnect wires to coolant temperature sender MT3 (see Figure 3-3).
(3) Remove coolant temperature sender MT3 from the thermostat housing.

c. Install
(1) Ensure that 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 is set to OFF.
(2) Install coolant temperature sender MT3 (see Figure 3-3) In the thermostat housing.
(3) Connect wires to coolant temperature sender MT3 and discard tags.
(4) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to ON.

4-124. FUEL LEVEL GAGE M4 (8, Figure 2-1). FUEL LEVEL GAGE M4 indicates the quantity of fuel Inside the fuel tank.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

a. Test
(1) Set 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 TO ON.
(2) Open engine control cabinet C Disconnect sender lead from sender input terminal on FUEL LEVEL gage M4. FUEL LEVEL gage pointer should deflect full scale to E (empty).
(3) With sender lead disconnected, jumper the sender input terminal on FUEL LEVEL gage M4 to the case ground or the mounting bracket FUEL LEVEL gage M4 pointer should now deflect full scale to F (full).
(4) Set 24 V dc CONTROL POWER CIRCUIT BREAKER CB1 to OFF
(5) Replace FUEL LEVEL gage M4 (3, Figure 4-75) if it falls this test. Reinstall sender lead on sender input terminal of FUEL LEVEL gage M4 If gage passes testing.
(6) If FUEL LEVEL gage M4 is properly functioning, test and/or replace fuel quantity transmitter MT4 in accordance with paragraph 4-31.
(7) If both FUEL LEVEL gage M4 and fuel quantity transmitter MT4 are good, check wiring using FO-2 to isolate any defective wire or component.

b. Remove See Figure 4-75.
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
   (2) Tag and disconnect wiring to FUEL LEVEL gage M4 (3).
   (3) Remove hexagonal nuts and lockwashers at rear of FUEL LEVEL gage M4. Remove mounting bracket from rear of gage and remove gage from front of cabinet C door.

c Install. See Figure 4-75.
   (1) Install FUEL LEVEL gage M4 (3) from front of cabinet C door while assembling mounting bracket from the rear.
   (2) Secure with lockwashers and hexagonal nuts provided.
   (3) Connect wires and discard tags
   (4) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-125. TIME TOTALIZING METER M5 (4, Figure 4-75). TIME TOTALIZING meter M5 Indicates the total running hours of the generator set.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

a. Test
   (1) Disconnect and tag leads from TIME TOTALIZING meter M5. Record indication on meter.
   (2) Connect positive side of 24 V dc supply to positive terminal of TIME TOTALIZING meter M5 and the negative side of the 24 V dc supply to Its negative terminal. TIME TOTALIZING meter M5 should run.
   (3) Perform a time check against a known accurate time source, such as a wrist watch, over a period of 30 minutes.
   (4) Read elapsed time from the last digit which displays tenths of an hour. Markings are shown as black numerals on a white drum TIME TOTALIZING meter M5 should show a change of five-tenths for a period of 30 minutes
   (5) If it fails to show a change of five-tenths, replace TIME TOTALIZING meter M5.

b. Remove. See Figure 4-75.
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE Tag and disconnect wiring from TIME TOTALIZING meter M5 (4).
   (2) Remove three attaching screws, nuts, and lockwashers, and remove TIME TOTALIZING meter M5 from cabinet C door panel.

c. Install. See Figure 4-75.
   (1) Install TIME TOTALIZING meter M5 (4) from front of cabinet C door.
   (2) Secure TIME TOTALIZING meter M5 (4) to cabinet C door with screws, nuts, and lockwashers provided.
   (3) Connect wires and discard tags.
   (4) Set MAINTENANCE LOCKOUT switch S100 to OPERATE

4-126. EXHAUST TEMPERATURE GAGE (M6) AND THERMOCOUPLES. EXHAUST TEMPERATURE GAGE operates on the thermo-electric principle, consists of a rugged galvanometer which measures the voltage generated by the thermocouple on the exhaust elbow of each turbocharger Since this voltage is very small, use extreme care in making connections that is to be sure of putting together only clean, bright, dry wires and contacts The thermocouple element is a pair of special alloy wires enclosed In a protecting tube. A special pair of alloy (iron and constantan) wires are used to connect the gage (M8) to each thermocouple

CAUTION

If you have to check continuity of these circuits with an ohmmeter, be sure the EXHAUST TEMPERATURE GAGE is disconnected because battery voltage of the ohmmeter will seriously damage the EXHAUST TEMPERATURE GAGE.

a. Adjustments.
   (1) With the EXHAUST TEMPERATURE GAGE selector switch in the off position and system wires connected the gage should indicate cold end temperature (temperature at terminals of gage). If this reading is not correct adjust the "Cold End Adjuster' screw until the pointer reads the correct cold end temperature. Never set the Indicator pointer to zero mark on the scale unless the cold end temperature actually is zero degrees.

b. Test.
   (1) Tag and disconnect wires from exhaust temperature gage (Figure 4-75, Item 5).
   (2) Using a multimeter set to RX1 scale, check continuity of each pair of wires going to each thermocouple. Multimeter should read less than ten ohms through each pair of wires and thermocouple If more than ten ohms, repair or replace wires or thermocouples.
   (3) Using a short length of alloy wires (Iron constantan) connect white wire to + and red wire - to EXHAUST TEMPERATURE GAGE No 1 + & - and No 2 + & - terminals. Twist other end of each pair of wires together. Set exhaust temperature gage selector switch to position one and heat (with match) the twisted end of the wires from terminals and observe meter deflection repeat for switch position two and its wires.
   (4) To test complete system disconnect wires used in step 3, reconnect wires removed in step (1), remove thermocouples from exhaust elbows (IAW Para. 3-15d(2)(a), reconnect wiring to thermocouples, heat thermocouples probe to a known temperature and compare to exhaust temperature meter. Repair or replace defective components if there is an error of 40 degrees or more noted.

c. Remove. See Figure 4-75
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
   (2) Tag and disconnect wiring to EXHAUST TEMPERATURE GAGE M6 (5)
   (3) Remove mounting hardware and gage M6

d. Install. See Figure 4-75
   (1) Install EXHAUST TEMPERATURE GAGE M6 and mounting hardware
   (2) Connect wires to gage M6 and discard tags
   (3) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-127. FUEL PUMP SWITCH S8 (4, Figure 2-1). FUEL PUMP switch S8 allows manual or automatic operation of the fuel transfer pump and is also used to turn the pump off

a. Test.
   (1) Tag and disconnect wires from switch terminals
   (2) Place FUEL PUMP switch S8 in OFF position.
   (3) Using a multimeter set to RX1 scale, check continuity across terminals 2 and 3, and 2 and 1 Meter should read Infinite
   (4) Place FUEL PUMP switch S8 in MANUAL position Multimeter should read zero ohm across terminals 2 and 3 Terminals 2 and 1 should read infinite.

(5) Place FUEL PUMP switch S8 in AUTO position. Multimeter should read zero ohm across terminals 2 and 1 and infinite ohms across terminals 2 and 3.
(6) Place FUEL PUMP switch S8 in OFF position and connect wires to terminals.
(7) Replace FUEL PUMP switch S8 if it fails any of the continuity tests in steps (3) through (5), above.

b. Remove. See Figure 4-76.
(1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
(2) Tag and disconnect wiring to FUEL PUMP switch S8 (1).
(3) Remove locking nut and remove FUEL PUMP switch S8 (1) from rear of panel.

c. Install. See Figure 4-76.
(1) Replacement FUEL PUMP switch S8 (1) should be preset to AUTO position prior to installation. Check for contact continuity between terminals 1 and 2 with a multimeter set to RX1 scale.
(2) Install FUEL PUMP switch S8 (1) and secure with locking nut and lockwasher so that the toggle is in the AUTO position.
(3) Retest for proper operation per step a, above
(4) Connect wires and discard tags.
(5) Set MAINTENANCE LOCKOUT switch S100 to OPERATE

4-128. FUEL PUMP ENERGIZED LIGHT DS107 (5, Figure 2-1). FUEL PUMP ENERGIZED light DS107 indicates when the fuel transfer pump is operating.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

a. Test.
(1) Tag and disconnect wiring to lampholder (9, Figure 4-75) from rear of cabinet C panel.
(2) Check that lamp (8) is screwed in securely.
(3) Apply 24 V dc to terminals of lampholder. Lamp should light.
(4) If lamp does not light, replace with known good lamp and repeat test.
(5) If lamp still does not light, replace lampholder.

b. Remove. See Figure 4-75.
(1) Remove amber lens (7) and lamp (8).
(2) Tag and disconnect wiring to lampholder (9) from rear.
(3) Remove locking nut and lockwasher at rear cabinet C door. Lampholder (9) will slide out from the front.

c. Repair. Repair consists of replacing defective lamp and lampholder. Refer to steps b and d.

d. Install. See Figure 4-75.
(1) Install new lampholder (9) and secure from rear of panel with the lockwasher and locking nut supplied.
(2) Screw in known good lamp (8) and amber lens (7) from front panel.
(3) Connect wires and discard tags.

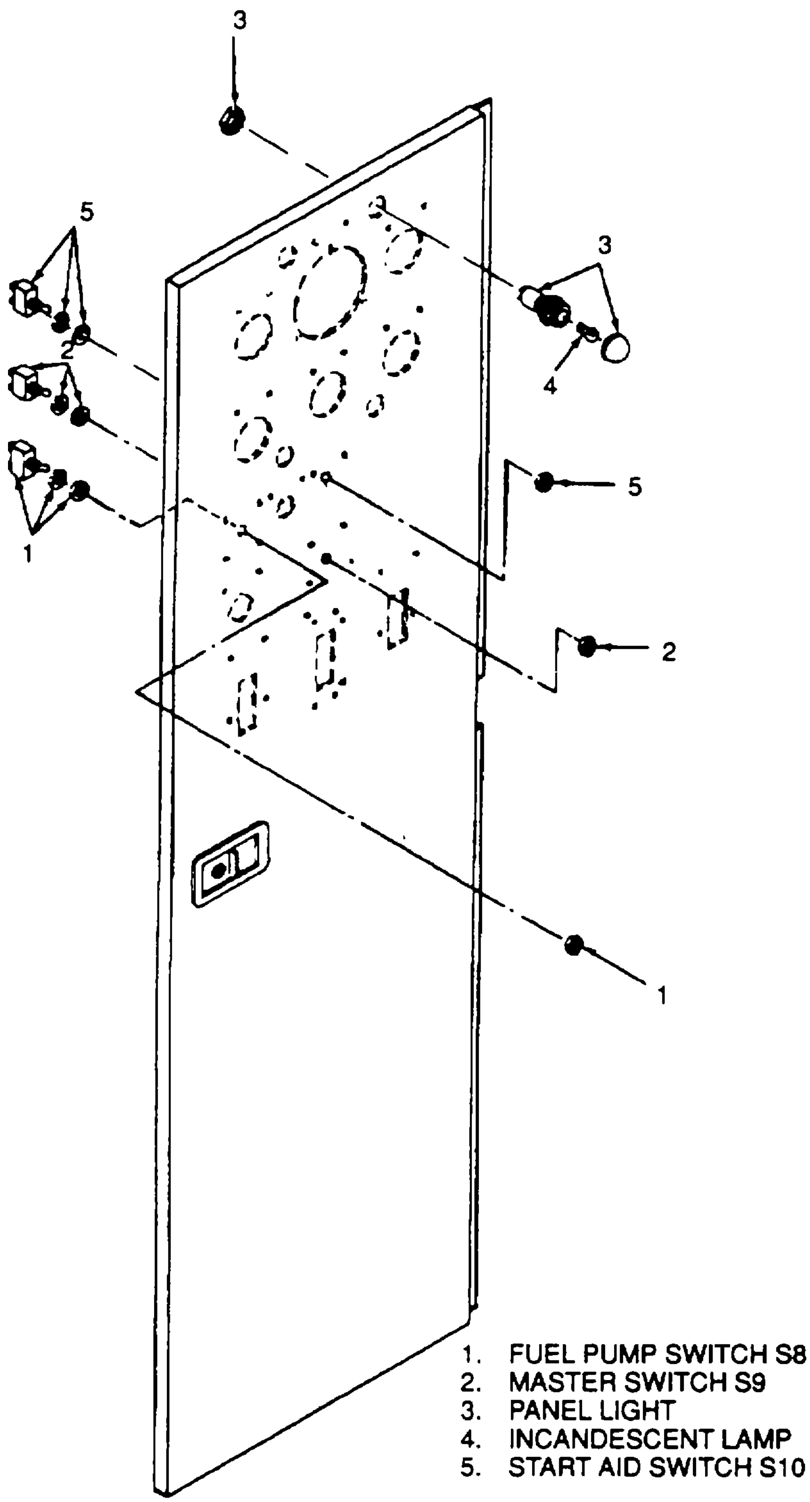


Figure 4-76. Cabinet C Frint Door

4-129. MASTER (START/RUN/STOP) SWITCH S9 (16, Figure 2-1). MASTER SWITCH S9 Is used to start and stop generator set operation. The switch is spring loaded to return to the RUN position after having been held In either the START or STOP position.

a. Test.
   (1) Disconnect and tag leads from terminals 3 and 4

NOTE

Do not remove jumper across terminals 2 and 6.

   (2) Using a multimeter set to RX1 scale with MASTER SWITCH S9 In RUN position, test for continuity across terminals 1 and 2 and 5 and 6 Meter should Indicate zero ohm
   (3) Hold MASTER SWITCH S9 in START position. Meter should indicate zero ohm across terminals 2 and 3 and 5 and 6.
   (4) Hold MASTER SWITCH S9 in the STOP position. Meter should indicate zero ohm across terminals 1 and 2 and 4 and 5
   (5) Connect leads to terminals 3 and 4 and discard tags.
   (6) Replace MASTER switch S9 if It falls any of the continuity tests In steps (2) through (4), above.

b. Remove See Figure 4-76
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
   (2) Tag and disconnect wiring to MASTER SWITCH S9 (2).
   (3) Remove locking nut and lockwasher to release MASTER SWITCH S9 (2) for removal from rear of panel.

c. Install
   (1) Install MASTER SWITCH S9 (2) from rear of cabinet C door.
   (2) Secure from the front with lockwasher and locking nut.
   (3) Connect wires and discard tags.
   (4) Retest for proper operation per step a, above.
   (5) Set MAINTENANCE LOCKOUT switch S100 to OPERATE

4-130. PANEL ILLUMINATION LIGHTS DS26 THROUGH DS29 (6, Figure 2-1). Panel lights illuminate engine control panel for better visibility.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III, of this manual.

a. Test
   (1) Apply 24 V dc to panel light holder contacts at rear of cabinet C door Each of the four panel lamps should light.
   (2) Replace inoperative lamps and repeat step (1), above If a known good replacement lamp falls to light, replace panel light holder and retest.

b. Remove. See Figure 4-76.
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
   (2) Remove hood from panel light (3) and remove lamp (4) for replacement.
   (3) Tag and disconnect wiring to panel light (3) and remove locking nut and lockwasher at rear of door panel. Panel light (3) will slide out from the front.

c. Repair . Repair consists of replacing lamps and panel lights. Refer to steps b and d.
d. Install . See Figure 4-76.
(1) Install panel light (3) and secure with lockwasher and locking nut from rear panel.
(2) Install lamp (4) and covering hood.
(3) Connect wires and discard tags.
(4) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-131. PANEL LIGHTS SWITCH S1 (13, FIGURE 2-1). PANEL LIGHTS switch S1 Is used to turn panel lights on and off.

a. Test

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III, of this manual.

(1) Disconnect and tag lead from terminal 3.
(2) Using a multimeter set to RX1 scale with PANEL LIGHTS switch S1 In ON position, test for continuity across terminals 2 and 3 Meter should Indicate zero ohm.
(3) Place PANEL LIGHTS switch S1 in OFF position and test for isolation with the multimeter probes across terminals 2 and 3. Meter should read infinity.
(4) Connect lead to terminal 3 and discard tag.
(5) Replace PANEL LIGHTS switch S1 if it fails any of the continuity tests in steps (2) and (3), above.

b.` Remove. See Figure 4-75.
(1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
(2) Tag and disconnect wiring from PANEL LIGHTS switch S1 (10).
(3) Remove locking nut and lockwasher to release PANEL LIGHTS switch Si (10) for rear panel removal.

c. Install. See Figure 4-75.
(1) Install replacement PANEL LIGHTS switch S1 (10) from rear of cabinet C door and oriented such that the ON position is upward Check with multimeter set to RX1 scale to meet test condition in step a, above.
(2) Connect wires and discard tags.
(3) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-132. MAINTENANCE LOCKOUT SWITCH S100 (1, Figure 2-1). MAINTENANCE LOCKOUT switch S100 is used to disconnect AC and DC voltage from generator set circuits. Unless specified otherwise, the switch is to be set to MAINTENANCE whenever the generator set is not being operated or is being maintained.

a. Remove
(1) Tag and disconnect wiring from rear of MAINTENANCE LOCKOUT switch S100 (1).
(2) Remove four mounting screws at front of cabinet C door and remove MAINTENANCE LOCKOUT switch S100 from the rear.

b. Test. Test for continuity using a multimeter set to RX1 scale. The MAINTENANCE LOCKOUT switch S100 is rated 225 amperes, 240 V ac, nonautomatic trip.

c. Install.
   (1) Install switch S100 (1) and secure with four mounting screws.
   (2) Connect wires and discard tags.

4-133. START AID SWITCH S10 (14, Figure 2-1). START AID switch S10 is used to Inject ether Into the engine intake manifold during cranking for cold weather starting.

a. Test.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

   (1) Disconnect negative lead from terminal 3.
   (2) Using a multimeter set to RX 1 scale place test probes across terminals 2 and 3. Meter should read Infinite ohms.
   (3) Hold toggle In the ON position. Meter should indicate zero ohm.
   (4) Release toggle.
   (5) START AID switch S10 should snap back to OFF condition and meter should again indicate infinity.
   (6) Connect negative lead to terminal 3.
   (7) Replace START AID switch S10 if it falls any of the tests In steps (2) through (5), above.

b. Remove. See Figure 4-76.
   (1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
   (2) Tag and disconnect wiring to START AID switch S10 (5).
   (3) Remove locking nut and lockwasher and remove START AID switch S10 (5) from rear of panel.

c. Install.
   (1) Install replacement START AID switch S10 (5) from rear of cabinet C door and orient with the toggle in the downward position (normally OFF).
   (2) Secure from the front with lockwasher and locking nut.
   (3) Connect wires and discard tags.
   (4) Retest for proper operation per step b, above.
   (5) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-134. OPERATION SELECTOR SWITCH S3 (21, Figure 2-2). OPERATION SELECTOR switch S3 is used to select automatic or manual paralleling mode. Automatic paralleling requires use of the SRM.

a. Test.

NOTE

Switch wiring position numbers are translated as follows: the first digit (alpha) defines the section, or deck, in relation to the handle end, the second digit is a specific terminal on that deck. For example, position B12 is located on the second deck, the contact is terminal number 12.

   (1) Tag and disconnect wires from switch contacts. See Figure 4-77.
   (2) Using a multimeter set to RX1 scale, test for contact continuity in the X marked positions specified in the chart in Figure 4-77 Meter should indicate zero ohm at all points marked in the chart.

CONTACTS	POSITION	
	MAN	AUTO
A11 - B11		X
A12 - B12	X	
A1 - B1		X
A5 - B5		X
A6 - B6	X	
A7 - B7		X
C11 - D11		X
C12 - D12	X	
C1 - D1		X
C5 - D5		X
C6 - D6	X	
C7 - D7		X

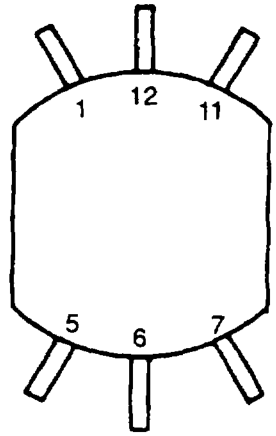


Figure 4-77. Test Data for OPERATION SELECTOR SWITCH S3

(3) Meter should indicate. Infinity at all blank contacts in the chart.
(4) Replace switch if it falls to meet these specifications.

b. Remove. See Figure 4-68.
(1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE
(2) Tag and disconnect all wiring to switch (2) contacts.
(3) Remove screw in center of handle and slide off handle.
(4) Remove two screws from face of mounting plate on front of panel.

c. Install.
(1) Install OPERATION SELECTOR SWITCH S3 (2) by positioning switch sections at rear of panel and assemble the mounting plate from the front. Secure the assembly with two screws.
(2) Slide on handle and secure with the attaching screw.
(3) Connect wires as tagged and discard tags.
(4) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-135. HUMIDISTAT S107 (1, Figure 2-12). Humidistat S107 senses humidity inside cabinet C and controls switchgear heaters to prevent formation of condensation inside cabinets A, B, and C.

a. Test.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

(1) Set MAINTENANCE LOCKOUT switch S1090 to MAINTENANCE.
(2) Tag and disconnect wiring from humidistat S107.

(3) With humidistat S107 dial set fully clockwise (full on), use a multimeter to check for continuity across humidistat.
(4) Replace humidistat S107 if It fails to pass this test.
(5) Connect wiring to humidistat S101 and discard tags.
(6) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

b. Remove.
(1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
(2) Tag and disconnect wires to humidistat S107.
(3) Remove screw and captive washer assemblies to remove humidistat S107.

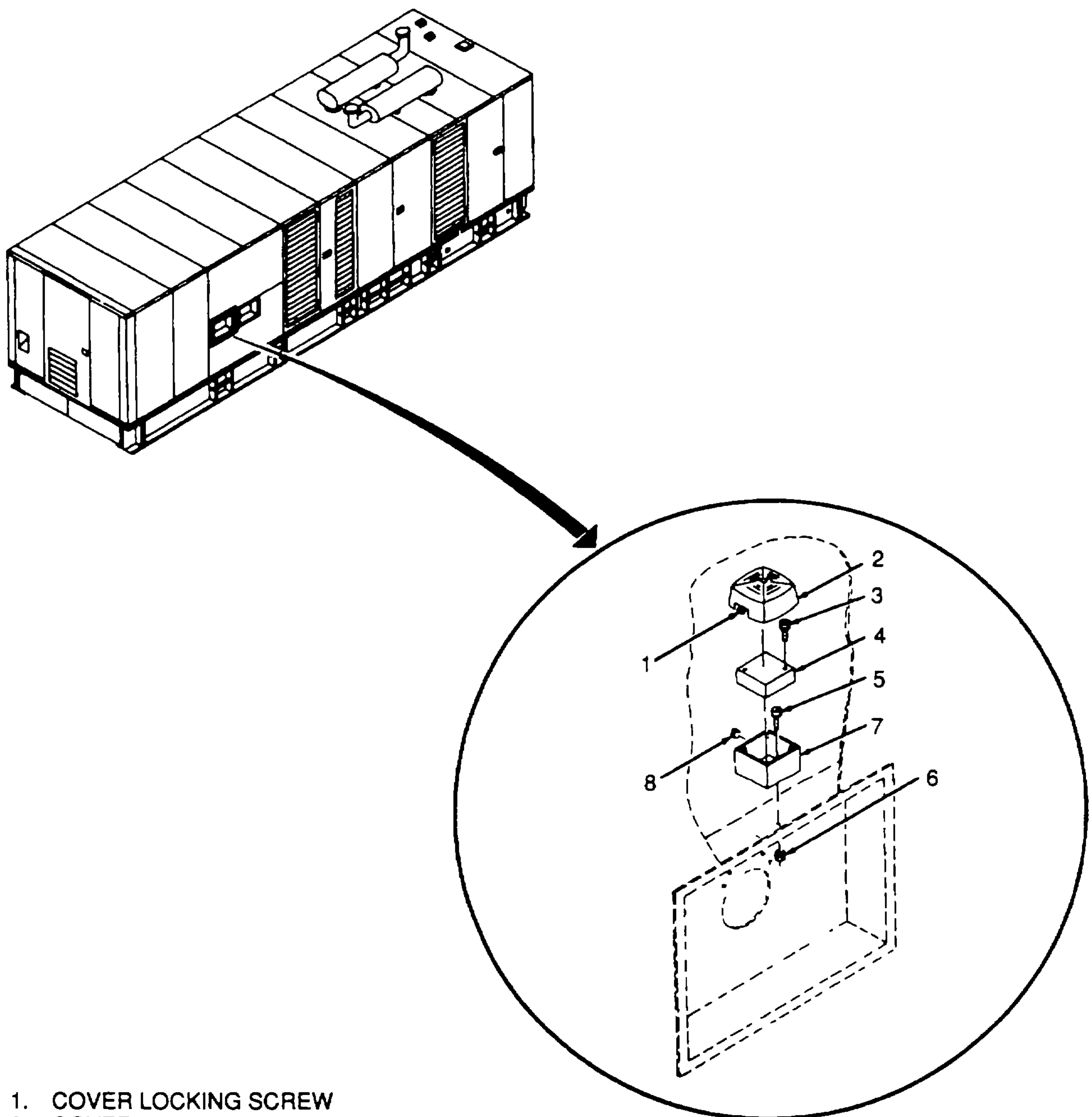
c. Install.
. (1) Mount humidistat and secure with screw and captive washer assemblies.
(2) Connect wires and discard tags.
(3) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

4-136. ANNUNCIATOR HORN LS1 (2, Figure 2-12). Annunciator horn LS1 provides an audible alarm upon the tripping of any generator set fault circuit. The alarm may be tested using ANNUNCIATOR TEST pushbutton S15 (5, Figure 2-3) on upper cabinet A door.

a. Test.
(1) Test by using the ANNUNCIATOR TEST pushbutton (5, Figure 2-3). Annunciator horn LS1 should sound when the button is pressed.
(2) If annunciator horn LS1 does not sound, open cabinet C door and remove annunciator horn cover (2, Figure 4-78) by loosening cover locking screw (1).
(3) Connect a multimeter set to 50 V dc scale across terminals 1 and 2 inside the annunciator horn housing. With ANNUNCIATOR TEST pushbutton pressed, check for presence of 24 V dc across terminals. If 24 V dc is not present, trace back through circuit using FO-2 to find the problem If 24 V dc is present, replace annunciator horn LS1.

b. Remove. See Figure 4-78.
(1) Set MAINTENANCE LOCKOUT switch S100 to MAINTENANCE.
(2) Loosen cover locking screw (1) to remove cover (2).
(3) Tag and disconnect wires connected to annunciator horn LS1 terminals 1 and 2.
(4) Remove screw and captive washer assemblies (3) to remove annunciator horn LS1 (4)
(5) If necessary, remove screw and captive washer assemblies (5) and nut and captive washer assemblies (6) to remove outlet box (7).

c. Install. See Figure 4-78.
(1) If removed, Install outlet box (7) and secure with screw and captive washer assemblies (5) and nut and captive washer assemblies (6). Install rubber grommet (8).
(2) Feed wires Into outlet box (7) through hole In grommet (8).
(3) Connect wires and discard tags.
(4) Install annunciator horn LS1 (4) and secure with screw and captive washer assemblies (3).
(5) Install cover (2) and secure by tightening cover locking screw (1).
(6) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.



1. COVER LOCKING SCREW
2. COVER
3. SCREW AND CAPTIVE WASHER ASSEMBLY
4. HORN LS1
5. SCREW AND CAPTIVE WASHER ASSEMBLY
6. NUT AND CAPTIVE WASHER ASSEMBLY
7. OUTLET BOX
8. RUBBER GROMMET

Figure 4-78. Maintenance of Annunciator Horn LS1

4-137. SET/UTILITY CIRCUIT BREAKERS (SET STATION POWER CIRCUIT BREAKER CB124 AND UTILITY STATION POWER CIRCUIT BREAKER CB125). SET/UTILITY circuit breakers are used to select set power or utility power for the generator set 120 Vac circuits.

a. Remove. See Figure 4-79

WARNING

To avoid death or injury to personnel, no electrical component will be worked on while energized. Ensure equipment Is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage Is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

(1) Set switchgear circuit breaker CB123 to OFF.
(2) Remove hexagon head capscrews (1) and lockwashers (2) to remove the circuit breaker enclosure cover (3).
(3) Remove hexagon head capscrews (4) and lockwashers (5) to remove circuit breaker support (6). Remove circuit breakers and support from enclosure. Tag and disconnect wires from circuit breakers.
(4) Remove pan head screws (7), flat washers (8), and nut and captive washer assemblies (9) to remove circuit breaker CB125 or CB124 (10 or 11).
(5) If necessary, remove screw and captive washer assemblies (12), flat washers (13), spacers (14), and nut and captive washer assemblies (15) to remove circuit breaker locking beam (16).

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

b. Test. SET STATION POWER circuit breaker CB124 and UTILITY STATION POWER circuit breaker CB125 are identical and rated at 240 V, 100 amperes each.
(1) Test circuit breakers CB124 and CB125 using MSIA test set.
(2) Replace circuit breaker CB124 or CB125 that falls circuit breaker test.

c. Install. See Figure 4-79.
(1) If removed, install circuit breaker locking beam (16) and secure with screw and captive washer assemblies (12), flat washers (13), spacers (14), and nut and captive washer assemblies (15).
(2) Install circuit breaker CB125 and/or CB124 (10 or 11) on circuit breaker support (6) and secure with pan head screws (7), flat washer (8), and nut and captive washer assemblies (9).
(3) Connect wires to circuit breaker and remove tags. Install circuit breaker support (6) and secure with hexagon head capscrews (4) and lockwashers (5).
(4) Install circuit breaker enclosure cover (3) and secure with hexagon head capscrews (1) and lockwashers(2).
(5) Set MAINTENANCE LOCKOUT switch S100 to OPERATE.

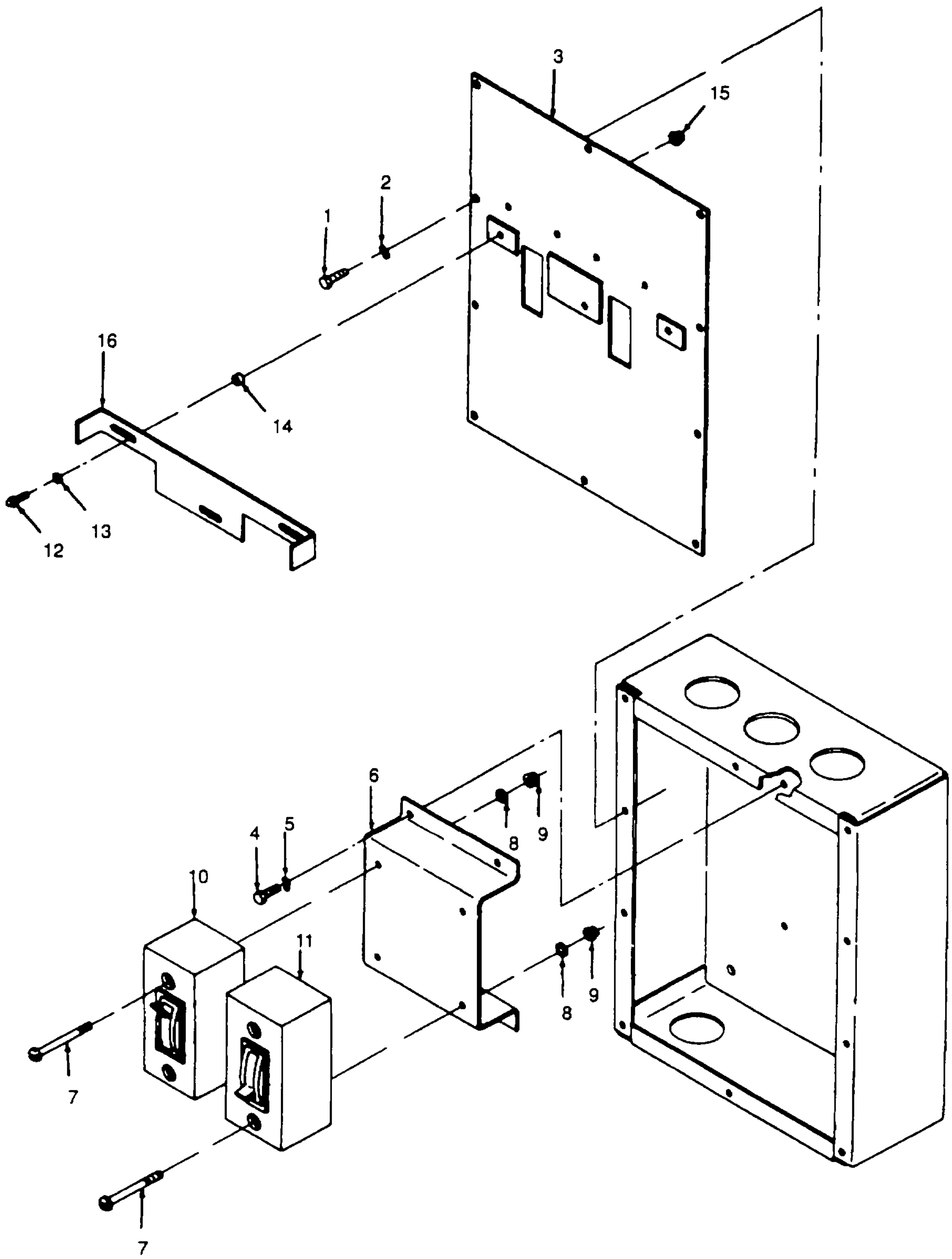


Figure 4-79. Utility/Set Circuit Breaker Assembly (Sheet 1 of 2)

1. HEXAGON HEAD CAPSCREW
2. LOCKWASHER
3. CIRCUIT BREAKER ENCLOSURE COVER
4. HEXAGON HEAD CAPSCREW
5. LOCKWASHER
6. CIRCUIT BREAKER SUPPORT
7. PAN HEAD SCREW
8. FLAT WASHER
9. NUT AND CAPTIVE WASHER ASSEMBLY
10. UTILITY POWER CIRCUIT BREAKER CB125
11. SET POWER CIRCUIT BREAKER CB124
12 SCREW AND CAPTIVE WASHER ASSEMBLY
13. FLAT WASHER
14. SPACER
15. NUT AND CAPTIVE WASHER ASSEMBLY
16 CIRCUIT BREAKER LOCKING BEAM

Figure 4-79. Utility/Set Circuit Breaker Assembly (Sheet 2 of 2)

4-138. UTILITY STATION POWER TRANSFORMER T103. UTILITY STATION POWER TRANSFORMER T103 transforms 380 V ac to 120/240 V ac for distribution panel DP1 and DP2 and is located inside engine control cabinet C.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III , of this manual.

NOTE

All megohmmeter tests must be performed for 30 to 60 seconds.

a. Test.
   (1) Tag and disconnect wiring from UTILITY STATION POWER transformer T103.
   (2) With multimeter set to RX10 scale, check continuity of primary winding across primary taps H1 and H2; and H2 and H3. Check continuity of secondary winding across secondary taps X1 and X2; and X2 and X3. Multimeter should read less than 10 ohms.
   (3) Connect a 500 V dc megohmmeter to either primary tap (H1 or H3) and to ground. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 10 megohms.
   (4) Connect the megohmmeter to either secondary tap (X1 or X3) and to ground Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 10 megohms.
   (5) Connect a 500 V dc megohmmeter across the primary and secondary windings. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 10 megohms.
   (6) If UTILITY STATION POWER transformer T103 fails any test described above, refer to the next higher level of maintenance.
   (7) Connect wiring and discard tags.

4-139. SET STATION POWER TRANSFORMER T101. SET STATION POWER transformer T101 transforms 2400 V ac to 120/240 V ac for distribution panels DP1 and DP2 and is also located In the rear compartment of cabinet C.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

a. Test.
   (1) Tag and disconnect wiring from SET STATION POWER transformer T101.
   (2) With multimeter set to RX1 scale, individually check continuity of transformer primary (H1 and H2 terminals) and secondary (X1 and X2, X2 and X3 terminals) windings.

(3) Connect a 500 V dc megohmmeter to either primary tap (H1 or H2) and to ground. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 10 megohms.
(4) Connect the 500 V dc megohmmeter to either secondary terminal X1 or X3 and ground. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 10 megohms.
(5) Connect the 500 V dc megohmmeter between the primary and secondary windings. Operate the megohmmeter for 60 seconds and observe resistance Reading should not be less than 10 megohms.
(6) If transformer fails any test described above, refer to the next higher level of maintenance.
(7) Reconnect wires and remove tags.

4-140. GROUND FAULT TRANSFORMER T100. See Figure 3-26 GROUND FAULT transformer T100 is located in generator control cabinet A and is used for ground fault sensing in conjunction with GROUND FAULT protection relay K115.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

a. Test.
(1) Tag and disconnect wiring from the ground fault transformer T100
(2) With multimeter set to RX1 scale perform individual continuity checks on transformer primary and secondary windings.
(3) Connect a 500 V dc megohmmeter to either primary lead and to ground Operate the megohmmeter for 60 seconds and observe resistance. Reading should be not less than 10 megohms.
(4) Remove megohmmeter from primary and connect to either secondary lead and to ground. Operate the megohmmeter for 60 seconds and observe resistance Reading should be not less than 10 megohms.
(5) Connect the megohmmeter across primary and secondary transformer windings. Operate the megohmmeter for 60 seconds and observe resistance. Reading should be not less than 10 megohms.
(6) If GROUND FAULT transformer T100 fails to pass any test described above, refer to the next higher level of maintenance.
(7) Reconnect wires and discard tags.

4-141. VOLTAGE REGULATOR TRANSFORMER T102. See Figure 3-26 VOLTAGE REGULATOR transformer T102 provides voltage Input for current boost system A101 and voltage regulator VR101.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III , of this manual.

a. Test.
(1) Tag and disconnect wiring from VOLTAGE REGULATOR transformer T102.
(2) With multimeter set to RX1 scale, individually check continuity on the primary and secondary windings. The readings should be:

H1 to H2......................127 ohms
H1 to H3 ....297 ohms
H2 to H3......................169 ohms
Secondary windings.....0.006 ohms

(3) Connect a 500 V dc megohmmeter to either primary lead, H1 or H2, and to ground. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 1000 megohms.
(4) Connect the megohmmeter to either secondary load X1 or X4 and to ground. Operate the megohmmeter for 60 seconds and observe resistance. Reading should not be less than 1000 megohms.
(5) Connect the megohmmeter between the primary and secondary windings. Operate the megohmmeter for 60 seconds and observe the resistance. Readings should not be below a minimum of 250 megohms.
(6) Refer to the next higher level of maintenance if VOLTAGE REGULATOR transformer T102 falls any test procedure described above.
(7) Reconnect wires and discard tags.

4-142. GENERATOR INSTRUMENT TRANSFORMERS T104, T106, T107, AND BUS INSTRUMENT TRANSFORMERS T108 THROUGH T110. See Figure 3-26. The instrument transformers are 20 1 stepdown transformers that furnish voltage input for the various generator control, metering, and fault protection circuits.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

a. Test. The following test procedures apply for generator instrument transformers T104, T106, and T107; and bus instrument transformers T108, T109, and T110.
(1) Tag and disconnect all wiring from transformers T104, T106, and T107; and transformers T108 through Tl10 Perform the following steps on each transformer.
(2) With multimeter set to RX1 scale, perform individual continuity checks on transformer primary and secondary windings. The readings should be:
primary winding ....122 ohms
secondary winding ....0.002 ohms
(3) Connect a 500 V dc megohmmeter to either primary lead and to ground Operate the megohmmeter for 60 seconds and observe resistance Reading on each transformer should be not less than 20 megohms.
(4) Connect the megohmmeter to either secondary lead and to ground. Operate the megohmmeter for 60 seconds and observe resistance Reading should be not less than 1 megohm.
(5) Connect the megohmmeter between the primary and secondary windings. Operate the megohmmeter for 60 seconds and observe the resistance. Reading should not be less than 20 megohms.
(6) Refer any instrument transformer that fails any of the above test procedures to the next higher level of maintenance.
(7) Reconnect wires and discard tags.

4-143. PARALLELING CURRENT TRANSFORMER CT114. See Figure 3-28 PARALLELING CURRENT transformer CT114 is used to balance load distribution between paralleled generator sets during isochronous parallel operation.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined in Chapter 1, Section III, of this manual.

a. Test.
(1) Tag and disconnect wiring from PARALLELLING CURRENT transformer CT114.
(2) With multimeter set to RX1 scale, check continuity of transformer winding. Ohmic value is approximately 0.002 ohms.
(3) Connect a 500 V dc megohmmeter across either transformer lead and ground. Operate megohmmeter for 60 seconds and observe the resistance Reading should be not less than 100 megohms.
(4) If PARALLELING CURRENT transformer CT114 falls to pass any test procedures, refer to the next higher level of maintenance.
(5) Reconnect wires and discard tags.

4-144. INSTRUMENT CURRENT TRANSFORMERS CT10 THROUGH CT12. See Figure 3-28. INSTRUMENT CURRENT transformers CT10 through CT12 sense current through the generator output line and provide signals used for metering and fault protection.

WARNING

Dangerous voltage levels may be present at components located within cabinet C. Observe all applicable safety precautions as outlined In Chapter 1, Section III , of this manual.

a. Test. Perform the following test procedures on each current transformer.
(1) Tag and disconnect wiring from INSTRUMENT CURRENT transformers CT10, CT11, and CT12. Perform the following procedures Individually on each current transformer.
(2) With multimeter set to RX1 scale, check continuity of the transformer winding. Ohmic value is approximately 0 002 ohms.
(3) Connect a 500 V dc megohmmeter across either transformer lead and ground. Operate megohmmeter for 60 seconds and observe resistance Reading should be no less than 1 megohm.
(4) Refer any INSTRUMENT CURRENT transformer that fails a test procedure to the next higher level of maintenance.
(5) Reconnect wires and discard tags.

CHAPTER 5
AUXILIARY EQUIPMENT USED IN CONJUNCTION WITH THE GENERATOR SET
SECTION I. INTRODUCTION

5-1. Major auxiliary equipments for use with the generator set are the remote control module (RCM) and the remote control cable.

SECTION II. REMOTE CONTROL MODULE

5-2. GENERAL. The remote control module (see Figure 2-21) allows remote operation of the generator set from a distance of up to 100 feet (30 meters) away via the remote control cable. Control and instrumentation provisions on the re- mote control module (RCM) are with exceptions, essentially identical to those on the main generator control panels The remote control module Is actuated by setting the LOCAL REMOTE switch S2 on generator control cabinet B to the REMOTE position. During remote operation, controls and indicators on the remote control module are connected In place of equivalent circuits on the main generator set. Refer to Table 2-13 and Figure 2-21 for control and instrumentation provisions contained in the remote control module along with their respective functions.

NOTE

All meters and indicators In the generator set control cabinets are operational when using the RCM with the exception of the synchroscope.

5-3. INSTALLATION. The remote control module (RCM) is a self-housed unit The unit should be sited as level as possible, on firm, dry footing, sheltered from the weather. Allow approximately 24 inches (62 cm) clearance on all sides of the unit for access during operation and maintenance To connect the RCM to the generator set, proceed as follows:

a. Remove RCM from Generator Set Control Room. When not In use, the RCM is bolted to the lower right wall in the control room for storage. (See Figure 4-1) To remove the RCM, refer to Figure 5-1 and proceed as follows:

(1) See Figure 5-1 Remove four self-locking nuts (42) and flat washers (41) holding the remote control module to the left and right storage brackets (38 and 39) Do not detach or remove storage brackets (38 and 39) from the generator set when removing the remote control module. Lift off the remote control module.

(2) Install hardware (42 and 41) removed in step (1), above, on the four mounting headscrews installed at rear of the remote control module to prevent loss.

b. Site RCM. Site the RCM In accordance with the opening statements of this paragraph The RCM cable is 100 feet (30 meters) long The RCM should be sited within 100 feet (30 meters), maximum, of the generator set RCM receptacle.

c. Connect RCM to Generator Set. Remove the RCM cable from the generator set (refer to Figure 4-1 for storage location of cable). Lay the RCM cable between the generator set RCM receptacle (refer to Figure 2-18 for location of receptacle) and the RCM.

WARNING

Do not attempt to make connections to the control cubivir while generator set is in operation. Death or injury may result from failure to observe this warning.

NOTE

The RCM cable may be above ground or buried. If the cable must traverse a road, It should be buried 6 inches (150 mm), minimum, below the road surface or be suspended above the road high enough to allow passage of anticipated traffic.

(1) Connect the remote control cable to the remote control module by connecting one end of the cable (34, Figure 5-1) to J26 on the generator set and connecting the other end to J26R on the back of the remote control. See Figure 2-18 for RCM receptacle.

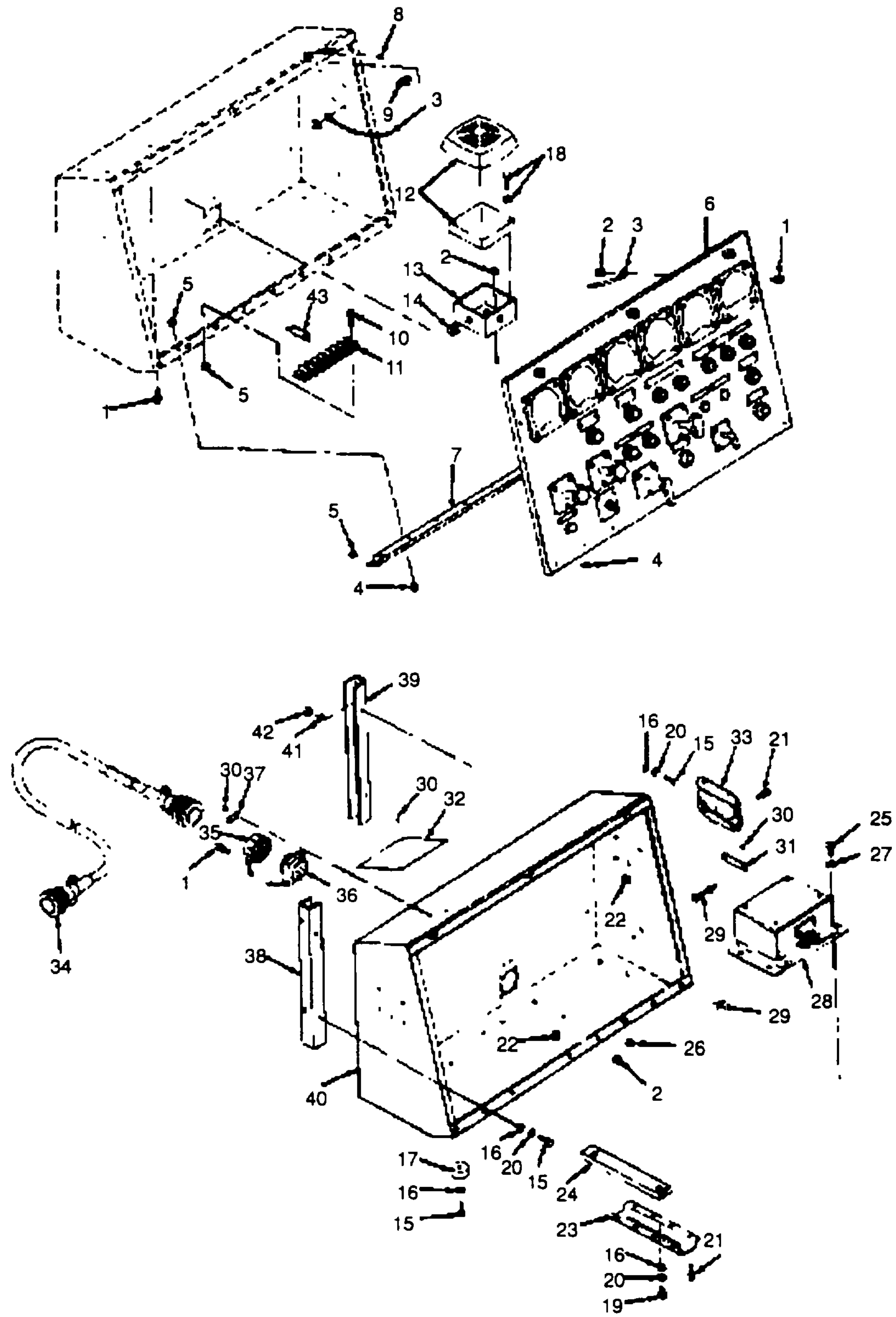


Figure 5-1. Remote Control Module Assembly (Sheet 1 of 2)

1. SCREW AND CAPTIVE WASHER ASSEMBLY
2. NUT AND CAPTIVE WASHER ASSEMBLY
3. DOOR HOLDER
4. SCREW AND CAPTIVE WASHER ASSEMBLY
5. NUT AND CAPTIVE WASHER ASSEMBLY
6. DOOR ASSEMBLY
7. HINGE
8. RIVET
9. RIVET TYPE RECEPTACLE
10. SCREW AND CAPTIVE WASHER ASSEMBLY
11. TERMINAL BLOCK TB1R MODULE
12. HORN
13. ELECTRICAL BOX
14. GROMMET
15. HEXAGON HEAD CAPSCREW
16. LOCKWASHER
17. RUBBER BUMPER
18. SCREW AND CAPTIVE WASHER ASSEMBLY
19. HEXAGON HEAD CAPSCREW
20. FLAT WASHER
21. SCREW AND CAPTIVE WASHER ASSEMBLY
22. NUT AND CAPTIVE WASHER ASSEMBLY
23. CHANNEL SUPPORT
24. BAR SUPPORT
25. HEXAGON HEAD CAPSCREW
26. HEXAGONAL NUT
27. LOCKWASHER
28. FREQUENCY TRANSDUCER A103R
29. LOAD GROUND TERMINAL
30. RIVET
31. IDENTIFICATION PLATE, GROUND
32. IDENTIFICATION PLATE, REMOTE CONTROL MODULE
33. HANDLE
34. CABLE ASSEMBLY
35. CONNECTOR COVER
36. RECEPTACLE CONNECTOR
37. IDENTIFICATION PLATE J26R
38. LEFT STORAGE BRACKET
39. RIGHT STORAGE BRACKET
40. REMOTE CONTROL BOX
41. MOUNTING FLATWASHER
42. SELF-LOCKING WASHER
43. DIODE

Figure 5-1. Remote Control Module Assembly (Sheet 2 of 2)

(2) Connect the LOAD GROUND terminal (29) on the side of the remote control to a suitable ground.
(3) Ensure that organizational maintenance personnel have performed the procedures described in Chapter 4, Section I , "Service Upon Receipt of Equipment".
(4) Ensure that before operation preventive maintenance checks and services have been performed on the generator set.
(5) Ensure that all shutters on the generator set are open and all doors on the generator set are closed.
(6) Set LOCAL REMOTE switch S2 (23, Figure 2-2, Table 2-2) to REMOTE.
(7) Set 24 V DC CONTROL POWER CIRCUIT BREAKER CB1 (2, Figure 2-1, Table 2-1) to ON.
(8) Set MAINTENANCE LOCKOUT switch S100 (1, Figure 2-1, Table 2-1) to OPERATE.
(9) Set OPERATION SELECTOR SWITCH S3 (21, Figure 2-2, Table 2-2) to MANUAL.

d. Use of the RCM. Refer to paragraph 2-9.

5-4. LUBRICATION. The remote control module requires no lubrication

5-5. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (A, N). To ensure that the remote control module is ready for operation at all times, It must be Inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance services to be performed are listed and described in Table 5-1 (A). Item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit should be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noticed which could damage the equipment if operation were continued. Record all deficiencies and short-comings together with the correct actions taken, on applicable form.

5-6. OPERATOR TROUBLESHOOTING. Table 5-2 contains troubleshooting information for use in correcting operating troubles which may develop in the remote control module. Each malfunction is followed by a list of tests or inspections which will help to determine probable causes and corrective actions to take. Perform corrective actions in the order listed. Any trouble beyond the scope of the crew level maintenance should be referred to the next higher (unit) level of maintenance.

WARNING

Dry cleaning solvent P-D-680, Type II, or equivalent, is flammable and moderately toxic to the skin, eyes, and respiratory tract. Skin, eye, and respiratory protection is required to avoid injury to personnel.

NOTE

Before referring to Table 5-2, be sure that all applicable checks have been performed in accordance with the Preventive Maintenance Checks and Services, Table 3-2.

Table 5-1. Remote Control Module and Cable Preventive Maintenance Checks and Services

Item No.	Interval	Location Item to Check/ Service	Procedure	Not Fully Mission Capable If:
1	Before	Control and Instrument	Inspect controls, gages, lamps and instruments for damage, loose mounting, or loose connections.	
2	Before	Remote Control Cable Assembly	Inspect for damaged or frayed insulation, and damaged connections When cable is buried only cable ends can be inspected.	
3	During	Control and Instruments	Inspect controls, gages, lamps and instruments for damage, loose mounting or loose connections.	

Table 5-2. Operator Remote Control Module Troubleshooting

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

WARNING

To avoid Injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment is NOT energized. Residual voltage is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

Table 5-2. Operator Remote Control Module Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NOTE

To determine whether it is the remote control module or the generator set that is malfunctioning, operate or monitor the corresponding control or indicator on the generator set to see if the correct. Indication is obtained with exception of synchroscope. When LOCAL REMOTE switch is in REMOTE position, synchroscope in control room is not operating If operation or indication is correct, the remote control module is, most probably, at fault. If the generator set still does not operate properly, the generator set is, most probably, faulty. Refer to Table 3-3 for troubleshooting procedures for the generator set.

1. GENERATOR SET SHUTS DOWN (AC AMPERES METER, AC KILOVOLTS METER, AND FREQUENCY METER READINGS DROP TO ZERO) BUT NONE OF THE FAULT INDICATORS ARE ILLUMINATED.

NOTE

Two persons may be required to perform the following following procedure.

Check bulbs with ANNUNCIATOR TEST pushbutton switch S15R (31, Figure 5-2).

If bulb is defective, replace bulb.

2. AC AMPERES METER M102R DOES NOT INDICATE CORRECT CURRENT.

Set AMMETER switch S114R to each position and observe AMMETER indication while checking against generator set AC AMPERES meter M102.

If indication is incorrect In all positions of AMMETER switch S114R, the AC AMPERES meter M103R is, most probably, at fault (refer to the next higher level of maintenance for replacement). If AC AMPERES meter M102R indication is correct in at least one position, refer to the next higher level of maintenance.

3. AC KILOVOLTS METER M101R DOES NOT INDICATE CORRECT VOLTAGE.

Set GEN/BUS VOLTMETER switch S112R to each position and observe AC KILOVOLTS meter M101R indication while checking against generator set AC KILOVOLTS meter M101.

If indication is incorrect in all positions of GEN/BUS VOLTMETER switch S112R, the AC KILOVOLTS meter M101R is, most probably, at fault (refer to the next higher level of maintenance for replacement). If AC KILOVOLTS meter M101R indication is correct in at least one position, refer to the next higher level of maintenance.

5-7. OPERATOR MAINTENANCE OF THE REMOTE CONTROL MODULE. This paragraph includes instructions to assist the operator in maintaining the remote control module. If defective components are noted during inspection, refer to the next higher level of maintenance for replacement or repair unless noted otherwise. Inspection of the remote control module consists of performing inspections specified below. Servicing of the remote control module is limited to cleaning with solvent, P-D80, Type II, or equivalent, and repainting In accordance with MIL-T-704.

a. AC AMPERES Meter M102R (1, Figure 5-2). .AC AMPERES meter M102R indicates the amount of current flowing through each individual phase of generator G1. Inspect for cleanliness, broken indicators, and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

b. AC KILOVOLTS Meter M101R (2, Figure 5-2). AC KILOVOLTS meter M101R indicates the voltage output of generator G1 In a line-to-line condition. Inspect for cleanliness, broken indicators, and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

c. Frequency Meter M103R (3, Figure 5-2). Frequency meter M103R indicates frequency output of generator G1. Inspect for cleanliness and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

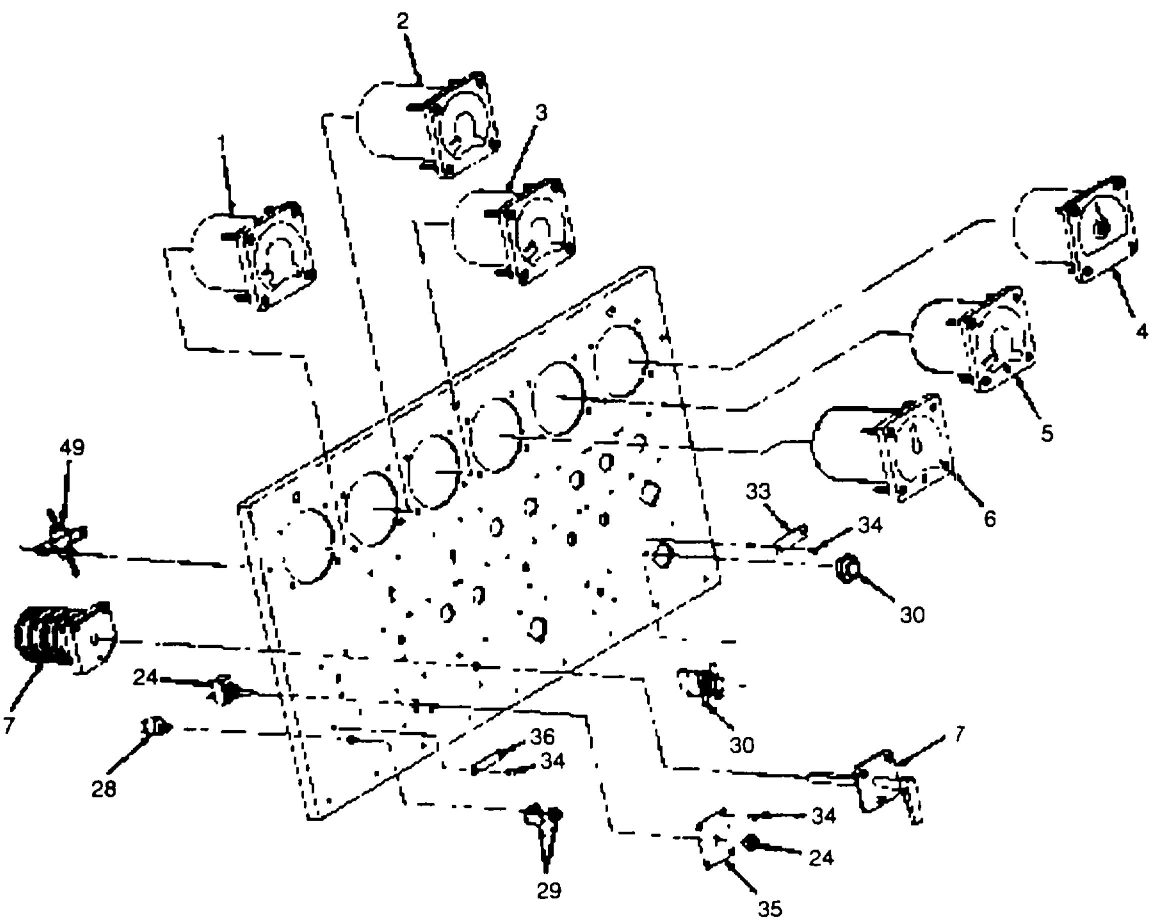


Figure 5-2. Remote Control Module, Door Assembly (Sheet 1 of 4)

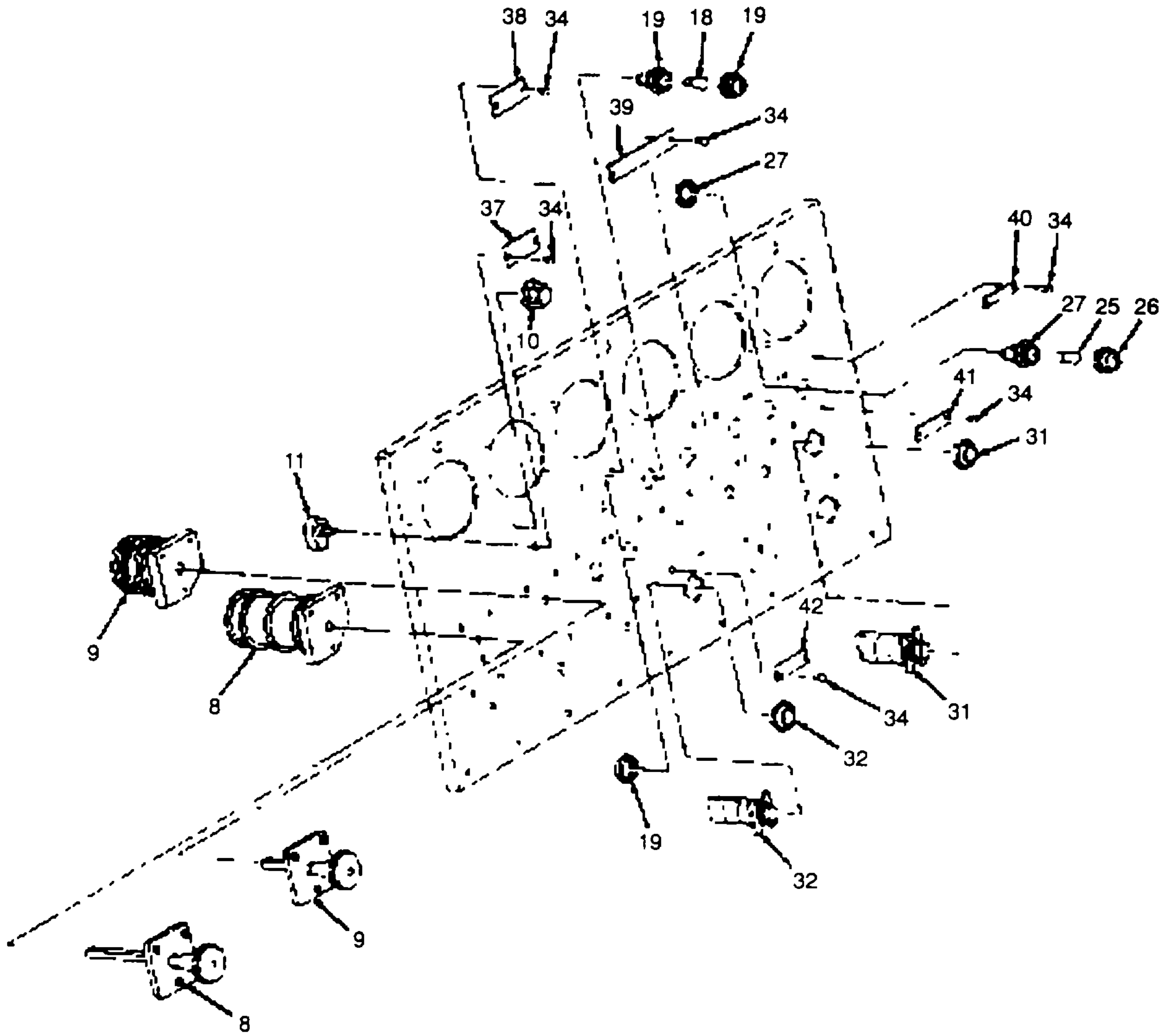


Figure 5-2. Remote Control Module, Door Assembly (Sheet 2 of 4)

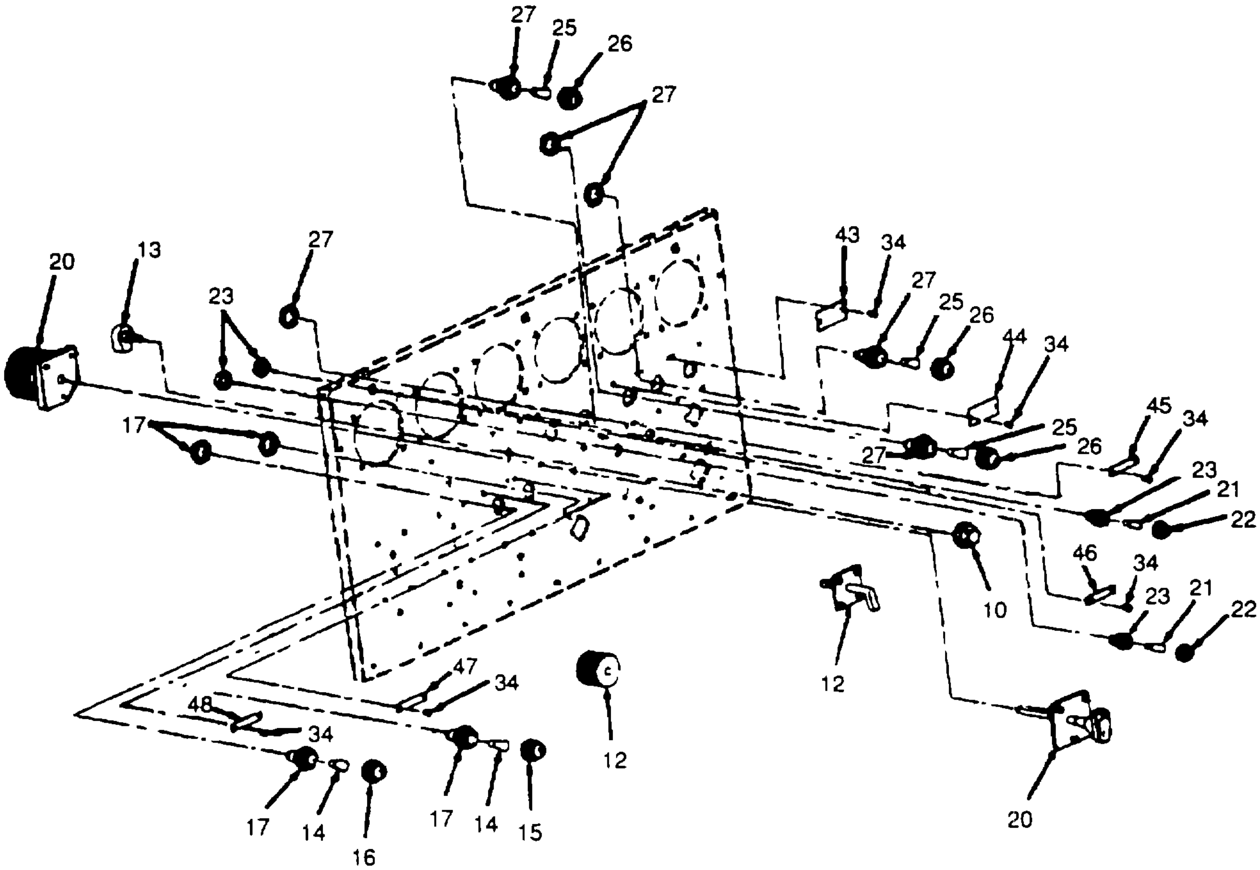


Figure 5-2. Remote Control Module, Door Assembly (Sheet 3 of 4)

1. AC AMPERES METER M102R
2. AC KILOVOLTS METER M101R
3 FREQUENCY METER M103R
4 POWER FACTOR METER M104R
5. AC KILOWATTS METER M107R
6. SYNCHROSCOPE M106R
7. BREAKER CONTROL SWITCH S4R
8 AMMETER SWITCH S114R
9 GEN/BUS VOLTMETER SWITCH S112R
10. KNOB
11. VOLT ADJ RHEOSTAT R101R
12 PARALLEL SWITCH S6R
13 FREQ ADJ RHEOSTAT R102R
14 OPEN/CLOSED INDICATORS DS33R AND DS34R
15 RED LENS
16. GREEN LENS
17. LAMP HOLDER
18 SYNCHRONIZING LIGHTS DS110R AND DS111R
19 LAMP HOLDER AND LENS
20. SYNCHROSCOPE SWITCH S115R
21. PARALLEL INDICATOR/SINGLE SET INDICATOR DS35R AND DS36R
22. CLEAR LENS
23 LAMP HOLDER
24 MASTER SWITCH S9R
25 HIGH COOLANT/LOW OIL/FAULT LIGHTS
26 LENS
27. LAMP HOLDER
28 TELEPHONE JACK
29. JACK COVER
30. ALARM SILENCE PUSHBUTTON SWITCH S16R
31. ANNUNCIATOR TEST PUSHBUTTON SWITCH S15R
32. EMERGENCY SHUTDOWN PUSHBUTTON SWITCH S7R
33. NAMEPLATE, ALARM SILENCE
34 RIVET
35. IDENTIFICATION PLATE, MASTER SWITCH
36. NAMEPLATE, TEL JACK
37. IDENTIFICATION PLATE, VOLTAGE ADJUST
38. IDENTIFICATION PLATE, FREQUENCY ADJUST
39. IDENTIFICATION PLATE, SYNCHRONIZING LIGHTS
40 IDENTIFICATION PLATE, FAULT
41 NAMEPLATE, ANNUNCIATOR TEST
42. NAMEPLATE, EMERGENCY SHUTDOWN
43 IDENTIFICATION PLATE, HIGH WATER TEMPERATURE
44. IDENTIFICATION PLATE, LOW OIL PRESSURE
45. IDENTIFICATION PLATE, SINGLE SET
46 NAMEPLATE, PARALLEL
47 NAMEPLATE, CLOSED
48 NAMEPLATE, OPEN
49. RESISTOR R110R AND R111R

Figure 5-2. Remote Control Module, Door Assembly (Sheet 4 of 4)

d. POWER FACTOR Meter M104R (4, Figure 5-2). POWER FACTOR meter M104R indicates the power factor of the load on generator G1. Inspect for cleanliness, broken Indicators, and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

e. AC KILOWATTS Meter M107R (5. Figure 5-2). AC KILOWATTS meter M107R indicates the power output of the generator set. Inspect for cleanliness, broken indicators, and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

f. SYNCHROSCOPE Meter M106R (6. Figure 5-2). SYNCHROSCOPE M106R indicates the phase relationship between the bus and a generator to be paralleled. Inspect for cleanliness, broken indicators, and signs of damage. Check for secure attachment to panel and for chipped, cracked, or loose cover glass.

g. BREAKER CONTROL Switch S4R (7. Figure 5-2). BREAKER CONTROL switch S4R is used to open or close load circuit breaker CB101. Inspect for cleanliness and signs of damage. Check security of panel mounting and wiring connections. Check handle operation in CLOSE position and in the TRIP position. Spring-loaded handle should return to vertical position after each command operation with handle index on the target window. Target window should show red when last command operation was CLOSE and green when last command operation was TRIP. Check for proper PULL TO LOCK operation for handle In TRIP position. Handle should remain locked until pushed for release and then should spring back to normal vertical position.

h. AMMETER Switch S114R (8. Figure 5-2). AMMETER switch S114R is a six-section rotary tap-switch contact design. An integral detent assembly provides positive click stops at operational switch positions. The switch is used in conjunction with AC AMPERES meter M102R to select any of three phases for a current draw indication. Inspect for cleanliness and damage. Check security of mounting to panel, wiring connections, and switch knob. Check for satisfactory operation of click stops in all five positions.

i. GEN/BUS VOLTMETER Switch S112R (9, Figure 5-2). The GEN/BUS VOLTMETER switch S112R is a two-section, rotary tap-switch contact design. An integral detent assembly provides click stops at all eight positions. This switch is used in conjunction with AC KILOVOLTS meter M101 R to select any one of the three generator. phases at either the generator or at the bus to check for voltage levels. Inspect for cleanliness and damage to knob Check security of knob on shaft. Rotate full range in both directions while observing that travel is smooth and uninterrupted and no evidence of bent shaft is noted. Check rear of panel for security of mounting and wiring connections.

j. VOLT ADJ Rheostat R101R (11, Figure 5-2). VOLT ADJ rheostat R101R is used to manually adjust voltage output of generator G1. Inspect for cleanliness and damage to knob. Check security of knob on shaft. Rotate full range in both directions while observing that travel is smooth and uninterrupted and no evidence of bent shaft is noted. Check rear of panel for security of mounting and wiring connections.

k. PARALLEL SWITCH S6R (12, Figure 5-2). PARALLEL SWITCH S6R is a two-section, or deck, rotary switch with handle spring return to vertical position following a command operation. The switch is used to select either single or parallel generator set operation. Inspect for cleanliness and damage. Check security of mounting to panel, wiring connections, and switch knob. heck for proper operation in both PARALLEL and SINGLE positions. Spring action should return knob to normal (vertical) position.

l. FREQ ADJ Rheostat R102R (13, Figure 5-2). FREQ ADJ rheostat R102R is used to manually adjust the frequency of the output of generator G1. Inspect for cleanliness and damage to knob. Check security of knob on shaft. Rotate full range In both directions while observing that travel is smooth and uninterrupted and no evidence of bent shaft is noted. Check rear of panel for security of mounting and wiring connections.

m. OPEN Indicator DS33R and CLOSED Indicator DS34R (14, Figure 5-2). These indicators light to provide a visual display of the BREAKER CONTROL switch position. Inspect that lenses are secure and not cracked and lampholders are secure in panel. Check wiring security at rear of panel.

n. SYNCHRONIZ1ING LIGHTS DS11OR and DS111 R and Resistors R11OR and R111R (18 and 49. Figure 5-2). These lights indicate the phase relationship of the bus and generator set to be paralleled Inspect that lenses are secure and not cracked and lamp holders are secure in panel. Check wiring security at rear of panel. Check dropping resistors R110R and R111R mounted at back of panel on either side of the synchronizing lights for secure mounting and electrical connections.

o. SYNCHROSCOPE Switch S115R (20, Figure 5-2). The SYNCHROSCOPE switch S115R Is a two-position switch consisting of three decks. This switch "arms" SYNCHRONIZING LIGHTS DS110R and DS111R. Inspect for cleanliness and damage Check security of mounting to panel, wiring connections, and switch knob. Check for proper operation of click stops in both positions.

p. PARALLEL Indicator DS35R and SINGLE SET Indicator DS36R (21, Figure 5-2). These indicators light to provide a visual display of the PARALLEL SWITCH position. Inspect that lenses are secure and not cracked and lamp holders are secure in panel Check wiring security at rear of panel.

q. MASTER Switch S9R (24, Figure 5-2). MASTER (Start-Stop-Run) switch S9R is a two-pole, spring return, toggle switch which allows the operator to start up, or stop, the generator set from the remote control module. Inspect for cleanliness and signs of damage. Check security of mounting and for satisfactory operation in START, RUN, and STOP positions.

r. HIGH COOLANT/LOW OIL PRESSURE/FAULT Lights (25. Figure 5-2). These lights illuminate to indicate that a fault condition has occurred at the generator set. Inspect that lenses are secure and not cracked and that lampholders are secure in panel. Check wiring security at rear of panel.

s. TEL JACK J15R (28, Figure 5-2). The TEL JACK allows communications between the remote control module site and the main generator set through the head set.

  (1) Inspect. Check TEL JACK for security of mounting, cleanliness, and signs of damage. Check wiring security at rear of panel.

  (2) Replace.

    (a) Tag and disconnect wiring to TEL JACK (28, Figure 5-2).

    (b) Remove TEL JACK (28) from rear of panel by removing mounting nut holding jack cover (29) to the front panel.

    (c) Position TEL JACK (28) from rear of panel and attach jack cover (29) from front and install nut removed in step (b), above.

    (d) Connect wires and discard tags.

t. ANNUNCIATOR TEST. ALARM SILENCE. AND EMERGENCY SHUTDOWN PUSHBUTTON SWITCHES, S15R. S16R, and S7R (30, 31, and 32. Figure 5-2). These switches test the annunciator alarm, silence the horn when the alarm sounds and shut down the generator set. Inspect pushbutton switches for cleanliness and damage. Check security of panel mounting panel and switch wiring connections.

NOTE

To reset fault alarm, annunciator reset pushbutton S16A In generator set must be actuated.

u. Connector Receptacle J26R (36. Figure 5-1). The connector receptacle J26R permits easy connection between the generator set control room and the remote control module by providing a single connector for all the wires contained in the remote control cable. Inspect for cleanliness, security of mounting, wiring security, and damage. Ensure that cap fits over receptacle and that threads are not damaged.

v. Wiring Harness (Figure 5-3). Interconnects all RCM contacts and indicators to generator set. Inspect the wiring harness for loose mounting or connections, fraying, damaged insulation, sleeving, or lugs.

w. Diode Assembly (DIR-D6R) TB1R. The diode assembly prevents spurious current surges through lamps. Inspect blocking diodes DR1 through DR6 mounted on terminal block TB1R (11, Figure 5-1) inside the RCM chassis. Check diodes for loose connections, signs of overheating, and signs of damage.

x. Annunciator Horn LS1 R. The horn provides an audible alarm when fault condition occurs. Inspect annunciator horn LS1R (12, Figure 5-1) inside the chassis for secure mounting, electrical connections, and signs of damage.

y. Frequency Transducer A103R (28. Figure 5-1). The frequency transducer provides driving current signals for the frequency meter M103R. Frequency transducer A103R is mounted at the interior lower right chassis of the remote control module. Inspect the transducer for secure mounting, wiring connections, and signs of damage.

5-8. UNIT TROUBLESHOOTING. Table 5-3 and paragraph 5-13 provide information for locating and correcting operating troubles which may develop in the remote control module. Each malfunction is followed by a list of tests or inspections which will help to determine probable causes and corrective actions to take. Perform the tests or inspections and corrective actions in the order listed. Any trouble beyond the scope of unit maintenance should be referred to the next higher level of maintenance.

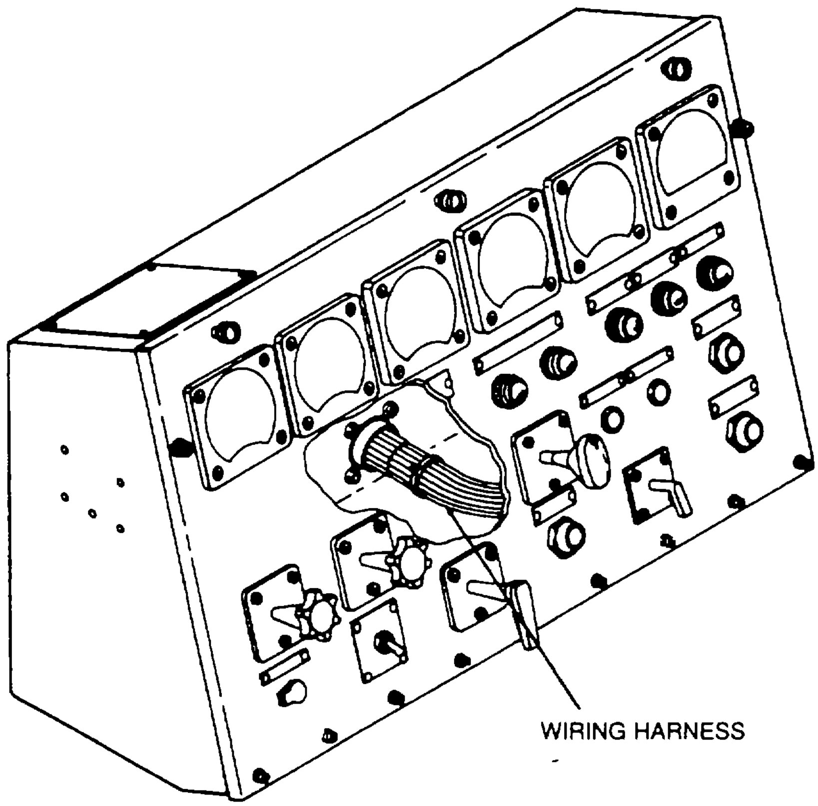


Figure 5-3. Remote Control Module, Wiring Harness

5-9. UNIT MAINTENANCE OF THE REMOTE CONTROL MODULE . Unit testing of the remote control module is accomplished by performing tests on components listed below. Replacement of the entire module is performed by disconnecting the remote control cable (see Figure 1-9) and ground wire from the unit and installation of another module in accordance with the information in paragraph 5-3. Repair of the remote control module is accomplished by the replacement of its components as required and detailed below.

a. AC AMPERES Meter M102R (1, Figure 5-2). The AC AMPERES meter M102R indicates the amount of current flowing through each individual phase of generator G1.

(1) Adjust. Zero Adjust AC AMPERES Meter M102R. An adjustment screw on the face of AC AMPERES meter M102R is used to zero the meter when It is not energized. If necessary adjust the screw on meter face to align the needle with the zero mark.

(2) Test.

(a) Start the generator set for REMOTE SINGLE SET operation in accordance with paragraph 2-9 and Figure 2-22 with constant output applied to any available and stable load.

(b) Monitor the following quantities off the appropriate meters on the remote control module and record.

<u>1</u> Current (I) output readout off AC AMPERES meter M102R.

<u>2</u> Voltage (E) output readout off AC KILOVOLTS meter M101R.

<u>3</u> Kilowatt (P) output readout off AC KILOWATTS meter M107R.

<u>4</u> Power factor (Pf) readout off POWER FACTOR meter M104R.

(c) Determine accuracy and serviceability of AC AMPERES meter M102R by calculation using the quantities recorded in step (b), above. Calculate theoretical current output using the following 3 phase equation.

$$I = \frac{P}{E\sqrt{3}\ Pf}$$

(d) Compare calculated current output against actual readout of AC CURRENT meter M102R Meter movement requires 1 milliampere DC for full scale meter deflection. Current readout of M102R should be within ±5 percent of calculated current if not, replace AC CURRENT meter M102R.

(3) Replace.

(a) Shut down the generator set. See Figure 2-23.

(b) Open the RCM panel by unlocking three oval studs across the top of the panel.

(c) Tag and disconnect wires from AC AMPERES meter M102R terminals.

(d) Refer to Figure 5-2. Remove nuts and lockwashers from AC AMPERES meter M102R (1) mounting studs to remove meter.

(e) Remove nuts and lockwashers from mounting studs of replacement meter M102R (1), if installed.

(f) Install replacement AC AMPERES meter M102R and secure with nuts and lockwashers.

(g) Connect wires to M102R terminals as tagged. Remove and discard tags.

(h) Close the RCM panel and secure by locking the three oval studs across the top of the panel.

b. <u>AC KILOVOLTS Meter M101R (2, Figure 5-2).</u> AC KILOVOLTS meter M101R indicates generator output voltage or bus voltage depending on setting of the GEN/BUS VOLTMETER switch S112R.

(1) Adjust. With the generator set shut down or the RCM deenergized, check that the AC KILOVOLTS meter M101R pointer is aligned with the zero adjust point on the meter dial. It necessary, adjust the screw on the meter face to align with the zero mark.

(2) Test.

(a) Start the generator set for REMOTE SINGLE SET operation in accordance with paragraph 2-9 and Figure 2-22 with constant output applied to any available and stable load.

(b) Monitor the following quantities off the appropriate RCM meters and record.

<u>1</u> Voltage (E) readout off AC KILOVOLTS meter M101R.

<u>2</u> Current I readout off AC AMPERES meter M102R.

<u>3</u> Kilowatt (P) output readout off AC KILOWATTS meter M107R.

<u>4</u> Power factor (Pf) readout off POWER FACTOR meter M 104R.

(c) Determine accuracy and serviceability of AC KILOVOLTS meter M101R by calculation using metered quantities recorded in step (b), above. Meter movement requires 1 milliampere DC for full scale meter deflection. Use the equation as follows to obtain theoretical voltage output.

$$E = \frac{P}{I\sqrt{3}\ Pf}$$

(d) Compare calculated voltage output against the actual voltage readout off AC KILOVOLTS meter M101 R. Voltage readout off M101 R should be within ±5.0 percent of the calculated voltage. Meter movement requires 262.5 V ac 50/60 Hz for full scale meter deflection. If not, replace AC KILOVOLTS meter M101 R.

(3) Replace.

(a) Shut down the generator set. See Figure 2-3.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wiring from AC KILOVOLTS meter M101 R.
(d) See Figure 5-2. Remove mounting nuts and lockwashers from the AC KILOVOLTS meter M101R (2) mounting studs to remove the meter.
(e) Remove nuts and lockwashers from mounting studs of replacement meter M101R, if Installed.
(f) Install replacement AC KILOVOLTS meter M101R and secure with mounting nuts and lockwashers.
(g) Connect wires to M101R terminals as tagged. Remove and discard tags.
(h) Close the RCM panel and secure by locking the three oval studs across top of the panel.

c. <u>Frequency Meter M103R and Frequency Transducer A103R (28. Figure 5-1 and 3. Figure 5-2).</u> Frequency meter M103R indicates frequency output of generator G1. Frequency meter M103R and frequency transducer A103R are a matched pair and should be tested and replaced, if needed, as a set.

(1) Adjust. Zero Adjust Frequency Meter M103R. An adjustment screw on the face of frequency meter M103R is used to zero the meter when it is not energized.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(2) Test.

(a) Shutdown the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wires from terminals 1 and 2 of frequency transducer A103R (28, Figure 5-1).
(d) Ensure that wires from terminals + and-of frequency transducer A103R (28) are connected securely.
(e) Connect a 120 V AC power source known to have a steady frequency across terminals 1 and 2 of frequency transducer A103R (28) and monitor frequency meter M103R (3, Figure 5-2) on RCM front panel.
(f) Frequency meter M103R should indicate a steady Hz value.
(g) Replace frequency meter M103R if the Hz value indicated vanes by more than ±2 percent.

(3) Replace frequency meter M103R and frequency transducer Al 03R are a matched pair and should be replaced as a set.

(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wires from frequency meter M103R terminals (3, Figure 5-2).
(d) See Figure 5-2 Remove nuts and lockwashers from frequency meter M103R (3) mounting studs to remove meter.

(e) Remove nuts and lockwashers from mounting studs of replacement meter M103R (3), if installed.
(f) Install replacement frequency meter M103R (3) and secure with nuts and lockwashers.
(g) Connect wires to M103R terminals as tagged. Remove and discard tags.
(h) Tag and disconnect wires from frequency transducer A103R (28, Figure 5-1) terminals.
(I) See Figure 5-1. Remove hexagon head capscrews (25), hexagonal nuts (26), and lockwashers (27) to remove frequency transducer A103R.
(j) Install replacement frequency transducer A103R (28) and secure with hexagon head capscrews (25), hexagonal nuts (26), and lockwashers (27).
(k) Connect wires to A103R terminals as tagged. Remove and discard tags.
(l) Close RCM panel and secure by locking three oval studs across the top of the panel.

d. <u>AC KILOWATTS Meter M107R (5, Figure 5-2).</u> The AC KILOWATTS meter M107R indicates power output of generator G1.

(1) Adjust. Zero Adjust AC KILOWATTS Meter M107R. An adjustment screw on the face of AC KILOWATTS meter M107R is used to zero the meter when it is not energized.
(2) Test.
(a) Start the generator set and set for REMOTE SINGLE SET mode in accordance with Figure 2-22 with constant output applied to any available stable load.
(b) Monitor the following quantities off the appropriate RCM meters and record.
<u>1</u> KW (P) output readout off AC KILOWATTS meter M107R.
<u>2</u> Voltage (E) output readout off AC KILOVOLTS meter M101R.
<u>3</u> Current (I) output readout off AC AMPERES meter M102R.
<u>4</u> Power factor (Pf) readout off POWER FACTOR meter M104R
(c) Determine accuracy and serviceability of AC KILOWATTS meter M107R by calculation using quantities recorded in step (b), above. Calculate theoretical power output using the following 3 phase power equation:

$$P = E \; I \sqrt{3} \;\; Pf$$

(d) Compare calculated power output against the actual kilowatt readout off AC KILOWATTS meter M107R. Kilowatt readout off M107R should be within ±5.0 percent of the calculated power output. Meter movement requires 1 millampere DC for full scale meter deflection. If not, replace AC KILOWATT meter M107R.
(3) Replace.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wires from AC KILOWATTS meter M107R (5), Figure 5-2) terminals.
(d) Refer to Figure 5-2. Remove nuts and lockwashers from AC KILOWATTS meter M107R (5) mounting studs and remove meter.
(e) Remove nuts and lockwashers from mounting studs of replacement meter M107R (5), if Installed.
(f) Install replacement AC KILOWATTS meter M107R (5) and secure with nuts and lockwashers.
(g) Connect wires to M107R terminals as tagged. Remove and discard tags.
(h) Close RCM panel and secure by locking three oval studs across the top of the panel.

e. POWER FACTOR Meter M104R (4. Figure 5-2). POWER FACTOR meter M104R indicates the power factor of generator G1 output.

(1) Adjust. Zero Adjust POWER FACTOR meter M104R. An adjustment screw on the face of POWER FACTOR meter M104R Is used to zero the meter when it is not energized.

(2) Test.

(a) Start the generator set and set for REMOTE SINGLE SET mode in accordance with Figure 2-22 with constant output applied to any available stable load.

(b) Monitor the following quantities off the appropriate RCM meters and record.

1 Power factor (Pf) readout off POWER FACTOR meter M104R.

2 Voltage (E) output readout off AC KILOVOLTS meter M101R.

3 Current (I) output readout off AC AMPERES meter M102R.

4 Kilowatt (P) readout off AC KILOWATTS meter M104R.

(c) Determine accuracy and serviceability of POWER FACTOR meter M104R by calculation using quantities recorded In step (b), above. Calculate theoretical power factor using the following 3 phase power equations:

$$Pf = \frac{P}{E\ I\sqrt{3}}$$

(d) Compare calculated power factor against the actual readout of POWER FACTOR meter M104R. Meter movement requires ± 0.5 milliamperes DC for full scale meter deflection.

(3) Replace.

(a) Shut down the generator set. See Figure 2-23.

(b) Open the RCM panel by unlocking three oval studs across the top of the panel.

(c) Tag and disconnect wires from POWER FACTOR meter M104R (4, Figure 5-2) terminals.

(d) Refer to Figure 5-2 Remove nuts and lockwashers from POWER FACTOR meter M104R (4) mounting studs and remove meter.

(e) Remove nuts and lockwashers from mounting studs of replacement meter M104R (4), if Installed.

(f) Install replacement POWER FACTOR meter M104R (4) and secure with nuts and lockwashers.

(g) Connect wires to M104R terminals as tagged. Remove and discard tags.

(h) Close RCM panel and secure by locking three oval studs across the top of the panel.

f. SYNCHROSCOPE M106R (6. Figure 5-2). The SYNCHROSCOPE indicates the phase relationship between the bus and the generator to be paralleled.

(1) Test. Synchroscope M106R can be checked while on the RCM by monitoring the scope and synchronizing lights DS110R and DS111R. This procedure will require two generator sets, one (one-line), to provide bus voltage for phase comparison against the output of the Incoming set where remote synchroscope is under test.

(a) Set up two generator sets for remote parallel operation. Start online generator set (to provide bus voltage) in accordance with paragraph 2-4. Start up incoming set (remote synchroscope under test) and set for parallel operation at a slightly higher frequency then the online set.

(b) Set SYNCHROSCOPE switch S115R on incoming set (under test) to ON Monitor SYNCHROSCOPE M106R and SYNCHRONIZING LIGHTS DS110R, DS011R on its RCM. Synchroscope pointer should start rotating and SYNCHRONIZING LIGHTS DS1110R, DS111R should start blinking. With incoming set operating at a higher frequency SYNCHRONIZING LIGHTS DS110R and DS111R should be glowing light and dark. SYNCHROSCOPE meter M106R pointer should rotate in the clockwise (FAST) direction and should pass through the 12 o'clock position when the SYNCHRONIZING LIGHTS DS110R and DS111R are dark.

(c) Lower frequency of incoming set using Its FREQ ADJ rheostat R102R SYNCHROSCOPE M106R pointer should slowly rotate In the clockwise (fast) direction but still pass through the 12 o'clock position when the SYNCHRONIZING LIGHTS DS110R and DS111R are dark.

(d) Monitor Incoming generator and bus voltages using GEN/BUS VOLTMETER selector switch S112R and AC KILOVOLTS meter M101R on the Incoming sets RCM. Adjust VOLT ADJ rheostat R101R on the RCM and continue adjusting until GEN and BUS voltages are equal. With GEN and BUS voltages equal, SYNCHROSCOPE M106R pointer should stop at 12 o'clock position and SYNCHRONIZING LIGHTS DS110R and DS111R should go dark.

(e) With GEN and BUS voltage equal, close incoming set load circuit breaker CB101 using BREAKER CONTROL switch S4R on its RCM. When breaker is closed, and sets are in parallels, SYNCHROSCOPE pointer should remain at the 12 o'clock position (in sync).

(f) Replace SYNCHROSCOPE M106R if it falls operational test as described above.

(2) Replace.

(a) Shut down generator set or set LOCAL REMOTE SW S2 In the generator set control room to LOCAL to deenergize the RCM.

(b) Open the RCM panel by unlocking three oval studs across the top of the panel.

(c) Tag and disconnect wires from SYNCHROSCOPE meter M106R (6) Figure 5-2) terminals.

(d) See Figure 5-2 Remove nuts and lockwashers from SYNCHROSCOPE meter M106R (6) mounting studs and remove meter.

(e) Remove nuts and lockwashers from mounting studs of replacement SYNCHROSCOPE M106R (6), if installed.

(f) Install replacement SYNCHROSCOPE meter M106R (6) and secure with nuts and lockwashers.

(g) Connect wires to M103R terminals as tagged. Remove and discard tags.

(h) Close RCM panel and secure by locking three oval studs across the top of the panel.

g. <u>BREAKER CONTROL Switch S4R (7. Figure 5-2).</u> The BREAKER CONTROL switch S4R (7) is a three-section (or deck) rotary, dual contact design. The BREAKER CONTROL switch S4R is used to open or close load circuit breaker CB101.

(1) Test.

(a) Shut down the generator set. See Figure 2-23.

(b) Open the RCM panel by unlocking three oval studs across the top of the panel.

(c) Tag and disconnect wires from BREAKER CONTROL switch S4R terminals.

NOTE

Switch wiring position numbers are translated as follows: the first digit defines the section, or deck, In relation to the handle end; the second digit is a specific terminal on that deck. For example. position 23 is located on the second deck, the contact is terminal number three.

(d) Set a multimeter test to RX1 scale and test for contact continuity in the switch positions specified. Meter should Indicate 0 ohms at the points marked In Figure 4-67.

(e) Multimeter should indicate infinite ohms at all open contacts in Figure 4-67.

NOTE

An integral spring return mechanism returns the handle to the normal-vertical position except in the pull-to-lock position. Slip contacts are incorporated to maintain contact closure in the last commanded position. These slip contacts are also used for the OPEN indicator light DS33 and the CLOSED indicator light DS34.

(f) The target window opening on the face of the switch plate should show green when last command operation was TRIP and red on.
(g) Switch handle should return to vertical position following either command, TRIP or CLOSE.
(h) Target window should show red when last command operation was CLOSE.
(i) Replace switch S4R if it falls to meet any of the above specifications.
(j) Connect wires to BREAKER CONTROL switch S4R as tagged. Remove and discard tags.

(2) Remove.
(a) Tag and disconnect wiring from BREAKER CONTROL switch S4R (7, Figure 5-2).
(b) Remove screw in center of handle and slide handle off switch shaft.
(c) Remove three screws from face of mounting panel on front of panel. Switch section may be removed from rear of the panel as an assembly.
(d) Install replacement BREAKER CONTROL switch S4R (7) by positioning the switch sections at the rear of remote control panel and assemble the mounting plate from the front, while securely attaching the entire assembly with the three mounting screws.
(e) Replace handle in the normal-vertical position and secure with attaching screw.
(f) Connect wires and remove and discard tags.
(g) Close RCM panel and secure by locking three oval studs across the top of the panel.

h. AMMETER Switch S114R (8, Figure 5-2). AMMETER switch S114R is a six-section rotary tap-switch contact design. An Integral detent assembly provides five positive click stops at operational switch positions. The switch is used with the AC AMPERES meter to select any of the three phases for a current draw indication.

(1) Test.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Rotate switch handle In both directions to ensure that AMMETER S114R clicks into all five switch positions.

NOTE

Switch wiring position numbers are translated as follows: the first digit defines the section, or deck, In relation to the handle end, the second digit is a specific terminal on that deck For example: position 23 is located on the second deck, the terminal is number 3.

(d) Tag and disconnect wring to switch contacts. Do not remove internal jumper wires.
(e) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in Figure 4-69. Meter should indicate zero ohms at all points marked in the chart.
(f) Multimeter should indicate infinity at all blank contacts in the chart.
(g) Connect wires to AMMETER switch Sl14R as tagged. Remove and discard tags

(2) Replace.
(a) Tag and disconnect wires from AMMETER switch S114R (8, Figure 5-2).
(b) Remove screw in center of handle and slide handle off the shaft.
(c) Remove screws from face of mounting plate on front of panel AMMETER switch (8) sections may be removed from rear of panel as an assembly.

NOTE

Before installing replacement switch transfer black jumper wires from old switch.

(d) Install replacement AMMETER switch S114 (8) by positioning the switch sections at the rear of panel and assemble the mounting plate from the front. Secure the entire assembly with three mounting screws.
(e) Replace handle In the normal dial-vertical position and secure with its attaching screw.
(f) Connect wires and remove and discard tags.
(g) Close RCM panel and secure by locking three oval studs across the top of the panel.

i. GEN/BUS VOLTMETER Switch S112R (9, Figure 5-2). GEN/BUS VOLTMETER switch S112R (9) is a two-section, rotary tap-switch contact design. An integral detent assembly provides positive click stops at all eight positions. This switch is used with AC KILOVOLTS meter to select any one of the three phases at either the generator or at the bus to check for voltage levels.

(1) Test.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.

NOTE

Switch wiring position numbers are translated as follows the first digit defines the section, or deck, In relation to the handle end, the second digit is a specific terminal on that deck. For example: position 23 is located on the second deck, the terminal is number 3.

(c) Tag and disconnect wiring to GEN/BUS VOLTMETER switch S112R contacts.
(d) Set a multimeter to RX1 scale and, test for contact continuity in the switch positions specified in Figure 4-70. Meter should indicate 0 ohms at all points marked in the chart.
(e) Multimeter should indicate infinite ohms at all blank places in the chart.
(f) Replace GEN/BUS VOLTMETER switch S112R. If it falls testing as described above.
(g) Connect wires to GEN/BUS VOLTMETER switch S112R as tagged. Remove and discard tags.

(2) Replace.
(a) Tag and disconnect wiring from GEN/BUS VOLTMETER switch (9) contacts.
(b) Remove screw In center of switch S112R handle and slide handle off shaft.
(c) Remove three screws from face of switch mounting plate on front of panel. Switch S112R sections may be removed from rear of panel as an assembly.
(d) Install replacement GEN/BUS VOLTMETER switch S112R (9) by positioning switch section at rear of panel and assemble the mounting plate from the front. Secure the entire assembly with the three mounting screws.
(e) Reinstall switch handle in the OFF position, ensuring that shaft is In the OFF condition. Secure handle with attaching screw.
(f) Connect wires as tagged Remove and discard tags.
(g) Close remote control panel and secure by locking the three oval studs at the top of the panel.

j. VOLT ADJ Rheostat R101R (11, Figure 5-2). The VOLT ADJ rheostat R101R is used to manually adjust voltage output of generator G1.

(1) Test.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Remove wire from terminal 3 of VOLT ADJ rheostat R101R (11).
(d) Rotate knob fully counterclockwise.

(e) Set a multimeter to RX1 scale and check for continuity across terminals 1 and 2. Resistance reading should be less than one ohm.
(f) Reset multimeter to RX 1000. While observing the multimeter indication, slowly rotate knob in a clockwise direction. Meter resistance indication must increase smoothly, with no erratic jumps at any points in travel.
(g) When knob (wiper arm terminal 2) is in the fully clockwise stop position, total resistance indication shall be 500 ±50 ohms.
(h) Reconnect wire removed from terminal 3.
(i) The rheostat is not repairable. Replace the rheostat if it does not meet the specifications above.

(2) Replace. See Figure 5-2.
(a) Tag and disconnect wiring from VOLT ADJ rheostat R101R (11), if necessary.
(b) Remove knob (10) from front panel.
(c) Loosen and remove rheostat locking nut at front of panel and remove the rheostat assembly from the rear.
(d) Install VOLT ADJ rheostat R101 R (11) at rear of panel and secure in position with locking nut so that when the knob (10) is attached with the shaft rotated fully counterclockwise, the arrow is at the 9 o'clock position.
(e) Secure knob (10).
(f) Connect wires as tagged. Remove and discard tags.
(g) Close remote control panel and secure by locking three oval studs at top of the panel.

k. PARALLEL SWITCH S6R (12. Figure 5-2). The PARALLEL SWITCH S6R is a two-section, or deck, rotary switch with handle spring return to normal-vertical position following a command operation. The switch is used to select either single unit or parallel generator set operation.

NOTE

Switch wiring position numbers are translated as follows. the first digit defines the section, or deck, In relation to the handle end, the second digit is a specific terminal on that deck. For example position 23 is located on the second deck, the terminal is number 3.

(1) Test.
(a) Shut down the generator set See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wiring from PARALLEL SWITCH S6R (12) terminals.
(d) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in the chart in Figure 4-71. Meter should indicate zero ohms at all points marked In the chart.
(e) Multimeter should indicate Infinite ohms at all blank contacts in the chart.
(f) Rotate handle to the SINGLE position and release handle. Handle should return to the normal-vertical position automatically.
(g) Repeat step f, above, with handle rotated to the PARALLEL position.
(h) Replace PARALLEL SWITCH S6R (12) if it falls to pass testing as described above.
(i) Connect wires to PARALLEL SWITCH S6R as tagged Remove and discard tags.

(2) Replace.
   (a) Tag and disconnect wiring to PARALLEL SWITCH S6R (12, Figure 5-2) terminals.
   (b) Remove screw in center of handle and slide handle off shaft.
   (c) Remove four screws from face of mounting plate on front of remote control panel. Switch sections may be removed from rear of panel as an assembly.
   (d) Install replacement PARALLEL SWITCH S6R (12, Figure 5-2) by positioning switch sections at rear of panel and assemble the mounting plate from the front. Secure the entire assembly with the three mounting screws.
   (e) Reinstall switch handle in the OFF position, ensuring that shaft is in the OFF position. Secure handle with attaching screw.
   (f) Connect wires as tagged. Remove and discard tags.

l. ADJ Rheostat R102R (13, Figure 5-2). The FREQ ADJ rheostat R102R is used to manually adjust the frequency of the output of generator G1.

(1) Test
   (a) Shut down the generator set See Figure 2-23.
   (b) Open the RCM panel by unlocking three oval studs across the top of the panel.
   (c) Remove wire from terminal 3 of FREQ ADJ rheostat R102R (13, Figure 5-2).
   (d) Rotate knob fully counterclockwise.
   (e) Set a multimeter to RX1 00 scale and check for continuity across terminals 1 and 2. Resistance reading should be less than 10 ohms.
   (f) Reset multimeter to RX10OK. While observing the multimeter indication, slowly rotate knob in a clockwise direction. Meter resistance indication should increase smoothly, with no erratic jumps at any point in travel.
   (g) When knob (wiper arm terminal 2) is in the fully clockwise stop position, total resistance indication should be 5000 ±50 ohms.
   (h) Connect wire removed from terminal 3.
   (i) Replace FREQ ADJ rheostat R102R if It fails testing as described above.

(2) Replace.
   (a) Tag and disconnect wiring to FREQ ADJ rheostat R102R (13) at rear of panel.
   (b) Remove knob (10) from rheostat shaft at front panel.
   (c) Loosen and remove locking nut at front of panel and remove the rheostat assembly from the rear.
   (d) Install replacement FREQ ADJ rheostat R102R (13) from the rear of panel and secure with locking nut at front. Position rheostat R102R so that when knob is attached, with shaft rotated fully counterclockwise, the arrow is approximately at a 9 o'clock indication.
   (e) Install and secure knob (10) on rheostat shaft.
   (f) Connect wires as tagged. Remove and discard tags.

m. OPEN Indicator DS33R and CLOSED Indicator DS34R (14, Figure 5-2). These lamps provide visual indications of load circuit breaker CB101 position. Green indicator DS33R lights when load circuit breaker CB101 is open and red indicator DS34R lights to indicate that the circuit breaker CB101 is closed.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or Injury may result from failure to observe this warning.

(1) Test. See Figure 5-2. If either indicator falls to light when the BREAKER CONTROL switch S4R is actuated to the corresponding operational position, test as follows.
- (a) Open the RCM panel by unlocking three oval studs across the top of the panel.
- (b) Set multimeter to 50 V dc scale and check for presence of 24 V dc at lamp holder (17) terminals. Connect red multimeter lead to the positive (+) terminal and black lead to ground. If 24 V dc is not present when lamp should light, check wiring to lamp(s) using FO-3. Trace back through circuit until defective wire or item is found. Repair or replace defective circuit component as necessary.
- (c) If 24 V dc is present at lamp holder (17), replace lamp (14) with a known good lamp if replacement lamp still does not light, replace the lamp holder (17) in accordance with step (1) below.

(2) Replace.
- (a) Remove green or red lens (15 or 16) covering lamp (14).
- (b) Tag and disconnect wiring from lamp holder (17).
- (c) Remove lamp holder (17) from panel by removing attaching hardware from rear.

(3) Test. Test lamp holder, using a multimeter set to RX1 scale. Test continuity across contacts. Multimeter should read infinity.

(4) Install.
- (a) Install replacement lamp holder (17) in panel and secure with attaching hardware.
- (b) Connect wrong as tagged, using shrink tubing as needed Remove and discard tags.
- (c) Install replacement lamp (14) and Install red or green lens (15 or 16).
- (d) Close RCM panel and secure by locking three oval studs at the top of the panel.

n. <u>SYNCHRONI7ING LIGHTS DS110R AND DS111 R (18, Figure 5-2).</u> The lights indicate phase relationship of bus and generator set to be paralleled. The lamps are off when the generator set and the bus are In phase.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(1) Test. See Figure 5-2. When a lamp fails to light when expected, proceed as follows.
- (a) Open the RCM panel by unlocking three oval studs across the top of the panel.
- (b) Set multimeter to 120 V ac scale and check for presence of 120 V ac at lamp holder (19) terminals. If 120 V ac is not present when lamp should light, check wiring to the lamp using FO-3 (RCM). Trace back through main generator circuits using FO-1 and FO-2 until defective wire or Item is found. Repair or replace as required.
- (c) Each indicator DS110R and DS111R is connected In series with a voltage dropping resistor (R110R or R111R) mounted on the rear of the RCM control panel. If 120 V ac is not present at lamp holder (19) terminals, deenergize the RCM and test resistors R110R or R111R for continuity using multimeter set to RX10K scale. Resistance reading for each resistor should be 3000 ohms ±10 percent. Replace resistors if they do not meet this specification.

(d) If power exists at lamp holder (19) terminals, replace lamp with a known good lamp. Refer to step (2), below.
(e) If known good lamp (18) does not light, replace lamp holder (19).

(2) Replace. See Figure 5-2.
(a) Remove lens covering lamp (18). Remove lamp.
(b) Tag and disconnect wires from lamp holder (19).
(c) Remove lamp holder (19) from panel by removing attaching hardware.
(d) Install lamp holder (19) In panel Secure with attaching hardware.
(e) Connect wiring to lamp holder (19) as tagged.
(f) Remove and discard tags. Install lamp (18).
(g) Install lens to secure lamp (18).
(h) Close RCM panel and secure by locking three oval studs at the top of the panel.

o. <u>SYNCHROSCOPE Switch S115R. (20, Figure 5-2).</u> The SYNCHROSCOPE switch S11 5R is a two-position switch consisting of three decks This switch enables SYNCHRONIZING LIGHTS DS11 OR and DS1 11 R and SYNCHROSCOPE M106R.

(1) Test.
(a) Shut down the generator set See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wires to SYNCHROSCOPE switch S115R.

NOTE

Switch wiring position numbers are translated as follows the first digit defines the section, or deck, In relation to the handle end; the second digit is a specific terminal on that deck. For example: position 23 is located on the second deck, the contact is terminal number 3.

(d) Set a multimeter to RX1 scale and test for contact continuity in the switch positions specified in the chart in Figure 4-73. Meter should indicate 0 ohms at all points marked in the chart.
(e) Multimeter should Indicate Infinite ohms at all blank contacts In the chart.
(f) Rotate switch handle to both ON and OFF positions to check mechanical functioning.
(g) Replace switch If It falls any test described above.
(h) Connect wires to SYNCHROSCOPE switch S115R as tagged. Remove and discard tags.

(2) Replace. See Figure 5-2.
(a) Tag and disconnect wiring to switch (20) terminals.
(b) Remove screw in center of handle and slide handle off shaft.
(c) Remove three screws from face of mounting plate on front of RCM panel Switch (20) sections can be removed at rear of RCM panel as an assembly.
(d) Install replacement SYNCHROSCOPE switch S115R (20) by positioning switch sections at rear of RCM panel and assemble the mounting plate from the front Secure the assembly with the three mounting screws.
(e) Replace switch handle In the OFF position and secure with the attaching screw.
(f) Connect wires as tagged. Remove and discard tags.

p. PARALLEL Indicator DS35R and SINGLE SET Indicator DS36R (21, Figure 5-2). These lights provide visual indications of the PARALLEL switch positions.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(1) Test See Figure 5-2. When a lamp fails to light when expected proceed as follows.
(a) Open the RCM panel by unlocking three oval studs across the top of the panel.
(b) Set multimeter to 120 V ac scale and check for presence of 120 V ac at lamp holder (23) terminals. If 120 V ac is not present when lamp should light, check wiring using FO-3 to the lamp. Trace back through main generator circuits using FO-2 until defective wire or Item is found. Replace or replace as required.
(c) If power exists at lamp holder (23) terminals, replace lamp (21) with a known good lamp.
(d) If known good lamp (21) does not light, replace lamp holder (23).
(2) Replace. See Figure 5-2.
(a) Remove clear lens (22) covering lamp (21). Remove lamp.
(b) Tag and disconnect wires from lamp holder (23).
(c) Remove lamp holder (23) from panel by removing attaching hardware.
(d) Install lamp holder (23) in RCM panel. Secure with attaching hardware. Connect wiring to lamp holder (23), remove and discard tags.
(e) Install lamp (21).
(f) Install clear lens (22).

q. MASTER Switch S9R (24. Figure 5-2). MASTER switch S9R allows the operator to start or stop the generator set from the remote control module. The toggle switch is spring loaded to return to the RUN position after having been held In either the START or STOP position.
(1) Test.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Disconnect negative leads from MASTER switch S9R (24) terminals 3 and 4.

NOTE

Do not remove jumper across terminals 2 and 6.

(d) Set a multimeter to RX1 scale with MASTER switch S9R in RUN position, test for continuity across terminals 1 and 2 and 5 and 6. Multimeter should indicate 0 ohms.
(e) Hold MASTER switch S9 in START position. Multimeter should indicate zero ohms across terminals 2 and 3 and 5 and 6.
(f) Hold MASTER switch S9 In the STOP position Multimeter should indicate 0 ohms across terminals 1 and 2 and 4 and 5.
(g) Connect negative leads to terminals 3 and 4.
(h) Replace MASTER switch S9R (24) if It falls any test described above.

(2) Replace See figure 5-2.
(a) Tag and disconnect wiring from MASTER switch S9R (24) terminals.
(b) Remove locking nut and lockwasher from RCM front panel and remove MASTER SWITCH S9R from the rear panel.
(c) Install jumper wire across terminals 2 and 6 of replacement MASTER switch S9R.
(d) Install MASTER switch S9R (24) from rear of RCM panel.
(e) Secure switch at front RCM panel with lockwasher and locking nut.
(f) Connect wires as tagged Remove and discard tags.
(g) Close RCM panel and secure by locking three oval studs across the top of the panel.

r. HIGH COOLANT TEMP/LOW OIL PRESSURE/FAULT Lights (25, Figure 5-2). These lights Illuminate to indicate that a fault condition has occurred at the main generator set.

WARNING

Do not touch exposed electrical connection when a source of power such as utility power or another generator set is connected to the load terminals. Death or injury may result from failure to observe this warning.

(1) Test Prior to performing individual tests on fault lamps and lamp holders, press the ANNUNCIATOR TEST switch S1 5R with the RCM energized, to verify both the availability of 24 V dc control power and the existence of an RCM fault indicator malfunction Horn LS1 R should sound and the HIGH COOLANT TEMP, LOW OIL PRESSURE, and FAULT indicators (DS3R, DS2R, DS103R, respectively) should light Perform the following tests on any fault lamp that falls to light when the ANNUNCIATOR test switch S15R is pressed.
(a) Open the RCM panel by unlocking three oval studs across the top of the panel.
(b) Set multimeter to 50 V dc scale and check for 24 V dc at lamp holder (27) terminals of malfunctioning indicator (25) at the same time that ANNUNCIATOR TEST switch S15R is being pressed Press the ALARM SILENCE switch S16R to prevent horn LS1R from sounding when test is being performed.
(c) If 24 V dc is not present at lamp holder (27) terminals, check blocking diodes D1 R through D6R (depending on malfunctioning indicator) mounted on terminal block TB1R (11, Figure 5-1) Inside RCM chassis. Test diodes as follows:
1 Release ANNUNCIATOR TEST switch S15R and test diode with multimeter set to RX1 scale. Connect multimeter leads to diode terminals and then reverse multimeter connections to diode under test.
2 Diode resistance reading should be infinite ohms going one way and zero ohms when multimeter leads are reversed. Replace any diode that fails to meet this test. Tag and disconnect wiring to diode by polarity for correct Installation of replacement component. If diodes are good, trace wiring back to main generator set using FO-1. Trace back through main generator set circuits until defective components are found Repair or replace as necessary.
(d) If 24 V dc is present at lamp holder (27) terminals, replace lamp (25) with a known good lamp. If known good replacement lamp still does not light, replace the lamp holder (25).

(2) Replace.
(a) Remove lens (26) covering lamp (25).
(b) Tag and disconnect wiring from lamp holder (27).
(c) Remove lamp holder (27) from panel by removing attaching hardware from rear.

(d) Install replacement lamp holder (27) in panel and secure with attaching hardware.
(e) Connect wiring as tagged, using shrink tubing as needed Remove and discard tags.
(f) Install replacement lamp (25) and Install lens (26).
(g) Close RCM panel and secure by locking three oval studs at the top of the panel.

s. <u>ANNUNCIATOR TEST, ALARM SILENCE, and EMERGENCY SHUTDOWN Pushbutton Switches. S16R. S15R. and S7R (30, 31, and 32. Figure 5-2)</u>. Switches S16R, S15R, and S7R are momentary contact switches that are used respectively to test the annunciator alarm system, to silence alarm horn LS1R, and initiate an emergency shutdown condition from the RCM.

(1) Test.
(a) Shut down the generator set. See Figure 2-23.
(b) Open the RCM panel by unlocking three oval studs across the top of the panel.
(c) Tag and disconnect wiring to switch under test (30, 31, or 32).
(d) Set multimeter to RX1 scale and connect across switch terminals at rear without pressing switch button (OFF position) Multimeter reading should be infinite ohms.
(e) Press switch button from front RCM panel with multimeter leads still connected at rear of switch. Multimeter should now read zero ohms.
(f) Replace switch (30, 31, or 32) if it fails testing as described above.

(2) Replace.
(a) Tag and disconnect wiring from switch (30, 31, or 32) terminals.
(b) Remove switch mounting hardware from front RCM panel and remove switch (30, 31, or 32).
(c) Position switch (30, 31, or 32) through rear RCM panel and secure with mounting hardware at front.
(d) Connect wiring as tagged Remove and discard tags.
(e) Close RCM panel and secure by locking three oval studs across the top of the panel.

t. <u>ALARM HORN LS1R. LS1R (12, Figure 5-1).</u> provides an audible alarm at the RCM site should a fault condition occur at the main generator set.

(1) Test.
(a) With the generator set operating and the RCM energized, press the ANNUNCIATOR TEST switch S15R. LOW OIL PRESSURE lamp DS2R, HIGH COOLANT TEMP lamp DS3R, and FAULT lamp DS103R should light and ALARM HORN LS1R should sound.
(b) Press ALARM SILENCE switch S16R. ALARM HORN LS1 should stop.
(c) If the fault indicators light as described in step (a), above, but alarm horn LS1 does not sound, shut down the generator set or deenergize the RCM by setting LOCAL REMOTE switch S2 in the generator control room to LOCAL.
(d) Open the RCM panel by unlocking three oval studs across top of the panel to gain access to ALARM HORN LS1 (12, Figure 5-1).
(e) Remove cover grill from alarm horn LS1 R by removing cover locking screw at side. Tag and disconnect wiring from the horn and remove from electrical box (13) by removing attaching hardware.
(f) Set a multimeter to RX100 scale and check horn coil for continuity by measuring resistance. Coil resistance reading should be approximately 24 ohms. Replace the horn if it does not meet the above specification.

(2) Replace.
 (a) Perform steps (d) and (e), above, if needed.
 (b) Install horn (12) in electrical box (13). Thread horn wiring through bottom hole of horn assembly and connect as tagged. Remove and discard tags.
 (c) Secure alarm horn LS1R (12) to the electrical box (13) using mounting hardware.
 (d) Close RCM panel and secure by locking three oval studs across the top of the panel.
 (e) Retest horn using ANNUNCIATOR TEST switch S15R as described in above test procedure.

u. RCM Cable Assembly (34, Figure 5-1). The RCM cable assembly is used for power and control interfacing of the main generator set with the RCM.

(1) Test.
 (a) Shut down the generator set. See Figure 2-23.
 (b) Detach the remote control cable (34) from the generator and RCM chassis.
 (c) With multimeter set to RX1 scale, check for isolation between all connector pins. Resistance reading across each pair of pins tested should be infinite ohms. Also test each pin for isolation from ground (connector body). Resistance reading should be Infinite ohms.
 (d) Reconnect remote control cable assembly.
 (e) Reconnect remote control cable (34) and wiring harness (see Figure 5-3) If required.

v. Wiring Harness (Figure 5-3). The wiring harness is used to interconnect the RCM circuits with the main generator set in conjunction with the connector receptacle and remote control cable.

(1) Test.
 (a) Shut down the generator set. See Figure 2-23.
 (b) Open the RCM panel by unlocking three oval studs across the top of the panel.
 (c) Unplug the wiring harness (Figure 5-3) from the connector receptacle (36, Figure 5-1). Set a multimeter to RX1 scale and test for continuity of each conductor from Its pin to its terminal point (refer to FO-3) and wiring diagram in this manual. Resistance reading for each conductor tested should be zero ohms.

(2) Replace.
 (a) Unplug harness from connector receptacle (36, Figure 5-1).
 (b) Tag and disconnect wires to all components in RCM chassis.
 (c) Remove straps securing harness (Figure 5-3) and remove harness.
 (d) Connect wires on replacement harness to components as tagged Remove and discard tags.
 (e) Plug harness (Figure 5-3) Into connector receptacle (36, Figure 5-1).
 (f) Close RCM panel and secure by locking three oval studs across the top of the panel.

(3) Repair.
 (a) Remove harness in accordance with step (2), above.
 (b) Disconnect and remove defective wire.
 (c) Connect replacement wire of the same size and type to the terminals from which the defective wire was removed.
 (d) Secure new wire to harness using tiedown straps.

w. Replacement of Nameplates and Identification Plates. If any of the nameplates (33, 35 through 48, Figure 5-2) are damaged to the point of being illegible, remove rivets (34) to remove damaged plate and Install a new plate using M24243/6-C602H rivets (34).

SECTION III. REMOTE CONTROL CABLE ASSEMBLY

5-10. GENERAL. The remote control cable (34, Figure 5-1) connects the remote control module to the generator set. All the required wires for connecting the module are gathered into the cable assembly, which requires only one plug-type connection at each end

5-11. INSTALLATION. Procedures for connecting the remote control cable assembly are included in paragraph 5-3.

5-12. OPERATOR MAINTENANCE OF THE REMOTE CONTROL CABLE ASSEMBLY . Operator maintenance of the remote control cable assembly consists of Inspection and replacement of the cable assembly as a unit.

a. Inspect. Perform visual inspection on RCM cable assembly (34, Figure 5-1) as follows.

(1) Inspect plug connectors on both ends of the RCM cable assembly (34). Check for cracks, deformities, and other damage. Check that the conductor terminals Inside each connector are free from dirt and other obstructions. Check mounting hardware on cable connectors for damaged threads.

(2) Lay out the RCM cable assembly Inspect cable bushings and cable insulation sleeves for cracks, cuts, ruptures, and other damage. Check that the cable clamps are securely mounted.

b. Remove.

(1) Unplug the damaged or defective RCM cable assembly (34, Figure 5-1) from the generator set and from the connector receptacle (36).

(2) Plug the replacement RCM remote control cable assembly (34, Figure 5-1) into connector receptacle (36) and into the generator set in accordance with the instructions in paragraph 5-3.

5-13. UNIT TROUBLESHOOTING. Table 5-3 contains troubleshooting information for use in correcting operating troubles which may develop in the remote control module. Each malfunction is followed by a list of tests or inspections which will help to determine probable causes and corrective actions to take. Perform the tests or inspections and corrective actions in the order of the organizational maintenance should be referred to the next higher (direct support) level of maintenance.

Table 5-3. Unit Remote Control Module Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WARNING

To avoid Injury to personnel, no electrical component will be worked on while energized. Ensure equipment is "tagged out" in accordance with Chapter 1, Section III, of this manual and equipment Is NOT energized. Residual voltage Is present at the generator leads with the regulator turned off, reaching SEVERAL HUNDRED VOLTS on the generator set. Proper insulation and isolation of metering equipment must be observed when testing this generator. USE PROPER TEST EQUIPMENT TO CHECK FOR VOLTAGE before proceeding with work.

Table 5-3. Unit Remote Control Module Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NOTE

To determine whether it is the remote control module or the generator set that is malfunctioning, operate or monitor the corresponding control or indicator on the generator set to see if the correct indication is obtained. If operation or indication is correct, the remote control module is, most probably, at fault. If the generator set still does not operate properly, the generator set is, most probably, faulty. Refer to Table 3-3 and Table 4-3 for troubleshooting procedures for the generator set.

1. ANY REMOTE CONTROL MODULE MOUNTED METER OR SWITCH IS NOT FUNCTIONING PROPERLY, BUT THE CORRESPONDING METER OR SWITCH MOUNTED ON THE GENERATOR SET IS FUNCTIONING PROPERLY.

Test the remote control cable assembly in accordance with paragraph 5-4.

If the remote control cable assembly is defective, it must be replaced.

If the remote control cable assembly is not defective, proceed to the applicable malfunction.

2. GENERATOR SET DOES NOT START WHEN MASTER SWITCH S9R IS MOVED TO START POSITION.

Test MASTER switch S9R in accordance with paragraph 5-9, step q.

If the MASTER switch is defective it must be replaced.

If the MASTER switch is not defective, troubleshoot generator set In accordance with Table 4-3.

3. FREQUENCY METER M101R READS INCORRECTLY.

Disconnect cable to remote control module and test FREQUENCY meter M101R In accordance with paragraph 5-9, step c.

If FREQUENCY meter is defective, It must be replaced.

If FREQUENCY meter is not defective, refer to the next higher level of maintenance.

NOTE

Frequency meter and transducer are a matched set.

4. AC KILOVOLTS METER M101R DOES NOT INDICATE CORRECT VOLTAGE.

Disconnect cable to remote control module and test the GEN/BUS VOLTMETER switch S112R in accordance with paragraph 5-9, step b.

If GEN/BUS VOLTMETER switch is defective, it must be replaced.

If GEN/BUS VOLTMETER switch is not defective, test AC KILOVOLTS meter in accordance with paragraph 5-9.

If AC KILOVOLTS meter is defective, It must be replaced.

If AC KILOVOLTS meter is not defective, refer to the next higher level of maintenance.

Table 5-3. Unit Remote Control Module Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. AC AMPERES METER M102R DOES NOT INDICATE CORRECT CURRENT.

Disconnect cable to remote control module and test AMMETER switch Sl1 4R in accordance with paragraph 5-9, step a.

If AMMETER switch is detective, it must be replaced.
If AMMETER switch is not defective, test AC AMPERES meter in accordance with paragraph 5-9.
If AC AMPERES meter is defective, it must be replaced.
If AC AMPERES meter is not defective, refer to the next higher level of maintenance.

6. WHEN OPERATED, FREQ ADJ RHEOSTAT R102R DOES NOT AFFECT OUTPUT FREQUENCY OF GENERATOR SET.

Test FREQ ADJ rheostat In accordance with paragraph 5-9 step I.

If rheostat is defective, it must be replaced.
If rheostat is not defective, refer problem to the next higher level of maintenance.

7. WHEN OPERATED, VOLT ADJ RHEOSTAT R101R DOES NOT AFFECT OUTPUT VOLTAGE OF GENERATOR SET.

Test VOLT ADJ rheostat In accordance with paragraph 5-9, step j.

If rheostat is defective, it must be replaced.
If rheostat is not defective, refer problem to the next higher level of maintenance.

8. GENERATOR SETS BEING OPERATED IN PARALLEL DO NOT LOCK INTO OPERATION WHEN PARALLEL SWITCH S6R IS SET TO PARALLEL MODE.

Test PARALLEL SWITCH S6R in accordance with paragraph 5-9, step k.

If PARALLEL SWITCH is defective, it must be replaced.
If PARALLEL SWITCH is not defective, refer problem to the next higher level of maintenance.

9. EMERGENCY SHUTDOWN PUSHBUTTON SWITCH S7R IS DEPRESSED BUT GENERATOR SET DOES NOT SHUT DOWN.

Test EMERGENCY SHUTDOWN pushbutton switch S7R in accordance with paragraph 5-9, step s.

If EMERGENCY SHUTDOWN pushbutton switch is defective, It must be replaced.
If EMERGENCY SHUTDOWN switch Is not defective, refer problem to the next higher level of maintenance.

10. AC KILOWATTS METER DOES NOT WORK.

Test meter in accordance with paragraph 5-9, step d.

Replace meter.

11. POWER FACTOR METER DOES NOT WORK.

Test meter In accordance with paragraph 5-9, step e.

Replace meter.

Table 5-3. Unit Remote Control Module Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

12. SYNCHROSCOPE METER DOES NOT WORK.

Test meter In accordance with paragraph 5-9, step f.

Replace meter.

13. HORN DOES NOT WORK.

Test horn in accordance with paragraph 5-9, step t.

Replace horn.

14. LOW OIL PRESSURE, HIGH COOLANT TEMP, AND/OR FAULT LAMPS DO NOT WORK.

Test lamps, lamp holders, and blocking diodes in accordance with paragraph 5-9, step r.

Replace component as needed.

15. ANNUNCIATOR TEST, ALARM SILENCE, AND/OR EMERGENCY SHUTDOWN PUSHBUTTON SWITCHES DO NOT WORK.

Test switches in accordance with paragraph 5-9, step s.

Replace switch.

16. MASTER (START/STOP/RUN) SWITCH DOES NOT WORK.

Test switch In accordance with paragraph 5-9, step q.

Replace switch.

17. GEN/BUS VOLTMETER SWITCH DOES NOT WORK.

Test switch In accordance with paragraph 5-9, step i.

Replace switch.

18. VOLT ADJ RHEOSTAT DOES NOT WORK.

Test rheostat In accordance with paragraph 5-9, step j.

Replace rheostat.

19. FREQ ADJ RHEOSTAT DOES NOT WORK.

Test rheostat in accordance with paragraph 5-9, step I.

Replace rheostat.

20. PARALLEL SWITCH DOES NOT WORK.

Test switch in accordance with paragraph 5-9, step k.

Replace switch.

21. PARALLEL LIGHTS DO NOT WORK.

Test lamps and lamp holders In accordance with paragraph 5-9, step p.

Replace lamp or lamp holders.

Table 5-3. Unit Remote Control Module Troubleshooting (Continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

22. BREAKER CONTROL SWITCH DOES NOT WORK.

Test switch in accordance with paragraph 5-9, step g.

Replace switch.

23. AMMETER SELECTOR SWITCH DOES NOT WORK.

Test switch In accordance with paragraph 5-9, step h.

Replace switch.

24. SYNCHRONIZING LIGHTS DO NOT WORK.

Test lamps, lamp holders, and resistors In accordance with paragraph 5-9, step h.

Replace lamps, lamp holders, or resistors as needed.

25. SYNCHROSCOPE SWITCH DOES NOT WORK.

Test switch In accordance with paragraph 5-9, step o.

Replace switch.

26. OPEN/CLOSED (BREAKER POSITION) INDICATORS DO NOT WORK.

Test lamps and lamp holders in accordance with paragraph 5-9, step m.

Replace switch.

5-14. UNIT MAINTENANCE OF THE REMOTE CONTROL CABLE ASSEMBLY. Unit maintenance of the RCM cable assembly (34, Figure 5-1) is limited to testing of the cable assembly.

a. Test

(1) Disconnect the RCM cable assembly in accordance with paragraph 5-12.

(2) Set a multimeter to RX1 scale and test RCM cable assembly. Check for isolation between adjacent conductors, and between any conductor and ground. Multimeter should read infinite resistance for each test.

(3) Check each conductor for continuity from one plug connector to the other. Multimeter should read zero resistance from one end of any conductor to the other.

(4) If tests fail to show Isolation or continuity, refer to the next higher level of maintenance for repair and overhaul of the defective RCM cable assembly.

APPENDIX A

REFERENCES

A-1. Fire Protection.

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved by Army Users.

A-2. Lubrication.

C9100-Ll	Identification List for Fuels, Lubricants, Oils, and Waxes.
LO 9-6115-604-12	

A-3. Painting.

TM 43-0139	Painting Instructions for Army Materiel

A-4. Radio Suppression.

MIL-STD-461	Radio Interference Suppression.
TM 11-483	Radio Interference Suppression.

A-5. Maintenance.

TB 750-651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
DA Pam 738-750	The Army Maintenance Management System (TAMMS)
TM 9-6115-604-12 NAVFAC P-8-633-12	Operator and Unit Maintenance Manual.
TM 9-6115-604-34 NAVFAC P-8-633-34	Direct Support, General Support, and Depot Level Maintenance Manual
TM 9-6115-604-24P NAVFAC P-8-633-24P	Unit, Direct Support, General Support and Depot Maintenance Repair Parts and Special Tools List

A-6. Shipment and Storage.

TB 740-97-2	Preservation of USAMECOM Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment.

A-7. Destruction of Material.

TM 750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use

A-8. Radioactive Material.

TB 750-248	Instructions for Safe Handling, Maintenance, Storage, and Disposal of Radioactive Commodities Managed by U.S. Army Mobility Equipment Command.

APPENDIX B

ADDITIONAL AUTHORIZATION LIST

SECTION I. INTRODUCTION

B-1. SCOPE.

This appendix lists additional items you are authorized for the support of the generator set.

B-2. GENERAL.

This list identifies items that do not have to accompany the generator set and that do not have to be turned in with it. These Items are all authorized to you by CTA, MTOE, TDA, or JTA.

B-3. EXPLANATION OF LISTING.

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. If item required differs for different models of this equipment, the model is shown under the "Usable on" heading In the description column. These codes are identified as.

Code	Used on
A	MEP 208A

SECTION II. ADDITIONAL AUTHORIZATION LIST

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION REF NO. & MFR CODE	USABLE ON CODES	(4) UNIT OF MEAS	(5) QTY AUTH
PAC	5120-01-013-1676	Puller, Ground Rod		ea	1
PAC	4930-360-2801	Grease Gun hand, lever operated, 16 oz. (448 g)		ea	1
PAC	5120-224-4045	Hammer Hand machinist ball-pean, 1-1/4 lb head (.56 kg)		ea	1
PAC	4930-262-8868	Oiler, Hand, pump, force fed 16 oz (448 g) capacity, flexible spout		ea	1
PAC	5120-223-7396	Pliers, Slipjoint: straight nose, combined with cutter, 6 inches long (152 4 mm)		ea	1
PAC	5975-878-3791	Rod, Ground, Assembled		ea	1
PAC	5120-293-3176	Screwdriver, Flat Tip: tip 1/4 Inches (6.35 mm) wide, blade 4 inches (101.6 mm) long		ea	1
PAC	5120-240-5328	Wrench, Open End, Adjustable; single head, 22 1/2 degree angle, heavy duty, 8 inches (202 3 mm) nominal, 19 overall, 0 947 inches (24.05 mm) maximum jaw opening		ea	1
PAC	4210-00-965-1107	Extinguisher, Fire, 10 lb (4 50 kg)		ea	2
PAC	4210-00-202-7858	Extinguisher, Fire, 15 lb (6.80 kg)		ea	1

APPENDIX C

MAINTENANCE ALLOCATION CHART (MAC)

SECTION I. INTRODUCTION

C-1. THE ARMY MAINTENANCE SYSTEM MAC.

a. This introduction (Section I) provides general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the Identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

(1) Unit - Includes two subcolumns, C (operator/crew) and O (unit) maintenance.

(2) Direct Support - includes an F subcolumn.

(3) General Support - includes an H subcolumn.

(4) Depot - Includes a D subcolumn.

c. Section III lists the tools and test equipment (both special tools and common tools sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental Instructions and explanatory notes for a particular maintenance function.

C-2. MAINTENANCE FUNCTIONS. Maintenance functions will be limited to and defined as follows' (see 3.2 5.2g for ammunition MAC exception).

a. Inspect To determine the serviceability of an Item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an Item In proper operating condition; i e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.

e. Align. to adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on Instruments or test, measuring, and diagnostic equipment used In precision measurement. Consists of comparisons of two Instruments, one of which Is a certified standard of known accuracy, to detect and adjust any discrepancy In the accuracy of the instrument being compared.

g. Remove/Install. To remove and Install the same item when required to perform service or other maintenance functions Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) In a manner to allow the proper functioning of an equipment or system.

h. Replace. To remove an unserviceable Item and install a serviceable counterpart In Its place "Replace" s authorized by the MAC and assigned maintenance level is shown as the 3d position code of the SMR code.

i. Repair. The application of maintenance services[1] including fault location/troubleshooting[2], removal/installation, and disassembly/assembly[3] procedures, and maintenance actions[4] to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure In a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR) Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e g., hours/miles) considered in classifying Army equipment/components.

C-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II .

a. Column 1. Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2. Component Assembly. Column 2 contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3. Maintenance Function. Column 3 lists the functions to be performed on the Item listed In Column 2. (For detailed explanation of these functions, see paragraph C-2.)

d. Column 4. Maintenance Level. Column 4 specifies each level of maintenance authorized to perform each function listed in Column 3, by indicating work time required (expressed as man-hours in whole hours or decimals) in the appropriate subcolumn. This work-time figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within listed maintenance function vary at different maintenance levels, appropriate work-time figures will be shown for each level. The work-time figure represents the average time required to restore an Item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), the troubleshooting/fault location time, and quality assurance time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized In the maintenance allocation chart The symbol designations for the various maintenance levels are as follows:

C .... Operator or crew maintenance
O .... Unit maintenance
F.................................. Direct support maintenance
L.................................. Specialized Repair Activity (SRA) 5
H .... General support maintenance
D .... Depot maintenance

e. Column 5. Tools and Equipment. Column 5 specifies, by code, those common tools sets (not individual tools), common TMDE, and special tools, special TMDE, and special support equipment required to perform the designated function.

f. Column 6. Remarks. When applicable, this column contains a letter code, In alphabetical order, which is keyed to the remarks contained In Section IV.

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[1] Services - Inspect, test, service, adjust, align, calibrate, and/or replace.
[2] Fault location/troubleshooting - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).
[3] Disassembly/assembly - The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component, that Is assigned an SMR code for the level of maintenance under consideration (i.e., identified as maintenance significant.)
[4] Actions - Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.
[5] This maintenance level is not included In Section II, column (4) of the Maintenance Allocation Chart.

C-4. EXPLANATION OF COLUMNS IN SECTION III.

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T and TE requirements column on the MAC. The letter represents the specific maintenance functions the item is to be used with. The letter is representative of columns A through K on the MAC.

b. Maintenance Category. This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or Identification of the tool or test equipment.

d. Tool Number This column lists the manufacturer's code and part number, or National Stock Number of tools and test equipment.

C-5. EXPLANATION OF COLUMNS IN SECTION IV.

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II The first letter references column 5 and the second letter references function, column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated in the MAC, Section II.

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT		DS	GS	Depot	TOOLS AND EQUIP	REMARKS
			C	O	F	H	D		
01	HOUSING AND BASE ASSEMBLY								
	Access Doors and Covers	Inspect	.1						
		Service	.2						
		Replace		.2					
		Repair		.5					
	Housing Panels	Inspect	.1						
		Service	.2						
		Replace		.3					
		Repair		.5					
	Air Louvers	Inspect	.1						
		Service	.2						
		Adjust	.1						
		Replace		.3					
		Repair		.5					
	Skid Base	Inspect	.1						
		Service	.1						
		Repair	.5						
	Tool Box	Inspect	.1						
		Service	.1						
		Replace		.3					
		Repair		.5					
	Fire Extinguisher	Inspect	.1						
		Service		.2					
		Replace	.1						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Exhaust Fan and	Inspect	.1						
	Shutter Assembly	Service	.2						
		Replace		5					
		Repair		1.0					
01	HOUSING AND BASE ASSEMBLY -Continued								
	Motor Exhaust Fan	Inspect	.1						
		Service	.1						
		Replace		5					
		Repair		1.0					
02	DC ELECTRICAL AND CONTROL SYSTEM								
	Batteries	Inspect	.1						
		Test		.1					
		Service	.2						
		Install		.2					
		Replace		.2					
	Battery Cable Assem-	Inspect	.1						
	biles	Test		.2					
		Service		.2					
		Replace		.3					
		Repair		.5					
	Battery Charger	Inspect	.1						
		Test		.2		1			
		Adjust		.2					
		Replace		.5					
		Repair	1.0						
	Starter Relays	Inspect	.1						
		Test		.3					
		Replace		.5					
		Inspect	.1						
	Wiring Harnesses	Test		.2					
		Replace		2.0		136			
		Repair		1.0					
		Overhaul	3.0						
	High Coolant	Inspect	.1						
	Temperature Switch	Test		.2					
		Replace		.3					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	MAINTENANCE LEVEL UNIT O	MAINTENANCE LEVEL DS F	MAINTENANCE LEVEL GS H	MAINTENANCE LEVEL Depot D	TOOLS AND EQUIP	REMARKS
	Low Coolant Level	Inspect	.1						
	Switch	Test		.2					
		Replace		.2					
	High Lubricating **Oil**	Inspect	.1						
	Temperature Switch	Test		.2					
		Replace		.2					
	Low Lubricating **Oil**	Inspect	.1						
	Pressure Alarm Switch	Test		.2					
		Replace		.2					
	Low Lubricating **Oil**	Inspect	.1						
	Shutdown Switch	Test		.2					
		Replace		.4					
	Emergency DC Lights	Inspect	.1						
	and Switches	Test		.2					
		Replace		.5					
02	DC ELECTRICAL AND CONTROL SYSTEM - Continued								
	Speed Switch	Inspect	.1						
		Test		.3					
		Adjust		.2					
		Replace		.5					
	DC Circuit Breakers	Inspect	.1						
		Test		.2		2			
		Replace		.2					
	Fuel Level Switches	Test		.2					
		Replace		.5					
	Fuel Level Transmitter	Test		.2					
		Replace		.5					
	Air Box Old Pressure	Inspect	.1						
	Disconnect Switch	Test		.2					
		Replace		.2					
	Starter Motors and	Inspect	.10						
	Starter Solenoid	Test		.2		3,4			
	Switches	Replace		.2					
		Repair	.5						
	DC Light Bulbs	Inspect	.1						
		Test	.1						
		Replace	.1						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	MAINTENANCE LEVEL UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Protective Relays	Inspect	.2						
		Test	.2						
		Adjust	.5						
		Replace	.7						
03	AC ELECTRICAL POWER GENERA-TION AND CONTROL SYSTEM								
	Wiring and Harnesses	Inspect	.1						
		Test	.2					136	
		Replace	1.0						
		Repair	2.0						
		Overhaul		3.0					
	Lights and Switches	Inspect	.1						
		Test		.2					
		Replace		.2					
	Circuit Breakers	Inspect	.1						
		Test	.2						
		Replace	.2						
	Generator Assembly	Inspect	.1						
		Test	.5	5					
		Replace	.5						
		Repair	1.0						
		Overhaul		2 0					
03	AC ELECTRICAL POWER GENERA-TION AND CONTROL SYSTEM - Continued								
	Rotating Rectifier	Inspect	.1						
		Test	.3						
		Replace	1 0						
		Repair	2 0						
	Bearing	Inspect	.1						
		Replace	1.0						
	Rotor Assembly	Inspect	.1						
		Test	.5						
		Replace	.7						
		Repair		1.0					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Stator Assembly	Inspect	.1						
		Test	.2						
		Replace	.5						
		Repair		1.0					
	Exciter	Inspect	.1						
		Test	2						
		Replace	.5						
		Repair	1.0						
	Voltage Regulator	Inspect	.1						
		Test	.3						
		Adjust	.3						
		Replace	.5						
		Repair		1.0					
	LOAD CIRCUIT BREAKER	Inspect	.1						
		Test	.2						
		Service	.2						
		Adjust	.3						
		Align	.3						
		Replace	.5						
		Repair	1.0						
	CONTROL RELAYS	Inspect	.1						
		Test	.2						
		Replace	.4						
	Surge Suppressor Capacitor	Inspect	.1						
		Test	.3	6					
		Replace		.5					
	Protective Relays	Inspect	.1						
		Test		.2				7, 8,9,10, 11	
		Adjust		.3					
		Replace		.5					
	Lightning Arresters	Inspect	1						
		Replace		.2					
03	AC ELECTRICAL POWER GENERA-TION AND CONTROL SYSTEM - Continued								
	Main Disconnect Switch	Inspect	.1						
		Test		.2				6	
		Align		.2					
		Replace		.4					
		Repair	1.0						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Parallel Cable Assembly	Inspect	.1						
		Test		.2					
		Install	.1						
		Replace	.1						
		Repair	1.0						
	Load Cable	Inspect	.1						
		Test	.2						
		Install	.1						
		Replace	.1						
		Repair	1.0						
	Utility Power Cable	Inspect	.1						
		Test		.2					
		Install	.1						
		Replace	.1						
		Repair	1.0						
	120 V AC Receptacles	Inspect	.1						
		Test		.2					
		Replace	.1						
	AC Light Bulbs	Inspect	.1						
		Test	.1						
		Replace		.1					
	Magnetic Pickup	Inspect	.1						
		Test		.2					
		Replace		.2					
	Current Boost Module	Inspect	.1						
		Test	.2						
		Service	.3						
		Adjust	.4						
		Replace	.5						
	Load Terminals	Inspect	.1						
		Test	.2						
		Replace	.2						
		Repair	.2						
	Current Boost Transformer	Inspect	.1						
		Test		.2					
		Replace	.4						
04	FUELSYSTEM								
	Fuel Transfer Pump Assembly	Inspect	.1						
		Test		.3					
		Replace		.5					
		Repair	1.0						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Solenoid Valve	Inspect	.1						
		Test		.2					
		Replace		.2					
		Repair	1.0						
	Fuel Strainer	Inspect	.1						
		Service	.2						
		Replace		2					
	Fuel Filter Assemblies	Inspect	.1						
		Service	.1						
		Replace		.2					
		Repair		.5					
	Fuel Injection Pump	Inspect	.1						
		Test			1.0			12,13, 14,	
		Adjust			.5			15, 16, 18,	
	Calibrate					5		19, 20, 21,	
		Replace			1.0			22, 24	
		Repair				2.0			
	Fuel Injectors	Test			.5				
		Adjust			.2			25, 26, 27,	
		Replace			.5			28, 29, 30,	
		Repair			1.0			32, 33, 34,	
								35	
	Fuel Tank	Inspect	.1						
		Test			.2				
		Replace			.5				
		Repair			.5				
	Fuel Lines	Inspect	.1						
		Replace		.2					
	Electronic Speed Con-	Inspect	.1						
	trol	Test		.2				36	
		Adjust		.2					
		Replace		.5					
	Ether Injection Assem-	Inspect	.1						
	bly	Test		.3					
		Service	.3						
		Replace		.5					
		Repair		1.0					
	Emergency Manual	Inspect	.1						
	Fuel Shutoff Valve	Test		.1					
		Replace		.3					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	MAINTENANCE LEVEL UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Filter Cap and Strainer	Inspect	.1						
		Service	.1						
		Replace	.1						
	Fuel Manifolds	Inspect	.1						
		Replace	1.0						
05	COOLING SYSTEM								
	Water Pump	Inspect	.1						
		Replace		.5				37-43	
		Repair	1.0						
	Radiator	Inspect	.1						
		Test		.2				44, 45	
		Service	.2						
		Replace		.5					
		Repair	.5						
	Radiator Cap	Inspect	.1						
		Test		.2					
		Replace	1						
	Water Filter Assembly Inspect	1							
		Service	.2						
		Replace		.2					
	Radiator Pipes, Hoses,	Inspect	.1						
	and Clamps	Replace	.2						
	Coolant Thermostats	Inspect		.1					
		Test		.2					
		Replace		.2					
	Coolant Level Sight	Inspect	.1						
	Glass	Replace		.2					
		Repair		.2					
	Fan	Inspect	.1						
		Replace		.5					
	Fan Belt	Inspect	.1						
		Replace		.3					
	Idler Pulley Assembly	Inspect	.1						
		Replace		.3					
		Repair		.5					
	Fan Guard	Inspect	.1						
		Replace		.3					
		Repair	.5						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL: UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Thermostat Sensing	Inspect	.1						
	Unit	Test		.3		4-6			
		Replace		.5					
	Coolant Heaters	Inspect	.1						
		Test		.3					
		Replace		.3					
	Preheat Shutoff Valves	Inspect	.1						
		Replace		.2					
06	LUBRICATION SYS-TEM								
	Temperature Transmit-	Inspect		.1					
	ter	Test		.3					
		Replace		.5					
	Pressure Transmitter	Inspect		.1					
		Test		.3					
		Replace		.5					
	Filter and Oil By-pass	Inspect	.1						
	Assembly	Test		.3					
		Service	.2						
		Replace		.5					
		Repair	.5						
	Lube Oil Cooler	Inspect	.1						
		Replace	.5						
	Drain Valve and Hose	Inspect	.1						
		Replace		.4					
		Repair		.5					
	Oil Pump Assembly	Inspect	.3						
		Test	.3						
		Replace	.5						
		Repair		.7					
	Oil Level Sight Glass	Inspect	.1						
		Replace		.2					
		Repair		.2					
	Oil Filler Cap	Inspect	.1						
		Replace	.1						
	Lube Oil and Prelube	Inspect	.1						
	Lines	Replace		.3					
	Crankcase Breathers	Inspect	.1						
		Service		.3					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Lube Oil Heaters and Thermostats	Inspect	.1						
		Test		.3					
		Replace		.5					
	Prelube Pump	Inspect	.1						
		Test		.5					
		Replace		.7					
		Repair	1.0						
07	ENGINE								
	Engine Assembly	Inspect	.1						
		Service	.1					12-29,	
		Replace	5.0					47-127	
		Repair	5.0						
		Overhaul	7 0						
	Air Filter Elements	Inspect	.1						
		Service		.1					
		Replace		.2					
	Air Filter Assembly, Pipes, Hoses, and Clamps	Inspect	.1						
		Replace		.1					
		Repair		.2					
	Air Restriction Indica-tors	Inspect	.1						
		Replace		.2					
	Air Control Valves	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair		1.0					
	Cylinder Head Assemblies	Inspect						48, 51-53	
		Replace	.5					62-67, 74,	
		Repair	1.0					77, 79, 80,	
		Overhaul	1.0					83, 86, 87,	
		2.0						91-93, 95,	
								99,102,116,	
				128					
	Valve Covers	Inspect	.1						
		Replace		.2					
	Intake and Exhaust Valves	Inspect		.1					
		Adjust		.5					
		Replace	1.0						
		Repair	1.0						
	Rocker Arms and Crossheads	Inspect		.1					
		Adjust		.5				72, 91	
		Replace	1.0						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Push Rods, Valve Lift-	Inspect	.		.1				
	er, and Followers	Replace			1.0				
	Camshafts, Gears, and	Inspect			1.0				
	Bushings	Replace			.10			58, 78, 115,	
		Repair			1.5			116,129-131	
07	ENGINE - Continued								
	Piston and Rod	Inspect				.1		69, 70, 73,	
	Assemblies	Replace				.5		75, 82, 88	
		Repair				1.0		94-101-132	
	Main Bearings and	Inspect				.1			
	Connecting Rod Bear-	Replace				1.0		50-101	
	ings								
	Cylinder Liners and	Inspect				.1			
	Seals	Replace				.5		57, 68, 87,	
								106-108,111	
	Crankshaft	Inspect				.1			
		Replace				1.0		50, 56,104,	
		Repair				2.0		105, 117	
	Vibration Damper	Inspect			.1				
		Replace			.3				
					.3				
	Cylinder Block	Inspect				5.0			
		Replace				2.0		49, 54, 55,	
		Repair						61, 76, 81,	
								84, 87, 89,	
								97, 98, 109,	
								112, 113,	
								117-124	
	Front and Rear	Inspect			.1				
	Crankshaft Accessory	Replace			1.0				
	Drive Seals								
	Flywheel Assembly	Inspect				.1			
		Replace				1.0		13	
		Repair				2.0			
	Ring Gear	Inspect			.1				
		Replace				.5			
	Flywheel Housing	Inspect			.1				
		Replace			.5				
	Timing Gears and Cov-	Inspect	.1						
	er	Replace			.3				

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Turbochargers	Inspect	.1						
		Replace		.5					
		Repair	1.0						
		Overhaul		2.0					
	Intake and Exhaust Manifolds	Inspect	.1						
		Replace	1.0						
		Repair		2.0					
	Water Manifolds	Inspect	.1						
		Replace	.5						
		Repair		1.0					
	Aftercooler	Inspect	.1						
		Test		.5					
		Replace	1.0						
		Repair	2.0						
	Front Engine Support	Inspect	.1						
		Replace	1.0						
		Repair	.5						
	Oil Pan Assembly	Inspect	.1						
		Replace	.5						
		Repair	1.0						
	Hand Hole Covers and Gaskets	Inspect		.1					
		Replace	.5						
	Expansion Plugs	Inspect	.1						
		Replace	.5						
	Piston Cooling Nozzles	Inspect	1.0						
		Replace		1.0					
08	ENGINE EXHAUST SYSTEM								
	Weather Caps	Inspect	.1						
		Replace	.3						
	Mufflers	Inspect	.1						
		Install		.5					
		Replace		.5					
	Muffler Bands	Inspect	.1						
		Replace		.3					
	Exhaust Pipes, Elbows, and Gaskets	Inspect	.1						
		Replace		.2					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
	Exhaust Temperature Thermocouples	Inspect	.1						
		Test		.3					
		Replace		.3					
09	INSTRUMENTS AND SWITCHGEAR CONTROLS								
	Engine Control Panel, Cabinet C	Inspect	.1						
		Test		.3					
		Repair		.5					
	Lube Oil Pressure Gage	Inspect	.1						
		Test		.3					
		Replace		.3					
	Lube Oil Temp Gage	Inspect	.1						
		Test		.2					
		Replace		.3					
	Coolant Temp Gage	Inspect	.1						
		Test		.3					
		Replace		.3					
	Fuel Level gage	Inspect	.1						
		Test		.1					
		Replace		.3					
	Time Totalizing Meter	Inspect	.1						
		Test		.2					
		Replace		.3					
	Exhaust Temp Gage	Inspect	.1						
		Test			.2				
		Adjust			.2				
		Replace			.3				
	Fuel Transfer Pump Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Fuel Transfer Pump Pi-lot Light	Inspect	.1						
		Test		.2					
		Replace		.4					
		Repair		.5					
	Master Switch	Inspect	.1						
		Test		.1					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	MAINTENANCE LEVEL UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Contin-ued								
	Panel Illumination Light	Inspect	.1						
		Test		.1					
		Replace		.1					
		Repair		.3					
	Panel Illumination	Inspect	1						
	Switch	Test		.1					
		Replace		.3					
	Generator Control	Inspect	.1						
	Panel	Service		.2					
		Repair		.5					
	AC Amperes Meter	Inspect	.1						
		Test		.2					
		Adjust		.3					
		Replace		.5					
		Repair			1.0				
	AC Kilovolts Meter	Inspect	.1						
		Test		.2					
		Adjust		.4					
		Replace		.5					
		Repair			1.5				
	Frequency Meter	Inspect	.1						
		Test		.2					
		Adjust		.3					
		Replace		.5					
		Repair			1.5				
	AC Kilowatts Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
		Repair			1.5				
	AC Kilovars Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
		Repair			1.5				

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Continued								
	Power Factor Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
		Repair	1 5						
	Synchroscope Meter	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair	1.0						
	Kilowatt Hours Counter	Inspect	.1						
		Test		.2					
		Replace		.5					
	Gen Temp Meter	Inspect	1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
		Repair	1.0						
	Breaker Control Switch	Inspect	.1						
		Test		.2					
		Replace		.2					
	Ammeter Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	GEN/BUS Voltmeter Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Synchronizer	Inspect	.1						
		Adjust		.2					
		Replace		.5					
	Volt Adj Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Parallel Switch	Inspect	.1						
		Test		.2					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Continued								
	Phase Sequence Indicator Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair		1.0					
	Cross Current Adjust Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Ground Fault Transformer	Inspect	.1						
		Test		.2					
		Replace		.5					
	Ground Fault Relay	Inspect	.1						
		Test		.2					
		Replace		.5					
	Ground Fault Resistor	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair	1.0						
	Freq Adj Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Frequency Sel SW	Inspect	.1						
		Test		.2					
		Replace		.5					
	Frequency Droop/ Isochronous Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Maintenance Lockout Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Local Remote Switch	Inspect	1						
		Test		.2					
		Replace		.5					
	Operation Selector Switch	Inspect	.1						
		Test		.2					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Continued								
	Circuit Breaker Position Indicator Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair		1.0					
	Synchronizing Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair		1.0					
	Synchronizing Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Annunciator Alarm System	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair	1.0						
	Clocks	Inspect	.1						
		Replace		.2					
	Annunciator Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
	Remote Load Voltage Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Utility Station Power Transformer 120/240/220/380/415/380/240	Inspect	.1						
		Test		.2					
		Replace		.5					
	Set Station Power Transformer 2400/240	Inspect	.1						
		Test		.2					
		Replace		.5					
	Telephone Circuits	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair		1.0					
	Incandescent Lamps	Inspect	.1						
		Replace	.1						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIP	REMARKS
			UNIT		DS	GS	Depot		
			C	O	F	H	D		
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Continued								
	Humidistat	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
	SET/UTILITY Circuit Breakers	Inspect	.1						
		Test		.2					
		Repair		.5					
	Heater Strips	Inspect	.1						
		Test		.2					
		Replace		.5					
	Control Room Heaters	Inspect	.1						
		Test		.2					
		Adjust		.2					
	Wattmeter Transducer	Inspect	.1						
		Test	.2						
		Replace	.5						
	Power Factor Meter Transducer	Inspect	.1						
		Test	.2						
		Replace	.5						
	Ammeter Transducer	Inspect	.1						
		Test	.2						
		Replace	.5						
	Current Transformers	Inspect	.1						
		Test	.2						
		Replace	.5						
	Potential Transformers	Inspect	.1						
		Test		.2					
		Replace	.5						
	Fuses	Inspect	.1						
		Test		.2		133			
		Replace		.1					
	Frequency Transducer	Inspect	.1						
		Test		.2					
		Replace		.5					
	Flasher	Inspect	.1						
		Test		.2					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
09	INSTRUMENTS AND SWITCHGEAR CONTROLS - Continued								
	Parallel Lights	Inspect	.1						
		Test		.1					
		Replace		.1					
		Repair		.5					
	Phase Seq. Sel. Sw	Inspect	.1						
		Test		.2					
		Replace		.5					
	Relay Panel Assembly	Inspect	.1						
		Test	.			2	134, 135		
		Replace	.5						
		Repair	1.0						
	High Voltage Fuse Holder	Inspect	.1						
		Replace	.2						
10	REMOTE CONTROL MODULE								
	Remote Control Module	Inspect	.1						
		Test		.2					
		Service		.2					
		Install		.3					
		Replace		.5					
		Repair		1.0					
	Master Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	AC Amperes Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
	AC Kilovolts Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
	Frequency Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
10	REMOTE CONTROL MODULE - Continued								
	AC Kilowatts Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
	Power Factor Meter	Inspect	.1						
		Test		.2					
		Adjust		.2					
		Replace		.5					
	Synchroscope	Inspect	.1						
		Test		.2					
		Replace		.5					
	Breaker Control Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Ammeter Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Gen/Bus Voltmeter Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Synchronizing Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Volt Adl. Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Parallel Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Freq Adj. Rheostat	Inspect	.1						
		Test		.2					
		Replace		.5					
	Synchronizing Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
	Telephone Jack	Inspect	.1						
		Replace		.2					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	MAINTENANCE LEVEL UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
10	REMOTE CONTROL MODULE - Continued								
	Connector Receptacle	Inspect	.1						
		Test		.2					
		Replace		.5					
	Remote Control Cable Assembly	Inspect	.1						
		Test		2					
		Install		.5					
		Replace		1.0					
		Repair	1.5						
	Wiring Harness Assembly	Inspect	.1						
		Test		.2		136			
		Replace		.5					
		Repair		1.0					
	High Coolant Temp, Low Oil Pressure Fault Lights	Inspect	.1						
		Test		.1					
		Replace		.5					
	Load Circuit Breaker Open and Closed Indicator Lights	Inspect	.1						
		Test		.1					
		Replace		.5					
		Repair		1.0					
	Annunciator Alarm System	Inspect	.1						
		Test		.2					
		Replace		.5					
		Repair	1.0						
	Emergency Shutdown Pushbutton	Inspect	.2						
		Test		.5					
		Replace		1.0					
	Parallel Indicating Lights	Inspect	.1						
		Test		.2					
		Replace		.5					
	Horn	Inspect	.1						
		Test		.2					
		Replace		.5					
	Frequency Transducer	Inspect	.1						
		Test		.2					
		Replace		.5					
	Diodes and Resistors	Inspect	.1						
		Test		.2					
		Replace		.5					

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	UNIT O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
11	SITE REQUIREMENT MODULE								
	U/O Voltage Device	Inspect	.1						
		Test	.2						
		Replace	.5						
	U/F Device	Inspect	.1						
		Test	.2						
		Replace	.5						
	O/F Device	Inspect	.1						
		Test	.2						
		Replace	.5						
	Time Delay Relay	Inspect	.1						
		Test	.2						
		Replace	.5						
	Lamps	Inspect	.1						
		Replace		.2					
	Relays	Inspect	.1						
		Test	.2						
		Replace	.5						
	Timer	Inspect	.1						
		Test		.2					
		Replace		.5					
	Pot	Inspect	.1						
		Test		.2					
		Replace		.5					
	Switch	Inspect	.1						
		Test		.2					
		Replace		.5					
	Fuses	Inspect	.1						
		Replace		.2					
	Fuse Holders	Inspect	.1						
		Replace	5						
	Synchronizer	Inspect	.1						
		Test	.2						
		Replace		.5					
	Rectifier	Inspect	.1						
		Test	.2						
		Replace	.5						

SECTION II. MAINTENANCE ALLOCATION CHART (Continued)

GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL UNIT C	O	DS F	GS H	Depot D	TOOLS AND EQUIP	REMARKS
11	SITE REQUIREMENT MODULE - Continued								
	SRM Cable Assemblies	Inspect	.1						
		Test		.2					
		Install		.5					
		Repair		.5					
	Wiring Harness Assemblies	Inspect	.1						
		Test		.2		136			
		Replace		.5					
		Repair		1.0					

SECTION III. TOOLS, TEST AND SUPPORT EQUIPMENT REQUIREMENTS

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) P/N TOOL NUMBER	
1	O	Multimeter	6622-00-495-3513		
2	O	Circuit Breaker Test		MS1A	(00426)
3	O	Ammeter	6625-00-892-1497		
4	O	Voltmeter		M-45	(94075)
5	F	Dryer, 160			
6	F, O	Grounding Stick		T6000891	(17438)
7	F	Power Supply, 24 V DC		PUC50-2	(98380)
8	F	Motor, Variable Speed			
9	F	Megohmmeter	6625-00-643-1030		
10	F	Stopwatch		403.201	(21999)
11	F	Power Supply Variable		62608	(28480)
12	F	Checking Tool, Plunger		ST-1241	(15434)
13	H	Puller, Tachometer Drive		ST- 1326	(15434)
14	H	Vise, Ball Joint		ST-302	(15434)
15	H	Fixture, Reaming		ST-490	(15434)
16	H	Mounting Plate, Fuel Pump		3375133	(15434)
17	H	Driver		3375172	(15434)
18	H	Drivers Seal		3375173	(15434)
19	F	Tachometer, Digital		3375631	(15434)
20	F, H	Test Stand, Fuel Pump		3375698	(15434)
21	F	Gage, Fuel Pressure		3375932	(15434)
22	H	Driver, Pressure Valve		3375959	(15434)
23	F	Idle Speed Adjusting Tool		3375981	(15434)
24	H	Driver, Lock-Clip		3376136	(15434)
25	F	Stand, Injector Assembly		ST-1298	(15434)
26	H	Wrench, Injector Cup		ST-995	(15434)
27	F	Driver, Seal		3375174	(15434)
28	F	Test Stand Kit, Injector		3375410	(15434)
29	F	Spray Tester, Injector Cup		3376350	(15434)
30	F	Injector Leakage Tester		3375375	(15434)
31	F	Injector Link		3375398	(15434)
32	F	Adapter Pot		3375440	(15434)
33	F	Puller		3376000	(15434)

SECTION III. TOOLS, TEST AND SUPPORT EQUIPMENT REQUIREMENTS (Continued)

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) P/N TOOL NUMBER	
34	D	Dial Indicator		CM200	(90191)
35	F	Rocker Lever Actuator		3375010	(15434)
36	F	RPM Indicator	6680-00-171-4584		
37	F	Water Pump Bearing Separator		3375326	(15434)
38	F	Main Bearing Cap Puller		3375356	(15434)
39	F	Puller Assembly		3375267	(15434)
40	F	Water Pump Bearing Mandrel		ST-658	(15434)
41	F	Water Pump Bearing Mandrel		3375318	(15434)
42	F	Water Pump Seal		3375319	(15434)
43	F	Water Pump Carbide Seal Mandrel		3375256	(15434)
44	0	Radiator Testers 15 psi			
45	0	Testers Antifreeze	6630-00-105-1418		
46	0	Thermometer			
47	H	Counterboring Tool, Water Hole		ST-1010	(15434)
48	F	Tester, Hydrostatic		ST-1012	(15434)
49	F	Drivers Rear Sea/Wear		ST-1093	(15434)
50	H	H Puller, Main Bearing Cap		ST-1116	(15434)
51	H	Driver, Valve Seat Insert Staking		ST-1122	(15434)
52	H	Guide, Head, Dowel Pin		ST-1134	(15434)
53	F	Magnetic Crack Detector		ST-1166	(15434)
54	H	Counterbore, Tool, Liner		ST-1168	(15434)
55	H	Bore Tool, main bearing		ST-1177	(15434)
56	H	Crankshaft Hardness Tester		ST-1196	(15434)
57	H	Plate, Puller		ST-1209	(15434)
58	F	Driver Sets, Camshaft Bushing		ST-1228	(15434)
59	H	Block, Weight Carrier		ST-1231	(15434)
60	H	Puller, Coupling Half		ST-1249	(15434)
61	F	Gage, Concentricity		ST-1252	(15434)
62	F	Vacuum Tester, Valve		ST-1257	(15434)

SECTION III. TOOLS, TEST AND SUPPORT EQUIPMENT REQUIREMENTS (Continued)

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) P/N TOOL NUMBER
63	F	Seal		ST-1257-36 (15434)
64	F	Seal		ST-1 257-37 (15434)
65	F	Cup		ST-1257-38 (15434)
66	H	Spacer, Crosshead Guide		ST-1264 (15434)
67	H	Driver, Valve Guide		ST-1265 (15434)
68	H	Clamp, Cylinder Liner		ST-1267 (15434)
69	H	Compressor, Ring		ST-1268 (15434)
70	H	Expander, Piston Ring		ST-1269 (15434)
72	F	Mandrel		ST-1284 (15434)
73	H	Driver, Connecting Rod Bushing		ST-1285 (15434)
74	H	Valve Seat Insert Staking Tool		ST-1288 (15434)
75	H	Mandrel Set, Locating		ST-1 305 (15434)
76	H	Counterbore Tool, Cylinder Block -		ST-1309 (15434)
77	H	Cutter Set, Valve Seat Insert -		ST-1310 (15434)
78	F	Pilot Camshaft		ST-1313 (15434)
79	F	Driver, Water Tube		ST-1319 (15434)
80	H	Extractor, Valve Seat		ST-1323 (15434)
81	F, H	Dial Gage Attachment		ST-1325 (15434)
82	H	Arbor, Expanding		ST-1331 (15434)
83	H	Tool Kit, Valve Seat Insert		ST-257 (15434)
84	F	Pulley Assembly Tool		ST-386 (15434)
85	H	Oil Seal Assembly Tool		ST-419 (15434)
86	F	Compressor, Valve Spring		ST-448-6 (15434)
87	F, H	Block, Gage		ST-547 (15434)
88	H	Fixture, Rod Checking		ST-561 (15434)
89	F	Standard Puller		ST-647 (15434)
90	O	Adapter, Torque Wrench		ST-669 (15434)
91	F	Valve Facing Machine		ST-6841 (15434)
92	F	Valve Seat Grinding Machine -		ST-685 (15434)
93	F	Eccentrimeter		ST-685-4 (15434)

SECTION III. TOOLS, TEST AND SUPPORT EQUIPMENT REQUIREMENTS (Continued)

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) P/N TOOL NUMBER
94	H	Connecting Rod Chamfering Tool -		ST-861 (15434)
95	F	Brush		ST-876 (15434)
96	H	Puller, Camshaft Gear		3375016 (15434)
97	H	Cutter, Thrust Surface		3375053 (15434)
98	H	Main Bearing Bore Kit		3375059 (15434)
99	F	Plate, Adapter		3375070 (15434)
100	H	Packing Set		3375071 (15434)
101	H	Pin, Guide		3375098 (15434)
102	F	Valve, Spring Tester		3375182 (15434)
103	H	Installing Tool, Ball, Shaft		3375204 (15434)
104	H	Gage, Fillet Ball		3375241 (15434)
105	H	Gage, Fillet Ball		3375242 (15434)
106	H	Cylinder Liner Installation		3375422 (15434)
107	H	Bridge Assembly		3375423 (15434)
108	H	Plate, Liner Installation		3375424 (15434)
109	F	Pilot, Drill		3375497 (15434)
110	O	Adapter, Radiator Cap		3375516 (15434)
111	H	Puller, Cylinder Liner		3375629 (15434)
112	F	Oil Seal Puller/Installer		3375786 (15434)
113	H	Liner Counterbore Salvage Tool -		3375820 (15434)
114	F	Puller Assembly		3375834 (15434)
115	F	Jaw, Puller		3375835 (15434)
116	F, H	Valve Guide Arbor Set		3375946 (15434)
117	H	Stand, Engine Rebuild		3375955 (15434)
118	H	Counterbore Repair Sleeve		3376347 (15434)
119	H	Cutter Assembly		3376219 (15434)
120	H	Driver, Sleeve		3376223 (15434)
121	H	Plate, Guide		3376224 (15434)
122	H	Shaft, Sleeve Driver		3376226 (15434)
123	H	Camshaft Bore Salvage Kit		3376345 (15434)
124	H	Bushing		3376222 (15434)
125	F	Fixture, Lifting		D-511856 (38151)

SECTION III. TOOLS, TEST AND SUPPORT EQUIPMENT REQUIREMENTS (Continued)

(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) P/N TOOL NUMBER
126	F	Wrench, Torque	5120-00-640-6364	
127	F	Spanner, Adjustable, 3 inch		383 (96645)
128	H	Valve Guide Driver		ST-1315 (15434)
129	F	Kit, Cam Bear Puller		3376400 (15434)
130	F	Bushing Mandrel		ST-598 (15434)
131	F	Lube Pump Bushing Boring Tool		3375206 (15434)
132	H	Gage, Piston Ring Groove		ST-560 (15434)
133	C	Fuse Puller		11223 (00101)
134	F	Soldering Iron	3439-00-223-2528	
135	F	Tool Kit, Electronic		K600 (27596)
136	O	Tool Kit, Crimping	5180-00-079-3400	

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	Balance Blades at Depot Level.
B	Repair by Original Manufacturer Only.
C	Visual Inspection

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DESIG TRM	DESCRIPTION	LOC	WD
A9	ANNUNCIATOR PANEL	SEE BELOW	
A90S1-6	OVERSPEED FAULT LIGHT	6-B6	80-7863
A90S2-5	LOW LUBE OIL PRESSURE FAULT LIGHT	6-B6	80-7863
A90S3-1	HIGH COOLANT TEMP FAULT LIGHT	6-C6	80-7863
A90S4-4	HIGH LUBE OIL TEMP FAULT LIGHT	6-C6	80-7863
A90S5-7	LOW FUEL LEVEL FAULT LIGHT	6-C7	80-7863
A90S6-8	HIGH FUEL LEVEL FAULT LIGHT	6-C8	80-7863
A90S7 9	OVERVOLTAGE FAULT LIGHT	5-B3	80-7863
A90S8-12	UNDERVOLTAGE FAULT LIGHT	6-C4	80-7863
A90S9-10	OVERCURRENT FAULT LIGHT	5-B4	80-7863
A90S10-11	REVERSE POWER FAULT LIGHT	5-B5	80-7863
A90S11-13	GROUND FAULT LIGHT	5-B5	80-7863
A90S12-2	SPARE FAULT LIGHT	5-B6	80-7863
A90S13-3	EXCESSIVE CRANKING FAULT LIGHT	5-B6	80-7863
A90S14-15	UNDERFREQUENCY FAULT LIGHT	6 C5	80-7863
A90S15-14	LOW COOLANT LEVEL FAULT LIGHT	5-B7	80-7863
A90S16-18	SPARE FAULT LIGHT	5-B8	80-7863
A90S17 17	SPARE FAULT LIGHT	5-C3	80-7863
A90S18-16	SPARE FAULT LIGHT	5-C4	80-786[illegible]
A9-C	COMM	5-B3	80-7863
A9-C	COMM	5-C4	80-7863
A10	ANNUNCIATOR RELAY PANEL	SEE BELOW	
A1001-A1004	BLOCKING DIODE	6-B6	80-7862
A1005-A1008	BLOCKING DIODE	6-C6	80-7862
A1009-A10011	BLOCKING DIODE	6-C7	80-7862
A10012	BLOCKING DIODE	6-C8	80-7862
A10013 A10014	BLOCKING DIODE	5-B3	80-7862
A10015-A10016	BLOCKING DIODE	6-C4	80-7862
A10017-A10018	BLOCKING DIODE	5-B4	80-7862
A10K1 2&7 COIL	OVERSPEED ALARM RELAY	6-A5	80-7862
A10K1-4&6	OVERSPEED ALARM RELAY	6-B5	80-7862
A10K2-2&7 COIL	OIL PRESSURE ALARM RELAY	6-A6	80-7862
A10K2-4&6	OIL PRESSURE ALARM RELAY	6-B6	80-7862
A10K2-3&5	OIL PRESSURE ALARM RELAY	6-D5	80-7862
A10K3 2&7 COIL	COOLANT TEMP ALARM RELAY	6-C5	80-7862
A10K3-4&6	COOLANT TEMP ALARM RELAY	6-D5	80-7862
A10K3-3&5	COOLANT TEMP ALARM RELAY	6-D5	80-7862
A10K4 2&7 COIL	OIL TEMP ALARM RELAY	6-C5	80-7862
A10K4-4&6	OIL TEMP ALARM RELAY	6-D6	80-7862
A10K5 2&7 COIL	LOW FUEL ALARM RELAY	6-C7	80-7862
A10K5-3&5	LOW FUEL ALARM RELAY	4-B3	80-7862
A10K5-4&6	LOW FUEL ALARM RELAY	6-D7	80-7862
A10K6-2&7 COIL	HIGH FUEL LEVEL ALARM RELAY	6-C7	80 7862
A10K6-3&5	HIGH FUEL LEVEL ALARM RELAY	4-B4	80-7862
A10K6-4&6	HIGH FUEL LEVEL ALARM RELAY	6-D7	80-7862
A10K7-2&7	OVERVOLTAGE FAULT ALARM RELAY	5-A3	80-7862
A10K7-3&5	OVERVOLTAGE FAULT ALARM RELAY	4-B5	80-7862
A10K7-4&6	OVERVOLTAGE FAULT ALARM RELAY	5-B3	80-7862
A10K8 2&7 COIL	UNDERVOLTAGE FAULT ALARM RELAY	6-C3	80-7862
A10K8-3&5	UNDERVOLTAGE FAULT ALARM RELAY	3-D5	80-7862
A10K8-4&6	UNDERVOLTAGE FAULT ALARM RELAY	6-D4	80 7862
A10K9 2&7 COIL	OVERCURRENT ALARM RELAY	5-A4	80-7862
A10K9-4&6	OVERCURRENT ALARM RELAY	5-B4	80-7862
A10TB1-1	TERMINAL BLOCK	5-C3	80-7862
A10TB1-1	TERMINAL BLOCK	6-A7	80-7862
A10TB1-4	TERMINAL BLOCK	5-A4	80 7862
A10TB1-4	TERMINAL BLOCK	6-A6	80-7862
A10TB1-5	TERMINAL BLOCK	5-B4	80-7862
A10TB1-6	TERMINAL BLOCK	6-C3	80-7862
A10TB1-7	TERMINAL BLOCK	5-B3	80-7862
A10TB1 8	TERMINAL BLOCK	6-D8	80-7862
A10TB1-9	TERMINAL BLOCK	6-D7	80-7862
A10TB1-10	TERMINAL BLOCK	6-C6	80-7862
A10TB1-11	TERMINAL BLOCK	6-C5	80-7862
A10TB1-12	TERMINAL BLOCK	6-B6	80-7862
A10TB1-13	TERMINAL BLOCK	6-B5	80-7862
A10TB1 14	TERMINAL BLOCK	3-D3	80-7862

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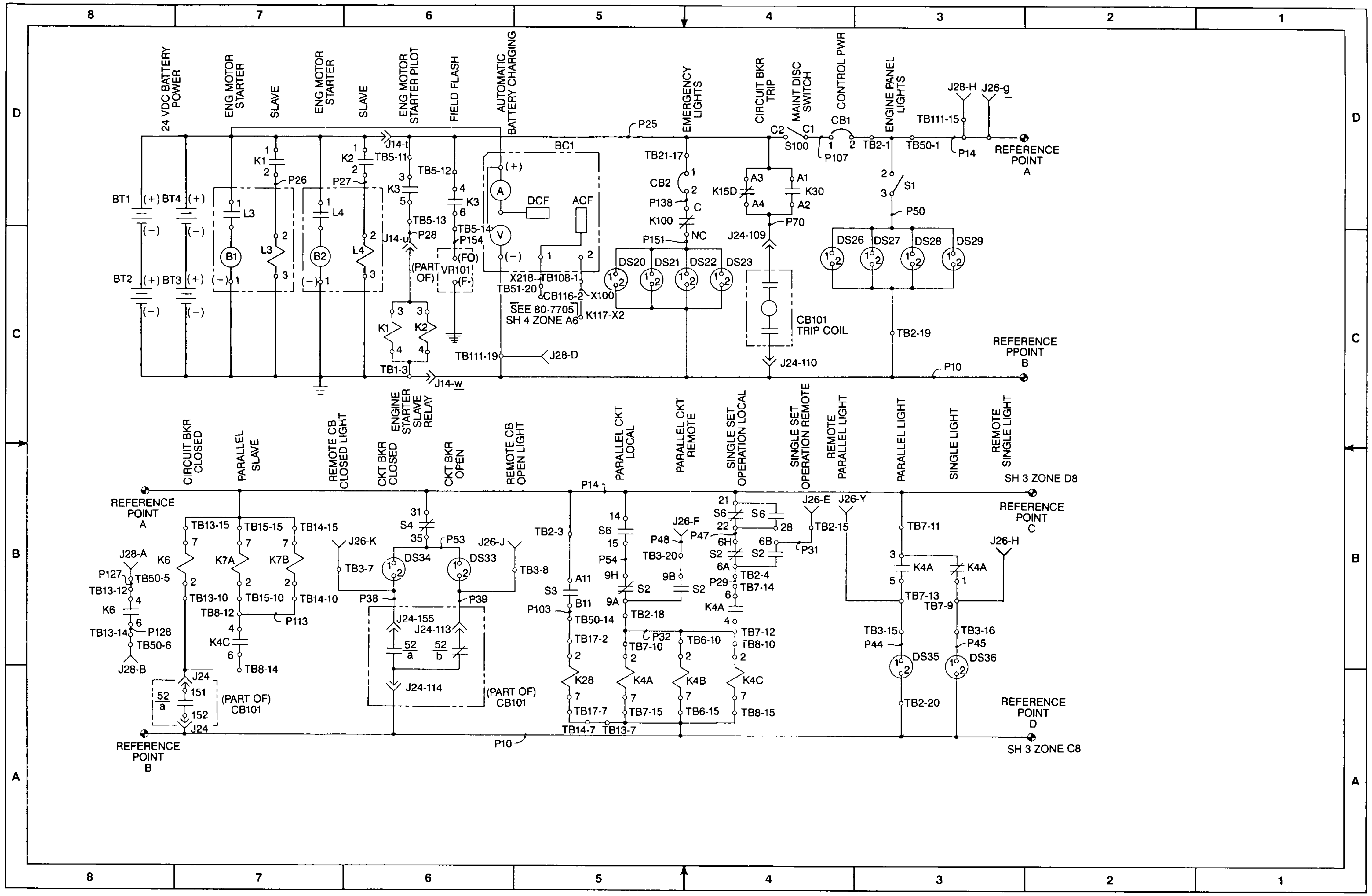
A10TB2-1	TERMINAL BLOCK	4-B5	80-7862
A10TB2-6	TERMINAL BLOCK	3-D5	80-7862
A10TB2-7	TERMINAL BLOCK	3-D5	80-7862
A10TB2 8	TERMINAL BLOCK	6-D5	80-7862
A10TB2-9	TERMINAL BLOCK	6-D5	80-7862
A10TB2-10	TERMINAL BLOCK	6-D5	80-7862
A10TB2-11	TERMINAL BLOCK	4-B3	80-7862
A10TB2-14	TERMINAL BLOCK	6-D5	80-7862
A10TB2-15	TERMINAL BLOCK	6-D5	80-7862
A10TB2-16	TERMINAL BLOCK	4-B4	80-7862
A10TB2-17	TERMINAL BLOCK	4-B4	80-7862
A10TB3-1	TERMINAL BLOCK	6-C6	80-7862
A10TB3-2	TERMINAL BLOCK	6-B6	80-7862
A10TB3-3	TERMINAL BLOCK	6-B6	80-7862
A10TB3-4	TERMINAL BLOCK	6-C7	80-7862
A10TB3-5	TERMINAL BLOCK	6-C7	80-7862
A10TB3-6	TERMINAL BLOCK	6-C6	80-7862
A10TB3-7	TERMINAL BLOCK	5-B4	80-7862
A10TB3-8	TERMINAL BLOCK	6-C4	80-7862
A10TB3-9	TERMINAL BLOCK	5-B3	80-7862
A10TB3-10	TERMINAL BLOCK	5-B4	80-7862
A10TB3-1	TERMINAL BLOCK	6-C7	80-7862
A10TB3-12	TERMINAL BLOCK	5-B4	80-7862
A10TB3 13	TERMINAL BLOCK	5-B4	80-7862
A10TB3-14	TERMINAL BLOCK	6-A6	80-7862
A11	ANNUNCIATOR RELAY PANEL	SEE BELOW	
A11D1	ANNUNCIATOR RELAY PANEL	5-B4	80-7862
A11D1-A11D4	BLOCKING DIODE	5 B5	80-7862
A11D5-A11D8	BLOCKING DIODE	5-B6	80-7862
A11D9-A11D10	BLOCKING DIODE	6-C5	80-7862
A11D11-A11D14	BLOCKING DIODE	5-B7	80-7862
A11D15 A11D17	BLOCKING DIODE	5-C3	80-7862
A11D18 COIL	BLOCKING DIODE	5-C4	80-7862
A11K1-2&7	REVERSE POWER FAULT ALARM RELAY	5-A4	80-7862
A11K1-3&5	REVERSE POWER FAULT ALARM RELAY	3-D6	80-7862
A11K1-4&6	REVERSE POWER FAULT ALARM RELAY	5-B4	80-7862
A11K2 2&7 COIL	GROUND FAULT-ALARM RELAY	5-A5	80-7862
A11K2-4&7	GROUND FAULT-ALARM RELAY	5-B5	80-7862
A11K3 2&7 COIL	SPARE	5-A6	80-7862
A11K3-4&6	SPARE	5-B6	80-7862
A11K4 2&7 COIL	EXCESSIVE CRANKING ALARM RELAY	5-A6	80-7862
A11K4-4&6	EXCESSIVE CRANKING ALARM RELAY	5-A6	80-7862
A11K5-2&7 COIL	UNDERCURRENT FAULT ALARM RELAY	6-C5	80-7862
A11K5-3&5	UNDERCURRENT FAULT ALARM RELAY	3-D5	80-7862
A11K5-4&6	UNDERCURRENT FAULT ALARM RELAY	6-D5	80-7862
A11K6 2&7 COIL	COOLANT LEVEL ALARM RELAY	5-A7	80-7862
A11K6-4&6	COOLANT LEVEL ALARM RELAY	5-B7	80-7862
A11K7 2&7 COIL	SPARE	5-A7	80-7862
A11K7-4&6	SPARE	5-B7	80 7862
A11K8-2&7 COIL	SPARE	5 C3	80-7862
A11K8-4&6	SPARE	5-D3	80-7862
A11K9 2&7 COIL	SPARE	5-C3	80-7862
A11K9-4&6	SPARE	5-D3	80-7862
A11TB1-1	TERMINAL BLOCK	5-A7	80-7862
A11TB1-1	TERMINAL BLOCK	6-A7	80-7862
A11TB1-2	TERMINAL BLOCK	5-B4	80-7862
A11TB1-3	TERMINAL BLOCK	5-B5	80-7862
A11TB1-4	TERMINAL BLOCK	5-A7	80-7862
A11TB1 5	TERMINAL BLOCK	5-D4	80-7862
A11TB1-6	TERMINAL BLOCK	5-D3	80-7862
A11TB1-7	TERMINAL BLOCK	5-B8	80-7862
A11TB1-8	TERMINAL BLOCK	5-B7	80-7862
A11TB1-9	TERMINAL BLOCK	6-C5	80-7862
A11TB1-10	TERMINAL BLOCK	5-B6	80-7862
A11TB1-11	TERMINAL BLOCK	5-B6	80-7862
A11TB1-12	TERMINAL BLOCK	5-B5	80-7862
A11TB1-13	TERMINAL BLOCK	5-B5	80-7862

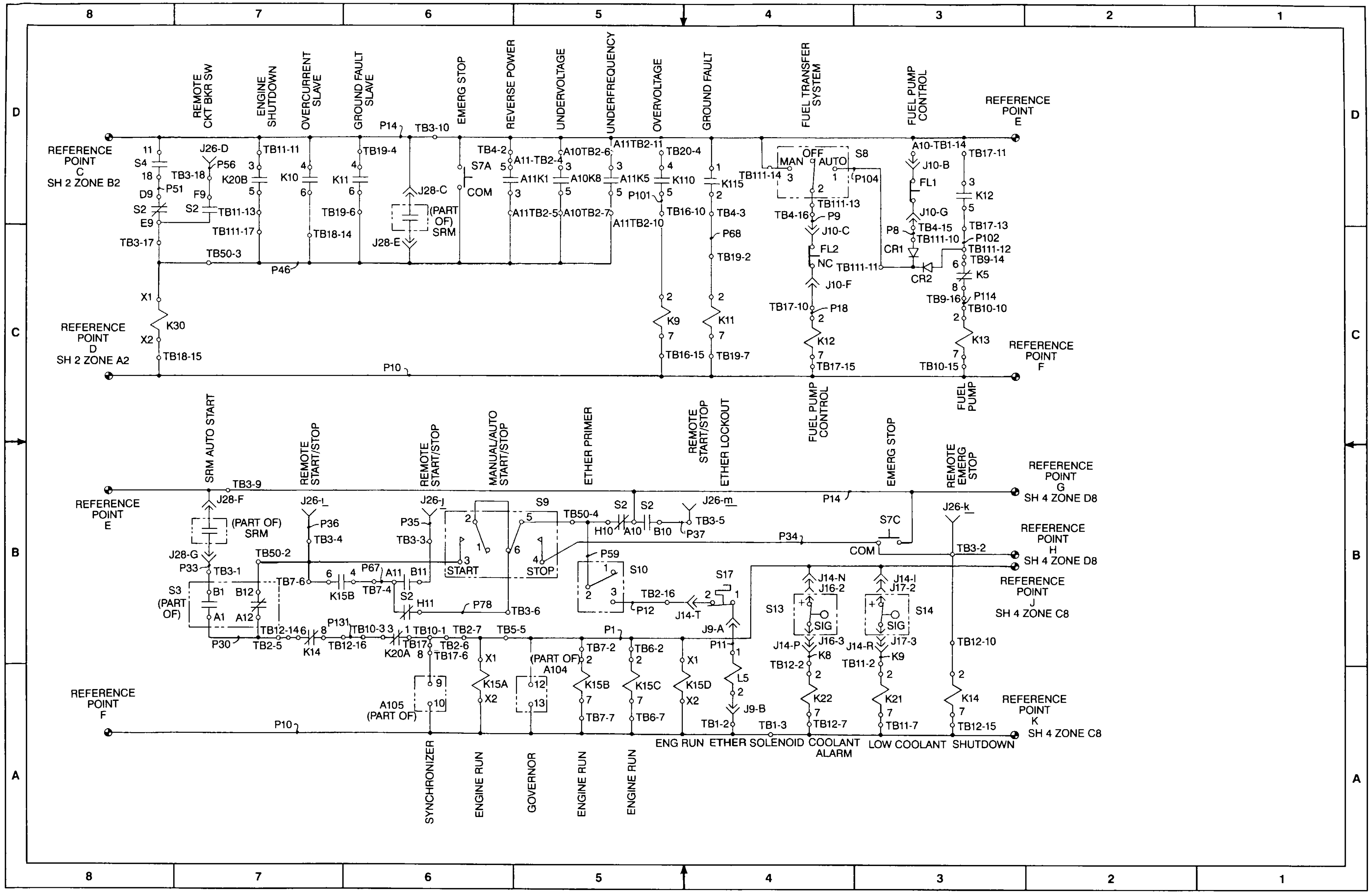
DESIG - TRM	DESCRIPTION	LOC	WD
A11TB2-4	TERMINAL BLOCK	3-D5	80-7862
A11TB2-10	TERMINAL BLOCK	3-D5	80-7862
A11TB2-11	TERMINAL BLOCK	3-D5	80-7862
A11TB3-11	TERMINAL BLOCK	5-B6	80-7862
A11TB3-2	TERMINAL BLOCK	5-B5	80 7862
A11TB3-3	TERMINAL BLOCK	5-B5	80-7862
A11TB3-4	TERMINAL BLOCK	5-B7	80-7862
A11TB3-5	TERMINAL BLOCK	6-C5	80 7862
A11TB3-6	TERMINAL BLOCK	5-B6	80-7862
A11TB3-7	TERMINAL BLOCK	5-C4	80-7862
A11TB3-8	TERMINAL BLOCK	5-C3	80-7862
A11TB3-9	TERMINAL BLOCK	5-B8	80-7862
A11TB2-10	TERMINAL BLOCK	5-D4	80-7862
A11TB3-11	TERMINAL BLOCK	5-A4	80-7862
A11TB3-11	TERMINAL BLOCK	5-C4	80-7862
A11TB3-12	TERMINAL BLOCK	5-D4	80-7862
A11TB3-13	TERMINAL BLOCK	5-D4	80-7862
A104	GOVERNOR/LOAD SHARING	3-A5	80-7861
A105	SYNCHRONIZER	3-A6	80-7861
B1 & B2	STARTER MOTOR	2-C7	80-7688
B3	PRE-LUBE PUMP	4-C7	80-7688
BC1-1&2	BATTERY CHARGER	2-C5	80-7688
BC1-(+)	BATTERY CHARGER	2-D6	80-7688
BC1-(−)	BATTERY CHARGER	2-C6	80-7688
BT1	BATTERY 12V	2-D8	80-7688
BT2	BATTERY 12V	2-D7	80-7688
BT3	BATTERY 12V	2-C8	80-7688
BT4	BATTERY 12V	2-C8	80-7688
CB1	CKT BRKR-DC CONTROL	2-D4	80-7860
CB2	CKT BRKR-EMERGENCY LIGHTS	2-D5	80-7860
CB101	CKT BRKR-GENERATOR LOAD	2-A7	80-7861
CB101	CKT BRKR-GENERATOR LOAD	2-C4	80-7861
CB116-2	CKT BRKR BATTERY CHARGER	2-C5	80-7494
CR1 & CR2	BLOCKING DIODE FUEL PUMP	3-C3	80-7860
CR3	DIODE SURGE SUPPRESSOR	4-B4	80-7688
CR4	DIODE SURGE SUPPRESSOR	4-A4	80-7688
CR5	BLOCKING DIODE	6-B7	80-7860
DS19	FLASHER	5-D6	80-7860
DS20	EMERGENCY LIGHT	2-C5	80-7494
DS21	EMERGENCY LIGHTS	2-C5	80-7494
DS22	EMERGENCY LIGHT	2-C4	80-7494
DS23	EMERGENCY LIGHT	2 C4	80-7494
DS26	ENGINE PANEL LIGHT	2-C4	80-7860
DS27	ENGINE PANEL LIGHT	2-C3	80-7860
DS28	ENGINE PANEL LIGHT	2-C3	80-7860
DS29	ENGINE PANEL LIGHT	2-C3	80-7860
DS33	CKT BRKR OPEN LIGHT	2-B6	80-7866
DS34	CKT BRKR CLOSED LIGHT	2-B6	80-7866
DS35	PARALLEL LIGHT	2-B3	80-7866
DS36	SINGLE UNIT LIGHT	2-B3	80-7866
FL1	SWITCH – PUMP CONTROL	3-D3	80-7866
FL2	SWITCH – PUMP CONTROL	3-C4	80-7866
FL3	SWITCH – LOW FUEL LEVEL	6-D7	80-7866
FL4	SWITCH – HIGH FUEL LEVEL	6-D8	80-7866

LETTER DESIGNATIONS CONTINUED ON SHEET 7

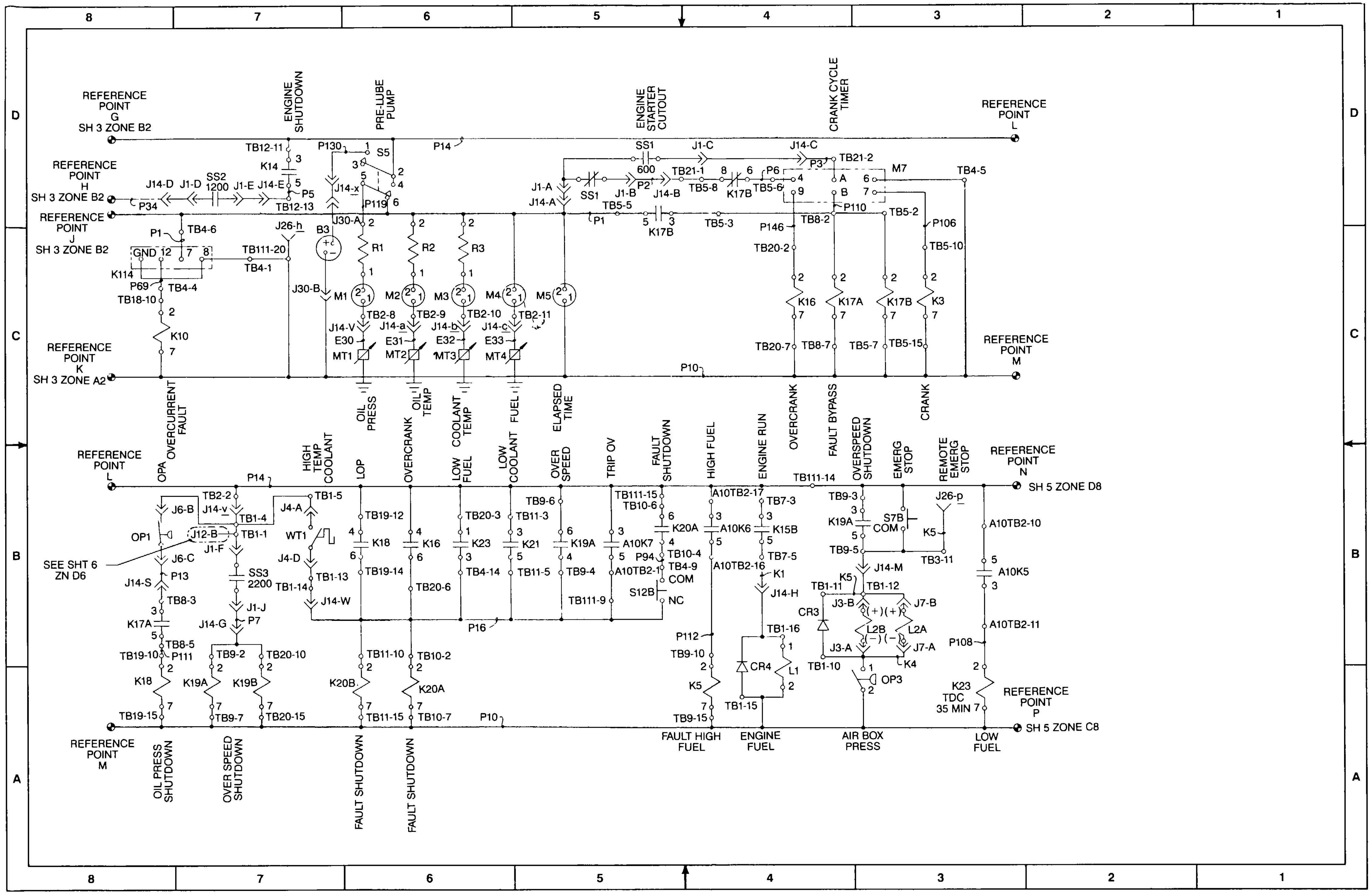
FO-1. DC Schematic Diagram
(Sheet 1 of 8)



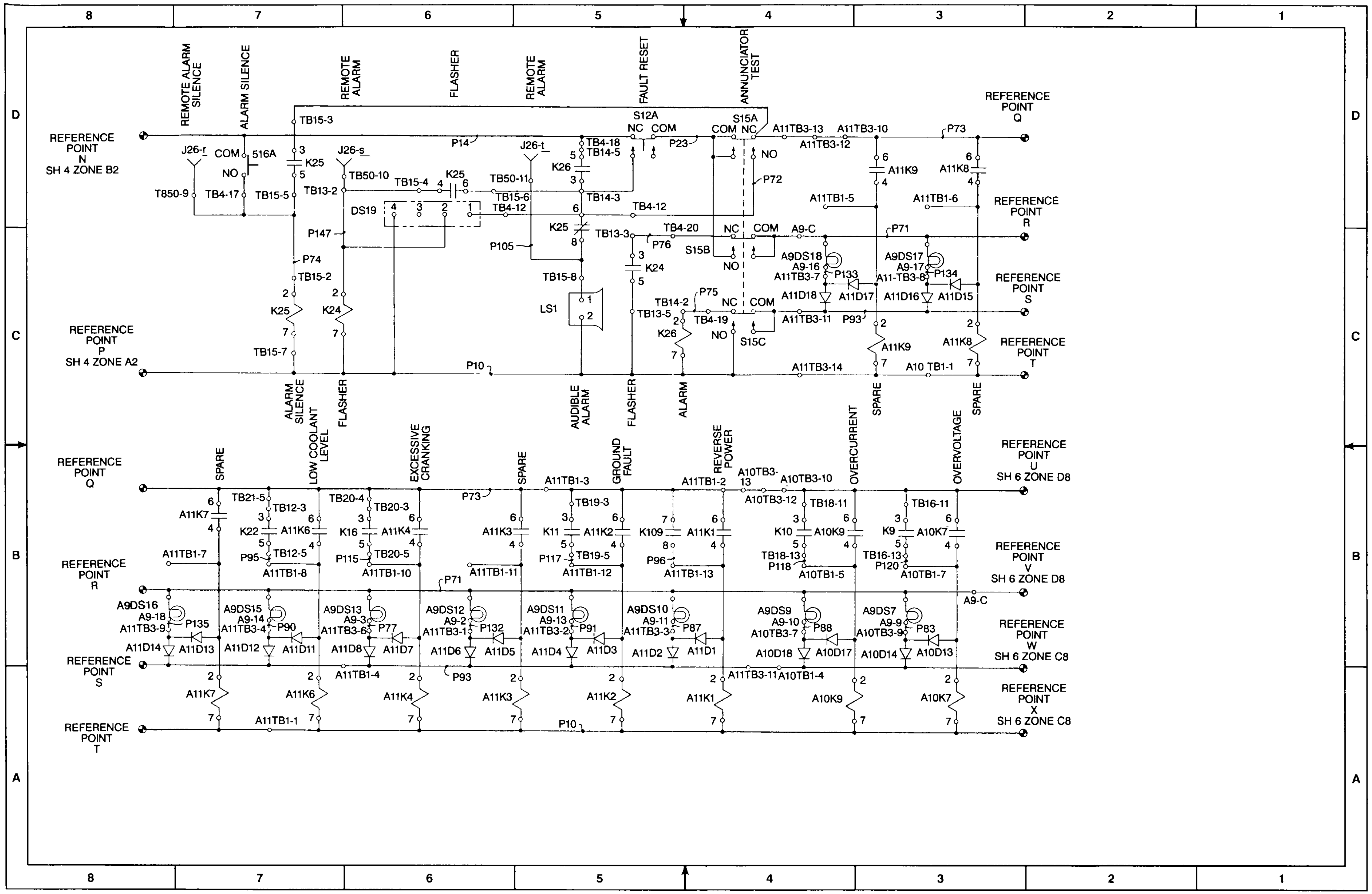
FO-1. DC Schematic Diagram
(Sheet 2 of 8)



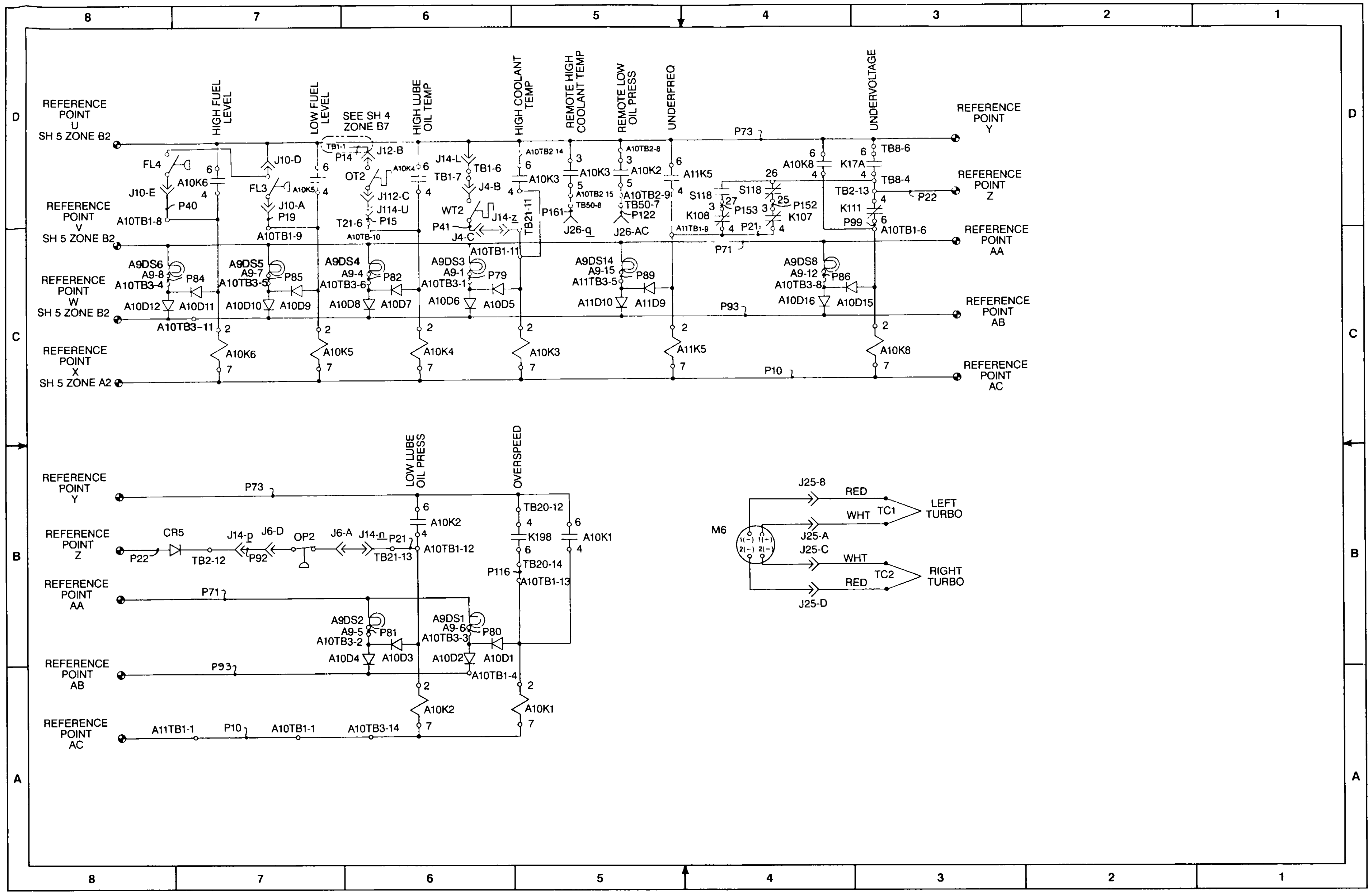
FO-1. DC Schematic Diagram
(Sheet 3 of 8)



FO-1. DC Schematic Diagram
(Sheet 4 of 8)



FO-1. DC Schematic Diagram
(Sheet 5 of 8)



FO-1. DC Schematic Diagram
(Sheet 6 of 8)

DESIG - TRM	DESCRIPTION	LOC	WD
J1A-8	CONN – SPEED SWITCH	4-D5	80 7688
J1-C	CONN – SPEED SWITCH	4-D4	80-7688
J1D-E	CONN – SPEED SWITCH	4 D7	80-7688
J1F-J	CONN – SPEED SWITCH	4-B7	80 7688
J3A-B	CONN – AIR BOX SOLENOID LT	4-B3	80 7688
J4A	CONN – COOLANT TEMP SW	4 B7	80-7688
J4B	CONN – COOLANT TEMP SW	6 D6	80-7688
J4D	CONN – COOLANT TEMP SW	4-B7	80 7688
J6A	CONN OIL PRESS WRN-SHT DN SW	6-B6	80-7688
J6B-C	CONN OIL PRESS WRN-SHT DN SW	4-B8	80-7688
J6D	CONN OIL PRESS WRN SHT DN SW	6-B7	80-7688
J7A-B	CONN AIR BOX SOLENOID SW	4-B3	80 7688
J9A	CONN ETHER SOLENOID	3-B4	80-7688
J9B	CONN ETHER SOLENOID	3-A4	80-7688
J10A	CONN FUEL TANK FLOAT SW	6 D7	80-7688
J10C	CONN FUEL TANK FLOAT SW	3-C4	80 7688
J10D	CONN FUEL TANK FLOAT SW	6-D7	80-7688
J10E	CONN FUEL TANK FLOAT SW	6-D8	80-7688
J10-F	CONN FUEL TANK FLOAT SW	3-C4	80-7688
J10G	CONN FUEL TANK FLOAT SW	3-D3	80-7688
J12	CONN OIL TEMP SW	6-D6	80-7688
J12B	CONN OIL TEMP SW	4-B7	80-7688
J12B-C	CONN OIL TEMP SW	6 D6	80-7688
J14A D	CONN ENGINE ROOM	4-D5	80 7860
J14E	CONN ENGINE ROOM	4-D7	80-7860
J14G	CONN ENGINE ROOM	4 B7	80-7860
J14H	CONN ENGINE ROOM	4-B4	80-7860
J14I	CONN ENGINE ROOM	3-B3	80-7860
J14L	CONN ENGINE ROOM	6-D6	80-7860
J14M	CONN ENGINE ROOM	4-B3	80-7860
J14N P	CONN ENGINE ROOM	3 B4	80-7860
J14R	CONN ENGINE ROOM	3-B3	80-7860
J14S	CONN ENGINE ROOM	4-B8	80-7860
J14T	CONN ENGINE ROOM	3-B4	80-7860
J14U	CONN ENGINE ROOM	6 D6	80-7860
J14V	CONN ENGINE ROOM	4-C6	80-7860
J14W	CONN ENGINE ROOM	4-B7	80-7860
J14a-c	CONN ENGINE ROOM	4-C6	80-7860
J14n	CONN ENGINE ROOM	6-B6	80-7860
J14p	CONN ENGINE ROOM	6-B7	80-7860
J14t-u	CONN ENGINE ROOM	2-C5	80-7860
J14v	CONN ENGINE ROOM	4-B7	80-7860
J14w	CONN ENGINE ROOM	2-C6	80-7860
J14x	CONN ENGINE ROOM	4-D7	80-7860
J14z	CONN ENGINE ROOM	6-D6	80-7860
J16 2-3	CONN COOL LEVEL WRN SW	3-B4	80-7688
J17 2-3	CONN COOL LEVEL SHT DN SW	3-B3	80-7688
J24-109-110	CONN – MAIN CKT BRKR DISCONN	2-C4	80-7861
J24-113	CONN – MAIN CKT BRKR DISCONN	2 B6	80-7861
J24 114	CONN – MAIN CKT BRKR DISCONN	2-A6	80-7861
J24-151-152	CONN – MAIN CKT BRKR DISCONN	2-A6	80-7861
J24-155	CONN – MAIN CKT BRKR DISCONN	2-B6	80-7861
J25A-D	CONN THERMOCOUPLE	6-B4	80-7688
J26D	CONN REMOTE	3-D7	80-7860
J26E	CONN REMOTE	2-B4	80-7860
J26F	CONN REMOTE	2-B4	80-7860
J26H	CONN REMOTE	2-B3	80-7860
J26i	CONN REMOTE	3-B7	80-7860
J26J-K	CONN REMOTE	2 B6	80-7860
J26Y	CONN REMOTE	2-B4	80-7860
J26AC	CONN REMOTE	6-D5	80-7860
J26g	CONN REMOTE	2-D3	80-7860
J26h	CONN REMOTE	4-C7	80-7860
J26j	CONN REMOTE	3-B6	80-7860
J26k	CONN REMOTE	3-B3	80-7860
J26m	CONN REMOTE	3-B4	80-7860
J26p	CONN REMOTE	4-B3	80-7860
J26r	CONN REMOTE	5-D7	80-7860
J26s	CONN REMOTE	5-D6	80-7860
J26t	CONN REMOTE	5-D5	80-7860
J28A-B	CONN – SRM	2-B8	80-7860
J28C	CONN – SRM	3-D6	80-7860
J28E	CONN – SRM	3-C6	80-7860
J28F-G	CONN – SRM	3-B7	80-7860
J28H	CONN – SRM	2-D3	80-7860
J30A	CONN – PRE LUBE PUMP	4-D7	80-7688
J30B	CONN – PRE LUBE PUMP	4-C7	80-7688

DESIG TRM	DESCRIPTION	LOC	WD
K1 COIL	RELAY STARTER SLAVE	2-C6	80-7688
K1	RELAY STARTER SLAVE	2-D7	80-7688
K2 COIL	RELAY STARTER SLAVE	2 C6	80 7688
K2	RELAY STARTER SLAVE	2-D6	80-7688
K3 COIL	RELAY CRANK	4-C3	80-7860
K3	RELAY CRANK	2-D6	80-7860
K4A COIL	RELAY PARALLEL	2-A5	80 7860
K4A	RELAY PARALLEL	2-B3	80-7860
K4A	RELAY PARALLEL	2-B4	80-7860
K4B COIL	RELAY PARALLEL	2-A4	80 7860
K4C COIL	RELAY PARALLEL	2-A4	80 7860
K4C	RELAY PARALLEL	2-B7	80-7860
K5 COIL	RELAY HIGH FUEL LEVEL SLAVE	4 A4	80-7860
K5	RELAY HIGH FUEL LEVEL SLAVE	3-C3	80-7860
K6 COIL	RELAY CKT BRKR CLOSED	2-B7	80-7862
K6	RELAY CKT BRKR CLOSED	2-B8	80-7862
K7A COIL	RELAY PARALLEL SLAVE	2-B7	80 7862
K7B COIL	RELAY PARALLEL SLAVE	2-B7	80-7862
K9 COIL	RELAY OVERVOLTAGE FAULT SLAVE	3-C5	80-7862
K9	RELAY OVERVOLTAGE FAULT SLAVE	5-B3	80-7862
K10 COIL	RELAY OVERCURRENT FAULT SLAVE	4-C8	80-7862
K10	RELAY OVERCURRENT FAULT SLAVE	5-B4	80 7862
K10	RELAY OVERCURRENT FAULT SLAVE	3-D7	80-7862
K11 COIL	RELAY GROUND FAULT SLAVE	3-C4	80-7862
K11	RELAY GROUND FAULT SLAVE	3 D6	80-7862
K11	RELAY GROUND FAULT SLAVE	5-B5	80-7862
K12 COIL	RELAY FUEL PUMP SLAVE	3-C4	80-7862
K12	RELAY FUEL PUMP SLAVE	3 D3	80-7862
K13 COIL	CONTRACTOR FUEL PUMP	3-C3	80-7860
K14 COIL	RELAY – SHUTDOWN	3-A3	80-7860
K14	RELAY – SHUTDOWN	3-B7	80-7860
K14	RELAY – SHUTDOWN	4 D7	80-7860
K15A COIL	RELAY – ENGINE RUN	3-A6	80-7860
K15B COIL	RELAY – ENGINE RUN	3-A5	80-7860
K15B	RELAY – ENGINE RUN	3-B6	80-7860
K15B	RELAY – ENGINE RUN	4 B4	80-7860
K15C COIL	RELAY – ENGINE RUN	3-A5	80-7860
K15D COIL	RELAY – ENGINE RUN	3-A4	80-7860
K15D	RELAY – ENGINE RUN	2-D4	80-7860
K16 COIL	RELAY – EXCESSIVE CRANKING	4-C4	80-7862
K16	RELAY – EXCESSIVE CRANKING	4-B6	80-7862
K16	RELAY – EXCESSIVE CRANKING	5-B6	80-7862
K17A COIL	RELAY – EXCESSIVE CRANKING	4-C3	80-7860
K17A	RELAY – EXCESSIVE CRANKING	4-B8	80-7860
K17A	RELAY – EXCESSIVE CRANKING	6-D3	80-7860
K17B COIL	RELAY – EXCESSIVE CRANKING	4-C3	80-7860
K17B	RELAY – EXCESSIVE CRANKING	4 D5	80-7860
K17B	RELAY – EXCESSIVE CRANKING	4-D4	80-7860
K18	RELAY OIL PRESSURE SHUTDOWN	4-A8	80-7862
K18	RELAY OIL PRESSURE SHUTDOWN	4-B6	80-7862
K19A COIL	RELAY OVERSPEED SHUTDOWN	4 A7	80-7860
K19A	RELAY OVERSPEED SHUTDOWN	4-B3	80-7860
K19	RELAY OVERSPEED SHUTDOWN	4-B5	80-7860
K19B COIL	RELAY OVERSPEED SHUTDOWN	4-A7	80-7862
K20A COIL	RELAY FAULT SHUTDOWN	4-A6	80 7860
K20A	RELAY FAULT SHUTDOWN	3-B6	80-7860
K20B COIL	RELAY FAULT SHUTDOWN	4-A6	80-7860
K20B	RELAY FAULT SHUTDOWN	3-D7	80-7860
K21 COIL	RELAY – LOW COOL SHT DN	3-A3	80-7860
K21	RELAY – LOW COOL SHT DN	4-B5	80-7860
K22 COIL	RELAY – COOL LEVEL ALARM SLAVE	2-A4	80-7860
K22	RELAY – COOL LEVEL ALARM SLAVE	5-B7	80-7860
K23 COIL	RELAY LOW FUEL LEVEL SHT DN	4-A3	80-7862
K23	RELAY LOW FUEL LEVEL SHT DN	4-B6	80-7862
K24 COIL	RELAY FLASHER	5-C7	80-7862
K24	RELAY FLASHER	5-C5	80-7862
K25 COIL	RELAY – ALARM SILENCE	5-C7	80-7862
K25	RELAY – ALARM SILENCE	5-C5	80-7862
K25	RELAY – ALARM SILENCE	5-D6	80-7862
K26 COIL	RELAY ALARM	5-C5	80-7862
K26	RELAY ALARM	5-D5	80-7862
K28 COIL	RELAY SYNCHRONIZER POWER	2-A5	80-7862
K30 COIL	RELAY CKT BRKR TRIP	3-C8	80-7862
K30	RELAY CKT BRKR TRIP	2-D4	80-7862
K100	RELAY EMERGENCY LIGHT	2-D5	80-7860
K107	RELAY – UNDERFREQUENCY 60 Hz	6-D4	80-7861
K108	RELAY – UNDERFREQUENCY 50 Hz	6-D4	80-7861

DESIG TRM	DESCRIPTION	LOC	WD
K109	RELAY – REVERSE POWER MOTOR	5 B5	80-7861
K110	RELAY – OVERVOLTAGE FAULT	3-D5	80-7861
K111	RELAY – OVERVOLTAGE FAULT	6-D3	80-7861
K114 COIL	RELAY – OVERCURRENT	4-C8	80 7863
K115	RELAY – GROUND FAULT	3-D4	80-7863
LI COIL	SOLENOID – ENGINE FUEL	4-A4	80 7688
L2A	SOLENOID – AIR BOX	4-B3	80-7688
L2B	SOLENOID – AIR BOX	4 B3	80-7688
L3 COIL	SOLENOID – STARTER	2-C7	80-7688
L4 COIL	SOLENOID – STARTER	2-C6	80-7688
L5	SOLENOID COIL – ETHER	3-A4	80-7688
LS1	ALARM HORN	5 C6	80-7860
M1	GUAGE – OIL PRESSURE	4-C6	80-7860
M2	GAUGE – OIL TEMPERATURE	4-C6	80-7860
M3	GAUGE – COOLANT TEMP	4-C6	80-7860
M4	GAUGE – FUEL LEVEL	4-C6	80 7860
M5	METER – ELAPSE TIME	4-C5	80 7860
M6	METER – EXHAUST TEMP	6-B4	80-7860
M7	CRANK CYCLE TIMER	4-D3	80-7862
MT1	TRANSMITTER OIL PRESSURE	4-C6	80-7688
MT2	TRANSMITTER OIL TEMPERATURE	4-C6	80-7688
MT3	TRANSMITTER COOLANT TEMP	4-C6	80-7688
MT4	TRANSMITTER FUEL LEVEL	4 C6	80-7688
OP1	LOW OIL PRESSURE SHT DN SW	4-B8	80-7688
OP2	LOW OIL PRESSURE WRN SW	6-B7	80-7688
OP3	AIR BOX DISCONNECT PRESSURE SW	4-A3	80-7688
OT2	HIGH OIL TEMP SW	6-D6	80 7688
R1	RESISTOR-VOLTAGE DROPPING	4-C6	80-7860
R2	RESISTOR-VOLTAGE DROPPING	4 C6	80-7860
R3	RESISTOR-VOLTAGE DROPPING	4-C6	80-7860
S1	SWITCH – ENGINE PANEL LIGHT	2-D3	80-7860
S2	SWITCH – LOCAL – REMOTE	2-B4	80-7866
S2	SWITCH – LOCAL – REMOTE	2-B5	80-7866
S2	SWITCH – LOCAL – REMOTE	3-B5	80-7866
S2	SWITCH – LOCAL – REMOTE	3-B6	80-7866
S2	SWITCH – LOCAL – REMOTE	3-B7	80-7866
S2	SWITCH – LOCAL – REMOTE	3-D8	80-7866
S3	SWITCH, AUTOMATIC – MANUAL	2-B5	80-7866
S3	SWITCH, AUTOMATIC – MANUAL	3-B7	80-7866
S4	SWITCH MAIN CKT BRKR CONT	2-B6	80-7866
S4	SWITCH MAIN CKT BRKR CONT	3-D8	80-7866
S5	SWITCH, OIL PRE-LUBE	4-D6	80-7860
S6	SWITCH PARALLEL OPER	2-B4	80 7866
S6	SWITCH PARALLEL OPER	2-B5	80-7866
S7A	SWITCH EMERGENCY STOP	3-D6	80-7860
S7B	SWITCH EMERGENCY STOP	4-B3	80-7860
S7C	SWITCH EMERGENCY STOP	3-B3	80-7860
S8	SWITCH FUEL TRANSFER PUMP	3-D4	80-7860
S9	SWITCH STOP	3-B5	80-7860
S10	SWITCH ETHER PRIME	3-B5	80-7860
S12A	SWITCH FAULT RESET	5-D5	80-7863
S12B	SWITCH FAULT RESET	5-B5	80-7863
S13	SWITCH COOL LEVEL WRN	3-B4	80-7688
S14	SWITCH COOL LEVEL SHT DN	3-B3	80-7688
S15A	SWITCH FAULT TEST	5-D4	80-7863
S15B	SWITCH FAULT TEST	5-C4	80-7863
S15C	SWITCH FAULT TEST	5-C4	80-7863
S16A	SWITCH ALARM SILENCE	5-D7	80-7863
S17	SWITCH ETHER LOCK-OUT	3-B4	80-7688

DESIG TRM	DESCRIPTION	LOC	WD
S100	SWITCH – MAINT DISCONNECT	2 D4	80-7860
S118	SWITCH – FREQ SELECT 50/60 Hz	6-D4	80 7862
SS1	SWITCH – STARTER CUTOUT	4-D5	80-7688
SS2	SWITCH – STOP RELAY RESET	4-D7	80-7688
SS3	SWITCH – OVERSPEED	4-B7	80-7688
SRM	SIGHT REQ MODULE	SEE J28	

LETTER DESIGNATIONS CONTINUED ON SH 8

FO-1. DC Schematic Diagram
(Sheet 7 of 8)

DESIG TRM	DESCRIPTION	LOC	WD
TB1-1	TERMINAL BLOCK – ENGINE	4-B7	80-7688
TB1-1	TERMINAL BLOCK – ENGINE	3-A4	80-7688
TB1-1	TERMINAL BLOCK – ENGINE	6-D7	80-7688
TB1-2	TERMINAL BLOCK – ENGINE	4-A4	80 7688
TB1-2	TERMINAL BLOCK – ENGINE	3-4A	80-7688
TB1-3	TERMINAL BLOCK – ENGINE	4-A4	80-7688
TB1-3	TERMINAL BLOCK – ENGINE	2-C6	80-7688
TB1-4	TERMINAL BLOCK – ENGINE	4 B7	80-7688
TB1-5	TERMINAL BLOCK – ENGINE	4-B7	80-7688
TB1-6	TERMINAL BLOCK – ENGINE	6-D6	80-7688
TB1-7	TERMINAL BLOCK – ENGINE	6-D6	80-7688
TB1-10	TERMINAL BLOCK – ENGINE	4 B4	80-7688
TB1-11	TERMINAL BLOCK – ENGINE	4-B4	80 7688
TB1-12	TERMINAL BLOCK – ENGINE	4-B3	80-7688
TB1-13	TERMINAL BLOCK – ENGINE	4-B7	80-7688
TB1-14	TERMINAL BLOCK – ENGINE	4-B7	80-7688
TB1-15	TERMINAL BLOCK – ENGINE	4-A4	80-7688
TB1-16	TERMINAL BLOCK – ENGINE	4-B4	80-7688
TB2 1	TERMINAL BLOCK – CABINET C	2-D3	80-7860
TB2-2	TERMINAL BLOCK – CABINET C	4-B7	80-7860
TB2-3	TERMINAL BLOCK – CABINET C	2-B5	80-7860
TB2-4	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB2 5	TERMINAL BLOCK – CABINET C	3 B7	80-7860
TB2-6	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB2-7	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB2-8	TERMINAL BLOCK – CABINET C	4-C6	80-7860
TB2 9	TERMINAL BLOCK – CABINET C	4-C6	80-7860
TB2-10	TERMINAL BLOCK – CABINET C	4-C6	80-7860
TB2-11	TERMINAL BLOCK – CABINET C	4-C5	80-7860
TB2-12	TERMINAL BLOCK – CABINET C	6-B7	80-7860
TB2-13	TERMINAL BLOCK – CABINET C	6-D3	80-7860
TB2-15	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB2-16	TERMINAL BLOCK – CABINET C	3-B5	80-7860
TB2-18	TERMINAL BLOCK – CABINET C	2-B5	80-7860
TB2-19	TERMINAL BLOCK – CABINET C	2-C3	80-7860
TB2 20	TERMINAL BLOCK – CABINET C	2-A3	80-7860
TB3-1	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB3-2	TERMINAL BLOCK – CABINET C	3-B3	80-7860
TB3-3	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB3-4	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB3-5	TERMINAL BLOCK – CABINET C	3-B4	80-7860
TB3-6	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB3-7	TERMINAL BLOCK – CABINET C	2-B6	80-7860
TB3-8	TERMINAL BLOCK – CABINET C	2-B5	80-7860
TB3-9	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB3-11	TERMINAL BLOCK – CABINET C	4-B3	80-7860
TB3-15	TERMINAL BLOCK – CABINET C	2 B3	80-7860
TB3-16	TERMINAL BLOCK – CABINET C	2-B3	80-7860
TB3-17	TERMINAL BLOCK – CABINET C	3-C8	80-7860
TB3 18	TERMINAL BLOCK – CABINET C	3-D7	80-7860
TB4-1	TERMINAL BLOCK – CABINET A	4-C7	80-7862
TB4-2	TERMINAL BLOCK – CABINET A	3-D6	80-7862
TB4-3	TERMINAL BLOCK – CABINET A	3-D4	80-7862
TB4-4	TERMINAL BLOCK – CABINET A	4-C8	80-7862
TB4-5	TERMINAL BLOCK – CABINET A	4-D3	80-7862
TB4-6	TERMINAL BLOCK – CABINET A	4-C7	80-7862
TB4-9	TERMINAL BLOCK – CABINET A	4-B5	80-7862
TB4-12	TERMINAL BLOCK – CABINET A	5-D5	80-7862
TB4-14	TERMINAL BLOCK – CABINET A	3-D4	80-7862
TB4-16	TERMINAL BLOCK – CABINET A	4-B6	80-7862
TB4-17	TERMINAL BLOCK – CABINET A	5-D7	80-7862
TB4-18	TERMINAL BLOCK – CABINET A	5-D5	80-7862
TB4-19	TERMINAL BLOCK – CABINET A	5-C4	80-7862
TB4-20	TERMINAL BLOCK – CABINET A	5-C5	80-7862
TB5-2	TERMINAL BLOCK – CABINET C	4-D3	80-7860
TB5-3	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB5-5	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB5-6	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB5-7	TERMINAL BLOCK – CABINET C	4-C3	80-7860
TB5-8	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB5-10	TERMINAL BLOCK – CABINET C	4-C3	80-7860
TB5-11	TERMINAL BLOCK – CABINET C	2-D6	80-7860

DESIG - TRM	DESCRIPTION	LOC	WD
TB5-13	TERMINAL BLOCK – CABINET C	2-D6	80-7860
TB5-14	TERMINAL BLOCK – CABINET C	2 C6	80-7860
TB5-15	TERMINAL BLOCK – CABINET C	4-C3	80-7860
TB6-2	TERMINAL BLOCK – CABINET C	3-B5	80-7860
TB6-7	TERMINAL BLOCK – CABINET C	3-A5	80-7860
TB6-10	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB7-2	TERMINAL BLOCK – CABINET C	3-B5	80-7860
TB7-3	TERMINAL BLOCK – CABINET C	4-B4	80-7860
TB7-4	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB7 5	TERMINAL BLOCK – CABINET C	4-B4	80-7860
TB7-6	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB7-7	TERMINAL BLOCK – CABINET C	3-A5	80 7860
TB7 9	TERMINAL BLOCK – CABINET C	2-B3	80-7860
TB7-10	TERMINAL BLOCK – CABINET C	2-B5	80-7860
TB7-11	TERMINAL BLOCK – CABINET C	2 B3	80-7860
TB7-12	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB7-13	TERMINAL BLOCK – CABINET C	2-B3	80-7860
TB7-14	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB7-15	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB8-2	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB8 3	TERMINAL BLOCK – CABINET C	4 B8	80-7860
TB8-4	TERMINAL BLOCK – CABINET C	6-D3	80-7860
TB8-5	TERMINAL BLOCK – CABINET C	4-B8	80-7860
TB8-6	TERMINAL BLOCK – CABINET C	6-D3	80-7860
TB8-7	TERMINAL BLOCK – CABINET C	4-C4	80-7860
TB8-10	TERMINAL BLOCK – CABINET C	2-B4	80-7860
TB8-10	TERMINAL BLOCK – CABINET C	4-C8	80-7860
TB8-12	TERMINAL BLOCK – CABINET C	2-B7	80-7860
TB8-14	TERMINAL BLOCK – CABINET C	2 A7	80-7860
TB9-2	TERMINAL BLOCK – CABINET C	4-B7	80-7860
TB9-3	TERMINAL BLOCK – CABINET C	4-B3	80-7860
TB9 4	TERMINAL BLOCK – CABINET C	4-B3	80-7860
TB9-5	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB9-7	TERMINAL BLOCK – CABINET C	4-A7	80-7860
TB9-10	TERMINAL BLOCK – CABINET C	4-B4	80-7860
TB9-14	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB9-15	TERMINAL BLOCK – CABINET C	4-A4	80-7860
TB9-16	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB10-1	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB10-2	TERMINAL BLOCK – CABINET C	4-B6	80-7860
TB10-3	TERMINAL BLOCK – CABINET C	3-B6	80-7860
TB10-4	TERMINAL BLOCK – CABINET C	4-B6	80-7860
TB10-6	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB10-7	TERMINAL BLOCK – CABINET C	4-A6	80-7860
TB10-10	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB10-15	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB11-2	TERMINAL BLOCK – CABINET C	3-B3	80-7860
TB11-3	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB11 5	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB11-7	TERMINAL BLOCK – CABINET C	3-A3	80-7860
TB11-10	TERMINAL BLOCK – CABINET C	4-B6	80-7860
TB11-13	TERMINAL BLOCK – CABINET C	4-D7	80-7860
TB11-15	TERMINAL BLOCK – CABINET C	4-A6	80-7860
TB12-2	TERMINAL BLOCK – CABINET C	3 B4	80 7860
TB12 3	TERMINAL BLOCK – CABINET C	5-B7	80 7860
TB12-5	TERMINAL BLOCK – CABINET C	5-B7	80-7860
TB12-7	TERMINAL BLOCK – CABINET C	3-A4	80-7860
TB12-10	TERMINAL BLOCK – CABINET C	3-B4	80-7860
TB12-11	TERMINAL BLOCK – CABINET C	4-D7	80-7860
TB12-13	TERMINAL BLOCK – CABINET C	4-D7	80-7860
TB12-14	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB12-15	TERMINAL BLOCK – CABINET C	3-A3	80-7860
TB12-16	TERMINAL BLOCK – CABINET C	3-B6	80-7860

DESIG - TRM	DESCRIPTION	LOC	WD
TB13-2	TERMINAL BLOCK – CABINET A	5-D7	80-7862
TB13-3	TERMINAL BLOCK – CABINET A	5-C5	80-7862
TB13-5	TERMINAL BLOCK – CABINET A	5-C5	80-7862
TB13-7	TERMINAL BLOCK – CABINET A	2-A5	80-7862
TB13 10	TERMINAL BLOCK – CABINET A	2-B7	80-7862
TB13-12	TERMINAL BLOCK – CABINET A	2-B8	80-7862
TB13-14	TERMINAL BLOCK – CABINET A	2-B8	80-7862
TB13-15	TERMINAL BLOCK – CABINET A	2 B7	80-7862
TB14-2	TERMINAL BLOCK – CABINET A	5-C5	80-7862
TB14-3	TERMINAL BLOCK – CABINET A	5-D5	80-7862
TB14-5	TERMINAL BLOCK – CABINET A	5-D5	80-7862
TB14-7	TERMINAL BLOCK – CABINET A	2-A5	80 7862
TB14-10	TERMINAL BLOCK – CABINET A	2-B7	80-7862
TB14-15	TERMINAL BLOCK – CABINET A	2-B7	80-7862
TB15-2	TERMINAL BLOCK – CABINET A	5-C7	80-7862
TB15-3	TERMINAL BLOCK – CABINET A	5-D7	80 7862
TB15-4	TERMINAL BLOCK – CABINET A	5-D6	80-7862
TB15-5	TERMINAL BLOCK – CABINET A	5-D7	80-7862
TB15-6	TERMINAL BLOCK – CABINET A	5-D6	80-7862
TB15-10	TERMINAL BLOCK – CABINET A	2-B7	80-7862
TB15-15	TERMINAL BLOCK – CABINET A	2-B7	80-7862
TB16-10	TERMINAL BLOCK – CABINET A	3-D5	80-7862
TB16-11	TERMINAL BLOCK – CABINET A	5-B3	80-7862
TB16-13	TERMINAL BLOCK – CABINET A	5-B3	80-7862
TB16-15	TERMINAL BLOCK – CABINET A	3-C5	80-7862
TB17-2	TERMINAL BLOCK – CABINET A	2-B5	80 7862
TB17-6	TERMINAL BLOCK – CABINET A	3-B6	80-7862
TB17-7	TERMINAL BLOCK – CABINET A	2 A5	80-7862
TB17-8	TERMINAL BLOCK – CABINET A	3-B6	80-7862
TB17-10	TERMINAL BLOCK – CABINET A	3-C4	80-7862
TB17-11	TERMINAL BLOCK – CABINET A	3-D3	80-7862
TB17-15	TERMINAL BLOCK – CABINET A	3 C4	80-7862
TB18-11	TERMINAL BLOCK – CABINET A	5-B4	80-7862
TB18-13	TERMINAL BLOCK – CABINET A	5-B4	80-7862
TB18-15	TERMINAL BLOCK – CABINET A	3 C8	80-7862
TB19-2	TERMINAL BLOCK – CABINET A	3-C4	80-7862
TB19-4	TERMINAL BLOCK – CABINET A	3-D6	80-7862
TB19-5	TERMINAL BLOCK – CABINET A	5-B5	80-7862
TB19-6	TERMINAL BLOCK – CABINET A	3-D6	80-7862
TB19-7	TERMINAL BLOCK – CABINET A	3-C4	80 7862
TB19-10	TERMINAL BLOCK – CABINET A	4-B8	80-7862
TB19-12	TERMINAL BLOCK – CABINET A	4-B6	80-7862
TB19-14	TERMINAL BLOCK – CABINET A	4-B6	80-7862
TB19-15	TERMINAL BLOCK – CABINET A	4-A8	80 7862
TB20-2	TERMINAL BLOCK – CABINET A	4-C4	80-7862
TB20-3	TERMINAL BLOCK – CABINET A	4 B6	80-7862
TB20-3	TERMINAL BLOCK – CABINET A	5-B6	80-7862
TB20-4	TERMINAL BLOCK – CABINET A	3-D5	80-7862
TB20-4	TERMINAL BLOCK – CABINET A	5-B6	80-7862
TB20-5	TERMINAL BLOCK – CABINET A	5-B6	80-7862
TB20-6	TERMINAL BLOCK – CABINET A	4-B6	80-7862
TB20-7	TERMINAL BLOCK – CABINET A	4-C4	80-7862
TB20-10	TERMINAL BLOCK – CABINET A	4-B7	80-7862
TB20-12	TERMINAL BLOCK – CABINET A	6-B5	80-7862
TB20-14	TERMINAL BLOCK – CABINET A	6-B5	80-7862
TB20-15	TERMINAL BLOCK – CABINET A	4-A7	80-7862

DESIG TRM	DESCRIPTION	LOC	WD
TB21-1	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB21-2	TERMINAL BLOCK – CABINET C	4-D4	80-7860
TB21-5	TERMINAL BLOCK – CABINET C	5-B7	80-7860
TB21-6	TERMINAL BLOCK – CABINET C	6 D6	80-7860
TB21 11	TERMINAL BLOCK – CABINET C	6-D5	80-7860
TB21-13	TERMINAL BLOCK – CABINET C	6-B6	80-7860
TB21-17	TERMINAL BLOCK – CABINET C	2-D5	80-7860
TB50-1	TERMINAL BLOCK – CABINET C	2-D3	80-7860
TB50-2	TERMINAL BLOCK – CABINET C	3-B7	80-7860
TB50-5	TERMINAL BLOCK – CABINET C	2-B8	80-7860
TB50-7	TERMINAL BLOCK – CABINET C	6-D5	80 7860
TB50-8	TERMINAL BLOCK – CABINET C	6-D5	80-7860
TB50 9	TERMINAL BLOCK – CABINET C	5-D7	80-7860
TB50-10	TERMINAL BLOCK – CABINET C	5-D6	80-7860
TB50-11	TERMINAL BLOCK – CABINET C	5-D5	80-7860
TB50-14	TERMINAL BLOCK – CABINET C	2-B5	80-7860
TB51-20	TERMINAL BLOCK – CABINET C	2-C5	80-7860
TB108-1	TERMINAL BLOCK – CABINET C	2-C5	80-7860
TB108-15	TERMINAL BLOCK – CABINET C	2-C5	80-7860
TB111-9	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB111-10	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB111-11	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB111 12	TERMINAL BLOCK – CABINET C	3-C3	80-7860
TB111-13	TERMINAL BLOCK – CABINET C	3-D4	80-7860
TB111-14	TERMINAL BLOCK – CABINET C	3-D4	80-7860
TB111-15	TERMINAL BLOCK – CABINET C	2-D3	80-7860
TB111-15	TERMINAL BLOCK – CABINET C	4-B5	80-7860
TB111-17	TERMINAL BLOCK – CABINET C	3-C7	80-7860
TB111 19	TERMINAL BLOCK – CABINET C	2 C5	80-7860
TB111-20	TERMINAL BLOCK – CABINET C	4-C7	80-7860
TC1	THERMOCOUPLE EXHAUST GAS	6-B3	80-7494
TC2	THERMOCOUPLE EXHAUST GAS	6-83	80-7494
VR101	VOLTAGE REGULATOR	2-C6	80-7861
WT1	SWITCH COOLANT TEMP SHT DWN	4-B7	80-7688
WT2	SWITCH COOLANT TEMP WRN	6-D6	80-768

FO-1. DC Schematic Diagram
(Sheet 8 of 8)

LETTER DESIGNATIONS

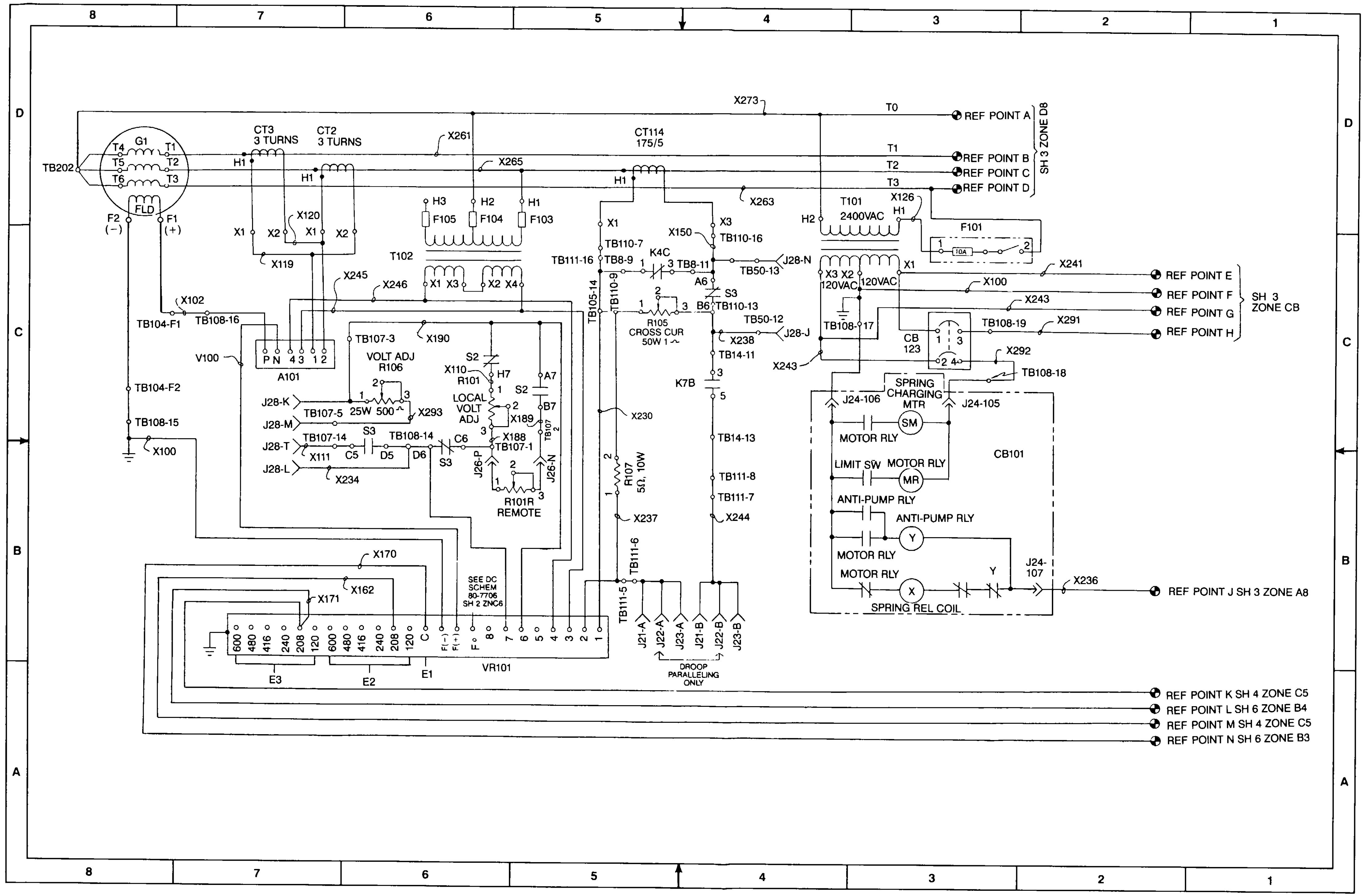
DESIG - TRM	DESCRIPTION	LOC	WD
AMT	AMMETER TRANSDUCER	5-C5	80-7861
AT	ISOLATOR	7-D4	80-7862
A101	CURRENT BOOST MODULE	2-CT	80-7861
A103	TRANSDUCER - FREQ METER	7-C7	80-7861
A104	LOAD SHARING MODULE/GOVERNOR	6-B6	80-7861
A104	LOAD SHARING MODULE/GOVERNOR	6-C6	80-7861
A104	LOAD SHARING MODULE/GOVERNOR	6-D6	80-7861
A105	SYNCHRONIZER	6-A2	80-7861
A105	SYNCHRONIZER	6-B2	80-7861
A105	SYNCHRONIZER	6-C2	80-7861
A105-13	SYNCHRONIZER	3 B6	80-7861
A105-14	SYNCHRONIZER	3-B6	80-7861
B102	FUEL TRANSFER PUMP	4-B4	80-7688
B103	EXHAUST FAN	3-B3	80-7494
BC1	BATTERY CHARGER	4-A7	80-7868
C101	SURGE CAPACITOR/GENERATOR	3 D6	80 7861
C102	CAPACITOR/PHASE SEQUENCE	7-B3	80-7866
CB2	CKT BKR EMERGENCY LIGHT	3-A5	80-7860
CB101	CKT BKR GENERATOR LOAD	7-D5	80-7861
CB101	CKT BKR GENERATOR LOAD	2-B3	80-7861
CB102	CKT BKR CONTROL ROOM RECEPT	3-C4	80-7494
CB103	CKT BKR CONTROL ROOM RECEPT	3-B4	80-7494
CB104	CKT BKR CONTROL ROOM LIGHTING	3-B4	80-7494
CB105	CKT BKR STATION POWER RELAY	3-B4	80-7494
CB106	CKT BKR ENGINE ROOM RECEPT	3-C3	80-7494
CB107	CKT BKR ENGINE ROOM RECEPT	3-B3	80-7494
CB108	CKT BKR ENGINE ROOM LIGHTING	3-B3	80-7494
CB109	CKT BKR CONTROL ROOM FAN	3-B3	80-7494
CB110	CKT BKR COOLANT HEATER	4-C6	80-7494
CB111	CKT BKR SPARE	4-C6	80-7494
CB112	CKT BKR HUMIDISTAT	4-B6	80-7494
CB113	CKT BKR SWITCHGEAR HEATERS	4 B6	80-7494
CB114	CKT BKR SPARE	4-B6	80-7494
CB116	CKT BKR BATTERY CHARGER	4-A6	80-7494
CB117	CKT BKR COOLANT HEATER	4-C6	80-7494
CB118	CKT BKR CONTROL RM HEATERS	4-C6	80-7494
CB119	CKT BKR SPARE	4-B6	80-7494
CB120	CKT BKR GENERATOR HEATERS	4-B6	80-7494
CB121	CKT BKR FUEL XFR PUMP MOTOR	4-B6	80-7494
CB122	CKT BKR FUEL XFR PUMP CONTROL	4-A6	80-7494
CB123	CKT BKR MAIN CKT BKR CLOSED	2-B5	80-7860
CB124	CKT BKR SET STATION POWER	3-C6	80-7494
CB125	CKT BKR UTILITY STATION POWER	3 C6	80-7494
CNTR	KILOWATT HOUR COUNTER	5-A2	80-7863
CT2-X	CURRENT BOOST CT	2-C7	80-7356
CT2-H	CURRENT BOOST CT	2-D7	80-7356
CT3-X	CURRENT BOOST CT	2-C7	80-7356
CT3-H	CURRENT BOOST CT	2-D7	80-7356
CT10	TRANSFORMER INSTRUMENT	5-D6	80-7861
CT11	TRANSFORMER INSTRUMENT	5-D7	80-7861
CT12	TRANSFORMER INSTRUMENT	5-D7	80-7861
CT114	TRANSFORMER PARALLELING	2-D5	80-7861
DP1	DISTRIBUTION PANEL 100 AMP	3-C3	80-7494
DP2	DISTRIBUTION PANEL 200 AMP	4-C6	80-7494
DS22	EMERGENCY LIGHT CONTROL ROOM	3-A5	80-7494
DS101	LIGHT CONTROL ROOM	3-B5	80-7494
DS102	LIGHT CONTROL ROOM	3-B4	80-7494
DS103	LIGHT ENGINE COMPARTMENT	3-A2	80-7494
DS104	LIGHT ENGINE COMPARTMENT	3-A2	80-7494
DS105	LIGHT ENGINE COMPARTMENT	3-A3	80-7494
DS106	LIGHT ENGINE COMPARTMENT	3-A3	80-7494
DS107	LIGHT FUEL XRF PUMP	4-B2	80-7860
DS110	LIGHT SYNCHRONIZING	7-C2	80-7866
DS111	LIGHT SYNCHRONIZING	7-C1	80-7866
DS112	LIGHT PHASE ROTATION	7-B3	80-7866
DS113	LIGHT PHASE ROTATION	7-B3	80-7866

DESIG - TRM	DESCRIPTION	LOC	WD
E101	LIGHTNING ARRESTOR	3-D4	80-7861
E102	LIGHTNING ARRESTOR	3-D5	80-7861
E103	LIGHTNING ARRESTOR	3 D5	80-7861
F101	FUSE DISCONNECT SW	2-C3	80-7860
F103	FUSE VOLTAGE REGULATOR	2-D5	80-7862
F104	FUSE VOLTAGE REGULATOR	2-D6	80-7862
F105	FUSE VOLTAGE REGULATOR	2-D6	80-7862
F106	FUSE GEN TRANSF PRIMARY	4-D6	80-7862
F107	FUSE GEN TRANSF PRIMARY	4-D7	80-7862
F108	FUSE GEN TRANSF PRIMARY	4-D7	80-7862
F109	FUSE GEN TRANSF SECONDARY	4-D6	80-7862
F111	FUSE GEN TRANSF SECONDARY	4-D6	80-7862
F113	FUSE GEN TRANSF SECONDARY	4-D6	80-7862
F114	FUSE BUS TRANSF PRIMRAY	7-D4	80-7862
F115	FUSE BUS TRANSF PRIMARY	7-D4	80-7862
F116	FUSE BUS TRANSF PRIMARY	7-D4	80-7862
F117	FUSE BUS TRANSF SECONDARY	7-C3	80-7862
F119	FUSE BUS TRANSF SECONDARY	7-C4	80-7862
F121	FUSE BUS TRANSF SECONDARY	7-C4	80-7862
G1	GENERATOR MAIN	2-D8	80-7356
H101	HEATER COOLANT	4-C4	80-7688
H102	HEATER COOLANT	4-C7	80-7688
H103	HEATER CONTROL ROOM	4-B4	80-7494
H104	HEATER CONTROL ROOM	4-B4	80-7494
H105	HEATER SWITCHGEAR	4-B7	80-7860
H106	HEATER SWITCHGEAR	4-B7	80-7860
H107	HEATER SWITCHGEAR	4-B7	80-7860
H109	HEATER GENERATOR	4-B3	80-7356
H110	HEATER GENERATOR	4-B3	80-7356
H113	HEATER LUBE OIL	4-C5	80-7688
J8 (A,B)	CONNECTOR MAGNETIC PICKUP	6 C5	80-7688
J14(t)	CONNECTOR ENGINE ROOM	4-B8	80-7688
J14(J,K)	CONNECTOR ENGINE ROOM	6-B5	80-7688
J14(A,w)	CONNECTOR ENGINE ROOM	6-C6	80-7688
J14(s,r)	CONNECTOR ENGINE ROOM	6-C6	80-7688
J18(A,B,C)	CONNECTOR GOVERNOR PARALLEL	6-C4	80-7860
J19(A,B,C,)	CONNECTOR GOVERNOR PARALLEL	6-C4	80-7860
J20(A)	CONNECTOR GOVERNOR PARALLEL	6-C5	80-7860
J20(B)	CONNECTOR GOVERNOR PARALLEL	6-C4	80-7860
J20(C)	CONNECTOR GOVERNOR PARALLEL	6-C3	80-7860
J21(A)	CONNECTOR REACTIVE CURRENT PAR	2-B5	80-7860
J21(B)	CONNECTOR REACTIVE CURRENT PAR	2 B4	80-7860
J22(A)	CONNECTOR REACTIVE CURRENT PAR	2-B5	80-7860
J22(B)	CONNECTOR REACTIVE CURRENT PAR	2-B4	80-7860
J23(A,B)	CONNECTOR REACTIVE CURRENT PAR	2-B4	80-7860
J24(105,106)	CONNECTOR MAIN CK BKR DISCON	2-C3	80 7861
J26(N)	CONNECTOR REMOTE CONTROL	2-B5	80-7860
J26(P)	CONNECTOR REMOTE CONTROL	2-B6	80-7860
J26(A,B)	CONNECTOR REMOTE CONTROL	3-B7	80-7860
J26(R)	CONNECTOR REMOTE CONTROL	5-A2	80-7860
J26(X)	CONNECTOR REMOTE CONTROL	5-A4	80-7860
J26(S)	CONNECTOR REMOTE CONTROL	5-B2	80-7860
J26(W)	CONNECTOR REMOTE CONTROL	5-B4	80-7860
J26(AB,AD,AH)	CONNECTOR REMOTE CONTROL	5 C5	80-7860
J26(AA,AE,AF)	CONNECTOR REMOTE CONTROL	5 C6	80-7860
J26(z)	CONNECTOR REMOTE CONTROL	6-B7	80-7860
J26(x,y)	CONNECTOR REMOTE CONTROL	6-C7	80-7860
J26(V,T,U)	CONNECTOR REMOTE CONTROL	7-C4	80-7860
J26(a,b,c,h)	CONNECTOR REMOTE CONTROL	7-D6	80-7860
J28(L)	CONNECTOR SRM	2-B7	80-7860
J28(J,N)	CONNECTOR SRM	2-C4	80-7860
J28(K,M,T)	CONNECTOR SRM	2-C7	80-7860
J28(R)	CONNECTOR SRM	6-B3	80-7860
J28(S)	CONNECTOR SRM	6-C3	80-7860
J28(P,U,V,W)	CONNECTOR SRM	7-D5	80-7860

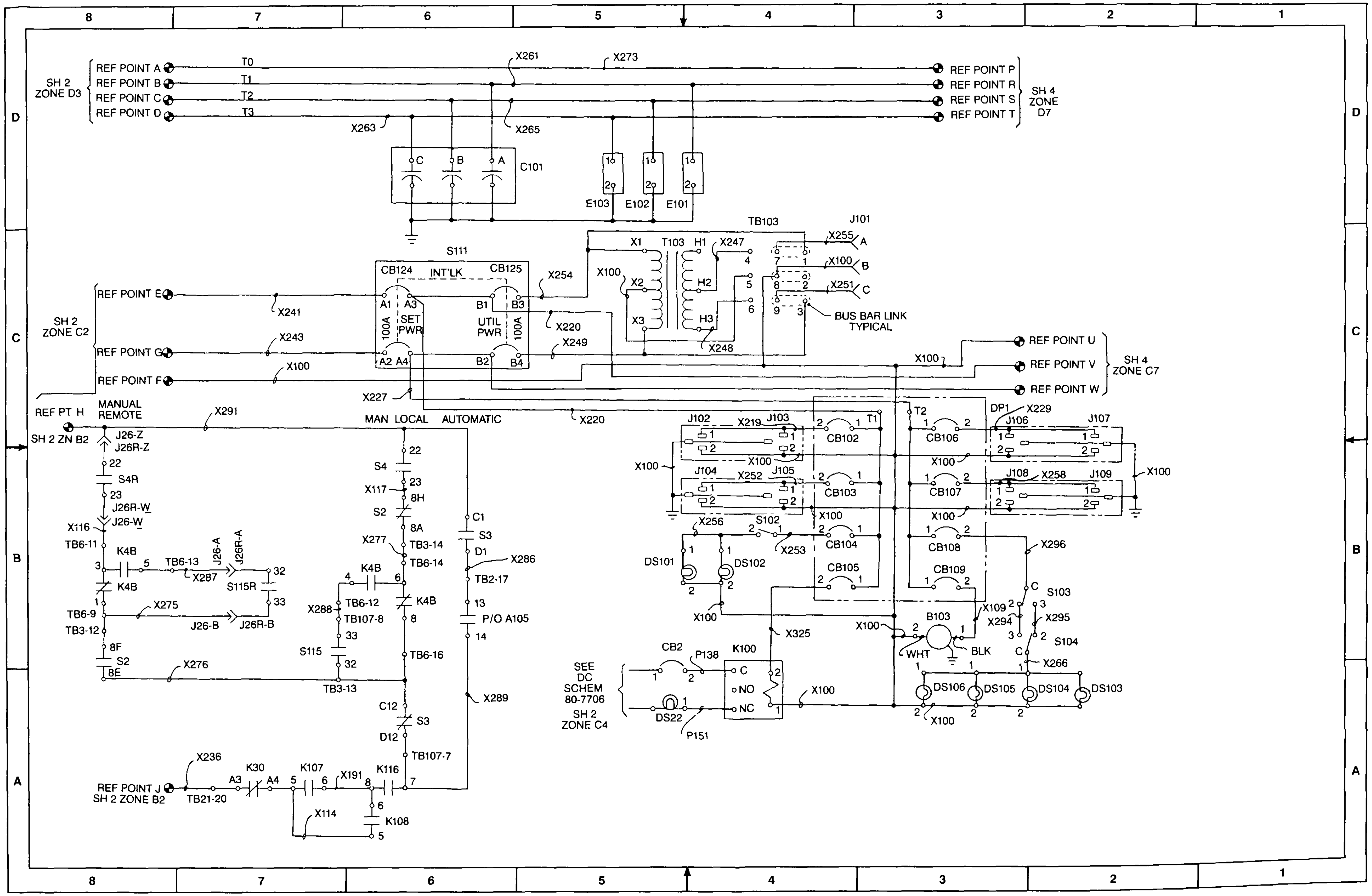
DESIG - TRM	DESCRIPTION	LOC	WD
J29(A)	CONNECTOR SRM	6-B6	80-7860
J29(C,D)	CONNECTOR SRM	6-C5	80-7860
J101	RECEPTACLE STATION POWER	3-C3	80 7860
J102	RECEPTACLE CONT RM CONVEN	3 C4	80 7494
J103	RECEPTACLE CONT RM CONVEN	3-C4	80-7494
J104	RECEPTACLE CONT RM CONV	3-B4	80-7494
J105	RECEPTACLE CONT RM CONV	3-B4	80-7494
J106	RECEPTACLE ENG RM	3-C3	80 7494
J107	RECEPTACLE ENG RM	3 C2	80-7494
J108	RECEPTACLE ENG RM	3 B3	80-7494
J109	RECEPTACLE ENG RM	3-B2	80-7494
K4B	RELAY PARALLEL	3-B6	80-7860
K4B	RELAY PARALLEL	3 B8	80-7860
K4C	RELAY PARALLEL	2-C5	80-7860
K6	RELAY CKT BKR CLOSED	6-B3	80-7862
K7A	SLAVE RELAY PARALLEL	2-C4	80-7860
K7B	SLAVE RELAY PARALLEL	6-C4	80-7860
K13	CONTACTOR FUEL PUMP	4-B2	80-7860
K13	CONTACTOR FUEL PUMP	4-A2	80-7860
K15A	RELAY ENGINE RUN	4-B5	80-7860
K15C	RELAY ENGINE RUN	4-B1	80-7860
K20B	RELAY FAULT SHUTDOWN	6-B4	80-7860
K28	RELAY SYNCHRONIZER	6-B3	80-7862
K30	RELAY CKT BKR TRIP	3-A7	80-7862
K100	RELAY EMERGENCY LIGHTS	3-B4	80-7860
K104A COIL	CONTACTOR COOLANT HEATER	4-B1	80-7860
K104A	CONTACTOR COOLANT HEATER	4-C4	80-7860
K104B COIL	CONTACTOR COOLANT HEATER	4-B1	80-7860
K104B	CONTACTOR COOLANT HEATER	4-C7	80-7860
K106	CONTACTOR FUEL TRANSFER PUMP	4-B2	80-7860
K106	CONTACTOR FUEL TRANSFER PUMP	4-B4	80-7860
K107 COIL	RELAY UNDERFREQUENCY 60 Hz	7-D7	80-7861
K107	RELAY UNDERFREQUENCY 60 Hz	3-A7	80-7861
K108 COIL	RELAY UNDERFREQUENCY 50 Hz	7-C6	80 7861
K108	RELAY UNDERFREQUENCY 50 Hz	3-A6	80-7861
K109	RELAY REVERSE POWER	5-C6	80-7861
K110	RELAY OVERVOLTAGE	7-C6	80-7861
K111	RELAY UNDERVOLTAGE	7-C5	80-7861
K114	RELAY OVERCURRENT	6-D5	80-7861
K115	RELAY GROUND FAULT	7-C3	80-7861
K116	RELAY SYNCHRONIZING CHECK	3-A6	80-7861
K116	RELAY SYNCHRONIZING CHECK	7-B2	80-7861
K117	CONTACTOR SWITCHGEAR HEATER	4-B7	80-7860
L101	ACTUATOR GOVERNOR	6-B5	80-7688
L102	SOLENOID FUEL TRANSFER	4-B2	80 7688
M101	VOLTMETER	7-B6	80 7866
M102	AMMETER	5-C2	80 7866
M103	FREQUENCY METER	7-B7	80 7866
M104	POWER FACTOR METER	5-A4	80-7866
M105	GENERATOR TEMP METER	6-B5	80-7866
M106	SYNCHROSCOPE	7-C1	80-7866
M107	KILOWATT METER	5-A3	80-7866
M108	KVAR METER	5-C7	80-7866
M110	CLOCK 60 Hz	7-D7	80-7866
M111	CLOCK 50 Hz	7-D6	80-7866
PFT	POWER FACTOR TRANSDUCER	5-C4	80-7861
PUI	MAGNETIC PICK-UP GOVERNOR	6-C5	80-7688

LETTER DESIGNATIONS CONTINUED ON SHEET 8

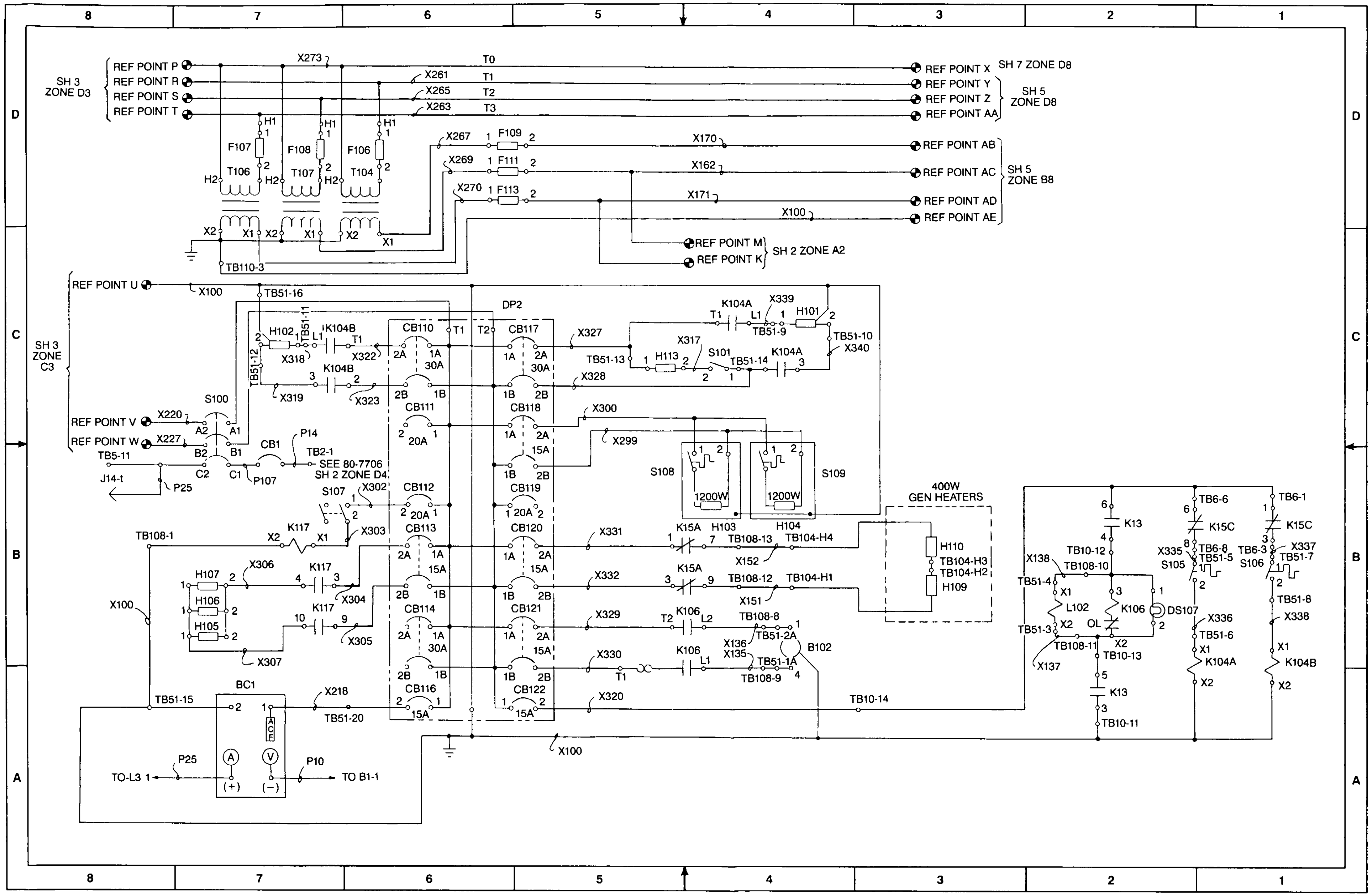
FO-1. AC Schematic Diagram
(Sheet 1 of 8)



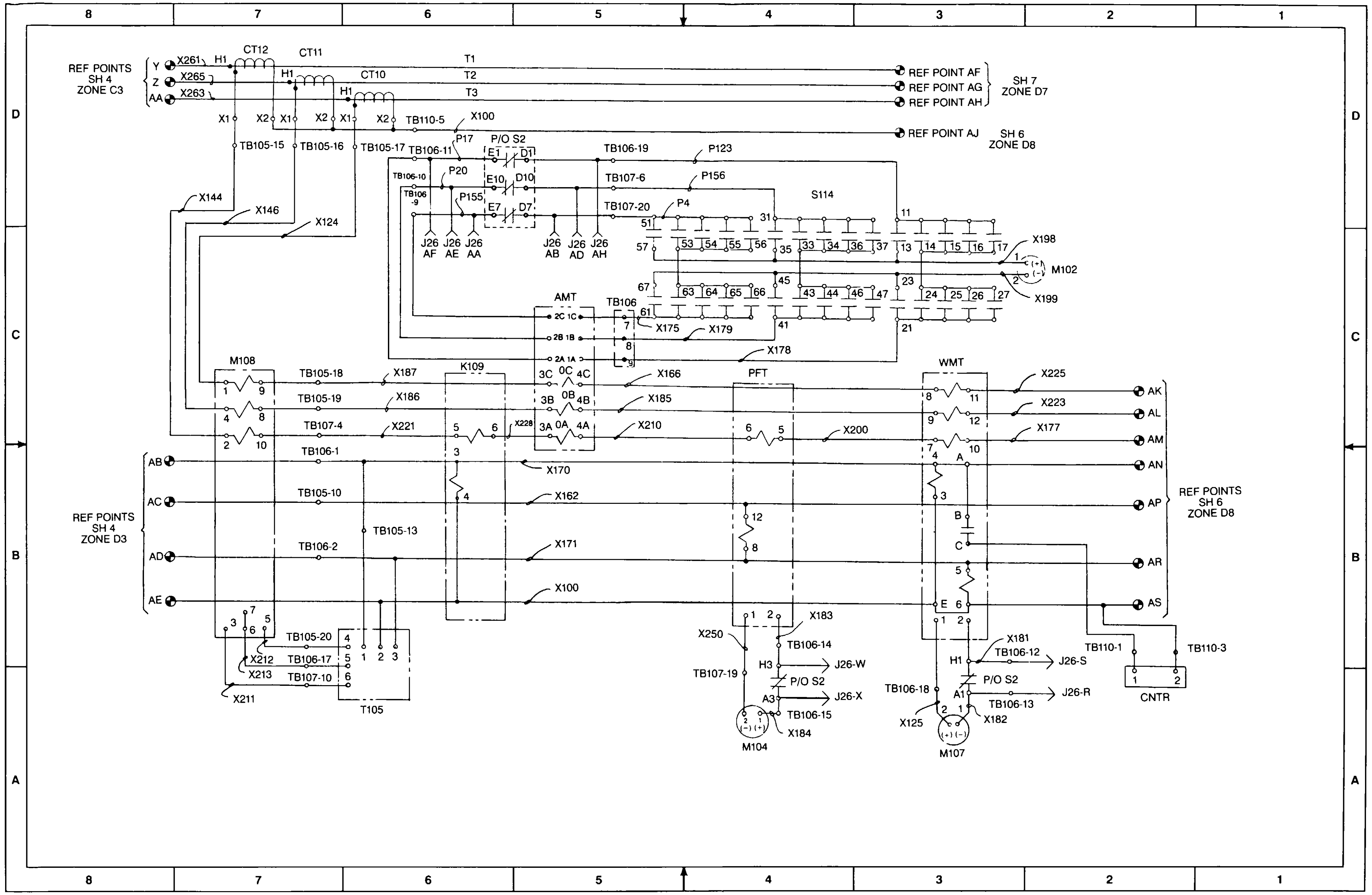
FO-1. AC Schematic Diagram
(Sheet 2 of 8)



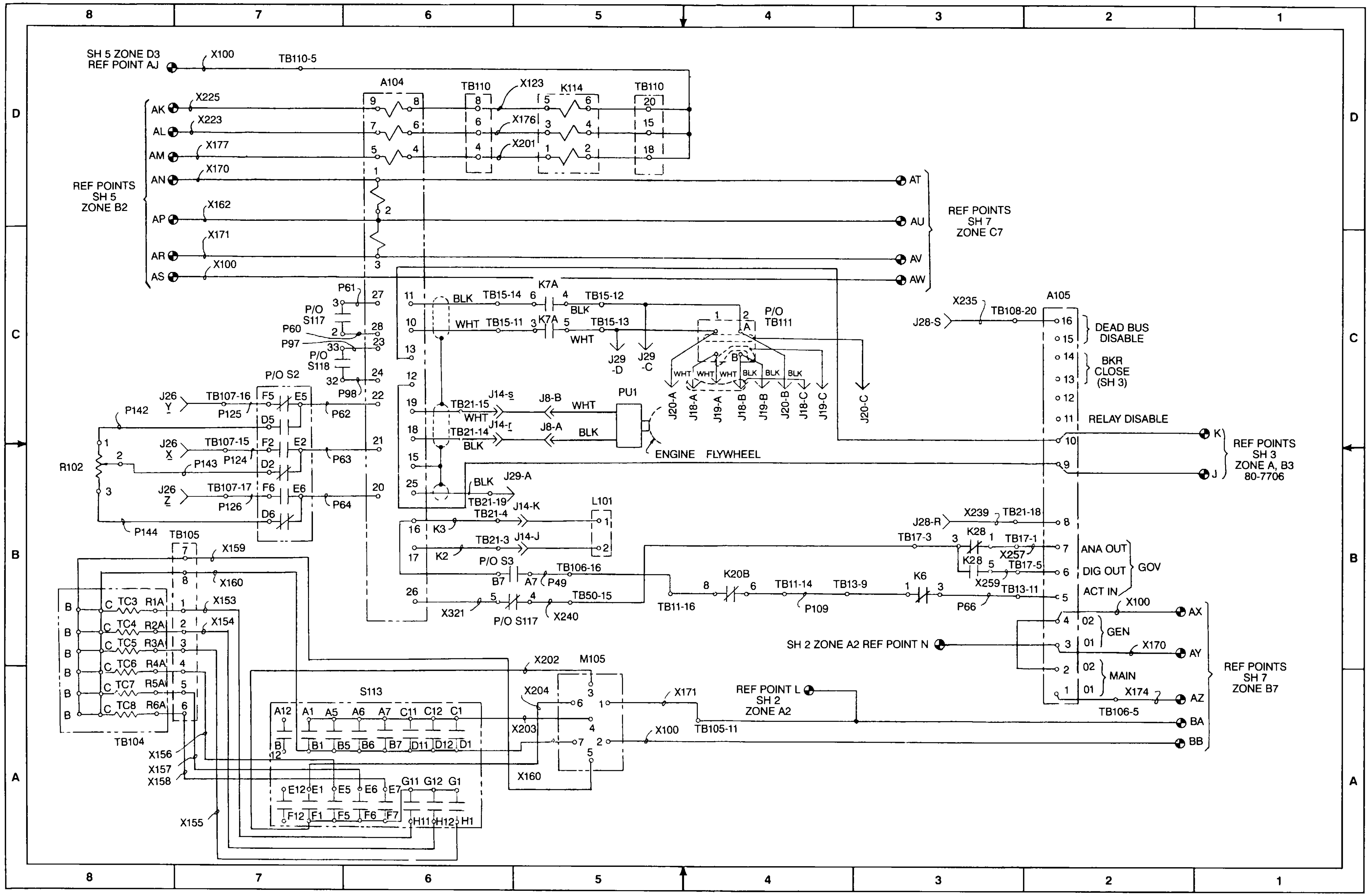
FO-2. AC Schematic Diagram
(Sheet 3 of 8)



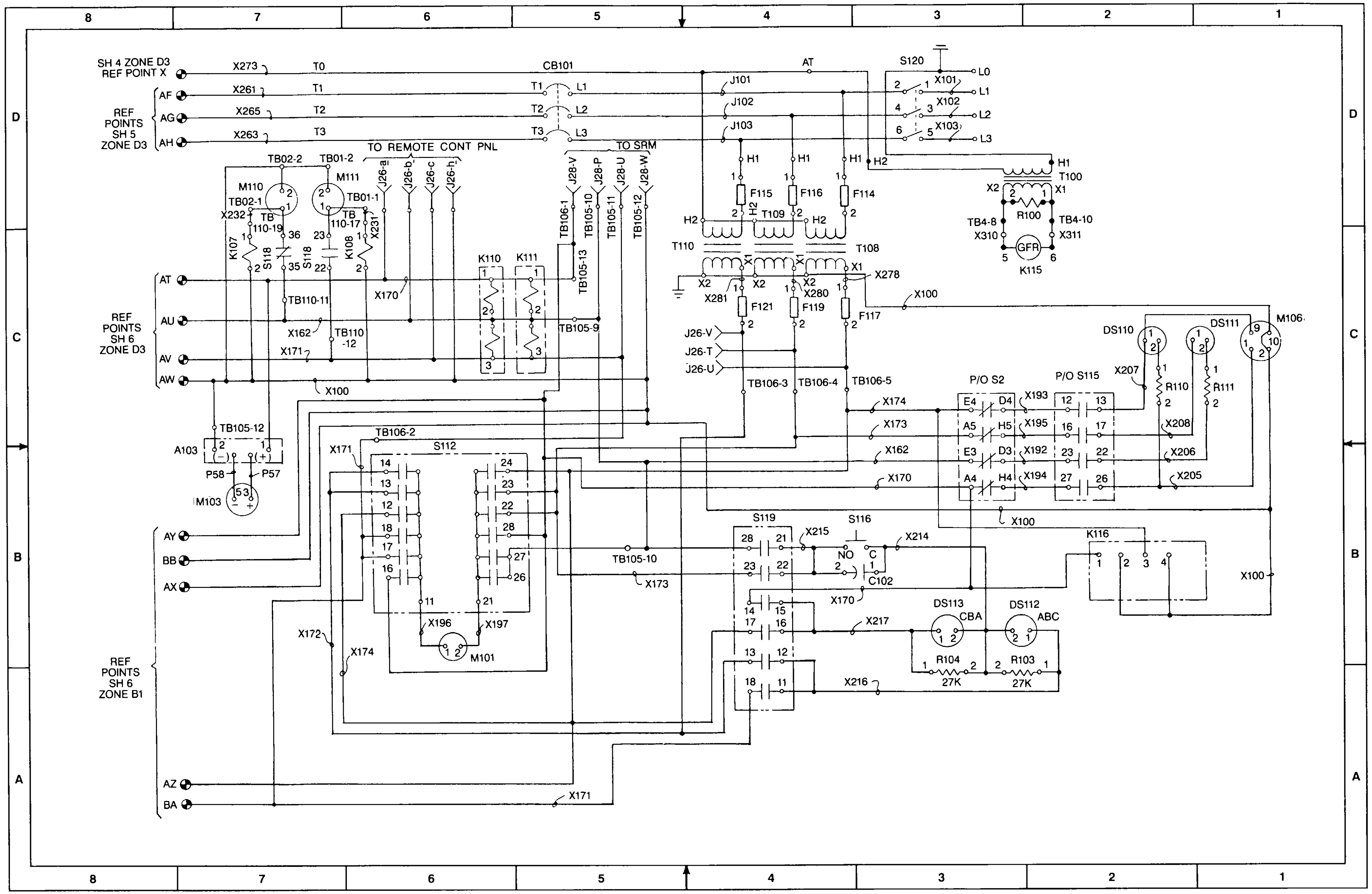
FO-2. AC Schematic Diagram
(Sheet 4 of 8)



FO-2. AC Schematic Diagram
(Sheet 5 of 8)



FO-2. AC Schematic Diagram (Sheet 6 of 8)



FO-2. AC Schematic Diagram
(Sheet 7 of 8)

LETTER DESIGNATIONS (CONTD FROM SH 1)

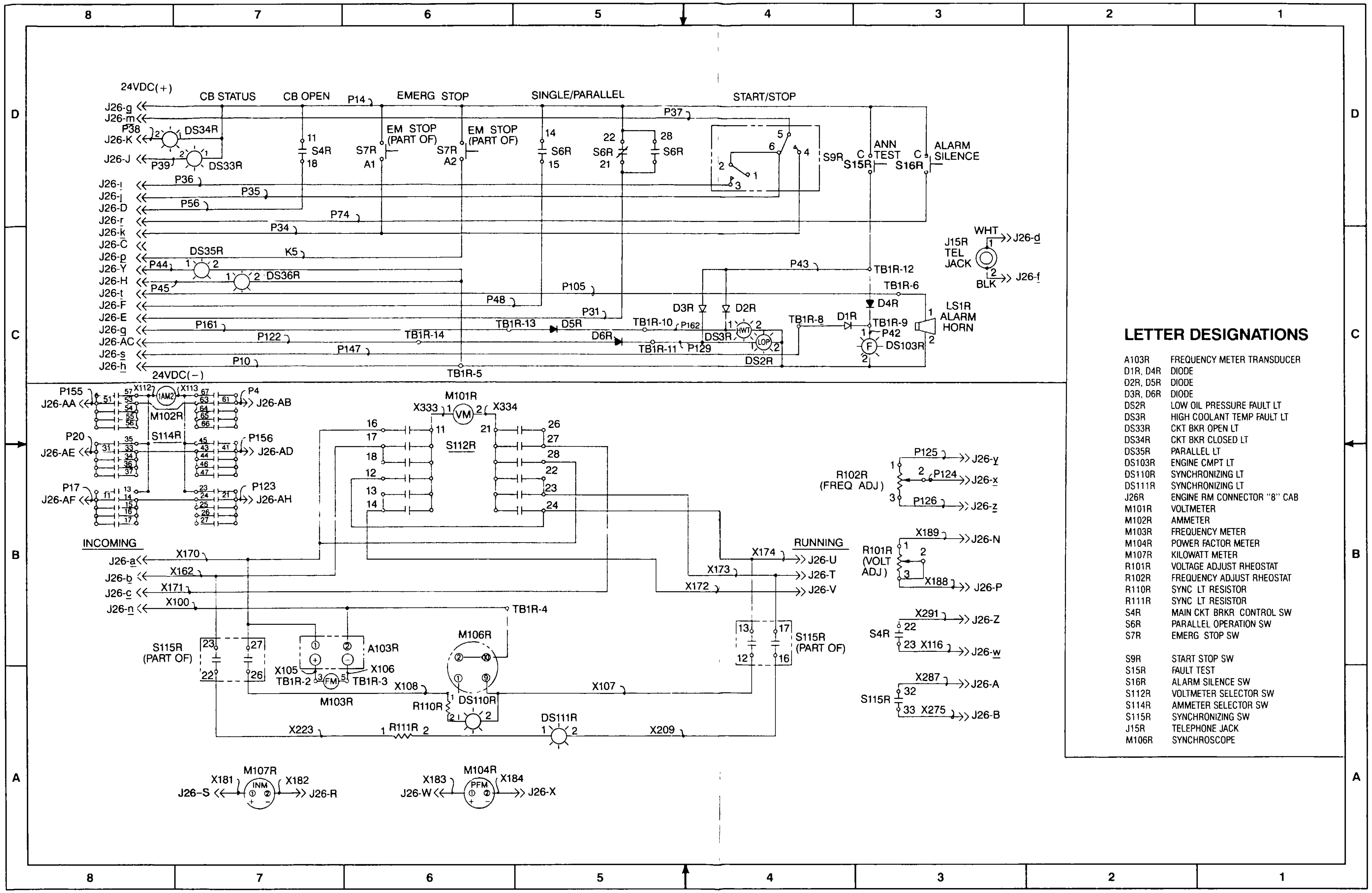
DESIG - TRM	DESCRIPTION	LOC	WD
R100	RESISTOR GROUND FAULT	7-D3	80-7862
R101	RHEOSTAT VOLTAGE ADJUST	2-C6	80-7866
R101R	RHEOSTAT VOLTAGE ADJUST	2-B5	80-7866
R102	RHEOSTAT FREQUENCY ADJUST	6 B8	80-7866
R103	RESISTOR PHASE SEQUENCE LIGHT	7 B2	80-7866
R104	RESISTOR PHASE SEQUENCE LIGHT	7-B3	80-7866
R105	RHEOSTAT REACTIVE CURRENT	2-C5	80-7862
R106	RHEOSTAT REMOTE VOLT ADJ	2-C6	80-7861
R107	RESISTOR REACTIVE CURRENT	2 B5	80-7861
R110	RESISTOR SYNCH LIGHT	7 C2	80-7866
R111	RESISTOR SYNCH LIGHT	7-C1	80-7866
S2	SWITCH LOCAL-REMOTE	2-C5	80-7866
S2	SWITCH LOCAL-REMOTE	2-C6	80-7866
S2	SWITCH LOCAL-REMOTE	3-B6	80-7866
S2	SWITCH LOCAL-REMOTE	3-B8	80-7866
S2	SWITCH LOCAL-REMOTE	5-A3	80-7866
S2	SWITCH LOCAL-REMOTE	5-A4	80-7866
S2	SWITCH LOCAL-REMOTE	5-D6	80-7866
S2	SWITCH LOCAL-REMOTE	6-C7	80-7866
S2	SWITCH LOCAL-REMOTE	7-C3	80-7866
S3	SWITCH AUTOMATIC MANUAL	2-C6	80-7866
S3	SWITCH AUTOMATIC MANUAL	2-C4	80-7866
S3	SWITCH AUTOMATIC MANUAL	3-B6	80-7866
S3	SWITCH AUTOMATIC MANUAL	3-A6	80-7866
S3	SWITCH AUTOMATIC MANUAL	6-B6	80-7866
S4	SWITCH MAIN CKT BKR CONTROL	3-B6	80-7866
S4R	SWITCH MAIN CKT BKR CONTROL	3-B8	80-7493
S100	SWITCH MAINT DISCONNECT	4-C7	80-7860
S101	THERMOSTAT LUBE OIL HEATER	4-C4	80-7688
S102	SWITCH CONTROL ROOM LT	3-B4	80-7494
S103	SWITCH ENGINE ROOM LT	3-B2	80-7494
S104	SWITCH ENGINE ROOM LT	3-B2	80-7494
S105	THERMOSTAT COOLANT HTR	4-B2	80-7688
S106	THERMOSTAT COOLANT HTR	4-B1	80-7866
S107	HUMIDISTAT SWITCH	4-B7	80-7860
S108(H103)	SWITCH CONTROL ROOM HTR	4-B5	80-7494
S109(H104)	SWITCH CONTROL ROOM HTR	4-B4	80-7494
S111	BREAKER SET/UTILITY CIRCUIT	3-C6	80-7494
S112	SWITCH VOLTMETER SELECT	7-C6	80-7866
S113	SWITCH GENERATOR TEMP SELECT	6-A6	80-7866
S114	SWITCH AMMETER SELECTOR	5-D4	80-7866
S115R	SWITCH SYNCHRONIZING	3-B7	80-7866
S115	SWITCH SYNCHRONIZING	3-B7	80-7866
S115	SWITCH SYNCHRONIZING	7-C2	80-7866
S116	SWITCH PHASE SEQUENCE TEST	7-B3	80-7866
S117	SWITCH DROOP ISOCH	6-B5	80-7866
S117	SWITCH DROOP ISOCH	6-C7	80-7866
S118	SWITCH 50/60 Hz SELECT	6-C7	80-7862
S118	SWITCH 50/60 Hz SELECT	6-D7	80-7862
S119	SWITCH PHASE SEQUENCE	7-B4	80-7862
S120	SWITCH GENERATOR DISCONNECT	7-D3	80-7862
T100	TRANSFORMER GROUND FAULT	3-D7	80-7862
T101	TRANSFORMER SET STATION PWR	2-D3	80-7860
T102	TRANSFORMER VOLTAGE REG	2-C6	80-7862
T103	TRANSFORMER UTILITY STA PWR	3-C5	80-7860
T104	TRANSFORMER GEN INSTRUMENT	4-D6	80-7862
T105	TRANSFORMER PHASE SHIFT	5-A6	80-7862
T106	TRANSFORMER GEN INSTRUMENT	4-D7	80-7862
T107	TRANSFORMER GEN INSTRUMENT	4-D7	80-7862

DESIG - TRM	DESCRIPTION	LOC	WD
T108	TRANSFORMER BUS INSTRUMENT	7C-3	80-7862
T109	TRANSFORMER BUS INSTRUMENT	7-D4	80-7862
T110	TRANSFORMER BUS INSTRUMENT	7-C4	80 7862
TB01 1	TERMINAL BLOCK	7-D7	80-7863
TB01-2	TERMINAL BLOCK	7-D7	80 7863
TB2-1	TERMINAL BLOCK	4 B7	80 7862
TB2-6	TERMINAL BLOCK	6-C6	80-7862
TB2-17	TERMINAL BLOCK	3-B6	80-7862
TB2-19	TERMINAL BLOCK	6-C6	80-7862
TB2-20	TERMINAL BLOCK	6-C5	80-7862
TB3-12	TERMINAL BLOCK	3 B8	80-7862
TB3-13	TERMINAL BLOCK	3-A7	80-7862
TB3-14	TERMINAL BLOCK	3 B6	80-7862
TB4-6	TERMINAL BLOCK	6-B3	80-7862
TB4-8	TERMINAL BLOCK	7 D3	80-7862
TB4-10	TERMINAL BLOCK	7 D3	80-7862
TB5-11	TERMINAL BLOCK	4 B8	80-7860
TB6-1	TERMINAL BLOCK	4 B1	80-7860
TB6-3	TERMINAL BLOCK	4-B1	80-7860
TB6-6	TERMINAL BLOCK	4-B1	80-7860
TB6-8	TERMINAL BLOCK	4-B1	80-7860
TB6-9	TERMINAL BLOCK	3-B8	80-7860
TB6-12	TERMINAL BLOCK	3-B6	80-7860
TB6-13	TERMINAL BLOCK	3-B7	80-7860
TB6-16	TERMINAL BLOCK	3-B6	80-7860
TB8-9	TERMINAL BLOCK	2-C5	80-7860
TB8-11	TERMINAL BLOCK	2-C4	80-7860
TB10-11	TERMINAL BLOCK	4-A2	80-7860
TB10-12	TERMINAL BLOCK	4-B2	80-7860
TB10-13	TERMINAL BLOCK	4-B2	80-7860
TB10-14	TERMINAL BLOCK	4-B3	80-7860
TB11-14	TERMINAL BLOCK	6-B4	80-7860
TB13-9	TERMINAL BLOCK	6-B4	80-7862
TB13-11	TERMINAL BLOCK	6-B3	80-7862
TB14-11	TERMINAL BLOCK	2-C4	80 7862
TB14-13	TERMINAL BLOCK	2-C4	80-7862
TB15-11	TERMINAL BLOCK	6-C6	80-7862
TB15-12	TERMINAL BLOCK	6-C5	80-7862
TB15-13	TERMINAL BLOCK	6-C5	80-7862
TB15-14	TERMINAL BLOCK	6-C6	80-7862
TB17-1	TERMINAL BLOCK	6-B3	80-7862
TB17-3	TERMINAL BLOCK	6-B3	80-7862
TB17-5	TERMINAL BLOCK	6-B3	80-7862
TB17-6	TERMINAL BLOCK	6-B3	80-7862
TB17-8	TERMINAL BLOCK	6-B3	80-7862
TB21-3	TERMINAL BLOCK	6-B6	80-7860
TB21-4	TERMINAL BLOCK	6-B6	80-7860
TB21-14	TERMINAL BLOCK	6-C6	80-7860
TB21-15	TERMINAL BLOCK	6-C6	80-7860
TB21-18	TERMINAL BLOCK	6-B3	80-7860
TB21-19	TERMINAL BLOCK	6-B6	80-7860
TB21-20	TERMINAL BLOCK	3-A7	80-7860
TB50-12	TERMINAL BLOCK	2-C4	80-7861
TB50-13	TERMINAL BLOCK	2-C4	80-7861
TB50-15	TERMINAL BLOCK	6-B5	80-7861
TB51-1	TERMINAL BLOCK	4-B4	80-7860
TB51-2	TERMINAL BLOCK	4 B4	80-7860
TB51-3	TERMINAL BLOCK	4 B2	80-7860
TB51-4	TERMINAL BLOCK	4 B2	80-7860
TB51-5	TERMINAL BLOCK	4 B1	80-7860
TB51-6	TERMINAL BLOCK	4-B1	80-7860
TB51-7	TERMINAL BLOCK	4 B1	80-7860
TB51-8	TERMINAL BLOCK	4-B1	80-7860
TB51-9	TERMINAL BLOCK	4-C4	80-7860
TB51-10	TERMINAL BLOCK	4-C4	80-7860
TB51-11	TERMINAL BLOCK	4-C7	80-7860
TB51-12	TERMINAL BLOCK	4-C7	80-7860
TB51-13	TERMINAL BLOCK	4-C5	80-7860
TB51-14	TERMINAL BLOCK	4-C4	80 7860
TB51-15	TERMINAL BLOCK	4-A8	80-7860
TB51-16	TERMINAL BLOCK	4-C7	80-7860
TB51-20	TERMINAL BLOCK	4-A7	80-7860

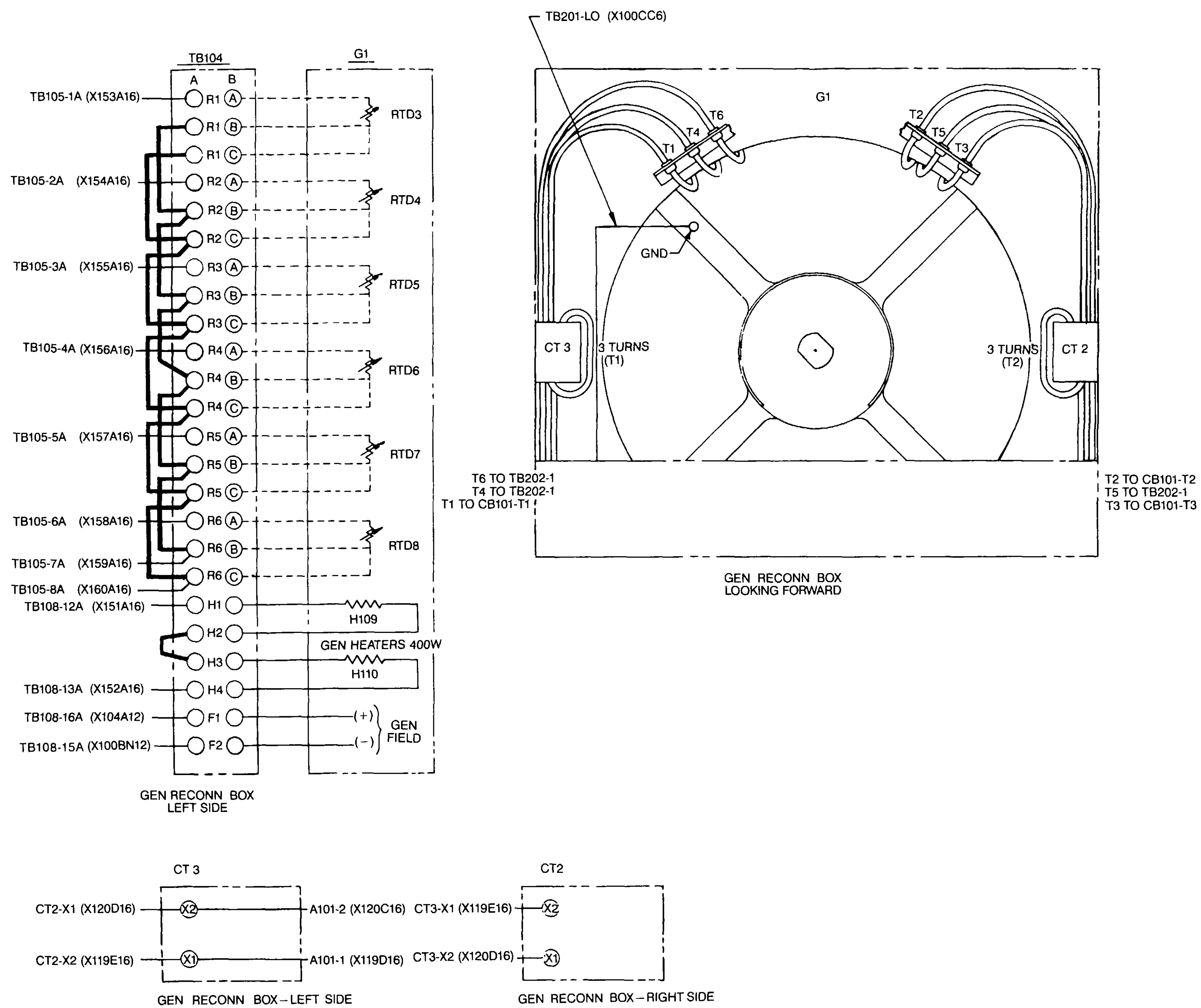
DESIG - TRM	DESCRIPTION	LOC	WD
TB103	TERMINAL BLOCK	3-C4	80-7860
TB104	TERMINAL BLOCK	6-A8	80-7356
TB104-F1	TERMINAL BLOCK	2-C8	80-7356
TB104-F2	TERMINAL BLOCK	2-C8	80-7356
TB104-H1	TERMINAL BLOCK	4-B4	80-7356
TB104 H2	TERMINAL BLOCK	4-B3	80-7356
TB104-H3	TERMINAL BLOCK	4-B3	80-7356
TB104-H4	TERMINAL BLOCK	4-B4	80-7356
TB105	TERMINAL BLOCK	6-B7	80-7861
TB105-9	TERMINAL BLOCK	7-C5	80 7861
TB105-10	TERMINAL BLOCK	7-B5	80 7861
TB105 10	TERMINAL BLOCK	7-D5	80 7861
TB105 10	TERMINAL BLOCK	5-B7	80-7861
TB105-11	TERMINAL BLOCK	7-D5	80-7861
TB105-11	TERMINAL BLOCK	6-A4	80 7861
TB105-12	TERMINAL BLOCK	7-D5	80 7861
TB105-12	TERMINAL BLOCK	6-C7	80-7861
TB105-13	TERMINAL BLOCK	7-C5	80-7861
TB105-13	TERMINAL BLOCK	5-B6	80-7861
TB105-14	TERMINAL BLOCK	2-C5	80-7861
TB105-15	TERMINAL BLOCK	5-D7	80-7861
TB105-16	TERMINAL BLOCK	5-D7	80-7861
TB105-17	TERMINAL BLOCK	5-D6	80-7861
TB105-18	TERMINAL BLOCK	5-C7	80-7861
TB105-19	TERMINAL BLOCK	5-C7	80-7861
TB105-20	TERMINAL BLOCK	5-B7	80-7861
TB106	TERMINAL BLOCK	5-C5	80-7861
TB106-1	TERMINAL BLOCK	5-B7	80-7861
TB106-1	TERMINAL BLOCK	7 D5	80-7861
TB106-2	TERMINAL BLOCK	5-B7	80-7861
TB106-2	TERMINAL BLOCK	7-C6	80-7861
TB106-3	TERMINAL BLOCK	7-C4	80-7861
TB106-4	TERMINAL BLOCK	7-C4	80-7861
TB106-5	TERMINAL BLOCK	7 C3	80-7861
TB106-5	TERMINAL BLOCK	6-A7	80-7861
TB106-9	TERMINAL BLOCK	5-D6	80-7861
TB106-10	TERMINAL BLOCK	5-D6	80-7861
TB106-11	TERMINAL BLOCK	5-D6	80-7861
TB106-12	TERMINAL BLOCK	5-B3	80-7861
TB106-13	TERMINAL BLOCK	5-A3	80-7861
TB106-14	TERMINAL BLOCK	5-B4	80-7861
TB106-15	TERMINAL BLOCK	5-A4	80-7861
TB106-16	TERMINAL BLOCK	6-B5	80-7861
TB106-17	TERMINAL BLOCK	5-B7	80-7861
TB106-18	TERMINAL BLOCK	5-A3	80-7861
TB106-19	TERMINAL BLOCK	5-D5	80-7861
TB107-2	TERMINAL BLOCK	2-C5	80-7861
TB107-3	TERMINAL BLOCK	2-C6	80-7861
TB107-4	TERMINAL BLOCK	5-C7	80-7861
TB107-5	TERMINAL BLOCK	2-C7	80-7861
TB107-6	TERMINAL BLOCK	5-D5	80-7861
TB107-7	TERMINAL BLOCK	3-A6	80 7861
TB107-8	TERMINAL BLOCK	3-B6	80-7861
TB107-10	TERMINAL BLOCK	5-A7	80-7861
TB107-14	TERMINAL BLOCK	2 C7	80-7861
TB107-15	TERMINAL BLOCK	6-C7	80-7861
TB107-16	TERMINAL BLOCK	6-C7	80-7861
TB107-17	TERMINAL BLOCK	6-B7	80-7861
TB107-19	TERMINAL BLOCK	5-A4	80-7861
TB107-20	TERMINAL BLOCK	5-D5	80-7861

DESIG TRM	DESCRIPTION	LOC	WD
TB108-1	TERMINAL BLOCK	4-B8	80-7861
TB108-5	TERMINAL BLOCK	2-C8	80-7861
TB108 8	TERMINAL BLOCK	4-B4	80-7861
TB108-9	TERMINAL BLOCK	4-A4	80-7861
TB108-10	TERMINAL BLOCK	4-B2	80-7861
TB108-11	TERMINAL BLOCK	4-B2	80-7861
TB108-12	TERMINAL BLOCK	4-B4	80-7861
TB108-13	TERMINAL BLOCK	4-B4	80-7861
TB108-14	TERMINAL BLOCK	2-C6	80-7861
TB108-16	TERMINAL BLOCK	2-C7	80 7861
TB108-18	TERMINAL BLOCK	2-C3	80 7861
TB108-20	TERMINAL BLOCK	6-C3	80 7861
TB110	TERMINAL BLOCK	6-D5	80 7862
TB110-1	TERMINAL BLOCK	5 B2	80-7862
TB110-3	TERMINAL BLOCK	5-B2	80 7862
TB110-3	TERMINAL BLOCK	4-C7	80-7862
TB110-5	TERMINAL BLOCK	5-D6	80-7862
TB110-5	TERMINAL BLOCK	2-C5	80-7862
TB110-5	TERMINAL BLOCK	6-D7	80-7862
TB110-7	TERMINAL BLOCK	2 C5	80-7862
TB110-9	TERMINAL BLOCK	2-C5	80-7862
TB110-11	TERMINAL BLOCK	7-C7	80-7862
TB110-12	TERMINAL BLOCK	7-C6	80-7862
TB110-13	TERMINAL BLOCK	2-C4	80-7862
TB110-16	TERMINAL BLOCK	2-C4	80-7862
TB110-17	TERMINAL BLOCK	7-D6	80-7862
TB110-19	TERMINAL BLOCK	7-D7	80-7862
TB111	TERMINAL BLOCK	6-C4	80-7860
TB111-6	TERMINAL BLOCK	2-C5	80-7860
TB111-7	TERMINAL BLOCK	2-B4	80-7860
TB111-8	TERMINAL BLOCK	2-B4	80-7860
TB111-16	TERMINAL BLOCK	2-C5	80-7860
TB202	TERMINAL BLOCK	2-D8	80-7861
VR101	VOLTAGE REGULATOR	2-A6	80-7861
WMT	WATTMETER/WATTHOUR TRANSDUCER	5-C3	80-7861

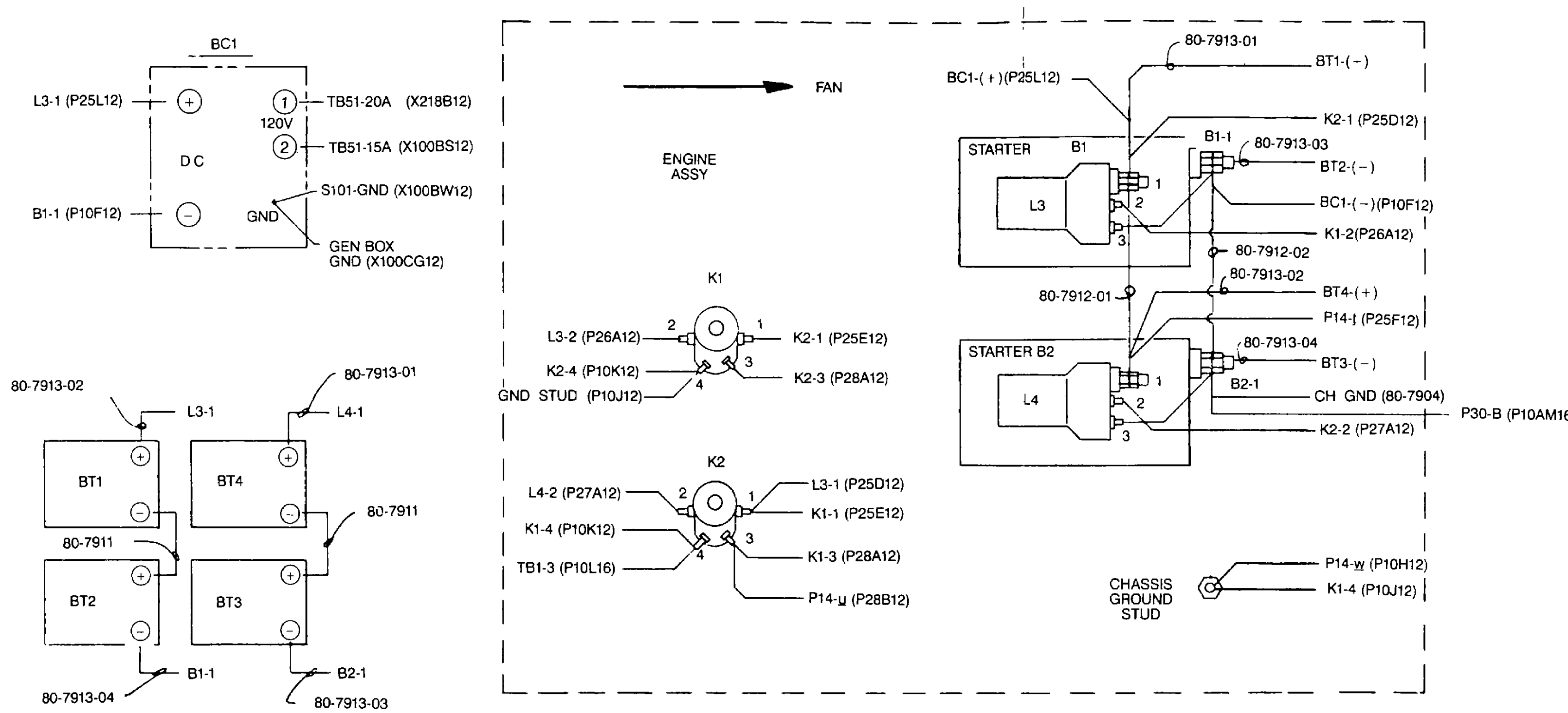
FO-2. AC Schematic Diagram
(Sheet 8 of 8)



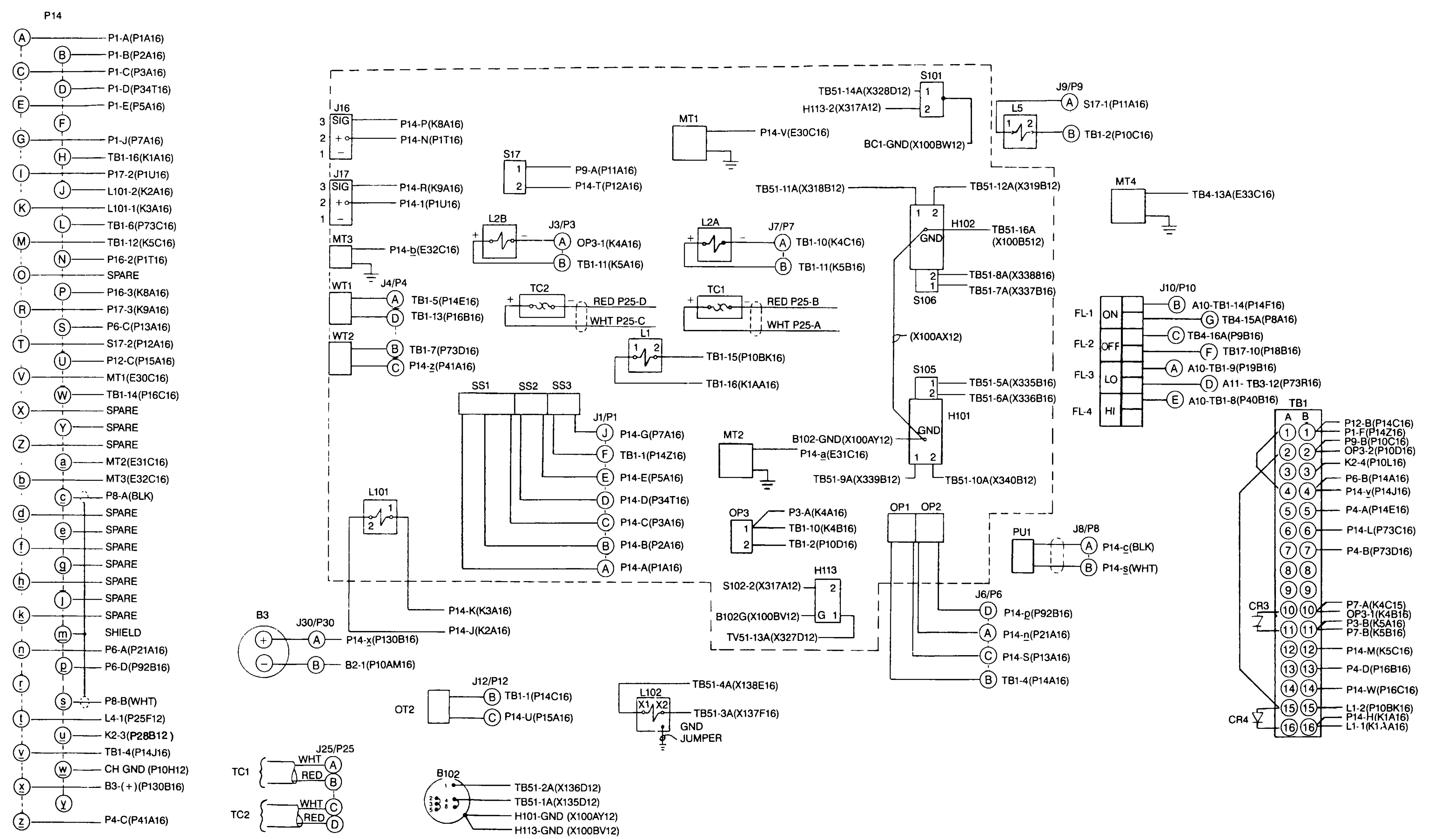
FO-3. Remote Control Module AC and DC Schematic Diagram



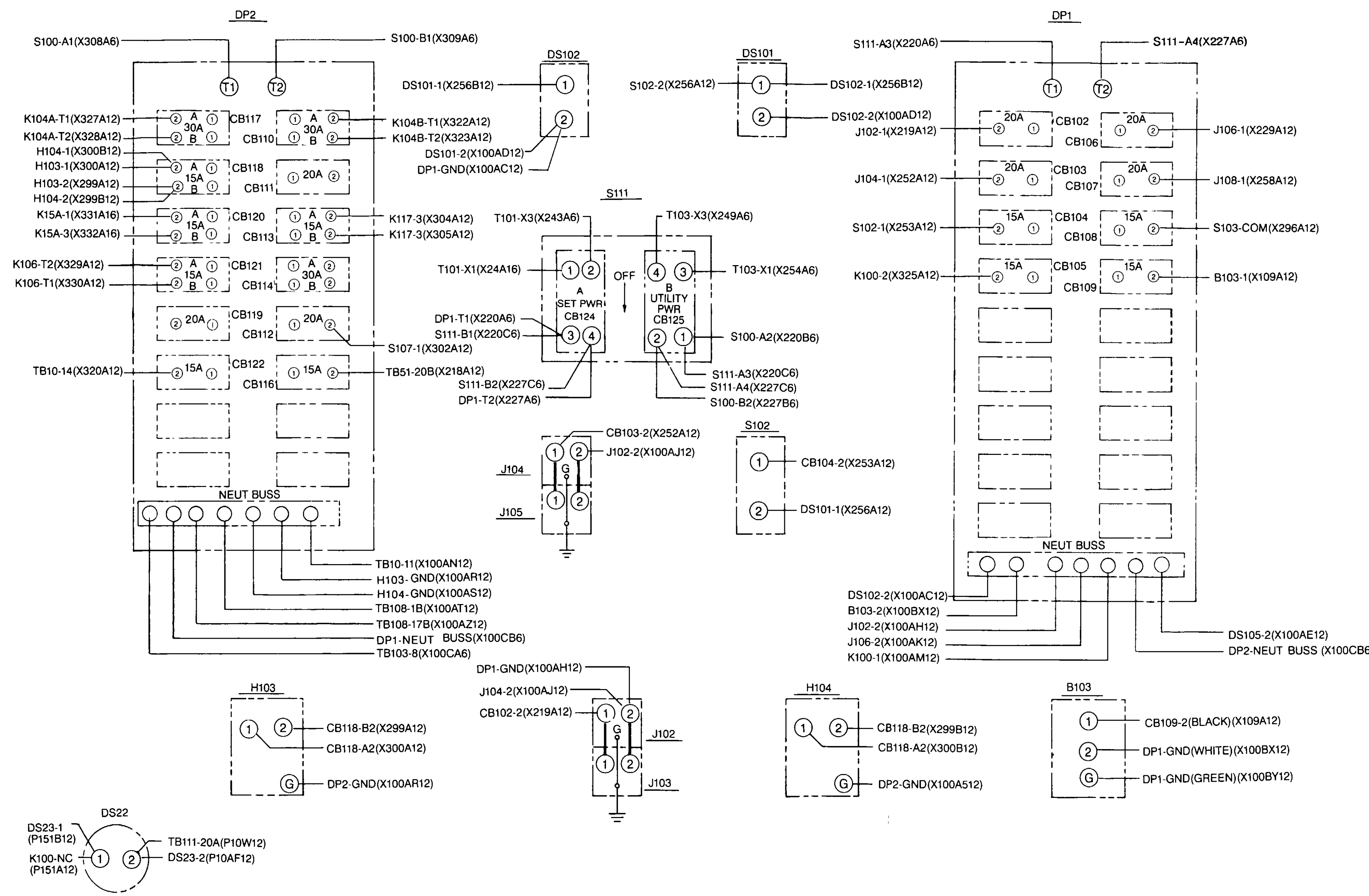
FO-4. Generator Connection Box Wiring Diagram



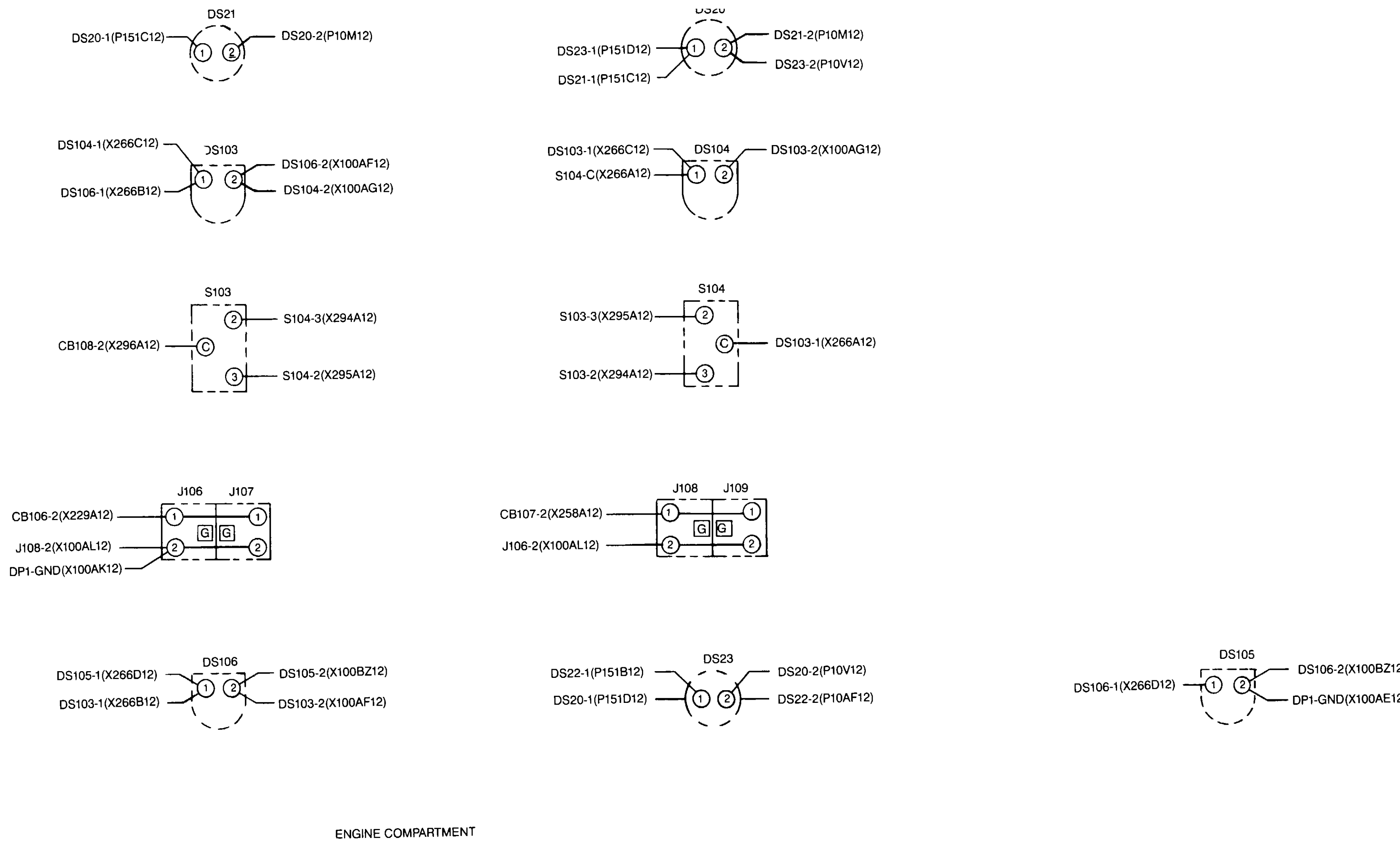
FO-5. Engine Accessories Wiring Diagram
(Sheet 1 of 2)



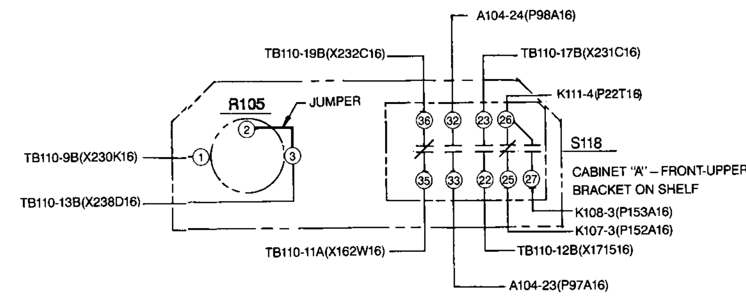
FO-5. Engine Accessories Wiring Diagram
(Sheet 2 of 2)

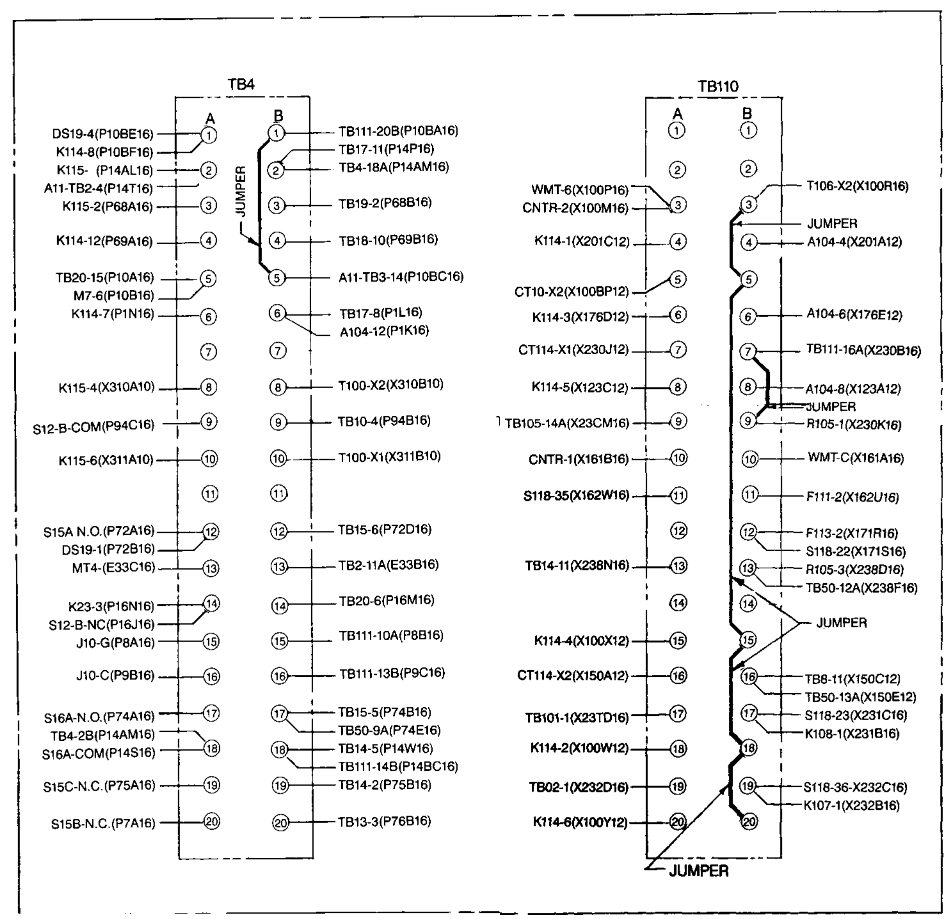


FO-6. Control Room Wiring Diagram
(Sheet 1 of 2)

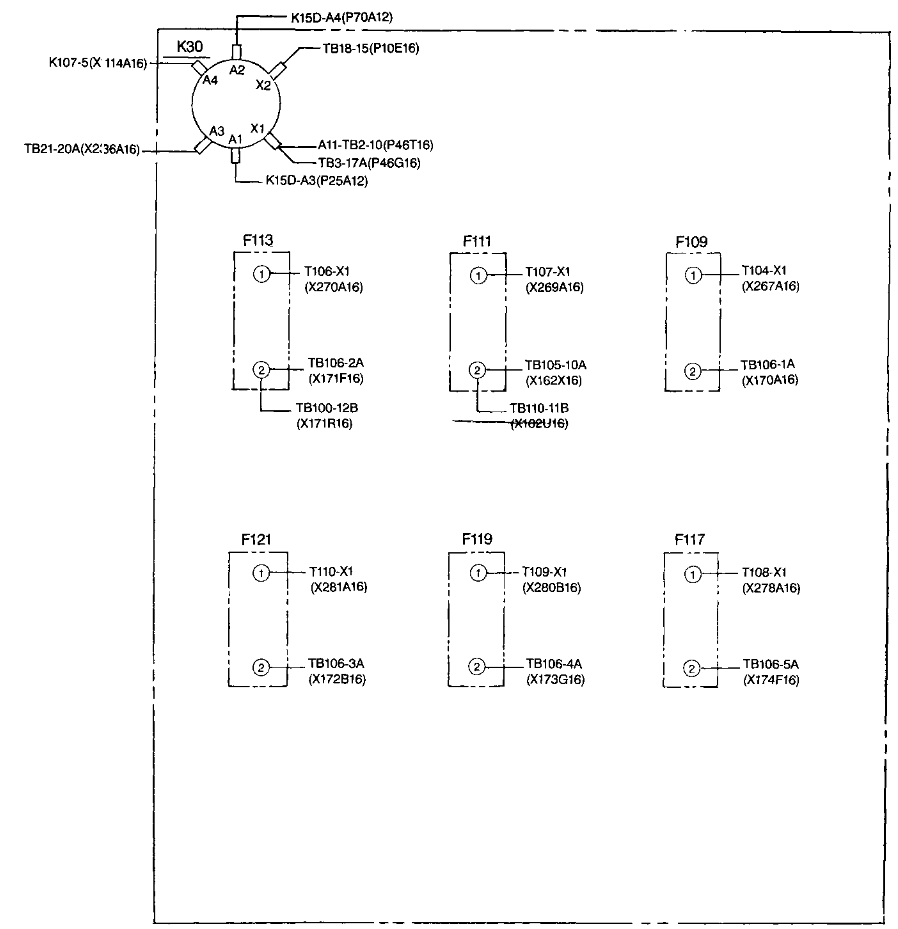


FO-6. Control Room Wiring Diagram
(Sheet 2 of 2)

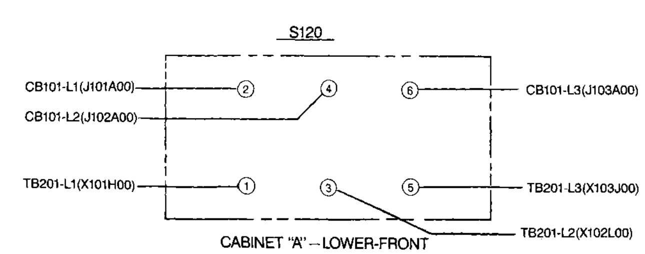




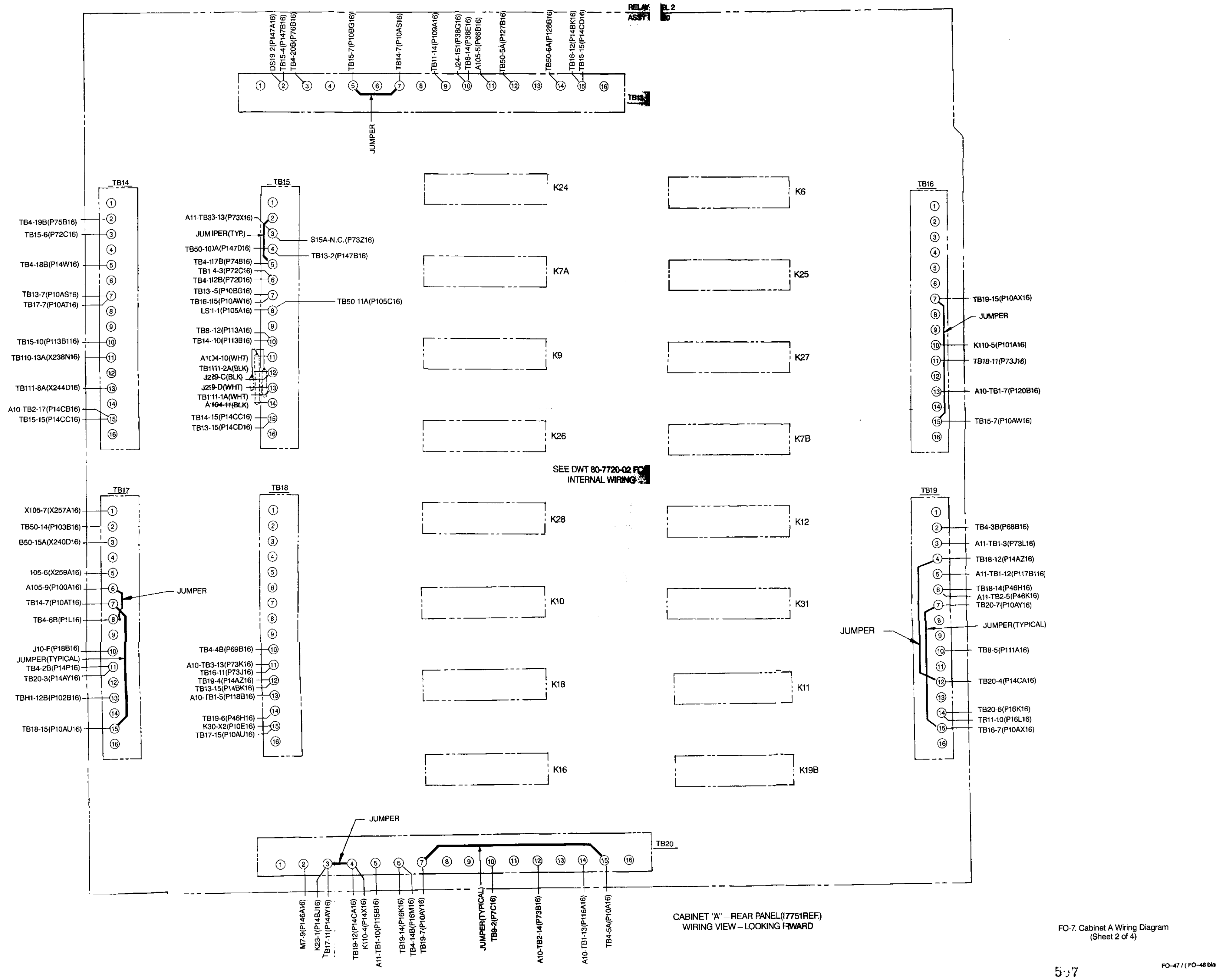
WIRING SIDE CABINET A
LEFT SIDE PANEL



WIRING SIDE CABINET A
RIGHT SIDE PANEL



FO-7. Cabinet A Wiring Diagram
(Sheet 1 of 4)



FO-7. Cabinet B Wiring Diagram (Sheet 2 of 4)
FO-47/FO-48 blank)

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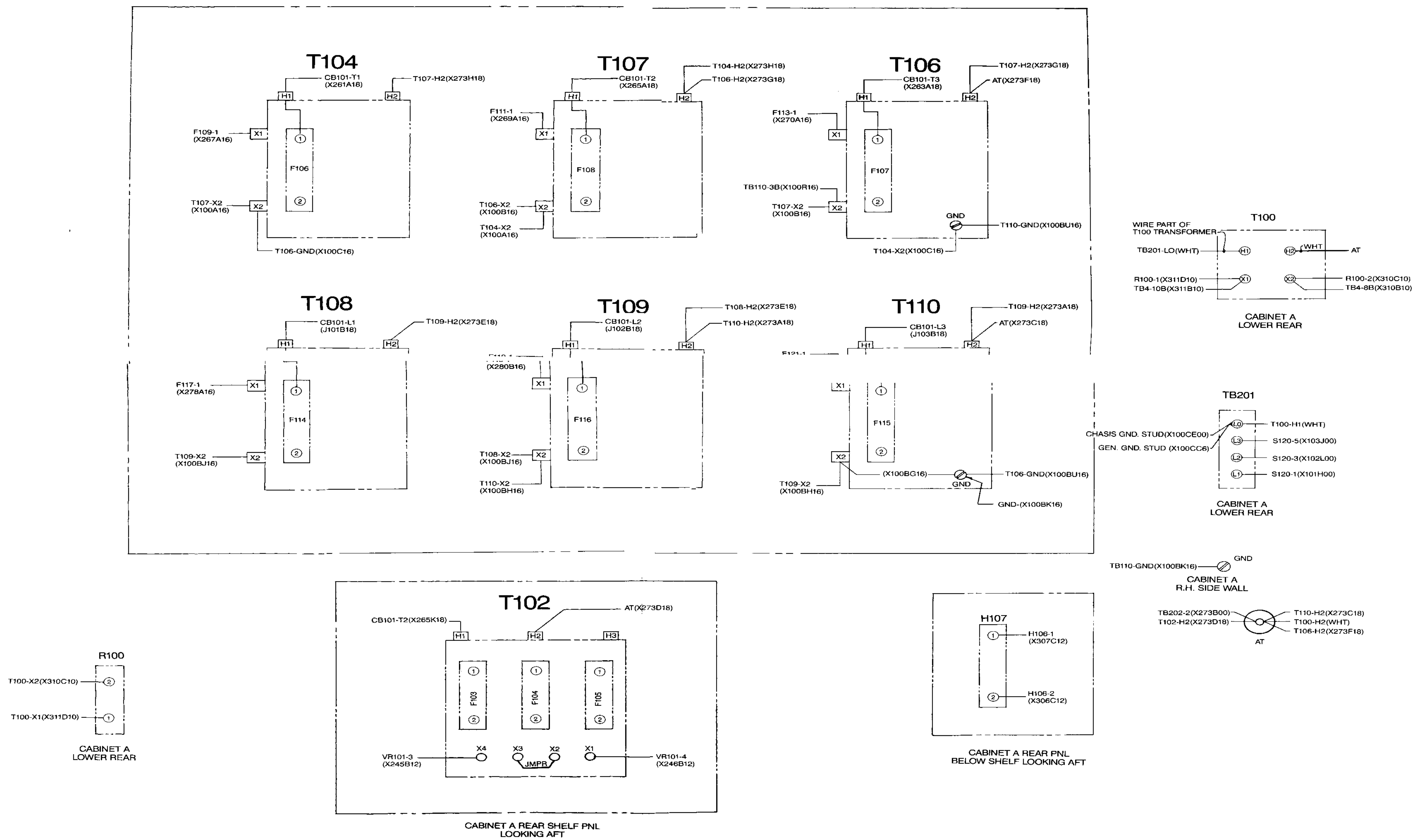
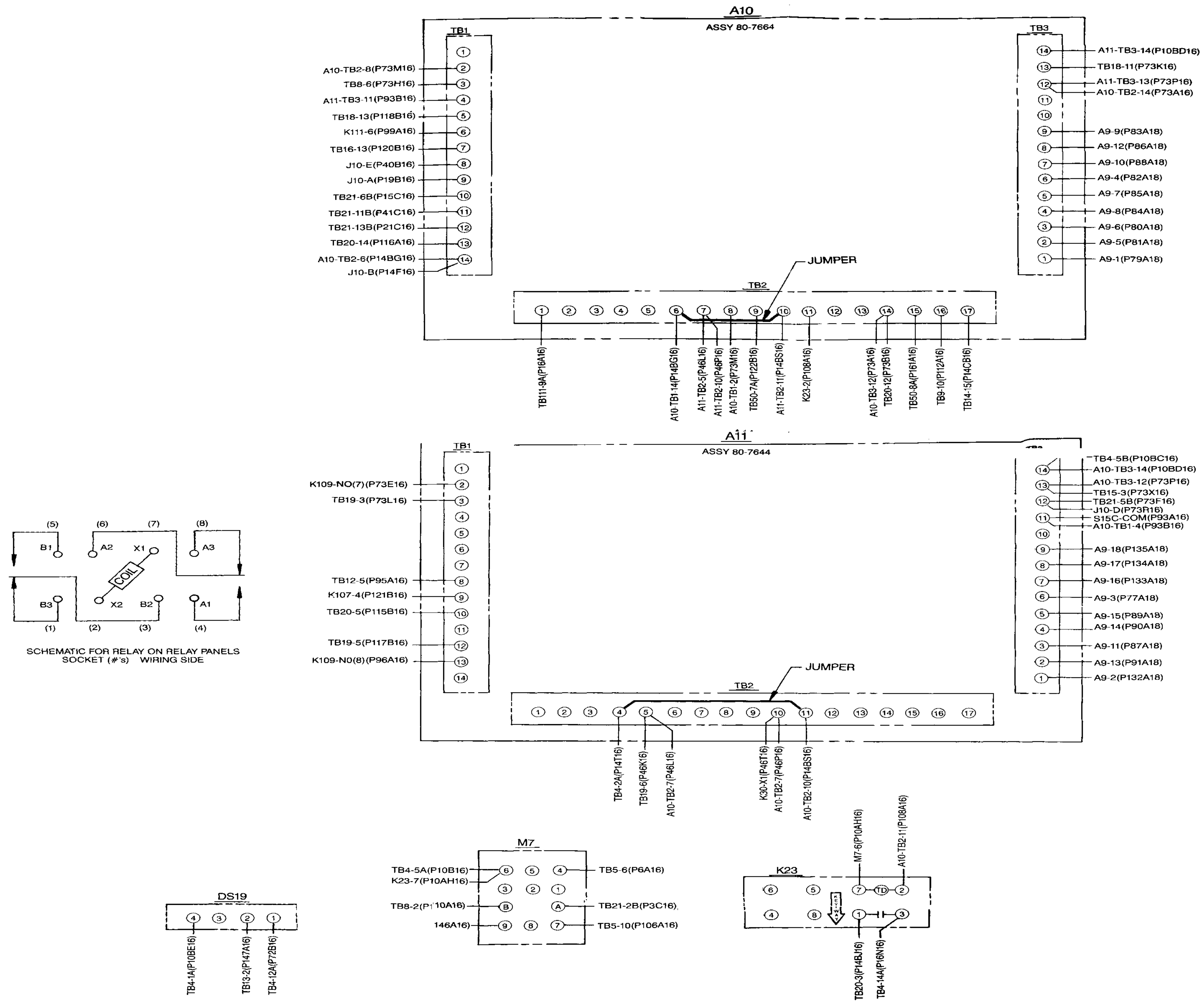
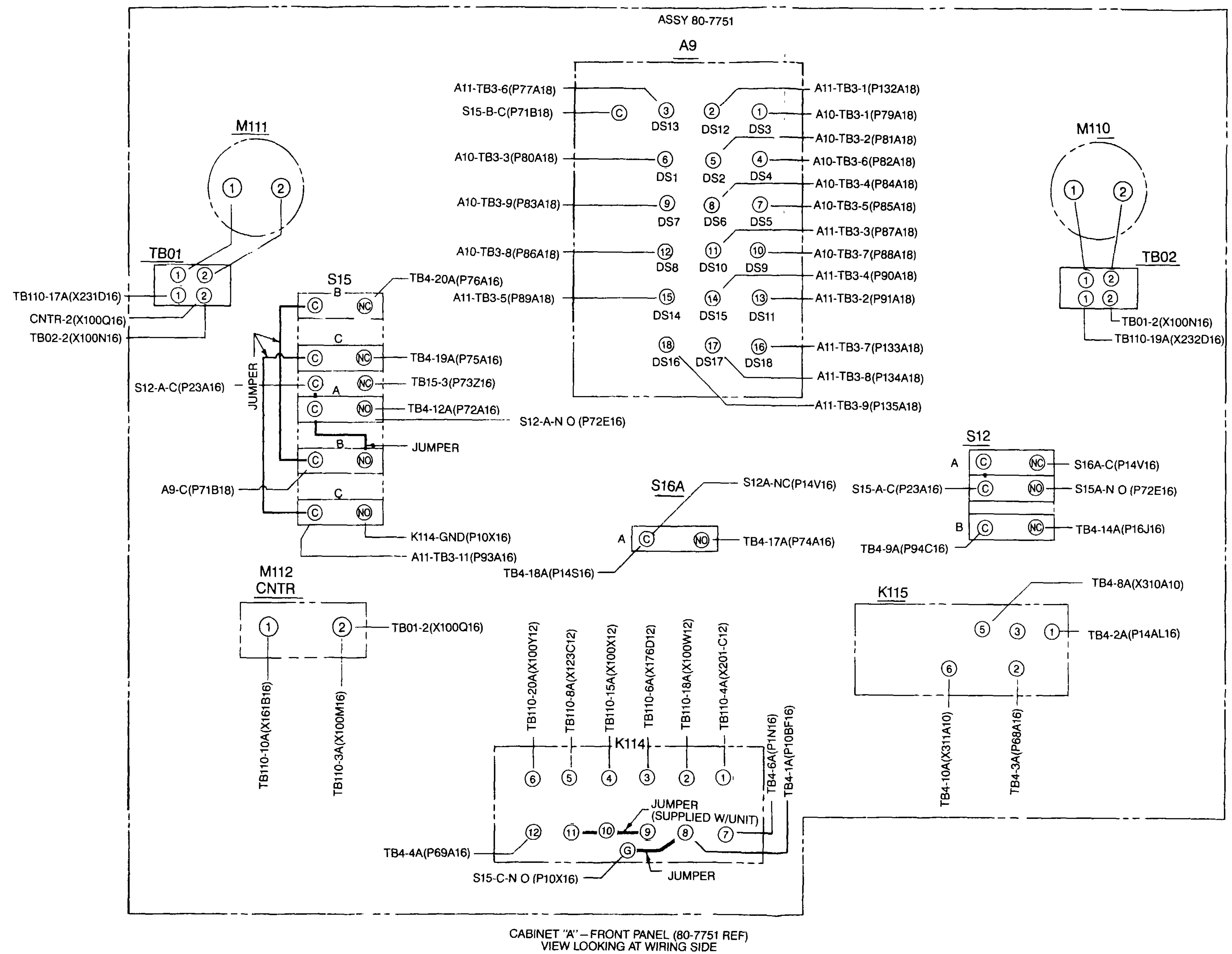


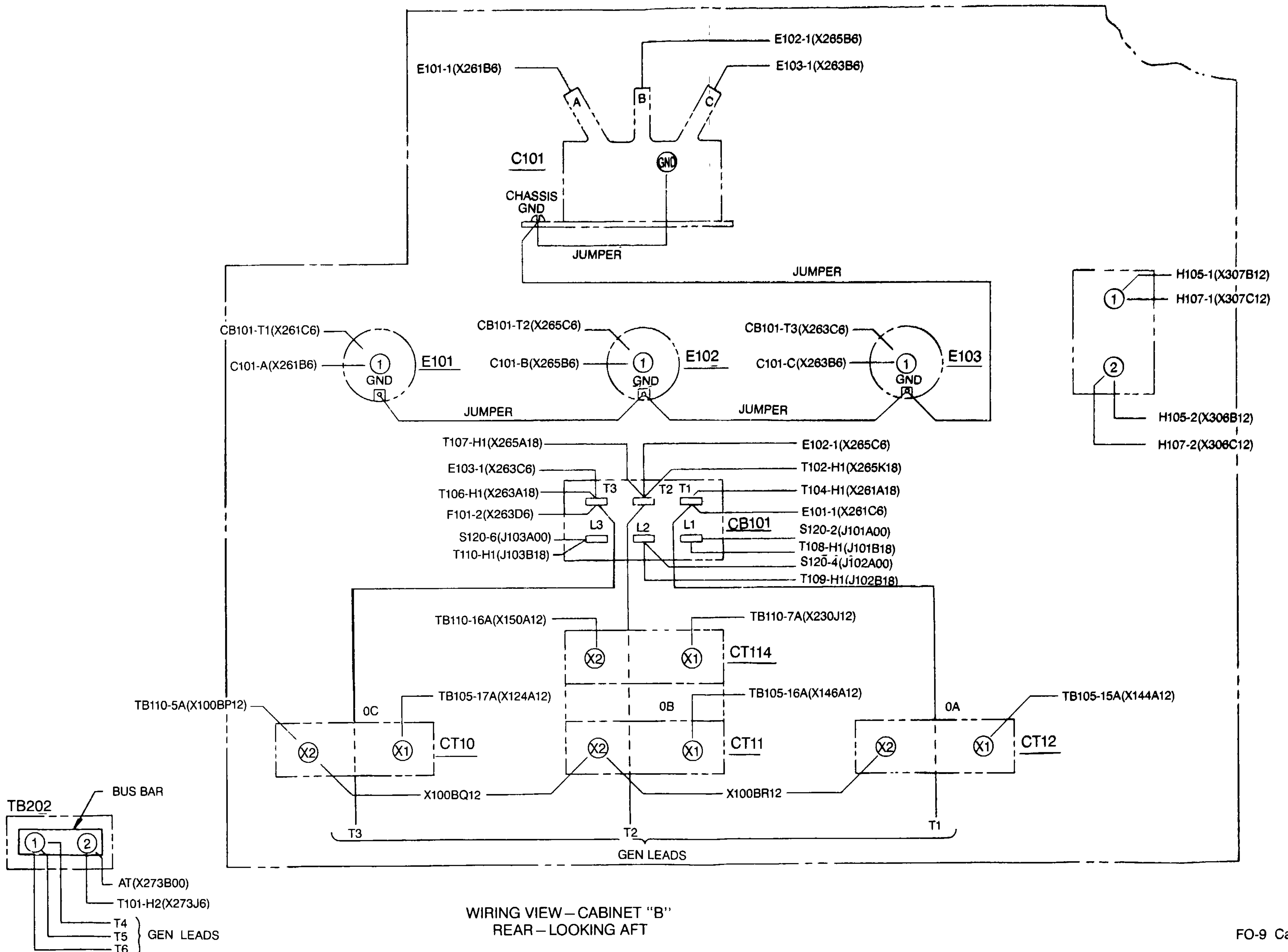
FO-7. Cabinet A Wirng Diagram (Sheet 3 of 4)



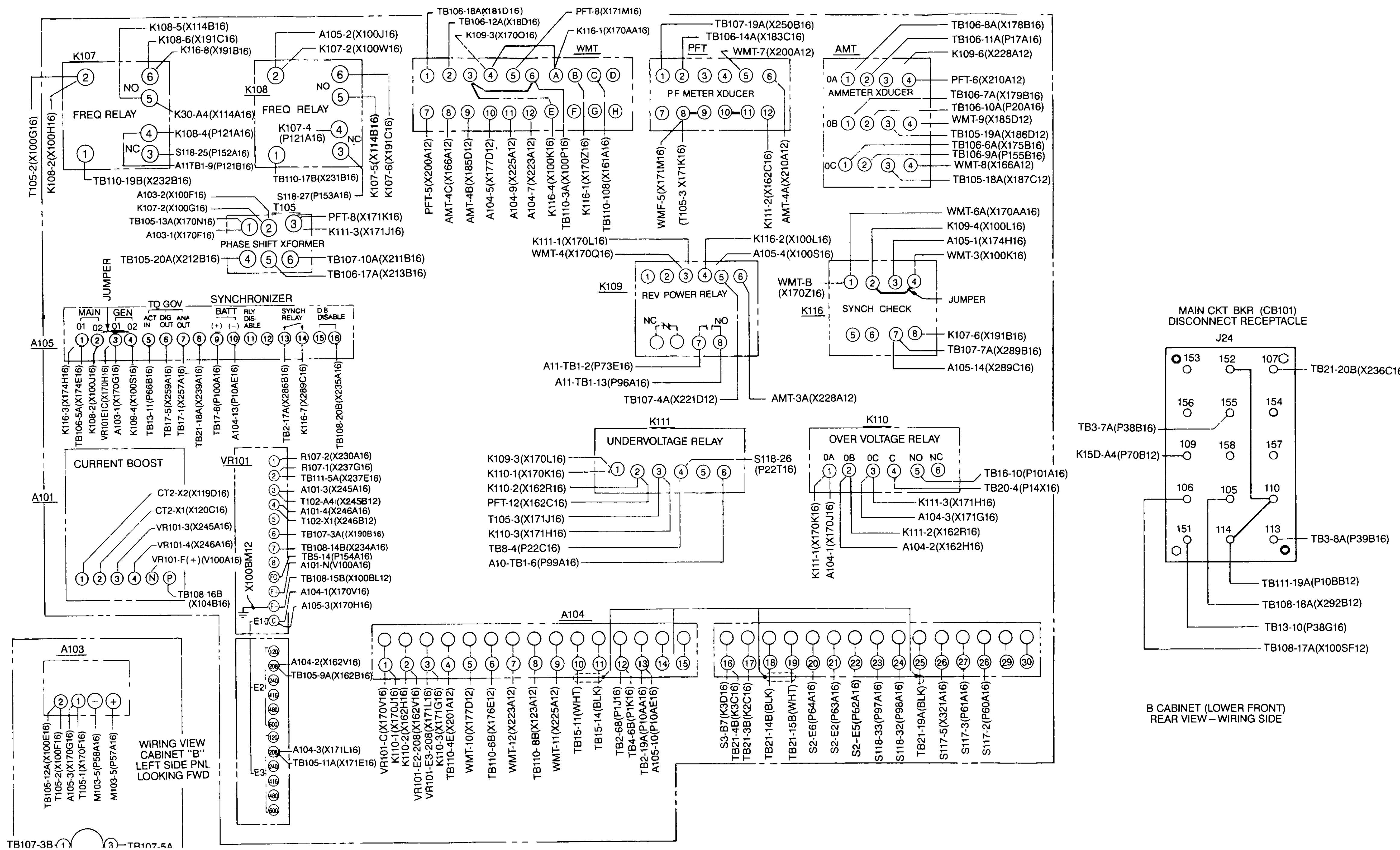
FO-7. Cabinet A Wiring Diagram (Sheet 4 of 4)



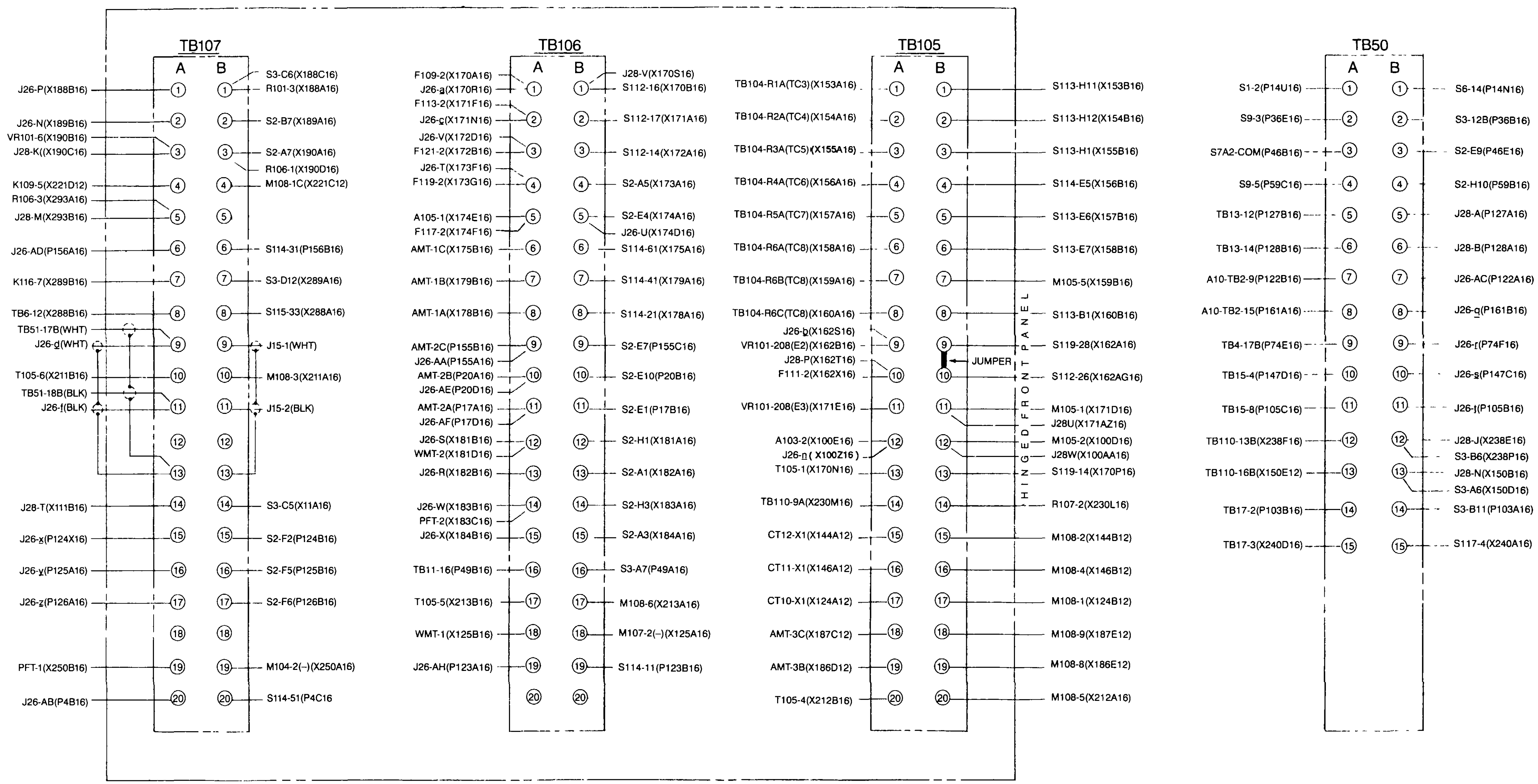
FO-8. Cabinet A Door Wiring Diagram



FO-9. Cabinet B Wiring Diagram (Sheet 1 of 3)

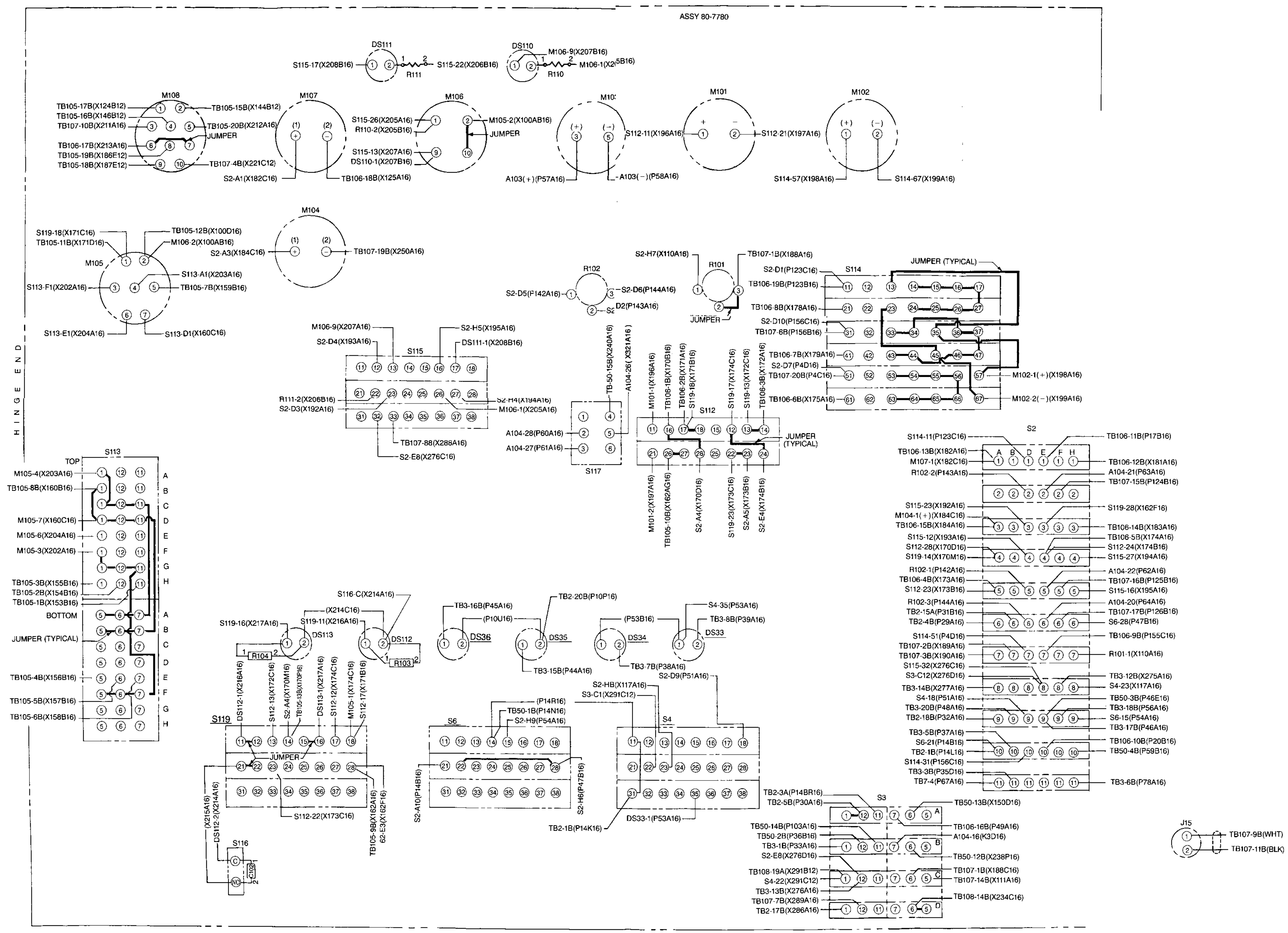


FO-9. Cabinet B Wiring Diagram
(Sheet 2 of 3)

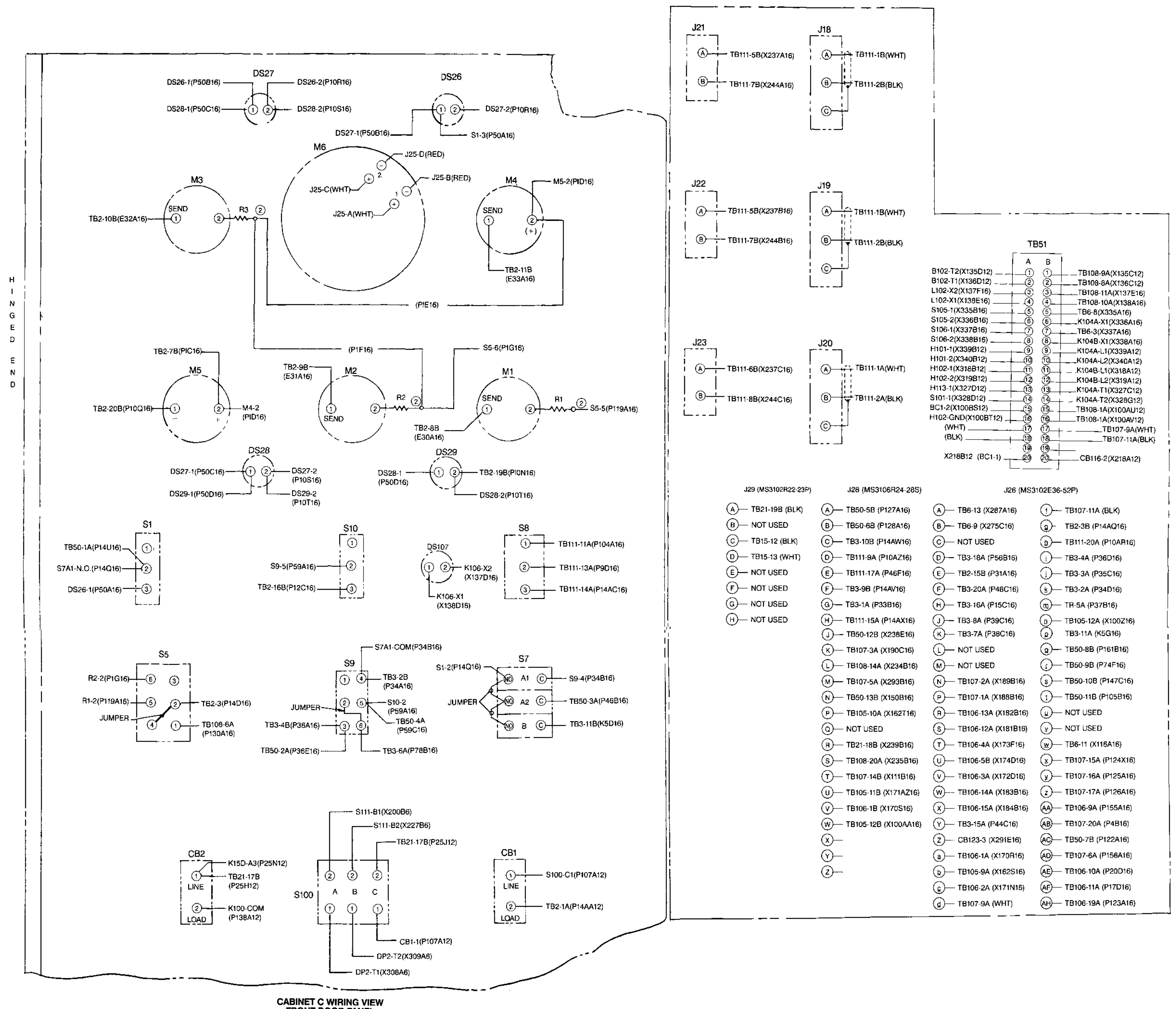


WIRING VIEW — CABINET "B" (80-7776 REF.)
RIGHT SIDE PANEL
LOOKING FORWARD

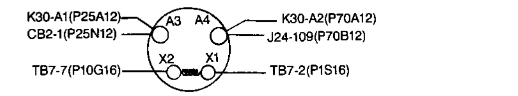
FO-9. Cabinet B Wiring Diagram
(Sheet 3 of 3)

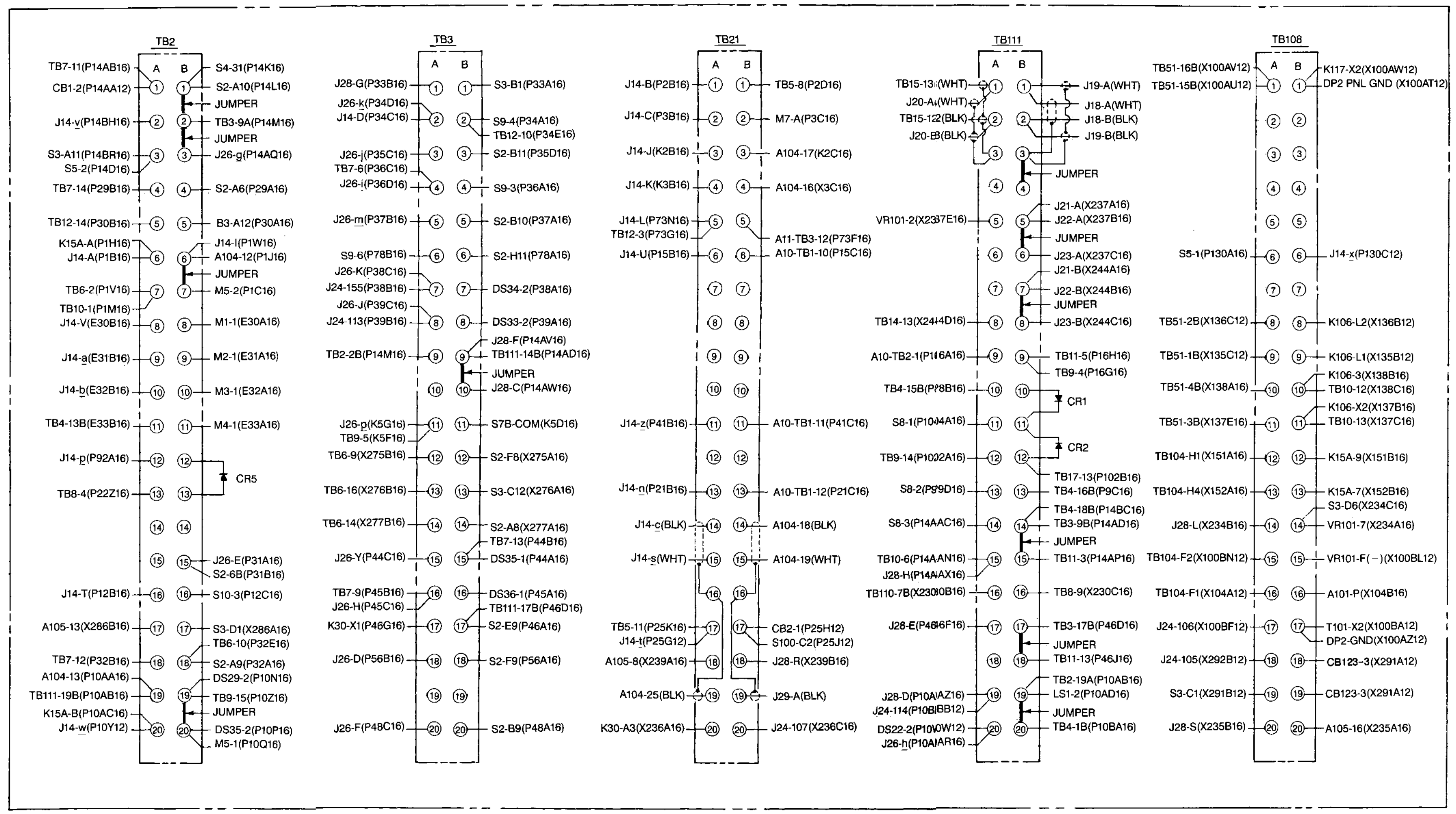


FO-10. Cabinet B Door Wiring Diagram

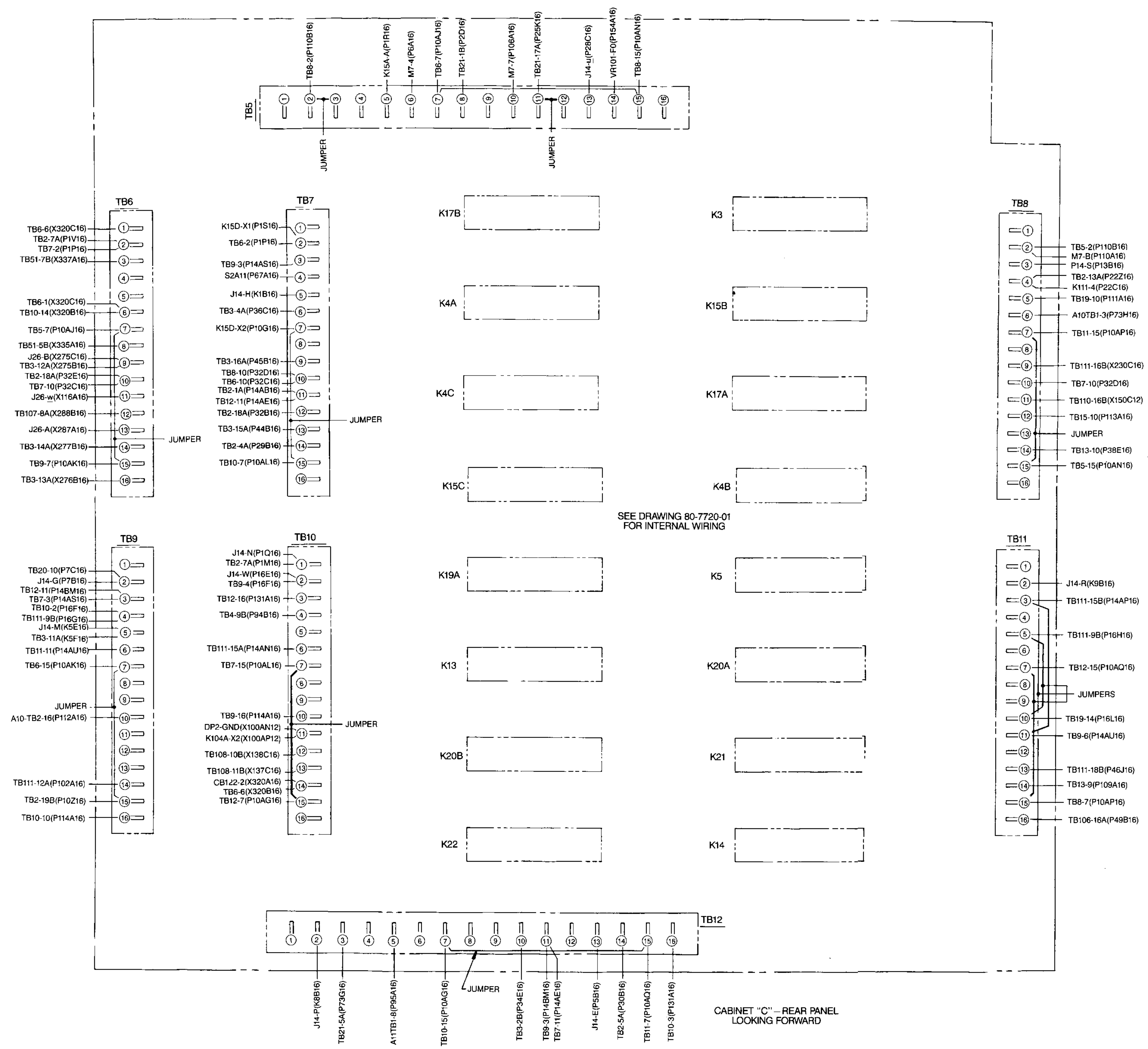


FO-11. Cabinet B Door Wiring Diagram
(Sheet 1 of 5)

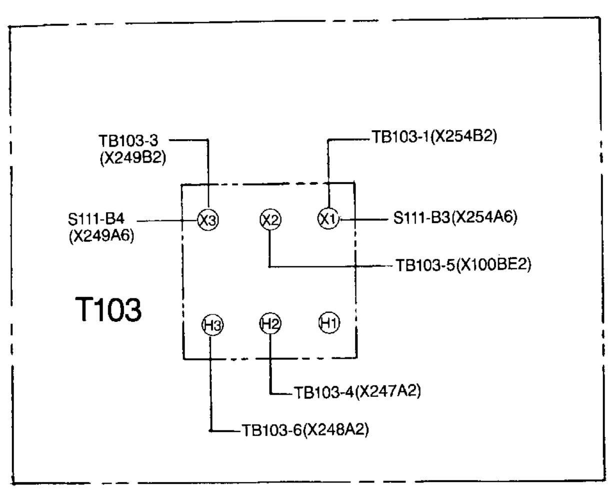


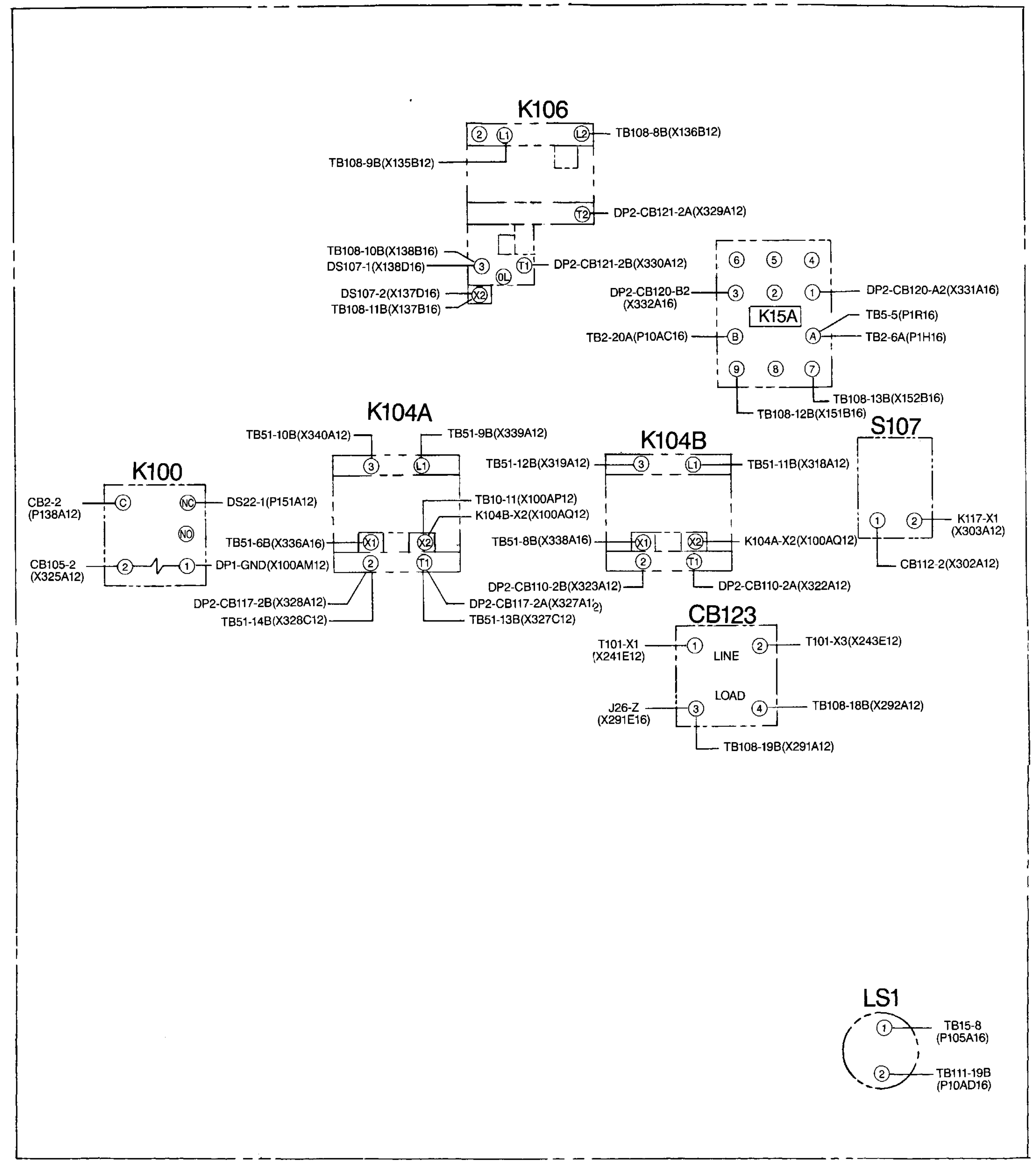


FO-11. Cabinet B Door Wiring Diagram
(Sheet 2 of 5)

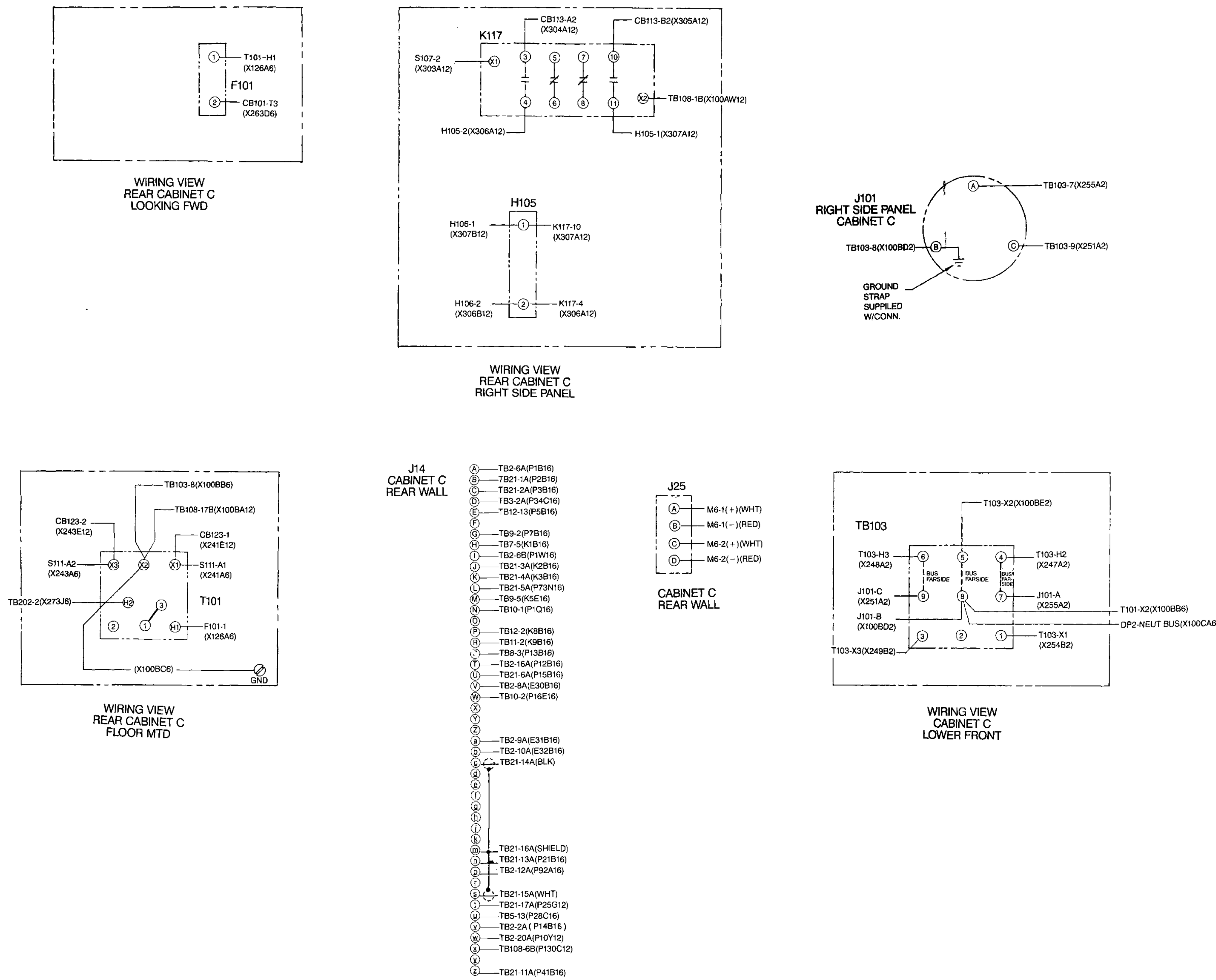


FO-11. Cabinet C Door Wiring Diagram
(Sheet 3 of 5)

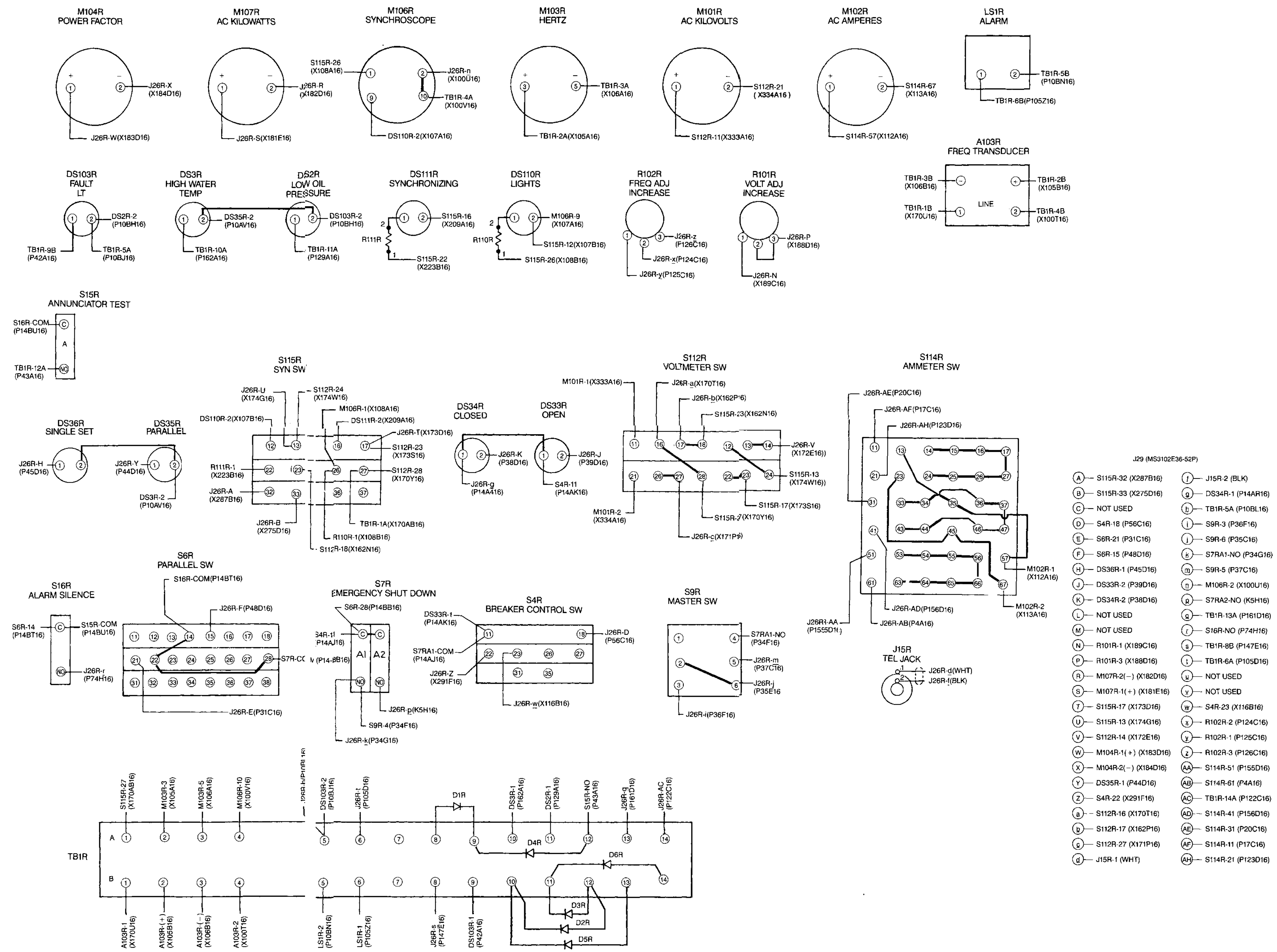




FO-11. Cabinet C Wiring Diagram
(Sheet 4 of 5)



FO-11. Cabinet C Wiring Diagram
(Sheet 5 of 5)



FO-12. Remote Control Module Wiring Diagram

By Order of the Secretaries of the Army and Navy):

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